THE EFFECTIVENESS OF NEW ROAD SCHEMES IN URBAN AREAS

by

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ABSTRACT

This thesis is primarily concerned with investigating the actual impacts associated with the building of new roads in urban areas, and in order to throw more light on the question of whether or not it is worthwhile building new roads in urban areas. It consists of a study of a number of examples of road building in different urban areas and in different countries. These examples were examined to see whether the schemes have met their stated traffic objectives, with particular attention to those operational objectives aimed at redistributing traffic and relieving traffic congestion. The different transportation planning policies and strategies in different countries were also appraised to see if these policies contributed to the effectiveness of the schemes considered.

A review of the literature and discussion of the arguments for and against road building is presented. A number of conjectures and hypotheses related to the subject are reviewed and commented on.

The cases taken are all from developed countries, namely the United Kingdom, the Federal Republic of Germany and Sweden. A number of examples, from each country, has been thoroughly examined. A review has been made of the historical background of each scheme; the development of the road network in the cities; the different policies adopted by the various local authorities responsible for the different schemes; the objectives of each scheme and the actual impacts associated with it.

Additional case studies cover the other side of the coin. These are studies of major improvements to public transport systems in different cities. Each scheme is reviewed, with particular reference to the degree they have relieved congestion on the roads in the same corridor. This was covered simply to see whether or not public transport improvements are the only answer to traffic congestion, as has been suggested.

In the event, every scheme was a unique example in itself. The different conditions in each situation are presented and the actual impacts of the schemes assessed, based on the available information. The available evidence has shown that, overall, the road schemes studied have served their objectives and provided improved travel and environmental conditions along the relieved roads. The assessment was based on the individual merits of each scheme, and the available information. Environmental changes are inferred from the changes in traffic flows along the particular corridor.

The findings with respect to public transport improvements were rather different from the expectations. Only marginal relief from road traffic was recorded, with a substantial shift from buses to the improved rapid rail system. In the case of Stuttgart, the growth on parallel roads was actually higher than the average growth on all city roads, though for other reasons.

A discussion is included of all the lessons to be learnt from these road building experiences in the Continent. Comparisons are also made between the priorities and approaches in the different countries studied, and areas for further research are identified.

To my parents,
who always believed in me

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CHAPTER 1 INTRODUCTION AND BACKGROUND

PREFACE

1.1 The idea for this research stemmed from the current debate on urban traffic congestion in which questions have been raised about the effectiveness of building new roads as part of the solution. Recent contentions and conjectures, in particular those claiming 'counterproductivity' of road schemes, presented an argument that had to be challenged in the light of the experience of cities that have recently built new roads.

1.2 Congestion is a problem common to many of today's cities and urban centres. The scale of the problem varies from one place to another, but the aggravations and perceptions of it, and the avid search for a remedy may well be equal in all these places. The term 'congestion' when used in the urban highway context, indicates a condition in which a road section or even a network is overloaded with vehicles attempting to use it, and where the number of these vehicles exceeds the capacity of the road. This is usually most obvious at peak hours when commuters are going to or from their place of work. Cities have always been crowded. Scenes from ancient cities portray crowds of people and animals filling whatever space was available in those days. The pictures from European and American cities of the past century show highly congested streets filled with horse-drawn vehicles, street-cars, and, of course, pedestrians. It appears as if congestion is an unavoidable by-product of the shift to urbanization.

1.3 In Europe, many cities have developed around an historic centre which is now the heart of the business centre of the modern city. The road networks in these centres will have developed well before the invention of motor vehicle and are often unable to cope with modern traffic demands and rigours. Since these roads tend to be in a radial pattern, they concentrate traffic approaching the centre and hence results in congestion. In the United States the approach has been to re-plan cities around cars with extensive freeway networks designed for large traffic volumes feeding a gridiron street network in the centre. The gridiron pattern does appear to be better than a radial pattern in spreading traffic evenly. However, congestion in these gridiron cities is still apparent. This is due to several reasons, the main one being

that the high capacity roads linked to central streets transfer large traffic volumes to a network less able to cope because they are already overloaded with local traffic. Not only that, but suburban congestion is increasingly becoming a problem in areas that had previously been free from it.

1.4 Over the past decade or so, the nature of traffic congestion in the United States has changed. It has lost its directional bias, and as a result, commuting within suburbs is likely to be under just as heavy traffic conditions as is commuting to city centres. Also, inbound and outbound traffic volumes during the morning and evening peak hours are virtually identical in many metropolitan areas. It is not only commuters who sit through the aggravation of traffic jams and snarl ups that are dissatisfied with the situation. Businesses are also becoming concerned over the observed effects of congestion on workers morale and productivity.

1.5 Congestion is becoming a politically more pressing issue. Public opinion surveys in certain metropolitan areas in the United States, for example, indicate that traffic congestion has superseded crime, housing, and pollution as the top ranking concern of those communities. I am unaware of any such public opinion surveys in this country, but I have little if any doubt that the findings of a similar survey in London would not be very different. It must be noted, however, that with all the apparent delays and worsening traffic conditions in general, the majority of urban travel still occurs under uncongested conditions (at least in America). This leads one to wonder whether the problem of urban congestion is overstated, and whether some congestion is tolerable or even desirable.

THE PROBLEM

1.6 Congestion is characterized by the formation of traffic queues that reduce movement to a crawl, and in some cases, to a complete stop. With a large volume of vehicles on the roads, the traffic noise and fumes cause environmental pollution and impair the urban environment. The main roads become saturated, and side roads also become hazardous as frustrated motorists turn to them for rat-running,disturbing residents and creating additional problems. The economic cost involved in congestion is also great as it affects everybody from residents to retailers. It may even affect through traffic. In these circumstances, public transport (road borne) becomes unreliable and the service often very costly. In turn this may lead to fare

increases and result in more people switching to cars instead, thus adding to the already existing congestion.

1.7 In the past, the solution to the problem of congestion has been to increase the capacity of the road network within a city, often by constructing new roads, some of which may be urban motorways. However, there is a growing feeling that traffic growth tends to accelerate when new capacity is provided. This in turn dilutes the impact of such improvements, and may even lead to worsened conditions. This may not be the only impact of such improvements. Once these improvements are made, a distinct modal shift may take place with people switching from public transport to private transport. So not only does the additional traffic bring congestion back again, public transport is also adversely affected by a drop in the number of passengers, and hence a drop in the quality of service–this in turn affecting all those still using public transport and creating an even greater demand for the use of private transport. All this makes one wonder, ***is it really worthwhile building new roads or even improving existing ones?***

THE ARGUMENTS

General Issues

1.8 In recent times, the debate has taken many dimensions with the issue of new roads in urban areas dominating the scene. It is now often stated that the provision of new capacity in urban areas does not help ease the problem of congestion. On the contrary, it is argued, such provision may lead to worsened conditions within the traffic corridor. This would result from the additional traffic, 'generated' by the new roads, filling up the additional capacity provided and even leading to worsened conditions on the older routes. New roads, it is said, can therefore be counterproductive.

1.9 This argument which seems to be catching on, is in fact one of the most heated subjects of discussions of our day, in this country as well as others. Research by Martin Mogridge of University College, London seems to suggest that an increase in the capacity of a congested urban road network only generates a disbenefit, and that the only way to improve road travel speeds is to improve mobility by public transport[1,2].

1.10 Mogridge is not the first to advocate such ideas. Anthony Downs had earlier suggested it in what has become known as 'Downs' Law'[3]. With particular emphasis on peak hour traffic, Downs suggests that if the urban road network is expanded, additional traffic will be generated, thus leading to continuous road building just to keep up with the traffic volume generated. Downs' Law, which is really Parkinson's Second Law adapted to traffic, states that:

> 'On urban commuter expressways, peak-hour traffic congestion rises to meet maximum capacity'.

1.11 Downs' Law expresses that in cities with a large commuter population, additional capacity is bound to be taken up during peak hours. While new expressways may offer immediate relief to older routes, this relief is short lived, and the congestion problem is spread even further. The impact such measures may have in terms of public transport is far reaching for they may, in instances, lead to a modal shift which may be significant enough to completely ruin the public transport system in the city. A summary of Downs' hypothesis and argument is presented in Appendix A.

1.12 Mogridge clearly contends that the solution to our problems today is not to increase the capacity of the road system, but rather to provide better public transport systems. The key to improving travel speeds by road is to improve those by public transport, and to achieve this, road space must be taken from the 'inefficient' car and allocated to the bus or tram. Some of Mogridge's arguments are briefly discussed in Appendix B.

1.13 It is very clear that road building in itself is not the solution to the urban traffic problem. It has been clearly manifested by the American experience that traffic problems cannot be simply and satisfactorily solved by road building[4]. In older cities of Europe and Great Britain it has proved to be even more difficult to solve traffic problems by building roads. Indeed, this was clearly demonstrated as long ago as 1963 in the **'Traffic In Towns'** report where the report concluded that:

> 'in the long run the most potent factor in maintaining a 'ceiling' on private car traffic in busy areas is likely to be the provision of good, cheap, public transport[5]'.

It also pointed out that if reasonable environmental conditions were to be achieved in residential and shopping areas, many localities would have to be bypassed. To achieve this and create more efficient networks for the more essential traffic, a great amount of road building may be required.

1.14 Other groups and individuals disagree with the arguments put forward by Mogridge, and Downs. They see the provision of new roads as a means to cater for the ever increasing demand for travel, to improve environmental conditions along existing residential and busy streets, and to provide the necessary links for a coherent strategic network. Some new roads are thus seen as an essential measure in any strategy to tackle the urban congestion phenomenon.

The Case For Better Roads

1.15 Advocates for better roads have always stressed the importance of a well connected network to facilitate traffic and ensure mobility, and to sustain the economy. The road network in some countries is also regarded most essential for national defence purposes. The problem as seen by this group, is the lack of roads. Had the necessary well planned roads been provided, they would accommodate more traffic and improved accessibility. They argue that any modal shift resulting from a road improvement implies a significant benefit attributable to this enhancement, otherwise the change in travel mode would not have occurred. They point out that public transport has always been a major deterrent with poor service, lack of punctuality and low standards of comfort. All of these are factors the individual is unable to improve on his own, whereas he could do a lot to improve the quality of travel with his own vehicle, given the necessary infrastructure.

1.16 New roads are, therefore, deemed essential for a great number of reasons including the following:

a) to cater for essential traffic which, by its very nature, has to be road-based,

b) in the general interests of mobility and accessibility by road-based transport,

c) to improve and enhance environmental conditions along residential streets and heavily congested local roads, by carrying through traffic away from these areas,

d) to obtain, and maintain a continuous strategic network of traffic routes of a hierarchical form,

e) for national defense purposes, where roads are important to mobilise defences and armed forces, and provide supplies and equipment where needed,

f) to satisfy the general demand by car owners for more road space, where it can reasonably be provided. These demands may be accentuated by people's reluctance to travel by public transport, for whatever reason, and they are increasing with increased car ownership, and if satisfied, there are benefits to be gained for the individuals concerned,

g) to meet general preference demands for 'independence' when it comes to transport,

h) for those with a handicap or dislike, for whatever reason, of public transport (e.g. poor quality of service, fear of attack, claustrophobia),

i) for environmental reasons: to enable, for example, 'pedestrian precincts' to be established, or simply to reduce the amount of through traffic in a sensitive area or enable traffic to by–pass a previously congested area,

j) to improve the efficiency of motorised travel for both people and goods by means of improved speeds, reduced delays, reduced energy consumption, and lower travel costs,

k) to provide safer conditions particularly for pedestrians and cyclists,

l) to help improve the economy generally, and also to improve that of depressed areas by means of regeneration,

m) to maintain a viable alternative transport system whenever public transport facilities are disrupted (due to strikes, power failures etc),

n) to improve the highway network generally; to give many more people with cars a wider choice of destinations and greater accessibility,

o) to allow for the degree of dispersion of the population (ie lower residential densities) which enables people to have better home environment,

p) in certain circumstances, to relieve dangerous peak-hour congestion levels on public transport services.

The Case Against New Roads in Urban Areas

1.17 Groups opposing the construction of roads in urban areas present arguments which usually stress the following:

a) the best way to improve overall accessibility is to improve travel times by public transport,

b) peak-hour congestion levels rise to meet maximum capacity provided,

c) new road building simply stimulates car use, and hence defeats the purpose of building them,

d) new roads encourage car use and divert people from public to private transport with consequent deterioration of public transport services for those remaining with public transport,

e) the adverse environmental impacts, direct and indirect, of new roads (e.g. land and property take, air pollution, noise, vibration, dirt, visual intrusion, community severance, increased danger) outweigh any environmental advantages,

f) there is no evidence to show that building roads improves the economy of an area, or creates new employment, or if it does, it is taking it from somewhere else. Growth depends much more on modernisation within the industry. An extension of this point argues that building roads to assist depressed areas may have reverse effect in that it simply gives people within the depressed area the opportunity to commute to non-depressed and probably congested areas,

g) they stimulate new development in areas where it is not necessarily wanted at the expense of existing development (relocation and redistribution of land-uses),

h) more resources put into roads means less resources in other publicly provided services, for example, health service, education etc,

i) on the social grounds that: 'new roads are built for the better off, generally at the expense of the worse-off',

j) it is better to put investment into public transport than in roads, because the latter has the potential to provide mobility for the majority. Such a policy is also less damaging to the environment and improves safety standards for pedestrians,

k) expenditure on new roads would give overall disbenefit (the community becomes worse off than before).

STUDY OBJECTIVES AND RESEARCH METHOD

1.18 It is evident that the nature of the traffic congestion problem, which threatens urban societies more and more every day, is one which has to be dealt with immediately and before a state is reached where no remedy is effective. Something should be done before streets and transportation systems become chaotic and unmanageable. This research, however, does not seek to resolve all traffic problems and provide effective solutions. It rather concentrates on the controversial arguments mentioned above. That is, the actual impact a new road has in an urban area, and whether or not it still is worthwhile to build new roads in urban areas. The complexity of this project, and the lack of a substantial amount of data and information needed made it rather clear how very little work has been done in this respect. It is hoped that the research may prove to be an important step in identifying the deficiencies that exist in the current approach to the appraisal of urban road schemes, and the areas where technical advances can be utilised more effectively to provide better and more efficient highway networks.

1.19 In undertaking this research, it was realised that many factors may influence what happens to traffic levels and traffic distribution when a new road is opened, including, for example, the extent of suppressed demand; whether or not effective traffic restraint measures are in operation; whether or not there are good public transport services; and whether car ownership levels in the area served are rising rapidly or not. To determine what happens when a new urban road is opened, it was decided that a number of case studies of such roads in various cities should be

carried out, to see if they have, in any way, turned out to be 'counterproductive'. It was also decided that if this proved to be the case, then an attempt should be made to identify the elements that caused such a situation. Where possible, remedial measures will be suggested, and future precautions recommended.

1.20 The case studies approach was seen as the most suitable for the purposes of this research, because it would enable one to cite various examples of new urban road building in different cities. The background to, and the outcome of these improvements (which have actually been implemented to deal with congestion in these cities) are reviewed in turn. It was decided to consider examples of relatively new roads (those built within the past 2–15 years) in cities and towns of different sizes. Another issue of interest which has been looked at, is whether institutional barriers are impeding attempts to deal with urban congestion. The concern with institutional barriers stems from the fact that the implementation process for improving an existing road or building a new one involves a number of approval and funding agencies, which can be a factor contributing to the delays in implementing new schemes and leading, therefore, to worsened traffic conditions on the highway networks with a great suppressed demand.

1.21 To give the research a wider horizon, it was decided to examine the road building experience on the Continent. The German experience was of particular interest since the impression always given is that the Germans have a good combination of high quality roads and efficient public transport systems, and do not seem, therefore, to suffer from the same degree of traffic congestion. Thus, it is important to try and understand the mechanisms of such a 'happy balance' (as I have called it) and see how the German experience with new urban road building has turned out.

1.22 Altogether, case studies have been made of examples from Britain, Germany and Sweden. In Britain, examples from London, Kingston-upon-Hull and Portsmouth were examined. Five cities in Germany, namely Hamburg, Duisburg, Düsseldorf, Stuttgart and Berlin were considered, while Stockholm and Göteborg provided the examples from Sweden. The interest in the European experience, and in particular the West German experience, is to see whether it lends further support to, or confounds the claims made, whether for or against new roads in urban areas. Contacts were initially established in Britain, Germany and Sweden by means of correspondence where some 40 local authorities in Britain were initially contacted, some 15 German planning authorities and relevant institutions, and 8 similar Swedish organisations. The response rate was rather low. Only a few authorities expressed an interest. The cases suitable for examination, based on the data and information

requested (e.g. traffic flows, journey times and modal split), limited the choice of the case studies to the ones covered in the thesis. Even the cases selected did not provide all the information required but they had substantially more information than the others. The sample, therefore, was dictated by the constraints of data availability, and the degree of cooperation on the part of the local authorities. Although the sample may not be sufficiently representative to draw concrete and precise or statistically significant conclusions, it does however highlight specific lessons to be learned. Furthermore, a number of case studies from Britain and Germany (e.g. Peterborough, Birmingham in Britain, Dortmond, Munich and Essen in Germany) were ruled out after assessment visits to these cities determined that very little information was available to enable an adequate appraisal of the schemes being considered.

1.23 It was also decided that an examination of the situation influenced by the provision of improved public transport would further show what actually happens when a new railway or Underground system is introduced, and what impact such major improvements have on road traffic within the same corridor. This is to examine the validity of the argument that building new roads does not relieve congestion or improve traffic conditions, and that the only answer to traffic congestion is simply to improve public transport on the grounds that improved public transport attracts drivers away from their cars leaving better conditions on the roads affected. Examples in this respect were studied in Britain, namely the Victoria Line, and in Germany, of a suburban rail (*S-Bahn*)extension in Stuttgart, and an Underground (*U-Bahn*) extension in Berlin. Theses case studies were used to assess the impacts of major public transport improvements in general, and that on parallel road traffic in particular. The cases illustrate how effective such measures have been in terms of the extent to which they have contributed to improved traffic conditions on the roads directly affected.

1.24 To sum it all up, the objectives of this research are these:

a) to determine the effectiveness of new roads in urban areas and examine the validity of statements made as to the counterproductivity of new roads, by means of case studies of recent urban road building in Britain and Continental Europe,

b) to examine the actual impact public transport improvements have on road traffic within the immediate corridor,

c) to determine the effectiveness of urban road schemes in various West German and Swedish cities, and to see what lessons may be applicable to UK practice.

d) to provide a general answer, from the case studies, as to whether or not it is worthwhile building new roads in urban areas,

HYPOTHESES

The Impact of New Roads

1.25 The main thrust of this research is to see what has actually happened when a new road has been built in an urban area to improve traffic conditions, particularly those designed to relieve traffic congestion and promote higher speeds and shorter journey times. In this respect, the research hypothesis is that such provisions will not necessarily lead to a situation where so much more traffic is generated that any benefits achieved are cancelled out because the level of congestion would remain much the same or even worse, with no improvements to overall travel times. Clearly,

if the amount of traffic on a new road is no more than that which it has been designed for, then it would have achieved its objective of relieving traffic congestion. An area of concern, is that where roads have been built under conditions of suppressed demand and therefore a potential for a high level of 'generated' traffic.

1.26 The second point of interest relates to the impact of a new road on public transport services in the corridor of influence. As mentioned earlier, one of the arguments against new roads in urban areas is that the provision of a new road would lead to a shift from public to private transport. Such a shift, it is claimed, would be significant enough to reduce the patronage, and hence the quality of the whole system which would likely lead to a reduced accessibility for people. As put by Mogridge[1]:

> 'Attempts to improve traffic conditions by providing more capacity (on the roads) can lead to a deterioration in public transport, if, by drawing paying customers away from the latter, they force an increase in fares and a reduction in service. In this case, the balance of traffic may shift from public to private transport until a new equilibrium is reached where each system is of lower quality than before'.

In this respect, my contention is that with a properly designed and managed highway and traffic system, there should not be a significant shift in the mode of travel. Even if there is a shift large enough to jeopardise the profitability of public transport service, this is a matter better rectified by subsidy rather than through highway improvement policy.

1.27 The third point stems from the Mogridge Conjecture and relates to conditions of high suppressed demand for car use. While Mogridge[1] suggests that *'we should build a substantial amount of new railway, especially underground in the centre linking the national networks'* as the only way to improve traffic speeds on the network, my contention is that in cases of such demand, any improvement to the public transport system may significantly improve accessibility for the public transport user, however, its effect on improving traffic conditions on congested network roads are likely to be marginal.

1.28 In the event, not all that much urban road building has occurred in the UK since the publication of the 'Traffic in Towns' report, though opposition to such measures has, for various reasons, increased. So what is the answer? This is the general question which is addressed in this study. The basic steps, and the major

questions that form the basis of this research are reviewed in the following paragraphs.

1.29 This research is primarily concerned with finding an answer to the general questions presented earlier, viz: *is it worthwhile building new roads in urban areas, or does the provision of new roads in urban areas simply tend to generate more traffic, and thus aggravate current traffic problems?* This is the prime objective, which is achieved by appraising situations where new roads have been built in various cities and towns.

1.30 In view of the claims presented by Downs' and Mogridge, it was necessary to look at various issues. To answer the general question, answers to some more basic questions have been established first. The first group of these are:

Has the newly constructed road in an urban area become congested? If so, to what extent? and how soon after opening has it become congested?

The answer to these questions is provided from the case studies taken from the various cities across the country, and Europe. The situation before the new road was opened is assessed from historical data, and then the changes that the new road has brought about are examined. The traffic volumes existing within the route corridor 'before', and those at present are compared, together with the forecast traffic, whenever possible. Changes in traffic flows on secondary roads directly or indirectly affected by the new roads, are also considered where feasible. In achieving this objective, the first step therefore was to find sites where 'before' studies have been carried out. Then by means of 'after' studies it is possible to compare and answer the first group of questions. Whenever possible, forecasts before the building of the scheme are compared with the actual growth of traffic on the road.

1.31 It should be noted that the terms 'effective' and 'worthwhile' as adopted in this thesis are used in a very specific sense. The test of a scheme's effectiveness , and hence its worthwhileness, in the various cases considered is mainly in relation to its role in alleviating congestion and improving traffic and environmental conditions, and whether or not it has generated more traffic (including whether or not it has caused a modal shift from public transport). The reference to environmental improvements in the case studies is based mainly on the changes in traffic flows along the roads affected by the scheme, and by the views of the local authorities. I

have not attempted to make a comprehensive analysis of the net environmental impact as this was beyond the scope of this research project. The investigation of the traffic generation aspects of the schemes has been, strictly speaking, based purely on the changes in traffic flows, and whether or not there has been a significant increase in these along the corridor of the scheme considered. That is, the changes in traffic flows 'before' and 'after' are examined to see if they indicate an abnormal growth in traffic which would obviously be a result of generated traffic as defined in the terminology used. It is understood, however, that the precise classification of the traffic elements would require in-depth household and origin-destination surveys.

1.32 The last part in the question refers to the period of time which elapsed before conditions, generally, reverted to former congestion levels (if at all). The length of the period can tell us a lot. If congestion occurred only after a long period of years, then the cause of that congestion could only be the natural result of the growing trend of vehicle ownership and use and not the result of new traffic generated by the new road. On the other hand, if it occurred soon after the opening of the road, then it is fairly clear that there is a very large element of so-called 'generated' traffic, though even in such cases it is unlikely that there will be much traffic that can genuinely be termed 'generated traffic' in the true sense of the word. To obtain information in this respect, it is again essential to have recorded data on the situation before the road in question was built. 'After' studies or collection of the present day data may not be easy, but unless the data for the 'before' situation is available, present data cannot be used to show the change.

1.33 A thorough review of traffic forecasts and the factors taken into consideration when the road was in the early planning stages was a necessary step towards establishing the degree to which predictions varied from the actual situation (if at all). The reasons for any major differences between actual and forecast traffic are discussed in the relevant cases. The journey time data is, of course, a good measure of any improvement's effect on road-based traffic. This, however, has proved to be very difficult to obtain. Most of the cities examined had no records of journey times with only two exceptions, namely Kingston-upon-Hull in Britain, and Göteborg in Sweden, and London in respect of the Rochester Way Relief Road.

The Implications For Public Transport

1.34 Another important issue related to new urban roads is the impact such roads may have on public transport. It has been argued that building a new road simply encourages many more people to use private vehicles instead of using public transport. The basis of this argument is that any improvements to part of a congested network may make it more attractive to the individual to switch from public to private transport. i.e. a modal shift. It is thus claimed that the number of vehicles on the new road increases beyond expectation and the ridership of public transport declines. With increased maintenance costs and low ridership, the quality of public transport services tend to decline, furthermore, the fares may be increased to meet the additional expenses incurred, and this in turn leads to another modal shift and yet more people using private transport.

1.35 There is substance in this argument, especially in a situation where there is a substantial degree of suppressed demand for car use and when public transport is a very important element of traffic restraint policy. Conversely, the new road could actually contribute to increases in the quality and efficiency of public transport if this happens to be road-based. Thus, we may need to consider the benefits to public

transport that a new road with its improved flow may provide (e.g better regularity, shorter journey times etc).

1.36 The major question we are looking at here is:

Has the opening of a new road had a significant impact on the number of people using parallel public transport services (i.e. more than might be expected from an extrapolation of general trends?) And if so, what were the wider implications?

To understand the dimensions and the extent of this problem, it is again necessary to compare conditions 'before' and 'after' building the new road. In investigating the point that new roads may have a negative impact on public transport, it was thought necessary to obtain the following data and information from public transport authorities and agencies:

(i)-The magnitude of ridership on public transport within the corridor of the new road, both before and after the building of the new road, compared with trends generally in the areas unaffected by the road.

Any major changes in the ridership of public transport have to be investigated thoroughly to determine as far as possible whether it was due to the opening of the new road; the result of a decline in the quality of service; or a planned increase of fares or simply a general reduction in the demand for the service.

(ii)-The rate of change in modal split.

At the same time, it is necessary to examine the amount of travel by car for various purposes to see whether there are any sudden shifts in the modal split. This would indicate a disturbance to the balance that previously existed between the various modes.

(iii)-Quality of service by public transport before and after the building of the new road.

If some of the bus services within the corridor had been rerouted onto the new road, the quality of services offered needs to be looked into, to see if the new road had

benefited road public transport by reducing journey times and providing better accessibility. Equally, the quality of services remaining on existing roads, which may be less congested as a result of the provision of the new road, would also be appraised.

Planning Policies and Objectives

1.37 The current transportation policies of the authorities involved may also be very important when it comes to analyzing the influence of the new road on the modal split (e.g. are positive and effective restraint policies in operation?). A review of these policies and their significance, plus a comparison of corresponding policies in other countries is expected to shed further light on the findings and conclusions. To this end, the discussions with Highway Authority Officials served to get their opinions and such data that may be available. It is realized that this approach may not provide concrete scientific evidence in terms of statistical significance, but it does, at least, give clues and indications in relation to the modal-split issue. There is very little information available on the modal-split issue in the cities considered. It also seems that the deregulation of the bus services in British cities has disturbed the way things used to be, and has complicated the issue.

1.38 In the case studies the prime interest has been in radial roads and tangentials rather than ring roads and bypasses, as these tend to be the most controversial. Nevertheless, the significance of orbital routes in relation to the discussed schemes are commented on. The location of the cases studied depended upon the existence of the appropriate elements and context for the purpose of the study. It was also restricted by the number of cities willing to cooperate. In Britain, more than 40 authorities were initially approached, and only three schemes could be examined. In Germany, the larger cities were approached for information. Meetings with local officials were carried out in a number of visits to Germany over the past three years. The same is true for Sweden where established contacts were visited in Stockholm and Göteborg.

TERMINOLOGY USED

1.39 It is important to distinguish between the different terminology used by different authors when discussing the issue of **'generated traffic'**. The term is used by some to refer to entirely new trips which did not take place before the urban road

improvement. Others use it to further include trips which once used a different mode of transport ('Modal Shift'), trips which exist but change destination ('redistribution'), and even trips which were previously made by the same mode but via a different route ('reassigned'), though the latter is generally referred to as **'Attracted Traffic'**.

1.40 The term **'Induced Traffic'** is also used. This term is normally used for traffic arising from movement that did not take place before at all, and it includes both primary and secondary induced traffic, with the first being a short-term effect resulting from travel being facilitated between existing generators and attractors, and the second a long-term effect resulting from changes in land use as a result of improved accessibility (though the latter has also been referred to as **'Development Traffic'**).

1.41 A number of writers have commented on the phenomenon of generated traffic, but scientific research or analyses is lacking, thus 'it has proved difficult to estimate the real extent, and distinguish between the various elements of generated traffic'[6]. In Britain, in general, the term **Generated Traffic** refers to 'future motor vehicle trips that are generated anew as a result of the provision of a new highway'[7]. This element ('generated') has three components as follows:

(i)-Induced Traffic, i.e. new journeys not made before, plus extra journey lengths caused by the new road.

(ii)-Converted Traffic, where an immediate modal shift occurs from public to private transport.

(iii)-Development Traffic, the portion of the future traffic volume, due to improvements on land adjacent to the highway. Increased traffic due to normal development of adjacent land is part of normal traffic growth and is not included under this heading.

1.42 Specifically **Not** included under the heading of 'generated traffic' is 'attracted traffic' i.e. traffic diverted from other routes onto the new or improved route, or any general annual increases in traffic as a result of increased vehicle ownership ('normal traffic growth').

1.43 For the purposes of this research, these above defined terms will be used in the case studies considered. It is also important to indicate that the term **'new road'**

does not always refer to a road that never existed before. In this study, the term will also be used to refer to major upgrading improvements of existing roads.

STRUCTURE OF THE RESEARCH REPORT

1.44 Chapter 2 contains the further factual description of the general transport situation in the countries studied. It also outlines the development in the road networks, the changes in the modal split for inland passenger travel and goods movement. Figures on the growth in car and vehicle ownership are also reviewed for Britain, Germany and Sweden in the period between 1962 and 1988. The chapter also contains a brief review of each of the case studies covered in the research.

1.45 Chapter 3 presents the case study from London, namely that of the Rochester Way Relief Road where an examination of the operational, environmental and economic impacts has been thoroughly carried out. The actual changes associated with the road are detailed, and a thorough analysis of the traffic flow changes within the corridor of the road in the immediate area are also discussed. The results of the Questionnaire Survey, and the regular users surveys carried out in conjunction with this scheme are analysed and commented on in this chapter and its associated appendices.

1.46 Chapter 4 contains the findings of the other case studies in Britain, namely those from Kingston-upon-Hull and Portsmouth. The schemes considered in these cities are discussed in detail, with the original objectives 'before' reviewed against the actual changes and benefits achieved 'after'. A general review of the local authorities policies and views is also presented.

1.47 Chapter 5 covers the selected three cases of highway construction in the Federal Republic of Germany, namely Hamburg, Duisburg and Düsseldorf. Each scheme is discussed in relation to its intended objectives and the actual outcome. The policies adopted in these cities with respect to road building, parking and public transport, plus the views of local officials are also reviewed.

1.48 The Swedish case studies, from Stockholm and Göteborg, are presented in Chapter 6 which also reviews the development of policies in Sweden in general. The recently proposed measures to counter traffic problems, as put forward by a specially

appointed Parliamentary committee, are discussed as well as the particular policies adopted within the individual cities.

1.49 In Chapter 7, the other side of the coin is examined. Examples of major improvements to the public transport systems in Britain and Germany are investigated to determine the actual impact associated with these measures on road traffic directly affected. In Britain, the Victoria Line is discussed with earlier predictions tested against the actual changes after the opening of the line. In Germany, two examples from Berlin and Stuttgart cover improvements to the public transport system, the *S-Bahn* and the *U-Bahn* respectively.

1.50 Chapter 8 describes the findings of the research and the lessons to be learnt from a comparative review of the various approaches in the different cities and countries. Certain individual policies are reviewed, and their suitability for application elsewhere is discussed.

1.51 The overall summary of the research and a discussion of the main conclusions are contained in Chapter 9. In addition, a discussion of how well founded the hypotheses given in this research with respect to the cases considered. This chapter also recommends the areas that need to be covered more extensively by local authorities to provide a suitable foundation for further research in this area.

CHAPTER 2 FURTHER BACKGROUND

INTRODUCTION

2.1 Before proceeding with the case studies, it is necessary to highlight some of the trends associated with the development of the transportation systems in Britain, Germany and Sweden. This chapter provides further factual description of the general situation in the countries studied. It is possible here to compare the British and German situations, simply because of the similarities in terms of population and the spread of conurbations, and the common history. Sweden is rather different due to its vast area, much lower population, and different urban structure.

BRITAIN AND GERMANY: FACTS AND FIGURES

2.2 Great Britain extends over an area of 230,000 km^2. Its total population is approximately 55 million[8], with about 80 per cent living in urban areas[9]. Major conurbation areas are: London, West Midlands, SELNEC, Merseyside, Tyneside, Clydeside, and West Yorkshire.

2.3 The Federal Republic of Germany was founded on 24 May 1949. It consists of eleven Federal *Länder* , which are states with their own government authorities and their own constitutions. These eleven *Länder* are, from North to South: Schleswig-Holstein, Lower Saxony, North Rhine-Westphalia, Rhineland-Palatinate, Hesse, the Saarland, Baden-Württemberg, Bavaria and the city states (Hansestadt) of Bremen, Hamburg and Berlin. Until recently, Berlin had a special status but was fully integrated into the legal and economic system of the Federal Republic of Germany.

2.4 The Federal Republic of Germany extends over an area of approximately 249,000 km^2 (including the city of West Berlin which is no longer landlocked by the territory of the German Democratic Republic). The largest north-south distance is 867 km, the largest east-west distance is 463 km. It's total population is approximately 61 million distributed very unevenly with about 70 per cent living in urban areas. Since 1974, the population has been declining and this trend is expected to continue. The Federal Republic of Germany has twenty four defined conurbations of which only six have over 1 million population. Major conurbation areas are the Rhein-Ruhr

(Essen, Dartmond, Köln, Düsseldorf, Duisburg) region, the Rhein-Main area around Frankfurt, the Rhein Neckar (Mannheim, Ludwigshafen) area, the Swabian industrial belt around Stuttgart and the concentrations around the cities of Bremen, Hamburg, Hannover, Nürnberg and München.

HISTORICAL BACKGROUND

2.5 Following World War II, a number of policies, which in turn laid the basis for the systems which exist today, emerged in Britain and Germany. The extent of war damage in many German cities provided a unique opportunity to replan the cities and reorganise the transport systems. Coupled with the admiration for the American suburban structure, and the car as a transportation mode, this resulted, with respect to roads, in a strong commitment to a comprehensive network of completely new urban motorways (*Autobahns*) and high capacity main roads. The construction of new *Autobahns* resumed in the mid fifties and continued according to systematic plans thereafter. The motor vehicle ownership rates in the early fifties were much lower than those in Britain (1,384,000 and 3,450,100 motor vehicles respectively)[10], and the badly damaged trams systems in German cities had to be restored as an essential basis to the reconstruction of the cities[11]. As a result, public transportation systems, in Germany, still provided the connections to the new urban areas built during the 1950's, with the main mode being the tram.

2.6 With growing car ownership, and the appearance of congestion in the 1960's, the decision in Germany was to put the tram systems underground in the city centres. These systems have been modernised and constitute the major mode of transport within German city centres.

2.7 The situation was somewhat different in Britain. With the increasing trend in suburban living, the large British conurbations back in the 50's began to become less densely populated. These forces of outward spread together with the extensive house building in the mid fifties and cheaper petrol made the existing tram systems not viable. This lead to these systems being scrapped altogether and being replaced with the bus as the main public transport mode, since this was more cost efficient. In the 1960's there were calls for extensive reconstruction of public transport systems, however, there were no funds for these schemes[11]. Car ownership was continuing to grow (from 2.3 million in 1950 to 5.5 million in 1960), but it was not until the very

late 1950's that the construction of an inter-city motorway network began with the first short stretch of motorway (8 miles) opened in December 1958[12].

THE DEVELOPMENT OF THE ROAD NETWORK

2.8 In Britain, the development of the road network has not been as quick or as extensive as that in Germany. In addition to having more cars, Britain also had substantially more kilometres of ordinary roads than Germany in the early fifties (nearly 298,000 km and some 128,000 km respectively)[10], but this was indeed very quickly reversed. Following the War, and influenced by the forces of suburban sprawl, the densities of British urban cities began to decline, with major conurbations spreading further out thus putting a lot of pressure on the demand for roads. In 1963, the Buchanan report was published[5]. The report was the first major work of its kind and aimed to deliver the guidelines for a reasonable, and well balanced approach to road spending and traffic restraint, to maintain environmental standards. It is, however, considered by some that this report was widely interpreted as a basis for extensive urban road building[11].

2.9 Plans for extensive urban motorway networks were put forward in the late 60's by American consultants who carried out large-scale transportation studies. They recommended the provision of more highway capacity to cater for the rapidly increasing number of private motorists. In the 70's a major part of the present motorway network was completed before political forces, coupled with strong opposition by environmental groups opposed the plans for more roads. Large parts of the plans for large scale reconstruction and urban motorway building were abandoned by the cities concerned. The road network, in general, and the motorway network in particular never recovered from this. Today, Britain possesses a fraction of the motorway network Germany has, and a total road system far less extensive than that in Germany.

2.10 In Germany, the road network has always been the backbone of the transport system. This is evident from pre-war days when Germany had 3,860 km of *Autobahns*, 2175 km of which were in the territory that is now the Federal Republic of Germany. These were built between 1929 and 1942. In 1952, however, Germany only had about 128,000 km of roads (including all local and residential streets) compared with nearly 298,000 km, or about two and a half times as much in Britain. Car ownership was much less in Germany than in Britain. After the War, and following

the American influenced policies of extensive road building to cater for the growth in car ownership, Germany surpassed the British levels in network length, and car ownership rates in under 10 years. Tables 2.1 and 2.2 present the development of the road network, by type of road, in Britain and Germany, respectively, between 1962–1988.

2.11 From these tables, it can be clearly seen that the German emphasis has been on extending the motorway network which was nearly tripled in the period concerned. The total length of all roads in Germany was only increased by 32 per cent in the same period. In Britain, this was different. While the motorway network was increased by more than twelve times between 1962 and 1988, it is only still one third that of Germany's. Even the total length of all roads, increased by 12 per cent, amounts to 71 per cent the German equivalent. Figures 2.1 and 2.2 show a graphic comparison of the development of Motorways and all roads in Germany and Britain. In 1988 car numbers in Germany were more than four fold those in 1962, while in Britain it was 2.8 fold. Looking at car and vehicle ownership figures (Table 2.3) it can be seen that until 1968 car and vehicle ownership levels in Germany were still less than those in Britain. After 1968, however, this trend was reversed and car and vehicle ownership levels in 1988 were considerably higher than those in Britain. Detailed car and vehicle ownership levels and relevant information for both countries are tabulated in Table 2.3 and presented in Figures 2.3 and 2.4. Table 2.4 is a presentation of the annual car mileage in million vehicle-kilometres in Germany and Britain. Appendix C contains additional graphic presentations and comparisons extracted from these tables (Figures C.1 and C.2). A more descriptive section on the German road network is provided in Appendix D.

2.12 The American influence in Germany was demonstrated by the plans to build extensive major motorways and highways to cater for the growth in traffic. These were carried out quickly and efficiently while reconstructing the public transport systems of the German cities. In 1964, the German government responded to growing traffic congestion in German cities by commissioning a group of experts to give some advice on the transport situation in local authorities. Their work[13], which was largely influenced and based on the Traffic in Towns report, has since been used by local and central agencies as a guideline. The Traffic in Towns report was also the subject of planning seminars across the country prior to the production of the German version of this report.

Year	Number of Kilometres by Road Type					Density
	Motorway	Main	Secondary	Other	Total	Km/km^2
1962	241	12,743	300,832	*	313,816	1.36
1963	320	13,354	303,854	*	317,528	1.37
1964	478	13,337	305,775	*	319,590	1.38
1965	560	13,356	307,773	*	321,689	1.39
1966	626	13,336	309,333	*	323,295	1.40
1967	761	13,409	311,942	*	326,110	1.42
1968	883	13,482	313,741	*	328,106	1.43
1969	998	13,456	317,207	*	331,656	1.44
1970	1,073	13,435	319,625	*	334,133	1.45
1971	1,255	13,406	322,030	*	336,691	1.46
1972	N/A	N/A	N/A	N/A	N/A	N/A
1973	1,754	13,449	326,184	*	341,387	1.48
1974	1,883	13,471	327,408	*	342,762	1.49
1975	2,026	13,471	327,591	*	343,088	1.49
1976	2,246	13,488	329,618	*	345,532	1.50
1977	2,297	13,350	332,000	*	347,600	1.51
1978	2,415	12,561	34,148	287,419	336,543	1.52
1979	2,485	12,463	34,345	288,699	337,992	1.53
1980	2,585	12,400	34,188	290,316	339,489	1.53
1981	2,641	12,376	N/A	292,282	341,743	1.53
1982	2,666	12,324	34,480	293,455	342,925	1.49
1983	2,775	12,293	34,752	293,865	343,685	1.49
1984	2,793	12,422	34,717	296,940	346,872	1.51
1985	2,838	12,293	34,534	298,680	348,344	1.51
1986	2,843	12,416	34,770	300,454	350,483	1.52
1987	2,980	12,425	34,879	301,987	352,291	1.53
1988	2,981	12,425	34,900	301,990	352,292	1.53

* Included in preceding column.

Table 2.1 **The development of the road network by road type in Great Britain (1962–1988).**

Source: World Road Statistics, International Road Federation, 1962–1988.

Year	Number of Kilometres by Road Type					Density
	Motorway	Main	Secondary	Other	Total	Km/km^2
1962	2,936	29,200	63,200	278,800	374,000	1.51
1963	3,077	29,600	66,162	285,100	384,000	1.55
1964	3,204	29,900	66,165	290,600	390,000	1.57
1965	3,372	30,000	66,200	295,700	395,000	1.59
1966	3,508	31,418	65,674	299,400	400,000	1.61
1967	3,617	31,987	65,253	301,100	405,857	1.62
1968	3,966	32,047	65,402	303,600	409,415	1.64
1969	4,110	32,205	65,358	313,000	414,673	1.67
1970	4,461	32,540	65,500	313,500	416,000	1.67
1971	4,829	32,590	65,340	314,241	417,000	1.68
1972	N/A	N/A	N/A	N/A	N/A	N/A
1973	5,481	32,703	65,458	355,810	459,452	1.85
1974	5,748	32,594	65,422	358,391	462,155	1.86
1975	6,200	32,500	65,500	359,800	464,000	1.87
1976	6,435	32,460	65,425	365,248	469,568	1.89
1977	6,711	32,292	65,400	370,000	474,303	1.91
1978	7,029	32,252	65,377	375,000	471,658	1.93
1979	7,292	32,248	65,543	376,917	482,000	1.94
1980	7,538	32,558	65,637	379,659	485,392	1.95
1981	7,784	32,356	65,643	379,707	485,490	1.95
1982	7,919	32,239	65,780	380,035	485,973	1.95
1983	8,080	32,096	65,797	381,278	487,251	1.96
1984	8,198	31,485	63,306	387,056	490,045	1.97
1985	8,350	31,372	63,296	388,222	491,240	1.97
1986	8,437	31,368	63,382	389,291	492,478	1.98
1987	8,618	31,196	63,393	390,383	493,590	1.98
1988	8,715	N/A	N/A	N/A	N/A	N/A

Table 2.2 **The development of the road network by road type in the Federal Republic of Germany (1962–1988).**

Source: World Road Statistics, International Road Federation, 1962–1988.

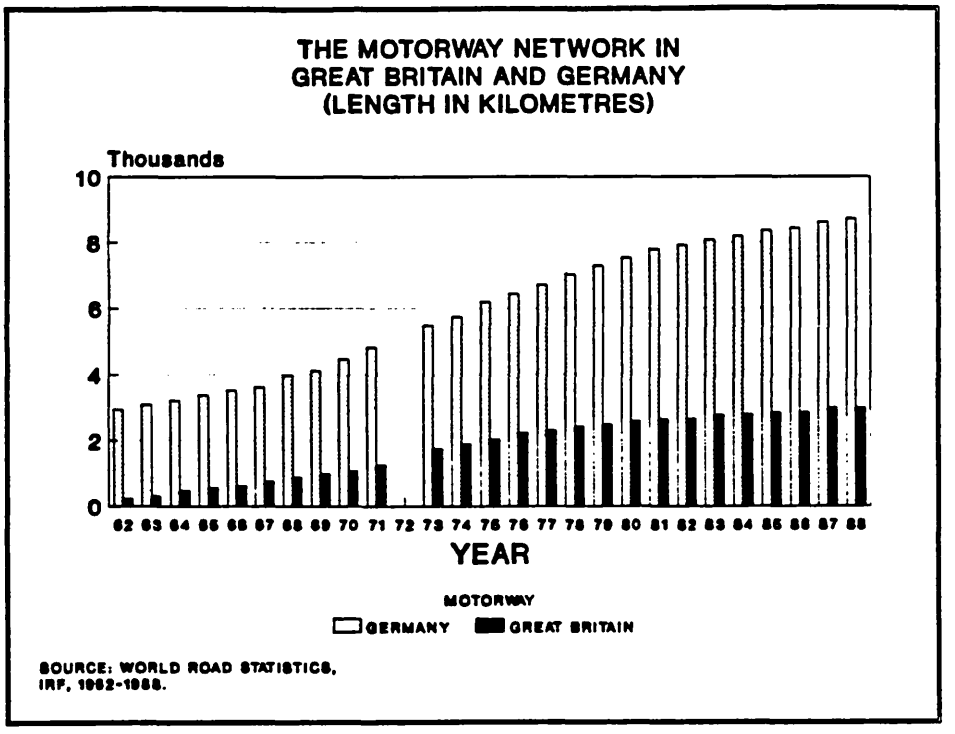


Figure 2.1 The development of the motorway networks in Great Britain and the Federal Republic of Germany (1962–1988).

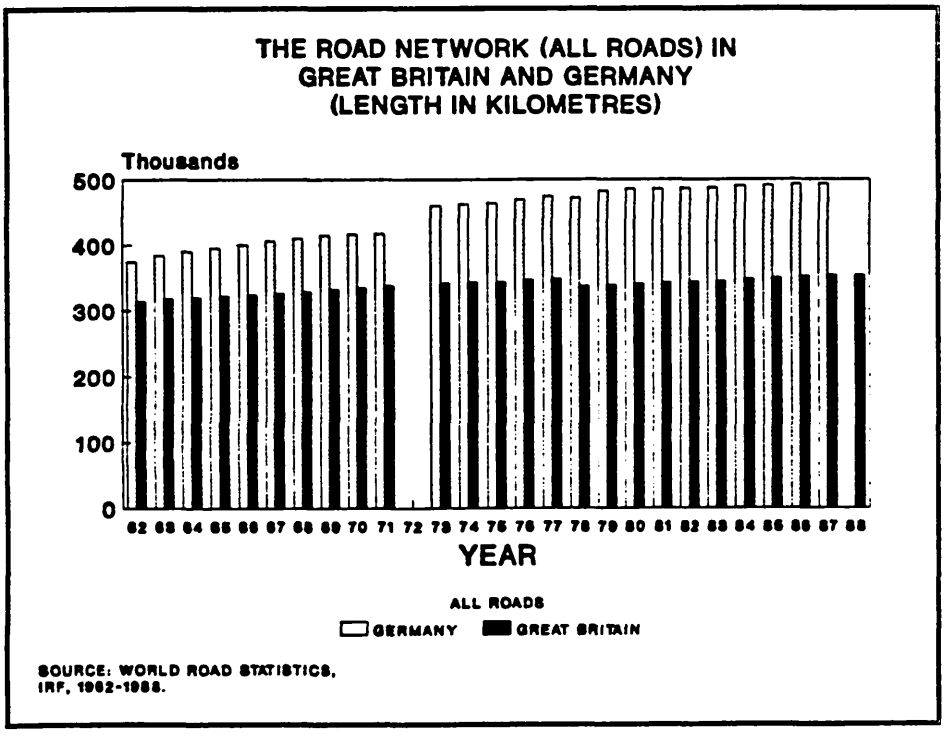


Figure 2.2 The development of the road networks (all roads) in Great Britain and the Federal Republic of Germany (1962–1988).

Year	Total Number of Cars		Cars per kilometre of road		Cars Per 1,000 Inhabitants		Vehicles Per 1,000 Inhabitants	
	Germany	Britain	WG	GB	Germany	Britain	WG	GB
1962	6,771,391	6,556,000	N/A	25.9	N/A	126.3	134	156
1963	7,751,047	7,375,000	N/A	28.3	N/A	141.1	151	172
1964	8,689,689	8,247,000	N/A	31.0	N/A	156.6	166	189
1965	9,718,778	8,917,000	N/A	33.0	N/A	168.1	181	200
1966	10,647,125	9,513,000	29.2	34.5	177	178.6	195	210
1967	11,292,924	10,318,300	30.0	36.8	189	193	206	225
1968	12,045,699	10,835,700	32.1	38.0	200	201	217	232
1969	13,168,560	11,252,200	34.5	38.9	216	208	234	239
1970	14,376,484	11,540,300	34.7	39.6	234	213	253	244
1971	15,475,603	12,086,800	40.1	40.9	250	224	270	255
1972	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1973	17,036,474	13,497,000	40.0	45	275	248	296	282
1974	17,356,276	13,639,000	40.4	45	280	251	301	285
1975	18,161,179	13,747,000	41.9	45	295	253	316	287
1976	19,180,465	14,047,000	43.7	45	312	258	334	293
1977	20,377,174	14,300,000	45.8	42	333	263	355	298
1978	21,619,697	N/A	48.0	N/A	354	258	377	291
1979	22,613,508	14,568,000	50.0	49	368	261	392	294
1980	23,236,060	15,073,000	50.7	50	377	269	399	303
1981	23,680,911	15,267,000	51.6	50	384	273	406	306
1982	24,035,907	15,687,000	51.2	51	389	287	412	320
1983	24,688,843	15,854,000	53.5	N/A	401	289	424	N/A
1984	25,377,637	16,055,000	54.5	53	414	293	437	337
1985	26,099,297	16,453,000	56.3	53	428	304	450	355
1986	27,223,810	16,981,000	58.0	61	446	310	468	360
1987	28,304,184	17,421,000	62.0	58	463	318	486	373
1988	29,190,322	18,432,000	N/A	60	477	333	499	382

Table 2.3 **The development of vehicle and car ownership in Great Britain and the Federal Republic of Germany (1962–1988).**

Source: World Road Statistics, International Road Federation, 1962–1988.

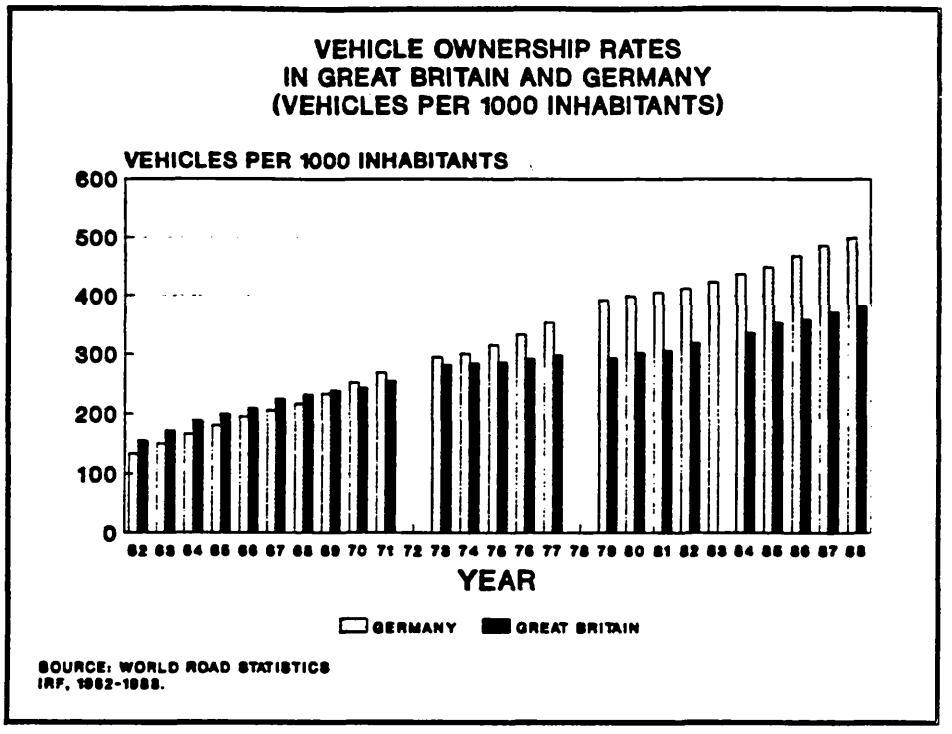


Figure 2.3 The Development of Vehicle Ownership Rates in Great Britain and The Federal republic of Germany (1962–1988).

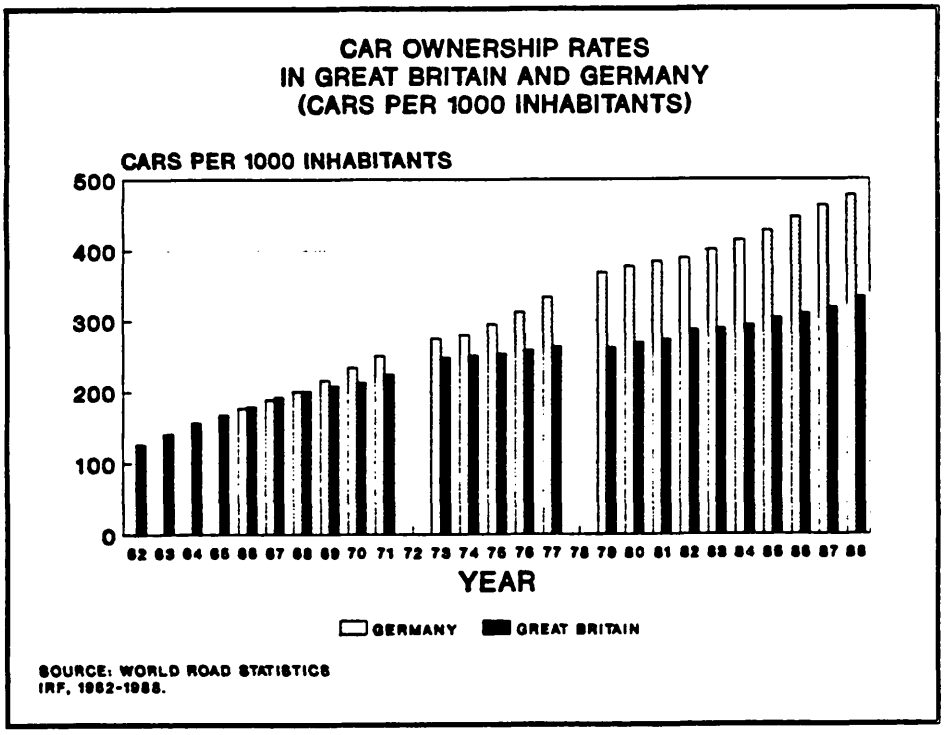


Figure 2.4 The development of car ownership rates in Great Britain and the Federal Republic of Germany (1962–1988).

Year	Annual Car Mileage (Million Vehicle -Kilometres)	
	Germany	Britain
1962	115,767	80,320
1963	N/A	86,720
1964	N/A	99,200
1965	N/A	107,250
1966	170,000	116,480
1967	180,700	137,000
1968	192,700	145,500
1969	207,900	151,000
1970	237,200	161,300
1971	247,610	N/A
1972	N/A	N/A
1973	241,918	194,540
1974	240,744	188,960
1975	263,300	192,480
1976	278,100	200,530
1977	295,000	207,000
1978	304,500	220,000
1979	291,000	221,000
1980	297,400	224,400
1981	282,700	222,700
1982	294,400	239,800
1983	N/A	N/A
1984	314,000	221,790
1985	313,400	228,000
1986	336,200	236,000
1987	356,900	257,000
1988	376,500	270,000

Table 2.4 **The annual car mileage (vehicle-kilometres) in Great Britain and the Federal Republic of Germany (1962-1988).**

Source: World Road Statistics, International Road Federation, 1962-1988.

2.13 The German report[13] addressed the changes in the urban structure influenced by the motor vehicle and the associated change in land use. It recommended that roads should be planned in the form of tangents or orbitals around the city centre; it also recommended the removal of through traffic from the city centre, and that the city centre should be as free as possible of car traffic and parking spaces. Public transportation was seen as an important measure to facilitate this and the improvement of public transport via means of improved accessibility and reduced conflict with the car (e.g. its own right of way). In the years that followed, urban planning was taking a different approach in attending more to the public transport element. The Federal Government first gave active support to public transport investments in 1967 and rapid rail systems started appearing in 1972[11]. In 1975, expenditure on public transport was about five times higher than in 1967.

2.14 The concepts put forward, by the 1965 report, have been applied to a large degree in Germany, and this is reflected, for example, in the environmental safeguarding of residential areas, the provision of public transport in central areas, and the construction of road networks to cater efficiently for the travel needs.

THE DEVELOPMENT OF PASSENGER TRAFFIC

2.15 The population of Britain between 1962 and 1988 rose by about 3.5 million inhabitants i.e. by about 6.6 per cent. During the same period: i) the total passenger transport mileage increased by 103 per cent, and ii) the total number of cars increased by 181 per cent. It is worth noting that the share of private transport by car increased by 173 per cent and that of the railways by only 7 per cent during the same period.

2.16 The population of the Federal Republic of Germany between 1960 and 1986 (no later information available) rose by about 5 million inhabitants, i.e. by about 9 per cent. During the same period: i) the number of individual trips increased by 58 per cent, and ii) the passenger transport mileage increased by 150 per cent[14]. Here it is noteworthy that the share of private transport by car increased by 215 per cent and that of the railways by only 5 per cent during the period in question.

2.17 By close examination of the trend in inland surface passenger transport in Britain, and from Table 2.5, a decline in the road public transport share of passenger-kilometres appears to have started in the late 60's and continued uniformly until the

Year	Inland Goods Transport (Million Tonnes-Km)			Inland Passenger Transport (Million Passenger-Kilometres)		
				Road		Rail
	Road	Water	Rail	Public	Private	
1962	54,560	244	26,200	59,400	165,900	36,500
1963	56,900	244	25,000	66,400	176,800	35,800
1964	62,600	224	26,000	64,800	200,800	36,800
1965	66,650	213	23,100	60,200	215,700	34,900
1966	N/A	N/A	N/A	N/A	N/A	N/A
1967	74,600	200	22,200	59,500	270,200	34,100
1968	79,000	200	24,000	58,400	285,900	33,500
1969	80,600	200	25,000	57,400	296,100	34,800
1970	83,000	200	26,800	54,900	315,700	35,700
1971	85,000	200	24,400	N/A	340,000	35,400
1972	N/A	N/A	N/A	N/A	N/A	N/A
1973	90,400	100	25,600	54,000	360,000	35,000
1974	89,900	100	24,200	54,000	346,000	36,000
1975	95,300	100	23,500	54,000	350,000	35,000
1976	95,600	100	23,100	53,000	359,000	33,000
1977	97,937	164	22,727	53,792	376,050	34,499
1978	99,100	100	20,000	52,000	390,000	35,000
1979	104,600	N/A	19,900	52,000	405,000	36,000
1980	95,900	N/A	17,600	52,000	423,000	36,000
1981	97,100	N/A	17,500	52,000	422,000	35,000
1982	100,000	44,000	15,900	40,000	452,000	31,000
1983	N/A	N/A	N/A	N/A	N/A	N/A
1984	106,900	43,200	12,700	42,000	417,000	35,000
1985	102,100	41,700	15,300	42,000	432,000	36,000
1986	104,100	51,400	16,500	41,000	424,000	37,000
1987	113,300	54,200	17,300	41,000	451,000	38,000
1988	N/A	N/A	N/A	41,000	452,500	39,000

Table 2.5 **The development of inland surface goods and passenger transport in Great Britain (1962–1988).**

Source: World Road Statistics, International Road Federation , 1962–1988.

early 80's. After1980 the fall in the public transport share was sharp and it has never recovered after that. This is no doubt associated with the poor service quality of buses, at least in the city of London, due to traffic congestion and unreliability. From Table 2.5 it can be inferred that the road public transport share of passenger-km is only about 60 per cent that in the sixties. The Rail share of passenger transport has not changed that much within the period considered, and this may be attributed to the fact that the system, at least in London, is overcrowded which leaves no additional capacity for the growth in this mode. The Private transport share, on the other hand, has continued to increase. While accounting for some 63 per cent of all passenger-kilometres in 1962, it took 85 per cent of this total in 1988. In the early and mid 70's the growth in the private transport share was slowed down by the oil crisis, but it continued to increase with some fluctuations thereafter. Figure 2.5 is a graphic presentation of the different modes share of total passenger kilometres in Britain between 1962 and 1988.

2.18 The German situation, as shown in Table 2.6, is different. In contradiction to the continuous decline in Great Britain, the road public transport share of passenger kilometres increased moderately in the 60's and in the 70's. This share, however, and probably due to the effect of the oil crisis, increased sharply (by almost 50 per cent between 1974 and 1970). This trend continued until the early 80's and it has been only since then that there has been any decline (Table 2.6). In the period considered, its total share of traffic has not changed very much, and at almost 10 per cent of all passenger kilometres, it remains in 1986 similar to that in 1966. In 1986, 'Rail'public transport accounted for 7 per cent of the total compared with nearly 9 per cent in 1966. Private road transport in Germany, like in Britain accounts for the majority of passenger kilometres. However, this mode has always maintained its large share (82 per cent in 1966, and 83 per cent in 1986). Figure 2.6 illustrates graphically the different modes share of the total traffic between 1962 and 1988. Figures C.3, C.4, C.5 in Appendix C illustrate the comparison between the same modes in Britain and Germany.

THE DEVELOPMENT OF GOODS TRANSPORT

2.19 Between 1962 and 1987 in Britain, the value of goods increased by about 22 per cent to over 1.5 billion tonnes[15]. However, the transport mileage increased by about 108 per cent to over 113 billion tonne-km. The increase here is almost exclusively concentrated on the roads whereas the railways lost part of their share.

Year	Goods Transport (Million Tonnes-km)			Passenger Transport Million Passenger-Kilometres		
	Road	Water	Rail	Road		Rail
				Public	Private	
962	26,500	40,000	67,100	40,538	N/A	38,415
1963	27,900	39,600	71,500	40,847	N/A	37,333
1964	30,300	40,600	70,500	40,522	N/A	37,218
1965	N/A	N/A	N/A	N/A	N/A	N/A
1966	N/A	N/A	N/A	41,000	348,600	36,700
1967	65,800	45,800	64,525	40,560	303,000	33,877
1968	70,800	47,900	70,649	40,798	328,000	34,985
1969	76,440	47,800	80,165	43,231	353,000	37,156
1970	78,700	48,800	86,100	44,775	403,000	38,210
1971	82,900	45,000	79,110	47,428	N/A	38,000
1972	N/A	N/A	N/A	N/A	N/A	N/A
1973	96,500	48,500	69,400	64,400	437,700	39,300
1974	97,700	51,000	71,400	66,000	433,000	38,600
1975	93,125	47,566	57,223	68,938	469,400	37,758
1976	103,402	45,805	61,415	67,373	488,700	38,347
1977	106,881	49,254	57,880	N/A	N/A	38,407
1978	111,673	51,479	59,479	70,096	517,700	38,251
1979	123,900	51,000	66,300	72,300	465,200	38,000
1980	124,000	51,400	64,900	73,900	470,300	38,900
1981	122,900	50,000	62,200	75,700	444,000	40,300
1982	121,050	49,400	57,408	74,500	459,800	38,600
1983	126,000	49,100	56,051	N/A	N/A	N/A
1984	128,400	52,000	60,000	70,000	484,100	39,600
1985	134,100	48,200	64,000	61,900	481,600	43,500
1986	140,300	52,200	60,600	61,300	510,300	42,100
1987	144,600	49,700	59,000	N/A	N/A	N/A
1988	153,500	52,900	60,000	N/A	N/A	N/A

Table 2.6 **The Development of Inland Surface Goods and Passenger Transport in The Federal Republic of Germany (1962-1988).**

Source: World Road Statistics, International Road Federation, 1962-1988.

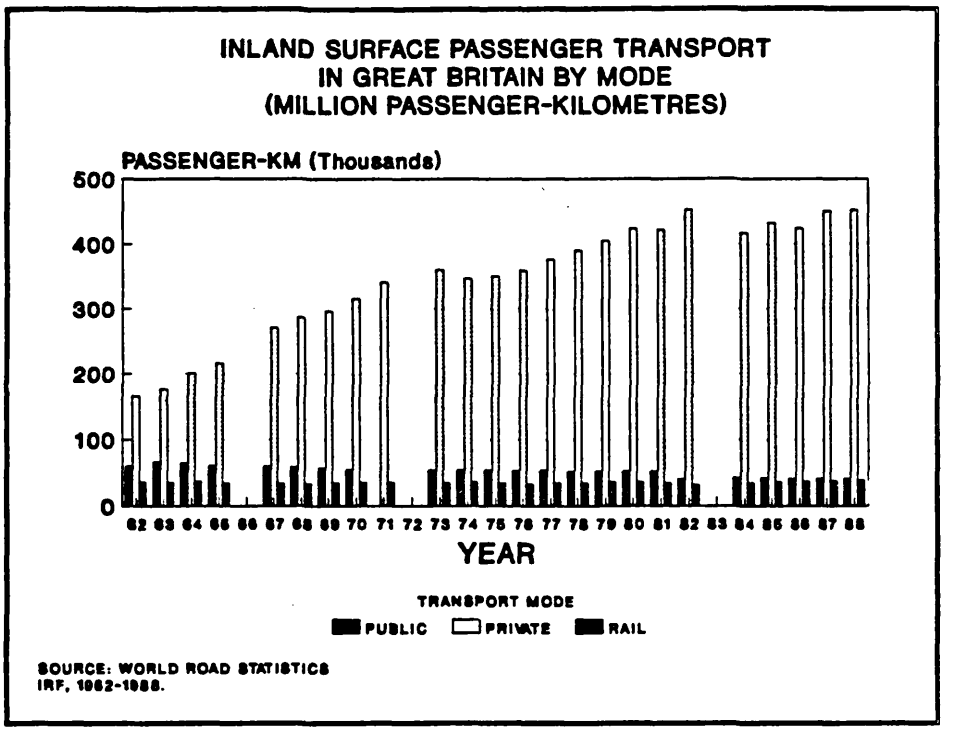


Figure 2.5 The development of inland surface passenger transport in Great Britain by mode (1962–1988).

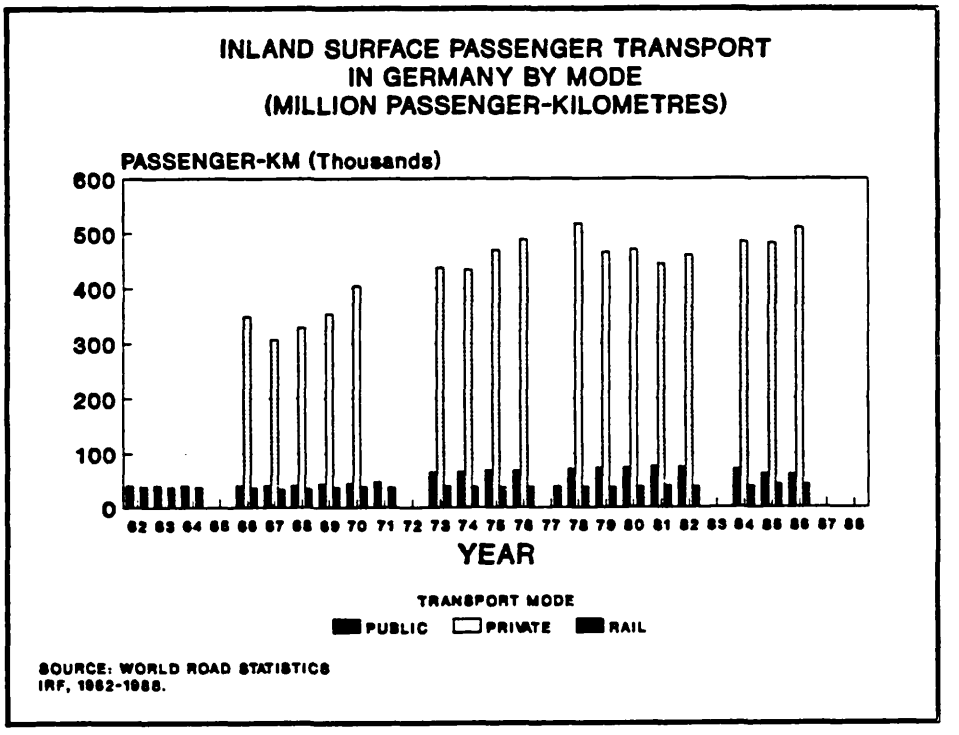


Figure 2.6 The development of inland surface passenger transport in the Federal Republic of Germany by mode (1962–1988).

The roads in the meantime attracted 61 per cent of the total transport mileage of traffic (Table 2.5).

2.20 In Germany, the development has been much stronger. The value of goods increased by about 2144 per cent to over 2.4 billion tonnes[15]. The transport mileage increased by about 446 per cent to over 144 billion tonne-km. The increase was on the roads with the railways losing part of its share (Table 2.6). Figures C.6 and C.7 (Appendix C) are graphic presentations of the road and rail share of the total traffic mileage over the period between 1962 and 1988 in Britain and Germany respectively. Additional figures in Appendix C show graphical comparisons of road and rail mileage in Britain and Germany (Figures C.8 and C.9). This prominence of the roads in Germany is attributed to the many advantages associated with them[15] which include:

- economic efficiency,
- multi-functionality,
- natural monopoly in making regions accessible, and providing a door-to-door service,
- permanent availability,
- adaptability to users ever changing demands and structures.

Nevertheless, there are certain disadvantages, mostly environmental, which are not overlooked by the Germans. These cover a number of issues, which are nowadays becoming widespread worldwide. These include[15]:

- road accidents, especially fatal and personal injury,
- cost of accidents to the economy (approximately 38 billion DM per year),
- the dangers associated with the transport of hazardous materials,
- the nuisance caused by road traffic especially in residential areas (noise, pollution, visual intrusion etc.).

2.21 The growth in the vehicle population and the increased demand for travel by road in Germany began to show, in the 1960's, in congestion symptoms appearing on certain parts of the network during the peak periods. These symptoms of delays and tail-backs, particularly in city centres were dealt with via a number of measures and policies. These included: i) the building of high capacity roads around the city centres to bypass the busy sections and cater for through traffic more efficiently with

minimal environmental impact; ii) the provision of ring roads around the cities; and iii) the provision of efficient public transport in the city centres.

2.22 Today, the transport policy objectives in Germany are[13] :

'- to keep existing traffic routes safe,

- the rapid completion of current projects and closure of gaps in the network,

- to meet changed qualitative demands on the traffic routes by means of improvement and/or modernisation,

- regional development and linking-in of structurally weak and peripheral areas,

- further development of traffic routes in accordance with demand.'

THE DEVELOPMENT OF PUBLIC TRANSPORT

2.23 There has been very few innovations in this respect in British cities in general. As explained earlier, British cities abandoned their trams systems soon after the 2nd World War was over, and replaced them with buses. This was the result of the shift towards suburban living which left city centres less dense and made the trams not viable. From then on, public transport in Britain has not experienced any major changes, except for some considerable achievements in Merseyside and Tyneside. Although the Buchanan report in 1963 stressed the importance of an efficient public transport system to help maintain a ceiling on car levels in city centres, comparatively little has been done to achieve this. Major conurbations, excluding London, are only beginning to consider the re-introduction of their light rail systems and some have introduced rapid rail. In London, the only major developments have been that of the Victoria Line, which was the first new line in sixty years, and the Docklands Light Rail system which only serves a particular development area. The other major change, after the War, was that of bus deregulation in 1986. This opened the door for private enterprise to compete along routes previously controlled by a single operator.

2.24 In Germany, the extent of war damage in many cities provided a unique opportunity to re-plan the cities and the transport systems. This resulted in a restructuring of the administrative system which unified and coordinated the different public transport modes in the city. Despite the strong commitment to a comprehensive network of completely new urban motorways, the public transport

systems were not neglected and new extensions to areas never served before were made while rebuilding the war damaged cities. In the early stages (between 1950 and 1964) the Federal Government investment in road and bridge construction was much higher than in the public transport system. The latter represented only 1.6 per cent of the total investments in transportation[11].

2.25 The German report[13], published in 1965, recommended catering for the increased demand for personal transportation, the promotion of public transport systems and better traffic regulation and management. With major emphasis on taking traffic out of city centres via high capacity roads (the *Autobahns)* and the promotion of public transport, certain elements in public transport needed special attention to ensure the achievement of this goal. Improvements in the system's speed, reliability and regularity were needed, if commuters were to be influenced to give up their cars and use public transport. In the early 60's , the time the Buchanan and the German reports were published, the conflict, on one hand, between the then existing road-based public transport systems and other road traffic, on the other, was increasing. Having a shared right-of-way with the rest of traffic, public transport was at a disadvantage, and its attributes were affected by the traffic conditions on the roads.

2.26 In Germany, enhancements to the systems varied according to the city structure and size. Cities of smaller populations (300,000 people) built tram systems which went underground in the city centre. Larger cities of 500,000 or more, built light rail systems with the potential to be transformed into rapid rail systems. Buses have been used to a large degree as collectors and feeders outside the centre connecting passengers with the rapid rail systems serving the centres. Park and ride facilities have also been built to encourage the use of public transport into the city centre. The Government in Germany contributes substantially to the subsidy of public transport systems. This is in line with the recommendations put forward by the 1965 report which, today, still contributes to the implementation of German transport policies.

2.27 In most German cities a balance exists between the various public transport modes in any one city. Further recommendations by the report[13] were to give public transport systems their own right-of-way, and these were largely implemented in all the cities. Some technical terms are used throughout the case studies to describe different public transport modes in the different cities. Because these terms are

important to the understanding of the situation , and because some of them may not be very clear, a brief description and discussion of these modes is presented in Appendix E.

2.28 Public transport in Germany is subsidised by the Federal, State and local governments. Table 2.7 presents the new transportation investments in public transport in the Federal Republic of Germany between 1967 -1981. From the table it can be seen that 22.9 billion DM were spent on the construction of public transport facilities. During the same period, the road building programme cost 195 billion DM[11]. The Federal support for public transport investment is being somewhat reduced. The Federal Government is introducing a form of cost-benefit analysis for new public transport investments reflecting a more stringent scrutiny of projects[11]. It is worth noting that the Federal Government is empowered to pay up to 60 per cent of investments in *S-Bahn* , rapid rail or light rail, construction of bus garages and Park-and-Ride systems[11]. Total public transport subsidies in German cities vary from one city to another. It also varies from one year to another since it is not a fixed proportion and is designed to ensure that the system remains attractive to the passengers and serves its objectives.

2.29 With the changes in the habitation structure and the growth of new outlying suburbs and residential areas, short-range commuter transportation has become very important. This development began in the 1960's and has given rise to strong commuter traffic demand that had to be met with efficient and fast rail services as well as new roads. As in other countries, competition from the motor vehicle poses a serious problem for the railways. Despite large subsidies put into the State-owned Federal Railways (*Deutsche Bundesbahn , DB)*,the railways ended 1985 with a deficit of DM3,300 million. The government support grants for that year alone were in the order of DM13,600 million. It must be noted, however, that a considerable sum (DM 9,300 million) went to non-rail obligations (e.g. pension schemes etc.).

SWEDEN: FACTS AND FIGURES

2.30 Sweden is rather different from either Britain or Germany. The country covers a vast area of over 411,000 km^2 with a population of only about 8.5 million. This has meant that the population is dispersed over a vast area of land. With some urban concentrations, namely Stockholm (approximately 1.5 million inhabitants in the region), Göteborg (around 750,000) and Mälmo (around 500,000). The rest of the

Paid By	Rapid Rail and light rail (million Dm)	%	*S-Bahn* (M DM)	%	Total (M DM)	%
Federal Government	7,800	51	5,100	67	12,900	56
Länder	2,800	18	1,900	25	4,700	21
Local Authority	4,700	31	600	100	22,900	23
Total	15,300	100	7,600	100	22,900	100

• Figures do not include investments in bus garages, repair shops, etc.

Table 2.7 New transportation investments in the Federal Republic of Germany, 1967–1981.

Reproduced from 'Can Rail Save The City?', 1985 (Table 2.2).

population is scattered across the land. This has meant that traffic patterns are different from those in countries with smaller areas and closer urban concentrations.

2.31 Sweden enjoyed a high rate of car ownership from the early 60's. This was partly influenced by the spread of the urban communities and the high income per capita. In 1962, the country had some 1.5 million cars on its roads. This translated into a high rate of car and vehicle ownership (188 and 207 per 1000 people, respectively). At this time, Sweden had a higher car ownership rate than either Britain or Germany (see Tables 2.3 and 2.8). This continued to be the case until 1978. This was due to the environmental awareness in Sweden and the international oil crisis in the early 70's which lead to a slowing down in the growth of the vehicle population. After 1978, Germany's car ownership rates exceeded those in Sweden, however, the later's ownership rates still remain higher than those in Britain. From Table 2.8 it can be seen that the car population in Sweden more than doubled in the 14 year period between 1962–1976. From the mid 80's an increase in car ownership is evident, and at 412 cars per 1000 people, sweden has on of the highest car ownership rates in Europe.

2.32 When looking at the development of the road network in Sweden, it can be seen from Table 2.9 that the density of the network, i.e. the length of all roads in kilometres divided by the area in square kilometres, has been comparatively small compared with that of Britain's or Germany's (Tables 2.1 and 2.2). Similar to the development in Germany, particular emphasis was on the motorway network which was increased by nearly six fold between 1976 and 1962. During the same period, comparatively very little changes were made on the rest of the network (Table 2.9). Figure 2.7 is a graphic presentation of the motorway network development in Sweden between 1962 and 1988.

2.33 When examining the development of inland passenger surface transport in Sweden, it can be seen that travel by private transport has always dominated the scene with over 80 per cent of the total traffic, and continues to do so (Table 2.10). A noticeable change, however, has been that of increased road borne public transport share where it doubled from its 1962 level. This, nevertheless, did not affect the private transport share. The rail's share (9.2 per cent in 1962) has only fluctuated slightly and was 8.3 per cent in 1980. Table 2.10 also presents the data available on inland goods and passenger transport in Sweden, while Figure 2.8 shows the different modes share of the total passenger traffic mileage traffic. Figures C.10, C.11, C.12

Year	Total Number of Cars	Annual Car Mileage (million vehicle-kilometres)	Cars per km of road	Cars per 1000 people	Veh per 1000 people
1962	1,424,049	N/A	9.6	188	207
1963	1,556,005	21,000	10.2	204	222
1964	1,665,782	23,000	10.7	216	235
1965	1,792,671	N/A	11.6	232	250
1966	1,875,000	N/A	12.0	240	259
1967	1,976,248	N/A	22	250	269
1968	2,071,303	N/A	23	261	280
1969	2,193,634	N/A	24	274	293
1970	2,287,709	N/A	25	283	302
1971	2,356,581	N/A	26	290	310
1972	N/A	N/A	N/A	N/A	N/A
1973	2,502,644	N/A	21	307	328
1974	2,638,885	N/A	23	322	344
1975	2,760,264	N/A	23	336	357
1976	2,881,311	N/A	25	350	372
1977	2,857,140	N/A	24	346	368
1978	N/A	N/A	N/A	N/A	N/A
1979	2,868,302	36,000	24	345	368
1980	2,882,956	35,000	24	347	370
1981	2,893,242	35,000	24	348	372
1982	2,935,985	35,000	24	353	377
1983	3,006,760	36,000	25	361	387
1984	3,080,981	N/A	24	369	396
1985	3,151,195	52,900	26	377	405
1986	3,253,601	N/A	27	388	417
1987	3,366,570	N/A	28	400	431
1988	3,482,656	53,000	28.7	412	445

Table 2.8 **The Development of Car and Vehicle Ownership in Sweden (1962–1988).**

Source: World Road Statistics, International Road Federation, 1962–1988.

Year	Number of Kilometres by Road Type					Density
	Motorway	Main	Secondary	Other	Total	Km/km^2
1962	132	11,970	83,925	N/A	N/A	N/A
1963	175	11,884	84,294	N/A	N/A	N/A
1964	198	11,856	84,696	N/A	N/A	N/A
1965	223	11,820	85,011	N/A	N/A	N/A
1966	252	11,803	85,294	N/A	N/A	N/A
1967	283	12,137	85,370	N/A	N/A	N/A
1968	329	12,159	85,531	N/A	N/A	N/A
1969	376	12,229	85,821	N/A	N/A	N/A
1970	403	12,247	85,707	N/A	N/A	N/A
1971	441	12,406	85,078	N/A	N/A	N/A
1972	N/A	N/A	N/A	N/A	N/A	N/A
1973	607	12,554	84,936	27,435	124,925	0.30
1974	642	12,464	85,002	27,435	124,847	0.30
1975	692	12,470	84,893	27,435	124,798	0.30
1976	735	12,551	84,850	27,435	124,837	0.30
1977	776	12,610	84,863	31,400	128,873	0.31
1978	799	12,623	84,849	31,500	128,973	0.31
1979	850	12,632	84,834	31,600	129,066	0.31
1980	850	12,684	84,734	31,600	129,018	0.31
1981	854	12,859	85,012	31,600	129,471	0.31
1982	868	12,906	85,012	31,600	129,518	0.31
1983	N/A	N/A	N/A	N/A	N/A	N/A
1984	892	12,944	85,474	38,000	136,418	0.30
1985	897	13,841	84,350	32,500	136,691	0.30
1986	999	12,135	84,199	32,500	130,834	0.40
1987	999	14,211	84,230	32,500	130,941	0.40
1988	999	14,176	84,372	32,500	131,048	0.40

* included in preceding column.

Table 2.9 **The Development of The Road Network by Road Type in Sweden (1962–1988).**

Source: World Road Statistics, International Road Federation, 1962–1988.

Year	Inland Goods Transport (Million Tonne-km)			Inland Passenger Transport (Million Passenger-Kilometres)		
	Road	Water	Rail	Road		Rail
				Public	Private	
1962	8,200	2,400	11,100	3,500	42,800	6,700
1963	9,000	2,500	12,000	3,500	46,700	6,500
1964	9,900	2,700	12,900	3,500	50,500	6,600
1965	N/A	N/A	N/A	N/A	N/A	N/A
1966	N/A	N/A	N/A	N/A	N/A	N/A
1967	24,000	4,000	16,500	7,000	61,000	5,000
1968	26,000	5,000	16,000	7,000	63,000	5,000
1969	29,000	5,000	17,000	8,000	67,000	5,000
1970	31,000	6,000	18,000	8,000	69,000	5,000
1971	34,000	7,000	18,000	8,000	71,000	5,000
1972	N/A	N/A	N/A	N/A	N/A	N/A
1973	20,670	7,000	17,191	7,200	61,500	4,473
1974	21,470	8,000	18,497	7,500	63,000	5,294
1975	20,190	9,500	15,171	7,950	64,500	5,422
1976	20,580	10,483	15,458	N/A	66,000	5,433
1977	19,940	N/A	14,211	N/A	N/A	5,519
1978	N/A	N/A	N/A	N/A	N/A	N/A
1979	22,570	10,200	16,582	N/A	68,320	5,843
1980	21,362	10,300	15,627	7,100	67,300	6,786
1981	20,950	N/A	14,555	N/A	N/A	6,851
1982	21,135	N/A	13,628	N/A	N/A	6,374
1983	21,105	9,000	14,773	N/A	N/A	6,547
1984	22,986	9,000	17,213	N/A	N/A	6,365
1985	21,177	9,000	17,587	N/A	N/A	6,586
1986	N/A	N/A	N/A	N/A	N/A	N/A
1987	22,611	N/A	17,630	N/A	N/A	6,088
1988	25,000	N/A	18,165	N/A	N/A	5,961

Table 2.10 **The Development of Inland Surface Goods and Passenger Transport in Sweden (1962-1988).**

Source: World Road Statistics, International Road Federation , 1962-1988.

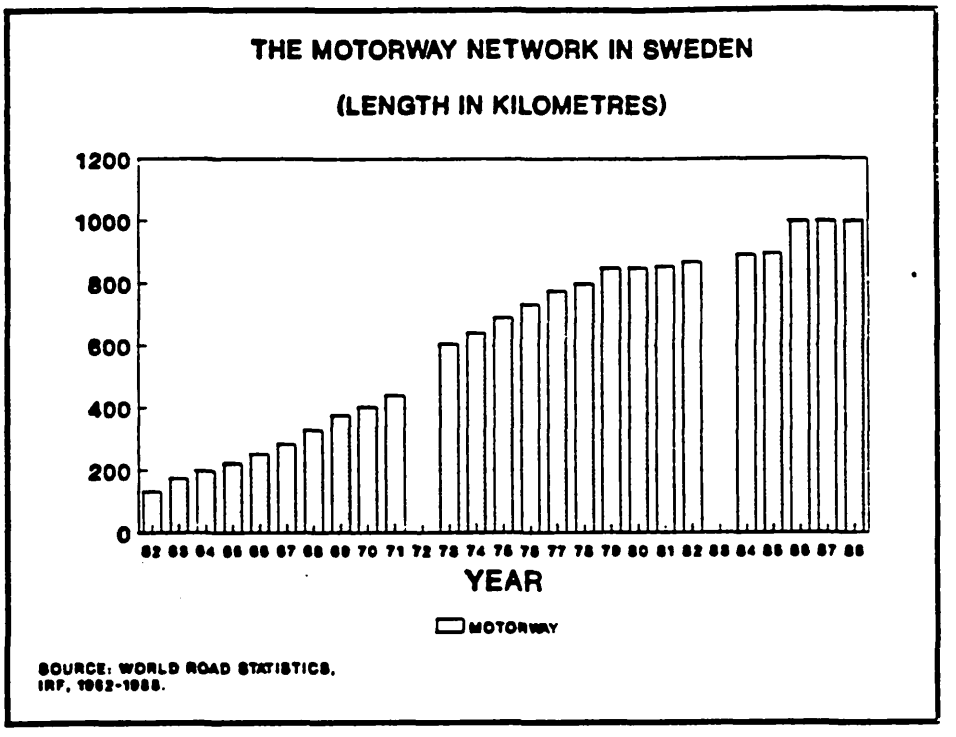


Figure 2.7 The development of the motorway network in Sweden (1962–1988).

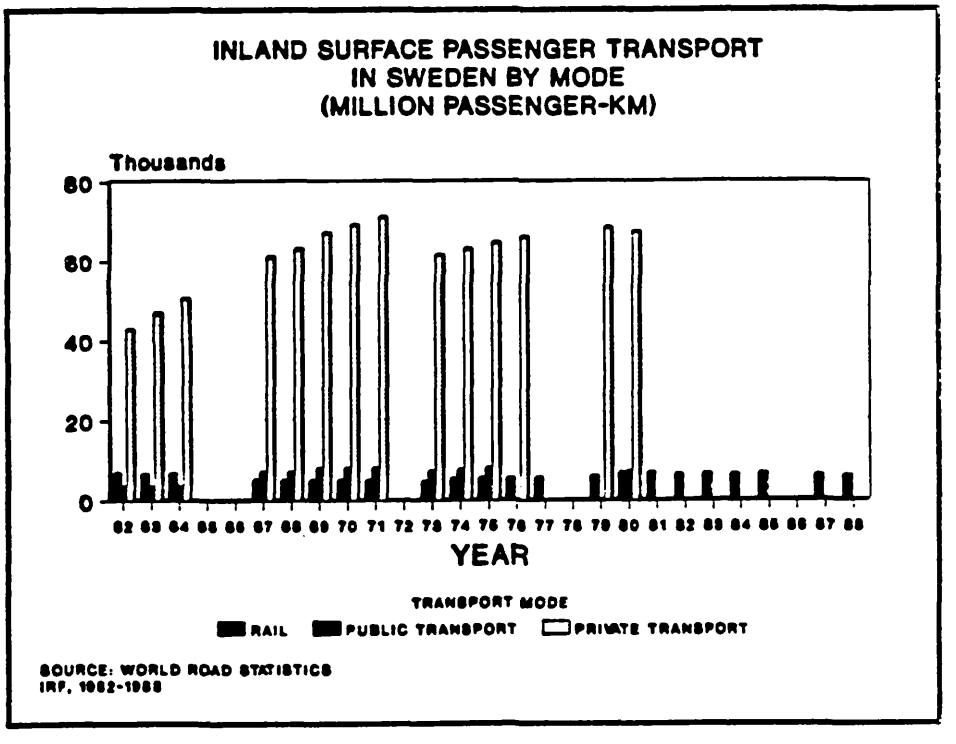


Figure 2.8 The development of inland surface passenger transport in Sweden by mode (1962–1988).

(Appendix C) show the mileage covered by the individual modes in larger scale. As in the other countries considered, there has been an increase in travel with private transport accounting for the largest share. In Sweden, this can be understandable due to the fact that the spread out nature of the country does not make it viable to implement public transport systems, and because a large proportion of travel is inter regional. Public transport, however, has an important role to play in the city centres as was demonstrated in the case studies from Stockholm and Göteborg.

2.34 While the value of goods transported by road in Sweden increased by 91 per cent to over 506 million tonnes between 1964 and 1987[14], the transport mileage, for the same period, increased by about 109 per cent to over 20 billion tonne-km. This, however, was followed by a declining trend with the roads in 1987 carrying only 337 million tonnes over longer distances, so while the road share of goods value dropped by about one third, the total traffic mileage was up by nearly 21 per cent. This cannot be explained due to the lack of data in this respect. In 1962, the road's share of total traffic (around 38 per cent) was second to the rail's (51 per cent). This, however, changed and in 1967 the road dominated with 54 per cent of the total tonnes-kms travelled. This trend appears to be continuing with the rail accounting for the 2nd largest share in the inland surface goods transport in Sweden. Figure C.13 (Appendix C) is a graphic presentation of the inland surface goods transport by mode in Sweden.

2.35 As mentioned earlier, a Parliamentary Committee was appointed to look into the problems facing Swedish cities, and put forward ideas to combat worsening traffic conditions. The main concerns for the committee were to devise plans and legislation to reduce the environmental impacts of traffic in urban areas and improve travel conditions. The Committee recommended a number of measures to achieve the goals sought. These included[16]:

i) a substantial upgrading and expansion of public transport services, with emphasis on environmental compatibility, and with the provision of improved modal change terminals and new park-and-ride facilities. This clearly shows that public transport has an important role to play in built up urban areas and city centres. Measures to make the system more attractive are ways of marketing the system and diverting traffic onto it.

ii) the building of main traffic routes that solve local environmental problems where the existing road network must be supplemented by traffic routes that can relieve some of the pressure on the network and solve local environmental problems. Street space liberated by these routes should be used to guarantee the accessibility of public transport, improve the conditions for commercial traffic, pedestrians and cyclists. This shows that new roads in urban areas still have an important role to play in relieving congested sections and providing better environmental conditions. In other words, the necessity of such provisions is an indication of their effectiveness.

iii) more stringent exhaust requirements for cars and heavy vehicles,

iv) parking fines increases to make parking controls a more effective measure in restricting car traffic, especially in city centres.

REMARKS

2.36 The case studies investigated have each provided a unique example of the experience of road building in these countries. The cases involving major public transport improvements have shown what actually happens when such improvements are implemented in conditions of suppressed demand. Together, the cases shed further light on the question of the effectiveness of new road schemes in urban areas; the measures associated with such provisions in the different countries; and the actual impacts associated with road schemes and public transport improvements on the modal split. This latter issue, however, proved difficult to assess due to the lack of data and cooperation on the part of the public transport operators. This is detailed further in the relevant cases.

CHAPTER 3 THE ROCHESTER WAY RELIEF ROAD

THE EXPECTATION

3.1 In line with the research objectives, the aim of this case study was to determine whether or not this scheme has met its stated objectives, and therefore to see whether or not the whole project has been worthwhile. The Rochester Way Relief Road (RWRR) is the most recent section of trunk road to be built in London. It is a 5.5 kilometre length of dual-carriageway which was designed to bypass the notorious bottleneck in the A2 Dover Radial at Eltham, and to improve environmental conditions on many of the local roads it would relieve. Opened to traffic in April 1988, the road now provides a high standard link between the existing Blackwall Tunnel Southern Approach motorway (BTSA) and the A2 Trunk Road at Falconwood, which in turn leads to the M2 motorway. The road is largely in cutting, replacing the old section of Rochester Way through Kidbrooke and Eltham which served this connection before, and remained for years a severe bottleneck in the strategic road network between London and the Channel Ports.

3.2 Being the most recent Trunk Road section to be built in London, the scheme is of great interest in relation to this research and to the current debate on the effectiveness of building new roads in urban areas. It will be seen from this study whether claims that new roads generate so much more traffic that any benefits achieved are short lived leading to worsened congestion, and that they cause people to shift from public transport to private transport, and that in the end they can even be counterproductive, are sustained by the evidence.

3.3 Construction of the RWRR was justified on environmental and operational grounds. Not only it would afford substantial relief to local roads suffering from congestion and adverse environmental conditions and benefit, considerably, the majority of residents in the Kidbrooke-Eltham area, but also because it would provide the very necessary capacity between the dual 3-lane motorway of the Blackwall Tunnel Southern Approach and the dual 3-lane section of the A2 Trunk Road beyond Falconwood, therefore increasing vehicular accessibility in this part of London.

3.4 With the Relief Road now open for over two years, the study shall examine the outcome of this new urban highway to see what promised benefits have actually been realised and how effective a road it has been.

OBJECTIVES OF THE STUDY AND METHOD OF APPROACH

3.5 To determine whether or not the project has been worthwhile overall, the study has sought to ascertain the following:

a) the extent of the environmental benefits/disbenefits that have resulted,

b) the degree to which the scheme has relieved or worsened traffic conditions on roads within the corridor of influence,

c) whether or not the project has brought, or promises to bring, local economic benefits,

d) what road safety benefits, and changes in the accident experience have accrued, if any,

e) the extent to which the project has achieved the broader economic and traffic objectives that were anticipated,

f) the climate of local opinion about the road.

3.6 The above objectives have been achieved by appraising all available sources of 'before' and 'after' information, and by means of new surveys where necessary to supplement the information available. The new surveys included a Questionnaire Survey of a sample of residents affected by the scheme : a) inside the immediate area and b) outside the immediate area; and enquiries into the changes experienced by local and national firms who regularly use the A2 route.

3.7 These surveys are discussed in more detail later. The appendices contain the findings of the major questionnaire survey and the detailed responses of national firms using the road. First, the events which led to the eventual implementation of the road will be reviewed with particular concentration upon all the reasons given for its implementation and its expected objectives since its these which have to be checked against reality.

THE PHYSICAL FEATURES OF THE AREA

3.8 The area affected by the Rochester Way Relief Road is situated in southeast London and is located in the London Borough of Greenwich some 10–16 kilometres

from Charing Cross. It comprises the suburbs of Eltham and Kidbrooke, between Shooters Hill (A207) in the north and Sidcup Road (A20) in the south. The location of the new road and the study area (as defined for the purpose of determining its main impacts) are shown in Figure 3.1.

3.9 Following the coming of the railways in 1895, Eltham developed rapidly. Many suburban estates, parts of which are of considerable architectural and historic interest were built. One of the landmarks, the Progress Estate, designated a conservation area by the Borough Council in 1971, has a remarkable history, stemming from the First World War. The Estate was built by the Ministry of Defence in 1915 to house munition workers from Woolwich Arsenal. It possesses outstanding urban design characteristics, and is regarded internationally as an example of good planning and has been referred to as the 'father of garden estates' (see Plate 3.1 at the end of the chapter). The boundary of this historic Estate is also shown in Figure 3.1. Even though this estate was built even before the old A2 Rochester Way was constructed, the eventual need for a new road to bypass the steep and congested Shooters Hill was envisaged at that early stage, and no houses in the Estate had to be demolished when the original Rochester Way was constructed in the late 1920's.

3.10 The area also contains an important shopping centre, Eltham Town Centre, which is the principal shopping centre in the area. Most shops are located on the two sides of the High Street to the east of its junction with Well Hall Road. Other smaller shopping centres are located on Rochester Way, Kidbrooke Park Road, Westhorne Avenue, and Well Hall Road. To the east and south lies a broad belt of open space of both strategic and local recreational and environmental importance (Oxleas Wood, Eltham Park, and Eltham Warren Golf Course).

3.11 Prior to the opening of the Rochester Way Relief Road, there were three main roads crossing the area on an east-west axis and providing radial routes into London. These were : Shooters Hill (A207); the old Rochester Way (then the A2); and Eltham Hill/Eltham High Street (A210). These are indicated on Figure 3.1. The main road crossing the area on a north-south axis is the South Circular Road (A 205) consisting of Westhorne Avenue and Well Hall Road. Another main road on this axis is A208 Court Road/Well Hall Road which converges on the South Circular at the five-way roundabout intersection with the old A2.

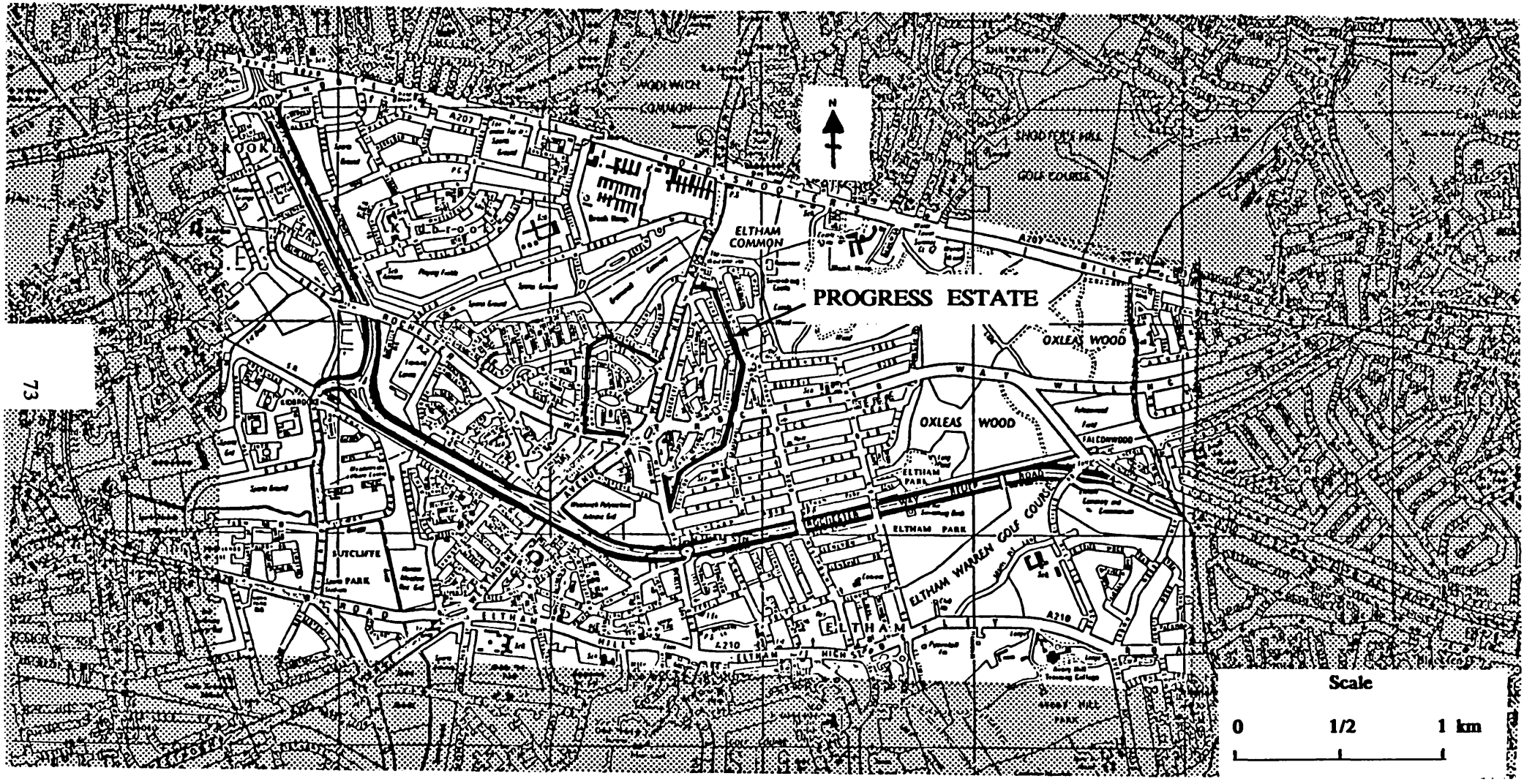


FIGURE 3.1 **Location of Rochester Way Relief Road Within The Study Area**
(Also shows boundary of Progress Estate)

THE HISTORICAL BACKGROUND TO THE SCHEME

3.12 The GLC Report of Studies on the scheme[17] describes the historical background to the scheme comprehensively and thoroughly. The brief outline here has been largely drawn from this document. The scheme's history goes back over 50 years. In 1937, following a comprehensive survey, Sir Charles Bressey prepared a plan of highway needs in London to meet increasing traffic demands. The main features of this plan were the proposals for the construction of three orbital routes around London connecting a number of improved radial routes into London, including the Dover Road. Immediate development of London's highway system was prevented by the Second World War, but the County of London Plan in 1943 again incorporated the principle of the three orbital routes linking the main radial routes into London, and this plan, confirmed the status of the A2 as one of the main radial routes into London. It proposed that it be improved to dual carriageway standards throughout.

3.13 In the late 1950's, the proposals for the improvement of the A2 section outside London to motorway standard were firming up. However, the original idea of improving the whole of the existing Rochester Way between the London County boundary and the South Circular Road became the subject of serious objections since it would have required the demolition of a substantial property and would have severed the Progress Estate even further.

3.14 An alternative alignment called the Dover Radial Route, was approved for consultation by the London County Council in May 1962. Before being approved by the GLC, this scheme was further modified following extensive consultations and additional studies of alternatives, particularly those put forward by objectors. The proposed scheme was to be a Special Road (motorway) below ground level over much of its length (to reduce adverse environmental impacts) and would extend from Falconwood to the Blackwall Tunnel Southern Approach. This revised Dover Radial proposal was then the subject of two public inquiries; the first into the amendment to the Initial Development Plan (IDP) and the second into the Special Road (motorway) Orders and accompanying Compulsory Purchase Orders. Despite considerable opposition to the IDP amendment, the Secretary of State confirmed the amendment in 1969.

3.15 The second inquiry (into the Special Road Orders and the Compulsory Purchase Orders) was held in September 1970. In view of the London Borough of Greenwich's objections to the scheme, as part of their objection in principle to the ringway system of primary roads proposed as part of the Greater London Development Plan (GLDP) which had been published in August 1969 and incorporated the Dover Radial proposal; and because the primary road network was being considered as part of the GLDP inquiry, the Secretary of State decided not to confirm the orders at that time.

3.16 In July 1973, and following a lengthy public inquiry into the GLDP, the GLC unilaterally decided to abandon the GLDP Ringway concept and pursue, instead, a policy of traffic control and restraint and improvement of public transport. Consequently, study groups were set up of officers from the GLC and the Borough Councils in each area. Their task was to examine urgently the situation in the particular areas so that a decision could be made on solutions to relieve the particular traffic and transport problems of each area. One of these groups, the South East London Traffic and Environmental Problems Group (SELTEP) dealt with South East London. Its aims were to consider various local environmental and movement problems in the study area and formulate possible solutions; and to 'determine whether the best solutions to these problems would involve any future road provision along the routes still safeguarded'.

3.17 The SELTEP Study Steering Group Report[18] was completed in March 1974. It revealed the poor and deteriorating environmental conditions on many of the area roads , and particularly the Rochester Way. Their findings showed that while on one hand significant environmental improvements could be achieved simply by the closure of a large number of the then trafficked roads to all but access traffic, on the other such drastic measures would have imposed stringent limits on a large part of the network. They concluded that if this were to be attempted 'without improvements to the roads designated to perform the main traffic carrying roles, or without constructing some new roads, the level of restraint necessary would be damaging to many aspects of the social and economic life of the area'. As far as the A2 was concerned, the study concluded that 'a dual two-lane road, as opposed to the proposed dual 3-lane motorway, would provide sufficient relief to traffic and the environment, particularly along Rochester Way and Eltham High Street, to warrant its construction.'

3.18 The SELTEP recommendations were accepted by the GLC Transport Committee, who agreed that a dual two lane road between Falconwood and the Blackwall Tunnel Southern Approach (to be known as the 'Rochester Way Relief Road') should be designed in detail with a view to implementation as soon as possible. It was also agreed that the old Rochester Way would be subsequently managed 'in such a way as to prevent there being any overall increase in traffic capacity' and that the GLC and Greenwich Borough (LBG) would work closely on the scheme. In March 1975, a multidisciplinary project team was formed of officers of the GLC and LBG to develop the scheme. The project team reported to a Steering Group formed of senior officers of the GLC and LBG which acted in a consultative capacity.

3.19 The Steering Group's Report[19] was published in December 1975. The recommendations put forward for the RWRR included specific conditions and objectives for the design of the scheme. These were:

> '(i) To design the RWRR as an all purpose road of not more than dual two lanes between Blackwall Tunnel Southern Approach and Falconwood via Kidbrooke.
>
> (ii) To achieve traffic measures that will reduce traffic on existing Rochester Way and in the surrounding area to within traffic capacity which is environmentally acceptable.
>
> (iii) To retain the existing vehicular and pedestrian links across the RWRR as far as practicable in order not to impair community life and to improve or add to these facilities wherever appropriate.
>
> (iv) To ensure that the RWRR blends with the local environment in engineering, urban design, planning and landscaping terms and, in its detailed design, conforms with the best of current practice in such matters and with the principles of the White Paper on Development and Compensation–Putting People First.'

3.20 Following public consultation, the GLC decided to accept most of the Steering Group's recommendations, and resolved that the Rochester Way Relief Road should be designed in detail with a view to implementation as soon as possible. This was certainly in view of the worsening traffic and environmental conditions in the area and the pressing need for their relief.

3.21 The GLC formally approved the final scheme in February 1978 and handed it to the Council's Construction Branch for implementation. In May 1978, a joint

working group consisting of GLC and LBG officers was set up to study the traffic and environmental effects in detail (officers of the London Borough of Bexley joined the working group in 1979). The planning applications for the proposed Relief Road were submitted to the London Borough of Greenwich in November 1978.

3.22 In November 1979, the proposed new road was classified as a principal new road by the Minister of Transport, and the applications were called in for decision by the Secretary of State the following month. The public inquiry opened on April 1980 and was closed on 2 May 1980. Clearly, this was a very short and sharp public inquiry, reflecting the need for the scheme and indicating that it was not at the time the subject of major dispute or disagreement (though there were serious and substantial objections).

3.23 The Inspector reported in August 1980 and the applications were confirmed by the Secretary of State on 30 January 1981 (the Side Road order with modification was confirmed on 15 May 1981). Bowing to public pressure, the GLC Transport Committee approved the amendment of a design detail (discussed in more detail later). Construction of the scheme commenced in August 1982. Until April 1986, the GLC was directly responsible for supervising and controlling the progress of the roadworks associated with the construction. After the abolition of the GLC in April 1986, the Department of Transport took over the GLC's role and became the body responsible for the completion of the scheme. This led to the appointment of the private consultancy firm, Bullen and Partners, to oversee the scheme to its completion. A large number of the GLC engineers who had been involved in the scheme, joined the firm and continued to work on the project. This was completed with only very minor changes being made to the GLC's original specification.

3.24 The Relief Road, was completed nearly six years after work first started, and was opened to traffic in April 1988. All the planned works are complete, with the exception of some minor landscaping and footpath works near the Kidbrooke intersection. At the same time as the new road was constructed, changes were made in public transport operations in the area. Eltham Park Station was demolished and what was Eltham (Well Hall) Station was rebuilt, in conjunction with a new bus/rail interchange facility on a site to the east of Well Hall Road and on top of the RWRR. The close juxtaposition of the road and the railway are shown in Figure 3.2.

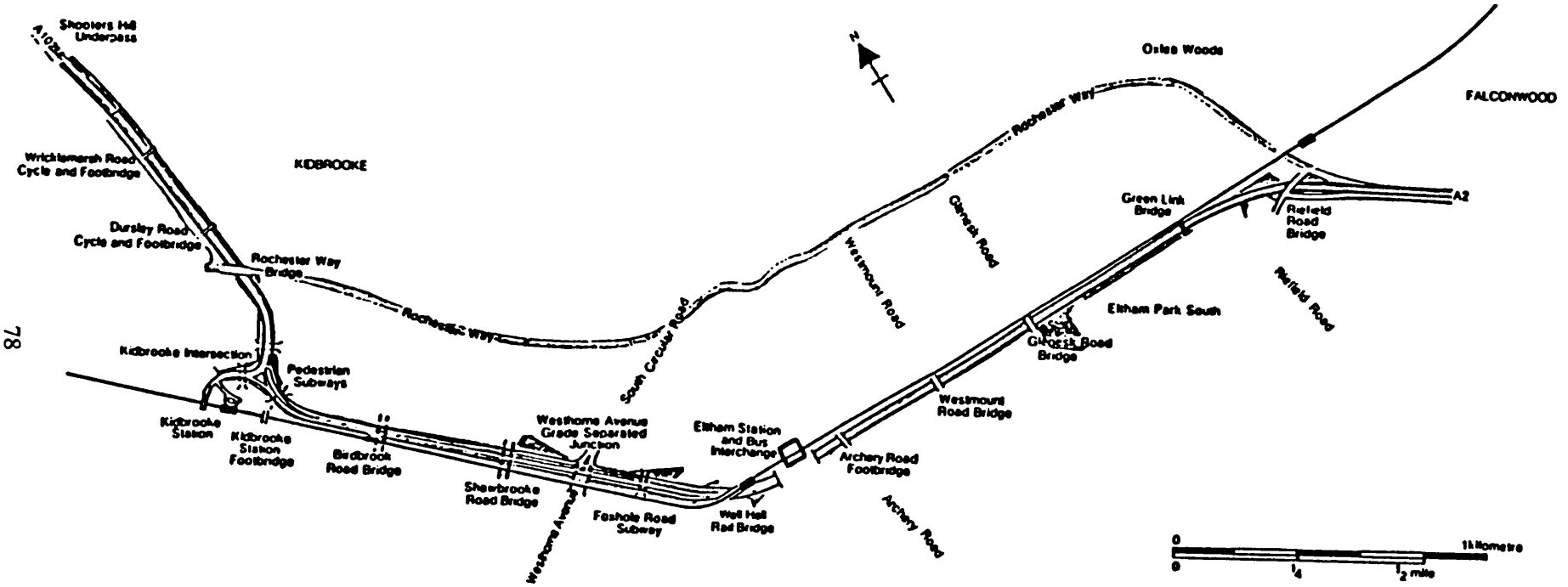


FIGURE 3.2 The Rochester Way Relief Road in Relation to the Railway

THE CASE FOR THE ROAD

3.25 The main case for the new road stemmed from the bottleneck in the strategic network created by the narrow twisting section of the old Rochester Way through the Progress Estate. Since this existing single carriageway road could not be widened (due to overriding conservation needs) it was clear that there was no alternative but to build a by-pass which would link up the dual 3-lane motorway approach to Blackwall tunnel with the dual 3-lane Trunk Road beyond Falconwood (Rochester Way East). Conditions on the Rochester Way had been deteriorating for years. The average daily traffic flow had reached 42,200 vehicles in 1978 with up to 31 per cent Heavy Good Vehicles (HGV). The traffic flow which included twice the average proportion of HGV remained high for the greater part of the day and night[20]. Congestion and delays were so bad that drivers were constantly trying to find other ways through the area. These included and adversely affected Eltham High Street (through the shopping centre) and many other residential streets, where the environmental and safety standards were seriously eroded. The abnormally high proportion of HGVs using the Rochester Way are presented in Table F.1, Appendix F.

3.26 Rat-running in the area had become widespread as shown by the extensive traffic surveys carried out in 1978 and 1979. These surveys revealed, for example, that there was a daily diversion of over 1,000 westbound vehicles in the morning peak from Rochester way East, via rat-runs along the local residential streets of Crown Woods Way and Chester Road into Bexley Road/Eltham High Street, in order to avoid the congestion on Rochester Way. All of these vehicles were identified as through traffic, which increased the flow to some 2,300 vph on the approach to Eltham High Street. The inadequate capacity there led to a further spill of traffic onto unsuitable local roads such as Glenesk road, Glenlea Road, Kidbrooke Lane and Briset Road. The extent of the 'overspill' of traffic from East Rochester Way as it approached Falconwood, and the consequent 'rat-running' problem, is graphically illustrated in Figure 3.3. In addition to this, heavy flows of north/south traffic added to traffic congestion at junctions with the main radial routes. The high morning peak hour rates of flow and congested conditions persisted between 7:00 and 9:30 a.m. Other residential streets used regularly as rat-runs were North Park and Wythfield Road (Figure F.1, Appendix F).

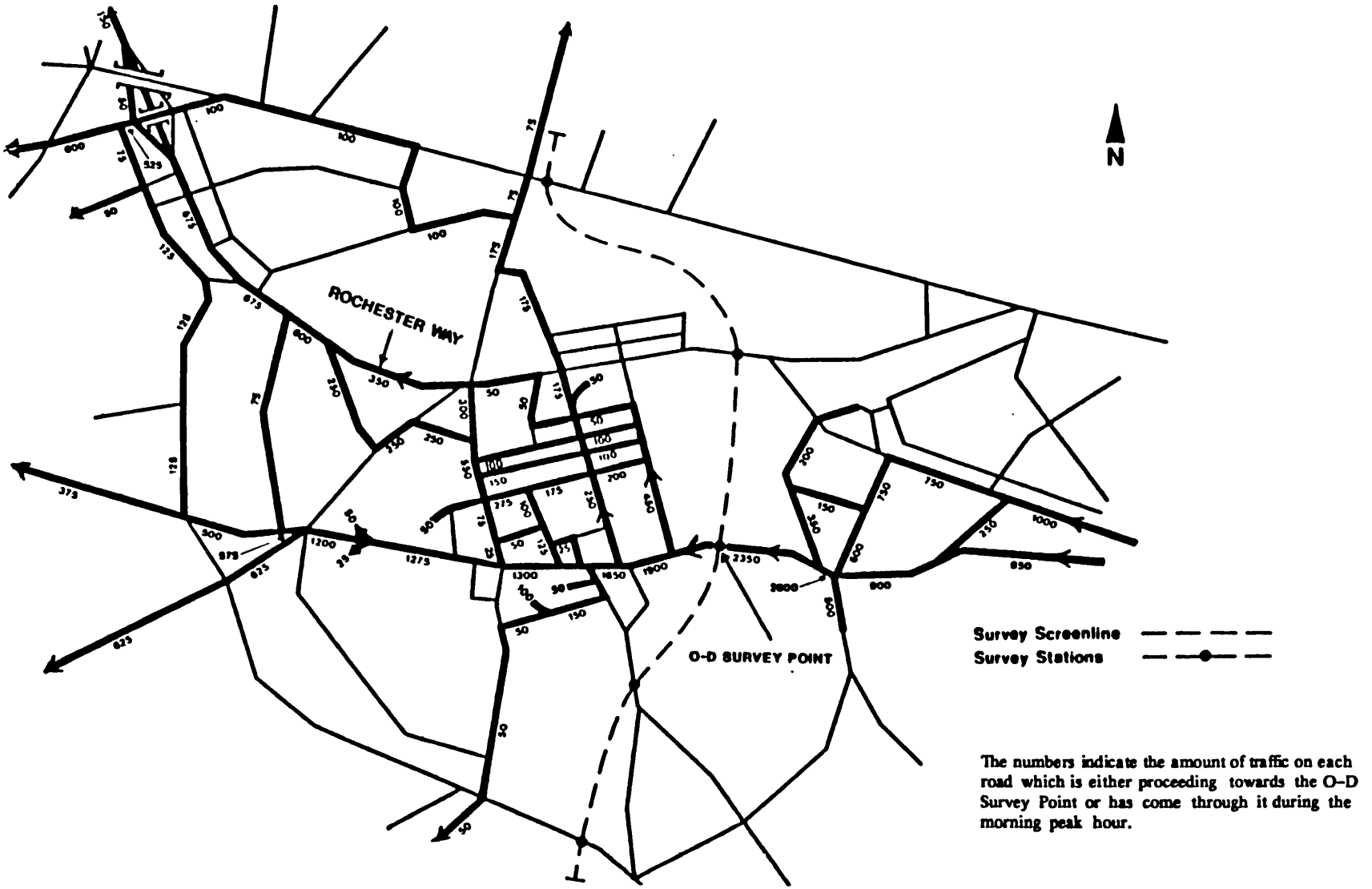


FIGURE 3.3 An Example of the 'Rat-Running' Problem in the Study Area Before the Rochester Way Relief Road

Source: RWRR Report of Studies, GLC, 1980. (Figure 3.12)

3.27 Another characteristic of the traffic through the Rochester Way corridor was the very high proportions of long distance traffic and journeys on employer's business. Two thirds of the vehicles, for example, were involved in trips of length greater than 25 kilometres. Further details of the trip length distributions on the various roads through the area are given in Table F.2 in Appendix F. Also in this appendix are details of the physical layout and traffic characteristics of the old Rochester Way, and the public transport services.

3.28 The deteriorating and extremely bad environmental conditions for the many residents who lived along the old Rochester Way, with traffic noise; traffic fumes and dirt affecting home interiors; and the disturbance of sleep at nights due to the passage of lorries lead to an ever increasing number of frequent complaints. This prompted the LBG to ask the GLC in 1978 to carry out a specific survey of environmental conditions in the area in general and on the road in particular. The report on this survey[17] (which covered a larger area than the study area adopted for this investigation) indicated that over 25,000 people, living or working in the area, or at schools and in hospitals in the area were adversely affected, when measured against the GLC's guideline levels for noise, fumes, dirt and vibration. Those living in close proximity to the narrow section of Rochester Way itself were found to be suffering from very significant excesses with some houses near Well Hall road suffering from noise levels as high as 82 dB(A). This narrow section known as the 'banana bend' was so named because of an accident involving a lorry carrying bananas, and because of a number of lorry overturning incidents on that sharp curve. Figure 3.4 illustrates a typical press cutting of the time, while Plate 3.2 shows how the 'banana bend' looks today.

3.29 In terms of the accidents experience on the Rochester Way, the road experienced a significantly higher number of accidents on the single carriageway section than on the dual 3-lane section east of Falconwood. The Well Hall Road/Rochester Way junction had an excessively high number of accidents, and so did the section of the road between the 'Dover Patrol ' Public House and Shooters Hill Road. Pedestrian-vehicle conflict also resulted in a higher rate of accidents in the shopping centres of Eltham High Street and Well Hall road. During the three year period between 1977 and 1979 some 285 personal injury accidents occurred on the length of the A2 road that is now relieved by the RWRR. Appendix F presents a more detailed description of the existing road network, traffic flows and public transport before the construction of the Rochester Way Relief Road.

Daily Mail, Monday, August 24, 1981

After waiting 20 years juggernaut victims are promised a by-pass

Coming soon...All Quiet on the Banana Bend

By HOWARD FOSTER

LIFE is to take a quieter turn for the folks who live on Banana Bend and The Bottleneck.

After 20 years of raised voices, hands cupped over ears and kissing of St Christopher medallions, peace is on the way for the residents of one of Britain's noisiest, overcrowded and ill-conceived roads — the Rochester Way in south-east London.



Mrs Martin: 'People are on tablets, some we n't go out

Picture: CHARLES CRAMP

Lobbying

You risk lynching if you mention the EEC to the locals. Rightly or wrongly, they blame the Common Market for the 24-hour flow of juggernauts that roar and hoot their way from Dover to London and back, frightening those brave enough to venture on to the pavements or foolhardy enough to try to cross the road.

But now, after years of lobbying, work is about to start on the Rochester Way relief road, £75 million worth of hard-core, concrete and tarmac that will bring peace and quiet to occupants of the beleguered road by 1987.

Banana Bend is, as you would expect, a sharply-curved piece of Rochester Way where the residents have long been hardened to the sight and sound of speeding cars and lorries mowing each other down in the cause of being first to the Dover ferry.

Paving stones outside Sue Garwood's house on the bend are cracked and raised: 'The lorries park up to make phone calls at the box, near here,' said Mrs Garwood, whose two young children Faye and Daniel are being monitored for lead levels in their blood.

Banana Bend leads to the most crackpot piece of planning—The Bottleneck. At its narrowest it is just 24 feet wide.

Mrs Marjorie Martin was 14 when she moved to her end of terrace house on The Bottleneck. Then, the greengrocer grazed his horse round the back and left his cart on the main road.

Now aged 65, reality for Mrs Martin is the lumbering giants of Hamburg, Turin and Valencia jamming on noisy air brakes ten feet from her front windows.

Ceilings periodically fall in, the garden walls have been rebuilt twice and three pet cats and a dog have met their maker early because of the traffic.

'People round here are on tablets to make them sleep,' said Mrs Martin. 'There's dust and dirt both inside and outside the house. Some people won't go out if they can help it.'

But in six years time they should all be able to take out the ear plugs, lower their voices and listen to the sound of silence.

FIGURE 3.4 A Typical Press Cutting Reflecting the Conditions Along the A2 Rochester Way

THE PUBLIC INQUIRY AND INSPECTOR'S RECOMMENDATIONS

3.30 The 1981 Public Inquiry into the proposals for the RWRR was a short one and not a protracted affair, as have been so many other Public Inquiries into road schemes. This was largely because all the main parties concerned were agreed, at least in principle, that a new road was needed. The salient points are given here, while a fuller report on the evidence given at the Inquiry is presented in Appendix G.

3.31 The case for the recommended scheme, by then fully detailed by the GLC and consisting of a largely grade-separated, all-purpose, dual two-lane carriageway alongside the railway between Kidbrooke and Falconwood, was comprehensively and convincingly put by the Council, who were supported by the Borough Councils of Greenwich and Bexley. Other options were considered, including two scales of on-line modification of the existing Rochester Way to increase its capacity; a larger dual 3-lane RWRR on the same line as the recommended scheme; and one in which the RWRR was put entirely in tunnel (at a cost estimated at three times that of the recommended scheme).

3.32 A summary of the comparative impacts of the various options was presented at the Inquiry in the form of a table. This is reproduced in Appendix G (Table G.1). The table revealed the price that would have to be paid for the road in terms of loss of dwellings, jobs, and open space and the number of properties which were likely to be affected by construction noise and subsequent traffic from the new road. Though considerable, the overall penalty was in fact comparatively small for a new road of the scale and length proposed, and it was shown to be clearly outweighed by the benefits which would result from the roads construction. The scheme did not quite show the normally required rate of return from a straight cost-benefit analysis, however, all the other indirect benefits that were anticipated, including the environmental ones, were reckoned to more than compensate for this.

3.33 The particular attention that had been paid in the design of the scheme to minimize the impact upon the area through which it would pass was impressive. The Inspector commented on all the measures being taken to ensure minimal severance effect; also on the effect of most of the road being in cutting and the provision of noise screens in the form of bunds and fences making noise levels that would be experienced by nearby dwellings, for the most part, below the GLC

adopted guideline levels. Finding acceptable the proposal for the north-west section (between Kidbrooke Way and Shooters Hill Road) to be put on a 15 foot embankment, he, however, commented adversely on certain aspects (slightly increased noise levels, and the visual impact which would be even worse if acoustic fences were provided). This particular feature was the subject of objections raised by the LBG and a number of residents associations in the area, and in the event it was decided to put this section in cutting also.

3.34 The Inspector saw the new Rail/Bus interchange as providing much improved facilities which would minimise passenger-vehicle conflict; provide much needed off-street parking facilities for park and ride passengers; and encouraging travel by public transport into Central London. He, however, questioned whether the present degree of uncontrolled kerbside parking would be reduced. The Inspector also noted that the planning application for the new road provided for the closure of Kidbrooke Park Road just north of Kidbrooke Way thus relieving that previously heavily trafficked section, and also that there was an associated package of traffic management measures that would be implemented, by the Boroughs, to prevent any further rat-running on local roads. It was envisaged at the time of the inquiry, provided that the management measures were implemented, that the then level of traffic on the old A2 Rochester Way would be significantly and usefully reduced by as much as 85 per cent, i.e to a very modest daily flow of 6,000 vehicles; and that Bexley Road/Eltham High Street traffic would be reduced by 60 per cent (to about 12,000 vpd).

3.35 The Inspector was quite critical of various alternatives which had been discussed at the Inquiry. He regarded the option involving a minimum widening of the existing trunk road A2 through Eltham and the Progress Estate as a 'ruthless idea' which would only exacerbate the environmental conditions, without properly solving the congestion problem. The A2 maximum widening option might solve the latter, but would be even more devastating, actually taking more houses than would the recommended off-line scheme.

3.36 The Inspector thought that the option of building the RWRR to the larger dual 3-lane standard would not be advisable because of its greater physical impact and because it would be incompatible with the scale and capacity of the road network to which it would be connected at the inner London end. He pointed out that the capacity of the route would be such that little growth in peak hour traffic

could take place and that growth could occur only by the extension of the peak periods. He concurred that pressures could build up, and this was why the accompanying package of traffic management measures was seen as being so important as an environmental safeguard to prevent overspill. Furthermore, he pointed to the need for signal control of traffic at Kidbrooke Junction to regulate the flow of traffic on the last section of the RWRR. This signal control has actually been introduced, thus breaking the 'free-flowing' nature of the remainder of the whole route (from the Blackwall Tunnel to M25 and beyond).

3.37 The Inspector's recommendation that planning permission be granted for the construction of the proposed Rochester Way Relief Road was 'subject to a condition reserving landscaping and other conditions needed to ensure that the detailed construction of the road is carried out in the manner outlined at the inquiries, so as to keep the impact of the scheme on the surrounding area to a minimum'.

3.38 It was clear therefore, that the overall weight of evidence at the inquiry indicated that the Rochester Way Relief Road was much needed and very well worth implementing. The scheme was not expected to eliminate congestion completely, but it would give very substantial savings in journey times. The RWRR Report of Studies stated that the road would provide:

> 'the additional capacity needed for removing through traffic, including lorries, from the road network serving local needs and the traffic management measures ensure that the new capacity is not dissipated by newly generated traffic but is properly used for reorganizing traffic patterns in the area, in a way which strikes a better balance between people's transport and environmental needs.'

On one hand, although the road was expected to have an adverse environmental impacts on a number of people who would be alongside the new road, on the other there would be more than compensating environmental improvements for a very large number of other people reckoned to be at least 20,000. there would be reduced severance; and there would be considerably fewer road accidents.

3.39 So what has actually happened, and how has it all worked out in practice? As mentioned earlier, it has been the objective of this study to find out whether the construction of the road has achieved all that was expected of it; and to see whether the adverse impact has been minimised to the extent anticipated. The

results of the examination are presented in the remaining paragraphs of this report. The overall conclusion, as will be seen, is that the scheme has been worthwhile, though in some respects, it has not quite achieved all that was expected.

THE REALISATION

3.40 The construction of the Rochester Way Relief Road, and all the associated alterations to the railway line and the stations, and modifications to the existing road network took place over the period from 1982 to 1988. The RWRR was officially opened by Peter Bottomley MP (the then Under Secretary of State for Transport) on April 11th 1988. Over this six year period, local people had to suffer inconveniences caused by the construction works, but in view of the complexity of the civil engineering works required, the speed of construction was commendably good. There was a need to keep the railway operating at all times; minimize disruption to the local circulation of vehicles and pedestrians; and to maintain the statutory services. To achieve this, a series of different contracts for the various major structures had to be coordinated and each had to work within considerable constraints to limit the local environmental impact, including limitations on night time and weekend working.

3.41 Today, the RWRR provides five and half kilometres of high quality, 50 mph, dual 2-lane carriageway linking the roundabout underpass of Shooters Hill Road at the southern end of the Blackwall Tunnel Southern Approach motorway (A102(M)) with the A2(T) East Rochester Way beyond Falconwood (a dual three-lane all purpose road) (see Plate 3.3). It has a major intersection with Kidbrooke Park Road (Plate 3.4) which in turn connects up with the A20(T) Sidcup Road. In strategic network terms, the A2(T) is the inner section of the Dover radial from London, and the A20(T) the inner section of both the Folkestone Radial and the Hastings Radial (A21(T)). At the Kidbrooke intersection, the northbound stream on RWRR is signal controlled to allow the right-turning element of the southbound stream to pass across. The RWRR has just one other intersection, and this is an overpass with ramped connections with the South Circular Road (Westhorne Avenue) (Plate 3.5). The majority of the new road is in cutting between concrete retaining walls, with only about 1.5 kilometres of the road between Kidbrooke and Eltham Stations above ground level. This section is alongside and north of the railway line, which is also on embankment. Near Eltham station the relief road dips under the railway, and from here eastwards it runs parallel to it on the south side,

first in cutting (Plate 3.6) and then gradually rising to ground level at Falconwood. At Falconwood, the new road curves south to join Rochester Way East, with the end section of the latter being widened to accommodate the on and off slip roads from Riefield Road.

3.42 The construction of the road has been quite a remarkable accomplishment of engineering. At a total cost (including the railway works) of about £ 85.0 m or £ 15.4 m per kilometre it has proved to be rather more than average for urban highway schemes, but this is largely due to the need to make substantial alterations to the railway and build a new station and bus interchange. Schemes in prospect of similar complexity, such as the Hackney Wick to M11 link, and the East London River Crossing, are expected to cost rather more. The key question to address now however, is has it been worth it? In the following paragraphs, the effectiveness of the scheme is examined in relation to its objectives, as outlined in the earlier sections. These objectives provide a fairly comprehensive list of expectations, most of which should have been realised in the short term, and can now be checked against reality. Some, however, such as the impact on the general economy of the area, are more likely to be longer term effects, for which as yet there are only indications.

MEASURES OF EFFECTIVENESS

3.43 In assessing the effectiveness of the relief road the following features have been examined :

i. its current traffic loadings, in relation to its capacity, and the degree, if any, to which the new road has 'generated' traffic,

ii. the extent to which it has provided traffic relief on the local roads in the area, particularly the old A2 Rochester Way and Eltham High Street;

iii. changes in the accident experience;

iv. the general climate of local opinion about the Relief Road, now that it has been built;

v. the changes in the quality of the environment in the area as a result of the redistribution of traffic, including changes in the extent of rat-running;

vi. the changes in accessibility, strategically and locally;

vii. the degree to which various other expectations have been realised, including the economic benefits;

viii. the overall appearance of the new road within the urban landscape setting;

ix. its role, function and fit within London's strategic road network.

x. other, less desirable effects.

3.44 The limited resources available necessitated the reliance mainly on data furnished by previous studies and reports made in relation to the scheme and the area. Nevertheless, no effort was spared to obtain a first hand account of the impact on those living in the area by seeking the views of the local residents. A questionnaire survey of local residents provided information about attitudes in general; on changes in the local environment; opinions on local accessibility, and also on any apparent changes in rat-running. In some cases it also revealed additional problems created by the road, some of which may not have been anticipated.

3.45 Traffic flow figures have been obtained from statistics published regularly by the DTp, and from other counts more specifically related to the road which were made previously by the GLC and LBG, and more recently by Bullen and Partners and by the London Regional Office (LRO) of the DTp. Further evidence of the changes in accessibility have been obtained directly from national and local firms who regularly use the A2 route. Information on public transport has been supplied by British Rail and London Transport.

THE TRAFFIC IMPACT

3.46 If the argument of new roads 'generating' a lot more traffic such that any benefits obtained are countered by worsened congestion on the new road and the old roads, therefore becoming counterproductive were true, then the new road would be likely to have become badly congested; much more traffic would have arisen on the local roads feeding into the new road; and there would have been little or no 'relief' to the old road. In addition to all this, a significant shift of travel mode from public transport to private. But has this actually happened? It can be fairly said that none of this has happened.

East–West Movement

3.47 Looking first at the four main east–west roads through the study area, traffic flows in a typical weekday in 1978 (18–hour two–way totals) can be readily compared with: a) flows that occurred shortly after the opening of the RWRR (July/August 1988) and b) more recent flows (February/March 1990). These flows are shown in Figure 3.5 and are also summarised in Tables 3.1 and 3.2 in relation to screen lines A–A and B–B also shown on Figure 3.5. Some other figures are available for the period immediately before the opening of the new road (January 1988), but the flows at these times were distorted by the construction works in the area, and are thus of little interest in the context of this study. The 1990 figures are probably more meaningful for the purpose of comparison for they allow nearly two years for the traffic patterns to settle down. It must be borne in mind, of course, that during the whole period from 1978 to 1990 there has been an increase in traffic generally throughout the area. It has therefore been necessary to determine what this general level of growth might have been, had the RWRR not been built, so that a true comparison can be possible.

3.48 Between the years 1975 and 1987 traffic across the outer boundary cordon of Greater London grew at the average rate of about 2.3 per cent per annum[21], whereas traffic growth across the inner London cordon (a cordon which circles through Lewisham) was only about 1 per cent per annum[21]. The RWRR lies in between these two cordon lines and across another of the DTp screen lines termed the 'South–East Peripheral Screen Line' which extends from Woolwich to West Wickham. Before the RWRR was opened, traffic across the first two cordons is predominantly radial, whereas traffic across the 'peripheral' screen line, though mainly radial, contains a substantial element of orbital traffic, which is a much faster growing element.

3.49 No origin–destination surveys have, as yet, been made of traffic on the Rochester Way Relief Road, but from observation of the character of vehicles it is clear that it contains a large element of long–distance traffic. Some is to or from more northerly parts, and may therefore be characterised as orbital. It would seem reasonable to assume, therefore, that the general growth of traffic that might have been expected within the A2 corridor, without RWRR, could have been at least 2 per cent per annum and more likely nearer 2.5 per cent per annum.

Count Location	1978	1988	1990	Change '78–'90
Shooters Hill Road (near Baker Road)	23,700	20,700*	17,700*	-25.3 %
Corelli Road	2,200	2,900*	2,100*	-4.5 %
Woolacombe Road	1,400	2,900*	2,900*	+ 107.0 %
Rochester Way (near Rochester Close)	42,200	N/A	39**	-89.1 %
Dover Patrol Slip Road	-	3,900	4,600*	
RWRR (West)	-	64,400 (48,400)	68,400* (53,400)	+ 12.1 %+ (+ 12.2 %)+
Kidbrooke Park Road (N)	17,700	15,500	14,400*	-18.6 %
Totals (18 Hours)	**87,200**	**110,300++**	**110,139**	**+ 26.3 %**

Table 3.1 **Total 18-hour two-way daily traffic Flow : Screen Line A-A.**

Count Location	1978	1988	1990	Change '78–'90
Shooters Hill Road (near Eaglestila Road)	26,800	21,300	22,300*	-17.0 %
Rochester Way (near Crookston Road)	33,200	11,700	16,200*	-51.0 %
RWRR (East)	-	57,200 (42,000)	60,400* (47,900)	+ 5.6 %+ (+ 14.1 %)+
Bexley Road (near Gravel Pit Lane)	27,700	17,500	18,100*	-35.0 %
Footscray Road (near Halons Road)	17,900	18,400	21,800*	+ 22.0 %
Sidcup Road (near Crossmead)	38,700	35,700	39,600*	+ 2.3 %
Totals (18 Hours)	**144,300**	**161,800**	**178,400**	**+ 23.6 %**

Table 3.2 **Total 18-hour two-way daily traffic flow : Screen Line B-B.**

* based on 12-hour counts
( ) 12-hour counts
\+ Increase between '88 and '90
** vehicles through 'bus only' filter
++ excluding vehicles through 'bus only' filter

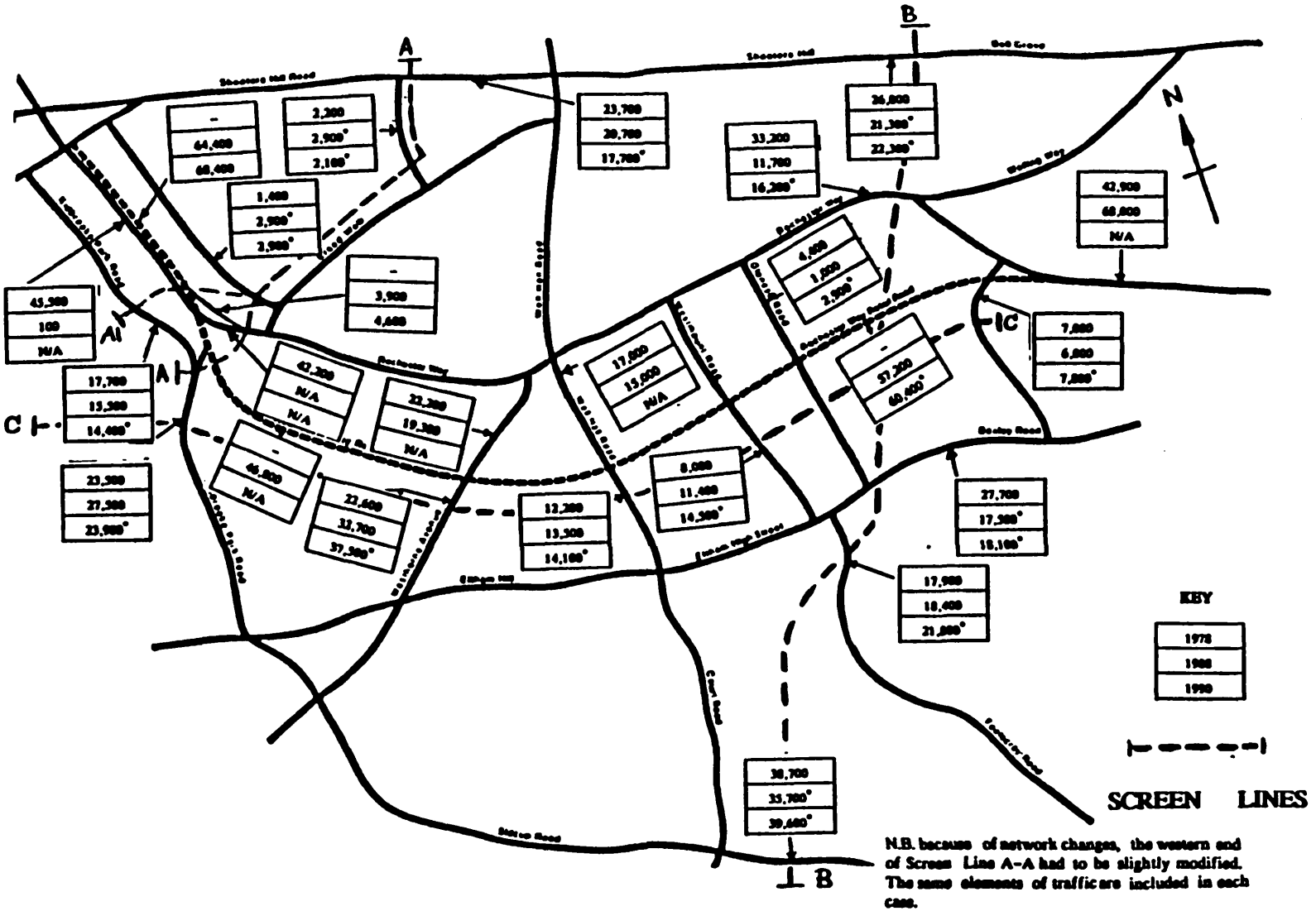


FIGURE 3.5 The location of Screen Lines: A–A, B–B, and C–C and the 18-hour Two-Way Daily Traffic Flow on Screen Line Roads 'Before' and 'After' RWRR (1978, 1988, 1990)

• based on 12-hour counts.

3.50 Table 3.1 figures give the comparative daily traffic flows across the inner screen line A–A near the western end of RWRR. The traffic corridor across which the screen line lies, is narrower at this end than at the eastern end (which is represented by screen line B–B). Inward traffic is thus being funnelled either towards Blackheath and inner London, or the Blackwall Tunnel. The main interest lies in the 'TOTAL' flows of traffic across the screen. This shows that despite the provision of additional capacity for at least another 72,000 vehicles per day, the total flow has increased by only 26.3 per cent, which is an average annual growth of just over 2 per cent per annum. This is no more than might have been expected, even if the RWRR had not been built. Figure 3.6 is a graphic presentation of the changes in daily traffic flows across screen line A–A.

3.51 If we now look at the situation at the other end of the corridor, represented by Screen Line B–B,and shown in Table 3.2, we find that the total screen line flow here has increased over the same period by about 24 per cent. This again represents an average annual rate of about 2 per cent, or rather less than might have been expected. Figure 3.7 is the graphic presentation of the changes in daily traffic flow across screen line B–B.

3.52 These figures clearly show that the Relief Road has **not** generated or induced any more traffic within the corridor than might have been the case had it not been built. The figures also indicate that the RWRR has contributed, to varying degrees, to the relief of traffic on the other main roads through the area. Traffic on the old A2 Rochester Way, as might be expected, is reduced the most. Due to changes in the way Screen Line A–A has been drawn, it is not possible to obtain a precise figure for the inner section (west of the South Circular Road), but it has clearly dropped from its almost maximum capacity flow of 42,200 down to only a fraction of this. This is as anticipated at the Inquiry. East of the South Circular, however, the drop is not so marked, the latest 1990 count showing that traffic is flowing at about half the level it was in 1978. This is nowhere near as much as anticipated beforehand (an 85 per cent reduction to about 6,000 vpd: see para 35). In October 1988, soon after the opening, the flow had been reduced by 67 per cent down to 11,700 vpd, but since then there has been an increase of 38 per cent in two years. There has therefore been a shift back onto this eastern section of the old route, by elements of traffic that have presumably, for some reason, diverted from RWRR (most of which occurs in the peak hour, as will be seen later).

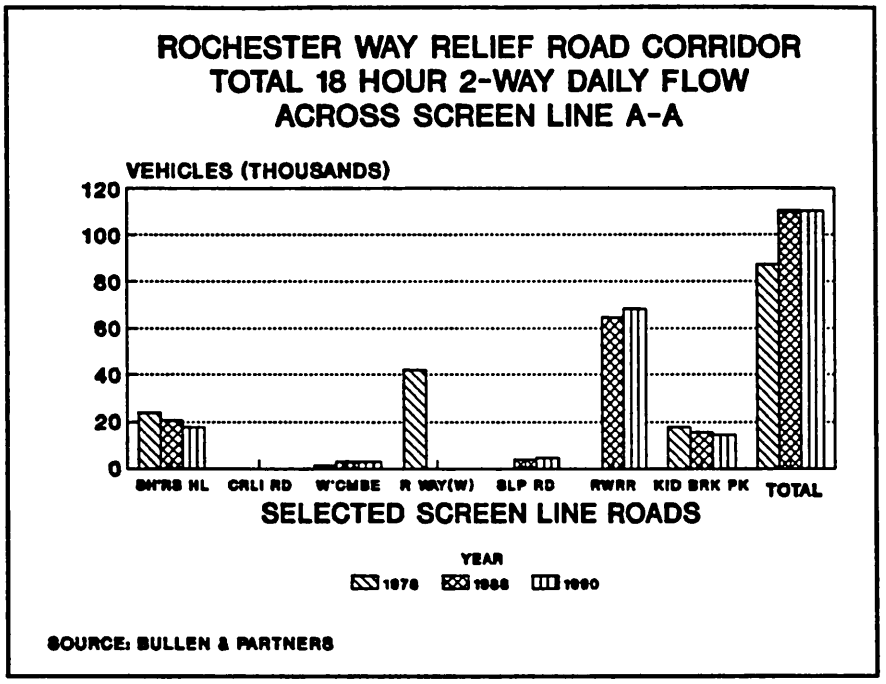


FIGURE 3.6 Changes in Traffic Flow Across Screen Line A–A

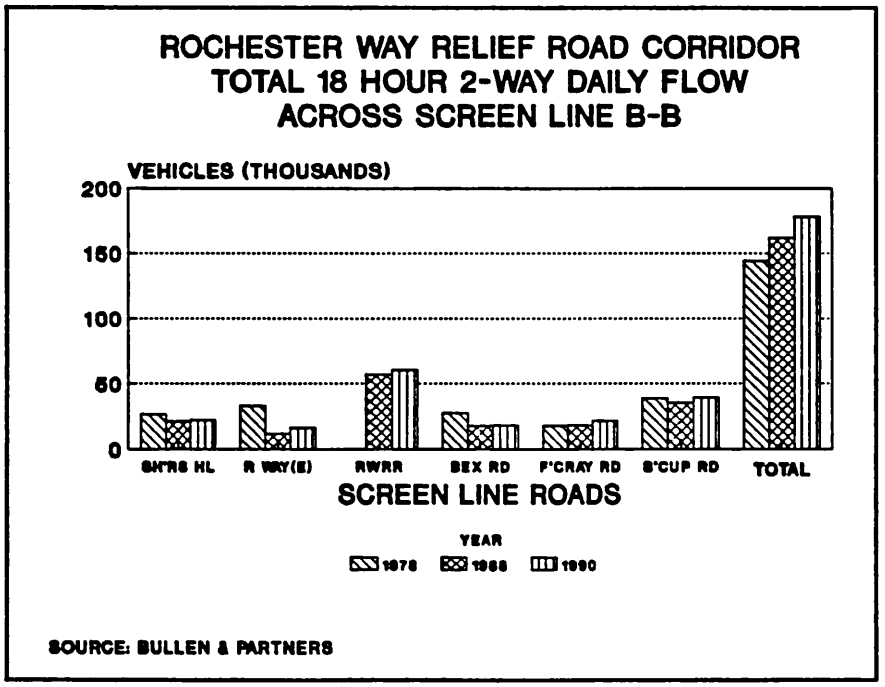


FIGURE 3.7 Changes in Traffic Flow Across Screen Line B–B

3.53 Table 3.2 also shows that flows on Bexley Road, just along from the shops in Eltham High Street, have been reduced by about a third, from 27,700 to 18,100 vpd. This again, is rather disappointing when compared with the forecast 60 per cent reduction to 12,000 vpd. It indicates that many drivers are still taking this route in preference to RWRR. On the other hand, the opening of the RWRR seems to have caused a significant and rather unexpected reduction in traffic on Shooters Hill.

3.54 The third screen line C–C was designed to reveal the amount of traffic flowing across the RWRR corridor, rather than along it (Table 3.3 and Figure 3.5). One would not expect the new road to have all that much influence on the total flows across this corridor; rather that it would cause distributional changes which throw more traffic onto those roads which are connected to it. In the event, the total daily flow across the whole screen line has increased considerably since 1978, by about 30 per cent, or an annual average increase of 2.2 per cent. This is, however, no more than the general growth rate that might have been expected in the area. Looking at the individual roads, we find that Kidbrooke Park Road (S) (which is connected) has experienced only a slight increase, presumably because the signal control of the intersection with RWRR still limits the flow. In contrast, Westhorne Avenue (part of the South Circular) which is also connected, has experienced a 66 per cent increase since 1979. In the two years since RWRR was opened, the increase on this section of the South Circular has been over 7 per cent per year. Figure 3.8 is a graphic presentation of the changes in daily traffic flows across screen line C–C.

3.55 Between 1978 and 1988, a similar proportionate increase took place on Westmount Road, yet this is not connected. It now carries about as much traffic as Well Hall road, which has experienced very little increase. These apparently curious differences are due to the fact that Well Hall Road traffic is restrained by the signalled junction at Eltham High street and Westmount Road traffic has increased as a result of the retiming of the signals at the junction with the Rochester Way. This has encouraged north/south traffic to use Westmount Road, in preference to Well Hall Road.

3.56 Since it is during peak periods that greater problems can occur, it is important to examine conditions during these periods before coming to any general conclusions about the effect of the RWRR on traffic flows. Data are available for

Count Location	1978	1988	1990	Change '78–'90
Kidbrooke Park Road (S)	23,500	27,500	23,900*	+ 1.7 %
Westhorne Avenue	22,600	32,700	37,500*	+ 66.0 %
Well Hall Road	12,200	13,500	14,100*	+ 16.0 %
Westmount Road	8,000	11,400	14,500*	+ 81.0 %
Glenesk Road	4,400	1,000	2,900*	-34.0 %
Reifield Road	7,000	6,000	7,800*	+ 11.0 %
Totals (18 Hours)	**77,700**	**92,100**	**100,700**	**+ 29.6 %**

Table 3.3 **Total 18-hour two-way daily traffic flow : Screen Line C-C.**

* Based on 12-hour counts.

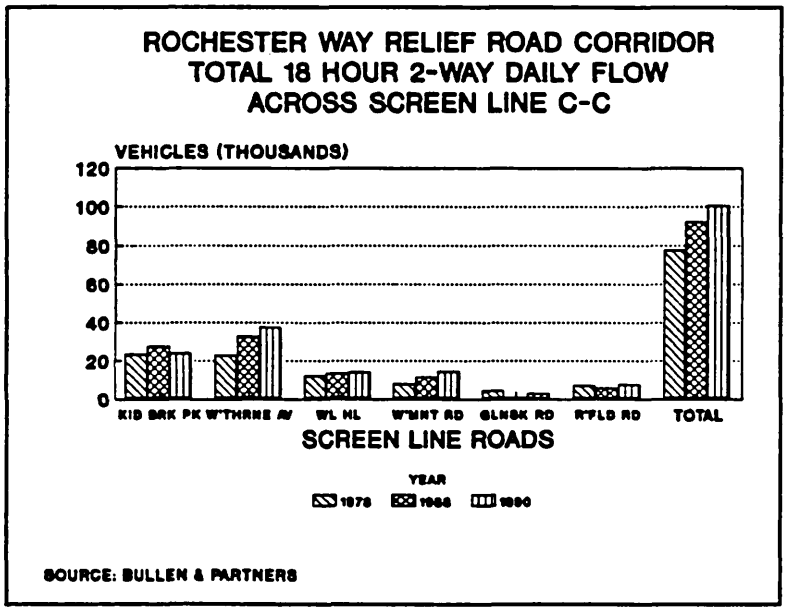


Figure 3.8 **Changes in traffic flow across Screen Line C-C.**

the dominant direction peak hour flows on all the roads across the same three screen lines.

3.57 Tables 3.4(a) and (b) show the dominant peak hour flows for line A–A. The total morning flow, which is towards Inner London or the Blackwall Tunnel has hardly changed, indicating that there is a distinct capacity limitation in the inward direction. The westbound flow on Rochester Way past the 'Dover Patrol' has been reduced to a trickle, but there is still a heavy flow on Kidbrooke Park Road (north). The Relief Road itself is running at near capacity, the latter being governed by the capacity of the signals at the Kidbrooke junction. Though the figures do not show it, there is usually a tail back from the signals with the queue sometimes extending beyond the junction with the South Circular. This point of congestion is often compounded by traffic incidents at the Blackwall Tunnel, where on average there is a complete blockage every two months, and at least one breakdown every week.

3.58 During the evening peak, in the opposite direction, there has been only a moderate increase in the total screen line flow since 1978, with something of an upsurge in the two years since the opening of the RWRR, however, this has been confined to the Relief Road itself. At the time of the count in 1990 this was running very close to its maximum theoretical lane capacity, with nose–to–tail fast flowing conditions.

3.59 Examination of the dominant direction flows in the morning and evening peak hours across screen line B–B (Tables 3.5(a) and (b)) also reveals some interesting features. In both cases, but particularly in the morning, the total percentage growth in peak hour traffic across this screen line between '78 and '90 has been far less than that for the whole day (para 52). In the morning peak hour, the total increase over the thirteen year period has been less than 10 per cent. Yet this is despite the opening of the Relief Road which has added almost 50 percent more capacity across this particular screen line. This again indicates quite forcibly that there are factors outside the influence of the RWRR which are limiting the growth of traffic within its corridor. In the evening peak, the increase in the outward bound traffic has been nearer 20 per cent. But even this is quite modest considering the length of the period of time, and probably indicative of the fact that much of the evening flow is the same traffic returning.

Count Location	1978	1988	1990	Change '78–90
Shooters Hill Road	1,400	934	616	-56.0 %
Corelli Road	300	373	143	-52.3 %
Woolacombe Road	188	334	345	+ 83.5 %
Rochester Way	2,800	243	4	N/A
RWRR	-	3,090	3,604	-
Kidbrooke Park Road (N)	1,150	872	922	-19.8 %
Total Crossing Screen Line	**5,838**	**5,846**	**5,634**	**-3.5 %**

Table 3.4(a) Screen Line A–A A.M.Peak (8–9)traffic flow (westbound).

Count Location	1978	1988	1990	Change '78–90
Shooters Hill Road	1,621	1,016	944	-41.8 %
Corelli Road	204	125	58	-77.9 %
Woolacombe Road	110	165	82	-25.5 %
Rochester Way	2,476	-	-	-76.3 %*
Dover Patrol Slip Road	-	447	588	
RWRR	-	3,050	3,977	N/A
Kidbrooke Park Road (N)	1,073	762	481	-55.2 %
Total Crossing Screen Line	**5,484**	**5,565**	**6,130**	**+ 11.8 %**

Table 3.4(b) Screen Line A–A P.M. Peak (5–6)traffic flow (eastbound).

* The Dover Slip Road figure for 1990 is used to calculate the change '78–'90 on Rochester Way.

Count Location	1978	1988	1990	Change '78–90
Shooters Hill Road	1,671	1,496	1,231	-26.3 %
Rochester Way	1,217	623	819	-32.7%
RWRR	-	3,024	3,559	N/A
Bexley Road	2,426	1,014	1,198	-50.6 %
Footscray Road	1,227	1,176	1,324	+ 7.9 %
Sidcup Road	2,347	1,798	1,570	-33.1 %
Total Crossing Screen Line	**8,888**	**9,131**	**9,701**	**+ 9.1 %**

Table 3.5(a) Screen Line B–B A.M.Peak (8–9)traffic flow (westbound).

Count Location	1978	1988	1990	Change '78–90
Shooters Hill Road	1,902	1,202	905	-52.4 %
Rochester Way	1,359	697	1,084	-20.2 %
RWRR	-	3,344	3,887	N/A
Bexley Road	2,145	1,095	1,151	-46.3 %
Footscray Road	989	916	1,161	+ 17.4 %
Sidcup Road	1,851	1,452	1,592	-14.0 %
Total Crossing Screen Line	**8,246**	**8,706**	**9,780**	**+ 18.6 %**

Table 3.5(b) Screen Line B–B P.M. Peak (5–6)traffic flow (eastbound).

3.60 The figures reveal another interesting feature, namely that the opening of the RWRR has caused a significant diversion from the A20 Sidcup Road, this presumably being longer distance traffic which had previously used the A20 rather than the old A2 Rochester Way because of the congestion and delays on the latter. Also revealed by the table are two warning signals, the first being that peak hour traffic on RWRR itself has increased fairly rapidly over the 2 years since opening and is now approaching its saturation capacity (particularly in the A.M. peak when the flow is in the realm of unstable flow). The second is that there has been a significant reversion of traffic onto the eastern half of the old Rochester Way in the evening. The current peak hour flow eastbound is now only 20 per cent less than before the Relief Road was built. This is curious, and difficult to explain, as there is no obvious deterrent to the use of the outer section of the RWRR. One possible explanation may be that some drivers may find peak conditions on the RWRR rather stressful (a condition aggravated somewhat by the narrow confines of the concrete cutting walls) and though it is slower, they presumably prefer the comparative peacefulness of the old road. That this does not occur so much in the morning may be partly due to the 'no right turn' prohibition at the western end of Rochester Way which prevents traffic turning towards Central London (though as discussed later, this particular restriction does create secondary problems associated with U-turning in Kidbrooke Park Road). Another possible explanation of the high peak flows on the eastern half of the Rochester Way is the lack of connection between the Relief Road and Welling Way at Falconwood. Because of this, traffic between Catford etc (on the South Circular) and the Bexleyheath/Erith/ Thamesmead area does not find the RWRR an attractive alternative to the (now uncongested) Rochester Way. However, it is also possible that when the East London River Crossing is complete and linked in at Falconwood, this element will find travel via the RWRR more convenient.

3.61 From this examination of the traffic flows before and after the opening of the Rochester Way Relief Road, the following overall conclusions can be made:

a) The road's principle effect has been to divert traffic from other routes and to redistribute the pattern of journeys as was its planned intention. This is clear from the fact that there are no indications that the new road has 'generated' a great deal more traffic within the corridor. Traffic growth within the corridor and across the screen lines has been no more than might have been expected over the years had the road not been built. The implementation of the new road has not

affected the forces suppressing the growth in radial movements (e.g. inner London congestion and parking controls) while the relatively unsuppressed orbital and local movements are increasing at normal rates.

b) The opening of the new road has relieved all other roads in the corridor including Shooters Hill and Sidcup Road. As anticipated by the forecasts made before the public inquiry, traffic on the western end of Rochester Way has been reduced to the very low level anticipated. However, traffic flow on the section east of the South Circular now stands at almost half of the pre-1988 daily level (rather than one sixth as forecast) and is increasing rapidly. The reduction in this flow (eastbound) has been reduced by only 20 per cent. The reasons for this need to be closely investigated and appropriate remedies taken.

c) On the Relief Road itself, peak hour flows are approaching saturation capacity. Regular queues which tail back from the traffic signals at Kidbrooke Junction to the intersection with Westhorne Avenue are experienced on weekday mornings. This situation however is not surprising since a deliberate decision to limit the size of the new road to dual two-lanes, rather than three lanes. This was intended to provide sufficient peak hour capacity only for the flows which were expected to divert to the new road from other routes (maintaining the 1978 level of flow). This was in accordance with the traffic function of the new road seen as being redistributional, rather than allowing for further growth. The decision not to provide additional capacity was made on the grounds that:

i) there would be little growth in peak hour traffic because of the limited capacity of adjacent routes (at least on the London side),

ii) the scale and impact of a dual 3-lane carriageway would be unacceptable.

With the threat of increased congestion because of further growth in the orbital traffic element, the need to prevent a repeat of the traffic overspill onto local roads in the future by means of traffic management is obvious. The operational incompatibility of the signalised junction at Kidbrooke make it a potential bottleneck within the otherwise free flowing route, which is the subject of a £5.8 m improvement scheme scheduled by the DTp to be completed by 1993[22].

MODAL SPLIT

3.62 Another aspect to consider is the impact the provision of the Relief Road may have had on the mode of travel. Unfortunately, the sample of respondents of the Questionnaire upon which to base any conclusions is rather small. It has been found impossible to obtain comparative information about bus travel, because of the very considerable changes made to the pattern of services as a result of the new rail/bus interchange station. London Transport (Buses), however, feel that patronage has increased as a result of the improvements to the services including the introduction of minibus services. As far as travel by rail is concerned, the information provided by British Rail was only on passenger throughput at the former Eltham (Well hall) and Eltham Park Stations up to December 1986. There are no later statistics available since surveys at the new station have not yet been carried out. Therefore, it has been impossible to detect whether or not there has been any significant shifts in the mode of travel from public transport to private or vice versa since comparisons of passenger traffic before and after the opening of the Relief Road cannot be made. British Rail, do not believe that there has been any significant change, and say that there may infact have been an increase in custom. This could be attributed to the generally improved travel conditions provided by the new station and interchange facilities. There is some external evidence of an increase in 'park and ride' at Eltham which may represent a shift of interchange point from stations further out of London.

3.63 The Questionnaire survey revealed that amongst the sample responding, 7 per cent had changed their mode of travel for regular journeys (Table H.2 in Appendix H). Nearly three per cent changed from 'car only' before, to 'car and bus' or 'car and rail' afterwards; and four per cent transferred to car only afterwards having used public transport before. The difference represents only a very marginal change from public to private transport, which may well have taken place anyway in view of the generally declining trend in British Rail passengers through the Eltham Stations. It may thus be concluded that the construction of the Relief Road has not significantly affected the mode of travel for regular journeys.

THE ACCIDENT EXPERIENCE

3.64 The London Accident Analysis Unit, part of the London Research Centre conducted a thorough before/after analysis of the accident experience in the study

area[23,24]. The study was carried out six months and twelve months after the opening of the route. The results were then compared to the equivalent period in 1987 (before the opening of the road). The results of the twelve months survey will be discussed here. The analysis covered all the main radial and orbital routes in the area. The procedure adopted for the purposes of the analysis was to compare the before accidents with the after accidents over a period of twelve months. The data was statistically tested against control figures of accidents in Bexley and Greenwich in general, for the relevant time periods. All percentage changes, therefore, are given relative to the control figures. Table 3.6 gives the disaggregated data as obtained from the study.

3.65 As far as the main radial routes were concerned, before accidents on the A207 (Shooters Hill Road), A210 Eltham High Street–Blackheath Road) and the Rochester Way were compared with the after accidents on these routes plus the RWRR. The overall number of accidents fell from 323, in the year before the opening of the RWRR, to 247 in the year after. Relative to the control data, this represents a significant reduction of 16 per cent. At the major junctions of classified radial roads in the area, accidents went down from 123 to 92 or a reduction of 18 per cent, however not considered statistically significant. Accidents along the links between these junctions also fell from 200 to 139 representing a significant reduction of 24 per cent. The largest reduction in accidents was by reported on the Rochester Way where the number of accidents dropped from 96 to 38 representing a significant reduction of 57 per cent. Accidents on Shooters Hill (A207) were down by 17 per cent, whereas accidents on Eltham High Street/Bexley Road (A210) showed practically no change.

3.66 On the main orbital routes crossing the radial routes, the reduction in the number of accidents has been to a lesser degree. The figures for the orbital routes showed a non–significant reduction of 15 per cent, thus indicating an improvement on the findings from the first six months which had shown a small increase in the number of accidents along these routes. Most of this reduction was observed on non–classified roads in the Eltham and Welling/Falconwood areas where the reduction was a significant 50 per cent and 34 per cent, respectively.

3.67 The comparison of the total number of combined fatal and serious injury accidents, before and after, shows a reduction from 86 to 75 representing a non–

AREA	Nodes/ Links/ Total	BEFORE (Mar 1987 - Feb 1988) Fatal	Serious	Slight	Total	AFTER (Mar 1988 - Feb 1989) Fatal	Serious	Slight	Total
RADIAL ROUTES									
RWRR	Total	-	-	-	-	2	4	10	16
A2	Nodes	1	8	38	47	0	5	14	19
	Links	2	11	36	49	0	4	15	19
	Total	3	19	74	96	0	9	29	38
A207	Nodes	1	4	36	41	0	4	34	38
	Links	2	11	72	85	0	12	46	58
	Total	3	15	108	126	0	16	80	96
A210	Nodes	0	5	30	35	1	7	27	35
	Links	2	12	52	66	0	15	47	62
	Total	2	17	82	101	1	22	74	97
TOTAL	Nodes	2	17	104	123	1	16	75	92
	Links	6	34	160	200	0	31	108	139
	* Total	8	51	264	323	3	51	193	247
ORBITAL ROUTES									
A205 (& A20)	Nodes	0	2	11	13	0	3	20	23
	Links	2	8	21	31	2	4	21	27
	Total	2	10	32	44	2	7	41	50
A213	Nodes	0	0	1	1	0	0	0	0
	Links	0	4	12	16	1	3	11	15
	Total	0	4	13	17	1	3	11	15
Eltham Area	Links	0	4	33	37	2	1	14	17
	Total	0	4	33	37	2	1	14	17
Falconwood/ Welling	Nodes	0	2	3	5	0	1	3	4
	Links	0	5	23	28	0	4	12	16
	Total	0	7	26	33	0	5	15	20
TOTAL	Nodes	0	4	15	19	0	4	23	27
	Links	2	21	89	112	5	12	58	75
	Total	2	25	104	131	5	16	81	102
GRAND TOTAL	Nodes	2	21	119	142	1	20	98	119
	Links	8	55	249	322	5	43	166	214
	* Total	10	76	368	454	8	67	274	349

TABLE 3.6 Rochester Way Relief Road Corridor : Analysis of Changes in Accidents on Radial and Orbital Routes

* Total including RWRR accidents

Source: London Accident Analysis Unit, June 1989.

significant drop of 17 per cent against the control data. The report of the London Accident Analysis Unit concluded with the following statement:

> 'The analysis of the first years accident data following the opening of the RWRR indicates that there has been significant reductions in accidents along the corridor comprising the radial routes of Rochester Way (old A2), A207, A210 and RWRR. The level of statistical significance achieved with a comparatively small amount of data indicates a fair degree of confidence in the results and the likelihood is that this reduction in accidents will continue.....The opening of the RWRR does not appear to have had any significant effect on accident severity'.

3.68 The last feature in this statement is of particular interest. At the public inquiry, the prediction made was that the Relief Road would reduce the overall number of accidents, but as they were likely to be more severe on the Relief Road, the savings in economic terms would be rather small. This has certainly not been the case. Based on the findings of the London Accident Analysis Unit study which showed that the Relief Road has contributed to a general reduction in the number of fatal and serious accidents, the economic savings in the first year after the road was opened amounted to nearly £1.5 m (using the average costs of various types of road accidents in built up areas published by the DTp[25]). It can thus be said that the RWRR has improved the safety conditions along the network roads in the study area and produced considerable economic savings to the community.

ENVIRONMENTAL IMPACT

3.69 In order to assess the overall environmental impact of the Rochester Way Relief Road it is necessary to examine the road's effect on a number of elements. These range from 'land and property take' to 'changes in accessibility'. They also include an examination of conditions on local streets as obtained by the analysis of the Questionnaire Survey mentioned earlier. In the following section, the changes in the different elements are presented.

(a) Land and Property Take

3.70 The construction of the RWRR involved the demolition of some 240 dwellings, together with a small number of shops and offices and some industrial premises. Most of these were located along the road's section between Shooters Hill Roundabout and Eltham Station. At the Falconwood end, a corner of the

Eltham Cemetery and a section of the Public Eltham Park were taken. Additional slices at the bottom end of the private playing fields in Kidbrooke Lane were also taken. This cost, however, was the least when compared with the other options presented at the public inquiry (see Table G.1, Appendix G).

(b) Severance

3.71 As intended in the original plans of the scheme, it has not increased physical severance. With the exception of Wricklemarsh Road and Dursley Road (where only the footpath is carried over), all roads and footpaths crossing the new road have been maintained on the same line and level as before. The same can be said for local journeys by motor vehicle with the exception of one or two instances such as those mentioned above, and where traffic management schemes had been introduced. The fact that the railway has always been a barrier has probably reduced the impact of the road in this respect. However, where visible the road is, of course, an intrusive element, and it has introduced a major new sources of noise and fumes through the area.

(c) Survey of Local Opinion

3.72 The Questionnaire Survey of local residents within the study area was carried out to enable the further assessment of the scheme impact. An area of immediate impact was defined (Figure 3.1). This area is bounded by Shooters Hill Road, Eltham High Street/Bexley Road, Kidbrooke Park Road and Falconwood. A random sample of households was selected by choosing the twentieth house of every street within the defined boundaries. This resulted in approximately 800 questionnaires being sent out to residents in the area. The questionnaires covered a wide range of issues, from overall environmental and accessibility impressions to specific changes experienced on local streets. A copy of the Questionnaire form is shown at the end of Appendix H. Although a good response was expected, only 16 per cent of the recipients responded to the questionnaire. All respondents indicated that they had been directly or indirectly affected by the new road and other associated changes. This is not altogether a surprising result from the population of an area which is fairly closely drawn around the location of the new road, but whether or not it is entirely representative cannot be said for sure. If recipients of the questionnaire genuinely felt that they were unaffected, it is possibly more likely that they would have ignored the exercise, hence the returns

may represent a sample which is biased towards those who had experienced distinct changes (and possibly towards those who feel they have something to complain about, rather than the more satisfied ones). A further 600 questionnaires were sent to the area immediately outside the study area to obtain some information on the impacts felt by those commuting through the area. The results of this survey will be disclosed fully under the 'changes in accessibility' section.

(d) General Opinion on the RWRR

3.73 The results of the Questionnaire Survey are fully tabulated in Appendix H (Tables H1 through H21). As typical of this kind of survey, the response received was somewhat mixed and sometimes contradictory. However, there can be no doubt about the issue of the worthwhileness of the scheme. The vast majority of the respondents (80 per cent) thought that building the Relief Road has been worthwhile, while only 10 per cent thought it was not (Table H.14). This is in contrast with the lesser number who were in favour beforehand (71 per cent). Only five of the nine respondents who opposed the scheme before it was built still thought it was not worthwhile. In all, twelve of the total respondents said that the scheme had not proved worthwhile. Table H.15 in Appendix H presents a breakdown of the respondent's attitudes before and after the building of the Relief Road.

3.74 An analysis of the location of the streets in which the various respondents lived, indicated a good general scatter over the study area. The housing in the area can be conveniently divided into nine sectors. These are the triangular area between Shooters Hill and Broad Walk in the north west, which includes the Evelyn Estate; the four quadrants around the intersection between Rochester Way and the South Circular (including the Progress Estate); the three blocks between RWRR and Eltham Hill/ Eltham High Street and divided by Westhorne Avenue and Well Hall Road; and the block at the Falconwood end of the Relief Road. Not surprisingly, the majority of the dissenters were from those sectors closest to the new road.

(e) Environmental Conditions Generally

3.75 It had been predicted that the Relief Road would remove extraneous traffic from Rochester Way, and lead to the reduction in the use of local roads for rat-

running, resulting therefore in considerable environmental gains for the whole area, with possibly as many as 20,000 people enjoying improved conditions.

3.76 In addition to more specific questions on particular environmental issues (e.g. traffic noise), participants were asked to state whether they had experienced better or worse environmental conditions generally as a result of the new road. 46 per cent of the respondents felt that it had given them 'better environmental conditions'. If this had been representative of the total population within the study area (nearly 45,000) it would have indicated that some 21,000 people have gained in this respect. For the reasons already explained, the sample responding was not necessarily representative.

3.77 Twenty six per cent of the respondents felt that they experienced 'worse environmental conditions' as a result of the new road. Similarly, this represents at least 11,000 people or approximately 4,500 households. This, however, is much more than the number of households receiving compensation under the Noise Insulation Regulations (about 600). Any one within an earshot of the road (depending on the extent they are screened by buildings, cutting walls etc.) is likely to have felt this way, and there are most probably 4,500 households who come within this category. Much of the annoyance, reported by some respondents and also by Residents' Associations, is due to the drone of traffic noise throughout the night.

(f) Traffic Noise

3.78 More people said they had noticed some increase in traffic noise, than said they had experienced 'worse environmental conditions' (38 per cent compared with 28 per cent). From Table H.7 it can be seen that only 23 per cent experienced a large increase. On the other hand, a larger proportion (41 per cent) experienced a decrease in traffic noise with more than half of these reporting a 'large decrease'.

3.79 A locational analysis of the 'worse-off'and 'better-off'revealed a clustering along the new road, and along the old Rochester Way respectively. There were however, significative numbers of complaints firstly from the Evelyn estate sector, (where the traffic patterns have been drastically altered by the Woolacombe Road closure); secondly along the Kidbrooke Park Road (S) in the south-west sector (where total traffic is about the same but the proportion of heavy vehicles is

higher); and thirdly from the Falconwood sector, where new access arrangements for the Eltham Cemetery and Crematorium and other traffic management schemes have altered traffic patterns. A quarter of those reporting a large increase, also indicated this was unexpected (see Figure 3.9 for the locational distribution of respondents).

(g) Air Pollution

3.80 Rather more people say they have experienced a decrease in air pollution than an increase (Table H.8). This is a cause for concern, even though the numbers are substantially smaller than those related to noise, for they indicate that as many as 3,000 households may have become conscious of a large increase in traffic fumes. The locational distribution of respondents (Figure 3.10) shows a random scatter of the streets.

3.81 The questionnaire also covered the issues of 'speeding vehicles' and 'risk while crossing the roads'. The results are shown in Tables H9 and H10 respectively. From the tables a similarity between the numbers representing increases and decreases can be seen, but the balance has for some reason been tipped towards those experiencing increases.

(h) Heavy Lorries

3.82 On this issue, the results are very positive (Table H.11) with nearly three and a half times as many people reporting a decrease than an increase. From the locational distribution in Figure 3.11, and as with air pollution, the increases are reported mainly by people on the main arteries, and the majority of the decreases by people on and around the old A2.

(i) Rat-running

3.83 The extreme congestion on the old A2 Rochester Way had previously overspilled onto local streets because of the great number of drivers seeking quicker alternative routes via side streets. This 'rat-running' had become so widespread, and not only did it cause residents much inconvenience and annoyance but it also increased the danger to children on their way to and from school. It is therefore extremely disappointing to find the perceived amount of 'rat-

running' apparently unchanged but occurring on different streets, even though the degree of congestion has been considerably reduced. Table H.12 shows that 24 per cent of respondents reported a large increase ('unexpected' in half of the cases), while 23 per cent reported a large decrease. These figures have to be considered with some caution since it is , of course, almost impossible to ascertain by simple observation whether a vehicle is passing along a particular street in order to avoid a congested main route, or whether it is simply locally generated traffic finding its way in or out of residential areas. This latter element is growing all the time due to increased car ownership and use.

3.84 Surprisingly enough, it seems that many of the traffic management measures that have been introduced since the opening of the RWRR (specifically to help reduce the amount of rat-running) have also caused a significant change in the pattern of local traffic. This is the main reason why so many people have reported adverse changes. When examining the location of reported changes, plotted in Figure 3.12, it can be seen that a large number of those reporting better conditions are on the roads within the north-west and north-east quadrant of the old A2/A205 (South Circular). The concentration of those reporting worse conditions is to the south-east of this same intersection, and this appears to be caused partly by the added attraction of Eltham Station for 'park and riders'; partly because of traffic filtering through to avoid the now very much more heavily loaded section of the South Circular namely Westhorne Avenue on either side of the interchange with RWRR; and partly because of the closure of Glenlea Road at the Eltham Station end. The increases along Broad Walk and through various roads in the Evelyn Estate (between Broad Walk and Shooters Hill Road) have resulted from the combined closure of the north end of Woolacombe Road, and the residual northern section of Rochester Way (north of the 'Dover Patrol') which is closed to all traffic but north bound buses and taxis.

3.85 Responses to the question on 'direct access to home' reveal another problem. While 29 per cent of respondents reported improvements, 24 percent reported a worsening situation (Table H.6). The worsened conditions are mainly due to the increase in kerbside parking by commuters in residential streets near Eltham Station. A spot count in a mid weekday morning revealed that there was substantially more 'park and riders' who had parked in the streets than in the official car park at the Station, despite that the latter was half empty (Plate 3.7).

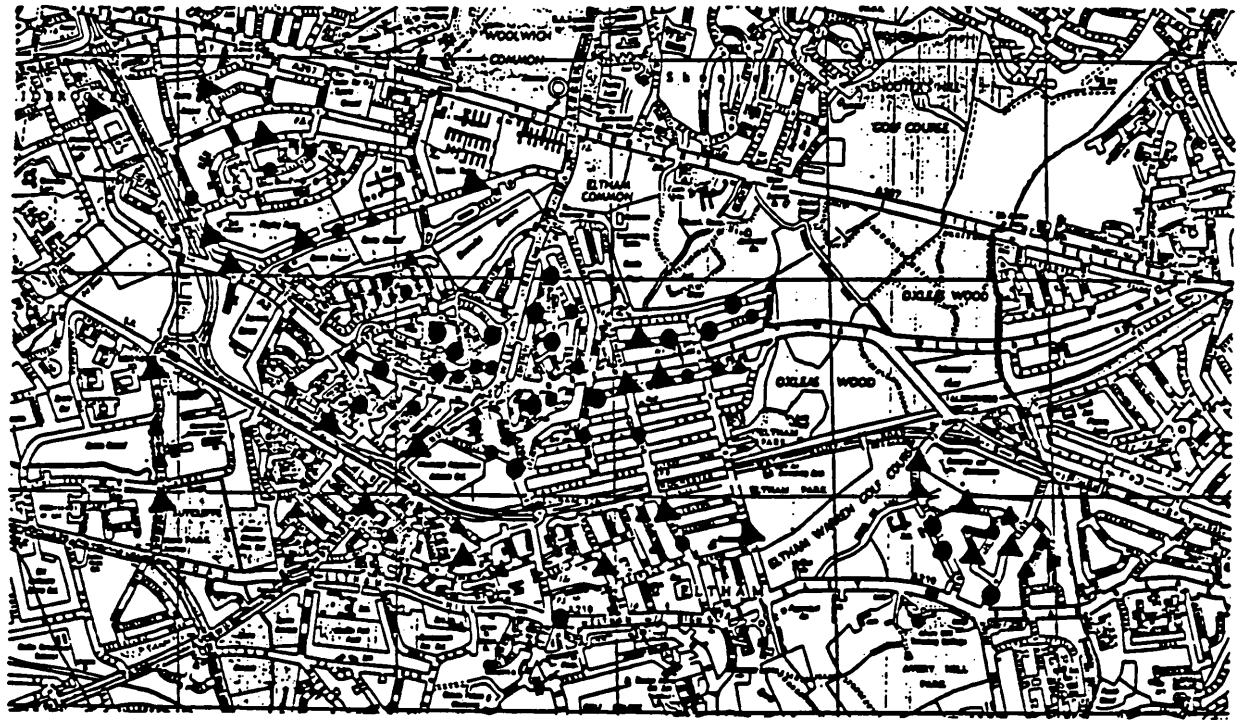


FIGURE 3.9 Locational Distribution of Respondents on Traffic Noise
(Marks do not indicate the exact location of respondents)

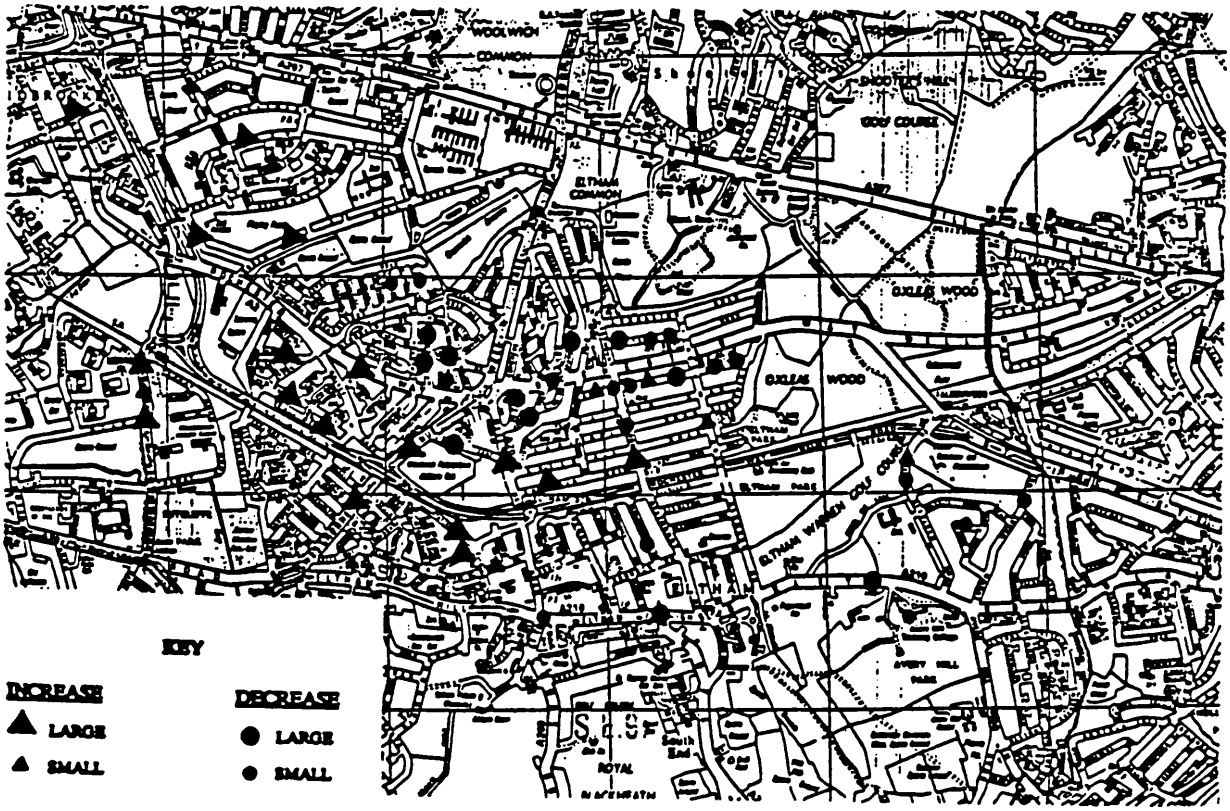


FIGURE 3.10 Locational Distribution of Respondents on Air Pollution
(Marks do not indicate the exact location of respondents)

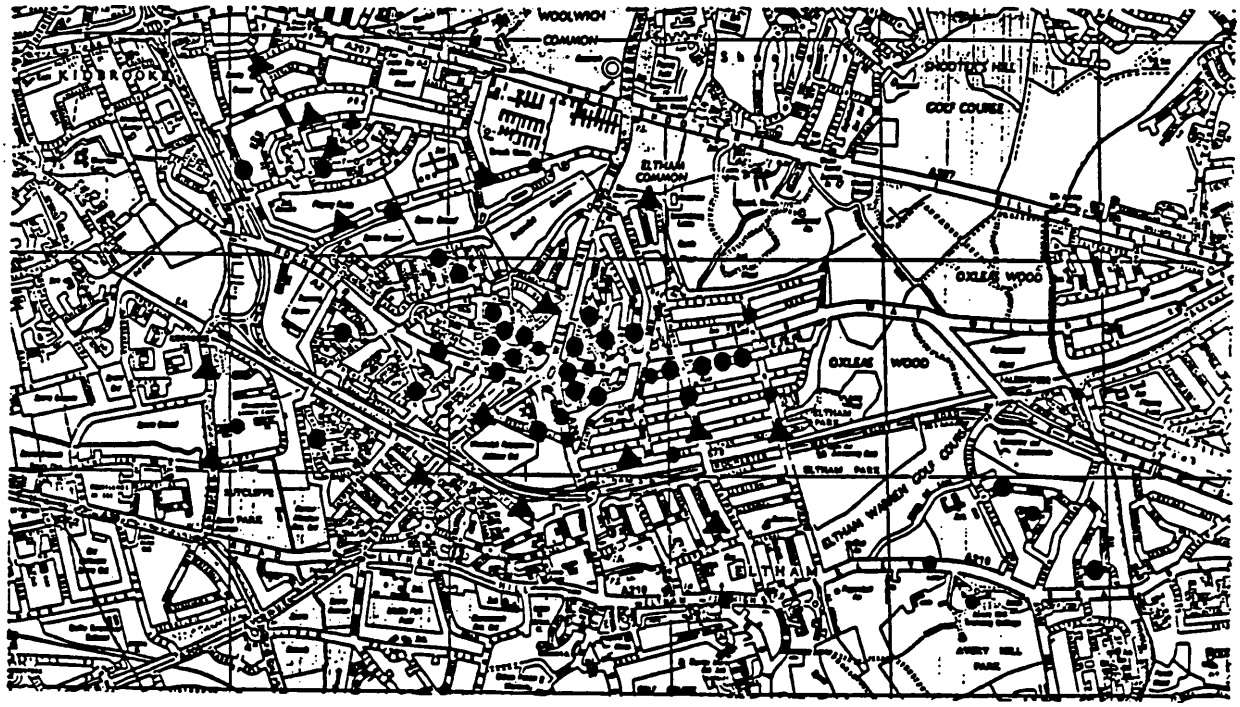


FIGURE 3.11 Locational Distribution of Respondents on Heavy Vehicles
(Marks do not indicate the exact location of respondents)

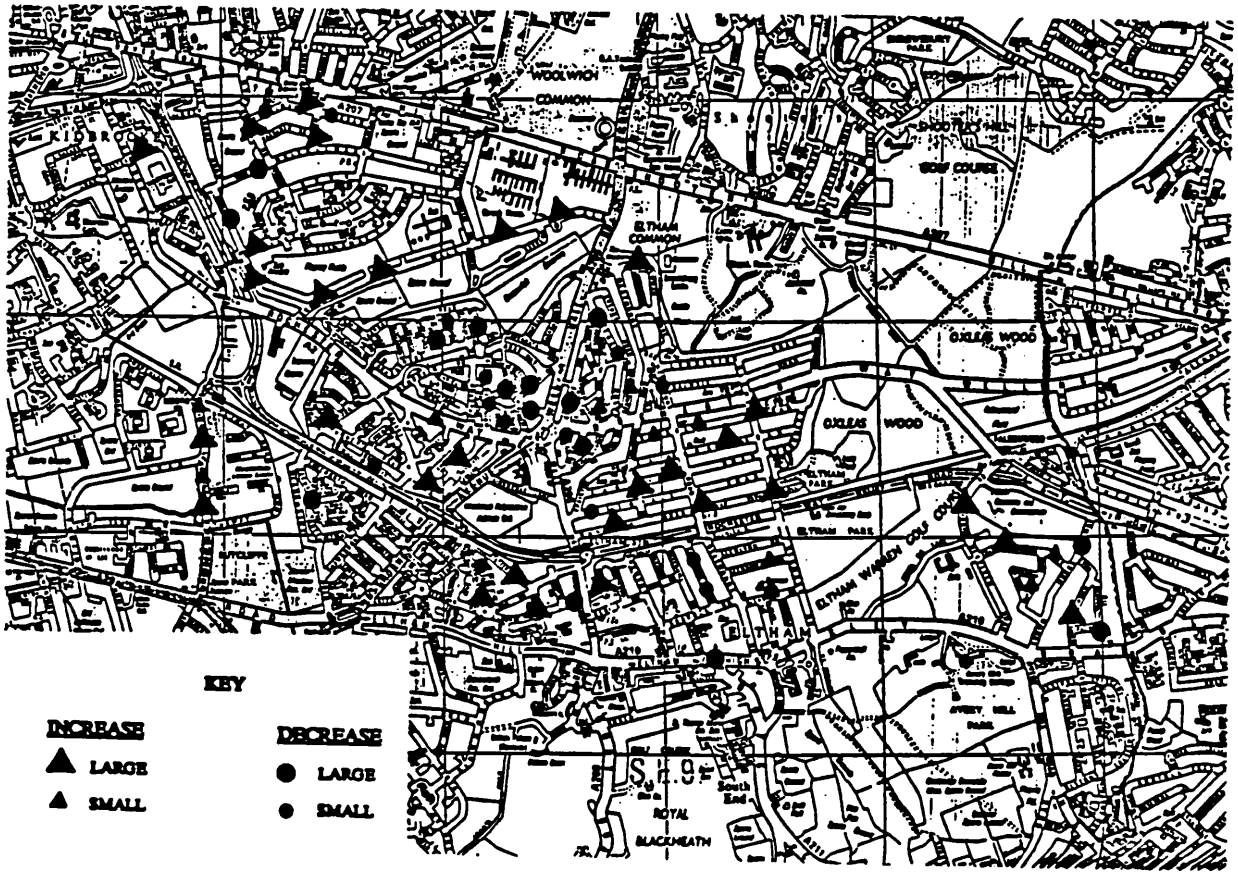


FIGURE 3.12 Locational Distribution of Respondents on Rat-Running
(Marks do not indicate the exact location of respondents)

It seems that this is because of the charge for the parking, although a small one, and because of reported vandalism in the car park.

CONCLUSIONS ON THE ENVIRONMENTAL IMPACT

3.86 From the previous paragraphs it can be concluded that:

(a) In terms of environmental improvements in general, the implementation of the RWRR has benefited a large number of people possibly as many as 21,000. However, some people are not as well off as they were before, mainly because of the shift of the corridor of traffic noise from the old A2 Rochester Way to the new Relief Road. Severance caused by the road has been contained to a minimal degree in line with the planned intentions, and accidents within the corridor have been significantly reduced.

(b) As far as more specific aspects of the environment are concerned, including the impact on 'rat-running' it seems that the redistribution of traffic patterns resulting from the way the new road is connected up, and from the associated traffic management measures, has meant a gain for some and a loss for others. In most respects, more have gained than lost, especially in respect of heavy vehicles traffic. It was only in respect of 'speeding vehicles' and 'risk while crossing the roads' that rather more people reported worsened conditions.

(c) The level of congestion has been reduced on the A2 especially around the old Rochester Way. Rat-running, however, was reported to have decreased by some while a similar number reported an increase. This, however, may be attributed to changes in the traffic flow patterns and the increased traffic from local activities including the schools and the new bus/rail interchange.

(d) Overall, an overwhelming majority of respondents regard the scheme as being 'worthwhile'.

CHANGES IN ACCESSIBILITY

3.87 Unlike most road schemes which are justified on the grounds of improved accessibility and the benefits resulting from reduced travel times and operating costs, the RWRR was justified on larger environmental grounds since the

economic case for implementation was not as strong as normally required. In order to assess the actual economic gains to road users, it would be necessary to carry out a comprehensive survey of travel times through the area before and after. The measurements made beforehand were not very comprehensive, and more spot measurements have been made since the road was opened. Together, these give some indication of the change. To get a more positive indication of the changes, it was decided to supplement this data with the opinions of local residents, and of other regular users of the road within the corridor.

3.88 As part of the Questionnaire Survey, a further 600 questionnaires were sent to households within the residential suburbs to the west and to the east of the Study Area. The total responses were 54, all from households with a car, 44 of whom stated that they regularly travelled to, from or through the study area. Almost 90 per cent of the respondents were in favour of the new road before it was built, with only two opposed (Table H.21). Better travel conditions for longer journeys by road were reported by the majority of the respondents (76 per cent), and only a few reported worse conditions (Table H.18). In all the latter cases, 'traffic management measures' were given as a cause (Table H.19). Understandably, a greater proportion of those living to the London side of the study area reported much better travel conditions.

3.89 Today, it is difficult to appreciate the degree of congestion that prevailed on the Rochester Way before the opening of the RWRR. There were reports of it being a 'solid jam' in both directions for most of the working day. It was referred to in the London evening paper, the Standard in 1985 as 'one of the worst bottlenecks in south-east London'; in the London Evening News in 1980 as 'The biggest traffic bottleneck in the capital' and by the MP for Farnham speaking in Parliament in 1979[26] as 'one of the worst traffic bottlenecks in Britain'. In the same debate, the MP for Woolwich West, Mr Peter Bottomley, referred to the bottleneck as 'one of the greatest transport scandals in the country' and also complained that 'one of my constituents (living on A2 alongside the bottleneck section) has had 17 cars and lorries in her small front garden in the past 15 years'.

3.90 Journey time surveys carried out in 1979, before the Public Inquiry, showed that the journey from Falconwood to the Blackwall Tunnel Southern Approach (BTSA) could take over 14 minutes in the morning peak (see Table F.3 in Appendix F). This is nearly double the time that it would have taken under free-

flow conditions and represents a drop in travel speed from 25 mph to 14 mph. Delays of up to 3 minutes were recorded on the approach to the Well Hall Roundabout, and up to 2 minutes at the signals at Westmount Road. No details of the survey are available, other than that it 'consisted of measurements by a survey vehicle of total time and stopped time (delay) on each link of traffic significance in the road network in the study area. These surveys consisted of eight runs in each direction during each of three time periods (morning peak, off peak and evening peak) on each link, spread over several weekdays during the survey period' (April–July 1979)[17]. Though they were clearly carried out in accordance with the normal code of practice, they unfortunately represent little more than a 'spot–check' on each link in the network, and they do not tell us what conditions were like whenever there was any kind of incident. As these were only too frequent, apparently, the figures do not give a true picture of the actual conditions. They do show however that alternative, but less direct routes from Falconwood to BTSA, such as the doubling back via Riefield Road, then along Bexley Road, Westmount Road, Dunvegan Road, Kidbrooke Lane, Briset Road and back onto Rochester Way, could be navigated in a much shorter time. A similar picture is revealed for journeys between Falconwood and the Yorkshire Grey Roundabout (A205/A210), and between the A211 Footscray Road and the BTSA (see Figure 3.3).

3.91 Journey time surveys have also been carried out since the opening of the RWRR, both by Bullen and Partners and by the researcher. Again however, these are only of a 'spot–check' nature and cannot be said to be representative of all conditions (such as those, for example, when there is a signal failure at the Kidbrooke Junction, or an incident in the Blackwall Tunnel). Putting the results together, the average journey time during the morning peak from Falconwood to BTSA , via the RWRR , is now almost exactly 6 minutes, with only short delays at the Kidbrooke signals (up to 2 minutes). The rate of flow during the peak is very close to saturation, so that both traffic lanes of the new road are running nose–to–tail. It is evident that any slight disturbance can cause a slowing down of the traffic stream. At off–peak times, the equivalent journey time is about 4 minutes and in the easterly direction it is normally possible to maintain a speed equal to the legal limit of 50 m.p.h. In the evening peak, it has been observed that the eastward flow, also running at near saturation level, is subject to some reduction in speed on the approach to the intersection with the South Circular (because of traffic entering from this route via the eastward slip road). A further reduction in

speed sometimes occurs a little further eastwards at the short tunnel under Eltham Station. This appears to be due simply to the psychological effect of the enclosed tunnel.

3.92 The survey results do appear to indicate that the RWRR has fulfilled its objectives as far as improving accessibility is concerned (at least up to the present). But to shed more light on this question, the views were sought of a number of firms which have regular road freight or coach movements through the study area. The local transport firms contacted were not very forthcoming with details of their operations, but the responses clearly indicated that they appreciated the benefits stemming from the new road in terms of improved conditions and travel times. Of six national firms, regularly using the route, all but one expressed complete satisfaction with the new road.

3.93 The firms contacted were the National Express Coach Lines, B R S Southern, Sainsbury's, Tate and Lyle Sugars, and the Royal Mail Parcel force. The benefits delivered were, generally, in terms of improved travel times, better timekeeping and increased accessibility. The impression was also given that there was an element of savings in fuel and operating costs. The amount of savings differed from one firm to the other depending on the type of operation but was not quantifiable in any respect except by the Royal Mail Parcel Force. In the Transport Manager response, and after consultation with some of his drivers, he expressed the view that the opening of the RWRR resulted in savings on running times (on the daily journey to Dover and back) of 45 minutes during peak periods. The responses from all firms are appended in more detail in Appendix I.

OTHER ECONOMIC EXPECTATIONS

3.94 The economic effects of new roads, namely those of 'opening-up' areas, the encouragement of new developments, increased employment and increases in land and property values, are normally long term in nature and can be felt well beyond the immediate area served by the road. At a national level, this particular link being part of the strategic road network may well help play a part in 'opening-up' the Country as a whole in relation to the European Community, though much more needs to be done in relation to all forms of transport. At a more local level, it appears that some firms have been able to achieve more efficient transport operations and distributional arrangements.

3.95 The immediate area is well built up and there is very little vacant land in the vicinity, and hence a little opportunity for land-use changes. However, there has been a keen interest in redeveloping land around the Kidbrooke Intersection, which formerly belonged to the Ministry of Defence. Sainsbury's Homebase are soon to begin building a retail warehouse on one of the sites, and Safeway may develop a superstore on another, if satisfactory access arrangements can be devised.

3.96 With respect to the road's impact on property prices, these seem to have hardly changed, though evidence in this respect is rather slim. Estate Agents in the area were contacted, however only one was prepared to answer, on personal basis, the detailed questions put to them. The views expressed were made with some caution in view of the adverse national trends in house prices and the difficulty in pinpointing the influence of individual factors.

3.97 As a result of announcing the road plans and at least five years prior to the construction, property values in the vicinity of the new road had depreciated between 5 and 15 per cent, depending on actual proximity. This was due to the uncertainty about the eventual impact of the road in terms of noise and pollution and the considerable disruption and inconvenience associated with the engineering works taking place in the neighbourhood. With properties adjoining the new road said to be 'virtually unsaleable' immediately prior and during construction, the view was that prices had to be reduced by around 20 per cent in comparative terms to achieve a sale. Today, with the road completed, house prices have generally been restored in comparative terms, with possibly only a 5 per cent depreciation in property values where the road is visually or aurally intrusive. The situation along the old Rochester Way has also changed. Before building the Relief Road values along the road were between 10-15 per cent below comparable properties in other roads. This price differential has now been narrowed down, however, the estate agent suggested that a differential of a round 5 per cent still prevailed along parts of the road. Due to fears of past conditions returning, demand for these properties has not been fully restored.

3.98 It can therefore be seen that the RWRR has not, as yet, had any significant economic impacts on land uses in its locality despite signs of marginal changes. In the longer term, the road possesses the potential for greater economic influence

on a much wider scale in its role as part of an improved strategic network of roads serving Greater London and the rest of the country.

OTHER EFFECTS

(a) General Appearance

3.99 The road's most remarkable attribute is that visually it is not all that noticeable from the majority of points on the ground nearby. There are few places, on the ground, other than bridges, where a good view of the road can be obtained. This is simply due to the fact that most of the road is within a cutting or behind embankments, reflecting the special consideration taken to minimise any adverse impacts. In addition, the road has been well integrated with its surroundings via both soft and hard landscape measures (Plate 3.8). Most of the planting of trees, shrubs and grassed areas is now complete at a cost of nearly £3 m, but there has been a considerable amount of theft and vandalism.

3.100 On the whole, a lot of attention to detail has been paid. This is best illustrated in the way the original wall of Eltham Cemetery has been taken down and rebuilt on line with the alignment of the slip road alongside (Plate 3.9). Finishes on the vertical cutting faces are well matched and the bridges simple and well proportioned. Some other details, such as the intersection with the South Circular (Westhorne Avenue), for example, can be criticised. In this major two-level intersection the RWRR is at an elevated level, with the South Circular maintained at original ground level. In order to keep the size of the intersection to an absolute minimum by means of keeping the four slip roads tight alongside the main route, and incorporating a minimum sized roundabout underneath, with all the approaches controlled by signals. The net effect of this has been to produce a most unfortunate dissonance of signals, signs and lighting columns with at least fifty columns of one kind or another on the underside of this intersection (see Plate 3.10).

3.101 From the road user's point of view, the least attractive feature is the proximity of the high vertical walls (over 8 metres in height in places) to the running lanes, which have a rather overbearing effect (Plate 3.11). They have been designed with a minimum verge width, to minimise land-take and severance, but anyone one breaking down on these sections is put into a very awkward and

dangerous situation. Although special arrangements have been made to allow access for emergency services, it would seem that a continuous shoulder would have been preferable from the operational point of view.

(b) Other Concerns of the Local Residents

3.102 In addition to the complaints already mentioned in respect of various forms of adverse environmental impact, other complaints voiced by Residents Associations included ones related to the traffic management measures; some are connected with the re-location of the Station and all the commuter parking associated with it; and there have also been complaints about residual conditions on other main roads, in particular the southern section of Kidbrooke Park Road.

3.103 When the plans were made by the GLC for the RWRR, the need for a complementary package of traffic management measures, to ensure the effective elimination of the 'rat-running'problem, was recognised. The details of all 35 of these measures were given at the public inquiry. With the abolition of the GLC, the implementation of these measures became the responsibility of the Boroughs. Today, most of the measures have been implemented though not all have been well received by the residents. There have been delays over some of the retaining measures mainly due to their controversial nature. Others have been postponed or cancelled. A complete list of the measures as proposed in April 1989 which includes all the original GLC proposals plus six additional schemes is presented in Table 3.7 with the location of each scheme shown in Figure 3.13. Twenty three of these schemes have been implemented, the most common type being a simple street closure by means of temporary posts planted across the road (one being removable in emergencies). Examples of these are at the north end of Woolacombe Road in the Evelyn Estate (Plate 3.12); Briset Road at the South Circular end; Kidbrooke Lane (at the Well Hall Road end). Other forms of traffic management are shown in Plates 3.13 and 3.14.

3.104 These closures have clearly prevented the passage of through traffic along the streets concerned, but in many cases they have simply diverted the vehicles onto other residential roads which are even less suitable. In some other instances the banning of certain movements (e.g. right or left turns) have lead to drivers making erratic U-turn manoeuvres. Another type of complaint relates to measures that have not so far been implemented. These include the closure of the old

Scheme No	NAME OF ROAD	PROPOSED SCHEME	STATUS
1	Crown Woods Way	Gated Closure	Implemented
2	Crown Woods Way/ Bexley Road	Revoke banned turn	Implemented
3	Eltham Cemetery/ Crematorium	New access road	Implemented
4	Riefield Road/ Rochester Way	Junction realignment banned right turn and landscaping	Implemented
5	Riefield Road/ RWRR Slip Road	Banned left turn	Implemented
6	Lingfield Crescent (East)	Closure	Implemented
7	Rochester Way/ Welling Way	New roundabout	Abandoned
8	North Park	Closure	Abandoned
9	Footscray Road/ Eltham High Street	Traffic signals with pedestrian phase	Abandoned
10	Eltham High Street/ Westmount Road/ Southend Crescent	Traffic signals	Implemented
11	Passey place	Closure and pedestrianisation	Implemented
12	Eltham High Street	Environmental treatment	Postponed
13	Glenlea Road	New link road	Implemented
14	Crookston Road	One way working	Postponed
15	Glenesk Road	One way working	Postponed
16	Rochester Way/ Westmount Road	Rephase, remove banned turns	Implemented
17	Rochester Way by Grangehill Road	Closure	Postponed
18	Rochester Way	Environmental treatment amend waiting restrictions	Under way
19	Wythfield Road	Closure	Implemented
20	Yorkshire Grey Roundabout	Junction improvement	Postponed
21	Rochester Way/ Westhorne Avenue/ Well Hall Road	Junction improvement	Postponed
22	Kidbrooke Lane	Closure	Implemented
23	Briset Road	Closure	Implemented
24	Shawbrooke Road/ Briset Road	Closure	Width restriction implemented
25	Birdbrook Road	Closure	Width restriction implemented
26	Shooters Hill Road/ Academy Road	Junction improvement	Postponed
27	Broad Walk	Closure	speed humps implemented
28	Woolacombe Road/ Eastbrook Road	Closure	Implemented
29	Rochester Way/RWRR Slip Road	Banned right turn except for buses	Implemented
30	Kidbrooke Park Road	Paved closure and width restriction	Width restriction implemented
31	Rochester Way near the Dover Patrol	Closure except for buses and taxis	Implemented
32	Kidbrooke Park Road/ Link Road to Kidbrooke Interchange	Traffic signals with pedestrian phase	Implemented
33	Kidbrooke Park Road/ Shooters Hill Road	Rephase signals	Postponed
34	Shooters Hill Road/ Strathedon Road	Junction improvement	Postponed
35	Westbrook Road/ Rochester Way	Revoke banned right turn	Implemented
36	Wricklemarsh Road/ Rochester Way	Revoke banned right turn	Implemented
37	Brook Lane	Revoke closure	Abandoned
38	Westmount Road	Width restrictions and pelican crossings	Implemented
39	Westbrook Road/ Kidbrooke Park Road	Banned right turn	Implemented

TABLE 3.7 Traffic Management Measures in Eltham As Proposed in 1989 and their Status As of May 1990.

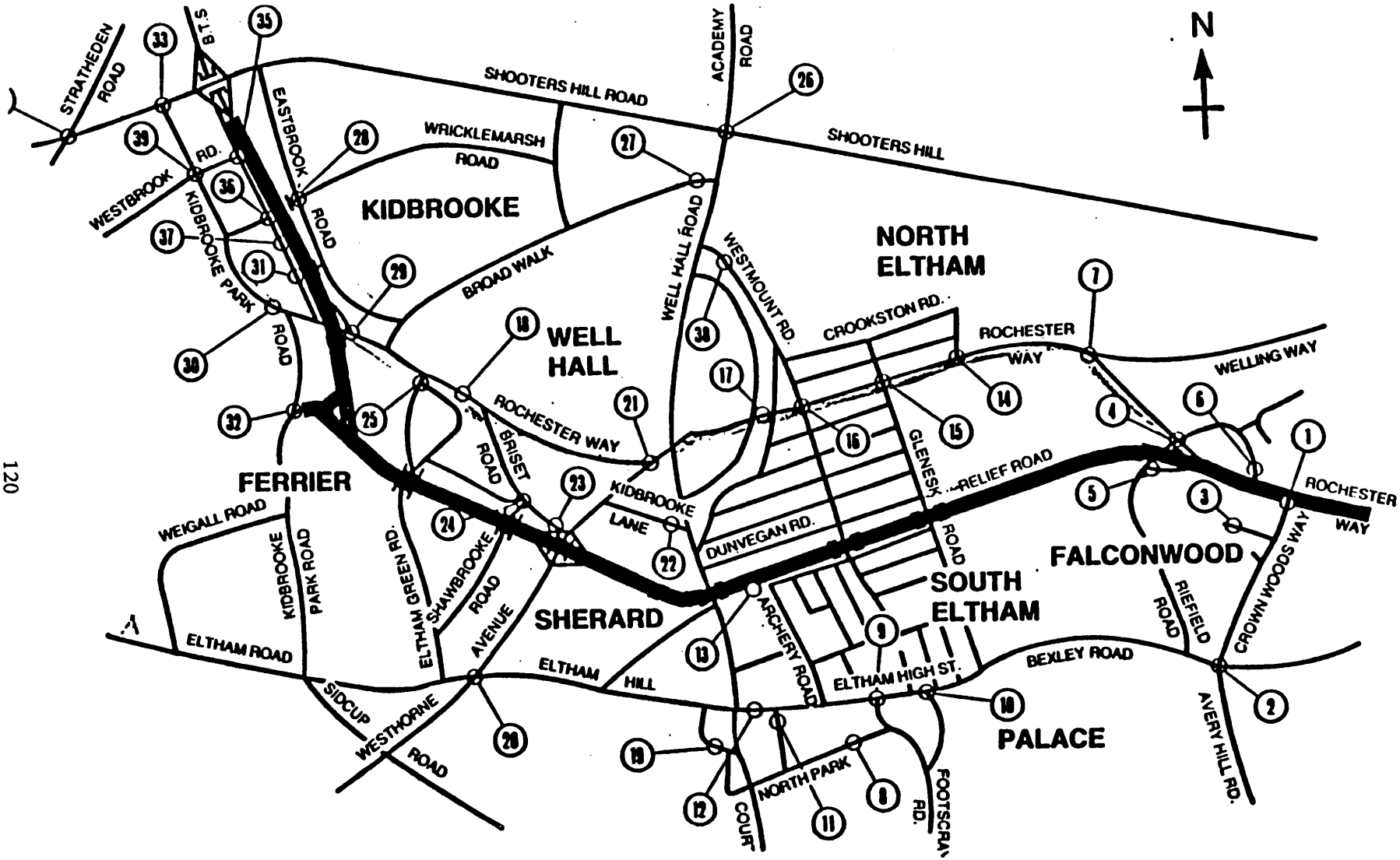


FIGURE 3.13 Location of Traffic Management Measures in Eltham

Rochester Way by Grangehill Road and the closure of the northern section of Kidbrooke Park Road. As a result traffic on both sections of the road has not been reduced to anything like the level forecasted.

3.105 In general, it seems that the implementation of the traffic management measures seem to shift the problem from one locality to another, and in some cases to less suitable roads. These measures, which are intended to prevent through traffic from using local roads, do seem to create a problem for local residents. This is because they have forced a change in local traffic patterns which is in most cases resented by the residents since it has affected their local movements. The Borough Council is in a sticky situation where the implementation of traffic management measures only seem to annoy the residents and shift the problem from one street to another. What is really needed is an approach towards more comprehensive traffic calming measures as those introduced in Germany (*Verkehrsberuhigung und Wohnumfeldverbesserung*) where residential areas are restricted to all but local access traffic. Such measures, however, are costly and may require certain statutory provisions but are the most effective in the removal of through traffic. Furthermore, these measures would be a very effective way of controlling unwanted commuter parking in residential streets (Plates 3.15 and 3.16).

CONCLUSIONS

3.106 The Rochester Way Relief Road is the latest addition to the strategic road network in London. The objective of this study was to ascertain whether the road has met its stated objectives now that it has been operational for over two years. The benefits and disbenefits have been examined to see whether the expectations in each respect have been fulfilled, in order to determine whether or not the scheme can be regarded as effective and worthwhile. The response rate to the Questionnaire Survey of local residents was, as mentioned earlier, rather disappointing. Furthermore, the majority of respondents (90 per cent) had access to a car which may make the sample representation of the area covered rather biased. Nevertheless, it is an indication obtained in this respect, and is one which was complemented by meetings and discussions with various individuals and residents associations in the area. Special care was also taken in examining the various written comments which supplemented some of the returned questionnaires. It should also be noted that traffic conditions on the scheme and in the immediate

area were observed over a long period (January–July 1990) by means of frequent visits and traffic observations during different hours of the day.

3.107 Looking at the road's impact on its urban surroundings, it must be acknowledged that the scheme was achieved at some considerable sacrifice in terms of lost homes and businesses and some loss of open space. In addition to that, the scheme caused disruption and inconvenience during its construction. On the other hand, the scheme has been designed and built in a way that resulted in minimal additional severance either physically or visually. The landscape measures implemented with the scheme coupled with excellent design features make it blend very well with its urban surroundings.

3.108 On the aspect of accessibility, the road has had a positive influence where it is clearly evident that the construction of the road has completely relieved the notorious bottleneck that previously existed in the London strategic road network. It had been decided that the narrow twisting section of the old A2 through Eltham could not be improved due to overriding conservation needs (the Progress Estate), and so a local by–pass was the only remedy. By adopting a convenient line alongside an existing railway and through redundant MoD land, this was achieved with minimal disruption and severance.

3.109 The constraints in terms of resources and information makes it rather difficult to assess the exact proportion of each element (e.g. diverted, generated, etc.) in the RWRR traffic, since this, of course, would require detailed origin–destination surveys to establish more confidently these elements. Nevertheless, based on the information presented earlier and the analysis of the available traffic flows before and after the opening of the Relief Road and across a number of screen lines, it appears that this five and a half kilometre of dual two–lane carriageway has been effective in performing its redistributionary function as envisaged by the GLC. Even with the road nearing its capacity during the peak periods, it may be inferred, from the different strands of evidence presented earlier (e.g. DTp cordon and screenline counts, Questionnaire etc.), that the scheme has not generated a great deal more traffic than would have been expected as a result of annual traffic growth. This therefore does seem to discredit the type of argument often used by opponents of new roads in urban areas to the effect that such schemes simply generate so much more traffic that they become congested themselves and lead to worsened situations within the corridor. As far as the information available on the change of peoples mode of travel, it can be

ascertained that there has been no significant change. There are indications, however, of an inward shift of park and ride activity to the new Eltham station. Other main roads on the same east–west axis have experienced a reduction in traffic flows, while the change in the total across the screenlines has been within the change expected over the years. Traffic across the corridor on a north–south axis has increased only at the average rate for orbital type traffic flows in this part of London.

3.110 In the peak periods, traffic on the Relief Road is approaching capacity leaving very little room for further growth during these periods. Prior to the public inquiry, forecasts made certainly underestimated the general growth of traffic in the area, though it recognised that it was not possible, or necessary, to cater for all that much more traffic in a radial direction because of the restraining forces acting on the use of cars for journeys to Central London. This lead to the decision to limit the capacity of the road to that required only to cater for flows which were expected to divert from other routes, with little room for growth. This was in line with the scheme's operational function seen as mainly redistributional. While on one hand there has been little growth in radial movements (no further capacity on the routes inward), on the other, there has been growth, and will continue to be some growth in orbital traffic which is likely to cause some operational problems.

3.111 Reduced travel times through the area are now enjoyed by regular users of the road. Though it has not been possible to quantify the economic benefits in monetary terms, the fact that the road only occasionally becomes congested, indicates that the expected operational and economic benefits have been realised. So far, the Relief Road has not had any significant impact on land uses, but it has the potential, in the long term, for a far reaching economic influence on a much wider scale.

3.112 A significant reduction in accidents has resulted along the radial roads in the area, with indications that this reduction will continue. The reduction in accidents was expected, but an increase in accident severity was also anticipated. The latter has not so far occurred to the extent expected, and substantial savings in the cost of accidents within the corridor were reported in the first year of operation.

3.113 The response to the Questionnaire Survey, which was mounted to determine local people's reaction to the scheme, was disappointingly small and hence the

results have to be interpreted with some caution. With respect to the environmental impact, many more people (46 per cent), responding to the questionnaire survey, reported 'better environmental conditions' as a result of opening the road, than had experienced 'worse environmental conditions' (26 per cent). And of those living within the study area, 80 per cent thought the road has been worthwhile. The proportion was even higher amongst those questioned who lived outside the area, but who regularly travel through it, where 90 per cent thought that building the road has been worthwhile.

3.114 Understandably, the main gains, in environmental terms, were to those living along the old A2 Rochester Way. Other gains have been achieved as a result of the reduction in rat-running, though in this respect the net effect does not seem to have been as comprehensive as expected, despite the introduction of much of the complementary traffic management package that had been planned. It is evident from residual complaints, that though the management measures have been somewhat successful in reducing traffic nuisance in the surrounding area, there is a need for more comprehensive 'traffic calming' measures for the effective maintenance of good environmental conditions. There is also a particular need for more effective control over unwanted commuter parking in residential roads around Eltham Station, and encouragement of the use of the parking area specially provided for 'park and riders'.

3.115 From the evidence presented here, it can be concluded that the Relief Road has met most of its objectives, especially the reduction of the previously prevailing traffic congestion. The road has also delivered most of its promised environmental improvements and has not generated more traffic than might have been expected had it not been built. The Rochester Way Relief Road appears therefore to have been effective in improving the operational and environmental conditions within the study area, and that, as far as we can judge, its construction has certainly been worthwhile.

The following photographs (3.1-3.16) were taken by Mr G P Crow on Thursday 28 June 1990. They form part of the co-authored report 'The Rochester Way Relief Road: An Appraisal of the Operational, Environmental And Economic Impacts'. This report was published in August 1990 as part of the Rees Jeffreys Road Fund initiative 'Transport and Society' Discussion Paper 20.



Plate 3.1 Section of the 1915 Progress Estate, the Conservation Area through which passed the old A2 Dover Road.



Plate 3.2 The 'Banana Bend' on the old A2 Rochester Way as it is today.



Plate 3.3 East Rochester Way. The dual 3-lane continuation of the RWRR towards the M25.



Plate 3.4 The Kidbrooke Intersection, controlled by traffic signals. Traffic on the RWRR on the left hand carriageway is not held up.



Plate 3.5 The RWRR at its intersection with the South Circular Road which passes underneath. The railway is immediately to the right of the Relief Road.

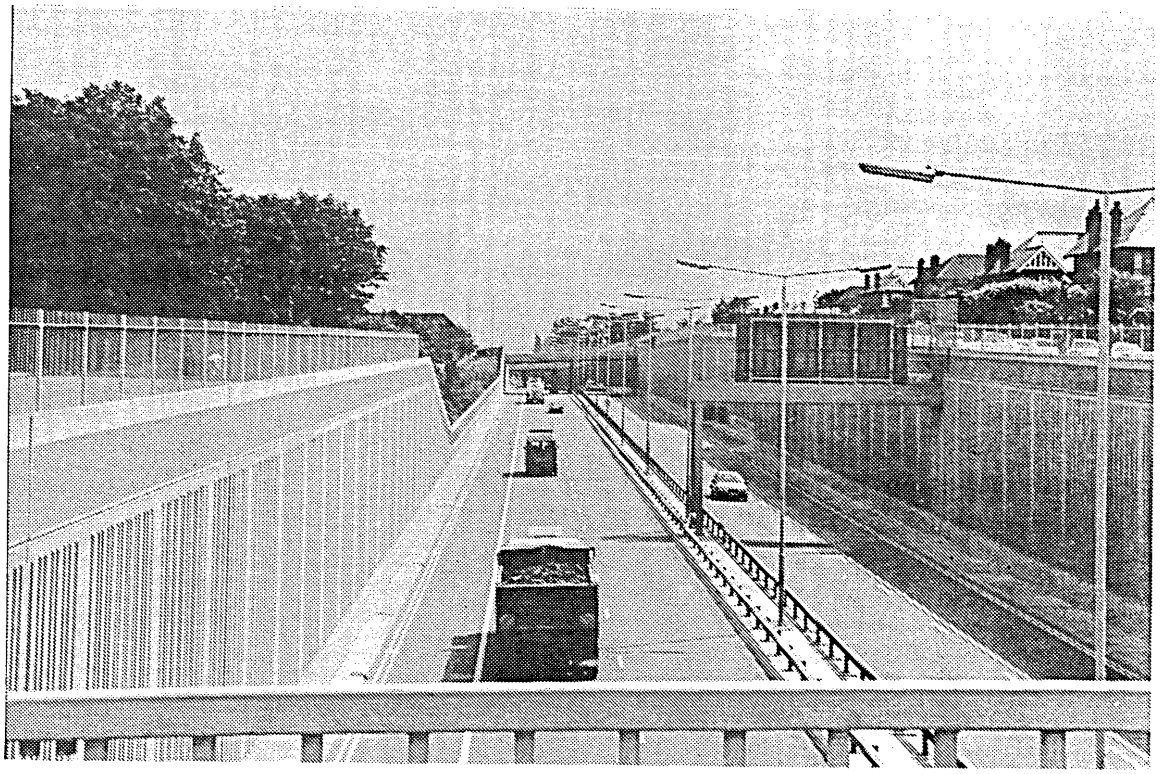


Plate 3.6 RWRR east of Eltham Rail/Bus Interchange, rising up to Falconwood in the distance.

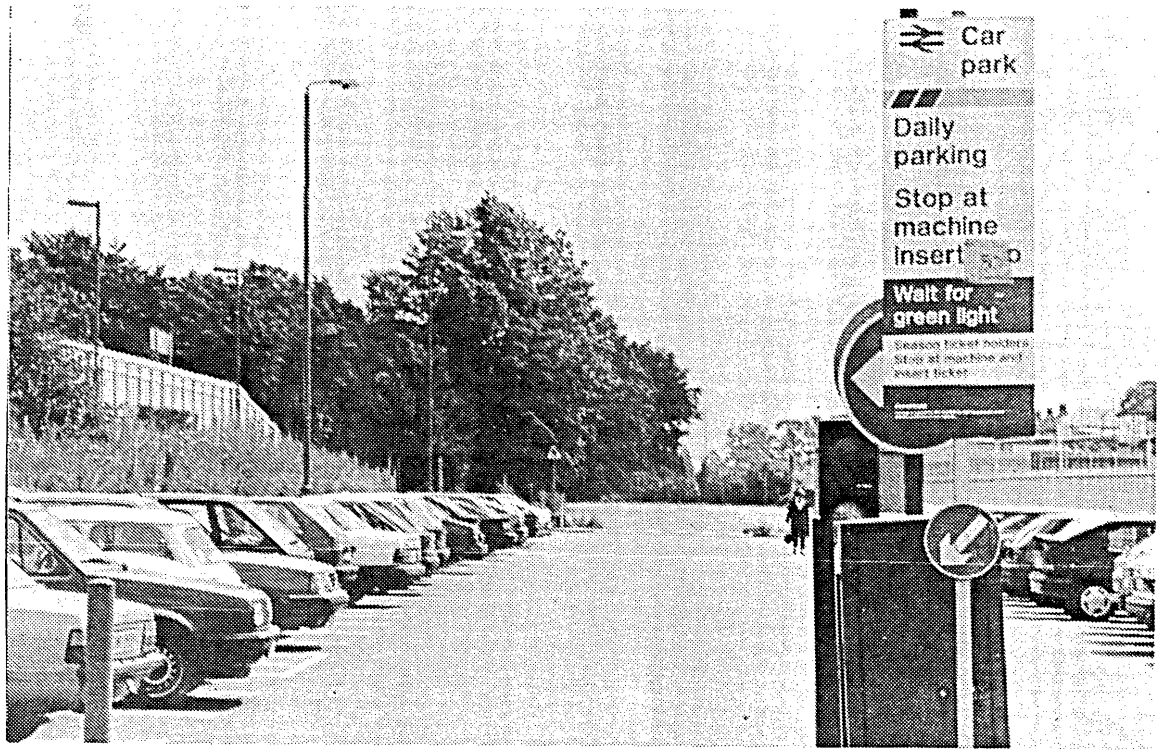


Plate 3.7 The commuter car-park at the new Eltham Station, with the far end completely unused.



Plate 3.8 The artificial cutting, or bund, between the RWRR and Will Crooks Gardens on the left. Planting maturing well, after only one season growth. Vandalism is a problem however.

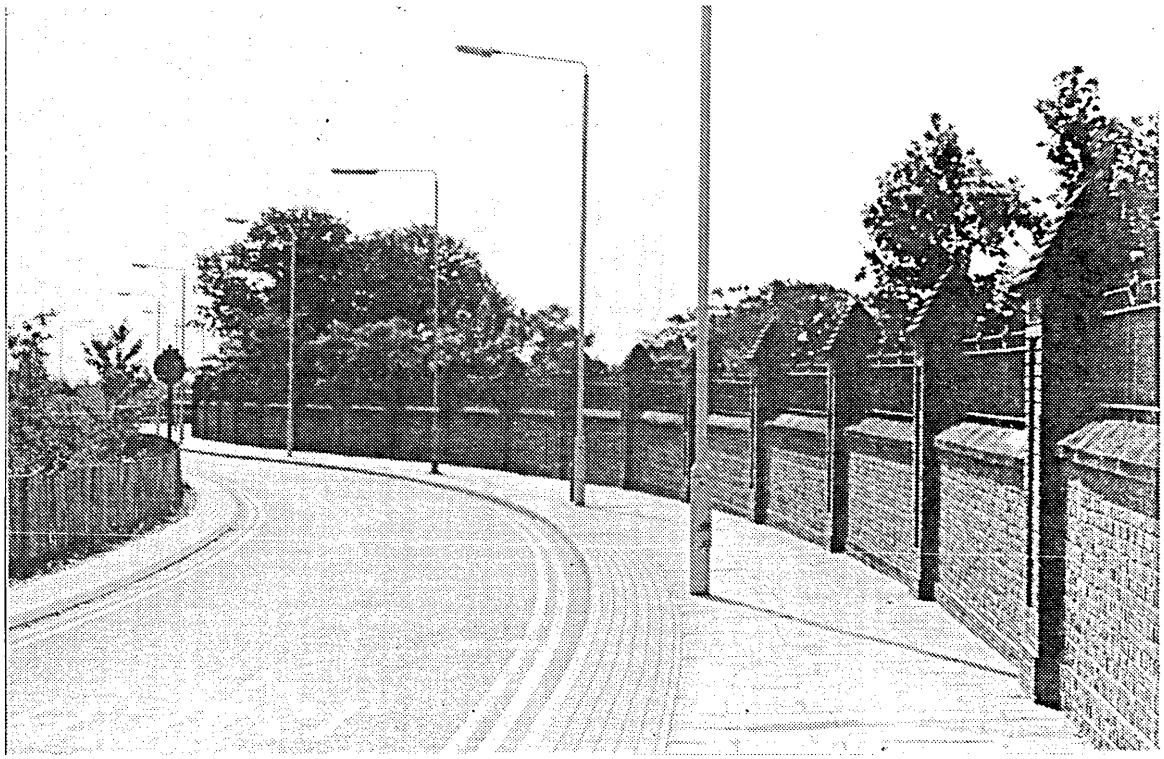


Plate 3.9 The wall of Eltham Cemetery, which was taken down and rebuilt alongside the slip road at Falconwood.



Plate 3.10 The visual clutter of signs under the RWRR where it intersects with the South Circular.

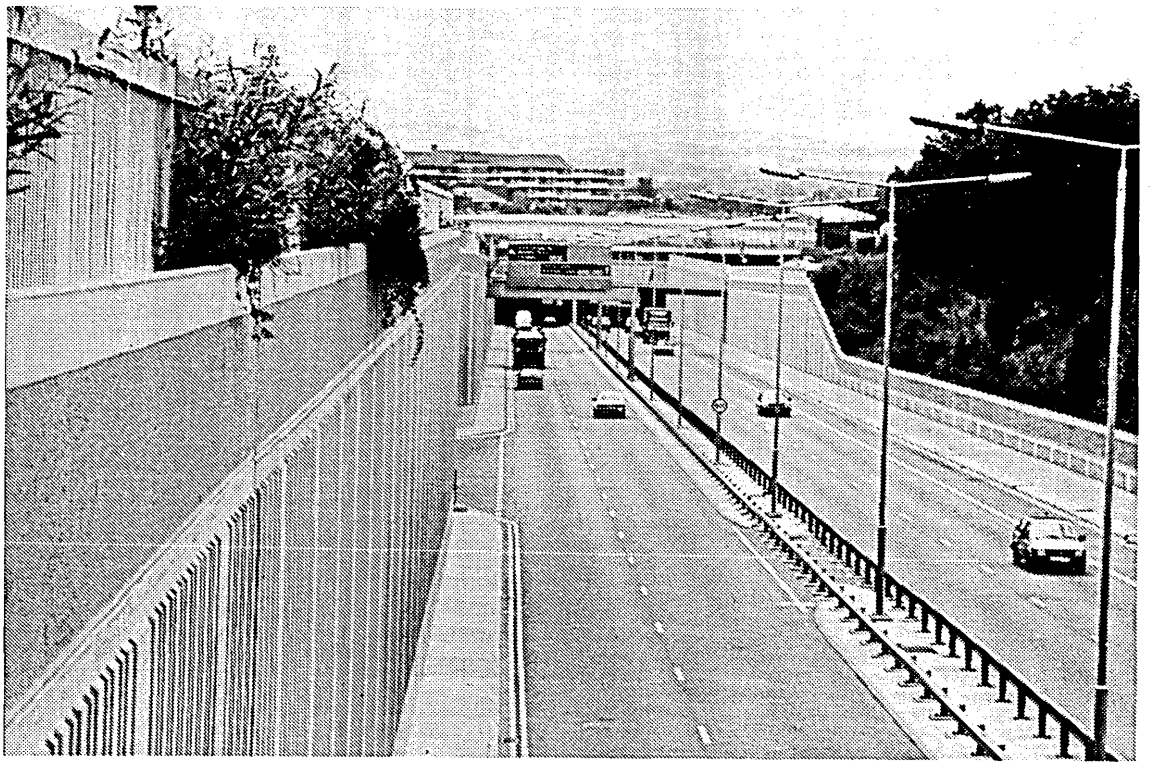


Plate 3.11 The high cutting wall on the south side of the new road as it passes Eltham Park. The Rail/Bus interchange station can be seen built over the road in the middle distance.

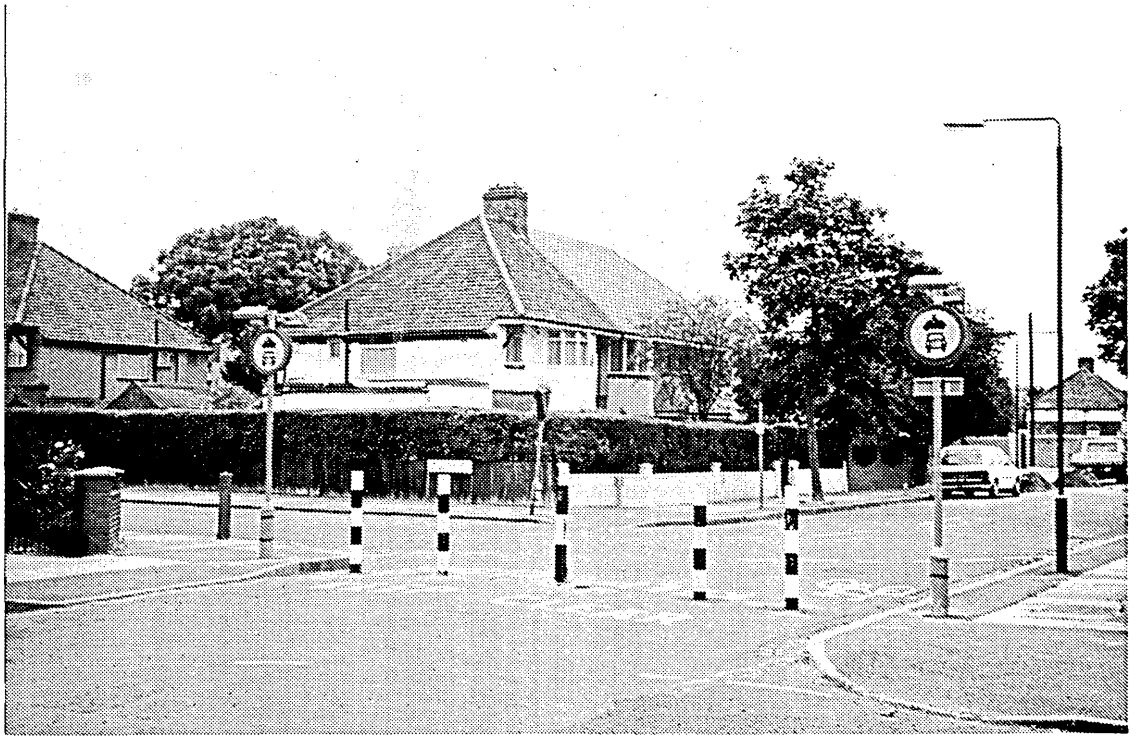


Plate 3.12 Crude form of road closure at the northern end of Woolacombe Road. The RWRR lies beyond the end of the *cul-de-sac* where the vehicles are parked.



Plate 3.13 Width restriction in Kidbrooke Park Road (northern section). The chicane designed to reduce traffic speeds can be seen in the distance.



Plate 3.14 One of the speed humps in Ridgebrook Road, designed to keep down the speed of vehicles.



Plate 3.15 Unwanted commuter parking in Archery Road, near Eltham Station.



Plate 3.16 More commuter parking in Dunvegan Road, near Eltham Station.

CHAPTER 4 CASE STUDIES FROM BRITAIN

A: THE SOUTH DOCKS ROAD SCHEME IN KINGSTON-UPON-HULL

INTRODUCTION

4.1 The Greater Hull urban area comprises the whole of the City of Kingston-upon-Hull, together with the suburban areas within the Borough of Beverley, Cottingham, Willerby, Anlaby, Kirk Ella and Hessle. The total population of the area is approximately 330,000. Hull is located on the banks of the River Humber which together with the River Hull have given the City its importance as a port and a centre for the shipping industry. The near peninsula position of the city has meant that in the past it had relatively poor communications. The completion of the M62, the A63 (dual carriageway), the M18, the M180, the A15 and the Humber Bridge have made the city more accessible (Figure 4.1).

4.2 The local geography and the nature of the built-up area is dominated by the River Humber. The central area is close to the river, and the built-up area extends from this, effectively in the form of a semi-circle. The city is divided by the River Hull with its seven opening road bridges and two rail bridges. The major employment areas are Stoneferry, Wincolmlee, Marfleet, the Docks (off Hedon Road), the area south of Hessle Road and Sutton Fields. The residential areas are mainly on the outskirts. The central shopping and business area includes the Old Town, an area that was largely disused a few years ago but which is now being revitalised.

4.3 The main external road communication to the urban area from the west is via the M62 motorway and the South Docks Road (the new A63 trunk road). Prior to the opening of the South Docks Road, the old A63 trunk road via Boothferry Road, Anlaby Road and Hessle Road (East) was the connection (Figure 4.2). Internally, the road system consists of a pattern of radial routes fanning out from the City Centre. Hessle Road, Anlaby Road, Spring Bank, Beverley Road, Stoneferry Road, Holderness Road and Hedon Road (Figure 4.2) are the main radials. There are limited cross connections between the radial routes but these have been recently improved by the part implementation of an inner ring route (Rawling Way and Mount Pleasant on the east are not complete).

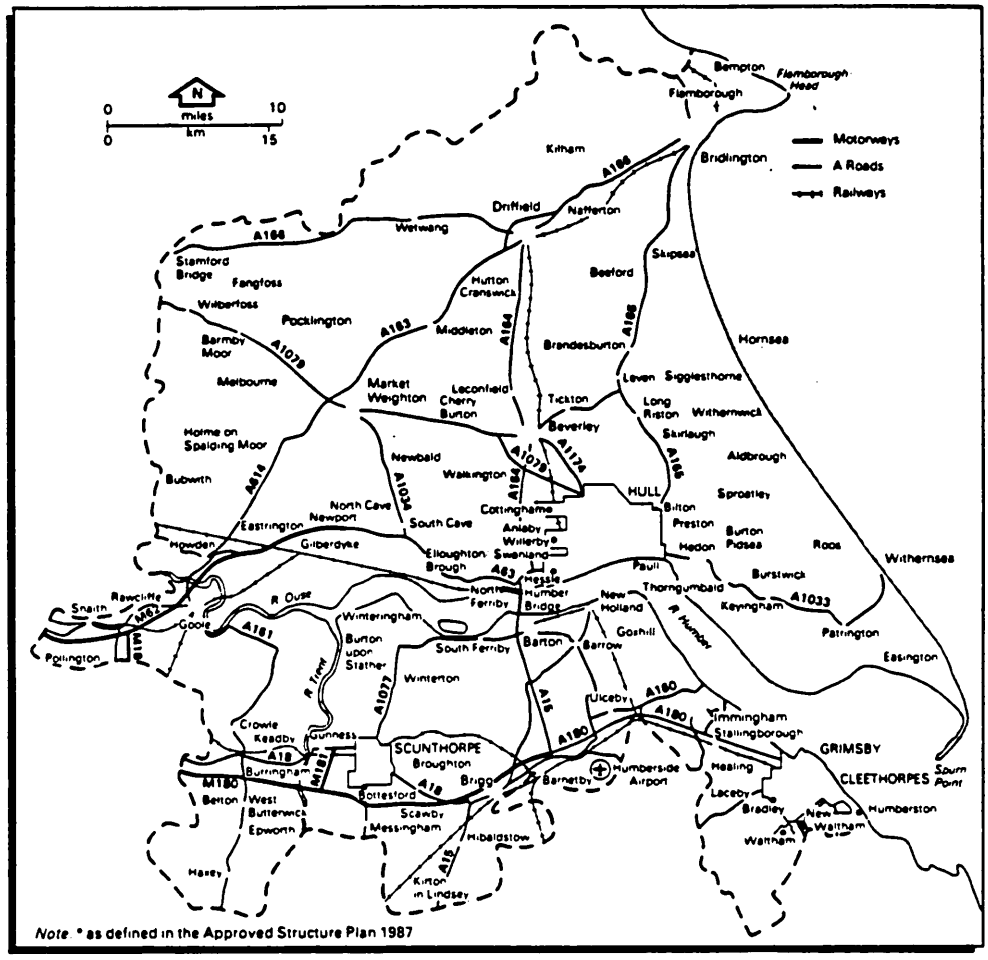


Figure 4.1 **The Motorways and major roads network in Humberside.**

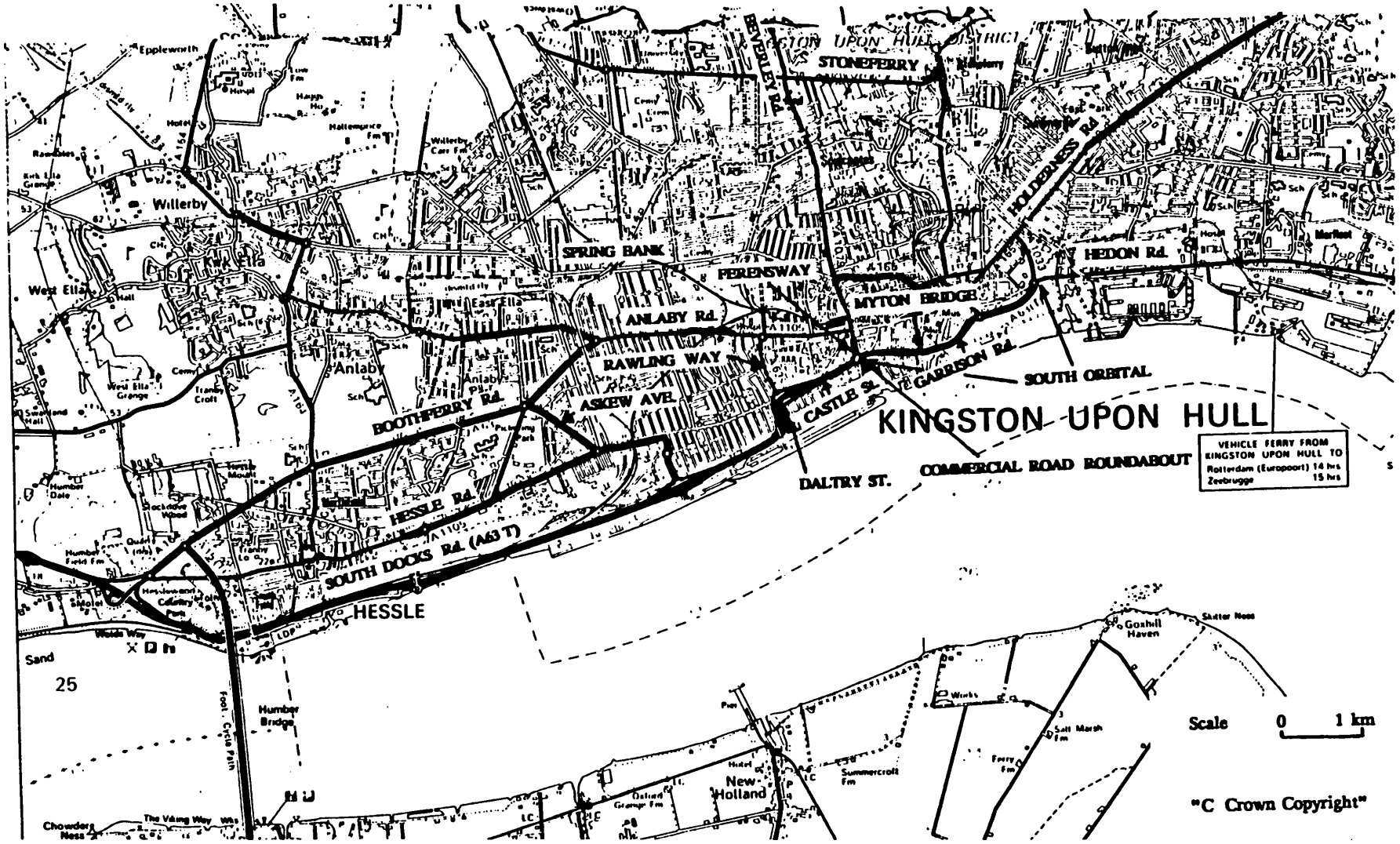


Figure 4.2 **Selected Hull roads including roads directly affected by the South Docks Road.**

BACKGROUND

4.4 The South Docks Road scheme stemmed from a land use and transportation study between 1967 and 1972 for the County Borough of Kingston upon Hull. The main objective of this particular study was to recommend an effective integrated system of land use and transport for the built-up area in and around Hull. Amongst other things, the study concluded that the construction of the South Docks Road would be clearly justified, not only on economic grounds but also on environmental grounds. The Government had also decided to accelerate the improvements of the roads to the Port of Hull as part of policy proposals outlined in the Government's White Paper 'Industrial and Regional Development' (March 1972). This paper included proposals for 'quicker and more comprehensive improvement of strategic routes to ports of special significance for trade with the E.E.C.'. Kingston-upon-Hull was identified as one of these ports.

4.5 The main emphasis of a more recent study (The Hull Transportation Study, 1981)[27] was to reassess the then existing problems (before the new scheme), review policies and establish a policy for major highway improvements. Addressing the problem of road congestion and delay, the study found that this was confined mainly to the radial routes and that 'this affects all road users including cyclists, pedestrians and public transport passengers as well as private and goods vehicles'. It mentioned that in the central area, the main roads were wide enough not to cause congestion of road vehicles, and that the peak hour traffic congestion in the central area was not then considered excessive. The situation was different on the main radial roads network, where 'there is considerable congestion and delay created often but not always, at the major junctions'. This occurred during the peak periods and occasionally during the off-peak. The Study also identified some road sections as having the lowest travel speeds. Of the roads within the western radial corridor, Anlaby Road was identified as being particularly bad.

4.6 The accidents issue on the radial and ring roads was also addressed, because of the large proportion of total travel that takes place on these roads. The problem was judged to be 'significant', for though these roads comprised only 8 per cent of the total road network in the Study area, approximately 24 per cent of the total road traffic casualties occurred on them.

4.7 The formal announcement of the scheme was made by the Parliamentary Under Secretary of State for the Environment in August 1972. Preliminary planning and route alignment studies for the South Docks Road were commenced in Spring 1973.

County Council Policies For Road Improvements

4.8 These policies are not directly relevant to the implementation of the South Docks Road since it is a Department of Transport Road. However, it is felt that reviewing the Council's policies regarding roads can be useful towards a better understanding of certain issues which may arise later. The County Council has certain policies which guide the improvement of its roads. The policies are contained in the Structure Plan. A great emphasis is given to the encouragement of economic activity and the creation of new jobs. There are 21 policies relating to transport facilities in Humberside. The most important of which is the one quoted as follows[28]:

> 'Road improvements will be made and new roads built where they help to:
>
> a) improve industrial and commercial accessibility and promote employment;
>
> b) shorten journey time and relieve congestion;
>
> c) reduce environmental conflict and damage;
>
> d) reduce accidents;
>
> e) open up land required for agreed development proposals.
>
> On routes between towns priority will be given to road schemes on the most important routes.....'.

Where a new road or route improvement is needed, the County Councils policy includes making provision for public transport, and to ensure optimum ease and safety of movement for pedestrians, cyclists and the disabled.

4.9 These policies are implemented through the Highway Capital Programme which contains schemes for major projects (over £1.0 M), and minor projects (under £1.0 M). In addition to these, the Council endorses some District Council schemes compatible with the County Council's policies. The Council has many schemes to

implement and these, generally, include commitments from its Urban Transportation Studies. Major schemes are more in Regional competition, therefore, the ability to implement them depends on their value for the money and regional merit[28].

THE SOUTH DOCKS ROAD

Brief Description

4.10 The South Docks Road (now named Clive Sullivan Way after the famous Rugby League star) extends over a distance of approximately 9.45 Km (6 miles). Its route starts at the eastern end of the North Ferriby By-pass and runs along the foreshore of the River Humber, before joining the dual carriageway section of Hessle Road east of Daltry Street in Hull (Figure 4.2). The South Docks Road now provides an alternative route for trunk road traffic to the centre and east of Hull, and a direct route to the Docks from the M62/A63 enabling heavy commercial and other traffic to by-pass residential and shopping areas to the west of the City Centre. The South Docks road is constructed as an all-purpose dual two-lane carriageway, with access limited to four grade-separated interchanges.

4.11 Complementary roadworks schemes to connect the South Docks Road with the docks, and provide a southern peripheral road system (the 'South Orbital') bypassing the city centre have also been completed by the Department of Transport (Humberside County Council built it on a 100 per cent grant then it was trunked). These schemes have included the widening and improvement of sections of the existing roads to the docks (e.g. Castle Street) and more notably the construction of Myton Bridge over the River Hull and Garrison Road which was opened in 1980 (Figure 4.2). The 1972 Land Use/Transportation Study (with traffic forecasts for 1982) stated that, the bridge 'will ensure that virtually all traffic to and from the Eastern Docks and much of East Hull will bypass the City Centre to the south and be directed along Hessle Road'[29].

4.12 A number of other schemes have also been completed, for example the Northern Orbital which is already providing major benefits for through traffic by avoiding the main shopping streets[28]. The scheme is part of the orbital box which also contains the Southern Orbital (Castle Street and Garrison Road), the western leg, namely Ferensway (recently duelled throughout its length), and the eastern leg or Great Union Street which is to be widened to a dual carriageway in the next two years.

The orbital box is a concept to allow all through traffic to bypass the city centre and allow pedestrianisation. 75 per cent of this is almost completed.

4.13 The environmental advantages of this have been very significant, and are displayed in extensive pedestrianisation of the city centre and the removal of extraneous traffic from the centre. With the pedestrianisation of these city centre roads, the traffic which was removed off these roads, together with the South Docks Road traffic, make Castle Street the busiest in Humberside (Figure 4.2). A scheme to widen this road to a 3 lane dual carriageway and grade separation is being considered to relieve the bottle neck created at that junction. The Department of Transport is negotiating with the Department of the Environment which has provided £17.0 million for the development of a housing project in the area. Part of this land is needed for the improvement of Castle Street.

Objectives of The South Docks Road Scheme

4.14 The stated objectives of the South Docks Road Scheme (as outlined in the Inspector's Report[29]) were as follows:

- 'To improve the environment of areas along the main routes from the West to the Docks and City Centre of Kingston-upon-Hull by transferring the through traffic, particularly the heavy commercial vehicles, on to a new road designed to carry it safely'. In reference to the second phase of the Hull Transport Study, the Inspector's Report states that there would be environmental advantages particularly from the diversion of heavy goods traffic from Hessle Road and Anlaby Road.

- 'To relieve traffic congestion on some of the network roads. The principal traffic routes which would be relieved by the South Docks Road were Boothferry Road/Anlaby Road, Hessle Road and Askew Avenue' (Figure 4.2). The same report in reference to the report published in 1969, on the first phase of the Hull Transportation Study, stated that the South Docks Road would provide a fast and direct route for traffic to the Central Area and to the Dock Areas and that, in consequence, the existing roads in the western corridor, Hessle Road, Boothferry Road, and Anlaby Road would be relieved of much through traffic. Such a reduction in traffic levels was deemed necessary to reduce traffic congestion and improve safety[27].

- 'To improve Safety and reduce accidents. Personal injury accident statistics for the period 1975 to 1977 reveal accident rates per million vehicle kilometres of approximately 0.6 on Boothferry Road, 2.6 on Anlaby Road, 1.5 on Hessle Road between Ferriby Bypass and Askew Avenue and 3.2 between Askew Avenue and Daltry Street and 1.7 on Askew Avenue'. The National Average for Personal Injury in built-up areas for that period was 1.52. The accident experience which is clearly more than twice the National Average on some of the sections constituted a serious problem that had to be dealt with effectively to reduce such high levels of injury accidents. Other accidents (non-injury) are not reported.

4.15 Various reasons for building the road were also given in the Inspector's Report and other reports, including:

- There would be economic advantages from the construction of the South Docks Road with either of two alternative major road schemes (the Intermediate Ring Road, and the Northern Bypass. These advantages were expected from the improved accessibility to the Docks area and the developments that would be associated with it, in addition to improved accessibility to the Port and therefore improved port activity.

- The South Docks Road will enhance the benefits of the South Orbital (Figure 4.2), which together with Rawling Way (also opened in December 1980), will enable all east-west through traffic to avoid the City Centre therefore making it possible to reduce flows on many city centre streets to between one half and one third of their former level[27].

4.16 Summing it all up, the Consultant/Contractor Report (a joint publication between the consultants, the Department of Transport and the contractor) viewed the objectives as follows[30] : 'The South Docks Road provides an alternative route for trunk road traffic to the centre and east of Hull, and a direct route to the docks from the M62/A63 enabling heavy commercial and other traffic to by-pass residential and shopping areas to the west of the city centre. The new road provides substantial relief to the original trunk road route giving the opportunity for enhancement of the environment, improved living conditions for local residents, reduced congestion and greater safety for local motorists and pedestrians'.

4.17 The objectives stated above can clearly be classified under four main groups:

a) Traffic advantages: reduced traffic congestion, improved travel speeds.

b) Environmental gains: diverting heavy vehicles from residential areas, improving living conditions for residents with less noise, fumes and vibration, pedestrianisation and fewer vehicles in the city centre.

c) Economic development: resulting from improved accessibility to the Docks area and to the Port.

d) Reduction in accidents: in particular improvements in safety for local motorists and pedestrians where accident levels on some of the primary sections of the network were higher than the National Average.

THE SITUATION 'BEFORE'[29]

4.18 Prior to the implementation of the South Docks Road, there had been a number of other improvements in the regional road network. The M62 Lancashire–Yorkshire Motorway was completed in May 1976 but ends at North Cave, 14 miles to the west of Hull (Figure 4.1). From here on the route into Hull continued as a high grade dual carriageway trunk road, the A63(T) carrying fast and heavy traffic, much of it destined for the docks and industrial areas on the eastern side of the City. At the time of the Public Inquiry into the South Docks Road, the Humber Bridge was still under construction, eventually to be connected to the A63(T) in 1985.

4.19 The main roads on the west side of Kingston–upon–Hull, serving the centre and linking the main bridges across the River Hull, were the A63 trunk road (Boothferry Road and Anlaby Road) and the A1105 (Ferriby Road, Prestongate, Hull Road and Hessle Road). The A1105 joins the A63 at Humberfield Quarry immediately to the west of the Humber Bridge. Askew Avenue formed a link between the A63(T) and the A1105, enabling traffic to reach the docks area whilst avoiding the length of the A1105 which passes through the centre of Hessle (Figure 4.2).

4.20 The Boothferry Road section (of A63(T)) is a dual carriageway road of generally good alignment and visibility but there is frontage development over the major part of its length which is predominantly residential in character. There are also

schools, and some shopping and other commercial uses. The road has 19 junctions and 225 vehicular accesses. The two-way traffic flow was measured in 1978 as approximately 22,000 vehicles per 16-hour day including 5,000 heavy goods vehicles. There was a 40 miles per hour speed limit over most of its length (which remains today).

4.21 The A63(T) continued as Anlaby Road which is a single carriageway except for the part formed by a dual carriageway flyover crossing over the Kingston-upon-Hull to Doncaster Railway Line. The frontage is fully developed, with a mixture of residential, shopping and commercial uses. There are 33 junctions and 37 vehicular accesses. It carried 28,000 vehicles per 16-hour day including 4,000 heavy goods vehicles, and was subject to a 30 mph speed limit.

4.22 The alternative route into Hull from the west, the A1105 (which included Hessle Road) had varying widths and visibility standards with considerable residential and shopping development. It has 66 junctions and 167 vehicular accesses. Traffic flows varied between 10,000 vehicles per day (including 500 HGV's) at the western end and 19,000 vehicles (including 2,700 HGV's) at the eastern end (to the east of the Askew Avenue Link). This traffic was subject to a 30 mph speed limit over most of its length. Askew Avenue is a dual carriageway road which gave inward trunk road traffic an opportunity to switch from A63 to A1105. It has mainly residential frontage development, with 8 junctions and 41 vehicular accesses and is subject to a 40 mph speed limit.

4.23 All these existing routes had, and still have, a considerable number of bus stops, vehicular crossings of the central reserve and pedestrian crossings, all adding to the problem of pedestrian and vehicle movement. The roads formed a strategic part of the local network and, in addition to catering for regional traffic, served as local traffic distributors. The large number of vehicular accesses and junctions of low capacity impeded free vehicular flow and resulted in traffic conflict and a situation which was unsafe for pedestrians and vehicles.

4.24 Traffic flows on these roads were heavy throughout the day and included a high proportion of heavy long distance traffic. There was congestion at peak periods on the A63, Anlaby Road, and the A1105, Hessle Road, east of Askew Avenue. The situation, as described in the Inspector's Report, was such that 'the heavy traffic created a hazard and environmental nuisance at the shopping centre of Hessle

Square, Gipsyville and the shopping area lying between Bean Street and Hawthorn Avenue; problems were aggravated by the need for kerbside servicing of the shops'[29].

4.25 The opening of the South Docks Road brought about few changes. It has allowed for more car parking spaces on Hessle Road. This is currently underway and is done by extending the sidewalks and making parking bays. An improvement scheme to widen Anlaby Road was recently dropped[31] . It must be noted that no real restrictions or other traffic management techniques were deployed to prevent traffic from going back on these roads, this is mainly due to local pressure against limited accessibility.

Traffic Forecasts

4.26 The forecasts of the original Transportation Study indicated that about 50 per cent of the traffic on the original trunk road route (Boothferry Road/Askew Avenue/Hessle Road), and about 25 per cent on Anlaby Road would be transferred to the South Docks Road. It was expected that during the first year of opening, the daily volume of traffic on the heaviest section of the new road would exceed 40,000 vehicles per day[30]. The traffic model predictions are shown in Figures 4.3 and 4.4. From the figures, it can be seen that a significant relief was expected on the original trunk road which would have carried traffic flows beyond its capacity had the new road not been built[30].

4.27 The daily traffic flows forecast for the South docks Road itself for the year 1982 (which was to be the opening year) and the design year 1997 are shown, by section, in Table 4.1. The 1988-89 TPP reports a total daily traffic flow of 36,000 vehicles (for a 24 hour day) on the South Docks Road[28]. The forecast extent of the traffic relief on the roads discussed earlier (Boothferry Road, Anlaby Road, Askew Avenue and Hessle Road) is presented in Table 4.2, and corresponding Figures 4.5 and 4.6 which show the forecast daily traffic flows both without and with the South Docks Road. From the Tables, and figures it can be seen that the road was needed to provide much needed relief from traffic for the main Hull roads which passed through built up and residential areas.

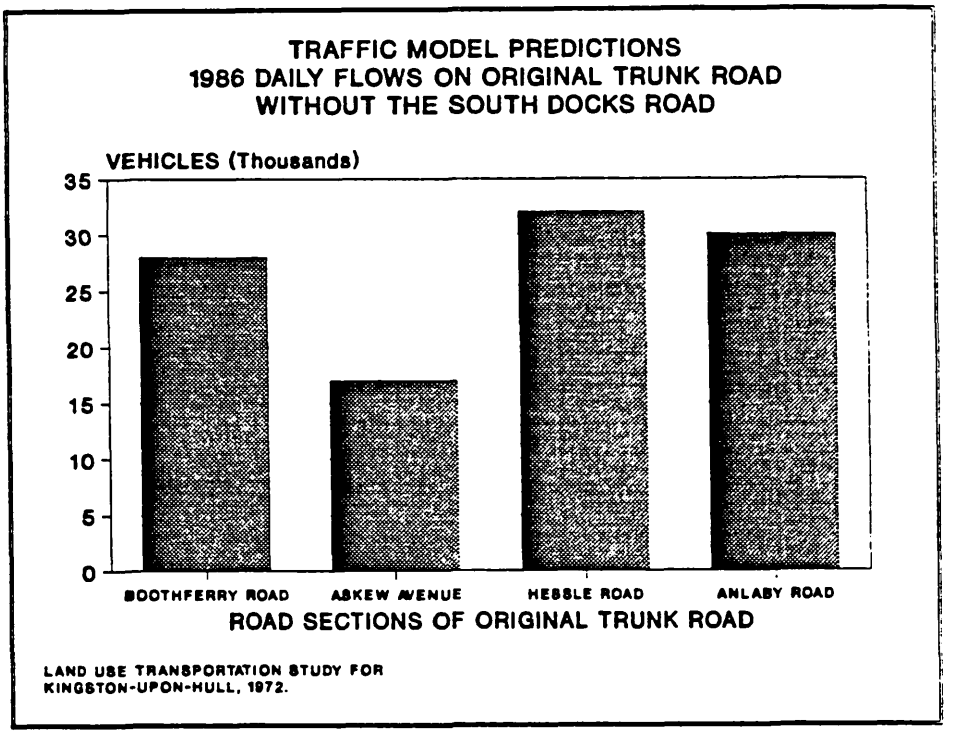


Figure 4.3 The Hull Transportation Study traffic model predictions for 1986 daily flows on the orignial trunk road without the South Docks Road.

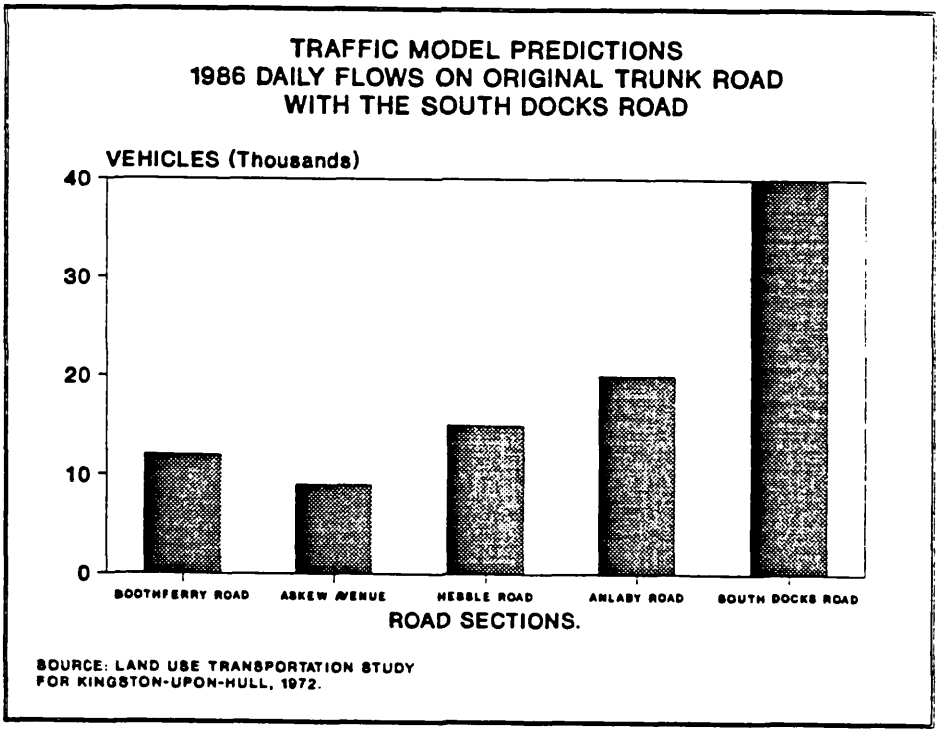


Figure 4.4 The Hull Transportation Study traffic model predictions for 1986 daily flows on the orignial trunk road with the South Docks Road.

Road Section	1982	1997
Boothferry Road to Hessle Interchange	22,000	29,000
Hessle Interchange to Brighton street	30,000	41,000
Brighton Street to Daltry Street	43,000	59,000
Hessle Link Road	11,000	15,000
Brighton Street Link Road	16,000	21,000

Table 4.1 Daily traffic flow (A.A.D.T.) on the South Docks Road as forecasted by the traffic model for 1982 and 1997.

Road Section	Without South Docks Road		With South Docks Road	
	1982	1997	1982	1997
Boothferry Road	28,000	33,000	12,000	11,000
Anlaby Road	30,000	39,000	20,000	27,000
Hessle Road (inner)	14,000	18,000	3,000	5,000
Hessle Road (outer)	32,000	44,000	15,000	21,000
Askew Avenue	17,000	23,000	9,000	12,000

Table 4.2 Daily traffic flow (A.A.D.T.) on selected Hull roads as forecasted by the traffic model for 1982 and 1997.

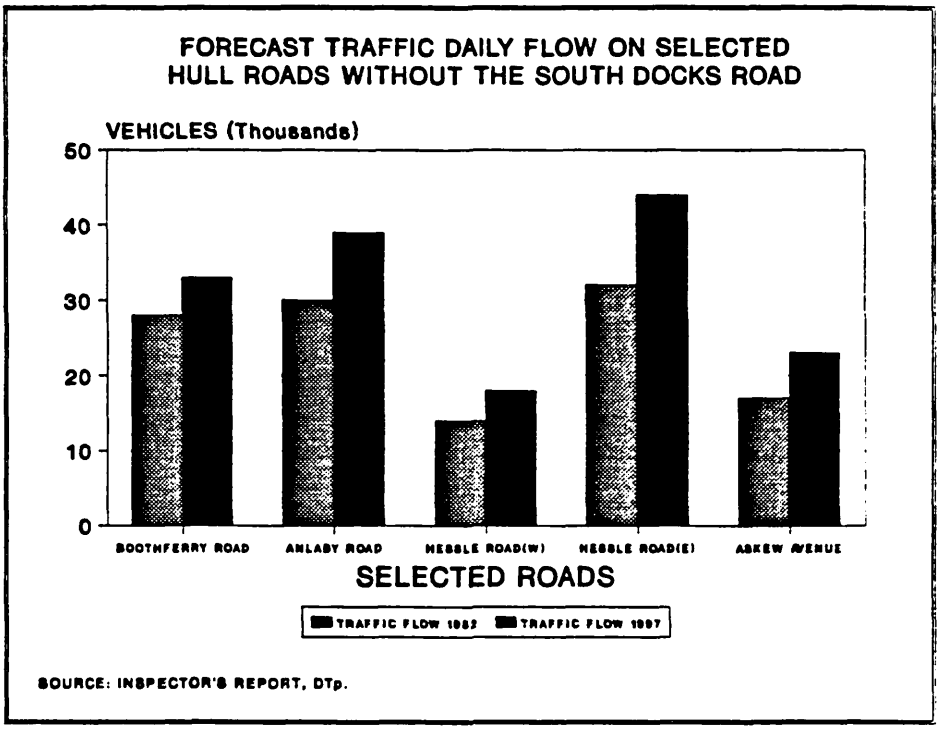


Figure 4.5 The forecast of daily traffic flow on selected Hull Roads without the South Docks Road.

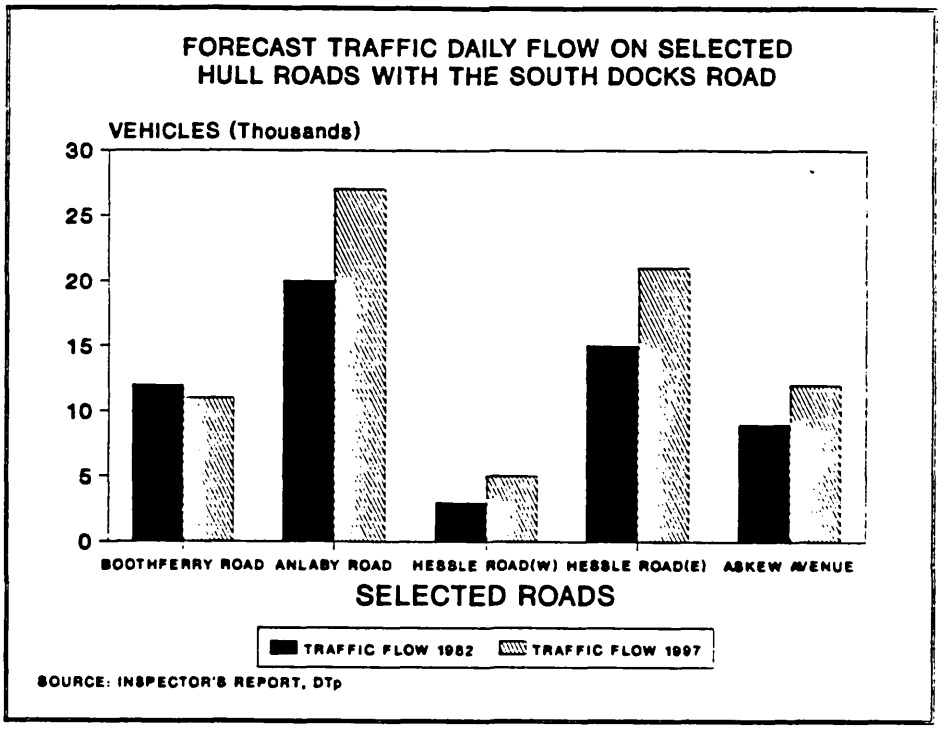


Figure 4.6 The forecast of daily traffic flow on selected Hull Roads with the South Docks Road.

THE SITUATION 'AFTER'

4.28 Regular counting has been carried out in Hull since 1979 (6 years prior to the opening of the South Docks Road). The counting is done at locations which form two screenlines/cordons within the city: the Low Level Railway and the River Hull (Figure 4.7). The counts are carried out yearly and generally during June or July for each of the screenlines (each screenline being surveyed every other year). Thus the counts available are for each screenline at 2 yearly intervals. The counts have generally been carried out over a 12 hour day, although some of the earlier ones were 16 hour counts. All counts have been converted to A.A.D.T. figures using factors derived from the original transportation study. Traffic flow data for both screenlines (Low Level Railway and River Hull), before and after the opening of South Docks Road, are shown in Tables 4.3 and 4.4 respectively. The overall annual growth rates of traffic across the two screenlines since 1974 were 2.4 and 2.5 per cent per annum respectively. When taking into account the effects of maintenance/construction, this overall growth rate was reasonably constant for all routes over the period up to 1984/1985 whereas there appears to have been significantly higher growth since that time (Table 4.5). From this table it can be seen that the growth rate on both screenlines was coniderably higher after the opening of the road than that before. This indicates a trend of increased traffic across the screenlines in the Hull area, and this increase appears to be associated with the new road.

4.29 This period (1985 onwards) corresponds with the opening of the South Docks Road, and this trend, it is said, 'may well be attributable to extra traffic generated by the extra highway capacity now available'[32]. However, this phenomenon is seen as only 'a very short term one'[32]. This is consistent with a national trend of growing traffic even where no new roads have been built. It remains to be seen whether this higher growth rate will be continued or whether the previous levels of growth will return once traffic has settled (results of further surveys will soon be available). It must also be noted that some variation in traffic volume between months was observed on commuter routes leading to Hull. A correction factor was used to convert the pre '86 months flow to the month of the '86 survey.

4.30 From Table 4.3, it is possible to consider just the immediate corridor of the South Docks Road, namely that containing Anlaby Road and Hessle Road. The

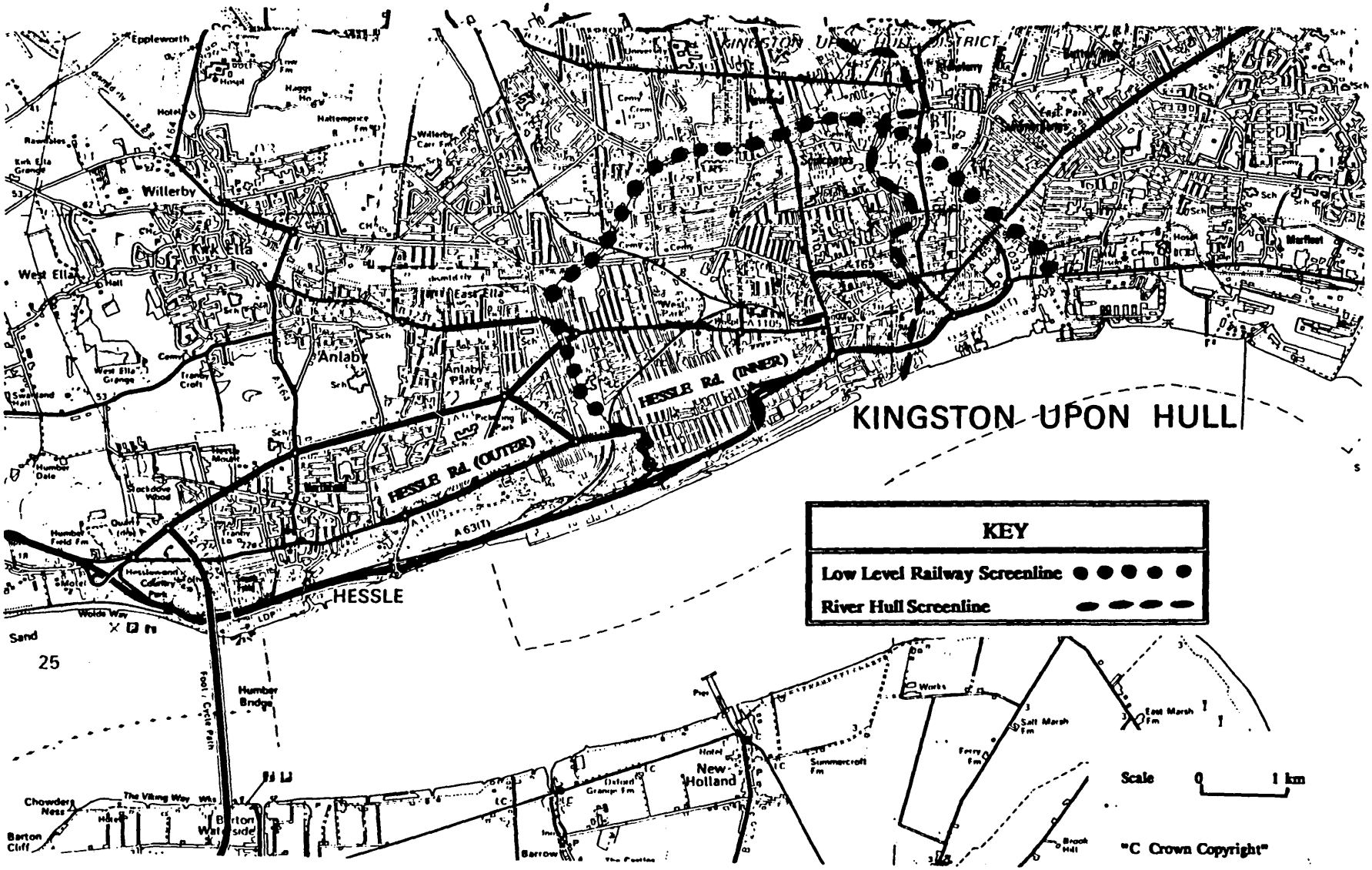


Figure 4.7 The Low Level Railway and the River Hull screenlines in Kingston-upon-Hull.

Count Point	Year of Count					
	1974	1979	1981	1983	1985	1987
Hedon Road	24,685	28,281	30,481	32,823	30,604	37,639
Holderness Road	22,090	23,830	24,169	21,802	20,022	21,696
Danson Lane	10,984	13,053	14,671	12,890	13,589	16,055
Stoneferry Road	14,500	16,953	18,113	16,206	188,870	20,318
Wincolmlee	7,557	8,743	9,284	8,822	8,482	10,594
Beverley Road	21,950	25,254	23,682	24,010	23,591	25,602
Spring Bank	28,238	32,083	32,058	32,256	32,530	36,170
Anlaby Road	26,916	26,716	32,968	33,841	34,379	28,275
Hessle Road	19,195	22,881	25,320	12,225	28,262	17,486
Jackson Street	2,881	5,548	6,9313	16,873	2,037	-
South Docks Road	-	-	-	-	-	38,093
TOTAL	185,957	203,342	217,677	211,748	212,366	251,928

Table 4.3 Traffic flow (A.A.D.T.) on the Low-Level Screen Line streets (1974-1987).

Count Point	Year of Count						
	1974	1977	1979	1980	1982	1984	1986
Sutton Road Bridge	22,125	21,819	20,150	22,685	23,137	24,926	27,720
Stoneferry Bridge	20,355	23,931	21,805	21,427	24,674	27,017	29,172
Sculcoates Bridge	8,613	10,852	-	12,694	11,733	-	9,962
Scott Street Bridge	4,144	-	12,427	3,891	38,24	7,737	5,064
North Bridge	27,528	32,870	27,517	28,050	22,348	27,844	25,747
Drypool Bridge	25,997	23,326	27,752	30,522	13,744	13,890	13,509
Myton Bridge	-	-	-	-	21,670	22,253	35,016
TOTAL	108,762	112,798	109,651	119,269	121,130	123,667	146,187

Table 4.4 Traffic flow (A.A.D.T.) on the River Hull Screen Line streets (1974-1986).

Screen Line	Growth Rate (% per annum)	
River Hull	1974/1984	1984/1986
	1.3	8.7
Low Level Railway	1974/1985	1985/1987
	1.2	8.9

Table 4.5 Annual growth rate across the two screen lines in Hull, 'before' and 'after' the South Docks Road.

annual growth rate on this corridor between 1974 and 1985 was approximately 3.0 per cent which is larger than the overall growth rate for the whole of the screenline (2.4 per cent). After the opening of the new road, and between 1985 and 1987, the growth rate for the new road corridor was around 16 per cent. This is considerably higher than the 8.9 per cent per annum growth rate for the whole screenline in the same period. Clearly, the new road has played a major role in the increase in traffic flows, however, it is important to define this increase and to see whether it has generated much more traffic which in turn has lead to worsened conditions.

4.31 The road was opened on November 1st, 1985. 'It provided a fast and direct route from the west side of the city to the City Centre shopping and business areas. It completed the A63 route from the M62 to the docks and southern industrial sites. Prior to the completion of the new route, commuter and heavy goods traffic from the west had to use roads which for the greater part of their length passed through residential areas and congested shopping streets'[32]. During 1986 (soon after the opening of the road), traffic surveys were carried out at selected sites to assess the amount of relief that the old western radial roads had received due to the completion of the new road. The Technical Services Department in Humberside Council carried out a survey to assess the reduction in traffic volume on the western radial routes due to the opening of the South Docks Road. A problem encountered was that throughout the construction period of the road, associated traffic diversions, road closures and route switching affected the established traffic flows on all the major roads west of Ferensway (Figure 4.2). In order to overcome this problem, where appropriate, traffic flows from years well preceding the opening date were used, by the Council, for comparative purposes, i.e. undisturbed traffic flows represented by those of the year 1981 and earlier. In other words, by comparing estimates with 'growthed up' present day figures. This was necessary, as explained, due to the many disturbances of the traffic patterns. The results of this survey are presented in Table 4.6. In this table, flows on the major western routes directly relieved by the new road, 'before' and 'after' the opening of the new road are compared to give the difference in total vehicle and HGV flow expressed as a percentage of the pre-opening figure. The count points are shown in Figure 4.8. It must be noted that due to the lack of consistent data, traffic flows have been compared with corresponding flows in different years for the different sections depending on the availability of the data.

Site No.	Location	Date	Total Vehicles	Diff (%)	HGV& Buses	Diff(%)	HGV Only	Diff (%)
1	A15 [ex A63 T] west of Humber Bridge Roundabout	6/84 7/86	18,455 11,680	-37.0%	4,244 1,869	-56.0%	N/A	
2	A164 [ex A63 T] Boothferry Road east of Humber Bridge Roundabout	9/85 7/86	26,615 11,730	-56.0%	5,323 1,407	-73.0%	N/A	
3	A1105 [ex A63] Anlaby Road west of Hawthorn Avenue	5/83 10/86	21,910 20,440	-6.5%	2,629 1,635	-38.0%	2,030 1,035	-49.0%
4	A1105 [ex A63] Anlaby Road west of Walton Street	11/83 11/86	21,160 16,200	-23.5%	2,539 1,620	-36.0%	1,940 1,020	-47.0%
5	A1105 [ex A63] Anlaby Road east of Walton Street	11/83 11/86	24,000 18,460	-23.0%	2,640 1,661	-37.0%	2,040 1,060	-48.0%
6	[Ex A1105] Hull Road east of Northolme Road	12/84 5/86	9,570 8,800	-8.0%	574 440	-23.0%	N/A	
7	[Ex A1105] Hull Road at Hessle Police Station	9/85 5/86	13,840 8,610	-38.0%	969 775	-20%	N/A	
8	[Ex A1105] Hessle Road west of Boulevard	6/81 6/86	18,320 10,230	-44.0%	3,664 1,023	-72.0%	3,460 820	-76.0%
9	[Ex A1105] Hessle Road west of Rawling Way	7/85 5/86	20,760 12,550	-39.5%	3,944 1,631	-58.5	3,740 1,430	-61.0%
10	[Ex A1166] Askew Ave at Midway Grove	7/84 10/86	10,700 4,950	-51.0%	2,618 445	-83.0%	2,550 375	-85.0%
11	Spring Bank West at Level Crossing	3/83 11/86	19,230 19,800	+3.0%	1,346 1,386	+3.0%	N/A	
12	A63T. Myton Bridge	9/85 6/86	23,700 25,050	+5.5%	4,029 4,509	+12.0%	N/A	

Table 4.6 **Comparison of traffic flows on road sections directly affected by the South Docks Road 'before' and 'after' the opening of the road.**

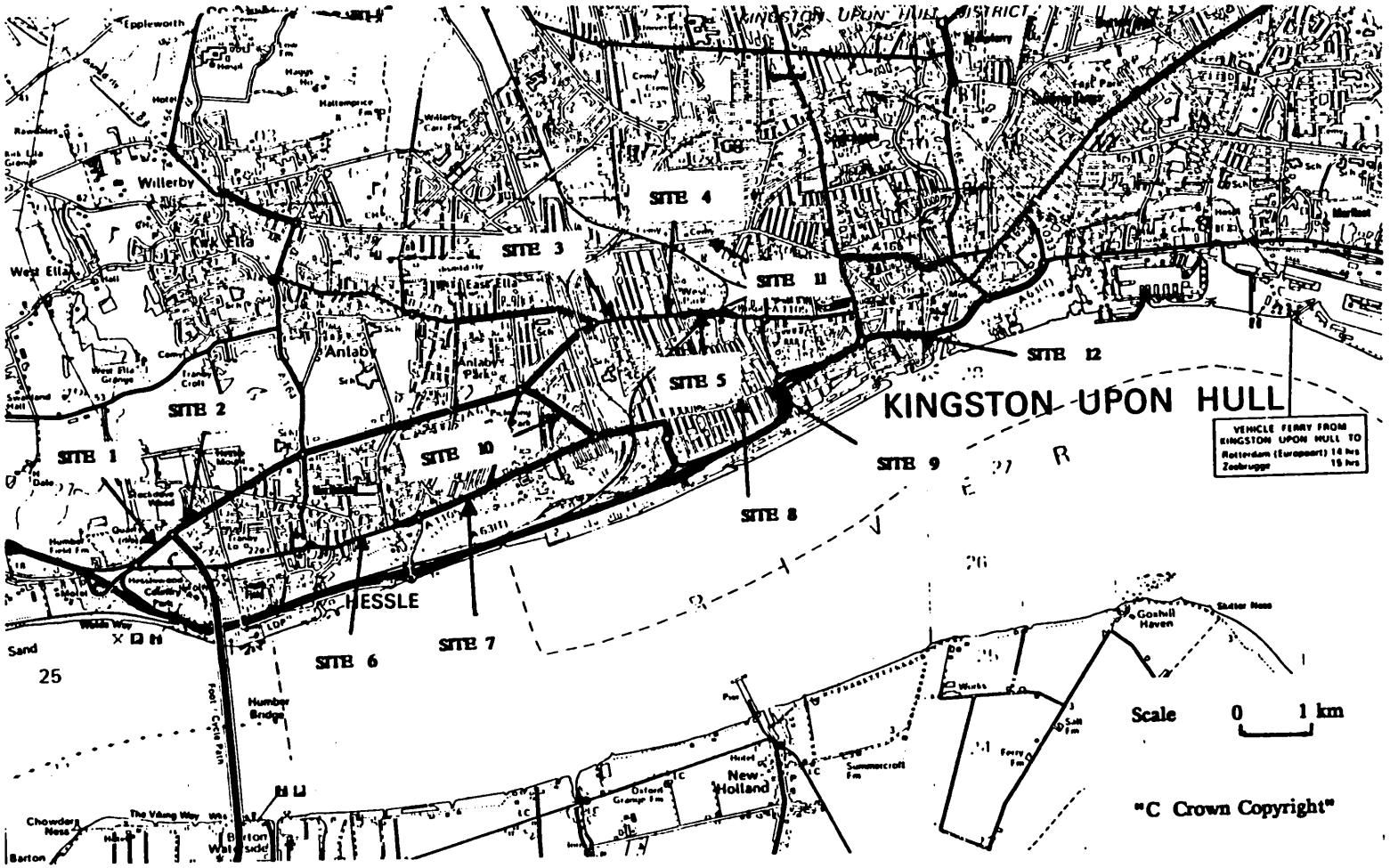


Figure 4.8 **The location of count sites used in the 'after' survey to assess the traffic impact of the South Docks Road.**

4.32 From the Table (Table 4.6), it can be seen that, as expected, the new road has afforded considerable relief to the previously congested western radials of the city. Most benefit has been experienced on the closest parallel route formed by Askew Avenue and Hessle Road with a reduction in overall traffic volumes of 51 per cent and 40 per cent respectively. The drop on this route of HGVvolumes has been even more dramatic both in terms of numbers and environmentally. This was especially noticeable on Askew Avenue which has now reverted to being a local distributor road (relatively quiet). On the Hessle Road and Anlaby Road routes 'the perceived value of the reductions (by the road inhabitants) is perhaps even greater than the numbers indicate'[33]. This is partly because the numbers representing the HGV totals include service buses, whose numbers have remained constant throughout.

4.33 The percentage reduction on these routes due solely to non-passenger HGV's diverting has been tabulated to show the environmental benefit of the new road on these routes in this respect. Around the most sensitive areas it was seen that in excess of 49 per cent of non-passenger carrying HGV's have 'moved away'. Table 4.7 shows a comparison of the '85-'86 volumes of the largest categories (4 and 5+ Axle Artics) of a long distance (i.e. through moving) HGV on Hessle Road west of Rawling Way. From the table, it can be seen that over 90 per cent of the traffic in each category has been removed. This is a considerable relief afforded to the previously congested sections of the western radials, and made possible only by the new road. It is obvious therefore that the new road has fulfilled one of its main objectives, namely the relief of the western radials in the city.

4.34 As seen from the previous paragraphs, the new road has delivered considerable relief to the roads which suffered under conditions of traffic congestion and worsened environmental conditions. Therefore, the significant increase in traffic along the new road's corridor does not seem to have any negative effect on traffic conditions on parallel routes. The increase experienced (16 per cent per annum), however, is substantial and needs to be explained. While part of this traffic may be attributed to the construction traffic associated with the many developments taking place in the Docks area made accessible by the new road, other factors also have a significant effect. By referring to information and data provided by the County Council[34], and pertaining to trade and traffic figures through the Port in Hull, and the economic development in the area, it was seen that this increase in traffic is that sought indicating prosperity and increased development. In other words, the

HGV Category	Number of Vehicles (Per Day)		% Change
	Before (July 1985)	After (July 1986)	
4 Axle Artic	745	64	-91.0%
5+ Axle Artic	554	36	-93.5%

Table 4.7 Comparison of the 'before' and 'after' volumes of the largest categories of HGV's on Hessle Road west of Rawling Way.

substantial increase in traffic is 'generated traffic', but as defined in Chapter 1, it is 'development traffic'.

4.35 The information available on Port traffic is presented in Table 4.8. From the table, it can be seen that total goods traffic (thousand tonnes) has increased from 1984 onwards. Between 1985 and 1986, the increase was 17.3 per cent. From Table 4.9, it can be seen that passenger traffic also increased by about 19 per cent per annum between 1985 and 1987. On the subject of development measured in terms of industrial and commercial floorspace, it can be seen from Figure 4.9 that there has been a sharp increase in the number of planning applications between 1985 and 1987. This increase is certain to have been influenced by the situation in Hull which, as can be seen from Table 4.10, has the largest share of all developments in Humberside.

4.36 From all the previous evidence, it can be said that the new road has certainly fulfilled its objectives of enhancing the environment and improving traffic conditions along the western radials. It has also opened up the Docks area for regeneration leading to increased developments in the docks area and the east of Hull. The significant increase in development traffic along the immediate corridor confirms this. Despite the increase in traffic (16 per cent per annum), the road still extended the benefits forecast to previously congested routes.

4.37 Within the City Centre, consecutive major road and traffic measures have made it difficult to pinpoint the actual benefits to the City Centre which can be directly attributable to the building of the South Docks Road. However, the earlier opening of the eastern end of the same A63 route (referred to as the South Orbital and Garrison Road) has given considerable relief by bypassing the City Centre[32].

4.38 An important element of traffic was also studied, namely Humber Bridge Traffic. Surveys had been undertaken in 1985 and 1986 to measure the number of Hull bound users of the Humber Bridge who switched from Boothferry Road to the South Docks Road as a route into Hull. The results indicated that the total Humber Bridge traffic to Hull was 4180 vehicles per day of which 58.5 per cent went via Boothferry Road and 41.5 per cent went via South Docks Road. The surveys also showed that of the total HGV Humber Bridge traffic to Hull, 59.5 per cent went via South Docks Road and 40.5 per cent via Boothferry Road. It must be noted that not all Boothferry Road traffic will be bound for the City Centre and East Hull, for part of this traffic will be diverting to the north and some to the eastern environs and

Goods	1981	1982	1983	1984	1985	1986
Bulk Fuel	313	234	267	281	308	327
Other	3,630	3,784	3,305	3,754	4,216	4,978
ALL	**3,943**	**4,018**	**3,572**	**4,035**	**4,524**	**5,305**

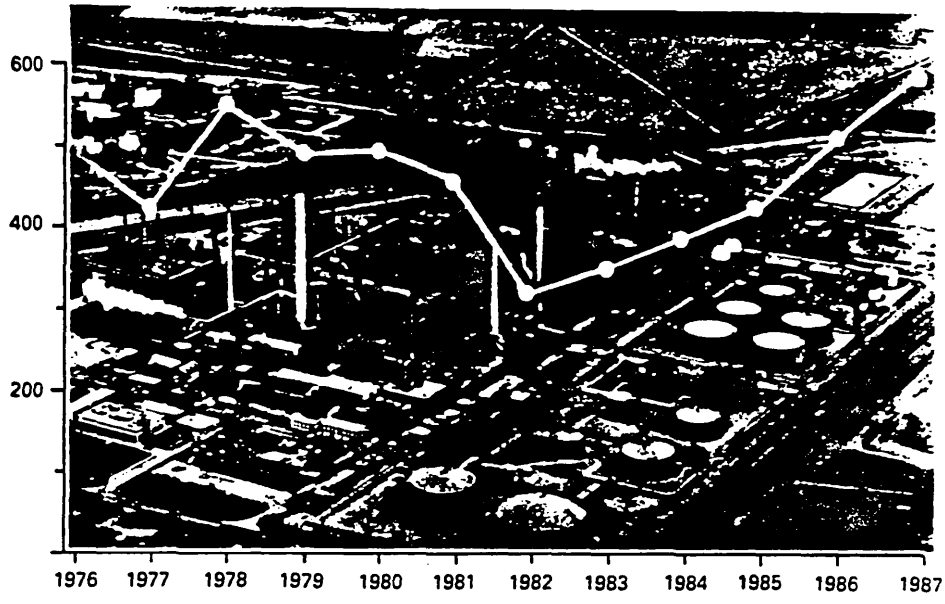
Table 4.8 **The development of total goods traffic using the Port of Hull (thousand tonnes).**

Port	1983	1984	1985	1986	1987
HULL	435,623	442,609	443,374	549,310	618,557

Table 4.9 **The development of passenger traffic using the Port of Hull.**

Annual Trends of Industrial and Commercial Floorspace

Applications in Humberside 1975/76 – 1986/87*



Note: *Figures shown are for year ending 31st March.

Source: Joint Development Analysis System – Humberside County Council Technical Services Department and District Council Planning Departments.

Figure 4.9 The annual trends (number of applications) of industrial and commercial floorspace in Humberside (1976–1987).

Industrial and Commercial Development
April 1974 – March 1987

District	Total Floorspace Applied for* (1)	Of Column (1) Floorspace Approved* (2)	Of Column (2) Floorspace Completed* (3)
	Sq. m.	*Sq. m.*	*Sq. m.*
Beverley	366,000	302,000	178,000
Boothferry	597,000	518,000	255,000
Cleethorpes	471,000	330,000	115,000
East Yorkshire	466,000	389,000	210,000
Glanford	726,000	590,000	376,000
Great Grimsby	703,000	566,000	389,000
Holderness	211,000	169,000	105,000
Hull	2,052,000	1,783,000	932,000
Scunthorpe	475,000	452,000	356,000
HUMBERSIDE	6,067,000	5,099,000	2,916,000

Note: *Floorspace rounded to the nearest 1,000 sq. m. therefore columns may not add. 1 sq. m. = 10.76 sq. ft.

Source: Joint Development Analysis System – Humberside County Council Technical Services Department and District Council Planning Departments.

Table 4.10 The industrial and commercial development by floorspace in Humberside (1974–1987).

therefore would not require the South Docks Road. Nevertheless, the reduction in City Centre bound traffic (both HGV and other Vehicles) on Boothferry Road is significant.

4.39 The Technical Memorandum 87/6 concluded that 'by the Spring of 1986 when surveys were started for the 'after study', the traffic and journey patterns were well established. Because of the heavy and fast flows on the new route, the older and now relatively quiet routes are more attractive for some drivers'[32]. The saving in journey times, however, have not been fully realised due to delays experienced by the South Docks Road traffic during the morning peak hour at the Commercial Road roundabout (Figure 4.2). However, the survey results showed that there has been a large reduction in total traffic volumes on two of the western radials, Analaby Road and Hessle Road. Environmental improvements to these routes have been considerable due to the substantial reduction of HGV's and especially those in the larger categories (Table 4.7). It is also evident that the South Orbital contributed to the benefits and enhanced the role of the South Docks Road by providing a good and compatible connection whereby traffic using the South Docks Road could bypass the City Centre.

JOURNEY TIMES SURVEYS

4.40 The Journey Times Surveys, which are carried out by the Technical Services Department of Humberside County Council every two years, provided some further information in respect of traffic benefits. However, the surveys were carried out for only a couple of days (sometimes only one day) for each road every two years. The survey was not carried out in 1980 but continued from 1982 onwards. The data obtained by these surveys may not be statistically sound, nevertheless, it provides a relatively true picture of the changes in travel speeds on the roads considered. The speed values which seemed to be inaccurate were disregarded when the average inbound and outbound speeds were calculated for each of the roads.

4.41 The travel speeds obtained from the Hull Journey times survey were checked for every road. The values were then used to calculate the average inbound and outbound speeds for both the morning peak, and the evening peak. By such comparison, i.e. of travel speeds prior to the implementation of the South Docks Road and those after, a conclusion may be made as to the change in congestion levels

based on improved or reduced travel speeds. The results for the different roads are presented as follows:

Anlaby Road:

(A.M.PEAK)

4.42 From Figures 4.10 and 4.11 a noticeable improvement on this road after the opening of South Docks Road can be clearly seen. The Inbound speed improved noticeably over the 1984 speed values but dropped slightly in 1988. Even with the slight drop in 1988 it remained higher than it was in 1984 indicating improved traffic flow conditions and less congestion. The outbound speed immediately improved over the 1984 level and continued to improve in 1988 suggesting a continuous improvement in the traffic conditions on this road and a reduced level of congestion.

(P.M. PEAK)

4.43 From Figures 4.12 and 4.13 it is apparent that both the Inbound and Outbound speeds have improved as measured by the surveys in the years that followed the opening of the South Docks Road. The figures also indicate a continuing improvement in the speeds which may be explained by a reduction in traffic congestion on this road during both peak periods, and in both directions (inbound and outbound).

Hessle Road (Outer):

4.44 Hessle Road was considered in two sections, namely: Hessle Outer and Hessle Inner for the survey purposes. Figure 4.7 shows both sections.

(A.M.PEAK)

4.45 Figures 4.14 and 4.15 show the improvement in both Inbound and Outbound speeds on this section of Hessle Road. The earlier improvement (beginning in 1982) may be attributed to the opening of Rawling way (December 1981) which relieved the road of some of the traffic which used Hessle Road to get to the City Centre and east Hull. The improvements in the years after the South Docks Road are more obvious suggesting, therefore, that the new road has reduced traffic levels on Hessle Road

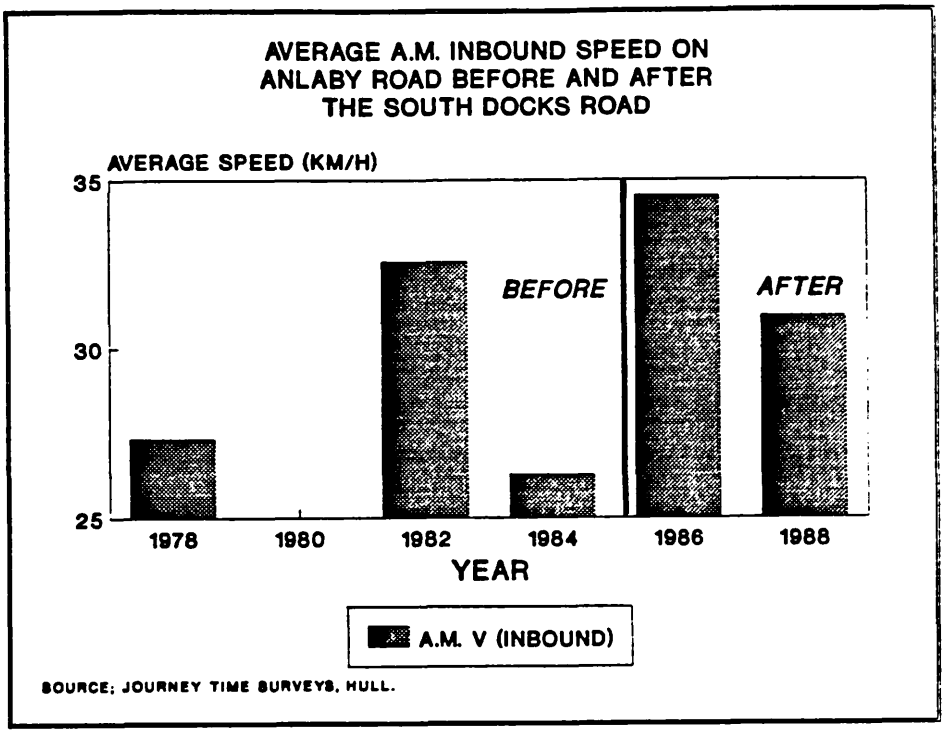


Figure 4.10 The average A.M. Peak inbound travel speed on Anlaby Road 'before' and 'after' the opening of the South Docks Road.

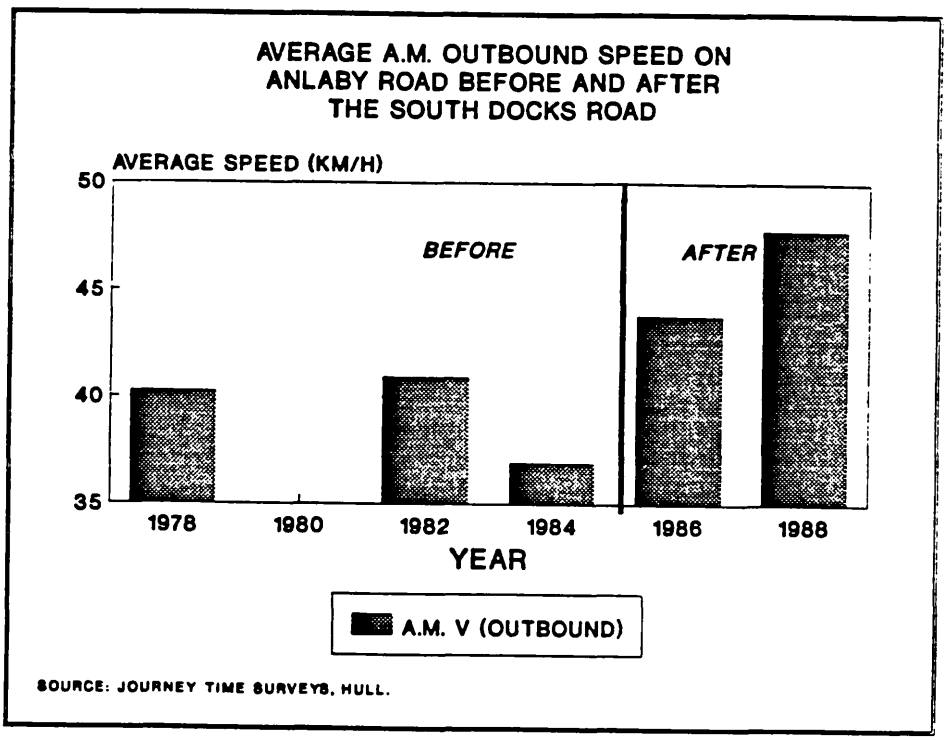


Figure 4.11 The average A.M. Peak outbound travel speed on Anlaby Road 'before' and 'after' the opening of the South Docks Road.

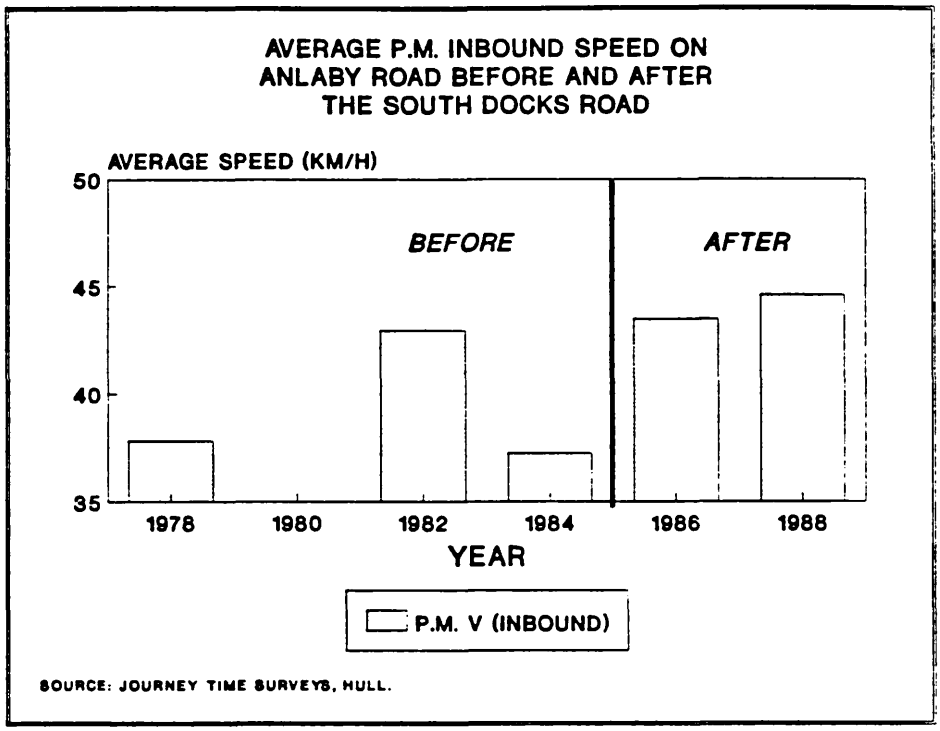


Figure 4.12 The average P.M. Peak inbound travel speed on Anlaby Road 'before' and 'after' the opening of the South Docks Road.

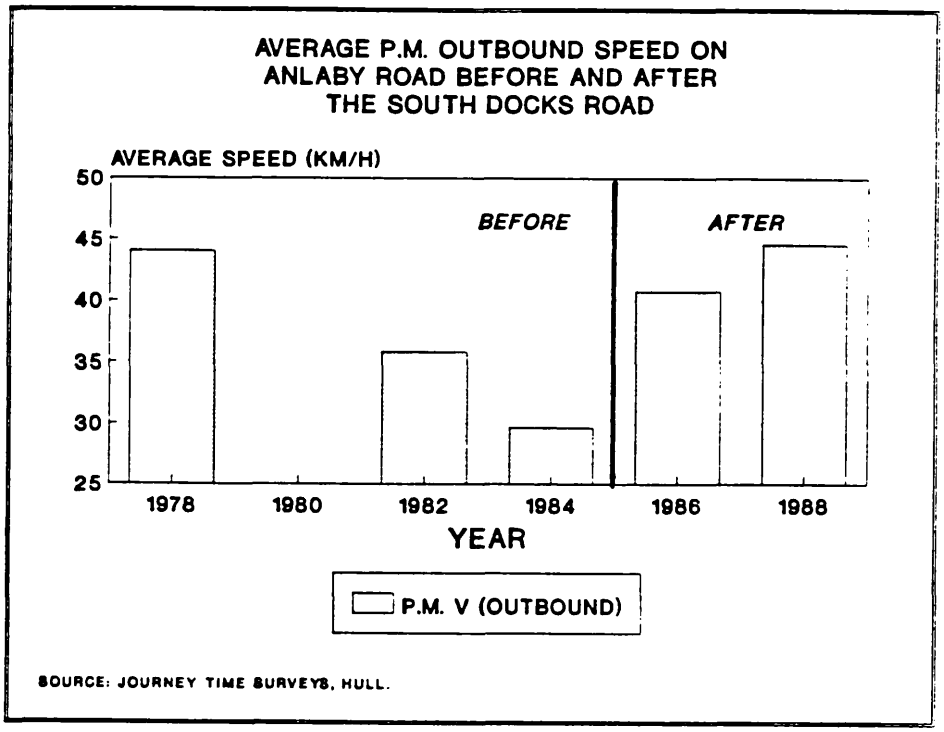


Figure 4.13 The average P.M. Peak outbound travel speed on Anlaby Road 'before' and 'after' the opening of the South Docks Road.

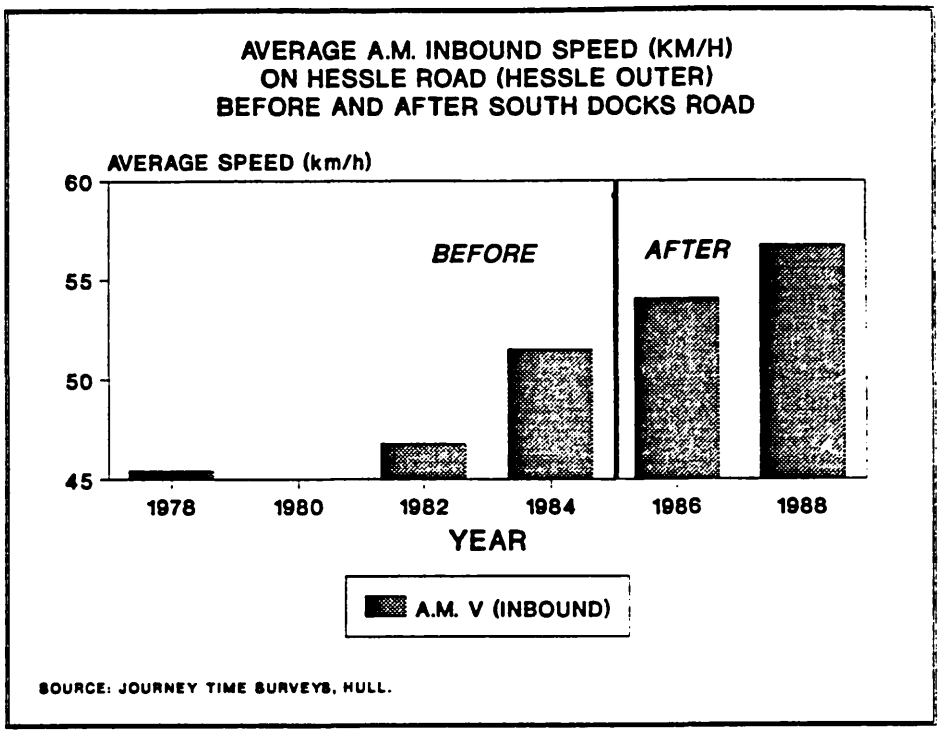


Figure 4.14 The average A.M. Peak inbound travel speed on Hessle Road (Hessle Outer) 'before' and 'after' the opening of the South Docks Road.

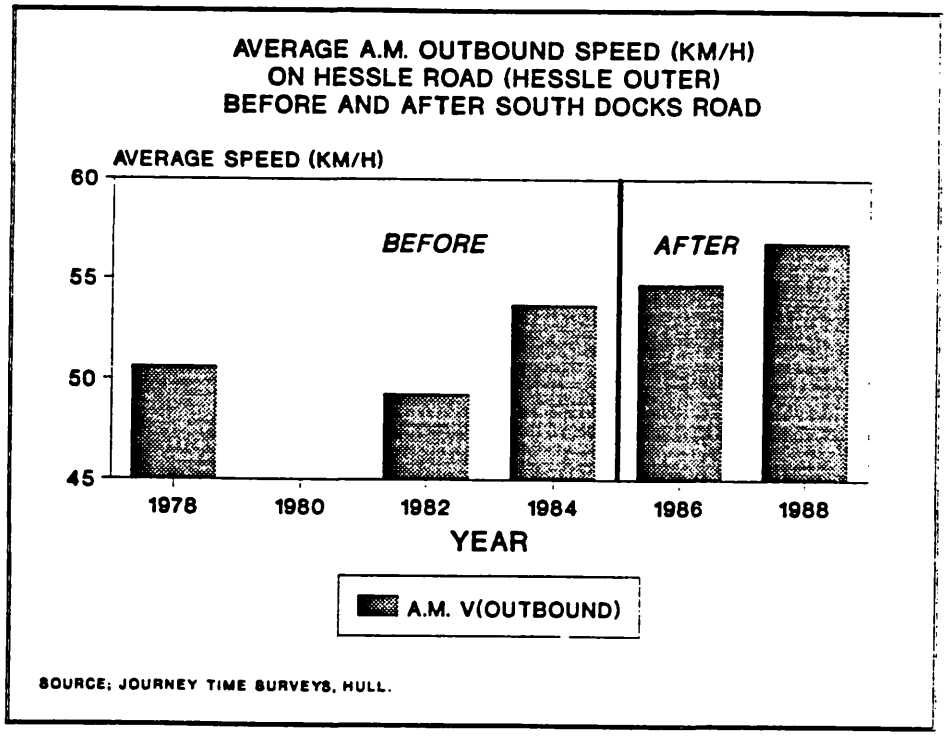


Figure 4.15 The average A.M. Peak outbound travel speed on Hessle Road (Hessle Outer) 'before' and 'after' the opening of the South Docks Road.

and hence improved traffic conditions and made possible a higher travel speed (less congestion).

(P.M.PEAK)

4.46 The Inbound speed obviously improved after 1982 due to the opening of Rawling way but dropped in 1986 and slightly improved by 1988 (Figure 4.16). The change (drop) in the Outbound speed was not as significant (as can be seen from Figure 4.17). This can be attributed to the South Docks Road keeping the traffic levels on this section rather constant throughout the period between 1985 and 1988. Further surveys will be needed to determine whether this trend will be reversed or will continue. The data for 1980 is not available.

Hessle Road (Inner):

(A.M.PEAK)

4.47 As a result of the opening of South Docks Road Figures 4.18 and 4.19 show improvements in both Inbound and Outbound speeds on this section of Hessle Road (this is the section of Hessle Road with lower speeds (than Hessle Road outer) in general. This improvement (continuing in 1988 for the inbound speed, and remaining the same for the outbound speed) indicates a reduction in traffic levels, therefore congestion levels on this road making it possible for traffic to flow at higher speeds. The new road probably carrying a portion of the traffic that previously used this road.

(P.M.PEAK)

4.48 Figure 4.20 shows the inbound speed to have slightly dropped after the opening of South Docks Road, but by 1988 it has gone back to what it used to be in 1984. The Outbound speed, which had dropped to around 14 km per hour in 1984 improved significantly in 1986 (Figure 4.21) but dropped slightly by 1988 nevertheless remaining higher than the Average speed in the years before South Docks Road. It is clear from both Figures that an improvement (probably due to the South Orbital and other associated road improvements) was felt in 1982. It may be that due to certain roadworks on that section, travel speeds continued to be the same (inbound). Here as well, further surveys will be necessary to indicate the changes associated with the South Docks Road. The data for 1980 is not available.

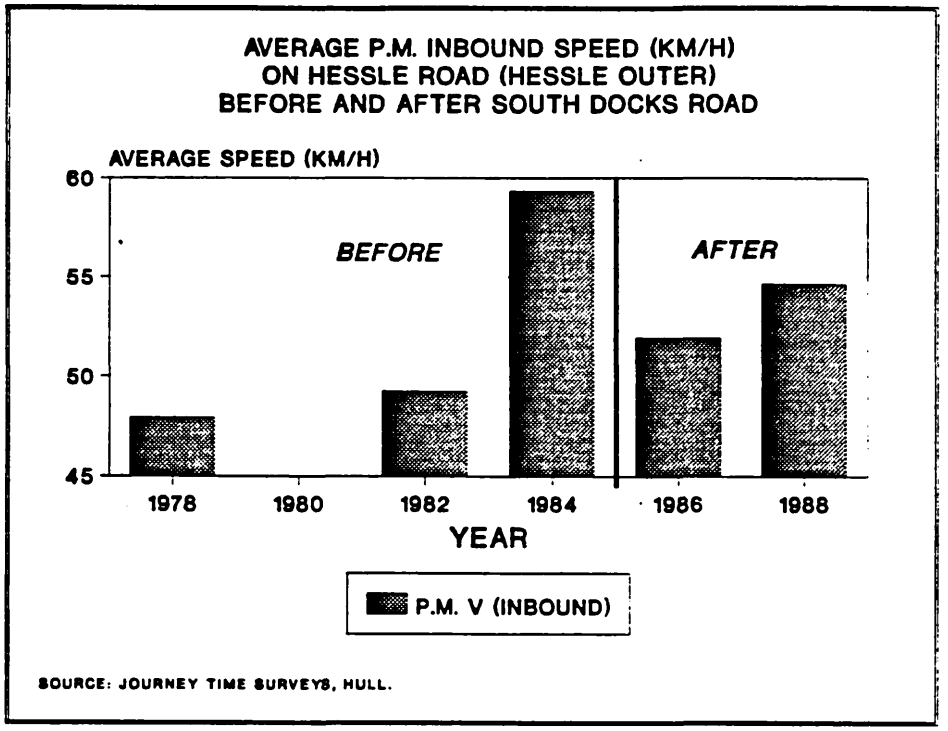


Figure 4.16 The average P.M. Peak inbound travel speed on Hessle Road (Hessle Outer) 'before' and 'after' the opening of the South Docks Road.

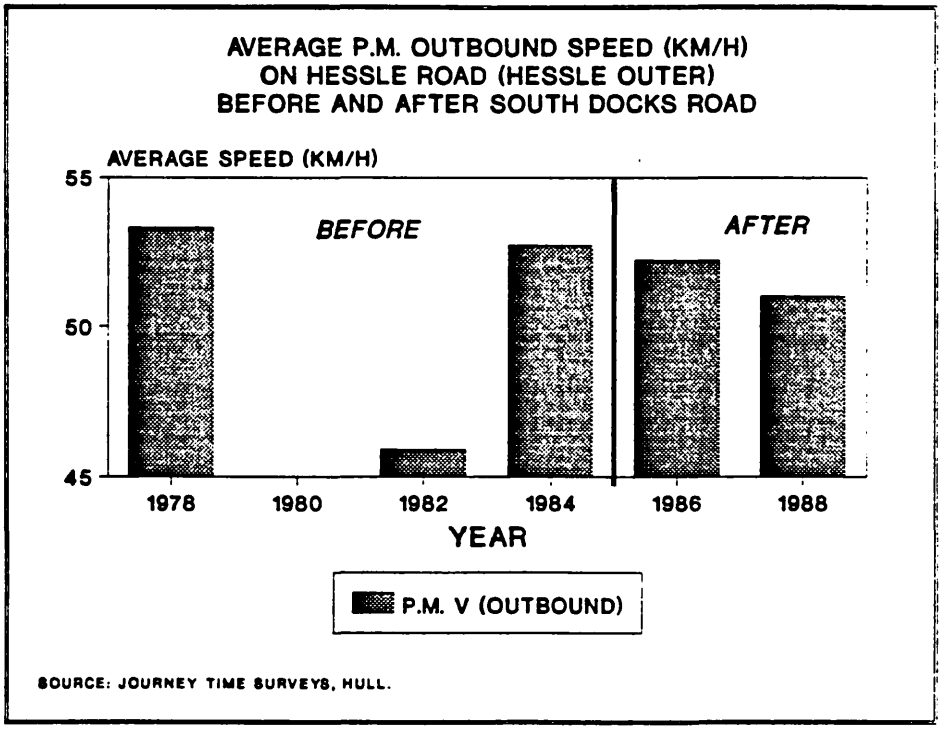


Figure 4.17 The average P.M. Peak outbound travel speed on Hessle Road (Hessle Outer) 'before' and 'after' the opening of the South Docks Road.

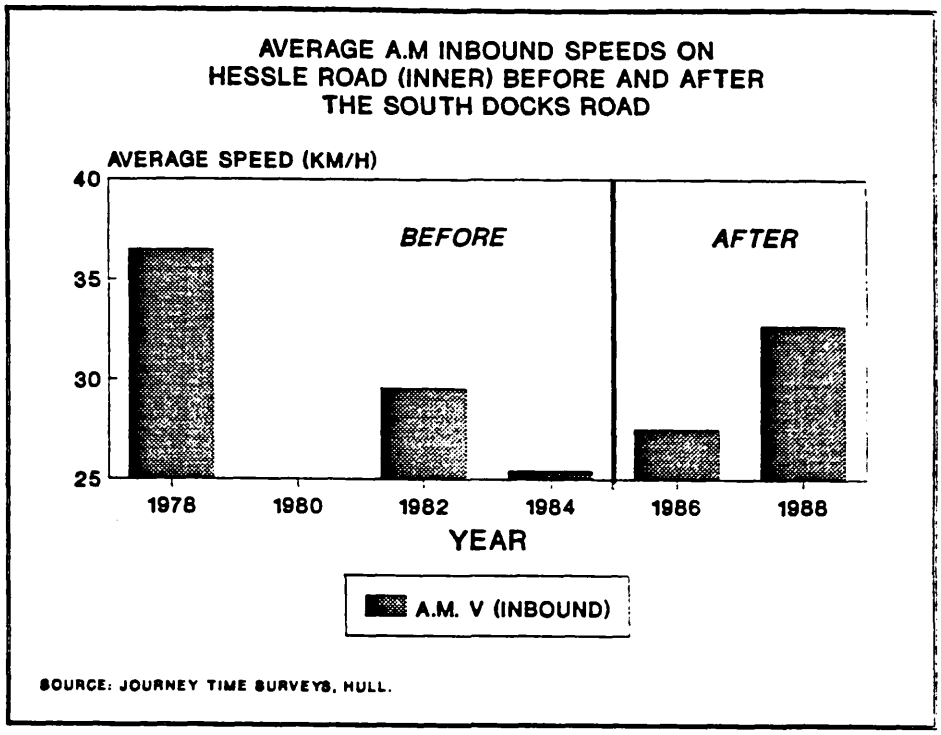


Figure 4.18 The average A.M. Peak inbound travel speed on Hessle Road (Hessle Inner) 'before' and 'after' the opening of the South Docks Road.

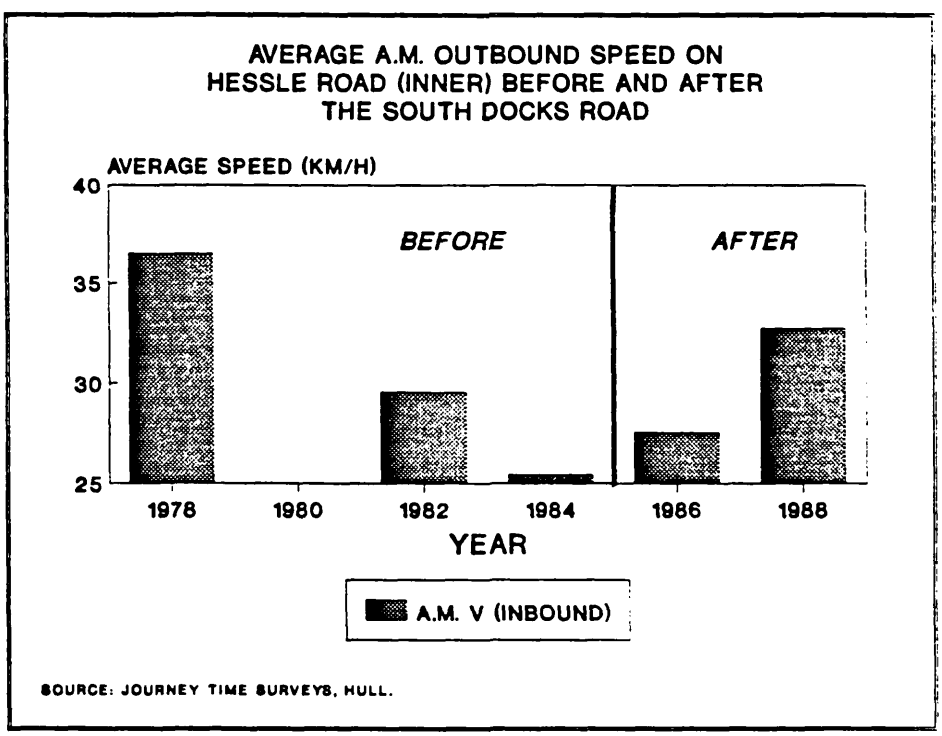


Figure 4.19 The average A.M. Peak outbound travel speed on Hessle Road (Hessle Inner) 'before' and 'after' the opening of the South Docks Road.

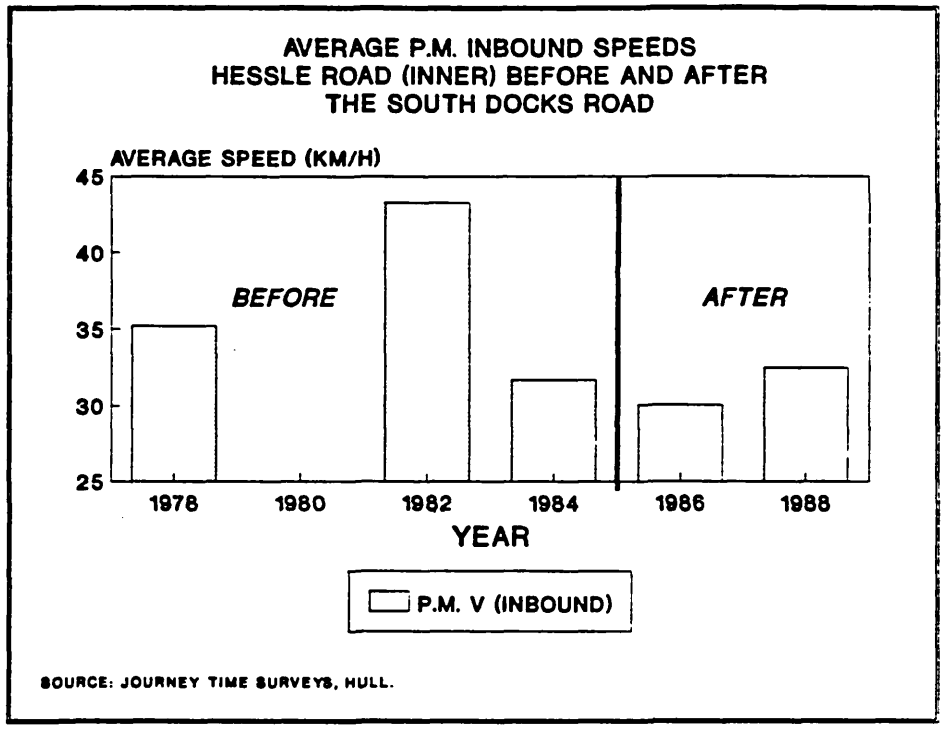


Figure 4.20 The average P.M. Peak inbound travel speed on Hessle Road (Hessle Inner) 'before' and 'after' the opening of the South Docks Road.

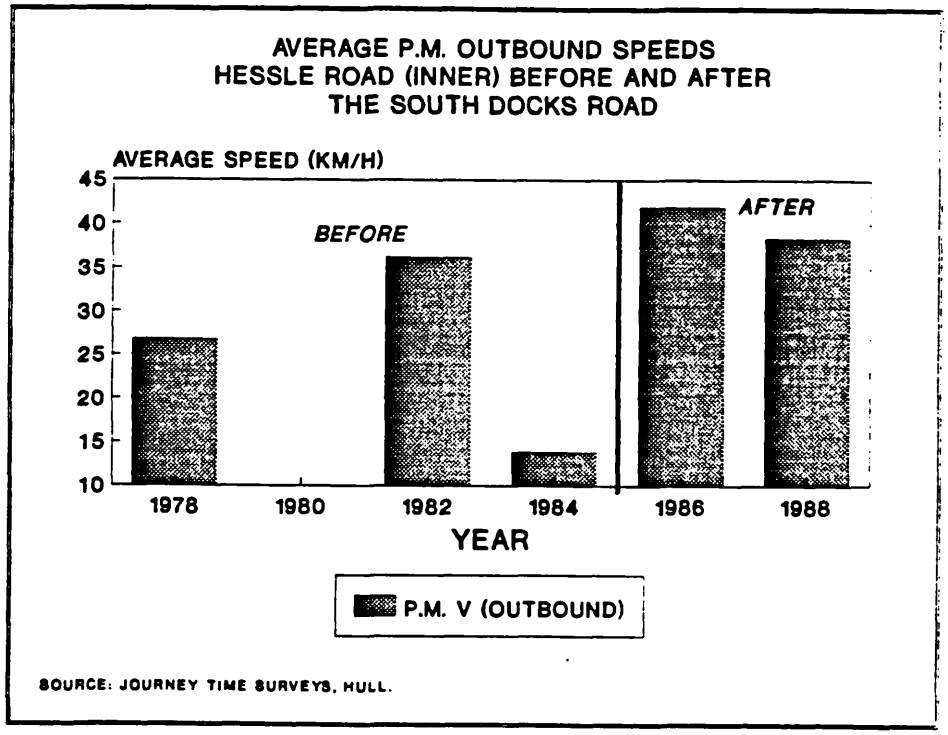


Figure 4.21 The average P.M. Peak outbound travel speed on Hessle Road (Hessle Inner) 'before' and 'after' the opening of the South Docks Road.

A.M.Peak:

4.49 Travel speeds on this new road have maintained a high level. Data from the 1986 survey is not available. The 1988 figures show an inbound speed of 80.39 km/h and an outbound speed of 85.55 km/h during the morning peak. This indicates a very fast route with quicker journey times as compared with travel speeds on the old trunk road. It is also an indication of the free flowing conditions on the road even in the peak period.

P.M. Peak:

4.50 The situation during the afternoon peak shows very high speeds as well. The inbound speed is 88.57 km per hour and the outbound speed is 91.76 km per hour. This is far higher than corresponding speeds on the old trunk road as can be inferred from the data available. The figures are represented in Figure 4.22.

THE ROAD'S IMPACT ON PUBLIC TRANSPORT

4.51 The public transport operators in Hull were unable to provide the specific information requested due to the fear of competition. However, discussions with officials from Hull's largest public transport operator indicated that the new road has made journeys quicker for most of the buses on the previously congested roads. This, however, was not followed by an increase in the frequency or change in the timetables. During these discussions[35], it was stated by one of the officials of the public transport operator that the patronage on their services and the demand for these services had hardly changed since the opening of the new road. This shows clearly that the contention made earlier in the study (see Chapter 1) is true. The opening of the new road did not adversely affect the public transport system and did not cause a significant shift on to the new road*.

4.52 This further emphasises the contention that the bulk of traffic generated by new roads in urban areas is diverted or redistributed traffic and that the percentage of new journeys (never made before) in this traffic is not very significant. However, and unless a comprehensive origin-destination survey which would cover all the routes influenced by a new road (a very costly and difficult exercise) is carried out,

* A recent correspondence with the Operations Manager of the Public Transport operator in Hull stated that 'In respect of Hessle Road itself I was assured from Inspectors and drivers alike, that the opening of Clive Sullivan Way made little difference to our passenger loadings. It is used mainly by lorries, etc., for the docks and as a fast route into the city for commuters who live beyond the extent of our bus services.'

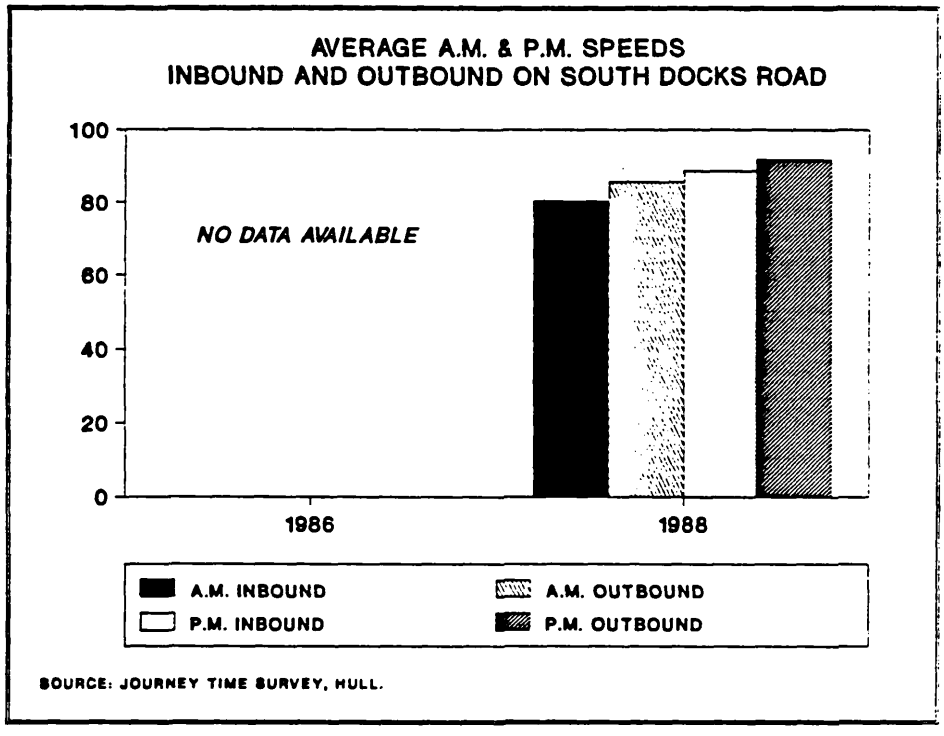


Figure 4.22 The average A.M. and P.M. inbound and outbound speeds on the South Docks Road.

any contention made in this respect to one effect is as credible as any made to the contrary.

SUMMARY AND CONCLUSIONS

4.53 The information collected from Hull and presented in the previous pages shows the traffic changes associated with the implementation of the South Docks Road. Although the data available was not as comprehensive as one would have liked, it was more than that which was available in many of the other cities surveyed for information. The task, however, is to review the objectives which were stated prior to the construction of the road, with an assessment of the situation after the road was completed. By referring to the objectives as they were stated earlier in this work the findings are as follows:

4.54 The South Docks Road carries a large proportion of the traffic which previously used the old trunk road in the western corridor. The new road has certainly taken most of the heavy commercial vehicles away from the old roads which have an almost completely developed and highly residential frontage. This has improved the environment of areas along those main routes from the West to the Docks and City Centre. With the reduction in traffic levels on those routes, and particularly the significant drop in the number of heavy vehicles which used those roads prior to the opening of the South Docks Road, the road inhabitants now enjoy calmer, safer and less polluted streets.

4.55 Traffic congestion, which was one of the main justifications for the South Docks Road has been relieved somewhat. Some of the network roads which suffered from highly congested sections and long delays before appear to be offering a better level of service to commuters on these roads. According to the Humberside County Council TPP 1988-89, the kind of delays experienced on Hessle Road prior to the opening of South Docks Road are now not anywhere as frequent[28]. The South Docks Road forms 'one complete high standard west to east route and this gives access for heavy traffic to the docks and industry without having to enter the City Centre or suburbs'[28].

4.56 As well as the by-passing of Hessle Road and reducing HGV traffic especial the larger categories, the South Docks Road has also brought much relief from heavy traffic to Anlaby Road and Boothferry Road. The immediate effects of the scheme

have been identified and the longer term implications are still being monitored. The South Docks Road has also made it possible to realise many of the benefits associated with other enhancements to the road network. The South Orbital and Myton Bridge, together with the South Docks Road offer a very attractive route to the Docks and East Hull areas avoiding busy City Centre streets and shopping areas, and bringing a step closer the plan to pedestrianise the Hull City Centre. It must be mentioned that traffic management improvements were also made. These include the upgrading of signals and the use of a new microprocessor which allows routine updating of traffic conditions therefore contributing to improve the situation along the radials. The effect South Docks Road had on safety and accident rates (personal injury), particularly on the sections which had a high average is still being investigated.

4.57 From the Journey Times Surveys, it can be seen that an improvement in the travel speeds has been recorded on almost all the road sections directly influenced by the South Docks Road. Such an improvement is indicated in both directions, Inbound and Outbound during different periods of the day. It is obvious that some roads show a more significant improvement than others, but overall, the impact has been very positive on the network. The improvements in travel speeds have continued on some roads, which show further improvement every year. Some, may argue that the situation only seems to have improved but soon the new road will fill up with traffic, and the old roads will revert to being as congested as before or even worse. Should such a situation occur, how long after the building of the new road would it occur, and are not the benefits obtained from the new road prior to reaching such a situation (if ever) worth being considered? It is clear from this example that this has not occurred despite an area wide significant increase in traffic associated, partly, with the regeneration of the Docks area and the increased developments and use of the port.

4.58 Kingston-upon-Hull is not a very large city and it is very clear that the success of a new road scheme in such a medium sized urban area does not necessarily indicate that all new roads schemes in urban areas are bound to be successful. However, this case study presents a strong argument that the building of new roads in urban areas is not necessarily 'counterproductive'. The South Docks Road Scheme as seen, was implemented to fulfil certain objectives. The objectives, as seen from earlier paragraphs, were to: a) reduce traffic congestion on the western corridor roads; b) remove HGV traffic from highly developed residential and shopping

streets; c) shorten journey times and improve accessibility to the City Centre and Docks area, leading therefore to new developments and assisting in improving the port activities; d) reduce accidents and reduce the pedestrian–vehicle conflict that existed in some areas, and last, but not least, to improve overall environmental conditions in the city.

4.59 The scheme has certainly, and as demonstrated in this study, improved the conditions for traffic on the previously congested roads. It has drawn away traffic from sections that were not coping with the always increasing traffic flows. Its effect on different sections, and on different roads varied. Most of the roads have experienced a relief and an improved travel speed in both directions since the opening of the new road. A large proportion of the HGV traffic (over 90 per cent of the larger categories) has actually been transferred onto the new road which provides a fast and direct link with east Hull. There has been an above average increase in traffic in the road's corridor; this, however, has been 'development traffic' which has not adversely affected the traffic conditions along the road itself (as seen in the high travel speeds recorded on the road even during the peak periods), or along the relieved routes which still continue to show improvements in journey times. The Docks area has been made more accessible, and hence regeneration and revitalisation is very much under way. This is seen by the growth in development traffic confirmed by the increase in development and port activity.

4.60 The Kingston–upon–Hull example shows that the new road improved the operational conditions on the network with much improved travel speeds. It may be inferred from the reduction in traffic flows on existing roads that environmental improvements have also been achieved. It clearly shows that travel speeds did not fall. In fact, the improvement in these speeds are apparent and felt area wide. The officials in Hull, most of whom commute to work, have mentioned that their journeys by car take less time. The savings are not those of a minute or two, as they claim more significant savings. The environmental impact has been appreciable, with much less HGV's in mostly residential and shopping areas, the quality of life has certainly improved. We must also keep in mind that the earlier improvements to the network (e.g. the South Orbital) has made it possible to realise the full benefits of the South Docks Road.

4.61 What needs to be realised here is that public transport ought to utilise the opportunities offered by a new road scheme to attract passengers. It is only logical that people will go for the improved mode, and if the public transport (road borne) is to make the most economically feasible use of an improvement in the road network,

the benefits of such an improvement can be stretched over a longer period of time. With this particular road scheme however, it may be difficult to promote public transport since the road is not directly near residential areas, access is limited on the road and the new developments in the docks area are oriented towards car users.

4.62 It is also clear that the new road has made it possible to develop the land contained in the docks area by providing better access to it. Discussions with City Council officials indicated that the development of the docks area would not have been possible without the new road. The easy access given by this road made it possible to attract many of the developments that are already there and those still underway. The new road has also contributed to land use changes within the city. The road also strengthened the importance of the city as a prime location for east coast trade with the EEC, especially after 1992. The quick and direct access the road provides for HGV's makes the city's port and docks a most attractive and accessible venue for ship borne trade.

4.63 In accordance with its goals in improving the environmental conditions along Hessle Road, the city is implementing a traffic management scheme to control traffic on this newly relieved road by providing additional parking spaces for shoppers and for businesses. These spaces are provided by using existing traffic lanes in both directions and hence reducing the road's actual capacity physically by means of structural alterations. This measure is not very popular however with public transport. The reason for this being that the scheme actually hinders buses at their stops and makes it difficult for loading and unloading passengers.

4.64 There are, however, few points which cannot be overlooked when examining the negative impacts which may be associated with the road. These can be easily identified by the bottleneck created on Castle Street which is due to the traffic being diverted on to the new road, and the fact that Castle Street's capacity is not capable of handling the flows from all other roads. This situation, as mentioned earlier, may be rectified once the improvement of Castle Street is completed. Another point of concern is that with access to the road being limited, and with most of the HGV traffic on this road, accidents on the road can lead to long tail backs of traffic. Advance warning techniques and diversion routes are being considered for the road, and bridge mechanics (Myton Bridge) which affect traffic on the road are also being reviewed. The city of Hull is still going under major road construction and

infrastructure improvements which make it rather difficult to fully assess the actual impacts and benefits of the South Docks Road.

4.65 The South Docks Road in Hull is a clear example of the potential effectiveness of new roads in urban areas. Without this road, none of the improvements in terms of the operational efficiency of the network, and the environmental conditions along busy and residential streets would have been achieved. This is in addition to making it possible for the developments in the docks area which would not have seen the regeneration and revitalisation it is currently going through. The economic benefits of this road are beginning to appear with more to come in the next few years.

4.66 It is clear from the findings that the road by itself, or any road for that matter, is not the answer to traffic problems in urban areas. Comprehensive planning is required to remove any deficiencies in the system which may jeopardise the fulfilment of a new scheme's objectives. The network as a whole must be considered when a scheme is considered.

4.67 Summing it all up, the South Docks Road Scheme is one that clearly manifests the potential effectiveness of new roads in urban areas in Britain under certain conditions, such as in this medium sized town. It is also obvious that the new road was borne out of the Council policies which were very reasonable and well defined. The need for this road was very obvious, and the implementation came accordingly thus making the benefits realised very significant. The scheme has demonstrated its effectiveness in improving the operational and environmental conditions within its corridor, especially on previously congested and busy residential streets. The scheme therefore appears to have been worthwhile in that it has achieved its intended objectives.

CHAPTER 4 CASE STUDIES FROM BRITAIN

B: THE NORTH-SOUTH ROAD IN PORTSMOUTH

INTRODUCTION

4.68 The city of Portsmouth was selected as a case study since it contained a number of new urban road schemes. The study was based on information obtained from the Portsmouth City Engineer's Department and the Hampshire County Council. The schemes appraised are a) the **M275**, an urban motorway opened 11 March 1976, part of the **'North-South Road'** which was built in 3 different stages, each providing a unique example, and b) the **Rudmore Flyover** which was first opened to traffic in March of last year (1988). It is the newly built **M275** and its extension southwards (Holbrook Road) that are the main subject of this case study since the data available on the Rudmore Flyover is not very comprehensive yet.

GENERAL BACKGROUND

4.69 Portsmouth is situated on the south coast of England, approximately 70 miles south west of London. It lies 21 miles east of Southampton and 48 miles west of Brighton. Geographically, the city is split into two parts, Portsea Island being separated from mainland Portsmouth by the narrow waterway of Portcreek (Figure 4.23). In the past, the pattern of communications has been constrained by the geography. The road pattern existing in 1970 is shown in Figure 4.24. The pattern owed its character to two major influences: 1) the major part of Portsmouth is located on Portsea Island (it must be noted that although Portsea Island has always been the commercial and economic centre of Portsmouth, the form of development of the road pattern has been determined by the early settlement and the Dockyard beginning in the south western corner of the Island and the need for the workforce to be able to walk and later cycle to work.), and 2) for many years the road connection to the mainland was limited to one bridge across Port Creek due to the function of Portsmouth as a Naval Base and Garrison Town.

4.70 Portsmouth has grown around the Royal Naval Dockyard, and has been important to the defence of the country since the 15th Century. With a population of

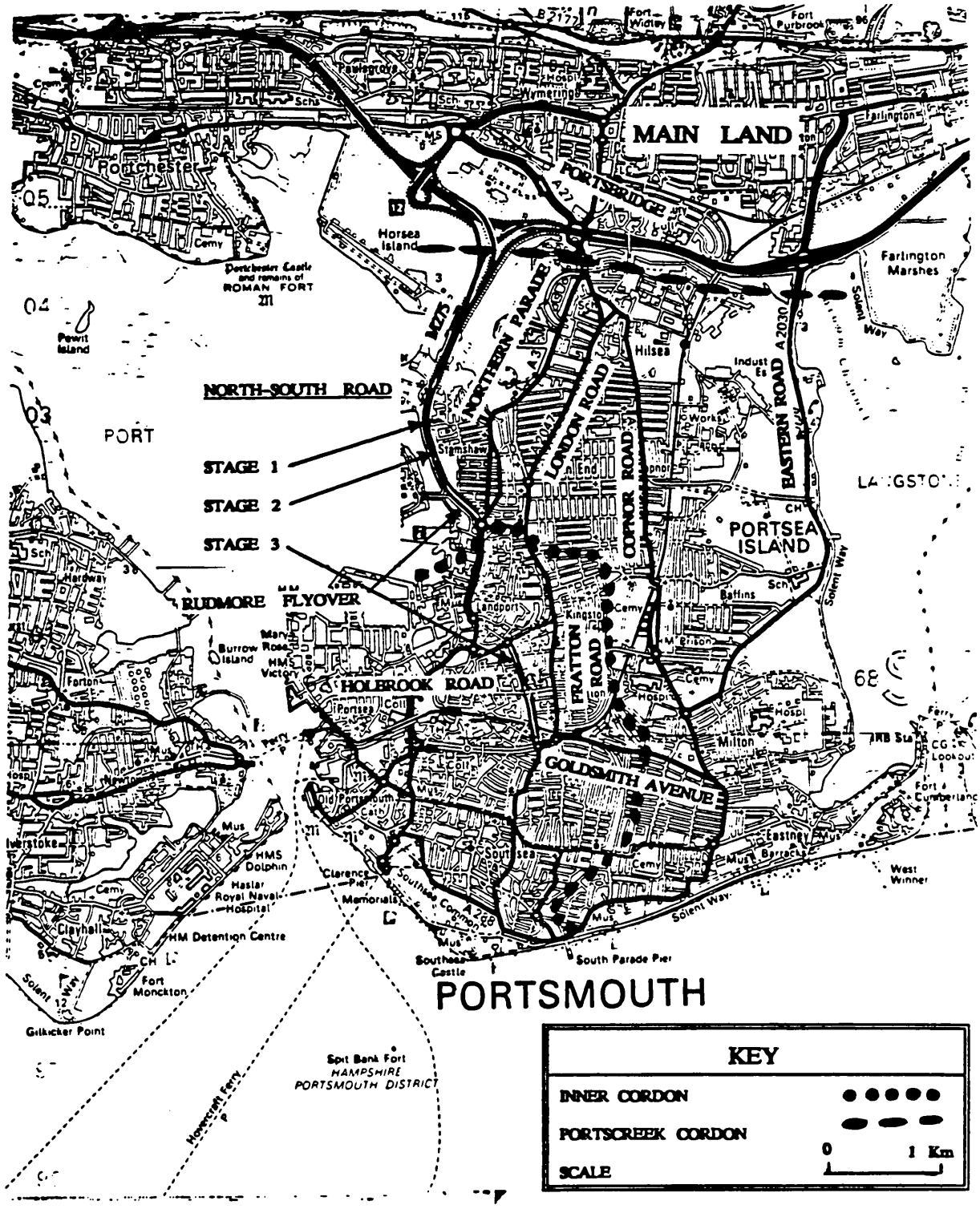


Figure 4.23 The City of Portsmouth: The present road network and the schemes considered.

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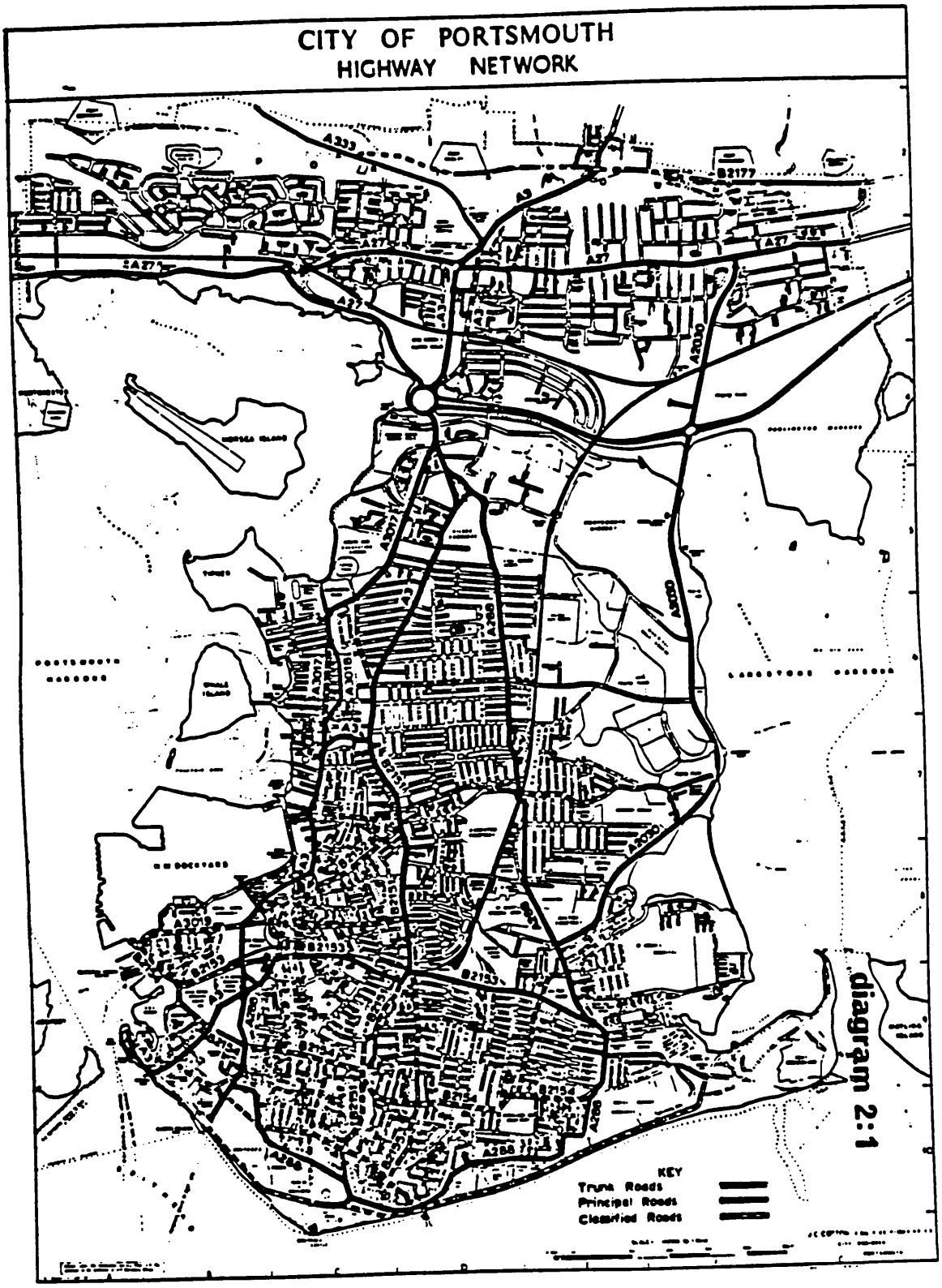


Figure 4.24 **The road network in Portsmouth in 1970.**

Source: The Portsmouth Transport Plan, 1970.

some 90,000, Portsmouth is the centre of commerce and population within south east Hampshire. The city is a major Naval Port with a growing commercial port. It is a centre for higher education and a holiday resort. It is also an important source of employment for surrounding towns and villages. In addition to all this it is a regional centre for shopping, education and entertainment.

4.71 Until the northern length of Eastern Road was constructed early in the Second World War, Portsbridge was the only connection to the mainland and prior to that time all the industry and the bulk of the residential development was situated on the western and southern areas of the Island. The general flow of commuter traffic on the Island is naturally north/south. According to the City of Portsmouth Traffic and Transport Plan (1971–1976–1981) there were 'several inadequate east/west routes, and these together with the many residential roads, enable the movement of local circulating traffic to be maintained, although there are many crossroads, and the journeys are somewhat torturous'.(36)

THE TRANSPORT SYSTEM

The Road Network in 1970 (the situation 'before')

4.72 In 1970, the main framework of the City road systems consisted of the London–Portsmouth Road (A3) entering the City from the north, which after crossing Portsbridge, divided into three main routes, i.e. London Road (A3017), Copnor Road (A288) and Northern Parade (A3), all eventually giving access to the Sea Front. The main land area was traversed in the east/west direction by the Brighton–Southampton Road (A27) which crossed the A3 route at Cosham, and by the Farlington and Cosham By–Pass which formed part of the Folkestone to Honiton Trunk Road, and which lies along the north bank of Port Creek (see Figure 4.24).

4.73 The alternative route to Portsea Island, i.e., Eastern Road (A2030) runs close to Langstone Harbour and connects with the A288 at Milton. The A288 continues along the Sea Front and eventually connects with the A3 on the western side of the Island, just south of the Guildhall. A link route A3 connects the A3 route with the Royal Dockyard. The total mileage of adopted roads in the City in August 1970 is given in Table 4.11.

Traffic Flows

4.74 A Census taken on a weekday in July 1970 showed a total of 66,700 vehicles crossing Portsbridge (two-way) during a 16 hour day, and 32,500 vehicles using Eastern Road in the same period. As seen from Table 4.12, these flows were split almost exactly into equal north and south bound movements, but the peak hour flows, clearly demonstrate the tidal condition of the traffic with the predominant movements being south bound in the morning and north bound in the evening. In 1970, many of the main road network roads already had a percentage utilisation* of 150 per cent or more, and it was deemed that these conditions would deteriorate further if the suggested improvements were not implemented.

HISTORY OF THE SCHEMES

4.75 The future road pattern for the City was agreed in principle by the City Council in October 1965 and details of the major road proposals were approved in October 1966. The proposals were for a phased programme over 20 years up to 1985 and the plan indicated how these fitted into the regional and national transportation system. The Future Road Pattern had been designed to cater for 1985 traffic flows, and the main road network was seen to be fully utilized by that date[36].

The Problems

4.76 The Traffic and Transport plan of the City of Portsmouth which was submitted on November 1971, and approved by the City Council on 20th June 1972 concluded the following with respect to the situation existing in that period[36]:

- the existing road network was overloaded at peak periods, with constant delays,

- movements by bus were severely hampered, particularly at peak periods due to that congestion,

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* This was based on calculating the utilisation of each road in the peak hour based upon the capacity of a road as classified in accordance with the Ministry of Transport publication 'Urban Traffic Engineering Techniques'.

Road Type	Length (Miles)
Trunk Roads	3.25
Principal Roads	27.93
Classified Roads	22.62
Unclassified Roads	179.18
Total Mileage	232.98

Table 4.11 **Length of the Portsmouth road network by road type as of 1970.**

Source: The Report, City of Portsmouth Trafficand Transport Plan 1971.1976.1981, Portsmouth 1970.

Number of Vehicles per day	Count Period		
	8–9a.m.	5–6p.m.	16 hour Total
Portsbridge–Northbound	1,774	3,750	33,298
Portsbridge–Southbound	3,919	2,140	33,411
Portsbridge–Totals	5,693	5,890	66,709
Eastern Road (South of Roundabout)			
Northbound	983	2,477	16,548
Southbound	2,383	1,245	15,920
Eastern Road–Totals	3,366	3,722	32,468

Table 4.12 **Daily traffic flow crossing Portsbridge and the number of daily vehicles using Eastern Road on a weekday.**

Source: Traffic census taken on a weekday in July 1970.

- there were several conflicts between pedestrian and vehicular traffic in shopping areas and on major routes,

- environmental conditions in many residential areas could be improved by the removal of through traffic and heavy vehicles.

Objectives of the 1971 Transport Plan

4.77 In view of the aforementioned problems, the objectives of the 1970 Transport Plans were[36]:

a) to improve conditions on the major traffic routes and relieve congestion, particularly during peak hours,

b) to assist the Public Transport Services to operate freely and conveniently by the use of priority schemes which are appropriate,

c) to improve car parking facilities adjacent to the shopping and business areas,

d) to improve facilities for pedestrians,

e) to improve Road Safety throughout the City,

f) to improve the environmental conditions throughout the City.

THE ROAD NETWORK TODAY

A Brief Description

4.78 There are now three road connections onto the island from the mainland, namely the M275 on the west side, Eastern Road on the east side, and Portsbridge in between. The latter quickly branches into Northern Parade, London Road and Copnor Road. The Island is also connected to the main British Rail network which provides services to surrounding areas, and London.

4.79 With Portsmouth being the centre of varied activities, this resulted in heavy movement demands focusing on the Central area and Naval Base particularly during the morning and evening peak periods.[37] The Naval Base continues to be the largest single employer of labour in the city, and there have already been problems of access to and egress from the base, particularly at muster times. Other port activities include roll on/roll off ferry services and general cargo operations and these are, in the main, located close to the Rudmore Roundabout at the southern end of the M275. The impact of these latter activities on the local road network is relatively minor. However, it was mentioned in meetings with city officials that the presence of the Continental Ferry Port had a significant effect on the pre-flyover Rudmore Roundabout, particularly when ferries docked.[38] The largest concentration of activity is in the city centre where shopping, education and entertainment activities plus offices are big traffic attractors.

The North-South Road

4.80 This scheme was built in 3 stages (Figure 4.23):

a) Stage 1 : the M275 was from the M27 to Kingston Crescent opened on 11 March 1976,

b) Stage 2 : the link between Kingston Crescent to Church Street opened in November 1980,

c) Stage 3 : this was done in two phases; Phase 1: Holbrook Road, (Lake Road-Somers Road North) opened on December 1983. Phase 2 Somers road-Winston Churchill Avenue opened on 21 December 1984.

The Rudmore Flyover

4.81 This scheme goes over the Rudmore Roundabout (Figure 4.23). It was opened to traffic on the 3rd of March 1988. The Flyover is one of the latest enhancements to the road network in Portsmouth, and can be considered part of the North-South Road scheme. Being a rather new scheme, the actual impacts associated with it will not be clear until the traffic have had the time to settle down. However, and as reported by city officials, early indications are that it has done much to relieve congestion on the west side of the Island, particularly during the P.M. peak

hours. Accessibility to and from the Continental Ferry Port has been improved and it is anticipated that the number of injury accidents on the roundabout has fallen substantially.

4.82 In the following paragraphs, each of the schemes considered will be introduced with a brief description of the scheme, objectives and other relevant information. A discussion of the impacts felt in the immediate corridor, and the changes associated with it, if any, will follow. It will also be pointed out how each scheme met its intended objectives, and whether the scheme has been effective or had turned 'counterproductive'.

THE CASE STUDY

The M275

Background

4.83 As mentioned earlier in this study, prior to the opening of the M275 back in March 1976, Portsea Island had only two road connections with the mainland, namely, Portsbridge and Eastern Road (A2030) with the latter providing a substantial part of the total capacity across Portcreek. As a consequence, many trips destined for the south-west quadrant of the Island via Goldsmith Avenue or one of the alternative parallel routes (Figure 4.23). A relatively heavy demand for east-west movement was observed, particularly in the Goldsmith Avenue corridor which is discussed in more detail later in the study.

4.84 The M275 is a dual 3 lane urban highway built to motorway standards. The opening of the M275 made it possible to utilise a now fully developed motorway and trunk road network (Figure 4.23). With the M275 and Eastern Road providing access to the western and eastern sides of the Island respectively, the volume of extraneous traffic movement on local east-west routes which was often through environmentally sensitive areas (high density residential areas) should have been minimised. And, similarly, the traffic on parallel roads (those branching off Portsbridge) should have experienced better conditions of improved travel speeds, and reduced journey times. In order to investigate the changes brought about by the M275 it was necessary to collect the following data:

- the traffic flow on roads within the M275 corridor which are directly influenced by the new road ('before' and 'after' the M275),

- journey times and travel speeds in the corridors 'before' and 'after' the opening of the M275,

- the changes experienced by public transport in the same period (i.e. number of passengers, passenger miles travelled, changes in the services offered etc.),

- the situation in general in the city after the opening of the new road, and the changes felt on a larger scale (primarily based on information from discussions with city officials).

4.85 Regular surveys of the M275 are carried out for the Department of Transport since the road was first opened, surveys are carried out regularly on Friday, saturday and Sunday monthly. The City Engineer's Department carries out its own surveys on non-motorway sites on Tuesdays or Thursdays, and these are carried out only as required for specific purposes. The Portscreek screenline surveys are carried out twice a year, in July and November. The Civil Engineer's Department also had data pertaining to journey times and average journey speeds for both, the morning peak and the evening peak for most of the network roads. However, such data was only available for 1968 only, and these have not been updated since which makes them of no use for the purposes of this study.

4.86 In the case of the M275, the data available was:

- traffic flows data (16 hour totals from 0600 to 2200 hours over the period 1974-1987) on the major roads directly influenced by the scheme. These are: Eastern Road (A2030), Northern Parade (A3), Copnor Road, and London Road. The development of traffic flows on theses roads is graphically presented in Figures 4.25-4.28. In addition to these flows, the M275 Motorway Traffic Flows over the period 1976-1987 (Figure 4.29), and the total traffic crossing Portscreek cordon (Figure 4.30) were also provided.

In the case of Holbrook Road, the data available was:

- modal Split Surveys carried out yearly by the Engineer's Department and providing percentages of people usage of various travelling modes to and from the central area. This survey is carried out over an inner cordon (Figure 4.23). The same surveys provide data on private vehicles crossing the inner cordon in both directions (inbound and outbound). The Modal Split Survey is usually carried out in November of every year.

At the time of the study, there was no data available on the Rudmore Flyover.

Objectives of The Scheme (The North-South Road)

4.87 The specific objectives associated with this scheme can be stated as follows:

- to provide a much needed connection between Portsea Island and the mainland, where the only two connections prior to the scheme were Eastern Road and Portsbridge,

- to improve traffic conditions in the city in general, where congestion and delays were increasing. Some of the City areas were still expected to continue to experience an increase in congestion and delays. This is mainly due to the road works associated with the many improvements that are underway in Portsmouth,

- reduce the intrusion of the motor vehicle in many areas of the City, hence improving environmental conditions and road safety.

The Traffic Impact of The Scheme

4.88 By looking at the data available in the case of the M275 and studying the traffic flows on each of the main roads before and after the opening of the M275 we find the following:

Eastern Road

4.89 Eastern Road is probably the second most important road in Portsmouth after the M275. It provides a major access between residential areas in the mainland and a large industrial area in Portsea Island. It also serves as a carrier of traffic bound to the City Centre as it connects with east-west roads. From Figure 4.25, it can be seen that after the opening of the M275 (1976), traffic flows on this road experienced a slight drop of about 2,000 vehicles per day down to 34,000 vehicles per day from around 36,000 vehicles per day. By 1980 the traffic flow was back to the 'before' levels. In 1983, a sudden rise to around 42,000 vehicles per day was recorded. This remained rather the same in 1984, rising slightly in 1985, and again in 1986. This can be attributed to the road works and certain road closures associated with the construction of the Rudmore Flyover. In 1987, the flow was up again to around 49,000 vehicles per day. 1987 was the year when the final stages of the Rudmore Flyover were being completed. Figures for 1988 show a slight drop in the flow on this road. This can be attributed to the completion of the Rudmore Flyover and the absence of road works associated with it. This may also be the beginning of a continuing trend on this road.

4.90 Whilst there was a consistent increase in the all day flows on Eastern Road, with a slight drop at the opening of the M275, the peak hour flow has remained constant. This can be interpreted in two ways: 1) the M275 had no attraction for peak hour traffic or 2) suppressed demand took up any capacity released by transferring trips which means that Eastern Road has been at peak hour capacity since pre 1974 and remains so. It remains to be seen whether flow levels changed once the Flyover was completed (sufficient data not yet available). Morning peak flows on Eastern Road dropped slightly as can be seen from the graph (Figure 4.25), but then gradually increased after 1983 to previous levels.

4.91 This is understandable due to the strategic role of Eastern Road whereby traffic heading for the east of Portsea Island find it more convenient. In addition, the road has been the alternative to the M275 during the construction period of the Rudmore Flyover, and because of other road works associated with other local schemes.

Northern Parade

4.92 Northern Parade is one of the major roads branching off Portsbridge. Before the opening of the M275 (1974 and 1975), this road carried a total daily traffic flow of approximately 30,000 vehicles per day (2-way flow, 16 hour day). The morning peak flow (0800-0900 A.M.), for the same period, was close to 3,000 vehicles.

4.93 Immediately after the opening of the M275 in 1976, a very significant drop in the traffic flow was noticed down to less than 18,000 vehicles per day. The peak hour period flow dropped down to about 1,750 vehicles per day. This reduction in vehicles using this road remained basically constant over the years that followed as may be seen from Figure 4.26. It can also be noted from this Figure that the peak hour flow is 10 per cent of the daily flow before and after the opening of M275, whereas in the case of Eastern Road, peak hour flow is a declining percentage of daily flow signifying severe congestion on Eastern Road and indicating once more that the peak hour capacity of Eastern Road had been reached since 1974. It is clear therefore that the new road has removed a large proportion of traffic from Northern Parade, delivering one of its intended objectives.

Copnor Road

4.94 Copnor Road averaged 19,000-20,000 vehicles per day prior to the implementation of the M275. A drop of about 1,000-2,000 vehicles per day down to around 18,000 vehicles per day was recorded shortly after the opening of the M275. In 1979 and the years which followed, however, Copnor Road maintained daily traffic flow levels similar to those in the years before the M275. The morning peak hour traffic flow level remained almost the same throughout (Figure 4.27). The relief experienced on this road was not as substantial as in the case of Northern Parade, because Copnor Road itself is a local distributor carrying little through traffic,

London Road

4.95 London Road also experienced relief from traffic after the opening of the M275. With traffic flows around 21,000 vehicles per day prior to the opening of the M275, the flow recorded shortly after the opening of the M275 was around 17,000 vehicles per day and remained rather constant throughout 1985. The increase observed in 1983 may be attributed to the road works associated with stage-3 of the

North South Road (Holbrook Road), phase 2 of which was completed in 1984 and that is the year when traffic appears to have reverted to its lower normal levels (Figure 4.28) in 1986, a sudden increase of about 3,000 vehicles per day can be seen from the Figure. this is probably due to traffic shifting back to use London Road while the Rudmore Flyover was under construction. Traffic flow in the morning peak remained almost the same throughout. This is not surprising since London Road is one of the main local shopping centres in Portsmouth. This may explain in part why the opening of the M275 did not have such an impact on the London Road traffic flows as it did on Northern Parade besides that London Road is also a distributor not just a through route.

The M275

4.96 The traffic flows on the new road itself have been increasing steadily from around 28,000 vehicles per day in 1976 to around 50,000 vehicles per day in 1987. It appeared to have levelled off between 1980–1983 but increased significantly after 1983. From 1985 onwards the tendency observed seems to indicate traffic levels remaining more or less the same. Traffic flow in the morning peak hour also increased steadily from about 2,500 vehicles per day in 1976 to around 4,000 vehicles per day in 1980 onwards (Figure 4.29). Since the M275 opened there have been almost constant road works taking place to the South of the road (e.g. Mile End Road, Rudmore Flyover and Marketway) which may have had some effect on route choice for drivers. This may explain the stability of traffic levels from 1985 onwards since the growth in traffic was diverted on to other routes to avoid the congestion associated with the road works.

4.97 The following information was obtained from the recorded and predicted traffic flows across Port Creek (dated 22.2.1974) and shows that:

- the total recorded North South flow for 16 hours day for Portsbridge (i.e. Northern Parade, London Road and Copnor Road), Peronne Road, Eastern Road in 1963,

- total recorded North–South flow for 16 hours day for Portsbridge and Eastern Road in 1973,

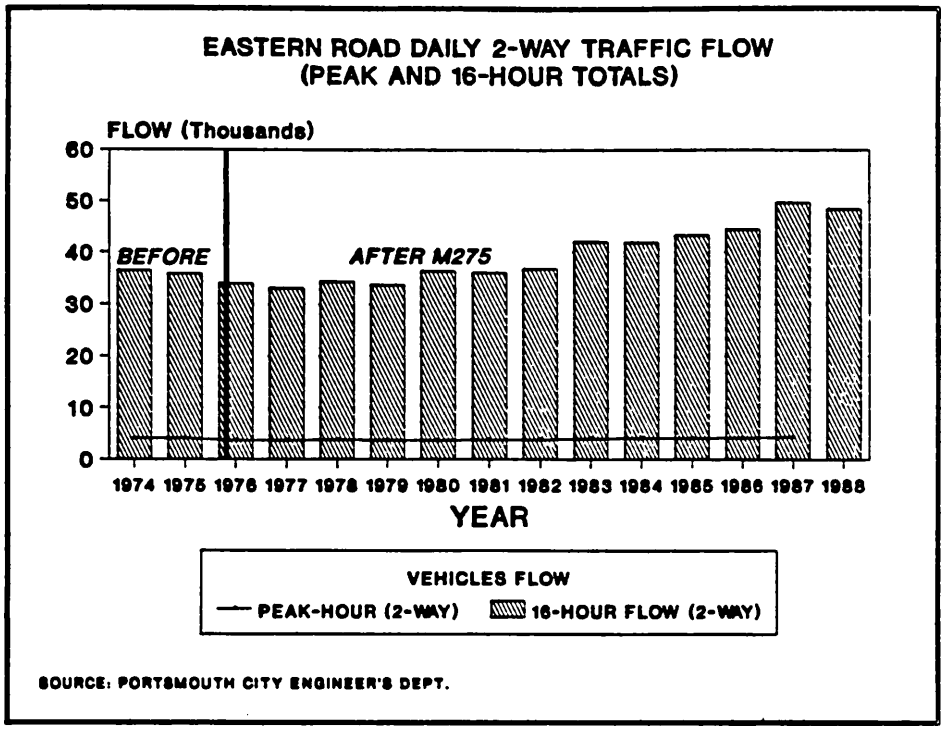


Figure 4.25 The daily two-way traffic flow on Eastern Road 'before' and 'after' the opening of the M275 (morning peak and 16-hour totals).

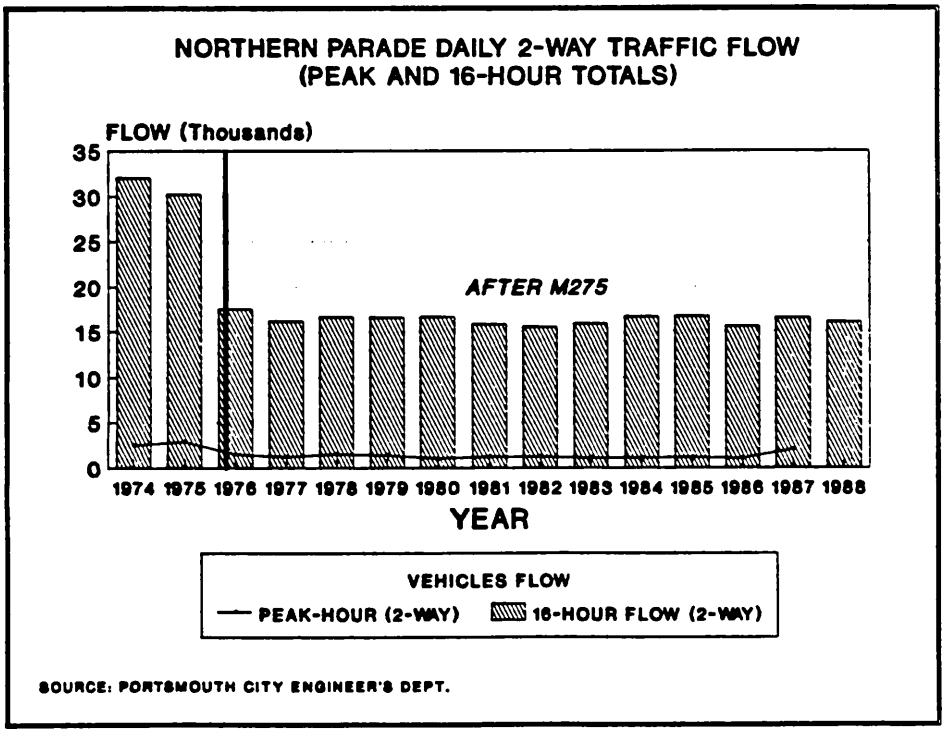


Figure 4.26 The daily two-way traffic flow on Northern Parade 'before' and 'after' the opening of the M275 (morning peak and 16-hour totals).

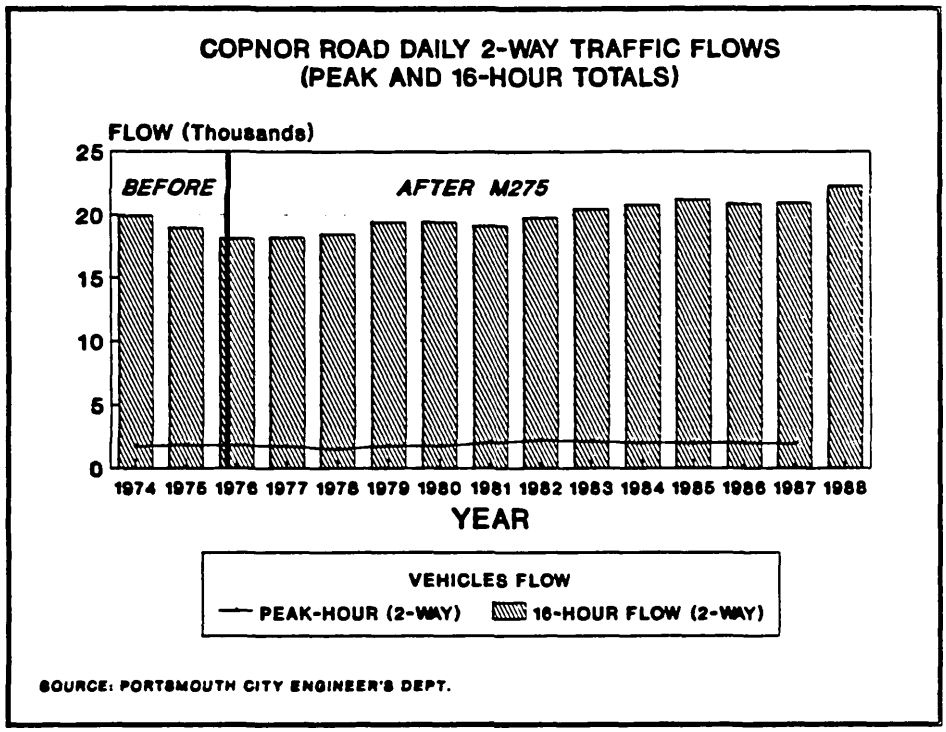


Figure 4.27 The daily two-way traffic flow on Copnor Road 'before' and 'after' the opening of the M275 (morning peak and 16-hour totals).

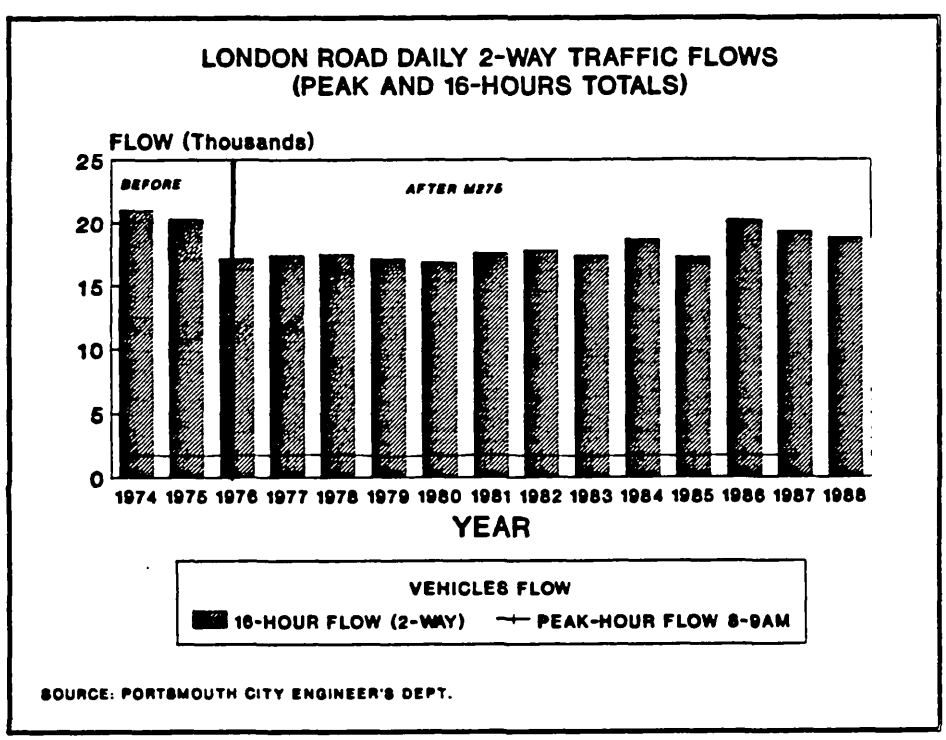


Figure 4.28 The daily two-way traffic flow on London Road 'before' and 'after' the opening of the M275 (morning peak and 16-hour totals).

-predicted total flow North South for 16 hours day for Portsbridge, Eastern Road and North South Road (M275) for 1981,

-recorded total flow North South for 16 hours day for Portsbridge, Eastern Road and North-South Route (M275) for 1981.

This information is presented in Table 4.13. From this table, it can be noted that Portsbridge, which was not to be improved, met the predicted traffic flow whilst Eastern Road and the M275 fell well short of predictions. This disparity between the 1981 predicted and recorded flows was discussed with the officials from Portsmouth who suggested that this was the result of: 1) the downturn in economic growth nationally and 2) the delays in implementing the Future Road Programme which resulted in reduced capacities on some links[38].

Goldsmith Avenue

4.98 As mentioned earlier in this study, the heavy demand on east-west movement of traffic using Eastern Road and heading to the City Centre should have been reduced when the M275 was opened. From the data available[39], and from discussions with the local authority[38], it was suggested that the situation has not changed as much as expected. Nevertheless, fluctuations can be seen from Figure 4.30. The drop seen, in all directions and during peak periods, after 1982 was due to the road works associated with the construction of stage-3 of the North-South Road which made it more attractive for traffic south of the railway in the City Centre to go north to Mile End Road rather than east to Eastern Road.

4.99 This drop is associated with some increases in traffic flow on some other roads of the network in the same period (Eastern Road (Figure 4.25), and Copnor Road (Figure 4.27), however, the drop in flow on Goldsmith Avenue does not equate to the increased flow on Eastern Road. It was suggested by the local authority that the latter was most likely the result of disposal of and development on the former City Airport for Industry/housing commencing 1980/1981 and continuing at present. Reasons given for the drop in flow on Goldsmith suggest that the noncompletion of the loop roads makes it very difficult to utilise the network to the full extent. With many road works still going on in different parts of the centre, bottlenecks from certain road works (for example that caused by the construction of the Rudmore Flyover) have always made it difficult to realise the actual relief that should have been

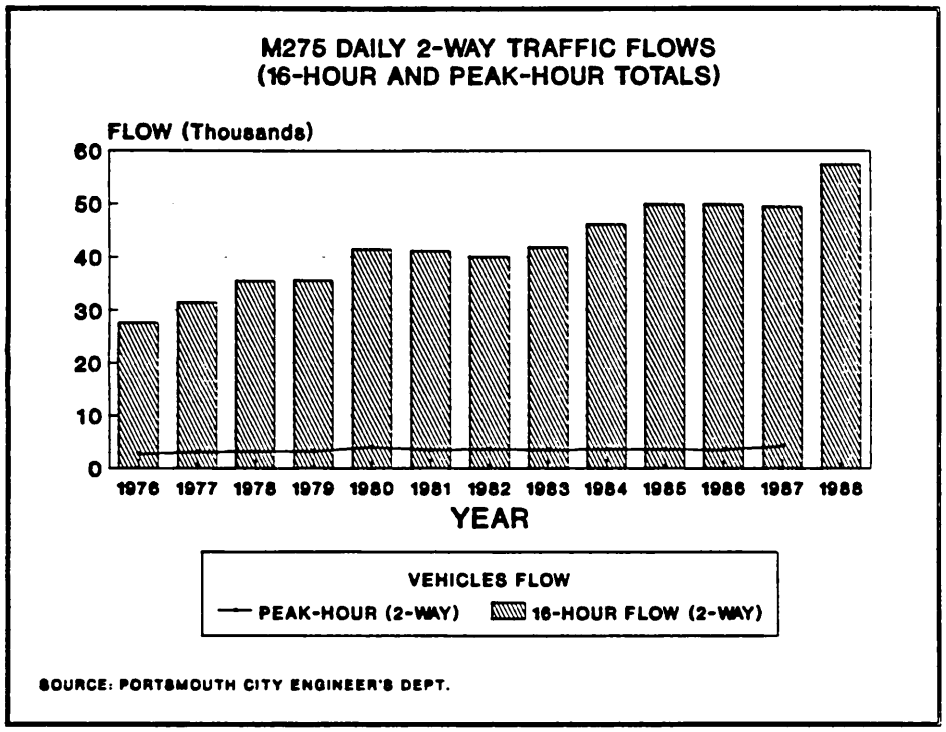


Figure 4.29 The development of daily two-way traffic flow on the M275 in Portsmouth.

Road Used	Year			
	1963	1973	1981 (predicted)	1981 (recorded)
Portsbridge	58,000	74,800	48,500	49,038
Peronne Road*	31,000	-	-	-
Eastern Road	18,300	37,700	60,500	35,647
M275	-	-	77,000	40,702
Total	107,300	112,500	186,000	125,387

* Peronne Road is now restricted to pedestrians\cycles\motorcycles.

Table 4.13 The development of total recorded 16-hour daily flow in PCUs on selected Portsmouth roads (1963-1981).

Source: Portsmouth City Engineer's Department.

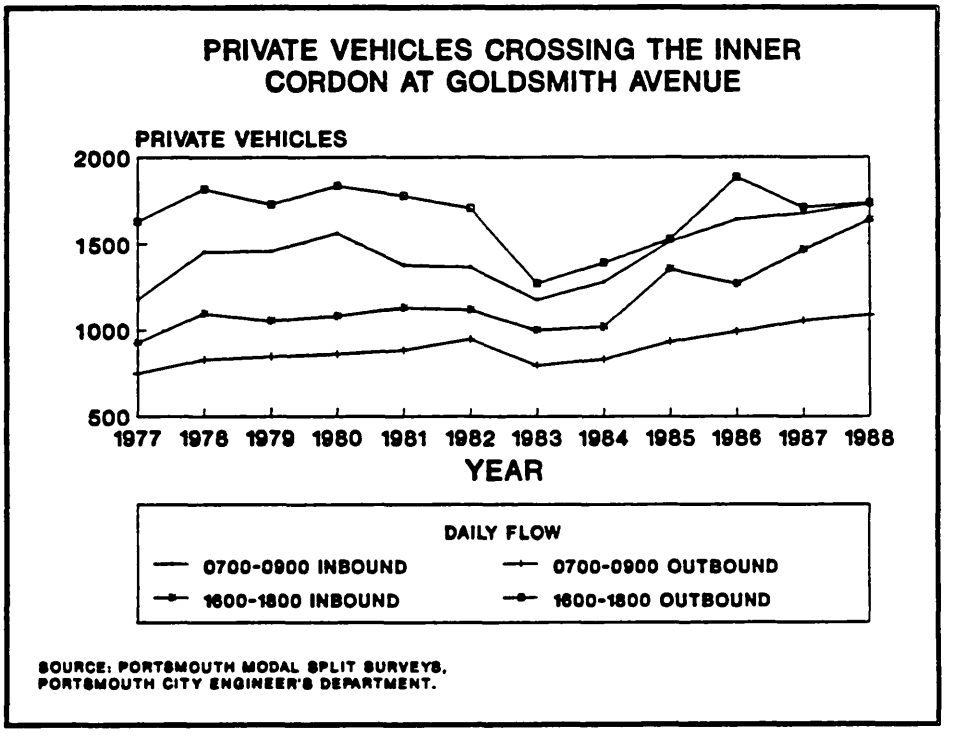


Figure 4.30 The development of private vehicles crossing the Inner Cordon at Goldsmith Avenue.

felt by the new road. At present, further road works in Market Way make it difficult to see the actual impact of the new road and the new Flyover but it was pointed out that, by observation, P.M.peak flows out of the city are much improved. Furthermore, Eastern Road is one that had been used by people for a very long time, and the fact that it is more enjoyable (scenery wise) makes it attractive for many motorists, thus keeping the demand on Goldsmith Avenue for the east-west movement.

The North-South Road Stage 3 (Holbrook Road)

4.100 The building of this road was partly justified on the basis of relieving traffic congestion and existing bad conditions of the parallel and busy shopping street Fratton Road. The relief of Fratton Road between Arundel Street and Goldsmith Avenue was dependent upon this road. One of the primary objectives of this scheme was the removal of extraneous traffic using restraint measures. Phase 1 of this scheme (Holbrook Road) was opened in December 1983. Phase 2 (Somers Road) was opened in December 1984. Both phases are shown in Figure 4.23.

4.101 The data available was in the form of four traffic censuses carried out by the City Engineer's Department. They were carried out on a Tuesday (February 3, 1977, a Thursday (April 27, 1978), a Saturday (March 26, 1983), and another Tuesday (March 22, 1988). The data from the Saturday census has not been taken into consideration. The data from the censuses is presented in Table 4.14. The percentage change in traffic volume on Fratton Road with comparison to the two earlier surveys before and after Holbrook Road was improved are presented in Table 4.15. From this table, it can be seen that a significant reduction in the traffic volume on Fratton Road was experienced equally in both the north and south directions.

4.102 It is clear from these tables (Tables 4.14 and 4.15) that the building of the North-South Road Stage 3 (Holbrook Road) has served to reduce the amount of traffic on Fratton Road, and hence, improved conditions for traffic and shoppers. A lot of through traffic has been successfully diverted on to Holbrook Road, therefore reducing the pedestrian-vehicle conflict and the pressure on this environmentally sensitive area. The building of this road has definitely made a change by eliminating previous delays and congestion experienced on Fratton Road, and making the street

Date of Traffic Census	Fratton Road (North)	Fratton Road (South)
Tuesday 03.02.1977	9,491	9,084
Thursday 27.04.1978	9,515	9,469
Tuesday 22.03.1988	7,041	7,018

* The figures in the table do not include pedal-cycles. They include motor-cycles, goods vehicles, motor cars, light vans, lorries, buses and coaches.

Table 4.14 **Traffic flow on Fratton Road 'before' and 'after' the opening of Holbrook Road.**

Source: Portsmouth City Engineer's Department.

Road Section	Difference 77–78 (Before)	Difference 78–88 (After)
Fratton Road (Northbound)	+ 0.25%	–26.00%
Fratton Road (Southbound)	+ 4.24%	–25.88%

Table 4.15 **The percentage change in traffic volume on Fratton Road 'before' and 'after' the opening of Holbrook Road.**

Source: Portsmouth City Engineer's Department.

more pleasant for shoppers and pedestrians as a result of improved environmental conditions.

4.103 A point which was raised during the presentation of a paper on this research at the UTSG Conference (1990) was that of the cost in terms of housing lost as a result of building Holbrook Road (about 400 homes were demolished). This matter was followed up with the City Engineer's Department in Portsmouth. The response was that 'the new road was always foreseen as offering relief to Fratton Road'.[40] This relief was even extended to Kingston Road, London Road and the parallel routes of Copnor Road and Northern Parade. In the Department's view, based on their experience, Holbrook Road affords considerable relief to Fratton Road even in diverting many local trips. Furthermore, and based on advise by the City Planning Officer, the situation was such that '..all the houses south of the railway line and north of Bradford Road between Somers Road North and Victoria Road North were scheduled for demolition as part of a clearance scheme; many of them had been condemned as unfit for habitation and although a case had been made for their retention and refurbishment, public inquiries into the Compulsory Purchase Order found in favour of clearance'. Furthermore, 'about half of the properties became incorporated into the road scheme, the balance of the clearance area has subsequently been redeveloped for new industrial units and offices'.[40] It is therefore clear that the road did not cause the demolition of these houses but that they were scheduled for demolition as part of a City clearance plan. Furthermore, this was investigated in the public inquiry and was approved.

4.104 The journey times, and average journey speeds data available dates back to 1968. It was being considered whether a limited survey to obtain present day corresponding data is feasible, however, since the 'before' data available is for a very different network from the one present today such a survey will not be of much significance for the purposes of this research.

4.105 The Portsmouth Modal Split Survey, which is usually carried out in November yearly, provided certain figures and findings. The Survey, as mentioned earlier, has many parts. For the purposes of* '*+' +(, it was possible to obtain the modal split figures across the Inner Cordon (Figure 4.23), in order to asses the impact Holbrook Road might have had on the modal split. The percentages of 'inbound' person trips, by mode during the morning peak period are presented in Table 4.16. From the table, it can be seen that well before the opening of the scheme (in 1984 and 1985),

the established trend had been that of increasing private transport share and a declining bus share. The changes after the road's second stage was completed in 1985, indicate that the trend of declining bus share was reversed, with 1986 figures actually showing a slight increase. This may be the result of improved travel times by road, however, the change is so small that no firm conclusions can be drawn in this respect. The car share continued to increase; nevertheless, there were no sudden changes immediately after the opening of the new road. The train maintained a stable share throughout the period and started to show an increase in 1987. Figure 4.31 is a graphic presentation of Table 4.16. It appears therefore that the provision of new capacity in this corridor did not cause a modal shift. On the contrary, the indications are that it slowed down the decline in bus share. The data available, however, is not adequate enough to substantiate a more conclusive deduction.

4.106 The Portsmouth Modal Split Survey also provided figures for the total number of private vehicles crossing the Inner Cordon during the same period. The figures are presented in Table 4.17. From the table, it can be seen that the opening of the road (1985) did not lead to any sudden changes in the number of vehicles entering the city during the morning peak, as they remained generally constant through 1987. It can therefore be said that the new road did not generate more traffic or lead to increased use of the private vehicle.

4.107 Over the years, nevertheless, the Modal Split Survey figures have indicated an increase in travel by private vehicles and a decline in the use of buses (public transport).[39] This trend had been foreseen by the City and County Councils and was attributed to a number of factors:

- the reduced quality of public transport services makes the service unattractive and hence leads to people using the other mode,

- Portsmouth is still a city with very little suppressed demand. Traffic conditions in the city make the use of a car more attractive in most respects.

The Rudmore Flyover

4.108 A more recent improvement to the road network in Portsmouth is the 'Rudmore Flyover' which was opened in March 1988. The flyover stretches from the end of the M275 over the Rudmore Roundabout, and was built to relieve the

Mode	1978	1979	1981	1982	1983	1985	1986	1987
Private Vehicle	56.5%	56.0%	61.0%	61.0%	60.0%	62.5%	64.0%	66.9%
Bus	18.2%	18.0%	12.0%	11.0%	11.0%	10.9%	11.0%	9.6%
Train	6.1%	7.0%	7.0%	7.0%	7.0%	7.0%	7.0%	7.9%

Table 4.16 Person trips by mode of travel across the Portsmouth Inner Cordon (1978–1987).

* The total percentages do not add to 100.0% since the table does not include figures for other modes, namely the pedal cycle and the Ferry.

Note: No data available for 1980,1984.

Source; The Portsmouth Modal Split Surveys (1978–1987).

1978	1979	1980	1981	1982	1983	1984	1985	1986	1987
14,140	13,639	14,310	14,241	14,172	14,045	13,717	14,416	13,745	14,918

Figure 4.17 The Total number of private vehicles crossing the Portsmouth Inner Cordon 'Inbound' in the morning peak period (0700–0900) between 1978 and 1987.

Source: Portsmouth Modal Split Surveys (1978–1987).

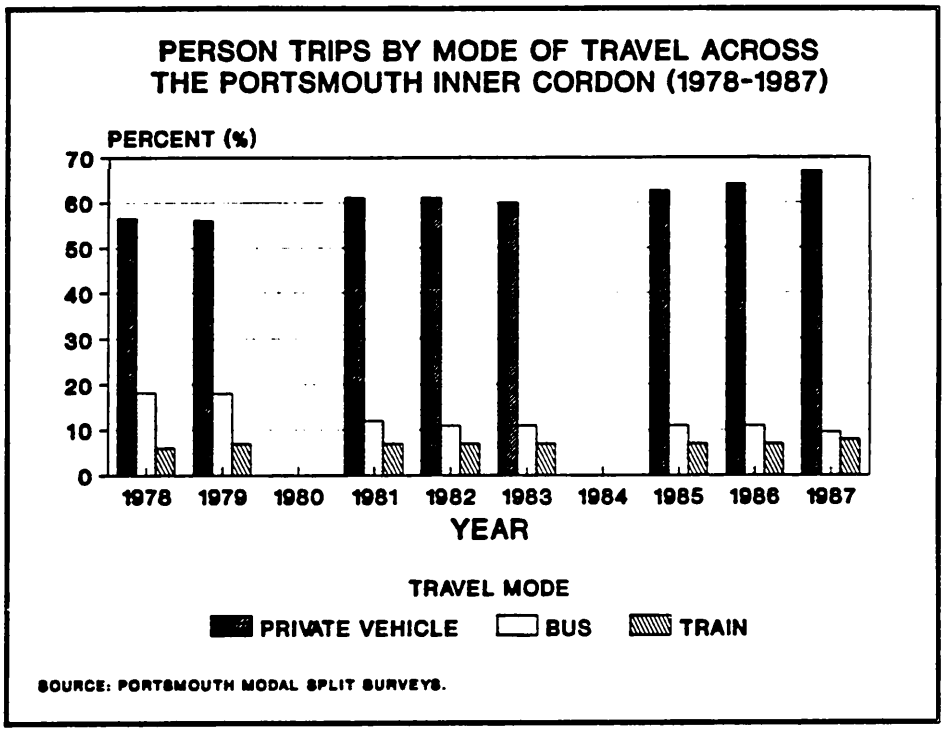


Figure 4.31 Person trips by mode of travel across the Portsmouth Inner Cordon 'before' and 'after' the opening of Holbrook Road.

bottleneck which was a characteristic of the latter. The building of the flyover was also justified as a measure to reduce the high accident rate at the roundabout. With road works still going on in the central area (Marketway), the full benefits expected from this flyover may not be realised for sometime particularly in the A.M. peak period.

4.109 The construction of the flyover itself which involved some traffic diversions and sometimes reduced road capacity during that period was one of the factors leading to sudden increases in flows on some roads during the construction period, as seen from graphs and figures presented in the previous paragraphs. Unfortunately, there were many gaps in the daily UTC (Urban Traffic Control) records caused by the malfunction of some counters on some days which made the data available rather inadequate to reflect a precise picture. The traffic situation, at the time of the study, was not settled. I am unaware of any surveys done in the city to assess the impact of this scheme which has been in operation for over two and a half years now.

4.110 By talking to people who use some of the roads directly affected, I was informed that the traffic conditions have improved to a large degree since the opening of the flyover. The long delays that used to be experienced by traffic coming down the M275 are not a common thing any more even during peak hours. The fact that many vehicles are now able to avoid the Rudmore Roundabout has improved traffic conditions, and also reduced the conflict at that location. This certainly seems to be another successful new road scheme. At the time of this study, a study of the Flyover's impact on accidents in the Rudmore Roundabout area was underway in the County Surveyor's Office (Accidents Unit),however, the findings of this study are not yet available.

4.111 At the time of the study, and based on a simple journey times survey done by some of the City Engineer's Department employees, a noticeable improvement in journey times was evident. The only major construction work hampering the recording of actual journey times in the network was the major construction underway on Marketway (realignment and widening) which also resulted in a bottle neck on that roundabout during peak hours, and particularly the morning peak. It was also noticed in the city that congestion in the evening peak, other than that directly related to the roadworks, has practically been eliminated, and that the situation has improved very noticeably as reflected by the disappearance of the typical evening queues before the building of the flyover.

PUBLIC TRANSPORT

4.112 The present situation under the deregulation is still not very clear. The attempts to establish contact with the local operators of public transport made it clear that the sort of information sought was considered confidential by the operators and would not be released. It is worth noting that there is no evidence to the suggestions that the construction of new roads causes the decline of a public transport in a way which leads to its complete deterioration. In the case of Portsmouth, where the public transport mode within the city is primarily road borne, it was mentioned that the relief on existing network roads made possible by the new road made journey times quicker, nevertheless, no major changes in the services schedule were made due to economic reasons.

4.113 In general, the meetings with the Portsmouth officials indicated that the experience of road building in Portsmouth has been a positive one.[38] The new roads have fulfilled their objectives of providing for the demand, and improving travel conditions on other roads in the network. The full impact of all the improvements, and the new roads built in Portsmouth is not fully realised yet. This is due to road works associated with ongoing road construction that still causes some bottle necks in certain locations. In spite of this, the benefits felt, area wide, are very positive. The opinion of officials who commute to the city is that journey times have been reduced significantly, and this indicates an improved travel speed and a smooth flow of traffic as witnessed on Portsmouth roads. It is expected, however, that when these works are completed, the total effect on road conditions will be felt bringing with it further improvements to traffic conditions, more savings in journey times and increased travel speeds.

REMARKS

4.114 The data available from Portsmouth was not as comprehensive as one would have liked. The figures were fragmentary with gaps in the period considered. In particular, the absence of adequate 'before' data to allow a thorough examination of the changes in the corridor of the M275. This was blamed on a fire in the Department which destroyed a substantial amount of files and records containing the earlier information. This made it difficult to determine the growth pattern in the corridor and the specific changes which might have been influenced by the implementation of the M275.

4.115 With relation to Holbrook Road, very little information was available. The traffic censuses used in the study were all the relevant material available. There were no traffic counts on Holbrook Road itself which made it impossible to determine the changes in the corridor. The lack of actual figures and data, in general, made it necessary to rely to a large extent on information provided in the meetings and discussions held with Portsmouth City Officials.

SUMMARY AND CONCLUSIONS

The M275

4.116 The need for this scheme was evident as early as the mid sixties when the Future Road Pattern Report was agreed on. The report, based on the then existing conditions in the city, deemed the scheme necessary to reduce increasing delays and congestion and reduce the conflict and danger from areas subjected to intrusion by the motor vehicle. The scheme's specific objectives were along the same lines of the main objectives of the report, namely to improve conditions on the major traffic routes, relieve congestion (particularly during peak hours), improve road safety throughout the City, and improve the environmental conditions throughout the City. The road was particularly needed to reduce the pressure of increasing demand on north–south movement (between Portsea Island and the mainland). A movement catered for by two connections only: Eastern Road, and Portsbridge. The road was also needed to improve conditions on roads used for east–west movement, i.e. to the City Centre where major attractions are located.

4.117 From the data available, it is apparent that the need for this scheme existed long before it was built. Its impact is felt throughout Portsmouth where the road has improved the North–South movement by providing a very convenient high capacity connection. It has also improved the east–west travel. The immediate impact of the road was most obvious on the roads branching off Portsbridge. The most apparent was that manifested in the reduction of daily traffic flow on Northern Parade from around 31,000–32,000 vehicles per day to only 17,800 vehicles per day in the same year the M275 was opened. This was even cut down further to under 16,000 vehicles per day in the years that followed. The level of traffic on this road (Northern Parade) has since remained almost stable at about 15,800–16,200 vehicles per day. This represents a reduction of about 50 per cent of traffic levels before the opening of the M275. The significance of this reduction can be appreciated since Northern Parade

is situated in an environmentally sensitive area of residential and educational frontage. The improvement to the environment, as well as to traffic conditions in terms of journey times and travel speeds (as can be interpreted from the reduction of traffic flow) is a very substantial one.

4.118 The road's benefits were not only confined to Northern Parade however. Much needed relief was also felt on Eastern Road which used to carry a very high portion of traffic heading to the centre. The reduction in traffic flow on Eastern Road was not as much as that experienced on Northern Parade (only 2,000-3,000 vehicles per day less). However, when taking into account the growth in traffic on Eastern Road, which seems to have been restrained as a result of the implementation of the M275, the relief can be appreciated. From Figure 4.29 it is clear that traffic levels went up noticeably as of 1982 reaching its highest ever levels in 1987. However, when taking into consideration the pressure put back on Eastern Road, as a result of road works associated with the construction of Holbrook Road first and, more recently, the Rudmore Flyover, and also the development at the former City Airport, we can imagine what the situation could have been like had the M275 not been built. With the Rudmore Flyover in operation now, the situation on Eastern Road should improve with traffic levels falling. This will have to be seen from future surveys. Discussions with highway officials, who commute to Portsmouth, made it clear that this road has given the city a very much needed relief. Accessibility was also improved, and the capacity enhancement made it possible to cope with traffic growth and the demand for travel in Portsmouth.

Holbrook Road (North-South Road Stage 3)

4.119 This scheme was justified primarily on the need to improve environmental conditions in the Fratton Road area, also to reduce traffic congestion and to complete an inner city ring road (with Marketway and Winston Churchill Avenue). Fratton Road, as described earlier, is a busy shopping street. A lot of through traffic used the road before to get to the City Centre. This created long delays, traffic congestion and pedestrian-vehicle conflict. The need for this road was clear to maintain the City policies stated earlier. The most direct impact of this scheme was felt on Fratton Road. The main objective of this scheme was to give a much needed relief to an environmentally sensitive area of shops and people (Fratton Road). The results, presented in this report, show the improvements achieved and indicate that the scheme was indeed successful.

4.120 This road was built in the heart of urban Portsmouth, and it does not seem that, even after more than 4 years of operation, there is any proof of counterproductivity. There is, however, more than one indication of improved traffic conditions, eliminated congestion and improved environmental conditions.

The Rudmore Flyover

4.121 The latest improvement to the road network in Portsmouth was this scheme. Because of the short period this scheme has been in operation, and due to road construction related works in the corridor of the scheme, very little information is available so far. The scheme was implemented based on the need to improve road safety and traffic congestion and delays at the Rudmore Roundabout. Since a large proportion of this traffic came down the M275, the scheme was seen as a measure to improve both safety and traffic conditions. According to highway officials, the flyover has already improved the conditions for the movement towards the Centre and west of Portsea Island. It has reduced the previous delays experienced on the Rudmore Roundabout, and journey times are reported to have been cut by more than half for some trips indicating better travel speeds and reduced congestion. Unfortunately, no data from surveys or studies is available yet. It will be interesting to see what the situation will be like in Portsmouth once the new traffic pattern is established.

4.122 From the schemes presented in the previous paragraphs, there is no evidence at all of any counterproductive effects on the road network in Portsmouth resulting from these new roads. On the contrary, there are many signs of positive impacts displayed in reduced traffic congestion, improved safety and reduced conflict, higher travel speeds, and improved overall environmental conditions. The highway officials commented that Portsmouth is, commercially, an island site. As such, it has no through traffic element. Everything coming onto the island has a destination there. Therefore, new roads may result in suppressed demand being released, and overall flows increasing accordingly, but trips are not generated by the road itself in the way that, say, a bypass scheme may attract longer journeys and more traffic on it because long delays in an urban area can be avoided.

4.123 The impact these schemes had on public transport was difficult to assess due to the deregulation of bus services back in 1986. The previously one public transport operator service, which covered all service routes, is currently shared by three

different operators with the routes distributed among them. The information sought from the public transport sector, namely: passenger numbers, journey times, cost etc. were deemed confidential and couldn't be made available in fear of competition. The main source of information was the modal split surveys carried out yearly by the City Engineer's Department. These surveys provided useful information of which relevant matter are presented in earlier tables and figures. The trend in Portsmouth has been that of a reduced demand for the public transport services, which was foreseen by early studies in Portsmouth and supported by the surveys' data. However, there is no evidence of any unexpected modal shift as a result of the new road.

4.124 Portsmouth is a small sized urban area with, probably, little suppressed demand. The new road schemes in this well developed city have turned out to be very effective in so far as they have improved traffic conditions as well as improving environmental conditions on the parallel roads. The implementation of these schemes in Portsmouth has proved to be very beneficial for the city and the people. As put by one of the highway officials in Portsmouth, 'with the city being a fully developed urban area, new roads have to be weaved between the existing developments. The schemes, all different in nature, have served and are still serving the city with better accessibility and environment'.

CHAPTER 5 CASE STUDIES FROM THE FEDERAL REPUBLIC OF GERMANY

A: HAMBURG

INTRODUCTION

5.1 Hamburg (Figure 5.1), is the second largest city in West Germany. It is situated on the River Elbe, only 70 km from the open sea and is the largest port in West Germany. On the 7th of May 1189 Emperor Frederick Barbarossa granted Hamburgians customs-free trading on the Elbe and it became Hansestadt Hamburg. This laid the foundations for the port's progress to one of the world's most important harbours. With the growth in North Sea and overseas trade since the 16th century Hamburg surpassed the neighbouring Hansestädte (Hanseatic cities) to become the second largest in Europe today.

5.2 Hamburg is one of the eleven Lands or states that constitute the Federal Republic of Germany. The boundary of the Land is quite tightly drawn around the built-up area and a considerable part of its hinterland for journeys to work , shopping and other functions is in the neighbouring Länder (states) (e.g. Schleswig-Holstein and Lower Saxony)[41]. The city has a population of 1,5 million within the city boundaries and about 2,5 million within the Greater Hamburg Area (Figure 5.1). The city has 200,000 jobs with only approximately 10,000 inhabitants living permanently in the city centre area. This separation between home and work means very large daily commuting flows[42]. The city centre (3.5 km^2) is largely contained within the boundaries of an inner ring road (Figure 5.1). The current private car and all vehicles ownership figures in Hamburg are: 400 PKV* (Personenkraftwagen) and 480 KFZ** (Kraftfahrwagen) per 1000 people, respectively.

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* Private cars only.

** All vehicles.



Figure 5.1 **The Greater Hamburg Area and the road scheme considered.**

BACKGROUND

5.3 Transport in Hamburg, like that in most German cities is well organised and coordinated. Large pedestrianised areas have been introduced in the city centre; a strict parking policy is in effect; and the city is served by a well integrated public transport system. In the region, it is easily accessible via a network of good roads and Autobahns (motorways) which connect it with the outer areas and the rest of the country.

5.4 In the 1970's and during the stagnation period (high oil prices, etc.) the politicians, and many others, thought that there will be no further growth of road traffic due to the high prices. This lead to a number of originally planned urban motorway schemes[43,44] being trimmed down. The reasons for scaling down the plans for more roads were[42] :

- Environmental: it was suggested that roads in the built-up area will create noise and air pollution in already sensitive areas.

- Economic: The need for such roads did not exist since no real growth in motorisation was anticipated.

As a result, two planned tangential roads were completely ruled out and a policy of relief on bottle necks was adopted.

5.5 With the growth in traffic continuing in the early 80's, a government paper (one of a series produced regularly) titled 'Entwicklung der Verkehrsinfrastruktur in Hamburg ('The Development of Transportation Infrastructure in Hamburg')[45] addressed the problem, and formed the basis of a Hamburg Master Plan[42]. The paper discussed transit lines as well as new roads and recommended the building of 3 new transit lines and the extension of few existing ones. Furthermore, the plan also proposed the provision of a complete network of motorways in the built-up area.

THE EXISTING SITUATION AND CURRENT POLICIES

The Existing Situation

5.6 The structure of development in Hamburg originated as a series of growth axes on road and rail transport[41]. The overall planning of traffic structure has been much influenced by the Hamburg Density Model[41]. This model combines three concepts: i) axes of growth into neighbouring Länder (states) with some of them branching; ii) the structuring of the main transport network around rapid transit with bus feeders and Park-and-Ride;iii) a hierarchy of central places along the axes. The model defines three main concentric zones: a) Outer Zone: where the private car is the dominant mode with buses to the rapid rail axes, and Park-and-Ride* at stations; b) Transitional Zone: park-and ride and a more dense bus-feeder network; and c) Inner Zone: where public transport is mainly by rapid transit and the roads are designed for business traffic.

5.7 The situation in Hamburg is not much different from that in other German cities. Traffic congestion is felt at certain road sections during the peak periods and at certain bottle necks on the major approaches to the centre from the south. A well-known bottle neck in Hamburg is that of the NordElbrücke (the New Bridge) (Figure 5.2). The bridge reaches its full capacity during the morning peak periods. The growth in traffic on this route has gone in different ways with additional use of the A1 (Figure 5.2). These bottle necks are the result of inadequacies within the network and are being remedied by means of added capacity to the network, junction improvements, and measures to create a redistribution of traffic. Past the bottle necks, and during off-peakperiods, traffic is generally free-flowing with no significant delays or hold ups.

Current Policies

5.8 The latest Master Plan for Hamburg has adopted 4 main objectives or goals:

a) priority for public transport in the city centre, with supporting measures of parking control and marketing strategy;

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* Park-and-Ride is provided at 48 rapid transit stations with a total capacity in 1981 of 7,250 places[41].

b) maintenance of economic growth by catering for the essential business traffic defined as weekday traffic, entering the city during the off peak period between 0900–1500;

c) promoting bicycles as a mode of transportation by the building of bicycle lanes. However, since the conditions necessary to ensure a significant bicycle traffic and make the mode successful (e.g. flat topography, short travel distances, large proportion of student commuters, etc.) were absent in Hamburg due to concentrations in the subcentres, and the difficulty in accommodating bicycles in the city this was not really feasible. Therefore, promoting Bike–and–Ride has been the major interest;

d) the continuous promotion of Park–and–Ride schemes which have been implemented in Hamburg since 1963.

THE ROAD NETWORK

5.9 Hamburg, like most German cities, is connected with the rest of the country via a well co–ordinated national Autobahn network. The city of Hamburg has a road system which consists of some 3,900 km divided as follows[42] :

–80 km of divided motorways with 4–6 lanes,

–800 km major arterial roads with at least half of them being 4–lanes and the rest being 2–lanes. In addition, there are also 20 km of major roads with 6 lanes with the remaining network roads being minor and residential roads.

As can be seen from the aforementioned figures, about 1/4 th of the system consists of major roads. It should also be noted that about 75 per cent of all traffic on the system (in terms of vehicle–kilometres per day) is carried by this part of the system[42]. This 25 per cent of the network carries the bulk of vehicle kilometres in the city, a situation similar to that in many cities around the world, but in many cases the network available is less adequate.

Policies for highway development

5.10 A non-written long time policy of the city has been to avoid building radial roads, at least into the city centre. In addition, a no widening policy of roads in the centre and high density built-up areas is adopted due to the mounting pressures from environmental groups which are very strong and active in Germany. The city, nevertheless, has a very strong policy towards the maintenance of existing roads. The roads are maintained to keep them in good operational order. The policy is also to enlarge existing roads, and add on capacity, especially motorway capacity whenever feasible (outside the boundaries of the centre). That is, the construction of more Autobahn links whenever feasible environmentally and economically. New road links are generally built through industrial areas and not through residential areas or open space. The new schemes, planned and underway therefore take into consideration many aspects which are generally aimed at fostering and strengthening circular and tangential roads rather than radial roads by adding more tangential and circular sections whilst avoiding, whenever possible, radial ones.

5.11 In addition to maintaining the network, traffic relief is provided by:

a) Building new by-passes to relieve congested roads.

b) Making the most of the existing capacity by encouraging drivers to use the most appropriate route, rather than environmentally sensitive alternatives, by means of: i) employing capacity reducing traffic management measures on the alternative link (e.g. the removal of lanes, traffic signals, longer green for pedestrians, etc.); ii) cutting the old link completely off the network (e.g. pedestrianisation); and iii) the provision of a link connecting the routes to the motorway therefore improving accessibility within the network.

The official view in Hamburg is that the provision of extensions within the road network make the whole network better accepted[42]. That is to say that the network can be better utilised when it is integrated through links that improve the accessibility within the network itself. This, therefore, makes the network more efficient. Connections with nearby motorways seem to have a significant effect in this respect.

5.12 The main benefits of building roads in urban areas are positively viewed in both operational and environmental terms. The operational aspects include reducing

traffic congestion on existing roads by diverting extraneous traffic off the old roads, and improving safety for the drivers and other users. Inducing a redistribution of traffic also helps relieve traffic congestion and improve the environmental conditions in the area affected.

5.13 The environmental objectives (which are not very different from those in other countries), include the relief of environmentally sensitive areas of so much traffic. This leads to the reduction in air and noise pollution plus the possible reduction of accidents and the conflict between pedestrians and the motor vehicle. In the highway policy making house, the emphasis is on striking a balance between both the environmental and operational aspects, however, environmental considerations seem to have more bearings on policy decisions, a trend only too well known throughout German cities. This does not mean the abandoning of new road schemes but their provision with the utmost of environmental safeguards.

5.14 On the matter of congestion, the view in Hamburg is that traffic congestion is to an extent an indication of the prosperity of the city. However, it is concerned that it does not spread unduly and it is the philosophy of the department that as long as the essential business traffic (between 0900–1500 hours) is kept running and is well catered for, the situation is acceptable[42]. In the peak periods, the commuter share of traffic rises sharply, but the city accepts this type of congestion only for the peak period since it is only a temporary situation resulting from commuter traffic. This recurring congestion is also seen as means of diverting people to public transport. The main emphasis is on the provision of adequate supply for the essential traffic demand. This essential traffic (between 0900–1500 hours) consists, generally, of people using the road for commercial purposes (commercial traffic), shopping, and businessmen rather than commuters to work. It is usually the bulk of daily traffic volume compromising about 75 per cent of that volume. At least 50–60 per cent of this traffic is considered vitally essential to sustain the economic life of the city, and the obligation is to serve this demand and try to provide a level of service with as little congestion as possible.

5.15 The road schemes which were recommended in the 1982 document are now seen (by the authorities in Hamburg) to be more than what is really needed in Hamburg. The amount of road building which was then suggested was not reasonable since it involved a considerable number of motorway links and high capacity roads which are not really needed in Hamburg since it was based on

unrealised forecasts of growth in population and traffic.[42] Nevertheless, improvements to the network are still needed. The land which was originally reserved for the proposed motorway schemes will not be used for other developments but will be kept available for transportation needs. The city plans to plant these areas (protected green space), therefore preventing other developments and leaving the city with the option to build these roads in tunnel should the need ever arise.

PARKING

5.16 The parking policy for the city goes back to the early 60's. In recognition of the inter-relationship between parking availability and traffic volumes, it was decided that there needs to be a ceiling on the number of parking spaces available in the centre (within the inner ring road). With essential traffic needs in mind, the ceiling was originally set at 30,000 spaces. Today, there are only 28,000 spaces available for both short and long stay parking. The 28,000 spaces is the total number of all parking spaces available at any one time. This includes private, backyard and kerb-side parking. Another policy adopted by the city is to change most of the long stay parking to short stay. This is all co-ordinated and done within the wider context of town planning and land use. The modal split to the city has been maintained steady for the past 10 years by means of land use changes and enforced parking policy[42].

5.17 This policy is evident when it comes to new developments in Hamburg. When developments in the urban area are approved, the planning laws require the developer to provide a number of parking spaces in direct proportion to the size of the development. With the many developments that took place after the war, the policy has been to allow the developers to provide only 1/3 rd of the number of spaces required, by the city, for short stay parking. The difference (the cost of the remaining 2/3 rds) is paid to the city. This money is then used in other projects such as building Park-and-Ride facilities, promoting and improving the public transport system. The main aim of all arrangements with developers is to provide short term public parking spaces while maintaining the ceiling of 30,000 spaces altogether in the city centre. This involves a redirection of the collected money to Park-and-Ride schemes which encourage the use of public transport in the city centre. That is to say that the parking spaces deemed necessary for the developments are actually provided, but are put elsewhere, so that they don't contribute to traffic congestion. Some of the money even goes to improving public access to stations (e.g. building another entrance). The city also subsidises the provision of parking spaces in

residential areas where only kerb-side parking is available. Developers are given concessions in return for providing parking spaces at a reasonable fee to local residents in the area.

THE PUBLIC TRANSPORT SYSTEM

5.18 Public transport in Hamburg plays an important role in the traffic picture., and is regarded as essential for the efficient functioning of the urban area[42]. The city is served by a total of 13 rapid transit lines with a total length of 287.7 km (excluding common sections) and 181 stations, complemented by bus routes[41].

5.19 These railway lines are run by different operators but everything (including the buses) is grouped under and co-ordinated by a Transport Association, the HVV (Hamburger Verkehrsverbund) (The Hamburg Transport Community) which was, at its foundation in 1965, the first of its kind in West Germany[46]. The buses are largely confined to the suburbs with relatively wide spacing of stops and high average speeds. Although the railway network is the backbone of the public transport system in Hamburg, buses also play a very important role (they account for a major part of journeys by public transport). The bus routes are radial in nature[46]. An express bus service with limited stops is also available on radial routes with no rail service. A few Park-and-Ride transfer routes are operated as an express service during peak hours only. Special attention is given to improving traffic conditions for the buses by means of: i) Bus lanes: usually segregated from the rest of the traffic and allowing time savings; ii) Priorities at traffic lights and controlled junctions; iii) Particular care at interchange stations since almost half the passenger traffic is involved in transfers.

5.20 Buses are controlled from a central control unit which ensures the reliability and the efficiency of the service. This is done by operations control which identifies where the buses are and whether or not they are on schedule. If not, the Central Control are able to dispatch another bus to be ahead of the one held back or delayed so that minimal waiting is experienced by people waiting at the stations ahead. The control also provides co-ordination with the rest of the public transport system to ensure a high quality service (e.g. trains waiting for late feeder buses, etc.). It also provides an additional service where passengers can request a taxi cab to be waiting at the final destination, which in turn improves their feeling of security and comfort when using public transport (especially late at night). Requests for such service are

made to the bus driver who passes the request by radio to the Central Control, who then arrange for it.

5.21 The public transport system is used by almost 600 million passengers every year[46]. Incentives and aggressive marketing strategies promote the system. These, coupled with strong investments in the infrastructure and a sharp awareness of the relationship between public transport and land use planning, make the system one of the least subsidised in Germany. This can be seen in Table 5.1 which provides a comparison between some of the German cities in terms of the percentage revenue. From the table, it can be seen that the revenue in Hamburg makes up about 60–65 per cent of the total costs incurred in running the system, which is a high percentage compared with other cities. The city pays 30–35 per cent (300 million DM per year) in subsidy for the running (operational) costs. The remaining 60–65 per cent is collected from fares, as seen in Table 5.1. In 1986, this was the best record in the whole of Germany with public transport revenues in other leading cities ranging between 45–60 per cent.

The Modal Split

5.22 Over the whole of the transport region, the modal distribution for motorised journeys on weekdays is shown in Table 5.2. From this table, it can be seen that travel by private vehicle has the largest share of journeys with 48 per cent. Public transport is second with 44 per cent of all journeys. The picture is rather different when the modal distribution for the work journey to the centre, where one fifth of the total population within Hamburg work, is considered. From Table 5.3, it is clear that public transport accounts by large for the largest proportion of all journeys to work in the centre. At 85 per cent, it is the main mode of transport for the work journey to the centre. The private vehicle share is only 10 per cent which is obviously due to the city's parking policy and effective public transport system. Private transport, however, is still the main mode of transport over the whole region.

THE CASE STUDY

Introduction and Background

5.23 The scheme considered in Hamburg is that of the western section of the Federal Autobahn A25 (known as the 'Marschenlinie'). The first section of this road

City	Operator	Percent of Operating Cost Recovered From Revenues
Hamburg	HVV	60–65%
Munich	MVV	60%
Stuttgart	VVS	54%
Rhein–Ruhr	VRR	47%
Frankfurt	FVV	45%

Table 5.1 The percentage of public transport operating costs recovered from passenger revenues for the German cities with best records in 1986.

Source: City of Hamburg.

Transport Mode	Percent of All Journeys
Private vehicles	48%
Two–wheeled transport	8%
Public transport	44%

Table 5.2 The modal distribution for all motorised journeys on weekdays in Hamburg.

Source: City of Hamburg.

Transport Mode	Percent of All Journeys
Private vehicle	10%
Different modes	5%
Public transport	85%

Table 5.3 The modal distribution for weekdays motorised work journeys to the centre on weekdays in Hamburg.

Source: City of Hamburg.

was opened in December 1981. It links the Autobahn triangle Hamburg-Südost in Moorfleet (which is some seven kilometres from the centre) with a provisional junction at Speckenweg on the outskirts at the Hamburg Land border (Figures 5.1 and 5.2). Another section of the scheme was opened to Geesthacht two years later with a connection to the planned by-pass in the region. However, no further information was available on the newer section. The scheme is initially a dual carriageway with a provision for more lanes if the future demand arises. The local authority in Hamburg made an assessment of the traffic impacts of the Marschenlinie. This was based on comparative traffic counts covering the situation just before the new section was opened and the situation six months after the first section was opened for traffic.

The situation 'before' the Marschenlinie

5.24 During the seventies, an increase in traffic in Bergedorf and Lohbrügge was evident from the traffic load* at many sections of the road network in the area. Table 5.4 shows the development of traffic on these sections which vary considerably from one section to another. This variation is attributed to changes in the population of the different areas[47]. Despite the loss of some of its own population, the Lohbrügge area was strongly affected by the large Mümmelmannsberg development which brought with it 20,000 inhabitants. There was also increase of 5,000 (since 1970) in the number of Reinbek inhabitants (Figure 5.1). In addition, the overall reduction in the number of inhabitants in Bergedorf has been largely balanced by new developments, mainly in Nettelnburg.

5.25 The B5, in particular, carried heavy traffic on many of its sections. In the centre of Bergedorf, the Mohnhof-Bergedorf strasse carried 35,000 to 45,000 vehicles per day. The section of Bergedorfer strasse between Reinbeker Redder and the junction to Billstedt carried 56,000 vehicles per day. Both sections experienced traffic congestion with frequent tail backs and hold-ups. Traffic congestion in the centre of Bergedorf was blamed on the rapid sequence of roads which join or cross the main road causing build-ups at junctions. Around the Billstedt junction (Figures 5.1 and 5.2), the heavy load, combined with the heavy flow of vehicles turning off to the BAB (Bundes Autobahn) A1 (13,000 vehicles per day) towards Moorfleet-Georgswerder often caused a sluggish flow and contributed to the traffic congestion. Figure 5.3 shows the traffic load on the different road sections directly influenced by the A25 before it was opened.

* The number of vehicles per day.

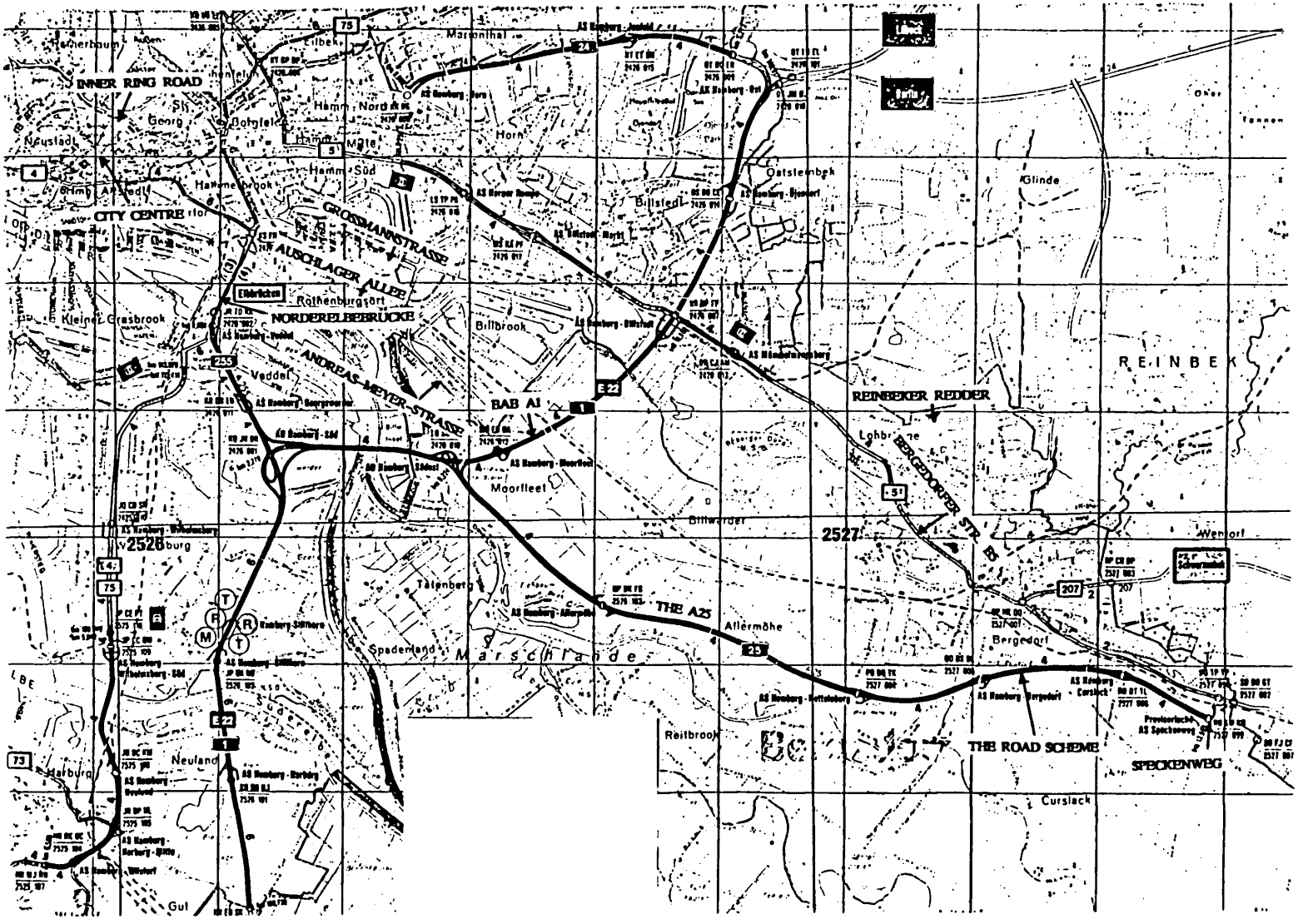


Figure 5.2 **The A25 Marschenlinie and the road network in the area.**

Count Point	Average Daily Load (1970)	Average Daily Load (1981)	Increase (%)	Average Load Mon-Fri (1981)
Wentorfer Stra. B207	15,000	16,000	5%	18,000
Am Brink B5	19,000	21,000	10%	24,000
Bergedorfer Str. B5 east of Heidhorst	29,000	36,000	30%	41,000
Reinbeker Reder	11,000	14,000	30%	16,000

Table 5.4 **Changes in the traffic load between 1970 and 1981 prior to the opening of the A25.**

Source: Verkehrliche Auswirkungen der Marschenlinie, Freie und Hansestadt Hamburg-Baubehörde, 29 September 1982).

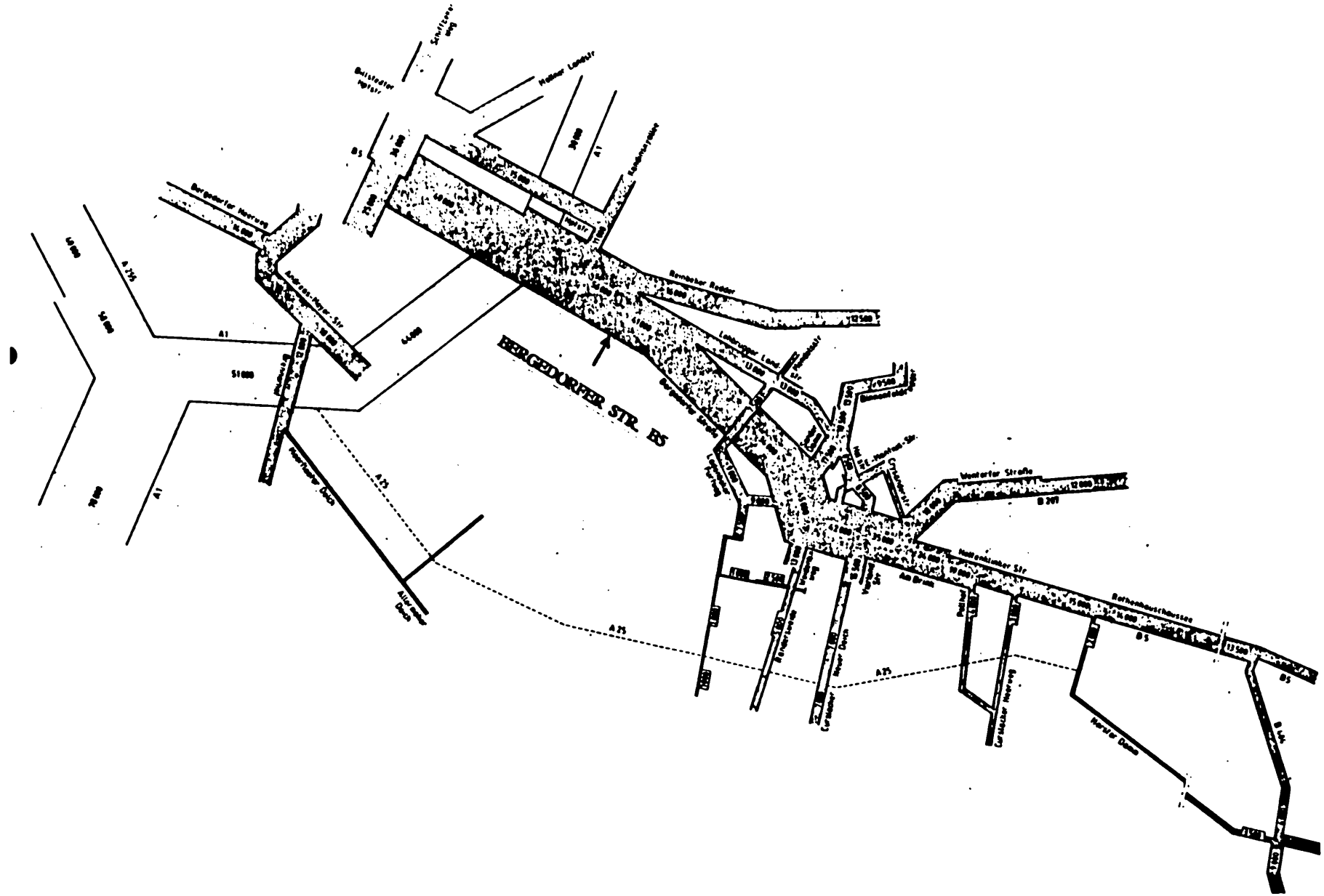


Figure 5.3 **The traffic load on road sections in the immediate corridor of the A25 Marschenlinie (the situation 'before').**

Objectives of the scheme

5.26 The scheme was primarily justified on traffic and operational grounds. However, environmental benefits were expected to result from the improvement. The operational objectives were:

i) to bypass Bergedorf and the B5, reduce traffic congestion and improve traffic conditions on the B5,

ii) improve the accessibility to some areas and the overall operational efficiency of the network,

iii) induce a regional redistribution which would improve traffic conditions and reduce traffic congestion on other network roads while catering for the demand.

The Traffic Impacts of the Marschenlinie

5.27 In order to assess the degree of success the scheme had in relieving traffic congestion off the B5, it is necessary to consider the changes in the traffic flows on the road sections directly influenced. Traffic counts were carried out 6 months after the road was first opened. A comparative study of the situation 'before' and the situation 'after' indicated the many changes that were influenced by this new scheme. The Marschenlinie caused some quite considerable shifts of traffic flows in the Bergedorfer–Lohbrügge area. Its impact extended beyond the land border in the area of Wentorf and Geesthacht (Figure 5.1). The road also diverted traffic heading for the city centre and the harbour out of this area. It has greatly improved traffic conditions on the Geesthacht axis and indirectly on to Lauenburg. Improvements have also been achieved for traffic from Elbmarschen/Lüneburg/Bardowick to Hamburg since the new section, in conjunction with the new B404, offers a genuine alternative to the B4 (Lüneburg–Winsen–Maschen) (Figure 5.1). The road also provided better access between Hamburg and Curslack, Altengamme, Neuengamme Kirchwerder and Billwerder–Allermöhe (Figures 5.1 and 5.2).

5.28 Table 5.5 shows the changes in the flows on the roads in immediate area, and some other Hamburg area roads influenced by the scheme. From this table, it can be seen that the biggest improvement has been on the B5 where the load has

Stretch	Section	Before	After	Change
BAB A1	AS Billstedt-AS Moorfleet	44,000	42,000	-2,000
	AS Moorfleet-ADHH-Suedost	51,000	52,000	1,000
	AD-HH-Suedost-ADHH-Sued	51,000	56,500	5,500
BAB 255	AD-HH-Sued-AS Georgswerder	58,000	62,500	4,500
Rothenhauschaussee	Landesgrenze-Speckenweg	14,000	18,000	4,000
	-Curslacker Heerweg	15,000	9,500	-5,500
Hotlinklinker Str.	Curslacker Heerweg-Pollhof	16,000	12,000	-4,000
	Westlich Pollhof	19,000	13,000	-6,000
AM Brink		24,000	18,500	-5,500
Monhof		35,000	30,500	-4,500
Bergedorfer Str. (BS)	Vierlandenstr.-Weidenbaumsweg	42,000	34,000	-8,000
	-Sander Damm	45,000	33,000	-12,000
	-Lohbruegger Landstr.	34,000	24,500	-9,500
	-Reinbeker Reider	41,000	31,000	-10,000
	-AS-Billstedt	56,000	45,000	-11,000
	-Moorfleet Strasse	49,000	43,000	-6,000
Wentorfer Str. (B207)		18,000	17,000	-1,000
Lohbruegger Landstr.	Oestlich Hendelstr.	13,000	11,000	-2,000
Reinbeker Redder	Westlich Hendelstr.	16,000	15,000	-1,000
Ladenbeker Furtweg	Suedlich Lohbruegger	8,500	7,000	-1,500
Vierlandstr.	Norerdlich Bergedorfer Strasse	8,500	9,000	500
Vierlandstr.	Suedlich Bergedorfer Strasse	15,500	17,500	2,000
Curslacker Neuer Deich Noerdlich Der A25		7,000	12,000	5,000
Pollhof		4,000	1,000	-3,000
Curslacker Heerweg	Suedlich der A25	3,000	4,500	1,500
Weidenbaumsweg	Suedlich Bergedorfer Strasse	13,000	11,500	-15,00
Randersweide		5,000	4,000	-1,000
Kampchaussee		9,000	10,000	1,000
Nettelnburger Landweg	Noerdlich der A25	1,000	6,500	5,500
	Suedlich der A25	1,000	2,000	1,000
Mittlerer Landweg		1,000	1,500	500
Brennerhof		12,000	10,500	-1,500
Andreas-Meyer Strasse	Westlich AS Moorfleet	16,000	19,000	3,000
	Westlich Brennerhof	17,000	19,000	2,000
Bergedorfer Heerweg		14,000	15,000	1,000
Grusonstrasse.		18,000	19,000	1,000

Table 5.5 **The changes in the traffic load on selected Hamburg roads six months after the opening of the A25 Marschenlinie.**

been reduced by between 6,000 and 12,000 vehicles per day. This meant that the flows around the original weak spots on the B5 (the section through Bergedorf and at the Billstedt junction) were largely relieved of congestion experienced before opening the road. Around the Billstedt Autobahn junction, the heavy traffic flow turning off to the BAB A1 towards Moorfleet–Georgsweder fell from 13,000 vehicles per day to only 6,500 vehicles per day. This is a 50 percent reduction which has greatly eased the flow at this previously congested point. The changes on the BAB A1 north east of the Autobahn junction Billstedt are caused by the new corner link in the Autobahn triangle Hamburg–Ost, which has eased the traffic on city roads (e.g. Schiffbekerweg, Möllner Landstrasse etc.). These changes coincide with the flows on the A25[47]. Figure 5.4 illustrates the changes that took place on certain network roads after the opening of the A25.

5.29 The increase in traffic on the roads leading on to the Autobahn around the Allermöhe and Nettelnburg junctions is attributed[47] to the Billwerder Billdeich, which is not shown now takes around 1,000 vehicles per day less than before the Marschenlinie was opened. An overall comparison of the traffic loads east of the A1 showed that 3,000 more vehicles per day traverse this point than before. This was attributed[47] to traffic from the region where approximately a further 2,000 vehicles per day cross the river Elbe at Geesthacht attracted by the new alternative to the B4 offered after the opening of the Marschenlinie. In addition, around 1,000 vehicle per day from the Wentorf–Schwarzenbek area used the route across the B5 at Speckenweg to the Marschenlinie. A reduction of about the same size was evident on the B207 (Wentorfer Strasse)[47]. The traffic load remained unchanged on the Binnenfeldredder (Ring 3) and the Reinbeker Redder (Land border) (Figures 5.3 and 5.4).

Future Expectations

5.30 It is expected that the traffic load on the A25 will continue to grow. The impression now in Hamburg is that the scheme has already resulted in many shifts in the city road network just as expected. The shift in traffic, which is as a whole desirable, is currently hindered by the bottleneck on the eastern roads to the city centre, and increasingly on the Norderelbebrücke (A1) (Figure 5.2). This bottleneck near Veddel is avoided, by motorists using the route, via Vierländer Damm–Auschläger Allee–Bergedorfer Heerweg–Andreas–Meyer–Strasse (Figures 5.1 and 5.2). Future plans include the widening of Grossmann Strasse (Figure 5.2) to serve as an

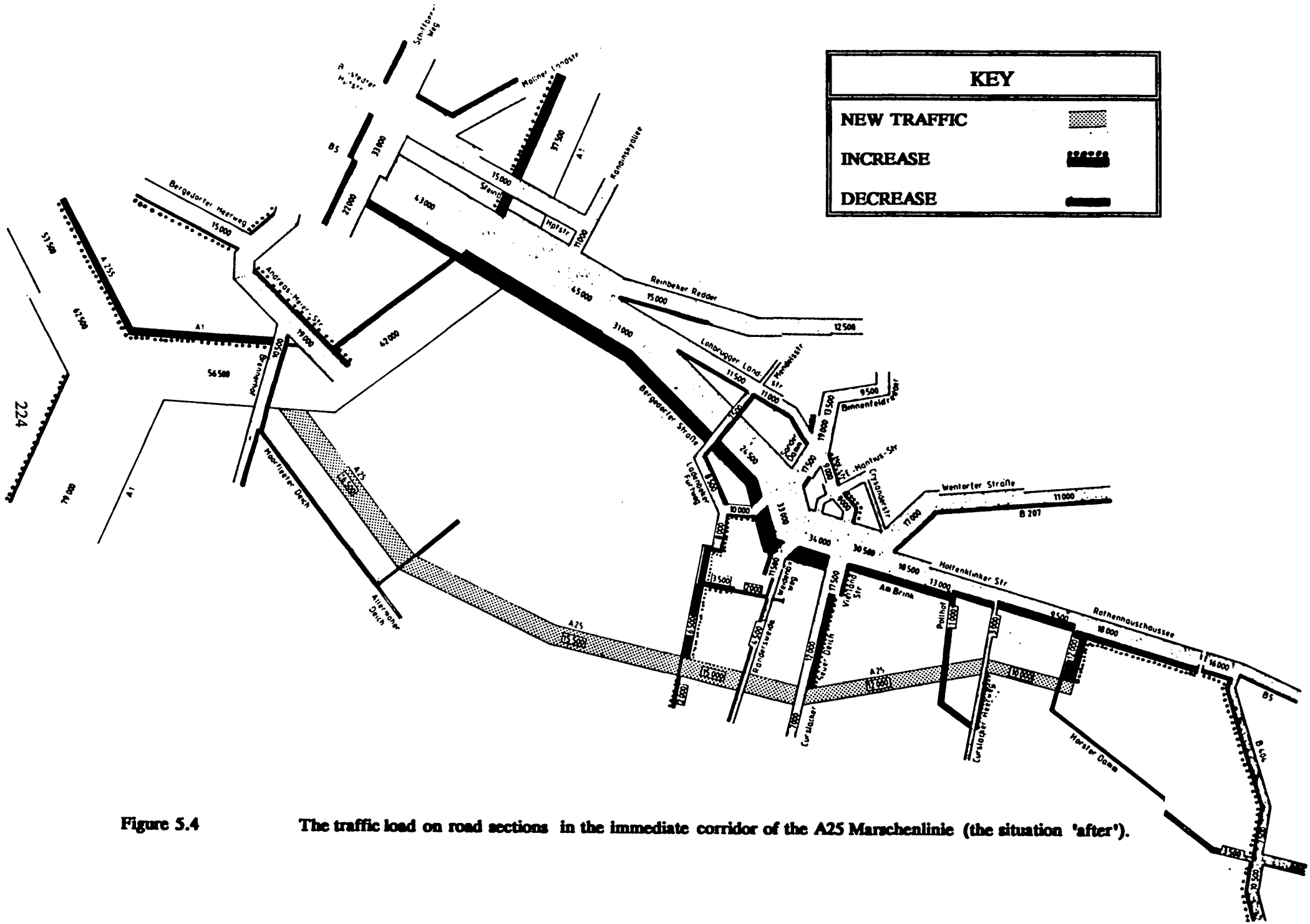


Figure 5.4 The traffic load on road sections in the immediate corridor of the A25 Marschenlinie (the situation 'after').

alternative route to Rothenburgsort with flanking measures to be introduced on Andreas-Meyer-Strasse then providing some relief.

5.31 The Marschenlinie is expected to have its full effect when supplementary measures, which were being prepared when the study was made, are complete[47]. They include:

- a six-lane section of the A1 between the A25 and the Autobahn triangle Hamburg-Süd,

-a by-pass round Veddel with the A255 (Figure 5.1) widened,

-a continuation of the A25 to B404.

When these are completed, further shifts in traffic towards the A25 which will improve general traffic conditions in the whole are expected.

COMMENTS AND CONCLUSIONS

5.32 The scheme considered in this case study, a dual two-lane motorway section, was justified on operational and environmental grounds. It was intended to relieve the growing problems of traffic congestion demonstrated in delays and tail backs along different sections of the B5 which passes through a densely developed residential and shopping area. The B5 itself is a bypass of some local roads in the area, but with the growth in car ownership and the increased demand for mobility it was beginning to show congestion symptoms. The conditions on the B5 had not reached crisis levels[42], but the dynamic transportation planning strategies ensured that something was done before the situation got to such a state. The road was planned with future prospects to connect with the rest of the Autobahn network in line of city policies, its major role to remove through traffic bound to the city and the harbour.

5.33 The first stage of the road connected Bergedorf with the junction Hamburg-Südost where it provided access to the BAB A1 and the rest of the Autobahn network serving Hamburg. The road's provision of a fast and direct link with the Autobahn network attracted a lot of the traffic that previously used the old road to get to the Autobahn network or to the city centre. With this new and better link, a shift in the

traffic load on many of the sections directly influenced lead to conditions of relieved congestion, and improved environmental conditions along the old roads. Some road sections, however, recorded an increase, as can be seen from Figure 5.4). This may be attributed to the redistributional impact of the road on outer regional traffic. This was seen as a sign that the new road met one of its main objectives, namely that of inducing a regional redistribution.

5.34 The expectation is that environmental conditions on the old road will be improved even further. Traffic restraining measures on the old road have not as yet been deployed, since the environmental conditions on the road do not yet require it. However, it is a normal practice in Germany to employ certain traffic management techniques which reduce the capacity of the older sections replaced, or bypassed, by new roads. It will probably be a matter of time before the capacity is reduced on Bergedorfer Strasse (e.g. lane closure, landscape etc.). This will be done only when the complementary schemes of the A25 are completed.

5.35 The provision of this high capacity link leading to the city and harbour has had the overall effect of improving the conditions along the old road, as was seen from the changes in the traffic loads along these roads. The argument of new roads generating so much more traffic that any benefits achieved may be cancelled out does not hold its ground here, although this would have been the perfect example. However, the attractiveness of this link does not appear to have generated much more traffic nor has it lead to worsened conditions of traffic congestion. As reported by city officials[42], the opposite is the case. Certain bottlenecks on the radial roads closer to the centre of Hamburg did not experience worsened conditions, and no more bottlenecks were created as a result of this increase in capacity. Some of the existing bottlenecks are the result of road works in conjunction with junction improvements and other road schemes. They are, as explained by city officials, temporary and will be removed once these works are completed.

5.36 That the route has been effective is almost certainly the result of the application of consistent and appropriately integrated policies within the city (e.g. parking policy). The added capacity to the network served to divert traffic off the older sections on to sections with higher standards and capacity. This meant a great relief from through traffic which was beginning to be a problem. Some local roads, as mentioned before, experienced an increase in traffic, but this, again, was the result of a wider inter-regional traffic redistribution influenced by the new road.

5.37 With the attractiveness of public transport in Hamburg, which is the result of a combination of factors (reliability, efficiency, comfort, cost and the good marketing strategy), no modal shift was observed[42]. A modal shift was not even anticipated since the public transport coupled with the various control policies practised by the city make it rather difficult for any more commuters to drive to work.

5.38 The roads are specifically designed for the expected off-peak traffic flows, including the more essential business traffic, with highway policies to ensure that this objective is achieved. A little congestion during peak periods is accepted since the situation then is not considered representative. According to City Officials, and from personal observation, traffic in Hamburg flows freely after passing certain bottlenecks. These are the result of incompatible capacities, and remedial measures either planned or underway by means of additional capacity and junction improvements. Such measures are, however, not expected to generate a lot more centre-bound traffic as the latter is said to be, and certainly appears to be, effectively controlled by other restraint mechanisms.

5.39 The city is regarded as having reached an adequate level of road development to serve its commercial and other needs. Further major local road plans are not being considered, but new Autobahn links are always welcome[42], since these are financed by the Federal Government and because of the positive role they play in improving the overall efficiency of the network. Autobahns are seen to carry the major bulk of through traffic therefore bypassing the city centre and avoiding congestion. The city would still, however, maintain the lands assigned to roads planned but not built. As explained earlier, some of the schemes recommended by the 1982 plans were deemed unsuitable for the city since its current traffic levels did not justify the need for such schemes. However, the lands assigned to these schemes are maintained by the city to ensure that any future demand can be met. This is achieved by planting these areas so they become protected green space which would not stop the city from building its roads, if they need to, underground.

5.40 The quality of the public transport system in Hamburg is well known. This can be attributed to the coordination under one authority of all the public transport modes. The level of subsidy for the system, though high by British standards, is one of the lowest in Germany, reflecting the popularity of the system and the large ridership. The public transport system in Hamburg is very well marketed. The marketing strategies used have brought about a positive response from the people. With

special fares during certain hours, and continuous control of the quality and reliability, plus coordination between the different modes in the system, the major part of the operating costs (60–65 per cent) are reimbursed from the revenue. Park–and–Ride schemes are also a major part of the strategic policy, and contribute to the attractiveness of the system. While providing a fast and reliable service to the city centre, they allow drivers to park their cars at the stations which makes it very convenient especially for those commuting from further regions.

5.41 In general, the city of Hamburg boasts a 'happy balance'. This is clear from the quality of both the road network and the public transport system. Each system works in coordination with the other. They complement each other. Under the prevailing conditions, a major improvement to the road network is not seen as a threat to the public transport system, but is viewed more positively as a contributor to improving travel speeds by buses. Similarly, an improvement to the public transport system is made so as to keep the system as reliable and attractive and not solely to be able to compete with the road system. However, it was not possible to investigate the speed relationship between the systems since no journey times and travel speeds data were available. The city of Hamburg does not carry out these surveys regularly, and the overall situation in the city is monitored via traffic studies and censuses.

5.42 The planning policies in Hamburg acknowledge the different travel needs for the different inhabitants of the city, these are taken into consideration and catered for. The different demands are not always served by the same mode, and while some demands are best catered for via one mode, a different mode is better suited to serve other needs. The environmental element is also an important issue. New road schemes have to meet certain environmental standards, and most of these (the schemes), are justified on environmental grounds. However, the operational and the traffic grounds are not ignored. With the issue of new road schemes in urban areas becoming increasingly a political issue, the city, like many others strives to achieve a balanced approach in addressing the traffic demands and problems.

B: Duisburg

INTRODUCTION

5.43 The city of Duisburg is located on the confluence of the rivers *Rhine* and *Ruhr*. The city is the industrialised centre of the Lower *Rhine* region, and is associated with its steel industry, trade and port. With its highly favourable position at the junction of the *Ruhr* and *Rhine,* Duisburg had already developed into a busy commercial centre by the early middle ages. Duisburg is the world's largest inland port, a status achieved through many years of development. Duisburg underwent an economic boom with the beginning of industrialisation in the second half of the 19th century. The merger with the neighbouring town and rival, *Ruhort*, in 1905 made it possible for Duisburg to become the city it is today.

5.44 Industry and commerce selected Duisburg for their business activities due to the transportation advantages offered by the *Rhine* for delivering their much needed raw materials and then shipping the goods which were produced. Today, the harbours of Duisburg port cater for a variety of inland and seagoing ships carrying mainly ores, mineral oil, scrap, raw minerals, grain and foodstuffs; outward bound, the ships usually carry coal, iron and steel products, machines, refinery products and industrial goods of all kinds. Duisburg is also at the centre of the iron and steel industry. Almost every second ton of crude steel produced in West Germany comes from the steel town Duisburg. This concentration of the steel industry is complemented by other basic industries in the chemical and non-ferrous metal sectors, mechanical engineering, plant construction and structural steel engineering, plastics processing and the manufacture of special electronics and light engineering products, amongst many others.

5.45 Duisburg is now a small conurbation which consists of seven satellite towns around the old city. These were, effectively, large environmental areas just waiting to be linked by a network of roads. The city has a total population of 530,000 inhabitants within the greater area making Duisburg's rank the 11th among West Germany's largest cities. 220,000 inhabitants live in Duisburg itself. The City Centre (Figure 5.5) employs 26,000 workers. Due to the nature of the industry in the region, employment is spread around the various sub-centres which are located around Duisburg.

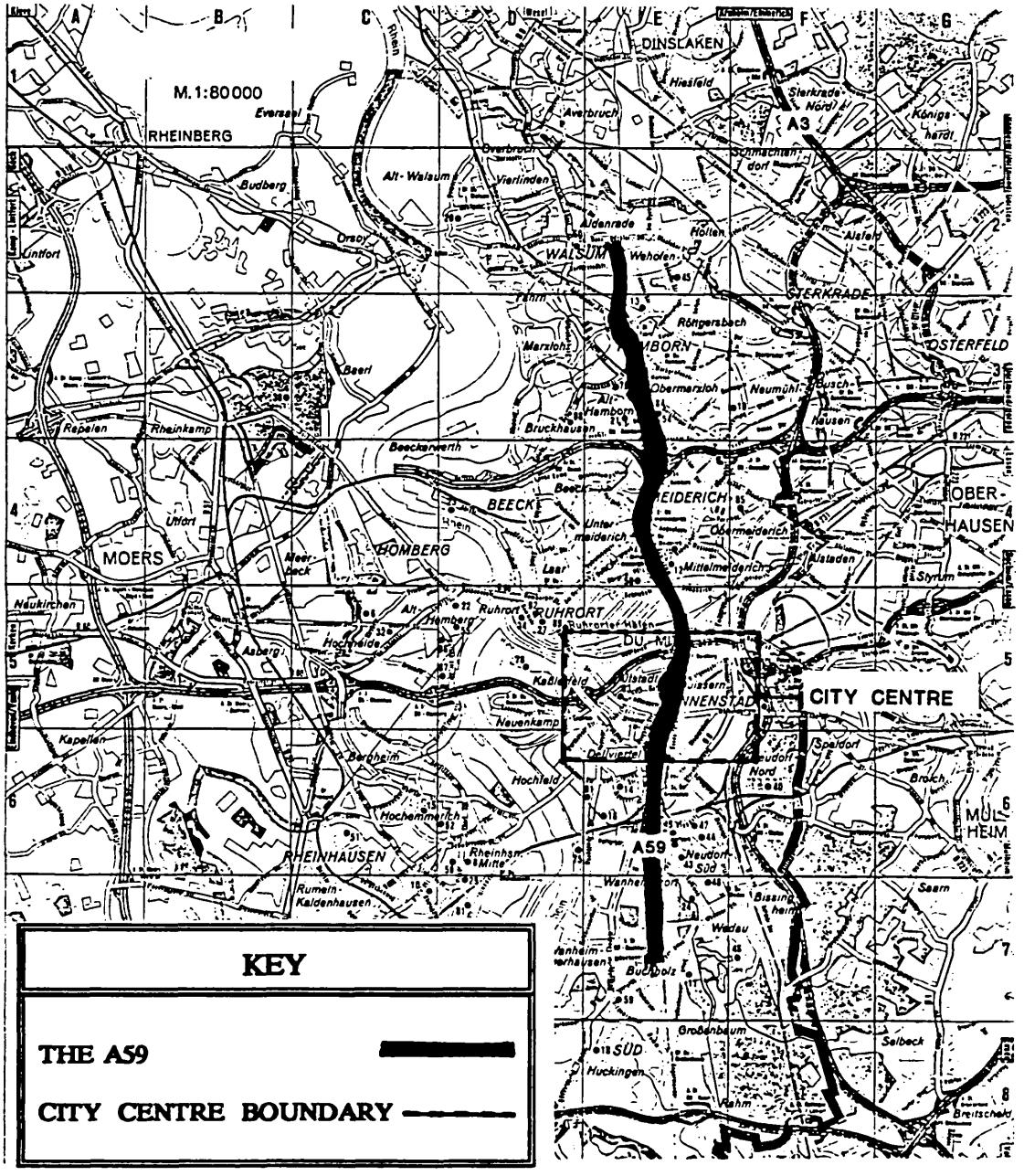


Figure 5.5 **Duisburg and surrounding area, the City Centre and the A59.**

THE EXISTING SITUATION AND CURRENT POLICIES

5.46 A comparison of total residents and vehicles in Duisburg on one hand indicates a trend of decreasing population, but, on the other, an increased vehicle ownership. Table 5.6, provides a detailed illustration of the situation. Current vehicle (*KFZ*)* and car (*PKW*)** figures now stand at 450 and 405 per 1000 people, respectively, indicating an increasing trend over the past few years.

5.47 The planning in Duisburg, similar to that in other German cities, always encouraged the construction of tangential high capacity roads which carry traffic away from busy road sections and the centre. Until now, the policy in Duisburg has been to improve the road system in line with the increasing traffic demand and to allow and provide free parking in the city centre. Parking is permitted on many of the pavements and side walks in the city. However, current policies are directed towards encouraging further use of the public transport system and restricting the parking space availability. In addition to this, the regional authority (who finance major roads) is discouraging the city from much further development of the road system.

5.48 Pedestrianisation schemes were introduced in the city in the early 70's[48]. *Verkehrsberuhigung* , or traffic calming, is strongly promoted in Duisburg[49]. With speed limits along residential streets, in theses designated areas, confined to 30 km per hour, noise levels and negative environmental impacts are reduced in sensitive areas. This is done by changes in the roads layout, and the provision of 'street furniture' (e.g. planting and width restrictions etc.) which make it difficult for traffic to go at higher speeds in theses areas[49]. In addition, all ecological and environmental considerations are taken rigorously in future plans as set by the *Land's* general policies[50], with environmental considerations and associated safeguards constituting a major part of planned schemes.

THE ROAD NETWORK

5.49 Duisburg is served by a comprehensive road network. Most of the roads around the city are in the form of *Autobahns* which connect Duisburg with the other major cities in the region. These roads are also vital for the economic welfare of the

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* KFZ = All Vehicles.

** PKW= Private Cars only.

region, in general, and the city in particular[48]. In 1989, the city had around 1,220 km of roads divided as shown in Table 5.7. From this table, it is clear that the city is served by an extensive road network. With 450 km of major roads and *Autobahns*, the city is well connected to other major cities and regions. The availability of such a large supply of roads is reflected on the modal split in the city where 74 per cent of those working in the centre commute by car, while 26 per cent use public transport (Table 5.8).

5.50 The city suffers from some congestion at certain bottlenecks in the city with average delays of 3–4 minutes during the peak periods (0700–0800, and 1600–1700). One of the bottlenecks in the city is that at the first main junction on the *A59* (Figure 5.6), where the northbound flow turning right to join the A2/A3 is usually held up for few minutes during the peak periods. This bottleneck, is the result of inadequacies within the system's capacities in the northbound direction since no similar bottleneck exist in the southbound direction. This, and other bottlenecks in the city which are also the result of incompatible capacities, are being remedied by widening some sections and improving certain interchanges[48].

PARKING

5.51 As mentioned before, the city's parking policy has always been to cater for the demand for parking in the centre resulting from the large proportion of commuters to work. The centre contains 10,000 parking spaces of which 6,000 are absolutely free. Parking is allowed by kerbs and on many pavements in the city centre with most of it being long stay parking, encouraging commuting by car even further. Duisburg, however, is a city built for the car, and the urban structure with its subcentres, and the demand, therefore, for travel by car is accommodated by the planning policies.

5.52 Recently, however, Duisburg began to reconsider its policies as a result of a planned shift from heavy industry to the service industry resulting from the reduced demand for heavy industries (e.g. steel). As the city regards parking control as the only effective measure of traffic control in the city centre, a special plan has been drawn up to deal with the issue[51]. Immediate plans are to eliminate free parking from the centre and convert existing parking spaces to short term and business parking only. Part of the income from these spaces will be used to subsidise

Year	Residents (thousands)	All Vehicles KFZ (thousands)	Private Vehicles PKW (thousands)
1955	478,983	31,588	12,898
1960	403,641	56,567	38,921
1965	486,920	83,968	71,774
1970	454,839	103,728	93,961
1975*	608,158	–	–
1976	599,089	175,593	160,780
1980	575,731	210,064	192,579
1985	533,836	216,140	195,181
1989	528,062	236,336	215,066

Table 5.6 **The development of residents and vehicles in Duisburg (1955–1989).**

* As of 1.1.1975 certain towns and regions were incorporated within Duisburg, that is why the number of residents suddenly went up. In addition to this, there is no data available for that year because of the new administrative borders for the area which required a change in the statistical method.

Type of Road	Length in km
Bundesautobahnen (Federal Motorways)	66
Bundesstrassen (Federal Roads)	46
Landstrassen (State Roads)	100
Kreisstrassen (Distributor Roads)	71
Städtische Hauptverkehrsstrassen (City Main Roads)	167
Verkehrsstrassen, Wohnsammelstrassen, Wohnstrassen (Local and Residential Roads)	750
Privatstrassen (Private Roads)	16
Total	1,219

Table 5.7 **The hierarchy and length of the road network in Duisburg by type (as of 1989).**

Source: Stadtplanungsamt Duisburg.

improvements in public transport. This is all done in accordance with the State's local policy and recommendations. These include[48,50]:

a) the reduction of traffic in city centres and the provision of pedestrianisation where feasible,

b) the improvement and promotion of the public transport system via parking policies and marketing strategies, so that the first objective can be achieved,

c) the enhancement of environmental conditions along streets in residential areas by means of traffic calming, and the removal of extraneous traffic off these roads to higher standard roads,

d) the safeguarding of environmental conditions in general, and keeping the environmental impacts of road schemes to a minimal.

PUBLIC TRANSPORT

5.53 The public transport system in Duisburg consists of two modes only, namely the tram and the bus. The construction of a new *U-Bahn* in the city is underway, and it is expected to be completed by 1995/6. So far, the city's main emphasis had been on improving the road network and catering for roadborne traffic needs due to the nature of the industry. A lot of the workforce has traditionally travelled to work by car and until recently the city's policies were to always accommodate them. However, and with escalating environmental concerns in Germany, the city is making major changes in its policies with the aim of catering for more travel needs via public transport. This is in line with the city's future anticipation to become a centre for the service industry rather than the manufacturing industry. This is also based on economic considerations since the manufacturing industries are currently suffering from diminishing demand, with some plants already closing down and some harbours deserted.

5.54 With the travel demand to city centres, associated with service industries, Duisburg is already preparing to cater for the demand by modifying its current policies. Until now, the demand for travel to the centre has been limited to local authorities and the few commercial organisations. Workers in the port and industries usually park in their own companies, and the nature of the city's satellite centres

makes this possible. The city's policies, so far, have been lenient on parking and catered for this demand, as explained under the previous section on parking. The city is now adopting a new policy of improving the public transport system and enforcing a stricter parking control. With the new *U-Bahn* under the city centre, it is expected that the new system will be able to attract twice the current number of people using the system today. The new improved system will provide fast connections between the city centre and the other parts of the town. Journey times will be considerably reduced with some journeys taking 22 minutes today completed in just 6 minutes by the *U-Bahn*[48].

5.55 The current system receives a 45 per cent subsidy in operating costs from the city, and is used for only 26 percent of all work journeys to the centre, which is a very small proportion given, for example, Hamburg's corresponding figure (85 per cent). Improvement plans are done concurrently with plans for stricter parking controls in the centre, and a vigourous marketing strategy to attract passengers to the system.

THE CASE STUDY

5.56 The overall highway scheme considered in Duisburg is that of the North-South Road or the *A59*. This scheme (Figure 5.5) is an *Autobahn* which goes through the centre and forms a major tangential route right through the city. The scheme was first planned in 1920 with the first part built in 1934 and the central part built in 1957/1958[52] (Figure 5.6). The extensions to the north were built in 1962, 1963, 1969 and 1985. Those to the south, in 1975 and 1977. All,but the final outer links are now complete. These are currently underway. A total of 16 km of this urban motorway has been built out of a total planned length of about 24 km.

5.57 The road started initially as a city road and became a federal road in the mid 1977/1978[48]. The different sections of the scheme were justified in their own right, but the grounds in each case were more or less the same as those given originally for the whole scheme. The stated objectives of the whole scheme were:

> Operational: i) To cater for travel demand and the growth in motorisation; ii) to improve accessibility and mobility; iii) and to relieve traffic congestion which was beginning to build up on some of the city's roads.

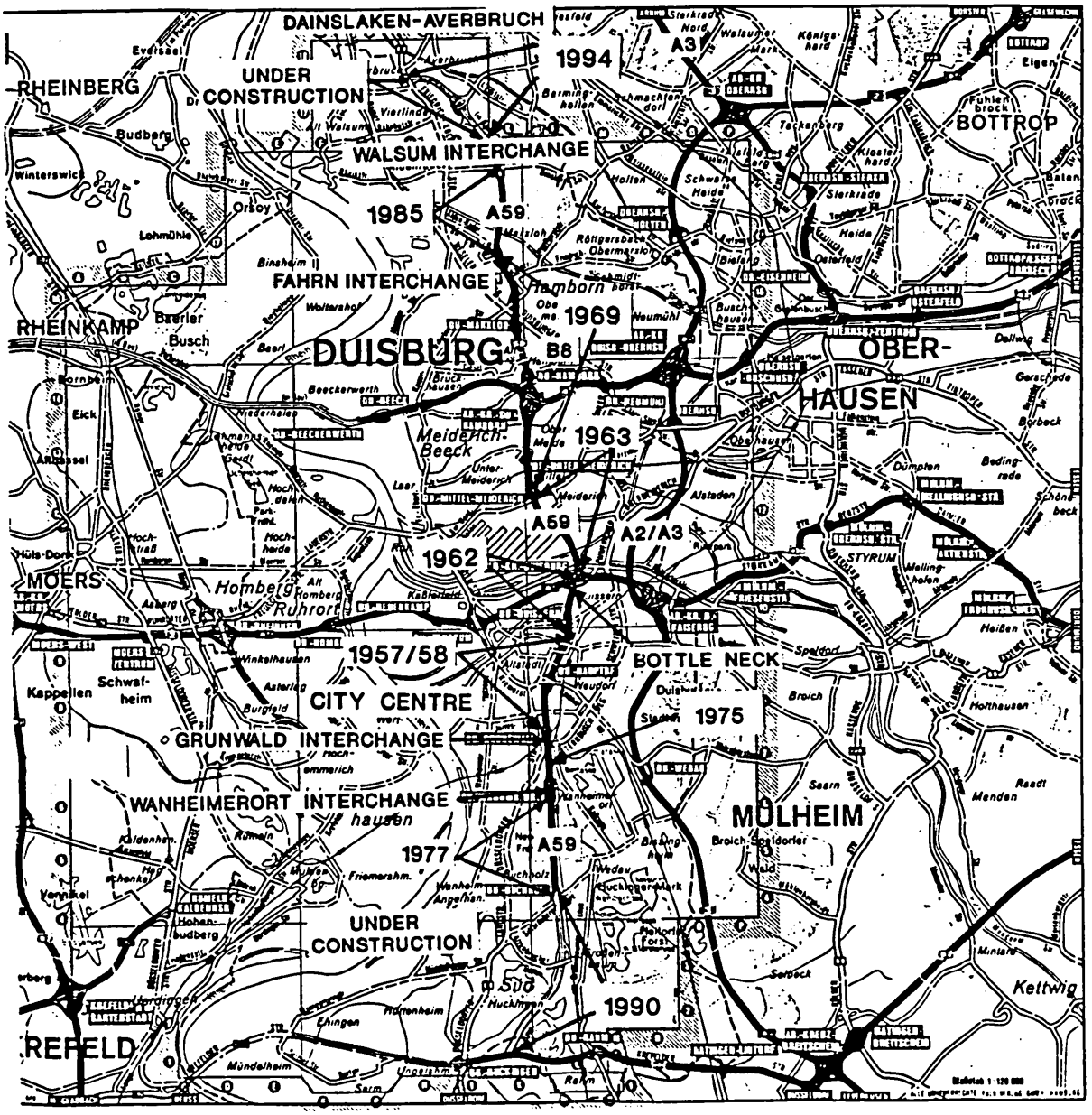


Figure 5.6 **The A59 and the dates of completion of the various stages of the scheme.**

Environmental: To remove through traffic from environmentally sensitive areas and improve the environment along these residential and busy roads by relieving them from noise and pollution.

Economic: To encourage and maintain developments in the city.

5.58 The data available from Duisburg was somewhat limited, only that on the sections completed in 1975 (Figure 5.7), and that completed in 1985 (Figure 5.8), being available. In the following, the specific objectives of each section and the impacts associated with it will be presented.

The A59 between Grunwald and Wanheimerort junctions

5.59 This section, which was completed in 1975, was justified on operational and environmental grounds. The operational objectives were to continue the then existing *A59* in a southerly direction to the junction at *Wanheimerort* (Figure 5.7) so that the then existing section of the *A59* would have an increased importance for local and through traffic. This would result, as suggested then, in improved accessibility to the *A59* and the centre from the southern part of the city and a relief from through traffic passing through residential streets to get to the *A59*. The aim of the plan was to relieve *Düsseldorfer Straße* between *Sternbuschweg* and *Wacholderstraße*, a section suffering from congestion and deteriorating environmental conditions (Figure 5.7). Environmental improvements were expected as a result of removing the extraneous traffic off this section, and also better accessibility to the motorway network and the centre.

5.60 The results achieved in terms of traffic relief are shown in Table 5.9. The results presented in the table are the combined effects of the section completed in 1975 and that soon after in 1977 (Figure 5.6). From this table, it can be seen that the amount of relief achieved is considerable, even when the growth in vehicle ownership (about 25 per cent over the same period) is taken into consideration. It was stated during the meetings with Duisburg officials, that the section relieved had previously suffered from frequent traffic congestion and delays. The environmental conditions along the old road, which is fronted by highly developed residential and shopping areas, were also deteriorating. With the opening of the A59 section, and hence the removal of nearly 55 per cent of the 1974 traffic flow, conditions on this road have shown great improvements, both in environmental and operational terms.

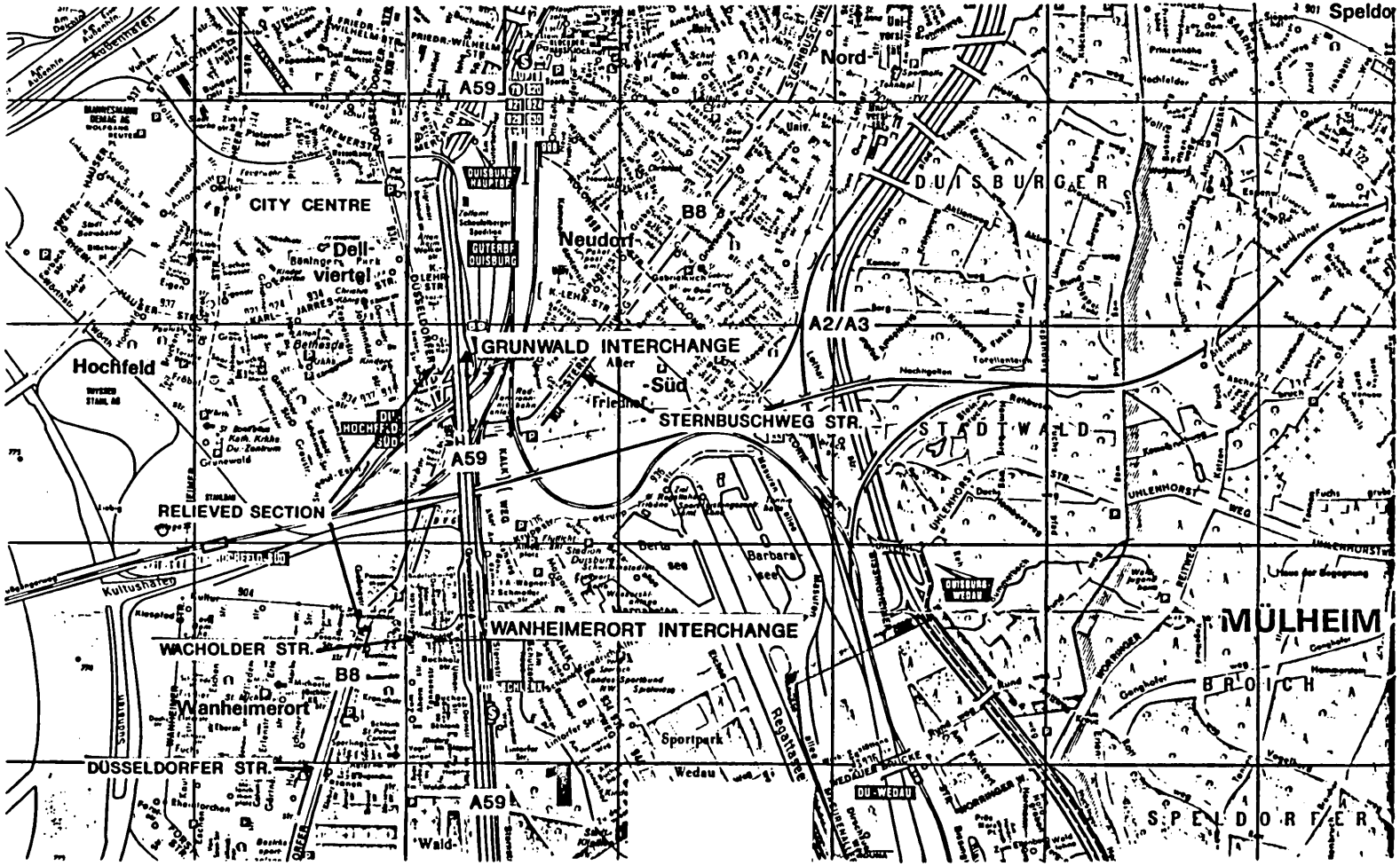


Figure 5.7 **The A59 section completed in 1975.**

The A59 between junctions Fahrn and Walsum

5.61 This section, which was completed in 1985, was justified on operational, strategic and environmental grounds. Operational objectives were[53]:

i) To continue the then existing *A59* in a northerly direction towards the area of *Dinslaken–Averbruch* (Figure 5.6), so as to improve traffic connections between Duisburg and the outer regions, and serve the internal city traffic between the northern and southern districts of the city of Duisburg;

b) to relieve both the *A2 / A3* running east of the *A59* as well as the inner city road network, especially the *B8* running east of the *A59* (Figure 5.8). The *B8* also runs in a north–south direction west of the *A59* and has several intersections which are spaced close to one another therefore reducing the capacity of this four–lane highway to two–lanes only, due to the turning movements of the traffic. This section was also in much need for relief.

The environmental objectives were to relieve the *A2 / A3* and the *A3* (Figure 5.8) running parallel to the *A59* which were heavily congested with local and through traffic. The *B8* (*Friedrich–Ebert Strasse*) which runs through a heavily built–up residential area also needed relief from a heavy traffic load. This road had high accident figures recorded on it, and it was expected that the reduction in traffic on this road would lead to a significant reduction in the high accident figures[53,54] . The heavy traffic flow on this road also created severance in the area[53,54].

5.62 Strategic objectives were seen as the induction of a traffic redistribution relieving some of the congested roads in the city and shifting traffic on to the higher capacity road. It was also important to complete this link in order to speed up further improvements of the motorway network and make the road network in Duisburg more efficient. This is in line with the city's policies, mentioned earlier, to cater for the growth in traffic and divert this growth onto high capacity roads relieving local and less adequate streets, and leading therefore to better environmental conditions in these areas. In general, it was expected that this section would provide safer traffic conditions and a more efficient road system, which would remove traffic problems from the Duisburg/Dinslaken area and contribute to an improvement in the residential environment.

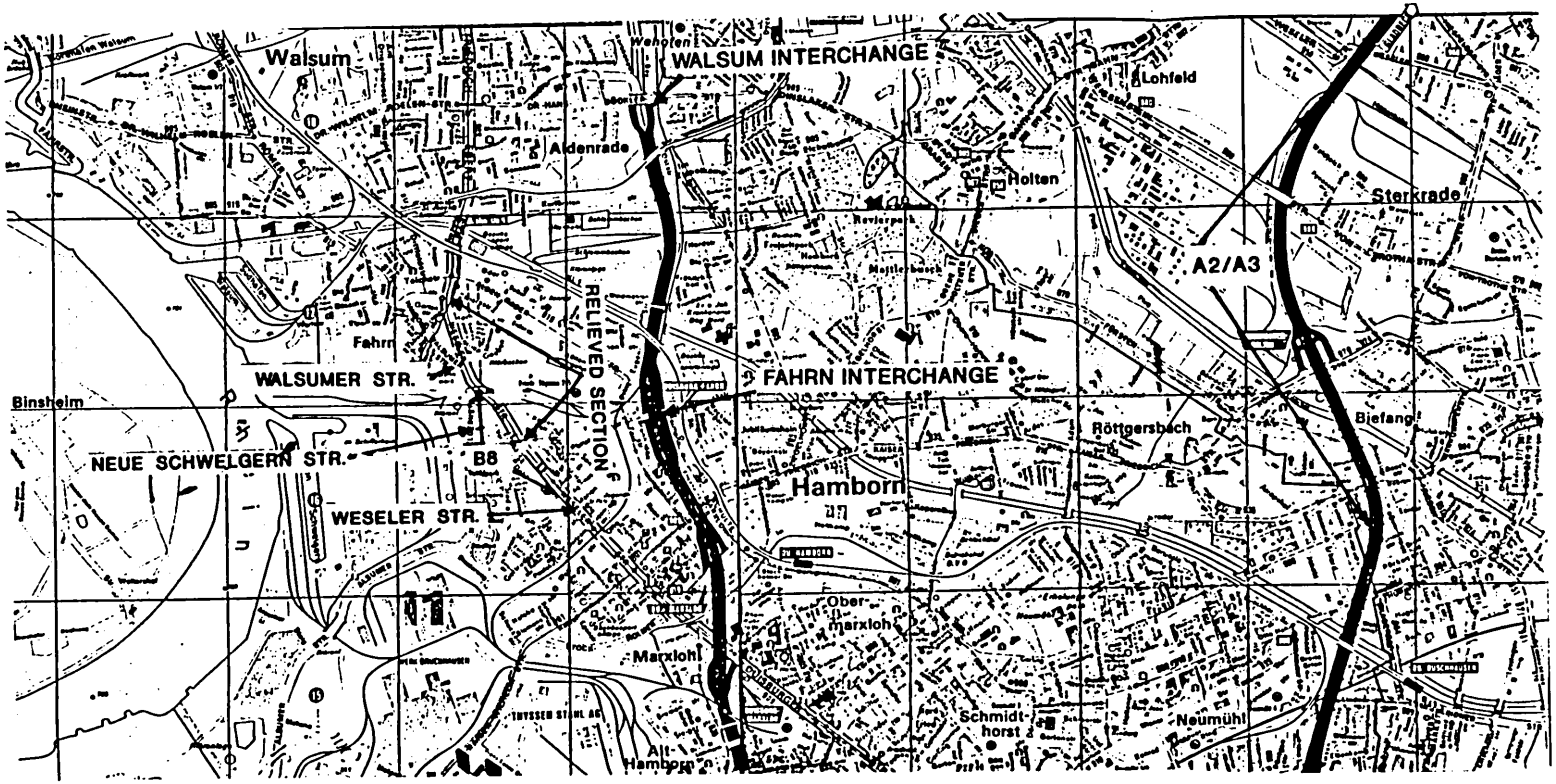


Figure 5.8 **The A59 section completed in 1985.**

5.63 The scheme was completed in 1985. Traffic counts which were carried out in 1987 are presented in Table 5.10. The table shows the traffic flows per 24 hours on the new section and on the *B8* section between *Walsumer Strase* and *Neue Schwelgernstrase* (Figure 5.8). From this table, it can be seen that in the two years after the opening of the new A59 section, traffic levels on the relieved B8 section fell by around 19 per cent from their 1983 levels. When considering the growth in motor traffic in that period, this reduction is, probably, even more considerable. This improvement was seen as only part of the total improvement that would be achieved when the last northern link of the *A59* is completed in 1994. Data for traffic flows and changes on the *A2 / A3* were not available. The scheme has afforded much needed relief to the B8 section which previously suffered from delays and congestion. The reduction in traffic is expected to be more substantial once the final link of the A59 is completed in 1994.

The scheme's impact on public transport

5.64 On this issue, the information available was merely that provided by the city planning office during the meetings. According to local city officials, the scheme had no negative impact on the public transport system since the latter has its own patronage who were unlikely going to shift modes. This is understandable since the system's share of all journeys to the centre is only one third that of the private vehicle, and is probably due to the fact that it is used by the population element with no access to a car. It may also be that the availability of parking spaces in the centre is taken up by commuter traffic at early hours, making it rather difficult for shoppers, for example, to park their cars. However, the new improvements in the public transport system which are currently underway, together with the marketing strategy and the planned parking control, are expected to have an impact on road traffic since it will improve travel speeds by public transport and offer greater savings in journey times.

REMARKS AND CONCLUSIONS

5.65 The nature of Duisburg's industry and its satellite sub-centres was orientated towards the car as the main mode for travel. This created a large demand for car travel which was catered for via an extensive road network and an accommodating parking policy as far as the centre was concerned. This is acceptable when most workers commute by cars, since the major employers were dispersed in the region,

Transport Mode	Percent Share
Private vehicle	26%
Public transport	74%

Table 5.8 **The share of different modes of the journey to work in the centre in Duisburg (1987).**

Year	A59 between Grunewald and Wanheimerort interchnages (1975)	B8 Düsseldorfer Strasse between Sternbuschweg and Wacholderstrasse
1974	-	42,900
1987	42,200	19,400

Table 5.9 **Daily traffic flow on the A59 section completed in 1977 (all vehicles KFZ per 24 hours).**

Year	A59 between Fahrn and Walsum interchanges (opened in 1985)	B8 Weseler Str. between Walsumer Str. and Neue Schwelgernstrasse
1983	-	23,800
1987	33,700	19,300

Table 5.10 **Daily traffic flow on the A59 section completed in 1977 (all vehicles KFZ per 24 hours).**

Source: Stadtplanungsamt Duisburg.

and parking availability is not a problem at these sites. With the planned, and much hoped for, change in the city's role from an industrial centre to a service centre, transport needs will vary and this is well perceived by the city. In preparation for the changing patterns of traffic, and the expected increase in the demand for travel to the centre, the city is now strengthening its public transport system by constructing a new *U-Bahn* which will reduce journey times by public transport considerably, and provide a more attractive mode for travel to the centre. This will be ensured via a change in the parking policy, by scrapping the free parking spaces which are available in the centre and changing long stay parking to short stay and business parking. The city is also embarking on a strong marketing policy for public transport which, together with other measures, is hoped to yield positive results.

5.66 In addition, a major campaign for driver education is underway. This involves seminars and lectures by local officials at resident associations meetings and at schools to educate drivers on the rules of the road as part of the city's overall plans for improving traffic conditions in the city. This is consistent with German policies and the 'dynamic planning' which seems to avoid worsened conditions by planning and implementing the suitable measures needed for the different situations before the situation is out of control. The city is well ahead in anticipating the changes in demand and catering for it via a co-ordinated transportation policy involving both demand and land use management. Furthermore, supply management is also evident. The case study provided a good example of the changing policies in Duisburg. With growing environmental concerns, the *Land* had recommended a reduction in road building since the city is now well served and connected. This, however, did not mean the elimination of schemes which were the reasonable and consistent extensions of existing schemes. In the case of the *A59* the final links north and south are underway to achieve the results expected and further improve traffic conditions in the city.

5.67 The case study shows that, in the case of Duisburg, the provision of new roads even in built-up urban areas has been effective in so far as it has served its intended operational, strategic and environmental roles. The whole A59 scheme, and both the sections discussed in detail, in particular, have proved to be effective in achieving the intended objectives. It provides a major link with the rest of the national *Autobahn* network, and a high class internal link between the northern and southern parts of Duisburg; it has carried large proportions of the extraneous traffic which previously used busy and less adequate parallel streets leading to reduced

traffic congestion on some of the heavily loaded sections, which passed through highly residential and developed areas. The two sections, presented in detail, have both been effective in achieving their specific objectives. The scheme's impacts are positively felt throughout the city where it relieved other roads from a high percentage of HGV traffic observed on the new road today. The scheme's full effect will be felt even more when the final links to the north and south are completed, since its influence in relieving local streets will extend further to the outskirts of Duisburg, and further improve the connection with the national Autobahn network.

5.68 The scheme, however, has some negative aspects and mainly that of visual intrusion at some parts where it is carried in flyovers. A lot of effort, though, has gone into providing noise screening by means of noise barriers and embankments that shield many of the residential areas along its route. From personal observation in a number of these areas, noise screening appears to be effective in reducing the traffic noise.

5.69 Once more, this case study indicates that well planned road schemes in urban areas do not necessarily lead to counterproductivity. The need for mobility and to cater for the travel demand is important for any urban area's welfare, be it environmental, operational or economic; environmental since new roads can bypass other heavily trafficked network sections providing relief and the opportunity to introduce environmental safeguards and improve the operation of road borne public transport; operational in the sense of providing the necessary links to facilitate both accessibility and mobility; and economic since most of the inland goods surface traffic is carried by road. The growth in traffic, as seen from Duisburg, continues even with falling population.

5.70 The broad conclusions that may be drawn from this particular case study are as follows:

a) New road schemes in urban areas are not necessarily 'counterproductive' but can improve traffic and environmental conditions on other network roads,

b) it is important to integrate road schemes in urban areas with the high capacity road network (motorways) since this appears to have a positive effect on improving the overall conditions on the network, by removing a large proportion of traffic from other roads,

c) the co-ordination between the different authorities concerned (e.g. city planning authorities and the public transport operator) coupled with a strong educational campaign for people can produce good results,

d) the marketing of public transport is a major element in attracting people to the system as part of a policy which acknowledges the needs and cater reasonably for it via a balance of modes, thus creating a 'happy balance' in urban areas.

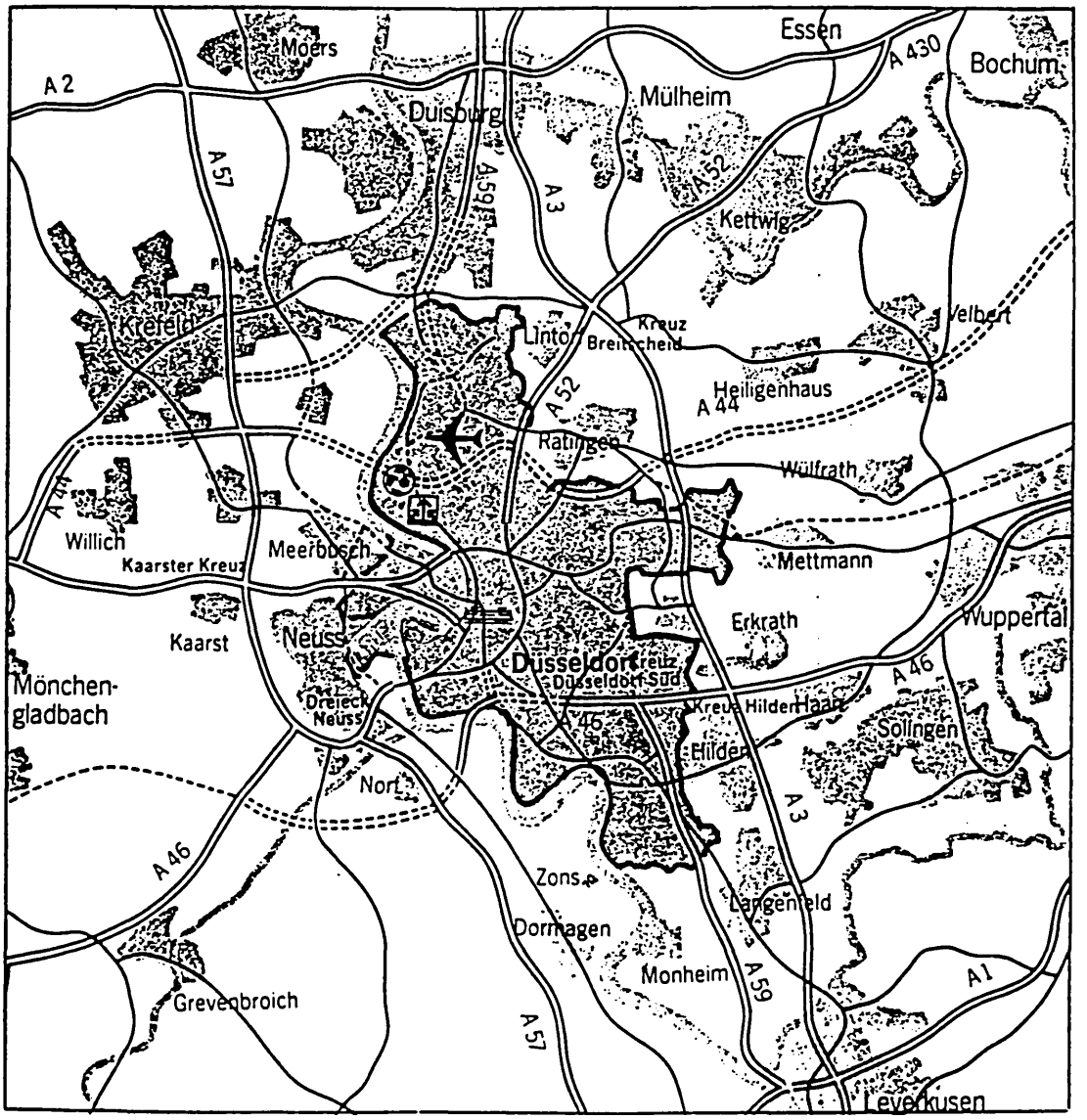
C: Düsseldorf

INTRODUCTION AND BACKGROUND

5.71 Düsseldorf was selected as a case study because it was felt that the city's location and role as the state capital of the Land North-Rhine-Westphalia where a third of the Federal Republic of Germany's 62 million citizens live and work would provide a picture of the policies in effect in such a highly urbanised region, and in a Land well known for its rigid environmental policies. Düsseldorf is also known for its prosperity, and with the recent changes in vehicle ownership rates worldwide in general, and in Germany in particular, this study should shed further light on the transport policies adopted in German cities, and on how well Düsseldorf is facing the problems associated with the motor vehicle.

5.72 The city of Düsseldorf lies in the heart of the Rhein-Ruhr area in West Germany (Figure 5.9). This city has been officially a town since 1288 and is one of the youngest in Germany. Since 1946, Düsseldorf has been the capital of the Land North-Rhine-Westphalia,one of the eleven constituent Lands (states) of the Federal Republic of Germany, as well as being the seat of the State Parliament and Prime Minister. Its eminence as one of the major cities in Germany rests, to a large extent, on its economic aura. The city is a foreign trade centre (Germany's foreign trade capital), and while being the foreign trade centre of the world's third strongest industrial nation, Düsseldorf maintains its traditional place in industry. Machine building, the chemical and iron industries and steel and vehicle construction dominate this aspect.

5.73 The city has about 1.2 million people within its boundary, and there are about 2.2 million in the greater area as a whole. The city employs 380,000 people with a 100,000 jobs in the city centre where about 20,000 people live. 65 per cent of the total workforce come from within the city boundaries while the remaining 35 per cent come from the region. The car ownership rate in Düsseldorf is one of the highest in West Germany with 300,000 private vehicles, and a total of 563,000 vehicles in the city altogether. About 35,000 people commute daily to the city centre by car.



KEY	
Düsseldorf Area	
Motorway	

Figure 5.9 **The Greater Düsseldorf Area and the Motorway connections.**

5.74 The policy in Düsseldorf aims at removing large portions of traffic from residential streets and other environmentally sensitive areas. This is generally done by diverting this traffic, and the general growth in traffic onto new roads with high capacity. In addition, the City has a rigorous maintenance policy of existing roads which is employed with upgradings of old sections to cater for additional demands (e.g. the upgrading of the A46 from four to six lanes). Traffic management techniques are also employed to facilitate the easy passage of traffic leaving the city, while restricting traffic entering it. These techniques, sometimes, involve the provision of better and higher capacity carriageways for outbound traffic[55]. The tendency in Düsseldorf, as in most German cities, is to build high capacity roads tangential to the centre and bypassing it. New roads of a radial nature are avoided whenever possible.

5.75 The objectives for building new roads in Düsseldorf are outlined as follows[55]:

- Environmental: A great emphasis in the city is on the removal of extraneous traffic from residential roads and roads with densely developed frontages. This is consistent with the general policy of the Land (Nord-Rhein-Westphalia) which has become well-known in Germany for its strong environmental initiatives.

- Operational: To improve traffic conditions and reduce traffic congestion. This objective is seen to be complementary to the environmental objective, and important for maintaining the economic welfare of cities.

5.76 The city of Düsseldorf, as mentioned earlier, pays special consideration to environmental issues. While building new roads, the city follows the policy of pedestrianising some of the roads in very sensitive areas of the centre. With the special emphasis given to landscape in the German towns, and the need to reduce the environmental severance impact of roads, the city leads the way in Germany in a new and bold concept which is the building of new roads in tunnels under beautifully landscaped areas. This is demonstrated in the example of the A46 upgrading to six lanes where a large section was taken underground and the area above landscaped and maintained as a public recreation area. Another scheme being considered is that to the airport where the A44 motorway is to be taken underground. The scheme is to be completed by 1992 and Figures 5.10 and 5.11) illustrate the

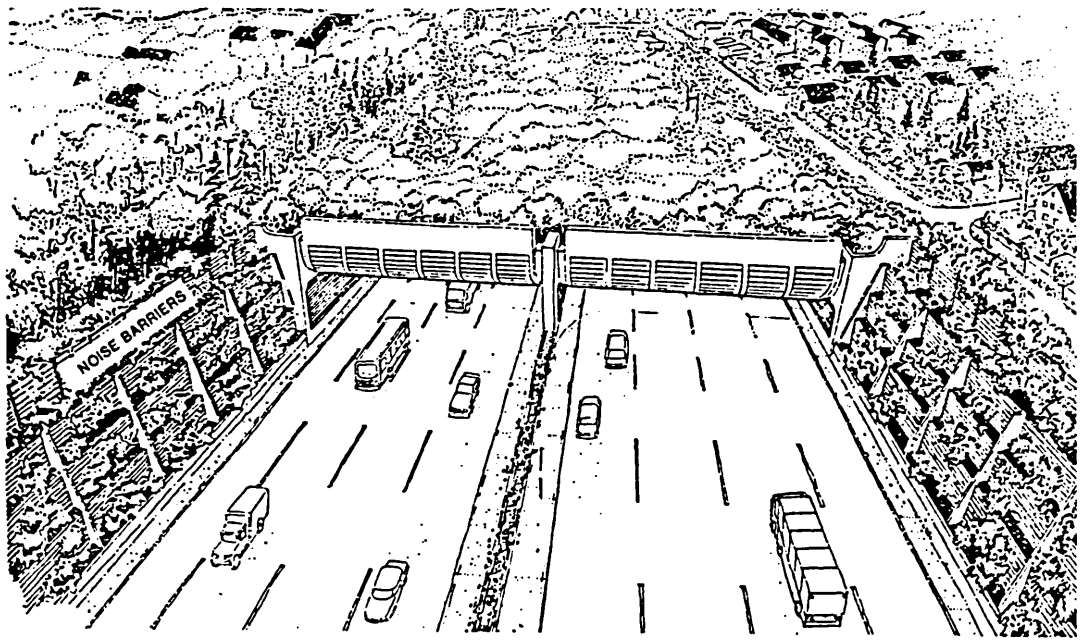


Figure 5.10 The principle of building roads in tunnels with the area above landscaped.

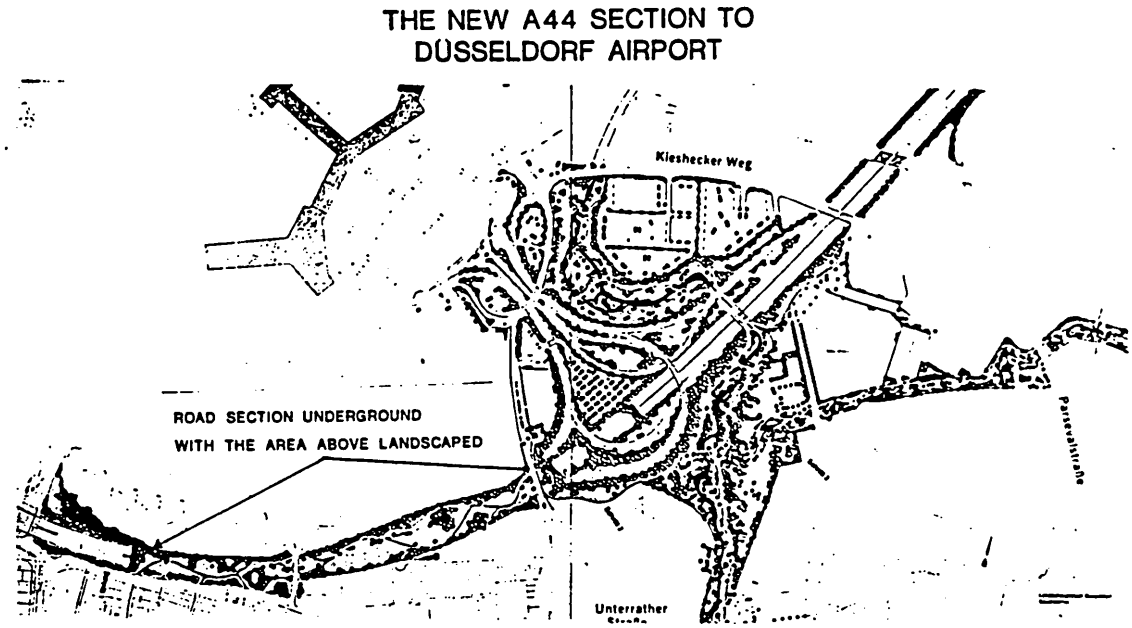


Figure 5.11 An example of the tunneling approach in Düsseldorf: the A44 section to the Düsseldorf airport.

concept. Another scheme, based on this concept, planned and to be underway soon is that of a major road which runs along the east bank of the Rhein in the City Centre. This idea of building new roads in tunnels while providing recreational areas by the landscape of the ground above, is gaining increased popularity in Germany since it significantly reduces, or even eliminates, some of the adverse environmental impacts (e.g. visual intrusion, noise, etc.) associated with roads. To this end, no cost is spared in ensuring that the provision of road schemes is done with minimal cost to the environment, even though this may mean the complete opposite in monetary terms. The trend of building roads in tunnels is spreading throughout Germany, and the detail to which some of the schemes are built is impressive (the A46 tunnel in Düsseldorf, Figure 5.12).

THE ROAD NETWORK

5.77 Düsseldorf is served by a comprehensive Autobahn and road network. With the city's location on the river, six bridges across the Rhein (five of them designated for traffic) provide a connection with the rest of the regions. Three of these bridges lead directly to the inner city. The city is situated in the middle of an Autobahn (motorway) quadrangle (Figure 5.9). On the right bank of the Rhine the Frankfurt–Köln–Oberhausen Autobahn (A3)and its parallels between Leverkusen and Düsseldorf Eller. On the left bank, the city is connected to the Ludswighafen–Köln–Kerfeld Autobahn (A57). Close to town, another Autobahn connection leads via Neuss, Mönchengladbach and Aachen to Belgium (A52). A connection to Northern Germany via Essen or Wuppertal is served by the A46. Due to Düsseldorf's central location a large proportion of through traffic exists on the roads leading to and out of the city. With the industrialised nature of the Rhein–Ruhr region, a large proportion of this traffic is HGV's. This leads to conditions of traffic congestion at certain bottlenecks in the city[55].

5.78 The morning peak in the city is spread over the period between 0600–0900. The evening peak period extends from 15:30–18:00 on weekdays. Entrance to the city is controlled by traffic signals and is monitored by a traffic control system. There are indications on some road sections that the peak periods are being extended, with the gap between the two peak periods gradually filling up. Some roads have peak periods at noon, indicating the extent of travel demand. In dealing with traffic growth, the city is continuing to improve the road network providing the missing links and connecting the network with the motorway network in the area. Currently, there are

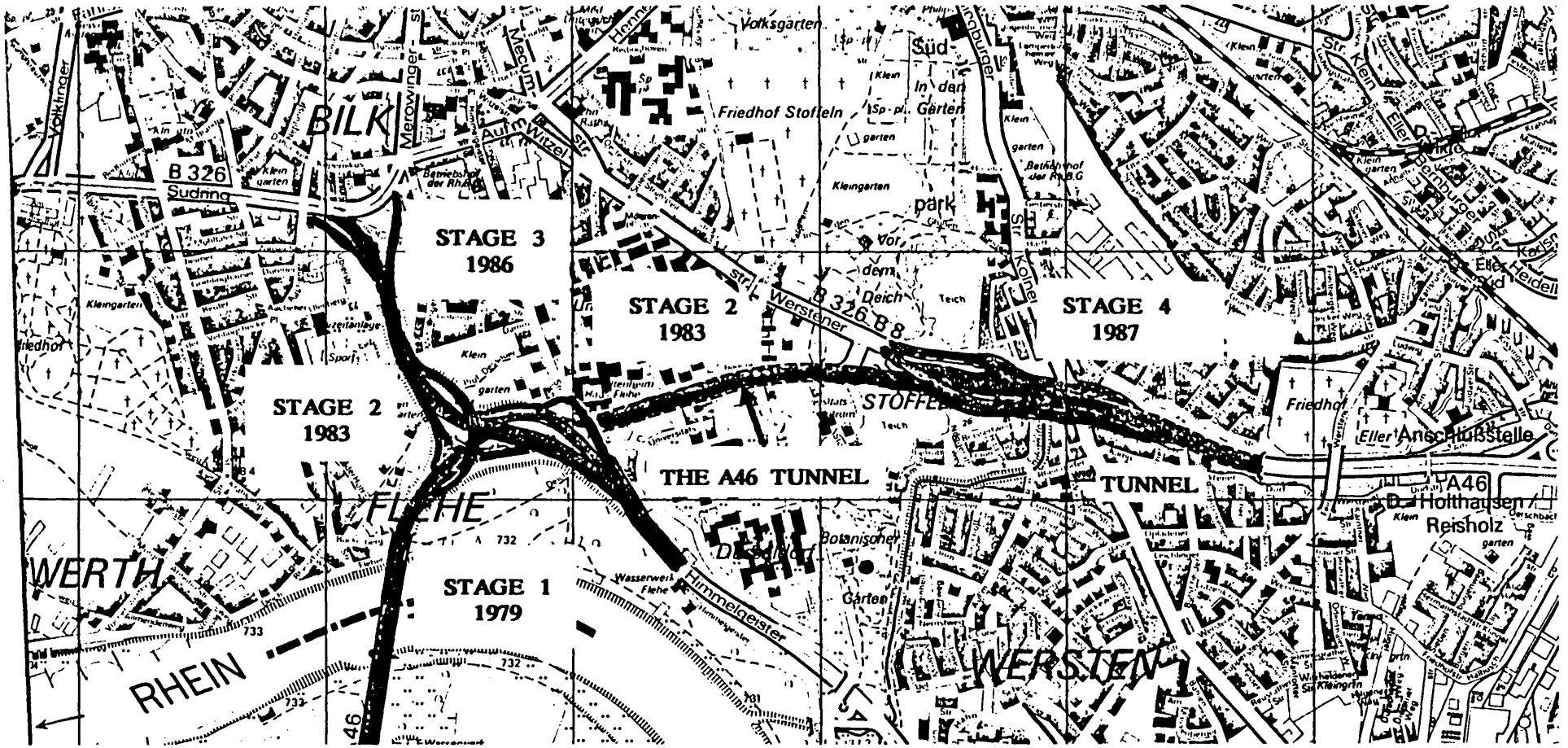


Figure 5.12 **The different stages of the scheme and their dates of completion.**

a number of new road schemes which are either underway or are being considered. The City authority stresses the need for these roads to improve environmental conditions along local streets and maintain its economic growth and prosperity[55].

PUBLIC TRANSPORT

5.79 The city owns 100 per cent of the rapid rail transit system which originally started as a private enterprise (The Rheinbahn). This rapid rail transit system serves the city centre and outlying suburbs and even reaches other towns in the area. Extensions to the system are underway to connect it to more nearby towns and regions, with long term plans to connect the major cities of the area. The rapid rail transit system carries the bulk of commuters to the centre. It receives, like all other public transport systems in German cities, a substantial subsidy from the city to ensure its remaining competitive and efficient as the major mode of transport to the city. This is consistent with the view in Düsseldorf that with a strong and well co-ordinated public transport system in the city centre, people can be dissuaded from commuting to the centre by car. Concessions on fares are given to passengers as part of a strongly braced marketing strategy aimed at attracting passengers on to the system.

5.80 Special attention is also given to improving traffic conditions for public transport. This is done by means of: i) allowing access to pedestrianised areas and car-free zones; ii) the provision of segregated tracks which give the system its own right-of-way and allow greater time savings; and iii) giving public transport priority at signalised junctions. Other measures include reducing conflict between the system and other road traffic in the centre where rapid rail stations go underground (U-Bahn). The city is also served by an extensive S-Bahn network with the stations conveniently located throughout the city*, and the service frequent (trains run every 10 or 20 minutes). The S-Bahn system connects Düsseldorf with other major cities in the area.

PARKING

5.81 The city's parking policy, in general, is to increase the number of short stay parking spaces and reduce long stay parking in the centre. Another goal is to reduce

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* In some German cities, the S-Bahn system is not a popular mode of travel due to the inconvenient locations of its stations in these cities.

on–street parking throughout the city and build underground or multistorey parking garages to cater for the demand. The inner city has an overall number of approximately 20,000 parking spaces of which a little over 14,000 is within the CBD. This is within the city set limits as part of the policy to maintain a ceiling on parking spaces.

THE CASE STUDY

5.82 The scheme actually being considered as a case study may appear to be of little interest since it is basically the completion of an intersection in the city. However, it illustrates a number of the city policies mentioned earlier and demonstrates how effective this improvement has been in delivering its intended objectives. The overall scheme involved the building of road links which were completed in four stages. The scheme was fully completed and opened in 1987. Figure 5.12 shows the different stages of the scheme, and the corresponding dates of completion. The scheme was built to deliver environmental and operational objectives. Stages 1, 2 and 4 of the scheme were justified on purely operational grounds, since they involved the completion of a section of the A46 (1983). The last stage (4) was basically the building of a major eastern interchange with the A46, improving the existing connection with the city and the motorway network and incorporating the 3–lanedual carriageway tunnel mentioned earlier (Figure 5.12). This tunnel section replaced the existing surface road on the same line. Stage 3 was the missing link needed to provide the relief from traffic congestion experienced on the section between Merowinger Strasse and Witzelstrasse.

The Situation 'Before'

5.83 The old route is a section of the south ring B8 (Sūdring) as shown in Figure 5.13. Immediately after the Sudbrücke bridge, the B1 section of the route traverses mostly open space (Figure 5.13). Traffic bound for the city centre usually left the route at the junction with Völklinger Strasse, whereas traffic from the centre (heading further South or east on the A46) joined continuing traffic on the route, and continued on the B326 B8 section of the road. From the junction with Völklinger Strasse onwards, the route goes through a developed area with a residential frontage. The area immediately between the road's junction with Merowinger Strasse eastward, is a particularly high density residential area. Prior to the opening of the new intersection, the traffic from other local and side streets heading in a southerly

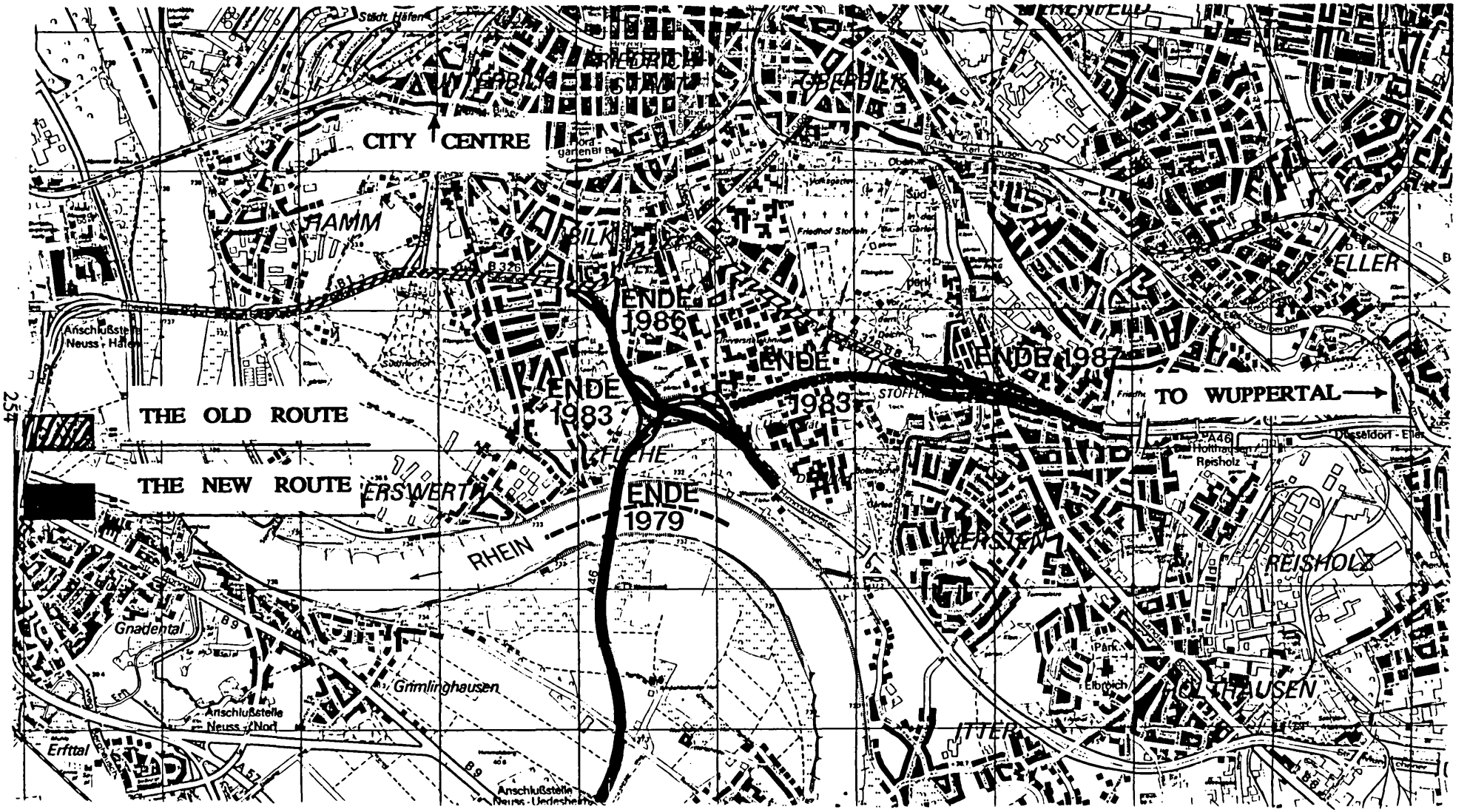


Figure 5.13 **The 'old route' and the 'new route'.**

direction (towards the A46 or Himmelgeister Strasse also joined the route at this busy section. To join the A46, traffic had to go through this residential area before turning off Witzelstrasse onto the A46 and from there on either eastward or further south. From 1983 onwards the newly completed section between the two ends of the A46 made this route more attractive for traffic bound east in the Wuppertal direction or south west via Neuss (Figure 5.13).

5.84 With no better alternative available, and with a large proportion of this traffic being heavy goods vehicles (HGV), the conditions on the old route became quite poor both environmentally and in operational terms[55]. The increased noise levels and air pollution in addition to all other hazards associated with such a high density of HGV traffic, especially through this highly sensitive area of residential development, made the situation 'unacceptable'. As described by the Director of the City's Planning Department, the situation was so bad that 'you could always look and see a very long wall of lorries'[55]. Traffic congestion brought movement to a crawl on this road making the conditions very unpleasant for the motorists as well as the residents.

Objectives of the scheme

5.85 The scheme was justified on environmental and operational grounds. These were:

-Environmental: a) To remove the through traffic off the old route, especially off the section between Merowinger Strasse and Witzelstrasse (Figure 5.12); b) improve environmental conditions by reducing air pollution and noise levels; c) improve safety and reduce the conflict between residents and the traffic by diverting the through traffic (mostly HGV traffic) to a better road with higher capacity and through a less sensitive area.

-Operational: a) to provide the necessary missing links and join the network with the motorway network; b) to relieve traffic congestion on the old route; c) to divert through traffic on to higher capacity roads; and d) to cater for the demand for movement along then A46 by providing a much needed link between the A46 and the city; e) reduce traffic levels on Witzelstrasse.

5.86 The information available is on the part of the scheme which involved the provision of a link between the B326 B8 section and the junction of the A46 and Herrelgeister Strasse. The bridge section of the A46 was completed in 1979. The upgrading of the A46 section, between the junction and Südlichre Strasse, to motorway standard was completed in 1983. The location of the new link was to ensure the fulfilment of the objectives, namely, to relieve the section between Merowingen Strasse and Witzelstrasse from HGV traffic and traffic congestion. The area traversed by this link is open space and was deemed suitable. The link, which was built to motorway standards, was completed in 1986. Another improvement in the area was the building of the interchange with Werstener Strasse, which was built to relieve the bottle neck caused by traffic coming on and off the Autobahn, and was completed in 1987 (Figure 5.12).

The Traffic Impacts of the Scheme

5.87 Immediately after the opening of the scheme in 1987, traffic counts were taken on the old route and on the new link. Counts were also taken on the local and side roads that were directly influenced. These figures were then compared to those of 1980 to see the percentage of reduction or increase in traffic flow on these sections. The study was not a comprehensive one, and the results gave some indication on the extent of relief on the old route section between Merowingerstrasse and Witzelstrasse, as well as the impact on other major roads in the area which are directly influenced by the new scheme. The percent change in the traffic levels on the roads showed that the reduction experienced on the previously deteriorating section is significant. With reductions of 30 percent and more, on 1980 traffic levels, the scale of this improvement is obvious. The increase on certain sections was explained[55] as the natural result of the release of suppressed demand (Völkinger Strasse, for example experienced an increase between 20–30 per cent in the southbound direction). There were also over 30 per cent increases on the old route section between Fleher Str. and Merowinger strasse. The increases observed southbound on the Mecumstrasse (Figure 5.12) which were in the order of 10–20 per cent, are the result of the completion of the interchange with the A46. This interchange made this road more attractive to the traffic which previously used local roads and lead to improvements along these roads, which were mainly in residential areas. The study, however, did not include these roads and was concerned with the immediate corridor of the scheme.

5.88 Some of the local roads which experienced increases in traffic levels were residential roads. These increases were seen as temporary and were attributed to road works associated with the building of a tunnel in the area (but no further information was available on this), and the traffic redistribution which followed the opening of the scheme. Once this tunnel is completed, and once things have settled down, it was stated, the scale on improvement on these roads will be obvious, and the situation, in the whole, will improve even further[55]. In 1988, traffic calming measures were being considered by the city on the old route to prevent traffic levels from going back to the 'before' situation. This is in line with the city's policy where traffic management techniques are deployed on older sections which have been relieved or replaced by newer ones. This controls the growth in additional traffic and prevent the situation from reverting to its worsened conditions[55]. This is similar to the approach in other German cities where relieved road sections are safeguarded against further traffic growth.

REMARKS AND CONCLUSIONS

5.89 The information made available by the City of Düsseldorf's Planning Department was rather minimal. Most of the information came from the meeting in Düsseldorf with officials from this and other local transportation authorities. The scheme described above was a rather small one. It does, however, illustrate the dynamic nature of German planning, where the continuity of the policies helped achieve the completion of the different stages of the scheme within relatively short periods from one another ensuring best the most effective utilisation of the scheme. The study also sheds some light on the planning policies and strategies adopted in one of the major cities. The scheme was discussed here, for the purposes of this study, as if it were one scheme. In effect, however, it was three different schemes, but as can be seen from the Figures, the different parts of the scheme were completed in relatively short periods between them. The scheme has improved the travel conditions on the old route, and contributed considerably to the reduction of traffic congestion and the removal of the HGV traffic from unsuitable local streets. The provision of these missing links has significantly improved the connection between the road network in the city and the A46, one of the main motorways serving the region. The scheme, therefore, does appear to have been effective in delivering its intended environmental and operational objectives.

5.90 In the case of Düsseldorf, the nature of the city's position as the Land capital, Germany's foreign trade centre, and its traditional place in finance and industry, create a large demand for mobility. The nature of the Rhein–Rhur region, with its large cities being closely located, make it very important to maintain a good connection via road networks and public transport systems. Düsseldorf, like Hamburg and other German cities, recognises the importance of catering for the essential business traffic. This is evident from the parking policy, and the traffic control and management exercised by the city to restrain unnecessary or commuter traffic and accommodate essential business traffic. This also includes the building of new roads and the continued upgrading of older sections with insufficient capacities.

5.91 The extensive and reliable public transport system in the city caters for most of the travel demand to the city centre via a rapid rail transit system[55]. This system goes underground in the city centre to avoid any conflict with other road traffic. When outside the centre, the system enjoys its own right–of–way even more and is made attractive to the public via a good marketing strategy. This strategy, coupled with a continued improvement policy and traffic restraining measures in the centre give the system a clear advantage over other modes. In addition, the S–Bahn system is conveniently located throughout the city (this is not usually the case in other German cities), enjoys a high rate of ridership, and contributes effectively to the public transport system within the whole region.

5.92 Traffic outside the centre and through the city is catered for by a network of high capacity roads and Autobahns. The need for more roads to meet the demand for mobility and provide improved accessibility in Düsseldorf is acknowledged. This is dealt via a combination of policies (e.g. priority to public transport in the centre, parking control, new roads etc.) aiming at providing the best option at the least environmental cost. With some sections upgraded and new ones implemented, the city does not neglect to keep monitoring older sections and employ management measures to control any future growth on them.

CHAPTER 6 CASE STUDIES FROM SWEDEN

A: STOCKHOLM

INTRODUCTION

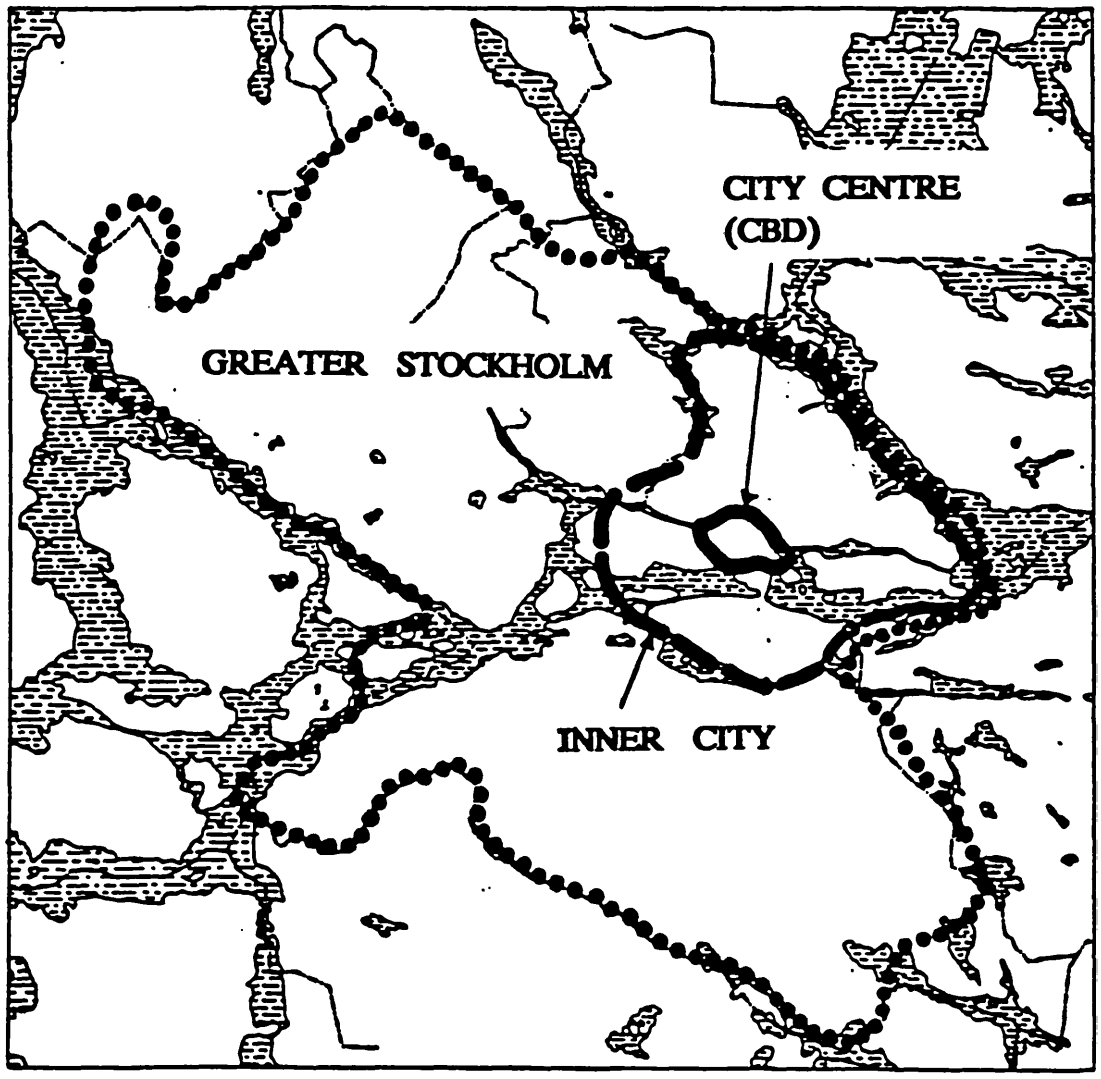
6.1 The City of Stockholm, the largest city and the capital of Sweden, provides an example of transportation planning in a major Scandinavian city. It illustrates the various strategies and planning concepts employed, and, more importantly, how effective building new roads in major cities in Sweden has been.

6.2 The city has a unique location on a cluster of 14 islands and can be divided into three areas: the Greater Stockholm area is the home of approximately 1,500,000 inhabitants, 650,000 live in the Inner City , 250,000 in the City Centre with the rest living throughout the region. Figure 6.1 shows the boundaries of Greater Stockholm, the Inner City and the City Centre. Of the 1.5 million population 900,000 lived in the Inner City (184 square kilometres) with the remaining 600,000 people scattered over an area six times larger. They, however, do not live in American style suburbs but in separate communities and planned New Towns, many alongside railway lines.

6.3 Current environmental world issues are a dominant element in shaping the new transport policies being discussed for Sweden in general, and the three main cities Stockholm, Göteborg and Mälmo in particular. The new traffic Master Plan for Stockholm is being prepared taking into consideration a number of factors that were the shortcomes of previous Master Plans.

THE ROAD NETWORK

6.4 Highway building has developed rather slowly but efficiently in Stockholm. Despite the space availability, the city had only five short stretches of motorway on radial routes in the suburbs by 1971. And, although the city centre was originally built to a grid pattern, twentieth-century developments avoided grid patterns and the whole road system is strongly radial. Despite the space available, and the fact that it had inherited a grid-street system, Stockholm did not build large highways out into the country and sprawl out after them as was the case in many American cities. On the



KEY

Boundaries

Greater Stockholm

Inner City

City Centre

FIGURE 6.1 The Boundaries of The Greater Stockholm Area, The Inner City and The City Centre.

Source: Stockholms gatukontor, 1989.

contrary, a review of general planning aspects in Stockholm reveals a consistent trend to minimise the need for using the car.

6.5 In 1971, Stockholm claimed to have had the highest incomes in Europe, and the highest level of car ownership (about 265 per 1,000 people). Car ownership figures for 1987 show that there were about 540,000 cars (1 car per 2.7 inhabitants) in the Greater Stockholm area, 220,000 (car per 3 inhabitants) in the Inner City and 50,000 in the City Centre (1 car per 4 inhabitants).

PUBLIC TRANSPORT

6.6 Stockholm has always attached great importance to public transport. The City Council decided to build a rapid transit system (Tunnelbana) utilising some of the tramway right-of-way. Developments increased around the new lines with the continuing closure of tramways and the introduction of the Tunnelbana. A reorganised bus network served as a feeder system to the Tunnelbana. Today, the city has an extensive system consisting of buses, Tunnelbana rapid rail, trams and local rail. Five commuter railway lines, operated by the State Railways, serve distant communities, and four Tunnelbana lines (with five branches) serve shorter distances. The total length of the public transport network in the Greater Stockholm area is about 7,800 km; this sum includes all bus lines, subways, tramways and local railways. Public transport plays a major role in the City Centre where 70-75 per cent of all journeys in the centre are made by public transport. There are about 600 bus stops in the Inner City, with another 1,000 bus stops in the other parts of the city. Twenty six kilometres of inner city streets and routes have reserved bus lanes for buses, and these are generally open for taxis and bicycles. All motor traffic is banned in about 60-70,000 m^2 of the CBD. Pedestrianised streets in old parts of the city are accessible for transport deliveries between 0500-1100 a.m. The public transport network is strongly radial.

PARKING

6.7 The City Centre contains a large number of jobs. The restriction of high-rise office building has resulted in a large amount of employment being located just outside the City Centre. This has led to the use of parking controls to restrict the number of cars driving into the city. To achieve this goal (the restriction of car traffic in the centre), the number of parking spaces in the centre has been reduced by some

10,000 spaces over the last 15 years, and multistorey car parks have been strategically located. Today, the inner city area contains about 12,200 on-street parking spaces plus an additional 3,600 spaces in public parking lots and garages[56].

TRAFFIC DEVELOPMENT IN STOCKHOLM

a) The City Centre

6.8 From Figure 6.2 it can be seen that traffic growth on City Centre streets followed a declining pattern from 1973 onward. Early in 1977, a sharp decline in traffic was recorded continuing to mid 1982 (289,000 vpd compared to 341,000 in 1977, a decrease of 18 per cent). From mid 1982 onwards the tendency was reversed and a sharp increase until 1985 (331,000 vpd or 14 per cent). Between 1985 and 1986 there was no change but in 1986 the increasing trend continued (355,000 vpd in 1988). There are, however, a number of elements which have probably attributed to these changes. The two main factors are the price of petrol and the price of the public transport season ticket.

6.9 Figure 6.3 shows the trend in petrol prices and the price of public transport season ticket, and its relation to the number of season tickets sold between 1977-1986. From the figure, it can be seen that the sharp increase in petrol prices continued until 1981 where it increased marginally before starting to fall down again in 1982. In 1984, the price fell to its lowest level since 1980 but increased before falling sharply after 1985. In the same period, the price of the monthly public transport season ticket was falling from 100.00 Skr (about £ 10.00) in 1977 to its lowest level at a little over 70.00 Skr in 1981 which was also the year with the largest number of season tickets sold during that period. Following this the price started to increase, a trend accompanied by a decline in the number of season tickets sold. Both trends continued with a stagnation period between 1984-1985 after which the trend of increasing ticket prices continued, and so did that of declining season tickets sales.

6.10 It is evident that the fall in number of cars entering the City Centre was influenced by the cheap cost of public transport season tickets and the increase in petrol prices during the same periods. The opposite is true, that is the number of cars entering the City Centre had gone up when season tickets were affected by price increases, together with falling petrol prices. Looking at the situation in general, it

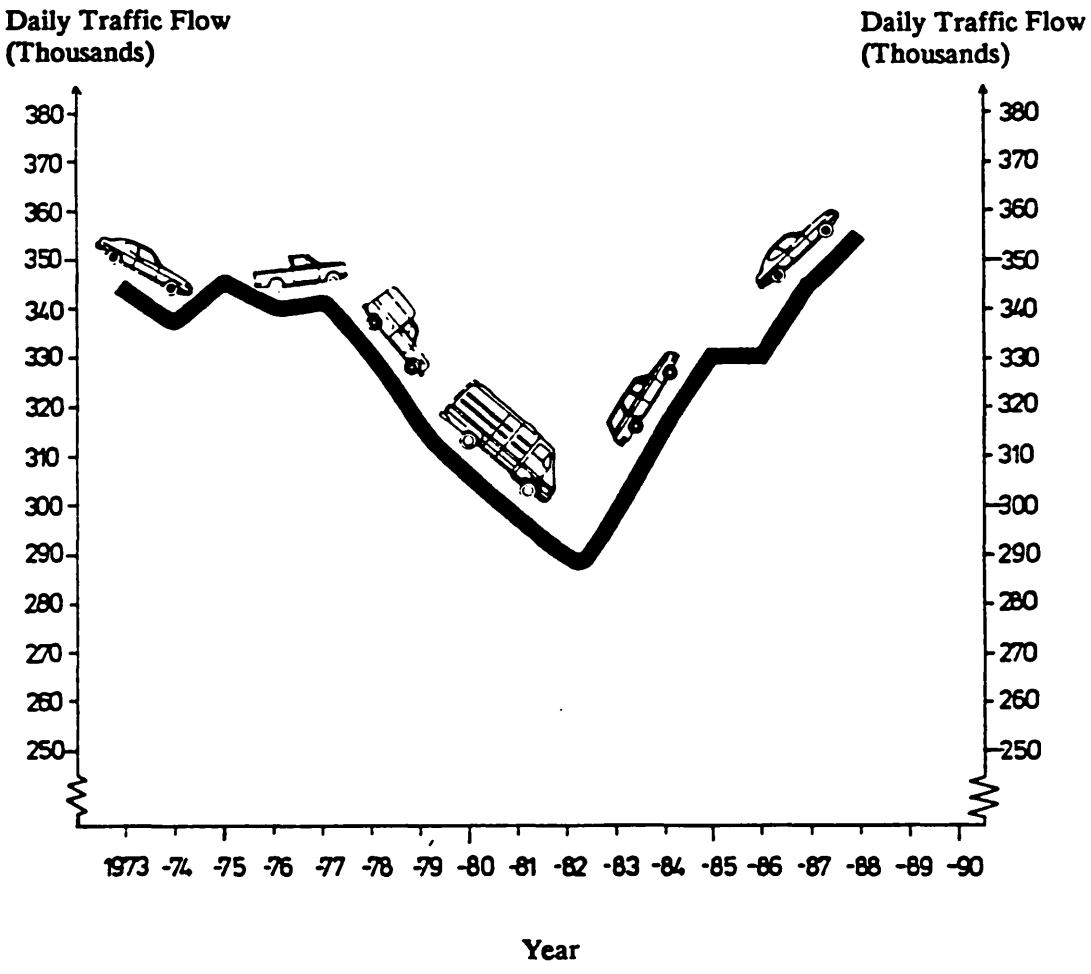


FIGURE 6.2 City Centre Traffic Development 1973 – 1988 (Number of Cars and Buses Per Day To and From The Inner City in Stockholm).

Source: Stockholms gatukontor, 1989.

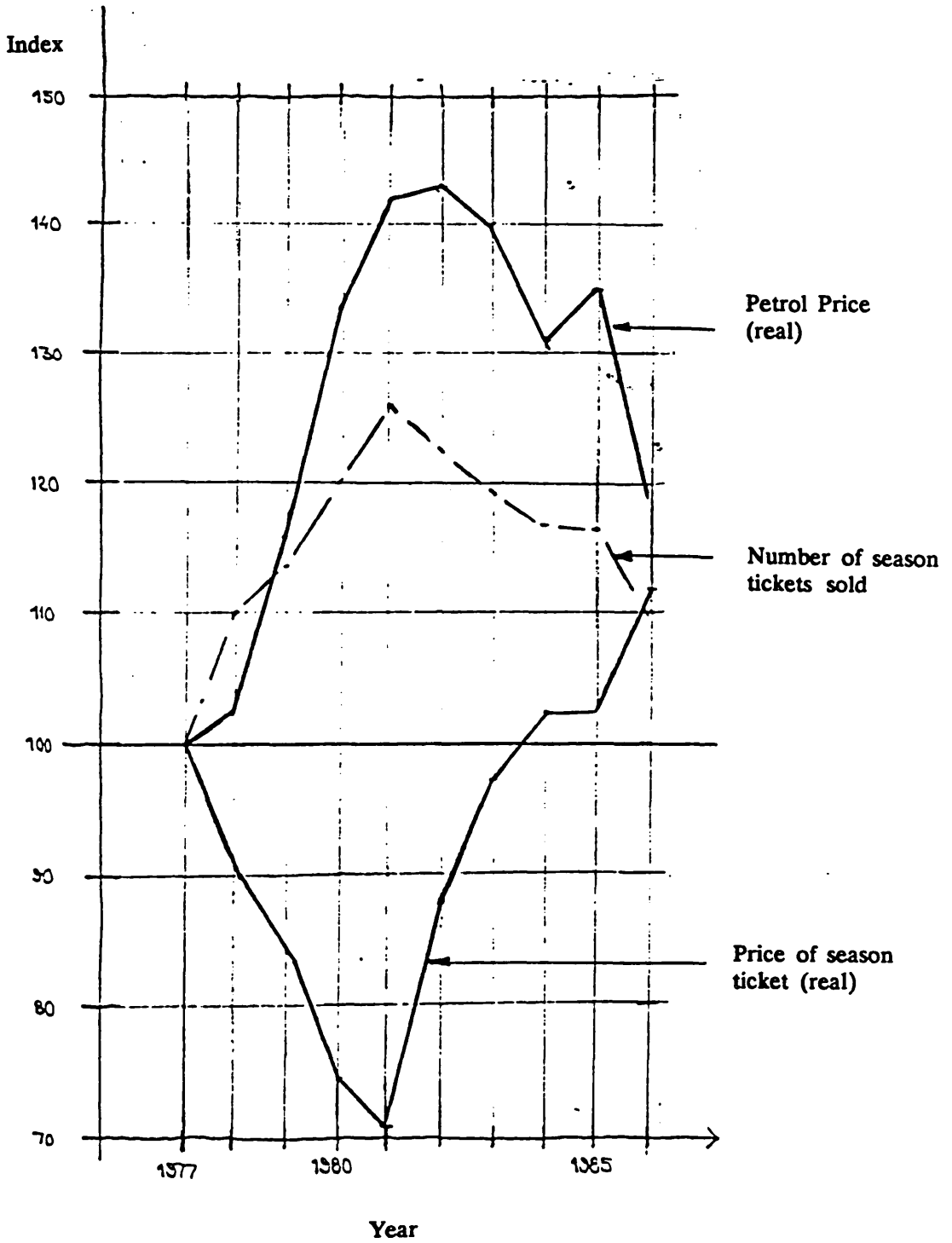


FIGURE 6.3 The Changes in Petrol and Season Ticket Prices, And The Number of Season Tickets Sold in The Stockholm Area (1977 -1986).

Source: Stockholms gatukontor, 1988.

can be seen that between 1976 and 1988, traffic entering the City Centre has increased by just 4.4 per cent over this twelve year period reflecting the capacity restraints and parking limits. However, when examining these changes more closely, the average increase between 1982 and 1988 has been about 3.5 per cent per annum. Table J.1 in Appendix J provides the complete picture of traffic flows on City Centre streets in Stockholm[57].

b) The Inner City

6.11 The overall daily number of vehicles that enter or leave the Inner City is presented in Figure 6.4 for the period between 1945 and 1988. The figure shows an increasing trend at a very high rate during the early 1950s. This trend continued into the late 1960s before beginning to fall in the beginning of the 1970s. A short lived recovery was experienced in 1974, however the falling trend continued after 1975 until 1983 when the growth rate continued somewhat higher than in the early 50s. For comparison purposes the 1976 and 1988 daily traffic flows to and from the Inner City were 517,000 vpd and 605,000 vpd respectively. This represents an increase of 17 per cent over the same 12 year period. However, if we look at the figures between 1982 and 1988 the increase has been more significant at 28 per cent or an average 4.4 per cent per annum which is greater than the rate in the City Centre. Table J.2 provides a complete list of traffic flows on major roads entering the Inner City from the south and north[57].

c) The Greater Stockholm Area

6.12 The growth in vehicle traffic on Greater Stockholm area roads has been, as would be expected, greater than that on City Centre or Inner City roads. Between 1976 and 1988 the increase has been in the order of 38 per cent (710,000 up from 516,000 vpd). Between 1982 and 1988 the increase was 32 per cent or an annual average of 4.8 per cent. The detailed description of these changes are presented in Table J.3 of Appendix J.

6.13 It can be clearly seen that the growth in vehicle traffic, though falling between 1977 and 1982, has gone back steadily and at relatively high rates. The growth has been largest within the greater area while it has been somewhat less across the boundaries of the Inner City and the City Centre. There has also been an increasing trend in car ownership.

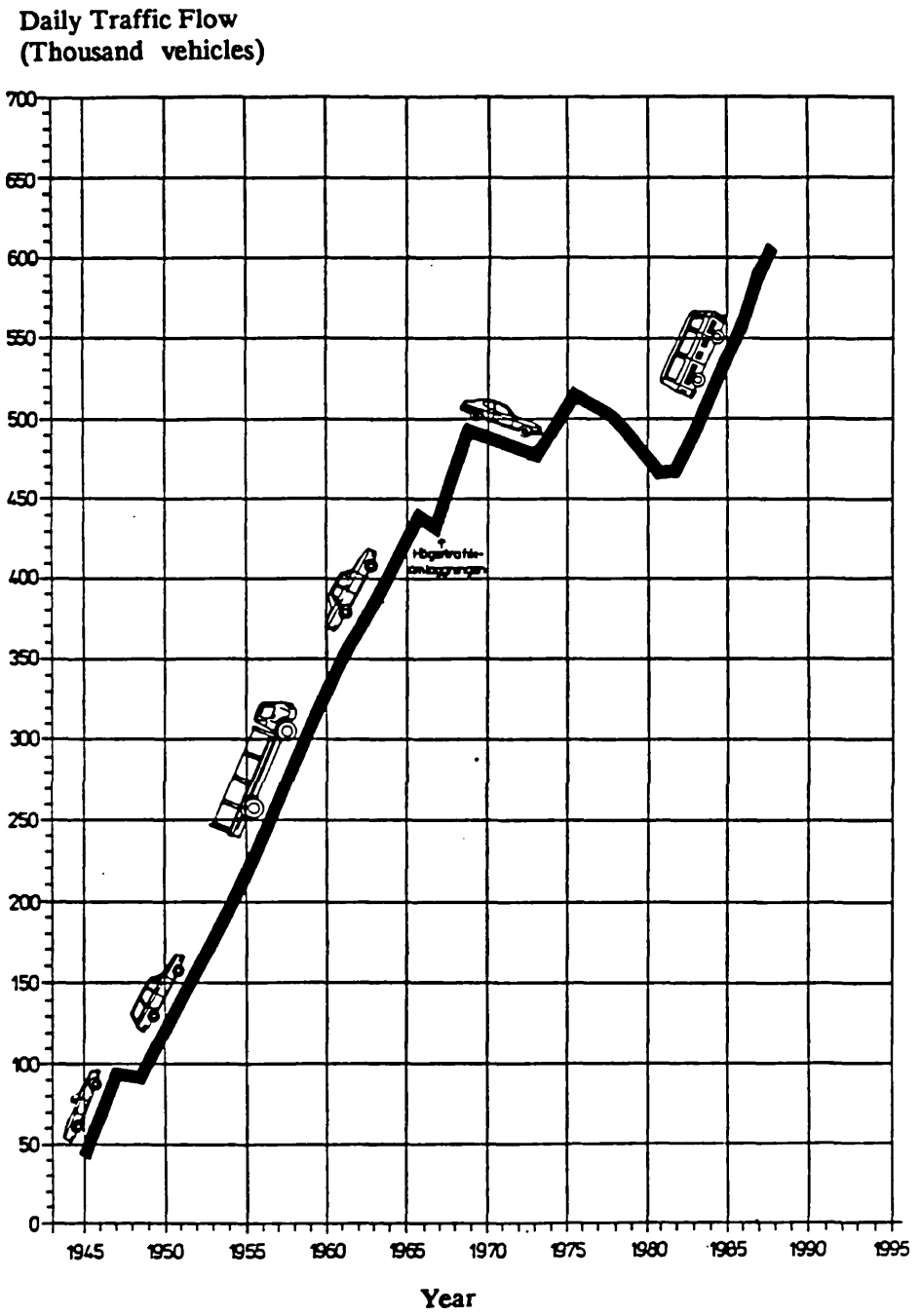


FIGURE 6.4 Inner City Traffic Development 1945 – 1988 (Number of Cars and Buses Per Day To and From The Inner City in Stockholm).

Source: Stockholms gatukontor, 1989.

6.14 All this brings us to an example of recent urban road building in Stockholm to see how it has affected the development in traffic at least in its immediate corridor, and the impacts it might have had on public transport services along the same corridor.

THE CASE STUDY

6.15 The scheme considered in Stockholm was that of a new radial main road with a new bridge and tunnel. The scheme is about 2.5 kilometres long, with some 1 kilometre in tunnel. The road is one of the main water crossing entrances into the Inner City and provides a radial connection right through the Inner City and into the City Centre via other roads (Figures 6.5 and 6.6). The scheme known as *Johanneshovsborn* was completed in 1984 and by-passed two other radials namely *Skanstullsbron* and *Skansbron* which up till then served as the main carriers of traffic into and through the southern part of the Inner City (Figure 6.6). *Skanstullsbron* was built to meet the increase in traffic demand back in the sixties and to bypass the then existing *Skansbron*. The scheme was badly needed to relieve congested conditions along these parallel roads. The new road was justified on operational and environmental grounds since the old road was suffering from excess traffic levels reaching some 60,000 vpd. The old road passed through a main shopping and residential area in the Inner City and the need to improve environmental and traffic conditions along it were pressing.

6.16 The road is located on a major entrance point to the Inner City, namely *Skanstull*, also shown in Figure 6.6. The road crosses the river on a high level bridge and then goes down through a tunnel through the Inner City. The new road removed a large proportion of the traffic that previously used to go on Gōt Gatan. Previous combined flows on *Skanstullsborn* and *Skansbron* had been more than 89,000 vpd (1976). With the opening of the new road, these flows were reduced to 32,000 and 19,000 vpd respectively. This is clearly a large reduction of nearly 51 per cent and 21 per cent on these two roads. This translated into much less through traffic using the unsuitable and environmentally sensitive Inner City streets especially *Gōt Gatan*. The new road has been in operation for some six years now and with increasing traffic growth the road has not filled up completely or generated so much more traffic within the corridor.

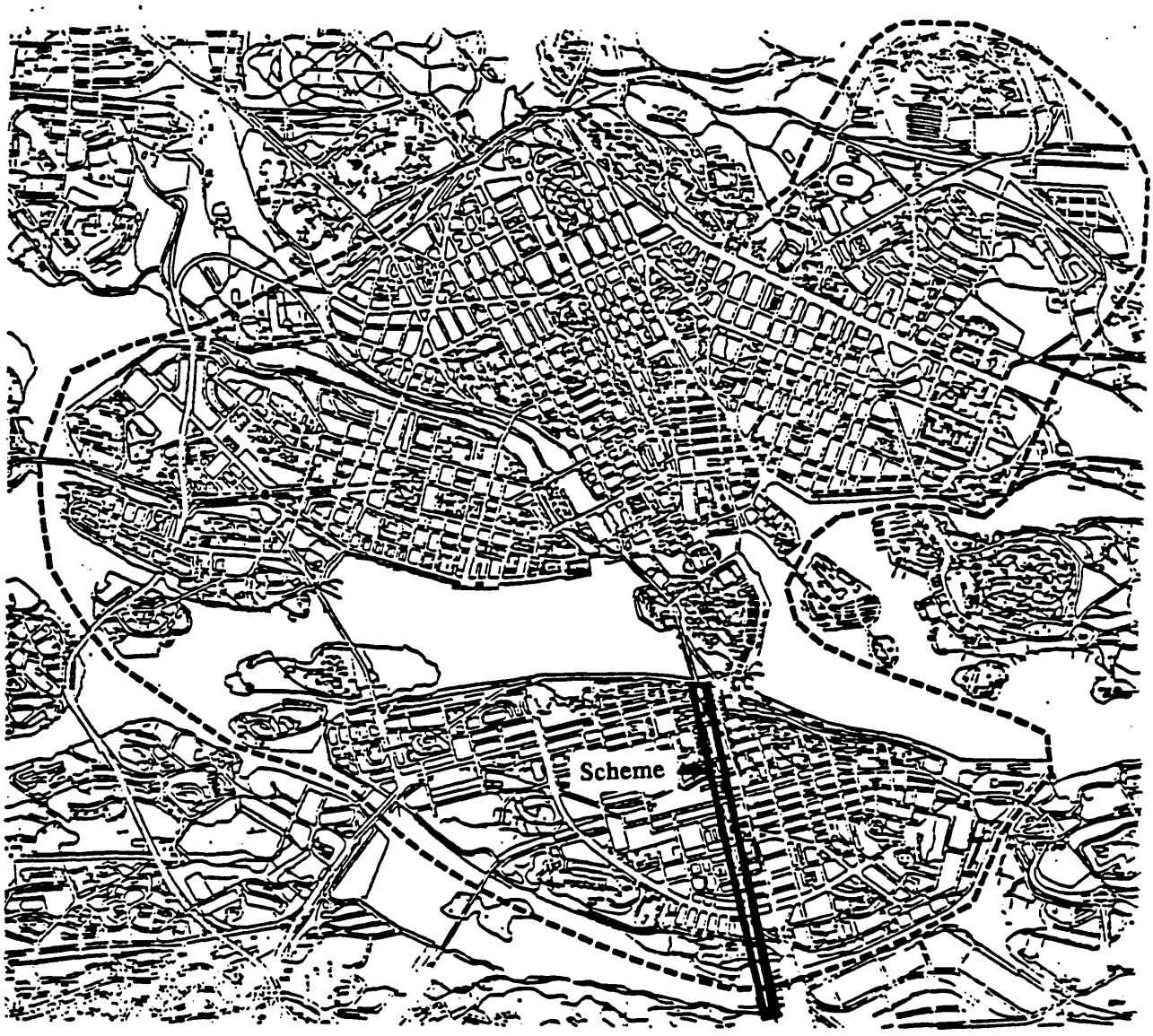


Figure 6.5 **The Stockholm Inner City boundary and the location of the scheme considered.**

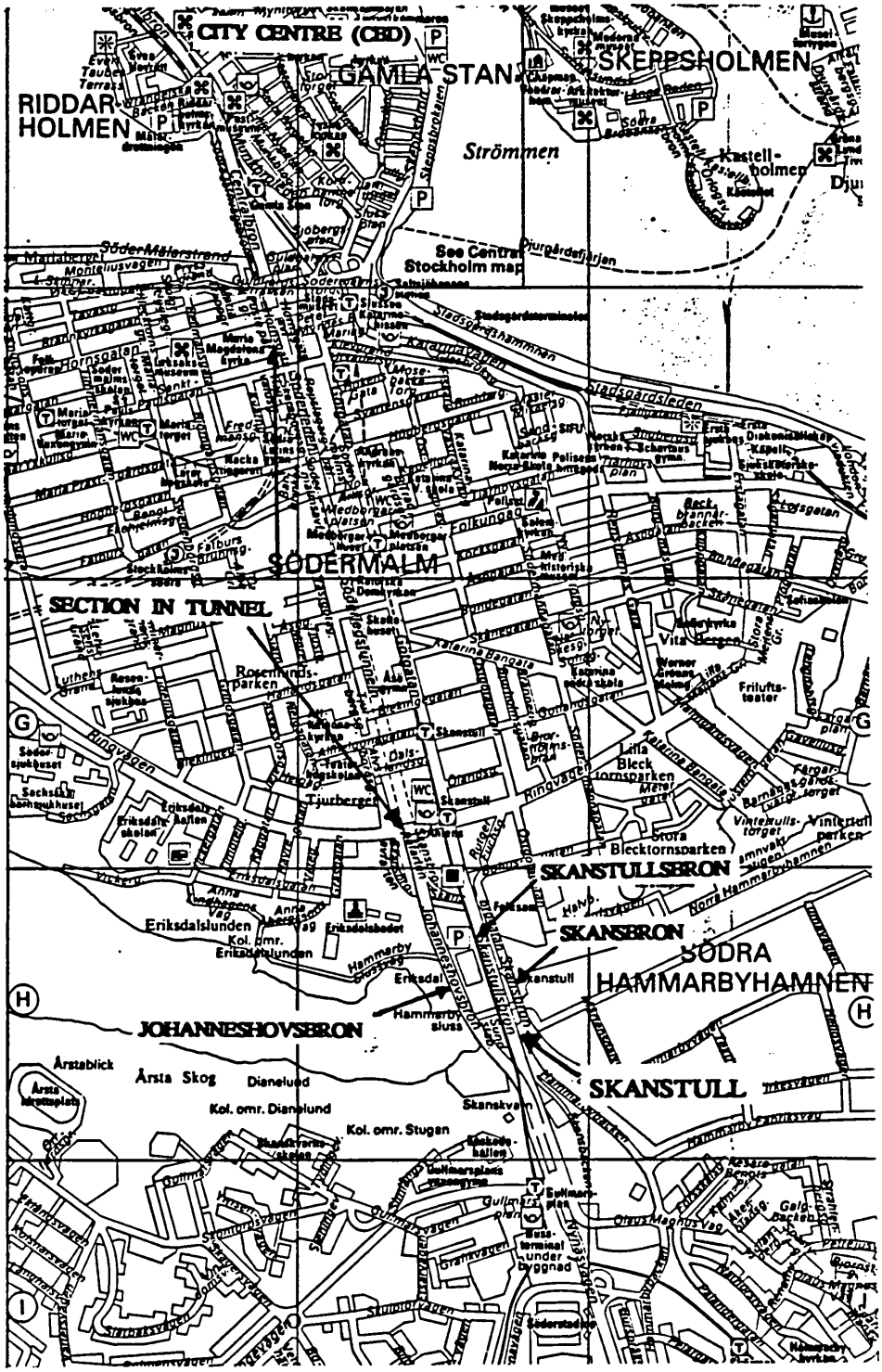


Figure 6.6 **Skanstull Inner City entrance, the scheme considered, and the roads relieved.**

6.17 For the purposes of assessment of this scheme the following data was obtained via correspondence and meetings with local highway and public transport officials in the city :

- traffic flow figures across Skanstull for the period 1966–1989,
- the overall number of vehicles per day that enter the City Centre for the period 1945–1987,
- the percentage of trips made by public transport to and from the City Centre both at all city points, and at Skanstull,
- traffic flows on the two parallel radials bypassed by the scheme

Furthermore, additional information on the scheme, obtained from discussions with the city officials, will also be presented for the purposes of this study.

THE IMPACTS OF THE SCHEME

Traffic Impact

6.18 The data available was that for two way daily traffic flows at Skanstull. The figures are available for the period between 1966–1989. Table 6.1 presents the total daily vehicles crossing to and from the Inner City at Skanstull. From the table, it can be seen that traffic levels increased during the late 1960s but started to fall in the early 1970s, due to increased petrol prices and fuel shortages resulting from the oil crisis which affected Europe. Construction works began in 1976 and this is reflected by the sharp fall in traffic flows in 1977 (down by 10 per cent). This trend continued and was more or less stable during the last three years of construction (1981–1983) with traffic diverted to other routes in the city. The road was opened to traffic in 1984 and this was associated with a sharp increase of 26.7 per cent (95,000 vpd immediately after the opening of the road compared with 75,000 vpd immediately before). It is more meaningful to compare the growth in traffic levels between 1970 and 1989, since until 1970 traffic flows appear to have developed in a way which was not subject to the influence of oil prices and road works associated with the scheme. It can be seen that traffic levels in 1989 were 120,000 vpd which is a growth of only 12 per cent over the 1970 figure of 107,000 vpd and represents a very small growth rate per anum (approximately 1.2 per cent).

6.19 Taking the period between 1976 and 1988, since these are available for all the different areas, it can be seen that the change has been 31.5 per cent, which is rather

Year	Vehicles Per Day	% Change
1966	96,000	
1967	89,000	-8.0%
1968	94,000	5.5%
1969	101,000	7.5%
1970	107,000	5.9%
1971	95,000	-12.6%
1972	92,000	-3.2%
1973	87,000	-5.4%
1974	85,000	-2.3%
1975	87,000	2.4%
1976	89,000	2.3%
1977	80,000	-10.0%
1978	81,000	1.3%
1979	77,000	-4.9%
1980	73,000	-5.2%
1981	71,000	-2.7%
1982	71,000	0
1983	72,000	1.4%
1984 (before)	75,000	4.2%
1984 (after)	95,000	26.7%
1985	93,000	-2.1%
1986	96,000	3.2%
1987	111,000	15.6%
1988	117,000	5.4%
1989	120,000	2.6%

Table 6.1 Two-way daily traffic flow at ***Skanstull*** 'before' and 'after' the opening of ***Johanneshovsbron***.

Source: Stokholm gatukontor, 1989.

more than the growth recorded across the Inner City for the same period (17 per cent) but less than that for the Greater Stockholm Area (38 per cent). Since the road is located immediately south of the Inner City and is rather on the boundary between the Greater Stockholm area and the Inner City, it can be expected to carry more than the average inner City street given that it is also a major water crossing and a main entrance to the Inner City and then the City Centre. However, looking at traffic flows on the two old roads, *Skanstullsbron* and *Skansbron*, 'before' and the three roads 'after' it can be seen from Table J.2 in Appendix J that traffic growth took place on the new road while both old roads experienced significant reductions leading to improved environmental conditions along these roads and along the other local roads in the Inner City[56]. An overall view of traffic growth along the southern Inner City corridor and other water crossings, shows that the change in traffic between 1976 and 1988 was 16.6 per cent or slightly less than that for the Inner City during the same period. Furthermore, comparing the 1966 figure available for *Skanstull* with the 1988 figure shows an increase of about 22 per cent. This is significantly less than the 38 per cent increase during the same period in the daily traffic entering and leaving the Inner City during the same period.

6.20 After opening the new road, the authorities in Stockholm reduced the width of the old road (*Skanstullsborn*) and allowed parking on it. Data from journey time surveys were not available as these were abandoned since the new road was opened. The general impression, however, is that travel conditions are much improved on the new road in addition to the great environmental improvements along the old one. The improved travel conditions have resulted in car journeys taking only half the time for similar journeys by public transport (buses) even during the peak hour periods. The conditions for buses are reported[56] to have improved on the relieved roads leading to improved journey times. However, no figures were available.

6.21 From all of the above, it can be concluded that even doubling the capacity at the Skanstull entrance did not 'generate' much traffic or turn counterproductive. The growth in traffic in this corridor has been no more than experienced in the city in general given its location. The argument that new roads 'generate' so much more traffic does not hold here. It can also be seen that traffic conditions have not reverted to their previous levels on the old roads. The increase in traffic on this road has been in line with the general trend and even less than the growth experienced across the City Centre during a similar period (1966–1988).

Modal Split

6.22 In order to investigate the changes in modal split, figures of the percentage trips by public transport to the Inner City, at all crossing points and at Skanstull were provided and are presented in the Table 6.2. This table shows that the share of public transport at Skanstull was rising between 1977 and 1984 where it reached its highest ever during that given period (70.8 per cent). This was due to the construction works at the site of the new road which made it more attractive to use public transport at that point. This trend was spread all over the city since the disruption at that crossing point affected a number of different routes. A year after the road was opened (1985), the public transport share fell by 5.5 per cent at Skanstull and by 1.8 per cent at all crossing points. The fall continued in the years that followed, however, its rate at *Skanstull,* was much smaller (only 0.2 percent between 1985 and 1987). At all crossing points in the City, the share of public transport continued to decline (2.8 percent between 1985 and 1987) reflecting a City wide trend of reduced public transport share.

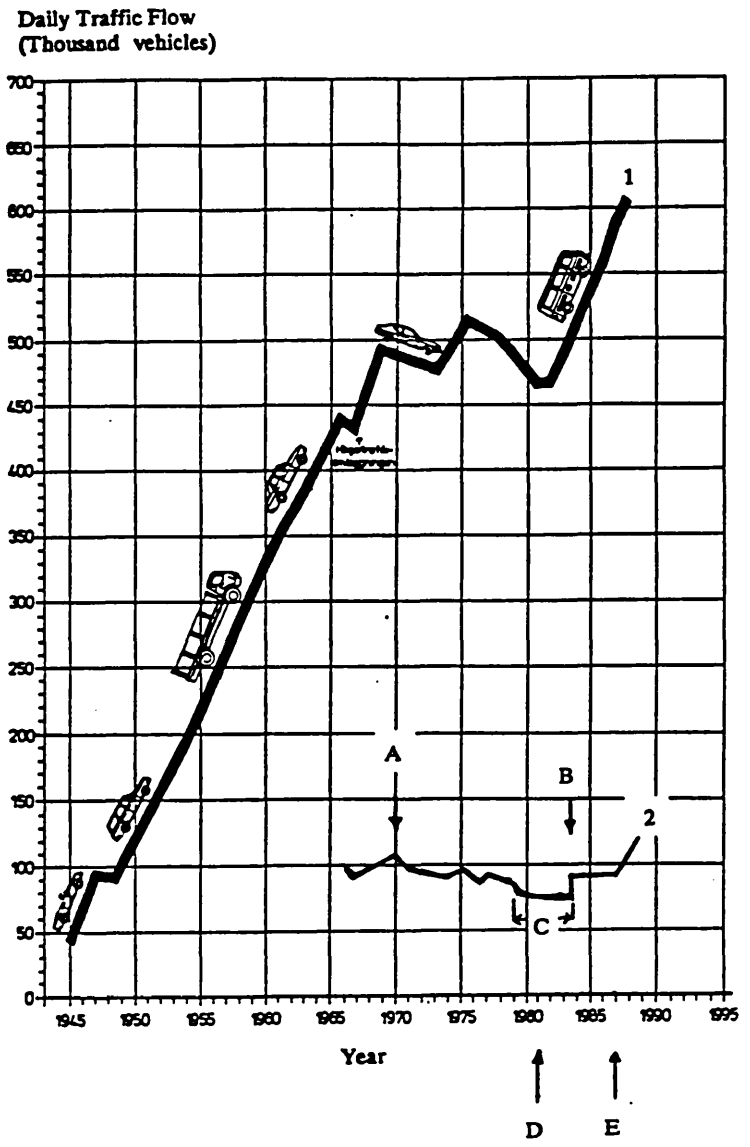
6.23 It seems, therefore, that the public transport share had not been adversely affected by the new road. The share of public transport remained very much the same after the opening of the road at Skanstull, and the share of public transport at all crossing points to the Inner City showed a slight increase from the before figure. During the construction period of the bridge–tunnel scheme, however, the public transport share increased due to the reduced highway capacity. Figure 6.7 shows the detailed development of traffic for both, the whole of the Inner City and that at Skanstull. The figure also indicates the factors (e.g. petrol prices) that could have influenced these developments.

6.24 With reference to the changes in the public transport share between 1984 and 1987, it appears that the trend has generally been that of increased public transport cost and reduced petrol prices. The decline in petrol prices has been a sharp one and so has the increase in public transport cost, and consequently the drop in the number of season tickets sold. Table 6.2 figures show that the increase in public transport share during the construction period was also the result of cheaper, more attractive public transport, and more expensive petrol (see Figure 6.3). The same can also be concluded for the increase in motor traffic, this increase is not the result of increased road capacity but the direct outcome of increased public transport cost and reduced petrol prices.

Year	All Crossing points	Skanstull
1977	54.2%	64.9%
1978	55.2%	66.3%
1979	55.2%	66.8%
1980	57.4%	69.1%
1981	59.0%	69.4%
1982	59.8%	70.6%
1983	-	-
1984	59.1%	70.8%
1985	57.3%	64.3%
1986	-	-
1987	54.6%	64.1%

Table 6.2 **Percentage trips by public transport to the Inner City at Skanstull and other crossing points in Stockholm 'before' and 'after' the opening of *Johanneshovsbron*.**

Source: Stockholm gatukontor, 1989.



KEY

1 Inner City Traffic Development (Number of Cars and Buses To and From The Inner City Per Day).

2 Traffic development at *Skanstull*.

A Western part of Ring Road opened.

B New bridge-tunnel scheme opens at *Skanstull*.

C Construction period for new bridge-tunnel at *Skanstull* (reduction in capacity).

D High Petrol price.

E Low Petrol price.

FIGURE 6.7 Traffic Development in The Inner City And at *Skanstull*.

SUMMARY AND CONCLUSIONS

6.25 It is clear from this case study that the building of the new bridge–tunnel road has increased the capacity at Skanstull crossing point. The scheme has provided a much improved access to and through the Inner City. This, however, did not lead to a large increase in motor traffic across the river at that point, or to a sudden shift from public transport. The increase in motor traffic that took place immediately after the opening of the road was mainly due to diverted traffic (during construction) reverting to using the route. The parallel decline in the public transport share was due to the return to old patterns by traffic which was diverted to the public transport system because of the construction works associated with the scheme. This shift should not be seen as an adverse effect of the road since the public transport share returned to its previous levels before opening the road. Taking into consideration the other factors of reduced petrol prices and the increase in public transport cost, this change was clearly not the result of opening the new road.

6.26 This case also shows that new roads in urban areas do improve environmental conditions along relieved busy and congested streets, at least as can be inferred from the significant reduction in traffic flows on the old roads. The authorities were quick to introduce width restrictions along the old road and provide parking spaces in order to prevent conditions from reverting to the past situation. The overall growth in traffic at this crossing (*Skanstull*) was relatively smaller than the general increase in traffic to and from the whole of the Inner City.

6.27 Even when the main objective is to achieve environmental improvements, Sweden recognises the need to build more roads in particular circumstances. Stockholm acknowledges the various transport needs of the different parts, and while, for example, public transport may not be seen as a viable option in the outer suburbs, a better and cheaper supply is needed for the Inner City and the City Centre. The flexibility of the Swedish policies results from the diversity of the country's geography and the few urban concentrations surrounded by widely dispersed populations in the outer regions. This in turn makes it necessary to adopt varying policies that best serve the needs for each area and situation. The current Master Plan being discussed for Stockholm[58] aims at tackling the environmental problems; mainly reducing emission levels (Carbon and Nitrogen oxides), noise levels, accidents and improve traffic conditions. The building of some new roads is seen as a necessary measures to achieve these objectives.

6.28 A number of ways are being considered to reduce traffic emission. The city is developing a well balanced plan that would deliver the goals sought without hindering the economic welfare or the personal freedom. In considering 'road pricing' or 'environmental fees', the city aims to control traffic entering the City Centre, but it proposes to give the drivers the option of having a dual purpose monthly ticket which entitles them to use their cars to enter the City, or, alternatively, use public transport. This element of giving the public the choice of using their ticket for one mode or another and with the intended public education, it is expected that the response to this scheme will be positive.

6.29 Like any other large city, Stockholm has its traffic problems, which are not very different from those in other cities. It is fair, however, to suggest that Stockholm also possesses a 'happy balance' between public transport and private traffic. It is suggested by the city officials that this may be attributed to the low level of suppressed demand. The nature of Stockholm's location and the limited number of access points to the Inner City and the City Centre make it a lot easier to introduce any form of traffic control or road pricing than it would be in other cities. The charges being considered for motorists entering the City Centre may not seem significant if considered in a London context, for example. A monthly charge of 300 Skr or roughly the equivalent of £30.00 per month allowing the unlimited use of public transport (within a 100 km radius), or covering the entry to the centre, is expected to deter a lot of commuters from the centre. Overall, the success of this measure would be due to the successful coordination Stockholm has struck between transport and land use. Public transport appears efficient and attractive, new roads are built where needed catering for the necessary traffic.

6.30 The successful coordination between transport and land use, and hence between public transport and the private car in Stockholm has a lot to do with a number of factors. These include: i) the consistency of policies adopted for the city favouring public transport in the centre, and catering for car traffic outside it; ii) the natural element of location and space availability; and iii) the restriction of car traffic in the Inner City and the City Centre, so far by means of parking control policies. The new restrictions being considered in Stockholm (road pricing), are not the result of severe and permanent congestion, as experienced on the streets of London, but are a means of meeting the newly set levels of vehicle emissions, and to improve the environmental conditions along the road network especially in the City Centre.

INTRODUCTION AND BACKGROUND

6.31 The City of Göteborg is Sweden's second city with approximately 450,000 inhabitants in a conurbation of 720,000 over an area of 450 square kilometres. The city is well known for its port which started to develop into one of international importance at the beginning of this century when the first transoceanic lines opened. Today, Göteborg is the principal maritime city in Scandinavia and has the largest oil port in Scandinavia where up to 67 per cent of the goods handled are oil and oil products. Approximately 40 per cent of Sweden's oil imports pass through Göteborg.

6.32 The city 's geographical location makes it a transport and communication feeder between the Scandinavian countries and the rest of the world. The whole of Scandinavia is linked with Göteborg via two European through roads, namely the E3 and the E6 (Figure 6.8). Trade and industry are changing with the changing times where heavy industry has been complemented by smaller and medium-sized companies in the service sector. The city centre is located south of the river and is only 2 square kilometres in area.

THE ROAD SYSTEM

6.33 In Göteborg, the new roads penetrate deep into the city, one of them passing right by the old centre. Up to 1966 there was only one bridge link over the river namely Götaälvbron. Today this connection is served by three bridges (Carnegie Kajun built in 1966) and a tunnel (that of the E6 built in 1968). Five major motorways carry traffic to and through Göteborg. The E6, for example, comes from Mälmo and Denmark in the south and passes through the eastern part of the city with a branch to the east (E3) towards Stockholm, and a shorter link to the west forming part of the inner ring-road around the city centre. The city also has a major outer ring-road in addition to the inner ring around the centre. Most of the main roads in the city are of radial nature. The major motorways and river crossings are shown in Figure 6.8.

6.34 A considerable number of new roads have been built in Göteborg since the year 1970. Figures 6.9 and 6.10 show the road network in Göteborg in 1970 and in

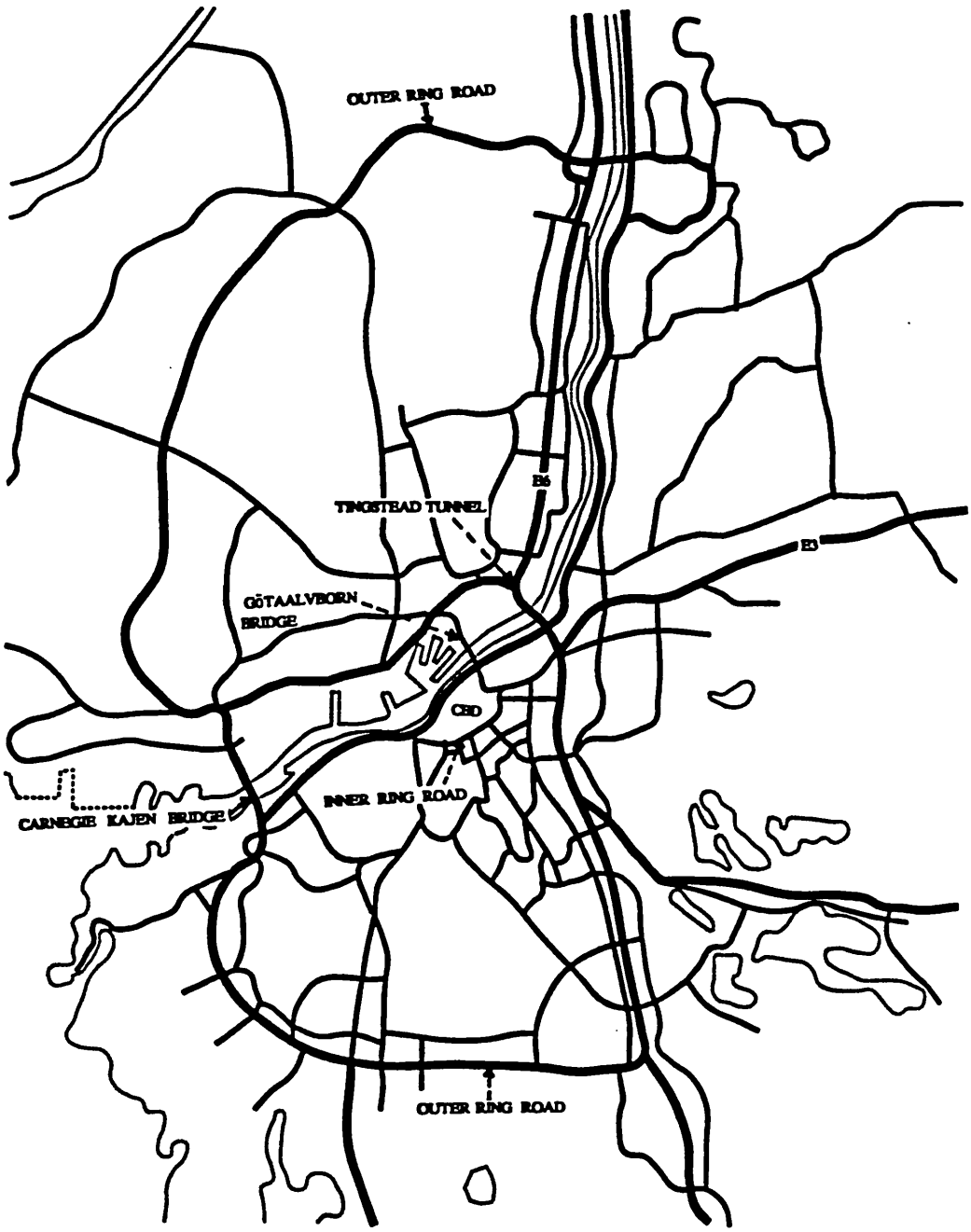


Figure 6.8 The major roads, river crossings and motorway connections in Göteborg as of 1987.



Figure 6.9 The Göteborg road network in 1971.

Source: Göteborg City Building Office, 1989.

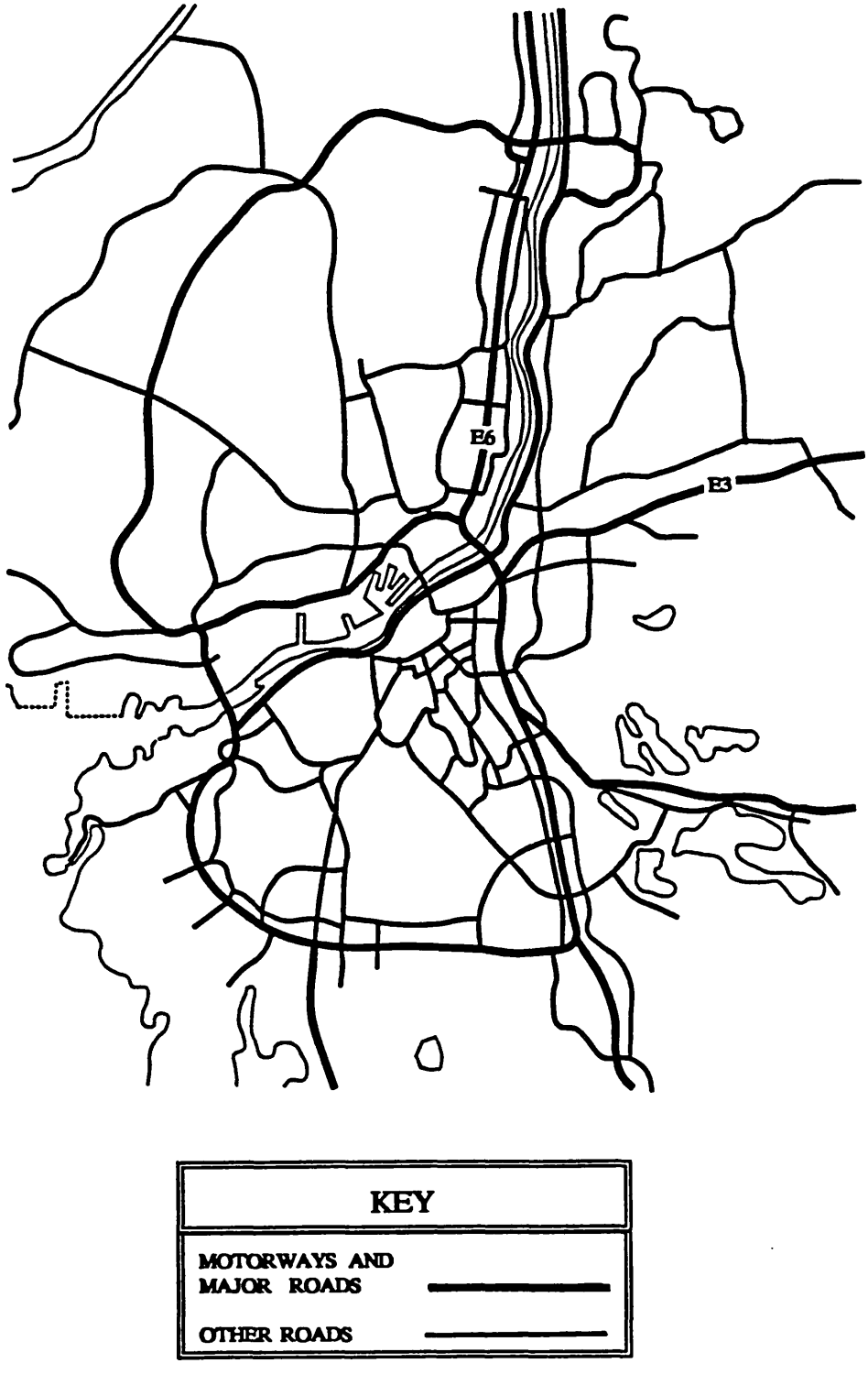


Figure 6.10 The Göteborg road network in 1987.

Source: Göteborg City Building Office, 1989.

1987, respectively. From the Figures, it is clear that the bulk of new schemes and improvements has been on outer major roads and in particular by-pass type and ring roads. This is in accordance with the city's policy of removing through traffic from environmentally sensitive residential areas, and carrying it instead on better standard roads[59]. The results have been that traffic growth takes place on major high capacity motorways and roads tangent to the centre, with reduced traffic flows on CBD (Central Business District) and CUA (Central Urban Area) roads as will be seen later in the case study. Figures K.1-K.10 show in more detail the different stages of development of the road network 1971 and 1987.

PUBLIC TRANSPORT

6.35 Göteborg's transport system is focused on the centre and consists of five lines of suburban rail services leading into the central station. The city also operates trams. In 1977 Thomson stated that 'in Göteborg one can see probably the best tram system in the world'[60]. The trams and most of the buses in Göteborg are owned by Göteborgs Spervägar which is mainly a tram operator using buses as feeders for the trams. Thomson also mentions that 'Göteborg is convinced that trams are sometimes preferable to buses and that a mixed system is better than a bus-only one'[60].

6.36 In Göteborg the trams are rather different from those in other European cities and are more like light railways with 90 per cent of them being operated on segregated track with their exclusive right-of-way. The non-segregated trams in the centre have reserved lanes and enjoy priority traffic signals at stops. They run down the centre of the road and stop at platforms every few hundred yards. At these stopping places the roads have been widened so as not to hinder the passage of other road traffic. The close integration between trams and buses created a policy of providing reserved areas where passengers transfer from one to the other without interference from other traffic and when possible without having to walk in front of the public vehicles themselves. This is best illustrated in the main square in Göteborg which is used as a bus and tram station. In general, it was stated that public transport is the main mode of travel in the CBD[59].

PARKING

6.37 In 1979, following a study of the effects of major parking restrictions on the environment; the use of public transport; and on retail shopping; the introduction of parking controls and restrictions appeared desirable. It was therefore recommended that measures should be applied so as to reduce car traffic in the city centre. Today, priority is given to residential parking in the city centre with 0.4 spaces per inhabitant; about three thousand parking spaces have been transferred to the periphery in order to reduce traffic flows as much as possible and allow for the introduction of new cells.

THE DEVELOPMENT OF TRANSPORT POLICY IN GÖTEBORG

6.38 Göteborg is not very different from other cities around the world in that transport policy is a major political issue. With different political views, different opinions vary from strong favouring for the car to stark opposition to it. However, the wave of environmental issues and considerations now dominate, which makes the issue one of social and political nature thus putting social, environmental and health issues ahead in decision making. This has resulted in the limitation of road building measures and a further emphasis on public transport. The view in Göteborg is that building major roads is necessary to improve conditions in inner areas, and that the better these roads are, the greater the relief afforded to local roads. When a new road is built, it is the City's policy to implement capacity reducing and other traffic management measures on the old roads relieved, to prevent traffic from growing again on these roads. Figure K.11 (Appendix K) presents the road closures/restrictions in the road network between 1971 and 1983. Physical environmental improvements are also introduced to make sure that any increase in traffic is where it should be on higher standard roads in less sensitive areas.

6.39 The experience in Göteborg has not been much different from that of Stockholm where from the sixties onward the growth in car traffic became very worrying. Despite the construction of two new bridges and a by–pass around the city centre, traffic problems still existed in 1970. This led to the introduction of a regulatory plan which restricted all unauthorised vehicles from the central shopping area at the weekends. This measure was regarded as 'successful' and prepared the ground for a major traffic regulation operation. In 1970, and after seven years of study and persuasion by the tramway company, an initial solution which had been introduced in Bremen in Germany, and which had been originally rejected by the

Göteborg City officials, was adopted. This consisted of dividing the CBD into five cells with three dividing routes with only public transport and emergency vehicles authorised to cross the boundaries between these cells. With no direct access from one cell to another, traffic wishing to move between the cells was obliged to go round the outside where an effective ring road existed round the area.

TRAFFIC DEVELOPMENT IN GÖTEBORG

City Structure

6.40 In this particular case study, no specific scheme could actually be considered independent of other changes to the network, as has been possible in other case studies. To understand the situation prevailing in Göteborg and the various policies influence on such outcome, the data available from the City will be presented and appraised in the context of this research. First of all, it should be made clear that the layout of the city and the network make it dividable into three different zones or areas; the Central Business District (CBD); the Central Urban Area (CUA);and the Greater Göteborg Area (also referred to as the Göteborg Administrative Border). Figure 6.11 shows the borders of each area, and the count stations.

Traffic Counts and Journey Time Surveys

6.41 Regular traffic counts are carried out on major streets in the three main areas once a year. In addition to this, traffic is counted on every link in the city every four years. Göteborg had by far the most comprehensive set of data pertaining to traffic flows. Journey time surveys had also been conducted regularly until recently when they had to be abandoned due to staff shortage and cost[59]. The data available in this respect is of no use in this study since it only covers the period between 1983 and 1989, a period when no further major road schemes were completed. In addition to this, the data available was for the peak period and no supplementary figures for the off-peak period were available. For the specific examples in this case study, the development of traffic in the CBD is presented in the following paragraphs.

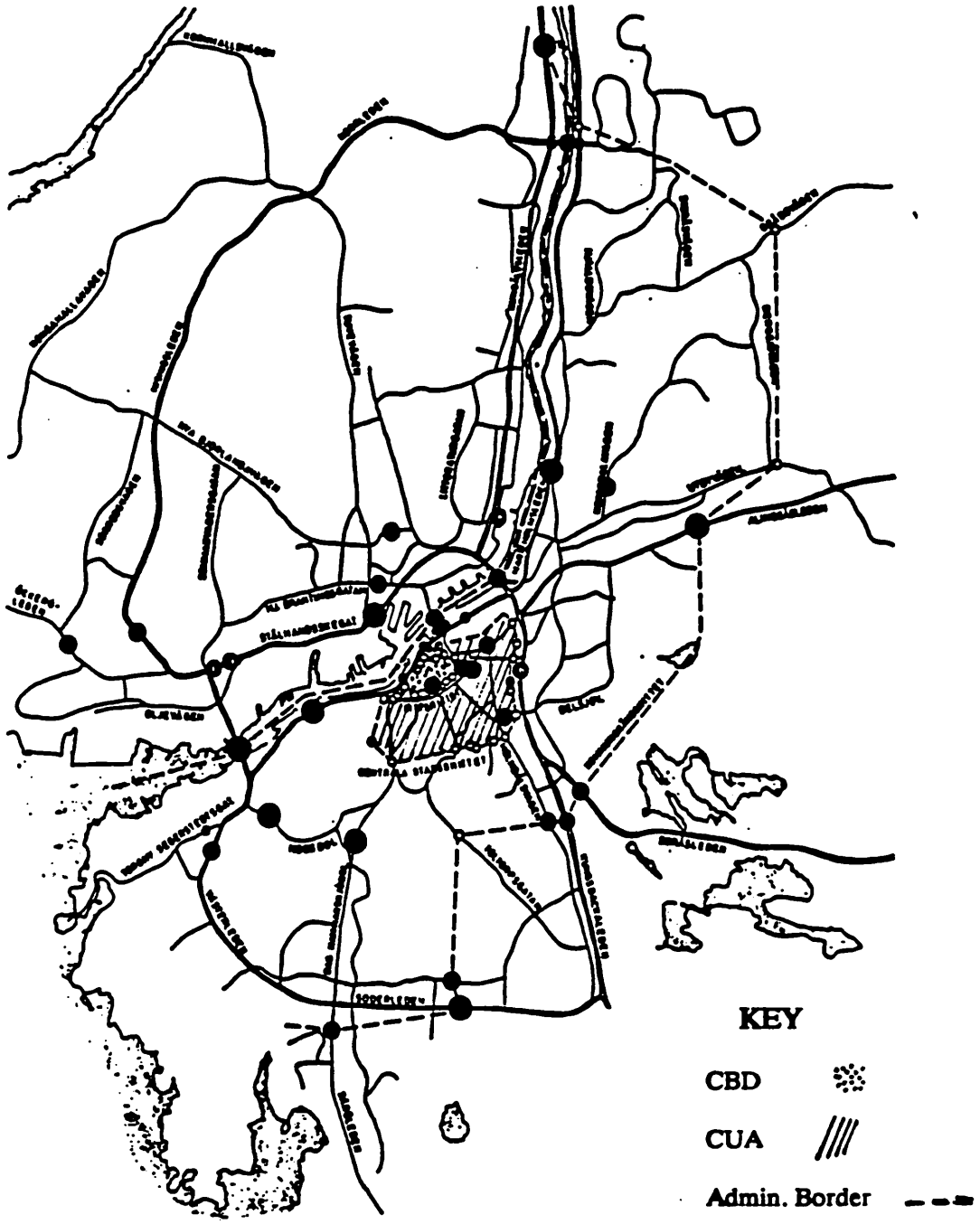


FIGURE 6.11 Borders of the CBD, CUA, and Göteborg Administrative Area

Traffic Development in The CBD

6.42 Daily traffic development over these borders and over the river crossings for the period 1970–1989 is presented in Figure 6.12. From this Figure, it can be seen that while traffic continued to increase across the Göteborg border with a sharp increase from 1981 onwards, the situation has been somewhat different in the CBD and the CUA. In the CBD, traffic levels showed a sharp drop after 1970 (when traffic cells were introduced). This continued until 1974 where for the following four years it increased slightly. Another sharp drop occurred after 1978 with traffic levels reaching half those of 1970 in 1981. Traffic levels increased slightly from there on but never went beyond a little over 60 per cent of the 1970 levels. This is clearly the result of the traffic policies and management measures, including parking policy, which made it much more difficult for traffic to go through the CBD[61]. This was also coupled with major improvements to the major outer roads especially the ring roads. More detailed figures on changes on CBD roads are presented in Table L.1 in Appendix L which also lists the percentage changes between the consecutive years.

6.43 Figure L.1 (Appendix L) shows the changes in the number of cars entering the CBD during the morning peak hour over the period between 1968–1984. As can be seen from the figure, the number of vehicles destined to the CBD has remained the same at 2,500 vehicles while in 1981 through traffic decreased, as a result of new roads schemes and various management measures to nearly 1,000 or only 25 per cent of its level in 1970, and remained constant thereafter. This demonstrates the effectiveness of new roads, which is presented in more detail later, in carrying through traffic away from the CBD and enabling traffic management measures to provide protective measures to relieved roads to prevent the recurrence of previous conditions.

6.44 Total traffic movements by mode of travel in Göteborg (pedestrians and cyclists excluded) are presented in Figure 6.13 with the year 1970 taken as the index year. The Figure presents all person trips (all purpose journeys) made by car and by public transport in one year, it considers all types of public transport in or to Göteborg. The car curve represents the number of people travelling in cars. From the Figure it can be seen that the car was the main mode of travel, with the largest share of all person trips made, from 1970 until 1980 when the trend was reversed until 1986. Since then, the old pattern has been reestablished. The car curve in this figure

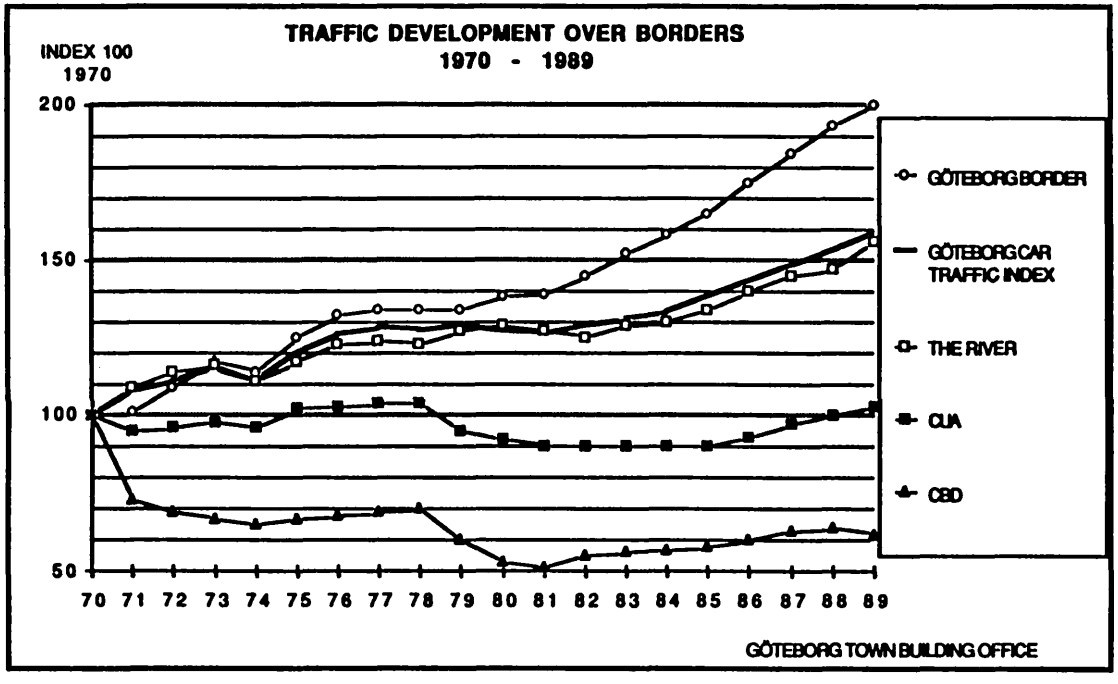


Figure 6.12 The development of daily traffic flow on Goteborg roads by area (two–way, 16–hours total).

is not as steep as the curve in Figure 6.12 (Traffic Development Over Borders), this is attributed to the falling car occupancy.

Car Ownership in Göteborg and the Suburbs

6.45 By referring to car ownership figures for Göteborg and the suburbs (Figure 6.14) it can be seen that this trend of increased traffic growth is consistent with increased car ownership. Car ownership figures show a strong increase from 1981 onwards, and with 310 cars per 1000 people in Göteborg and approximately 350 per 1000 in the suburbs (1975), in 1989 these were 377 and 439 respectively. The actual changes in car ownership in Göteborg and its suburbs are presented in Table L.2 in Appendix L and indicates a trend of increasing car ownership which is, understandably, stronger in the suburbs than in the city[62]. These figures are further compared with car ownership figures for Stockholm, the rest of Sweden (Sverige), and the suburb of highest car ownership in Göteborg, namely Kungsbacka, and are presented for the period 1974–1988 in Figure L.2 of Appendix L. From this Figure it can be seen that from 1983 onwards, there has been a trend of increasing car ownership levels. This increase in car ownership has been accompanied by decreasing vehicle occupancy rates during similar period, where the rate has fallen from 1.38 persons per car in 1974 to 1.18 in 1989. This also reflects the fact that more people are acquiring and using their own cars to travel.

THE CASE STUDY

6.46 An example of the City's policy to reduce traffic on local streets in the centre by building high capacity orbital and tangential roads is best demonstrated by the example presented here. This is namely the improvement and extension of the Europa–road (E6) section constituting the easterly section of the inner ring road (Kungsbackleden) which was upgraded immediately south of the Tingstadstunneln to 8 lanes and a new section of 6 lanes added in 1973 (Figure 6.15). This was in addition to improving the northern most section of the inner ring road Götaleden to six lanes in 1970 (Figure 6.15, and Figures K.1, K.2, and K.3 in Appendix K). As can be seen from Figure 6.15, this increase in capacity, and the introduction of traffic cells in the city centre, did not only lead to large increases in traffic on these new and improved sections, but it also delivered significant reductions to the CBD road network.

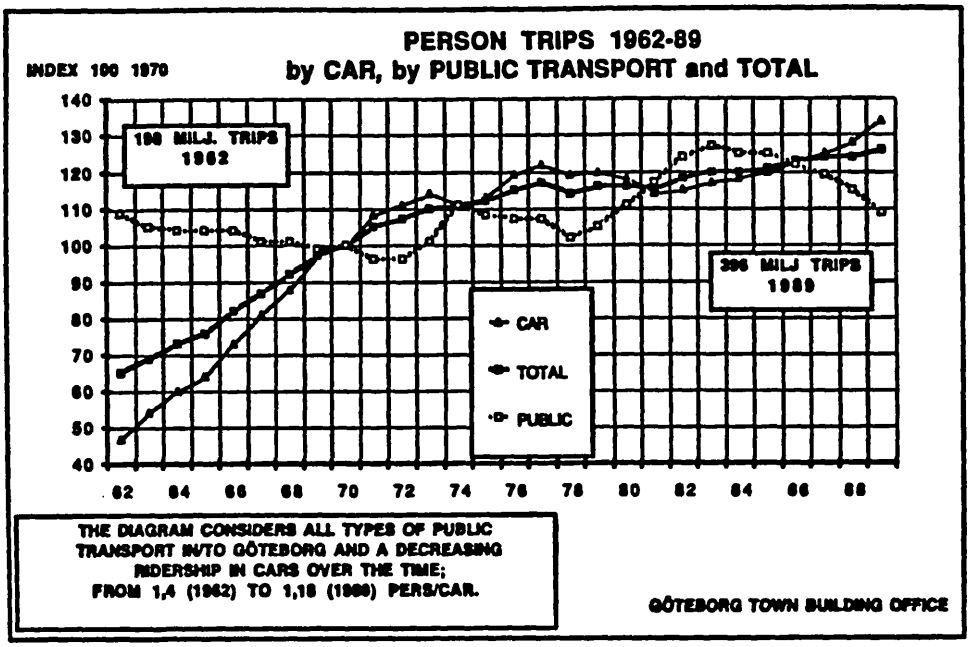


Figure 6.13 The development of Person trips by car and public transport in Göteborg (all purpose journeys, 1962–1989).

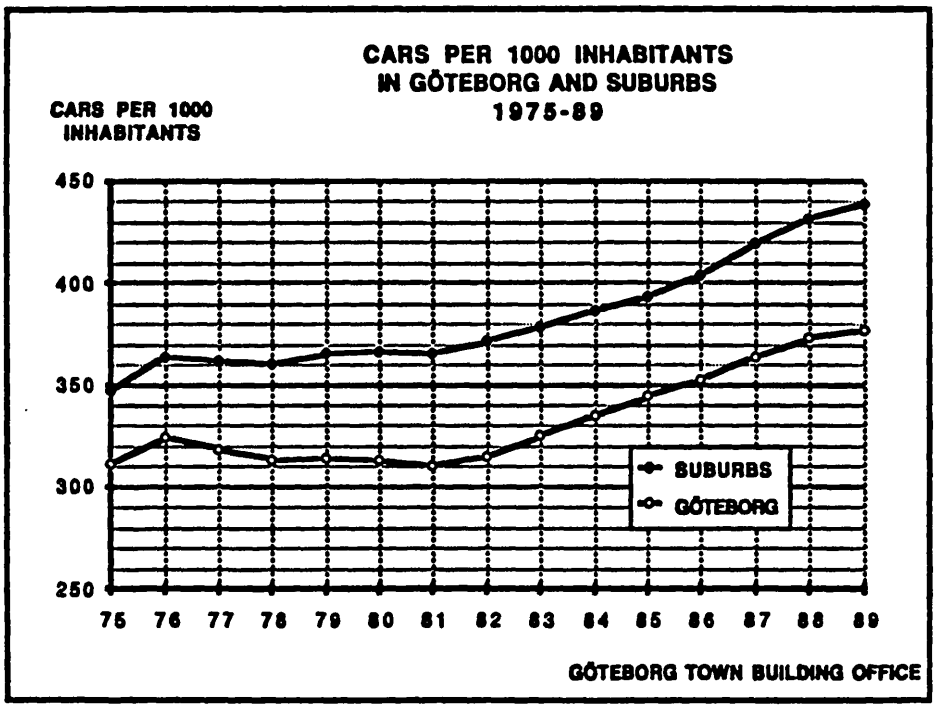


Figure 6.14 The development of car ownership in Göteborg and the suburbs (1975–1989).

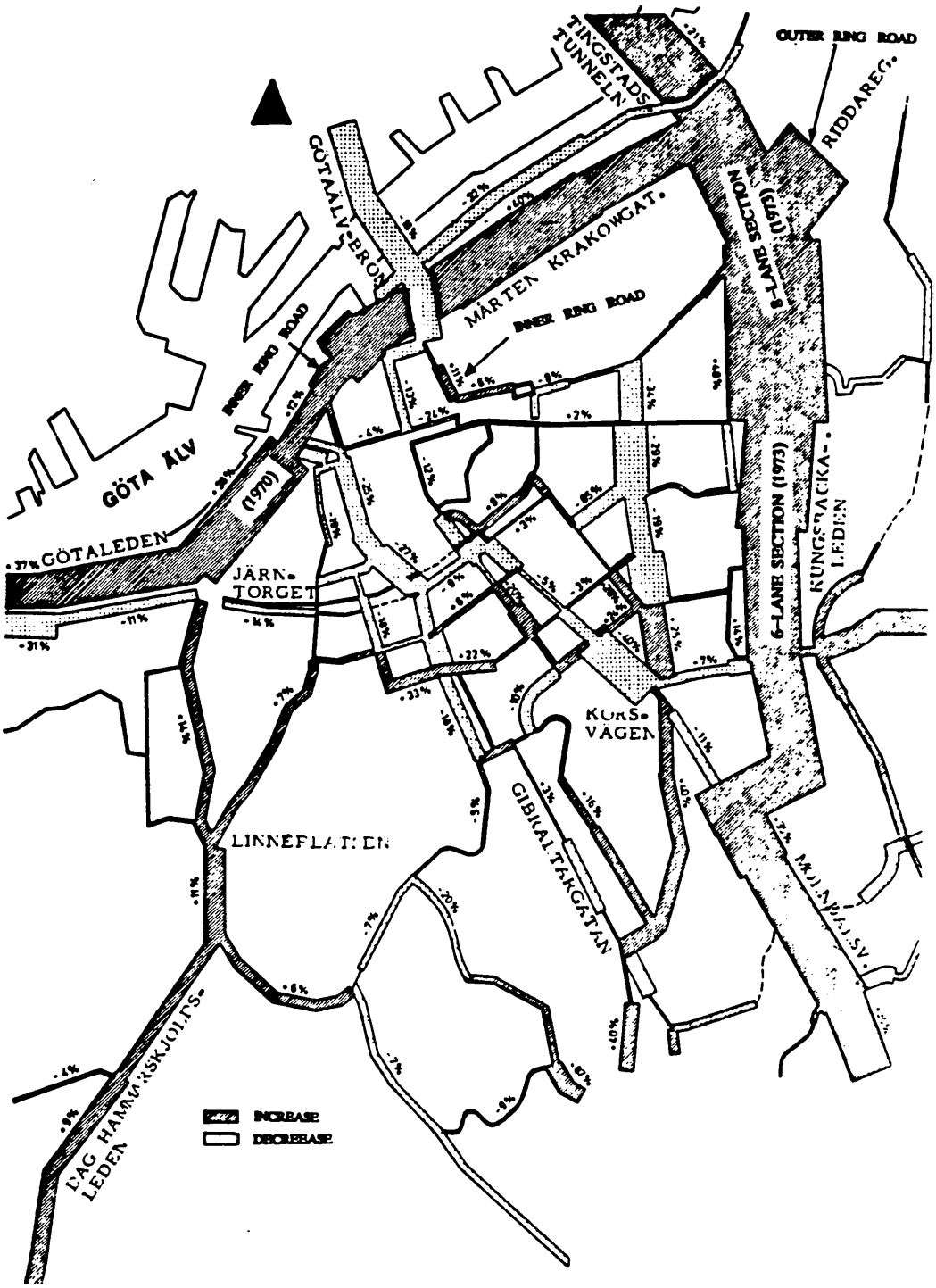


Figure 6.15 The changes in daily traffic flow (two-way 16-hour total) on UCA roads in Göteborg between 1971–1975 and following the improvements to the outer ring road in 1970, and 1973.

Source: Stadsbyggnadskontoret I Göteborg, 1989.

6.47 With the traffic growth in Göteborg being 20 percent during this period (1971–1975), some of the increases were well above that (+48 per cent on Kungsbackaleden, for example). However, the reductions on the lesser hierarchy roads in the CBD and the CUAhave been also significant. As can be seen from the Figure, some of the reductions were in the order of 65 per cent on the roads parallel to the new road. The relieved sections had previously carried the bulk of traffic through the built-up areas of the city. Increases were also recorded on certain sections of the inner ring road. This further reflects the success of the City's policies in relieving traffic congestion from the city centre, and catering for the growth in traffic via orbital and tangential roads connected to the motorway network, whenever feasible. Travel speeds were reported by Thomson in 1979[60] to have increased by 50 per cent on the inner ring road despite the increase of traffic.

6.48 The above example demonstrates clearly that the growth in traffic on new roads in urban areas can be accompanied by a significant drop in traffic levels on local parallel streets. With the implementation of adequate management techniques and policies, the relief extended to streets, which are normally busy local streets in environmentally sensitive areas, can be maintained. Meanwhile, accessibility is not hindered for city traffic and is catered for via the new improved links. Overall, the outcome of the policies taken in Göteborg in the late 60's and early 70's is illustrated in the bulk of growth in car traffic taking place on the orbital routes especially the ring road around Göteborg as can be seen in Figure 6.16. From this Figure, it can be seen that while traffic on the ring road has more than doubled in the period between 1971 and 1987, traffic on local streets has been reduced and stands, in 1987 at 95 per cent its level in 1971. This is a remarkable achievement given the growth in car ownership; the annual traffic growth during the same period; and the amount of road building which has taken place during this period (Figures 6.9 and 6.10). Göteborg has successfully shifted the traffic growth onto the ring roads and relieved local streets even though the outer ring is not yet complete.

6.49 This lends further support to the contention put forward in Chapter 1 of this thesis, namely that the provision of new roads in urban areas will not necessarily lead to a situation where so much more traffic is generated that any benefits achieved are cancelled out because the level of congestion would remain much the same or even worse. This certainly has not been the case here. On the contrary, the local streets within the corridor of the improvements have experienced significant relief, while

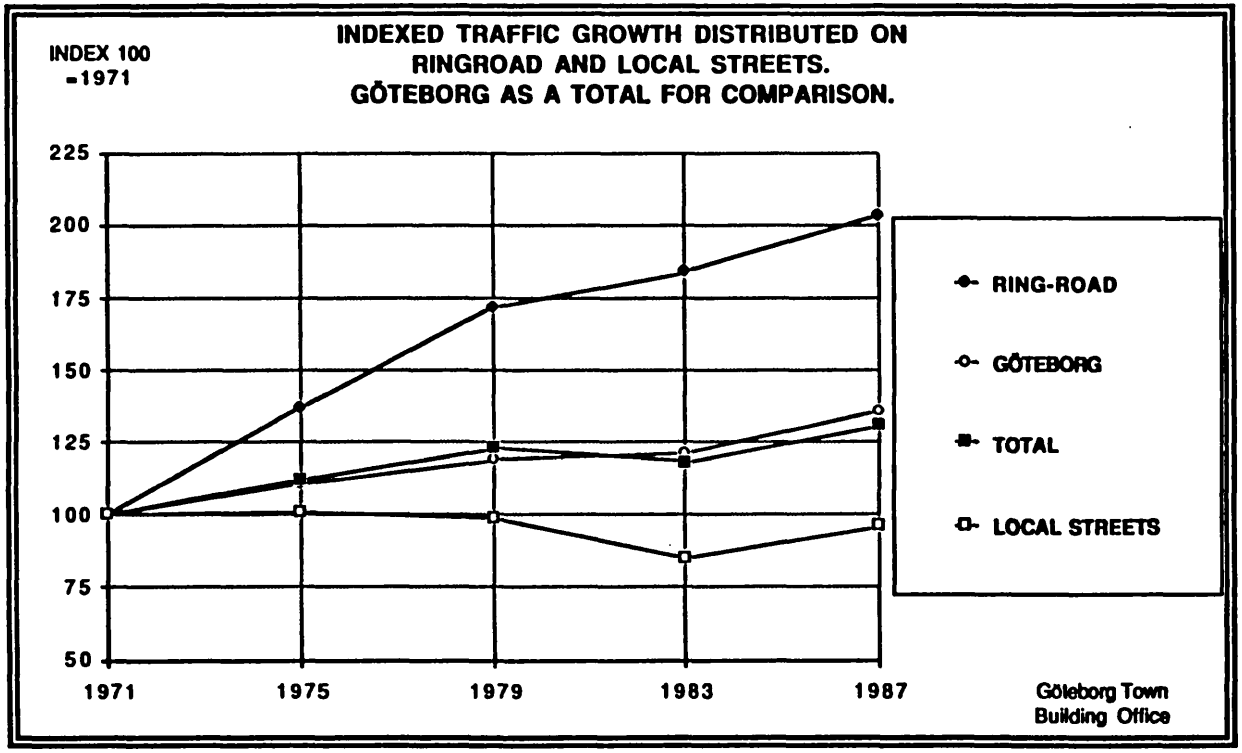


Figure 6.16 The indexed traffic growth on the outer ring road and local streets between 1971 and 1987 (1971 taken as a base year).

travel speeds on the new roads increased despite carrying twice the amount of traffic[60].

CHANGES IN THE PUBLIC TRANSPORT SYSTEM

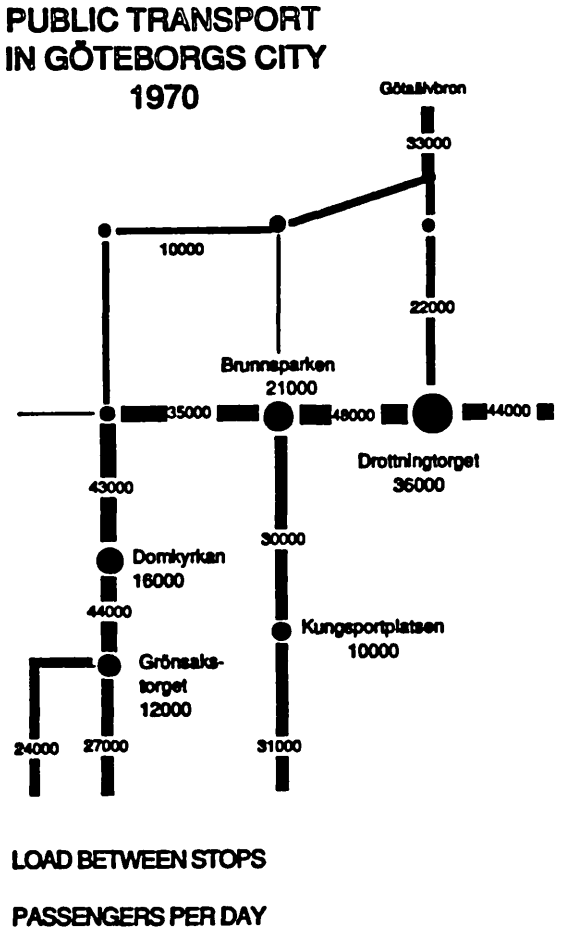
6.50 All the above discussed changes in the road network and the growth in car traffic in Göteborg make one wonder how these have affected the public transport system in the city. The data available is for daily traffic loadings between the major CBD stations in 1971 and 1985. These are presented in Figure 6.16. From the figure it can be seen that the growth varied from one link to the other, and while some links experienced increases of up to 97 per cent, others were around 40 per cent during the 15 year period. Daily loads at Brunnsparken, which is in the heart of the CBD increased from 21,000 passengers per day to 64,000, an increase of 205 per cent corresponding to more than 12 per cent per annum. This increase is an indication of the success of the city's policies to promote public transport in the CBD and restrict car traffic.

6.51 It is also clear that the road building in Göteborg over the years has not lead to a deterioration of public transport. In fact, the system's ridership in the CBD has more than doubled at some points as seen from Figure 6.17. This, once more, indicates that new roads in urban areas do not necessarily lead to a significant shift from public transport on to the roads creating more congestion and leading to less public transport patronage. When the role for each of the transport modes is clearly defined and the necessary policies implemented, the resulting combination can lead to an effective transport system catering adequately for the various transport needs in the city.

SUMMARY AND CONCLUSIONS

6.52 The City of Göteborg provided a good example of a medium sized European city. Traffic problems are not of the scale experienced in larger cities in Europe. Nevertheless, the emphasis on environmental considerations are pretty much the same, making transportation planning a rather difficult task influenced to a large degree by politics.

6.53 Göteborg was one of the first cities to implement an area wide traffic management scheme as early as the year 1970. This was done in anticipation of



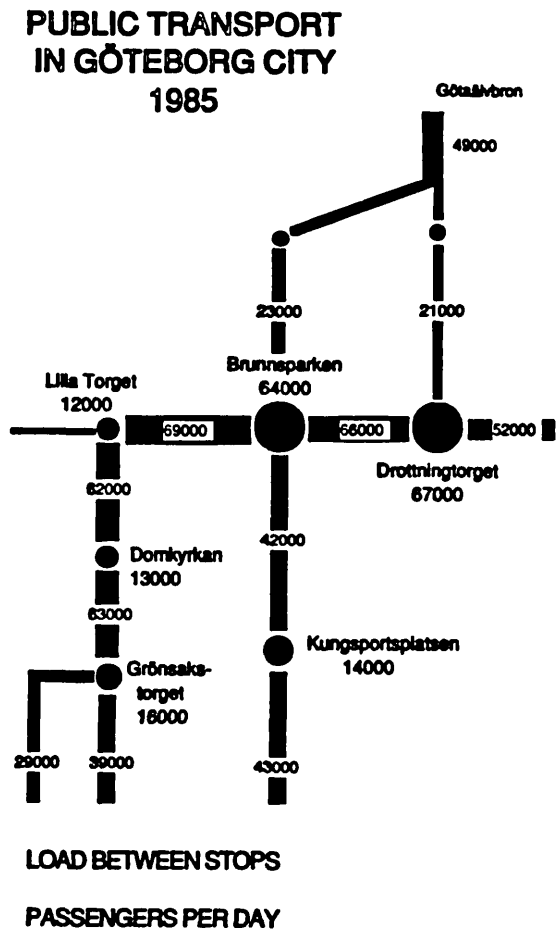


FIGURE 6.17 **Daily Public Transport Passenger Loadings Between CBD Stations.**

traffic growth and increased demand for the motor car, and was the result of strong lobbying by the tram operator who supported restrictions of the motor car in the central area in general and the CBD in particular. This was coupled with improved right-of-way for the city trams and physical segregation of these lines on the roads to ensure their effectiveness over other road borne traffic modes. The parking policy in the city has been set to assist in the implementation of the transportation policies adopted for the city.

6.54 To facilitate the growth in traffic, and not hinder the economic prosperity of the city, major roads outside the central area were constructed or improved to cater for the increase and allow for the transfer from other less adequate central area roads. Ring roads have been especially favoured to carry traffic around the city centre and across the river. With major industrial and port areas located north of the river, and with many other businesses and residential areas located south, the need for a good and well connected road network has always been a determining factor of the city's policies.

6.55 With no major schemes completed after 1982, and with the closure of some previously heavily trafficked roads, one would expect little growth of traffic on the network. This however is clearly not the case. While Göteborg has successfully reduced and maintained lower flows on its CBD and CUA roads, the general trend has been that of increasing car ownership and traffic flows. This may be explained in the fact that more and more people are choosing to live in the suburbs rather than in the city. Commuting between the home and the workplace generates more long distance journeys which explains the large growth in traffic on outer motorways and roads which have been improved and upgraded in the 70's and early 80's as shown earlier.

6.56 The new schemes implemented in Göteborg have certainly proved to be effective in delivering the city's long term policies and strategies. The emphasis on public transport in the City Centre has been strengthened by restrictions to commuter traffic varying from parking control to the actual physical layout of the cells in the CBD. Göteborg has anticipated the growth in car traffic, and catered for it via an improved network of roads with special emphasis on orbital and tangential roads. The environmental considerations, which are a major factor dictating some of the most crucial policies for the city, imposes strict conditions on the implementation of new roads. The City, however, as expressed by an official, feels that the completion of

the ring road around the city is a necessary measure to ensure the free flowing of traffic, and to facilitate the important communications role Göteborg plays in Europe and Scandinavia.

6.57 The City has also implemented associated policies with respect to public transport. These policies coupled with effective traffic management (e.g. traffic cells, road closures) in the centre have given public transport priority in the centre and provided an effective public transport system for the city. With public transport considered an essential service in Sweden, the subsidies put into the system maintain a good standard of service as observed in Göteborg and Stockholm.

6.58 The policy in Göteborg, which is similar to that in the German cities considered earlier, has managed to cater for increasing traffic growth while reducing traffic flows on city centre roads and areas. The implementation of new large capacity motorways of a mainly orbital nature allowed the closure and the restriction of some previously congested roads in environmentally sensitive areas. The layout of Göteborg, and its strong emphasis on public transport and parking control early in the 60's and 70's made it possible for the city to realise a more effective transport system than many cities of its size. The 'happy balance' which seems to exist in Göteborg today is the result of all the elements discussed earlier and would not have been possible with one without the other. The package approach to solving transportation problems is certainly the way to tackle the changes we face today. The content of these packages, and the balance of the different elements must however vary from one place to another and must take into consideration the whole situation and variables involved.

6.59 In the terms adopted in this study, the road building experience in Göteborg does appear to have been very effective. The city managed via these roads to divert the growth in car traffic onto better standard roads and motorways and away from local streets and city centre roads. In achieving their highway improvement objectives in relation to the much improved road system, they recognised the need for very effective traffic management and restraint measures and a first class public transport system. The effectiveness of the highway improvements in Göteborg is without doubt, the result of this well balanced approach.

CHAPTER 7 CASE STUDIES ON THE IMPACTS OF MAJOR PUBLIC TRANSPORT IMPROVEMENTS

PART A: THE VICTORIA LINE

INTRODUCTION

7.1 In this part of the research, we look at examples of major improvements to the public transport system. This is so that a general impression can be obtained of how substantial the relief may be to congested roads in the improvement's corridor. It is also to see whether or not the contention made earlier, namely that major public transport improvements only have a marginal effect on relief on the affected roads, is sustainable. The Victoria Line provided a suitable case study since it was built, relatively speaking, not so long ago and since it has been the last major improvement to the public transport system in London over the past 80 years. It was the first underground railway built in central London since before 1914.

HISTORY AND DESCRIPTION OF THE SCHEME

7.2 The scheme's origins go back to the 'Railway (London Plan) Committee' of 1944. From this, the report published by the 'London Plan Working Party' in 1949, a proposal for a 'Route C', or the forerunner of the Victoria Line, was included as 'a scheme deserving high priority[63]. The proposed scheme extended from the Tottenham area to Brixton. London Transport obtained parliamentary Powers for the line from Walthamstow to Victoria in 1955. The government authorised the start of building the first part of the line–the10.0 miles between Victoria and Walthamstow in August 1962. Approval for the 3.5 mile extension from Victoria to Brixton was given in August 1967.

7.3 The construction period, for the whole scheme, was about nine years. The first section opened from Walthamstow to Highbury in September 1968. The Line to Victoria was opened on the 7th of March 1969, and the extension to Brixton on the 23rd July 1971. The line has sixteen stations including five which provide particularly convenient interchange facilities across the platform. The line serves the northern suburbs of Walthamstow and Tottenham where contact is made with British Rail services. The line also connects with the Piccadilly Line at Finsbury Park and the

Northern Line at Highbury. The Line enters Central London* at King's Cross where multiple connections are available with two main line terminals (Kings Cross and St. Pancras), and with other Underground lines namely, Metropolitan, Piccadilly, Circle and Northern Lines. It also serves another main line terminal at Euston where interchange facilities are available with the two in-town sections of the Northern Line. Figure 7.1 shows the complete scheme with all its stations.

OBJECTIVES OF THE SCHEME

7.4 The main purpose of the line was to provide a general improvement in travel conditions throughout Inner London through a multiplicity of interchanges with other Underground lines and with British Rail[63] since it was deemed necessary at the time[64] to:

-Relieve the heavy rush-hour pressures on the then existing system (pressures resulting from changes in commercial life and overcrowded underground routes).

-Give a new route under the River Thames from south London across the west end and out towards the north-east .

-Relieve the heavy peak-hour pressure on sections of other underground lines.

-Help ease the strain on many of the heavily-used bus services in South London.

-Bring relief to the traffic-congested streets above by attracting drivers away from their cars-by providing faster and more direct travel between north-east and central London, and by providing a better onward service for passengers from Victoria-and hence help the buses run more regularly[65].

THE FOSTER BEESLEY STUDY

7.5 The scheme was the subject of a number of papers and researches. The work by Foster and Beesley[66], into the social costs and benefits of the line, is by far the most well known. In a number of papers and in discussions and seminars, Foster and Beesley presented their findings in attempting to measure the surplus of social benefits over social costs of the line. The purpose of their study was to measure the overall effect of the investment on the community, in terms of savings in travel time; alleviating discomfort resulting from overcrowding on underground lines; relieved congestion on the roads above; improved mobility of workers within the central area;

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* The area referred to as 'Central London' is bounded in the west by Queen's Gate and Westbourne Terrace, in the north by a line just north of Merlyebone Road/Euston Road, in the east by Commercial Road, and in the South by Elephant & Castle and Vauxhall.

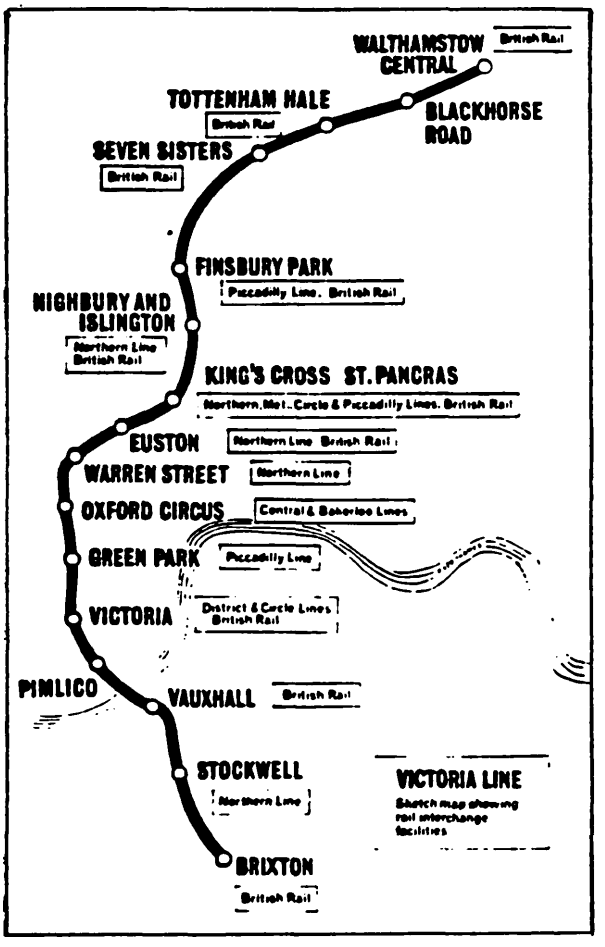


Figure 7.1 The Victoria Line and connecting Lines.

and relieved in-town sections of main lines. This approach was different from an ordinary financial calculation since the latter took into account only the profitability of an investment, considering only the costs and benefits of the investment. In 1962, the scheme was seen by Foster and Beesley as almost certain not to earn enough at the then existing fare levels to meet its interest charges after covering operating costs and allowing for depreciation.

7.6 The authors argued that 'benefits accruing to transport-users from investment in improving urban transport are greater than are indicated by purely financial calculations.' The costs and benefits were assessed as follows:

Costs: these were divided into two main categories namely

(i) the initial capital invested in the scheme,
(ii) the operating expenses of the Victoria Line

The capital cost of the scheme (to Victoria) was estimated at £ 56.1 million at April 1962 of which £ 8.0 million would have had to have been incurred in rebuilding some stations (Victoria, Euston and King's Cross). The cost of the scheme eventually amounted to roundly £ 70.0 million (the extension to Brixton was estimated to cost an additional £ 18 million in 1969 prices). In 1970, annual operating costs (after allowing for staff and other expenses shared with other lines) were £ 2.7 million and the revenue was estimated at over £ 3.0 million.

Benefits: these were divided into three kinds:

i) time savings to those affected by the improvement,
ii) savings involving cash transactions (e.g. cost reductions to motorists in less congested running conditions or savings in bus operating costs),
iii) the value of increased comfort and convenience.

7.7 The different benefits were then quantified. These came under three main categories, namely: a) benefits to 'diverted traffic' (to the Victoria Line); b) benefits to 'undiverted traffic'; and c) benefits to 'generated traffic'. The benefits to both 'diverted' and 'undiverted' traffic, were then assessed in respect of:

-Underground traffic
-British Rail traffic
-Bus traffic
-Road traffic
-Pedestrians

Benefits to 'generated traffic' were assessed by area, that is outer and central areas.

7.8 The terms 'diverted', 'undiverted' and 'generated' need to be explained in the context of this study, this is as follows:

'Diverted Traffic' : This term comprises all those who use the Victoria Line for at least part of its length, substituting, in part at least, for other means of travel.

'Undiverted Traffic' : This refers to traffic elsewhere on the Underground or on other means of travel which does not divert to the Victoria Line.

'Generated Traffic' : This is new traffic resulting from the fall in costs of transport, not only on the Victoria Line, but because of the Victoria Line.

7.9 Benefits incurred by the road users are the relevant issue for the research purposes, and will therefore be discussed in detail in the following paragraphs. Benefits to other modes users and to those using the new line are not covered in as much detail. Benefits to the road users were calculated under benefits to 'diverted traffic' and 'undiverted traffic' based on certain assumptions and predictions to obtain monetary values. The savings were calculated in reference to : a) time savings, and b) savings in vehicle-operating costs.

Benefits to Diverted Traffic

a) Time Savings

7.10 Estimates of private car passenger-miles expected to divert to the Victoria Line were made by London Transport indicated that 5,000 vehicle trips per day would be diverted to the Victoria Line, 4,000 of these were to be car trips (the remaining 1,000 were to be motor cycle trips). This was then converted to passenger trips per year and was found to be 3.96 million car trips per annum (assuming an occupancy rate of 1.5), and 0.66 million motor cycle trips per annum. The weighted average distance of road trips between the different areas served by the Victoria Line and the

area was assumed to be 9.6 miles. This was based on different assumptions for traffic in the central area and area outside. It was divided as follows: 2 miles in the central area (at 10 m.p.h.), 4 miles in the bordering area subject to some town congestion (at 15 m.p.h.),and 3.6 miles in a zone subject to freer suburban running conditions (at 20 m.p.h.). The car mileage diverted was 25.4 million, and that for motor cycles 2.4 million. Time savings of 5 minutes per passenger journey were assumed and the total time savings were assumed to be 0.38 million hours (0.326 million car hours and 0.054 motor cycle hours). Allowing for a further diversion of 8.2 million car miles to tubes, in the central area, and an average time saving of 2 minutes per vehicle, the total time savings were estimated at £ 153,000 per annum.

b) Savings in vehicle-operating costs

7.11 In general, it was assumed that diverted vehicles would have saved money since the cost of the Victoria Line would be less. The only relevant costs on which savings would have been incurred were namely those of fuel, lubricants, tyres, maintenance and depreciation. Assuming that half the mileage was performed by small and half by large cars, the figure reached was £ 377,000*.

Benefits to Undiverted Traffic

7.12 Road-users remaining on the road were assumed to benefit from the improved traffic conditions caused by diversion to the Victoria Line. In estimating these benefits, it was necessary to estimate total annual vehicle mileage run by private cars, public service vehicles, taxis and commercial vehicles in the London area. The effect of motor and pedal cycles on traffic speeds was assumed negligible, and vice-a-versa.

a) Time Savings

7.13 In order to estimate the total annual vehicle mileage run by all types of vehicles (e.g. private cars, public service vehicles, taxis and commercial vehicles in the London area), the Metropolitan Police census was used to estimate the proportion of passenger-mileage travelled by different means. Assuming 12 per cent of total vehicle mileage to be performed in the central area, and that traffic in zones

* Cost savings applied to the car mileage and allowing for motor cycle savings at one-third the rate for small cars produce a figure of 274,000 a year. With similar assumptions for the extra diverted traffic in the central area, the final figure amounts to 377,000.

decreases according to the linear distance from the centre, the two outer areas have 30 per cent, and 58 per cent of total traffic respectively.

7.14 The estimates showed that 5.0 million public services car–miles per annum, or the equivalent of 15.0 million private car–miles, would be saved if the Victoria Line is built. The total therefore becomes 40.4 million car–miles per annum saved as a result of the V.L. Further assumptions and calculations were made before estimating time savings for the central area at 1,940,000 hours for public services vehicles, and 951,000 hours for cars and taxis. These time savings were valued at a total of £ 1,462,000. Time savings estimated for other areas totalled £ 420,550.

b) Savings in vehicle–operating costs

7.15 The savings in fuel, tyres etc. arising from shorter journey times and better travel conditions amounted to £ 578,000 for the central area and £ 202,500 for the other areas. Different discount rates were used to estimate the benefits incurred by the different categories of traffic. Discounting at 6 percent, benefits to 'undiverted traffic' are about 52 per cent of the whole; to 'diverted traffic' about 34 per cent of the whole. The benefits to all traffic predicted to use the Victoria Line – 'diverted' and 'generated' traffic – were approximately 48 per cent. The Foster Beesley report went on to suggest that 'the most important single category, amounting to 25 per cent of the total, is time savings of vehicle–users from reducing congestion in London streets'. If the other effect of decongestion–savings in vehicle–operating costs– was added, they went on, the two make 35 per cent of total benefits and savings in vehicle–operating costs to motorists diverting to the Victoria Line.

TRAFFIC OBSERVATIONS 'BEFORE'

7.16 Certain traffic observations were carried out by a number of different authorities. The authorities involved in these counts and observations were namely:

–**London Transport:** counts carried out in respect of train and bus loadings on sections and routes of the Underground and Bus systems affected by the V.L.

–**British Railways:** counts of train loadings on lines affected by the Victoria Line.

–The Greater London Council: The Council carried out vehicular traffic counts on certain roads liable to be affected by the Victoria Line. In addition to these counts, the Council maintained a normal practice of regular traffic counts in London. These counts were repeated after the opening of the Victoria Line.

THE SURVEYS AND STUDIES 'BEFORE' AND 'AFTER'

7.17 In addition to the Foster–Beesley Study and the repeating of the traffic counts (mentioned in the preceding passage) after the opening of the line, a major questionnaire and interview survey was carried out by London Transport and the Greater London Council with the financial support of the Department of the Environment. This survey was carried out soon after the opening of the line in May/June 1969. The increase at a fairly rapid rate of traffic on the Victoria Line during the summer and autumn of 1969 made the survey of May/June 1969 non–representative. It was, therefore, decided to carry out a second survey in 1970. The second survey was very similar to the first except for a smaller sample size (5 per cent of total traffic on the line compared to 10 per cent in the year before) and a slightly modified questionnaire to assist in distinguishing between 'generated' and 'diverted' traffic. The results of these surveys were believed to represent 'one of the most comprehensive sets of traffic surveys ever undertaken on any urban railway.' The questionnaire was designed to obtain detailed information on all stages of each passenger's journey; the way the journeys were made before and the route taken; the frequency of making the journey both before and after; and the purpose of the journey.

Survey Objectives and Method

7.18 The survey was aiming at assessing the effect of the Victoria Line on London's travel patterns. The objective of the questionnaire was to determine the composition of the Victoria Line traffic in terms of 'diverted' and 'generated' traffic. In general, its purpose was to build up a picture of the total effect of the Victoria Line on all forms of transport, both private and public. In May 1969 (2 months after the line was opened to Victoria),one–day counts were taken systematically of passengers entering the Victoria Line platforms at all stations from anywhere (e.g. from the street, other Underground lines or from British Railways). This was the first stage of the survey with the counts were carried out during a fortnight. These counts provided the statistical calculation basis for the subsequent questionnaire survey which took place

during a fortnight in June 1969. This stage involved some 60,000 questionnaires being handed to passengers at each access point.

Impacts of the Victoria Line

7.19 The evaluation of the 1969 and 1970 questionnaires yielded the different classifications of the Victoria Line traffic. The results are presented in Table 7.1.

	May/June 1969	May/June 1970
Diverted from Rail and mixed modes	152,800 (82) [100]	182,000 (69.5) [119]
Diverted from 'bus only'	16,800 (9) [100]	21,900 (8.5) [130]
Diverted from 'car only'	2,700 (1.5) [100]	5,500 (2) [204]
Total 'diverted' traffic	172,300 (92.5) [100]	209,400 (80) [123]
'Generated' Traffic	13,700 (7.5) [100]	51,500 (20) [375]
Totals	**186,000 (100) [100]**	**260,900 (100) [140]**

Table 7.1 **Revised classification of the Victoria Line total daily number of journeys.**

Note: Figures in ( ) indicate the percentage share of the total, while figures in [ ] indicate the percentage change in the traffic element between 1969 and 1970 with 1969 taken as the base year.

Source: The Victoria Line Traffic Study Report, 1973.

From this table, and the graphic presentation in Figure 7.2, it appears that the composition of the traffic has changed in the year following the opening of the line. While 92.5 per cent of the journeys in 1969 were 'diverted', only 7.5 per cent were 'generated', these categories represented 80 per cent and 20 per cent, respectively, of the total journeys in 1970. On the strength of these figures, the study report acknowledged that the method used in estimating 'generated traffic' was 'of necessity, somewhat arbitrary and may err on the generous side'. The table also shows that only 2,700 (1.5 per cent) of the total journeys were diverted from car only,

rising to 5,500 journeys (2 per cent) in 1970. These figures are discussed in more detail in the section 'The Victoria Line Impact on Other Road Traffic'.

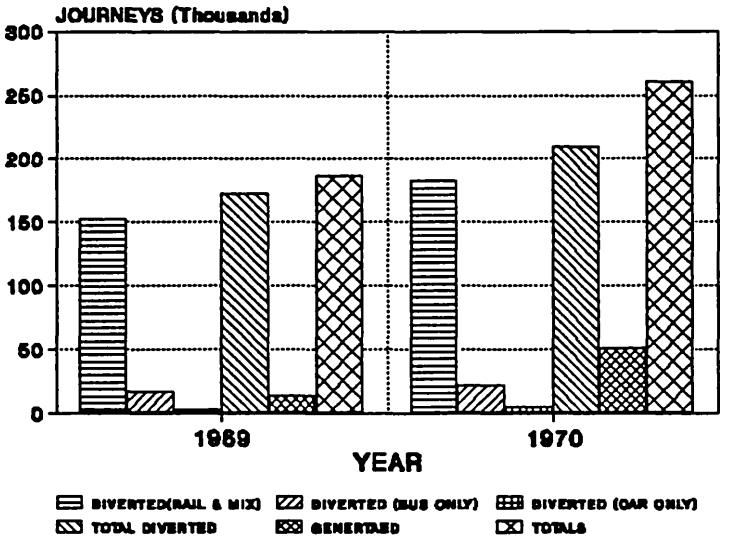


Figure 7.2 Classified total number of daily journeys on the Victoria Line.

THE IMPACT OF THE VICTORIA LINE ON OTHER MODES OF TRAVEL

1) The Impact on Other Underground Lines

7.20 The Line's impact on other Underground lines (Figure 7.3) varied from one section to another. The greatest measure of relief was, as expected, on sections of the District and Piccadilly Lines. The most significant relief for the District Line was on the section between Charing Cross and Victoria stations. The line also brought much needed relief to other lines in the network; on the Piccadilly Line between Finsbury Park and Green Park; and on the Northern Line between Euston and Charing Cross. On the other hand, the new line induced more traffic on the Bakerloo Line. The net effect of diversions on the total number of Underground journeys is presented in Figure 7.4.

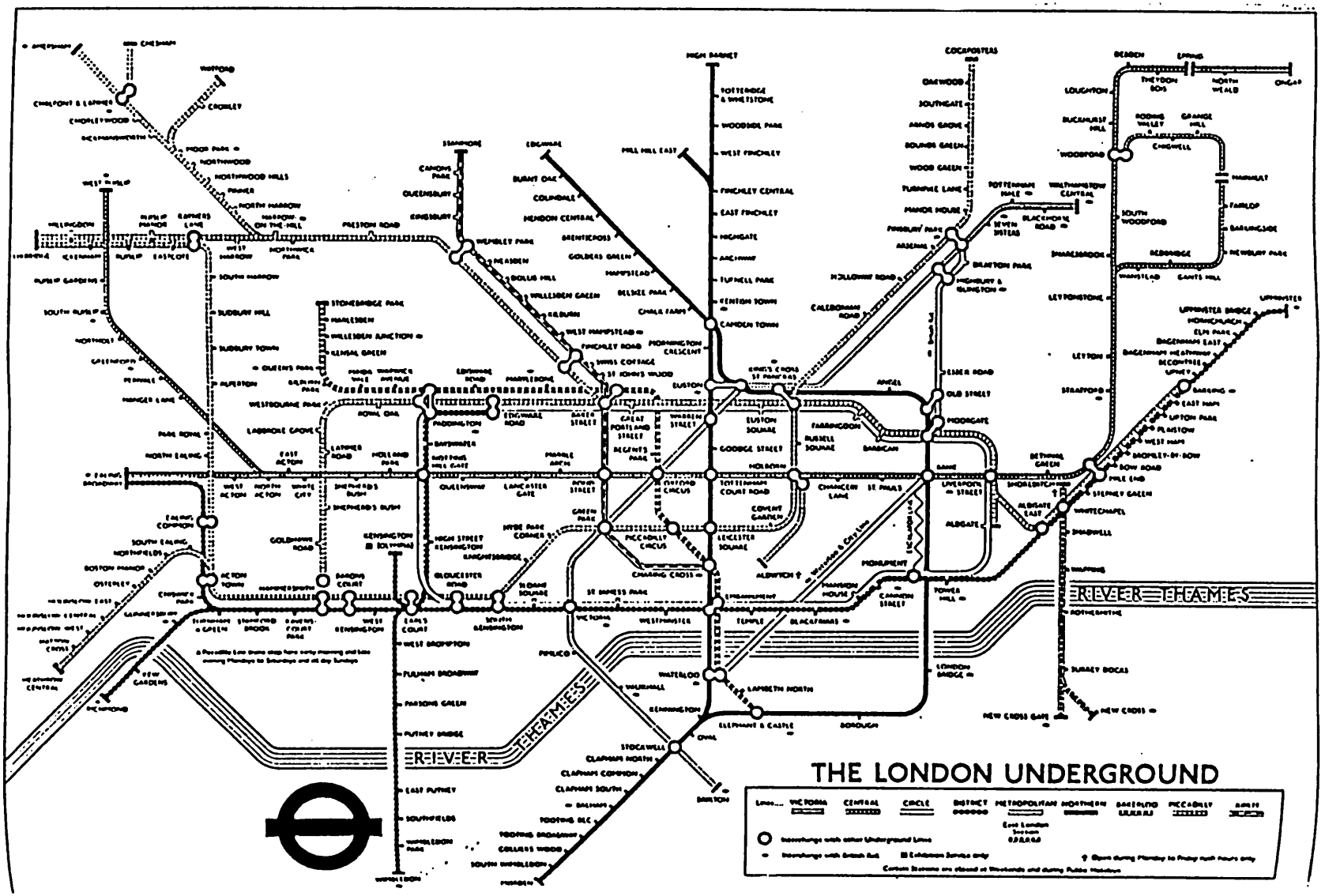


FIGURE 7.3 The London Underground System

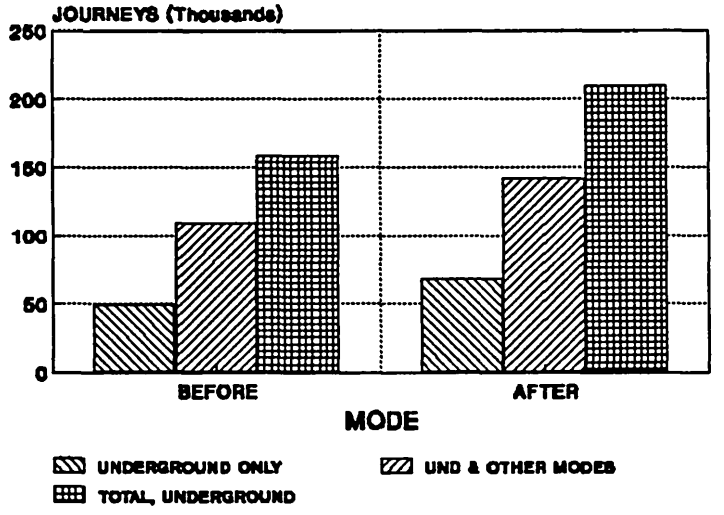


Figure 7.4 **The daily number of journeys using the Underground 'before' and 'after' the opening of the Victoria Line.**

2) The Impact on British Railways Traffic

7.21 As mentioned earlier in the description of the line, it had a number of contact points with major British Railway main lines. This meant a considerable impact on this traffic. In some cases a sizable proportion of the traffic was diverted from British Rail lines on to the Victoria Line, this was seen by the net traffic decrease of the order of a half million passengers per annum both on the Chingford Line and on the Enfield Town Line. Further west, a similar loss was suffered by the Great Northern suburban lines north of Finsbury Park and as far as Wood Green. The loss between Finsbury Park and King's Cross was nearly 1 million passengers per annum. The line also had an opposite effect on other lines (the London Midland Region Suburban Lines) which benefited from the improved in-town distribution facilities offered by the Victoria Line (e.g. at St. Pancras and Euston). Figure 7.5 is a graphic presentation of the total number of diverted British rail journeys.

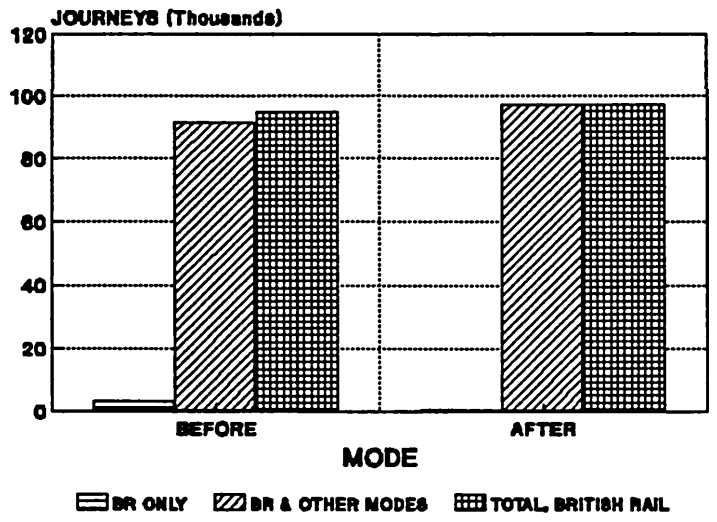


Figure 7.5 **The daily number of journeys using British Rail 'before' and 'after' the opening of the Victoria Line.**

3) The Impact on Bus Traffic

7.22 The wide impact of the line on bus services in the affected area was reflected in falling bus ridership. Changes in the pattern of bus services in the area, mainly as a result of the opening of the Victoria Line also accounted for variations in the patterns of bus passenger journeys. In the central area, the numbers of bus passengers arriving at Victoria from Oxford Circus and Green Park dropped, initially by about one-third, whilst the numbers of bus passengers set down by northbound buses at Warren Street from Oxford Circus or Victoria dropped by one-fifth. Table 7.2 provides detailed figures on the numbers of 'diverted' journeys per week day by modes of transport used 'before' and 'after' the opening of the Victoria Line, and covers in more numerical detail the Victoria Line impact on the three modes discussed. Figure 7.6 presents the total number of diverted bus journeys graphically.

Before \ After	Underground only	Car and Underground	Bus and Underground	B.R. and Underground	Car, B.R. & Underground	Bus, B.R. & Underground	Car, Bus & Underground	Totals
Car only	1,700	700	700	1,100	600	600	100	5,500
Bus only	12,100	400	6,900	1,900	200	400	–	21,900
B.R. only	500	100	400	2,100	–	100	–	3,200
Underground only	43,600	1,200	2,100	2,200	200	100	–	49,400
Car and B.R.	–	–	–	100	1,200	–	–	1,300
Car and Underground	200	5,400	200	300	600	–	–	6,700
Bus and B.R.	500	–	400	10,300	200	3,900	–	15,300
Bus and Underground	6,000	900	20,000	2,100	200	1,400	–	30,600
B.R. and Underground	2,900	500	1,000	38,100	600	600	–	43,700
Car, B.R. & Underground	–	500	100	200	14,100	100	–	15,000
Bus, B.R. & Underground	400	100	2,200	1,000	300	8,800	–	12,800
Car, Bus & Underground	–	100	–	–	–	–	300	400
Car, Bus and B.R.	–	–	–	100	3,500	–	–	3,600
Total	67,900	9,900	34,000	59,500	21,700	16,000	400	209,400

TABLE 7.2 **Number Of 'Diverted' Journeys Per Weekday By Modes of Transport Used 'Before' And 'After' The Opening Of The Victoria Line**

Source: A Report on The Traffic Implications of The Victoria Line North of Victoria, London Transport, 1973 (Appendix J).

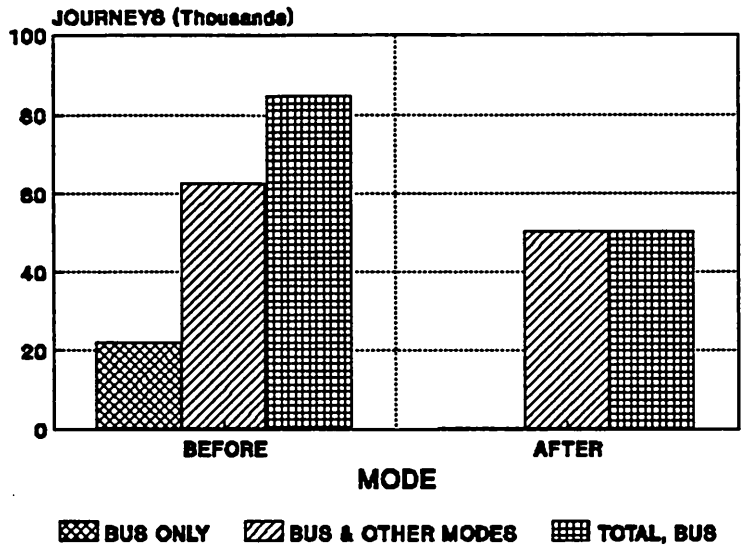


Figure 7.6 **The daily number of journeys using buses 'before' and 'after' the opening of the Victoria Line.**

4) The Impact of the Victoria Line on Other Road Traffic

7.23 This is the issue most relevant to the research purposes. It was argued in the studies, as presented earlier, that the Victoria Line was to have certain benefits for road users. These benefits were to be incurred in the form of savings in a) time and b) vehicle-operating costs as a result of decongestion. The Foster Beesley report estimated that a significant number of car journeys would be diverted on to the line, leaving behind improved traffic conditions and leading to a 35 per cent of the total expected benefit of the line.

7.24 Investigating the actual findings of the Victoria Line Survey and the Study which followed, provided the basis for establishing whether or not the Victoria Line has met its stated objectives. As can be seen from Tables 7.1 and 7.2, the survey showed that by May 1970 the Victoria Line had eliminated about 5,500 person trips which had used the car as the main mode of travel. This figure was seen to correspond to roundly 4,000 vehicle trips a day. The report acknowledged the difficulty in obtaining a corroboration of this figure by road traffic counts. This was attributed to the general upward trend of traffic by private car and the wide dispersion of that traffic. Nevertheless, some traffic counts taken by the GLC and by London

Transport were referred to as an indication of the general changes experienced after the opening of the line.

7.25 The GLC carried out traffic counts on a 'screenline' along the River Lee and across the major routes from North East to Central London, by means of automatic counters. These figures are reported to have shown 'virtually identical' before and after" one-way traffic flows (approximately 42,000 vehicles between 07.00 and 10.00 hours, and approximately 202,000 all day) over a period of one year from 1968 to 1969 during which motor traffic in general 'increased by about 6 per cent'. This can be seen as suggesting that the line has reduced traffic along its route by some 6 per cent of the total traffic, which is quite a substantial relief, if this had been what actually happened.

7.26 London Transport counts, carried out as an annual routine, of private cars entering Central London during the morning period across an 'Inner Cordon' showed a decline from 11,357 cars in July 1968 to 9,289 in July 1969 in the north-east sector potentially affected by the Victoria Line. This decline of 2,068 (18 per cent) also represented the bulk of a decline of 2,200 (71,300 down from 73,500) or 3 per cent in the total number of private cars entering central London during the morning peak period (all sectors) thus implying a virtual stagnation of traffic from other areas. These figures were seen to be 'broadly compatible with the elimination of 4,000 'car only' trips per day (i.e. 2,000 trips per day each way) as shown by the Victoria Line Survey.' The figures given here (71,300 and 73,500) did not agree with figures obtained from the LT archives. The change in total private vehicles entering Central London was 4,353 cars, or 83,140 in July 1969 down from 87,493 in July 1968. These figures, however, appeared to be inconsistent but this was later explained by London Transport officials as being the result of adjusting the annual counts to cover a larger cordon. A detailed explanation is provided in Appendix M.

7.27 So the Survey, and the conclusions drawn from the traffic counts mentioned above, indicated that the new line has eliminated about 4,000 vehicle trips a day. The original estimates by Foster and Beesley suggested a reduction of 3.96 million passenger trips p.a. calculated for 4,000 trips per day each way, for a total of 330 days and an occupancy rate of 1.5. The same calculation performed for 2,000 trips would only be half the predicted savings suggested in the Foster Beesley report, or 1.98 million passenger miles per annum. If we accept that the results of the Victoria Line survey are plausible, then the actual reduction was only half that originally estimated.

This is, of course, if we assume that no shifts occurred in the other direction (i.e. to using the car, wholly or partly, to make journeys). However, the changes in travel modes associated with the Victoria Line were more far reaching than this. We must take into consideration the number of new journeys made by car only, or those made by a combination of car and another mode, and which were previously made via a public transport mode.

7.28 From Table 7.2, the results of the May/June 1970 showed that the total diverted traffic made up 80 per cent of the total traffic on the Victoria Line. Further analysis of this traffic showed the following:

– While the total number of journeys involving the use of the car, for part of a multi-mode combination, was 32,000 journeys (15.3 per cent of all diverted journeys) after the opening of the line, the corresponding figure 'before' was 32,500. In other words, an elimination of 500 journeys which used the car wholly or partially (Figure 7.7).

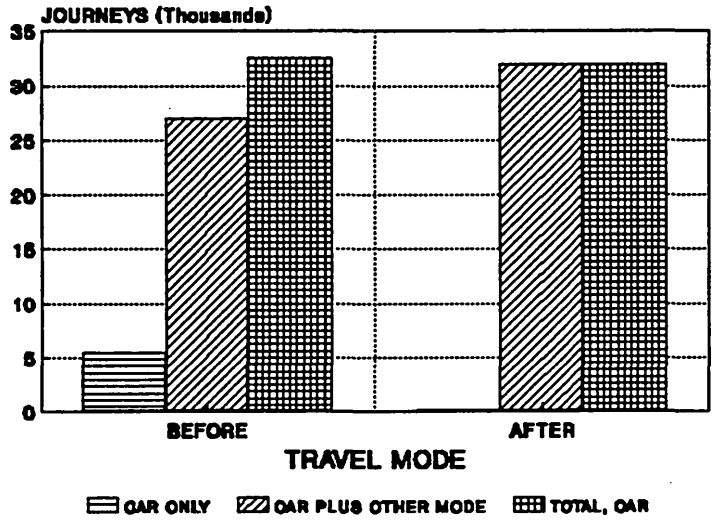


Figure 7.7 The daily number of journeys using the car 'before' and 'after' the opening of the Victoria Line.

This reduction amounted to an insignificant 0.24 per cent of the total diverted journeys and is no where near the earlier forecasts. Further analysis also showed that

of the 32,000 'after'journeys which involved the use of the car, 4,900 had not involved the use of the car 'before'. Even if 1,400 of these journeys had become 'park-and-ride' or 'kiss-and-ride' journeys, as claimed in the Study Report, the net reduction would be the 2,000 journeys mentioned earlier, still far from the original expected relief.

- There were 67,900 diverted journeys (nearly 1/3rd of all diverted traffic) that used the underground. Out of these only 1,900 (2.8 per cent) were previously made wholly or partially by car while 12,100 (17.8 per cent) were made by bus.

- Nearly 28 per cent of all diverted journeys (59,500) used a combination of British Rail and the Underground. Of these 1,800 (3 per cent) previously involved the use of a car, while the number of journeys which previously involved buses was 15,400 (26 per cent).

7.29 A comparison between the 1958 and 1969 forecasts of 'diverted' and 'generated' traffic, and the 1969 and 1970 surveys (presented in the Study report) was, in London Transport's own words, to 'be regarded with considerable reserve'. The 1958 and 1969 forecasts for the total percentage share of traffic new to public transport, i.e. traffic generated by the new facility plus traffic diverted from private transport, was in terms of Victoria Line 'passenger mileage' estimated to be 30 and 31 per cent, respectively. According to the May/June 1969 survey, the total percentage share of 'passenger journeys' generated' and 'diverted from car only' amounted to 9 per cent at that time, rising to 22 per cent in May/June 1970.

7.30 This brings us to another area of inconsistency. As we know, in order to obtain a reliable comparison, similar ratios or factors are usually taken to achieve the principle of comparing the like with the like which is obviously not the case here. It was not explained why in the after surveys the number of passenger journeys rather than the passenger miles were used. Nevertheless, calculations of the annual passenger mileage on the line were carried out using factors based on 'London Transport general experience of traffic fluctuations'. In the case of passenger mileage diverted from the car, a straight comparison, however, could be misleading, and apart from any inaccuracies due to comparing passenger mileage with passenger journeys, the study report accepted that the category of traffic 'diverted from car only' could not be directly compared with the earlier estimates. It went further to admit that it was possible that there had been some over-estimation, however, this was seen to be of

the rate at which the traffic would accrue to the line after the opening rather than of the total 'generated' and 'ex-motorist traffic'.

7.31 In order to independently assess the changes associated with the Victoria Line, traffic counts from London Transport and the GLC were used. The change in the number of private vehicles entering the Central area was one of particular importance. According to London Transport's counts (Table 7.3), the number of people using cars to enter the Central area has shown a tendency to increase by varying degrees. A growth rate of 3-4 per cent p.a. was obvious between 1961-1964. This slowed down in 1965-1967 but showed a sudden increase to 6.6 per cent between 1967-1968. The 1969 figures, taken about four months after the opening of the Victoria Line to Victoria, showed a reduction of 5 per cent in the number of cars entering the Central London area. In 1970, however, another increase of 6 per cent was recorded followed by a slight increase in 1971 and a much larger increase of 9 per cent in 1972. Over the period between 1961-1971, the total number of vehicles of all kinds entering the Central area had decreased by 9.2 per cent while the number of cars entering the area increased by 22.6 per cent over the same period. It must be noted that while the 1969 counts indicated a reduction of 5 per cent in the number of cars entering the Central area, the year before (1968) had shown an unprecedented increase of nearly 7 per cent. The year immediately after the opening of the line showed an increase of 6 per cent (0.7 per cent compared to 1968).

7.32 From the same table, the number of passengers in these cars tended to increase until 1966 where this was reversed and remained stable until 1968 where an increase of 7.7 per cent was the largest recorded over the period 1961-1971. After opening the Victoria Line, counts in 1969 showed that the number of passengers using cars had fallen by 6.5 per cent from its 1968 level. This did not last very long, and the 1970 counts showed an increase of 6.5 per cent followed by another 3.7 per cent in 1971. The increase was even larger in 1972 with 9.1 per cent . These trends are presented graphically in Figure 7.8.

Passengers arriving by	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972*	1973
Car	194,051	108,296	110,657	115,206	117,308	115,533	115,252	124,169	116,158	123,665	128,208	139,863	127,543
Motor Cycle/Scooter	23,314	22,605	19,903	18,804	15,775	12,105	10,578	8,902	7,495	7,423	6,347	7,232	8,634
Pedal Cycle	12,371	10,126	9,062	7,811	5,969	5,088	4,467	3,778	3,281	3,274	2,128	2,000	2,942
Total	**139,736**	**141,027**	**139,622**	**141,821**	**139,032**	**132,726**	**130,297**	**136,849**	**126,934**	**134,362**	**136,683**	**149,095**	**139,119**
Passenger Vehicles													
Cars	72,359	74,554	77,382	80,486	81,607	81,457	82,104	87,493	83,140	88,127	88,748	96,816	89,739
Motor Cycle/Scooter	21,116	20,357	18,207	17,349	14,620	11,183	9,927	8,455	7,165	7,070	6,078	6,926	8,275
Pedal Cycles	12,371	10,126	9,062	7,811	5,969	5,088	4,467	3,778	3,281	3,274	2,128	2,000	2,942
Total	**105,846**	**105,037**	**104,651**	**105,646**	**102,196**	**97,728**	**96,498**	**99,726**	**93,586**	**98,471**	**96,954**	**105,742**	**100,956**

Table 7.3 Private passenger traffic into Central London during the morning peak (0700–0959) hours.**

Notes: * 1972 private transport figures estimated from a G.L.C. sample survey.

** This area approximates to that defined as the Greater London Conurbation Centre in the Population Census of 1961. It is bounded by the main line terminals in the north, Shoreditch and Aldgate in the east, Elephant & Castle and Vauxhaul in the south, and Sloane Square and Lancaster Gate in the West.

Source: London Transport Archives.

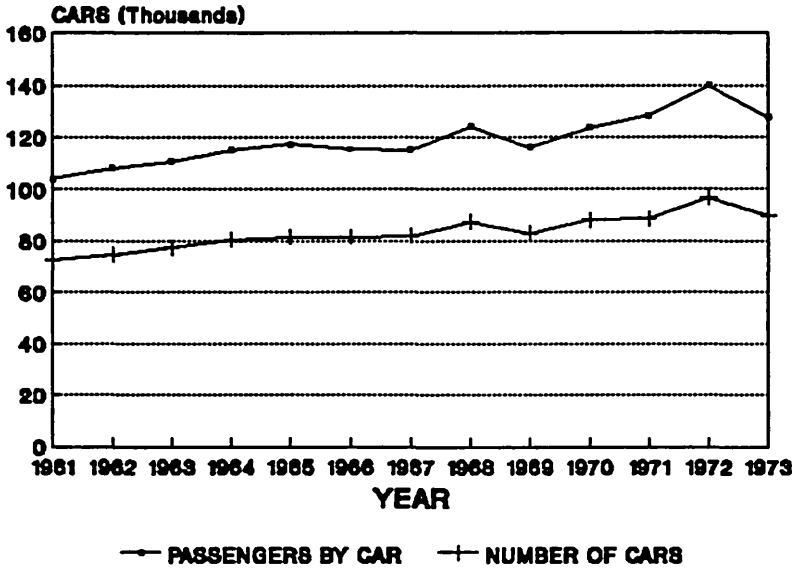


Figure 7.8 **The numbers of cars and car passengers entering Central London during the morning peak period.**

7.33 These changes were then checked against figures available from the GLC surveys presented in Table 7.4. These figures, however, showed a continuing increasing tendency reversed only during the 'oil crisis' in the early 70's. The increase between 1969 and 1970 was also high here (at 6 per cent) with the number of passengers increasing by nearly 6.5 per cent. These percentages were in agreement in both counts. The absence of GLC data for the year 1968 made it unfeasible to compare the two different counts. It should also be noted that an amendment in the area's cordons was made for the purposes of the GLC survey in 1968 and that it was not until 1971 when these counts were compatible. Figures 7.9(a) and 9(b) show the graphic presentation of trends in the number of passengers by mode of travel to Central London, and the change in the number of private cars entering the central area in the peak period, respectively according to the GLC counts.

Mode of Transport	Broad Estimates			1969	1970	1971	1972	1973	1974	1975
	1961	1962	1966							
Total British Rail	451,800	461,400	455,900	453,800	463,800	459,900	442,300	435,400	418,700	402,900
Underground Total	547,400	563,400	538,700	517,700	504,100	502,800	494,700	482,000	482,700	447,000
Also counted by British Rail	117,800	123,000	122,500	112,400	117,500	117,500	113,700	112,200	107,900	103,300
Underground Net	429,600	440,400	416,100	405,300	386,700	385,300	381,000	369,800	374,800	343,600
Total Rail	881,400	901,800	872,000	859,100	850,400	845,200	823,300	805,100	793,500	746,500
LT Bus	208,500	214,500	174,900	156,700	152,400	145,600	143,900	143,900	143,000	148,000
Total–Public Transport	1,089,900	1,116,300	1,046,900	1,015,700	1,002,800	990,800	967,100	949,000	936,500	894,600
Private cars	125,100	130,600	142,100	147,400	156,900	162,700	171,900	173,500	169,600	161,900
Motor cycles	32,200	31,200	16,700	10,300	10,200	8,800	10,000	10,700	9,900	13,800
Pedal cycles	17,100	14,000	7,000	4,500	4,500	2,900	2,800	3,500	3,300	5,100
Total Private Transport	174,400	175,800	165,800	162,300	171,700	174,400	184,700	187,700	182,800	180,800
Total Passengers Entering Central London	1,264,300	1,292,100	1,212,700	1,178,000	1,174,500	1,165,200	1,151,800	1,136,700	1,119,300	1,075,300
Passenger Vehicles										
Cars	87,000	89,900	100,200	105,500	111,800	112,600	120,000	122,100	123,100	115,100
Motor Cycles	29,100	28,100	15,400	9,900	9,800	8,400	9,600	10,200	9,500	13,200
Pedal Cycles	17,100	14,000	7,000	4,500	4,500	2,900	2,800	3,500	3,300	5,100
LT Buses	5,100	5,200	4,600	4,000	4,000	3,800	3,500	3,200	3,100	3,200
Total Passenger Vehicles	138,300	137,200	127,200	123,900	130,100	127,700	135,900	139,100	139,000	136,600

Table 7.4 **Passenger traffic entering Central London during the Morning peak period (0700–1000).**

Source: GLC and operators surveys.

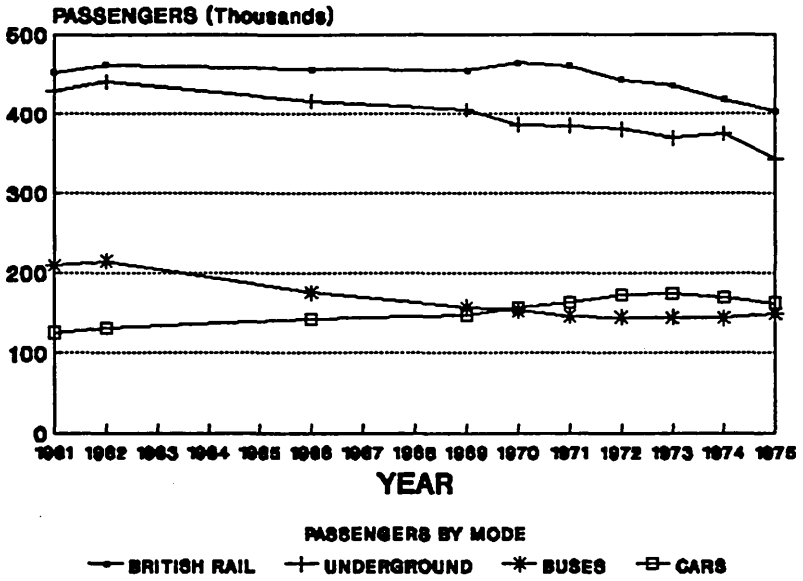


Figure 7.9 (a) Changes in the number of passengers by mode of travel into Central London during the morning peak.

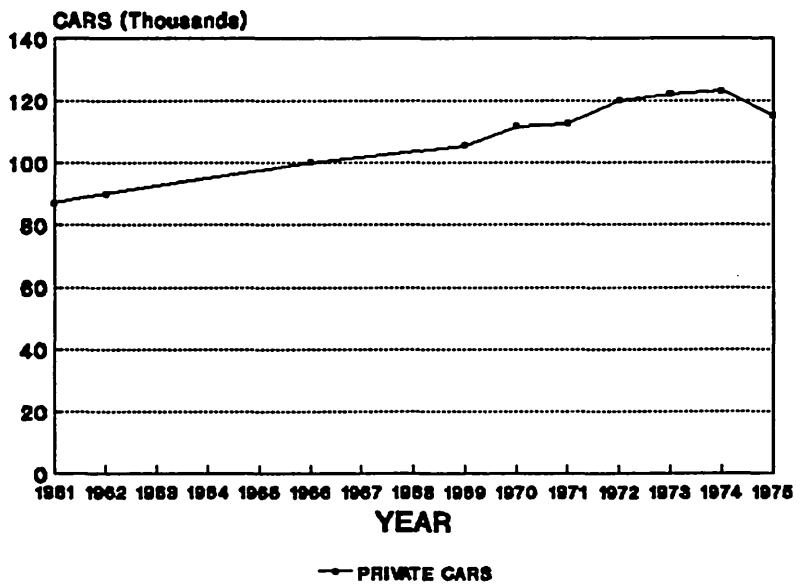


Figure 7.9 (b) Private cars entering Central London in the morning peak period.

7.34 Table 7.5 is a list of the morning peak arrivals by mode of transport to Central London as counted by London Transport. From the table, the general trend of declining patronage of public transport services in general and buses in particular for the period 1962–1971 is obvious. A closer examination of ridership figures on the underground revealed similar irregularities in the rail public transport context. The 1968 figures showed a sharp decrease in traffic in 1968 (down by 9.4 per cent). This was followed by an increase of 4.5 per cent in 1970 only to fall again by 3.8 per cent in 1971. These abrupt changes in traffic reflected in an increase in underground ridership, and a decline in car numbers immediately after the opening of the line, but taking on a reverse trend one year after, indicates that these changes are in no way permanent. It can be seen that immediately before the opening of the line the usual trend is reversed only to return back to normal immediately after the opening of the line. This was not consistent with the GLC figures (Table 7.4), however, a comparison was not possible due to the missing figures for some years in between since the GLC counts were not carried out every year. Figure 7.11 is the graphic presentation of the changes in the number of passengers by mode as counted by London Transport.

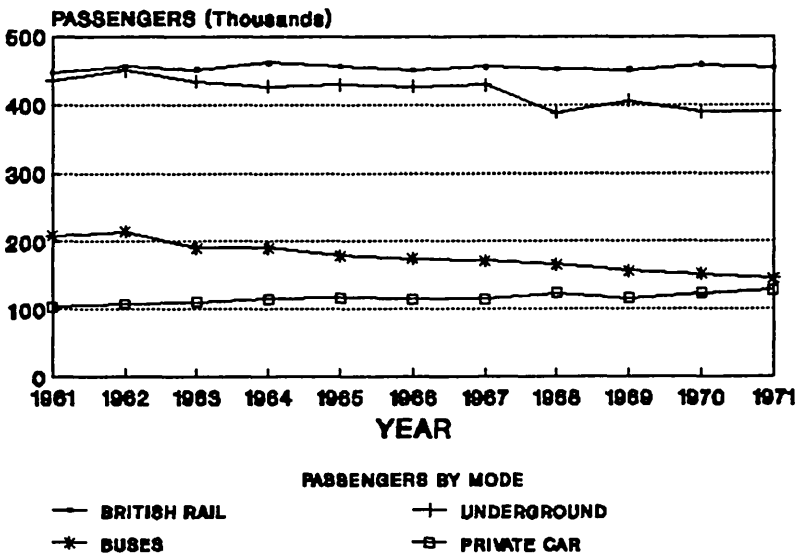


Figure 7.10 Morning peak arrivals into Central London by mode.

Mode of Transport	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971
Total British Railways	446,297	455,805	450,692	460,733	455,760	449,931	455,015	452,026	450,895	458,215	449,156
L.T.E. Rail Total	547,359	563,383	546,055	541,500	542,564	538,670	542,354	501,442	517,657	504,127	502,765
overlap with B.R.	111,574	113,951	112,673	115,183	113,940	112,483	113,754	113,007	112,724	114,554	113,546
L.T.E. Rail Total (less double counting)	435,785	449,432	433,382	426,317	428,642	426,187	428,600	388,435	404,963	389,573	389,219
Grand Total Rail (less double counting)	882,082	905,237	884,074	867,050	884,384	876,118	883,615	840,461	855,858	847,783	843,405
L.T.E. Bus	208,541	214,513	190,807	191,046	179,736	174,908	172,163	166,595	156,655	152,417	145,629
Total Public Transport	1,090,623	1,119,750	1,074,861	1,078,096	1,064,120	1,051,026	1,055,778	1,007,056	1,012,513	1,000,205	989,034
Private											
Car	104,051	108,296	110,657	115,206	117,308	115,533	115,252	124,169	116,158	123,665	123,208
Motor Cycle	23,314	22,605	19,903	18,804	17,755	12,105	10,578	8,902	7,495	7,423	6,347
Pedal Cycle	12,371	10,126	9,062	7,811	5,969	5,088	4,467	3,778	3,261	3,274	2,126
Total Private Transport	139,736	141,027	139,622	141,821	139,032	132,726	130,297	136,849	126,934	134,363	136,633
Grand Total	1,230,359	1,260,777	1,214,503	1,219,917	1,203,152	1,183,752	1,186,075	1,143,905	1,139,447	1,134,567	1,125,717

Table 7.5 **Morning peak period arrivals (0700–0959) by mode of Transport to Central London.**

Source: London Transport.

7.35 All of the above confirms that the changes associated with a major improvement to the public transport system have only marginal and short lasting effects, if any. The car traffic growth had always been higher than the average trend immediately after the opening of the line. It is also questionable whether this temporary relief is the direct result of the improvement of public transport. It may be possible that the relief experienced on the roads immediately after the opening of the line was reversed by the suppressed demand taking up the additional capacity released. Even when accepting the accuracy of these figures, they still however point to weaknesses in the arguments and reaffirm that the new line only had a marginal effect on road traffic in its immediate corridor. The findings of the GLC household survey carried out in the northern suburbs provided even more surprising evidence.

THE GLC HOUSEHOLD SURVEY

7.36 In addition to these surveys and traffic observations, and prior to the opening of the Victoria Line from Walthamstow to Highbury in September 1968 the GLC conducted a series of some 5,000 household interviews at or near the northern end of the Victoria Line. The aim of these interviews was to try and ascertain the effect of the line on local travel habits in that area (the northern suburbs). This survey was then repeated about five months after the opening of the line to Victoria. The surveys were carried out in August 1968 just before the opening of the first section of the line from Walthamstow Central to Highbury & Islington in September 1968. The repeat was in August 1969, five months after the line had been opened all the way to Victoria. The households were partly selected at random in the direct catchment area of the Victoria Line (e.g. in the Walthamstow and Tottenham areas) and partly selected judiciously in areas with convenient rail or bus connections to the Victoria Line (e.g. in the Enfield, Southgate and Hornsey areas). The 'before' interviews covered 5,233 households of which 4,621 were successfully interviewed in the 'after' survey.

7.37 The interview forms used for each survey were similar in concept and included questions on household information (number of persons; employment; car ownership), personal details (income group; occupation; workplace; main mode of travel; use of a car) and details of home-based work trips and non-work trips. Additional questions in the 'after' survey were included to mitigate the 'August effect'* on trip rates. Despite some reservations (timing of the surveys; limitations

* Referring to the fact that the 'after' survey was carried out during the height of the holiday season.

inherent in the method of sampling; and the smallness of the percentage of the total number of Victoria Line trips on which the results may be used to have a bearing), the results of the household survey were seen as an 'indication of the initial impact of a new rapid transit facility on an already developed suburban area'.

Findings of the Household Survey

7.38 From Table 7.6, which presents the numbers of home based trips by main mode per weekday, it can be seen that the total daily number of trips for all purposes had increased over the year from 206,550 to 217,200 (a 5.2 per cent increase). Excluding the number of main-mode walk trips, the total number of 'non-walk'trips showed an increase from 159,790 to 164,050 (2.7 per cent). Changes for each main-mode within this total number of 'non-walk'trips were influenced by : i) a general decline in bus traffic; ii) a general increase in trips by private transport (reported to be mainly over short distances); and iii) changes in the bus route network from long to short bus routes, especially in the Walthamstow area. The impact on private transport was demonstrated in a net increase of 7.6 per cent in trips for all purposes (83,410 up from 77,530) over the year with the private transport share of trips for all purposes rising from 49 per cent to 51 per cent. The increase in private transport was even more significant on trips other than work trips where it went up by 13 per cent (only 0.5 per cent of the of the mode's share of all trips).

7.39 On the other hand, while the private transport as a main mode showed an increase of 7.6 per cent, the public transport as a main mode showed a drop of 2 per cent. The change, however, varied between the different public transport modes. The number of trips made by the Underground as a main mode showed a sharp increase of 36.7 per cent, and an even higher one (93.2 per cent) for trips other than work trips. This, increased the Underground's share of total trips to 14 per cent up from 10.5 per cent 'before'. Overall, however, this is not as significant when considering the numbers involved, which are much lower than those for private transport (Table 7.6). The use of British Rail as a main mode fell by 13.5 per cent indicating a transfer to the Victoria Line from British Rail, the drop in the total share was only 1.5 per cent. For the bus as a main mode of travel, the result was a decline by 11.3 per cent in trips using the buses as the main mode, and the share of the buses in the total number of 'non-walk'main mode trips was reduced by 4 per cent from 28 per cent to 24 per cent.

Main mode of travel	August 1968		August 1969		Increase or decrease	
	Numbers	Standard-ized	Numbers	Standard-ized.	Numbers	per cent.
	TRIPS FOR ALL PURPOSES					
Underground	16,900	10½	23,110	14	+ 6,210	+ 36.7
British Rail	20,090	12½	17,370	11	− 2,720	− 13.5
Total, Rail	36,990	23	40,480	25	+ 3,490	+ 9.4
Bus	45,270	28	40,160	24	− 5,110	− 11.3
Total, public transport	82,260	51	80,640	49	− 1,620	− 2.0
Total, private transport	77,530	49	83,410	51	+ 5,880	+ 7.6
Total, non-walk trips	159,790	100	164,050	100	+ 4,260	+ 2.7
Walk trips	46,760	29	53,150	32	+ 6,390	+ 13.7
Grand total	206,550	129	217,200	132	+ 10,650	+ 5.2
	ALL TRIPS OTHER THAN WORK TRIPS					
Underground	2,490	5	4,810	8½	+ 2,320	+ 93.2
British Rail	2,780	5	3,250	5½	+ 470	+ 16.9
Total, Rail	5,270	10	8,060	14	+ 2,790	+ 52.9
Bus	15,460	30	14,580	25½	− 880	− 5.7
Total, public transport	20,730	40	22,640	39½	+ 1,910	+ 9.2
Total, private transport	30,650	60	34,640	60½	+ 3,990	+ 13.0
Total, non-walk trips	51,380	100	57,280	100	+ 5,900	+ 11.5
Walk trips	25,650	50	31,250	54	+ 5,600	+ 21.8
Grand total	77,030	150	88,530	154	+ 11,500	+ 14.9

TABLE 7.6 **Numbers of 'Home-Based' Trips By Main Mode, Per Weekday Made by Approx. 150,000 Persons Resident in The Northern Suburbs Directly Or Indirectly Served By The Victoria Line**

Source: A Report On The Traffic Implications Of The Victoria Line North Of Victoria, London Transport, 1973 (Appendix P).

7.40 It can be seen, from the above discussion, that the Victoria Line being the first major addition to the underground network in London in over 60 years, at the time it was built, had an important effect on the London transport system. However, this impact varied in degree and was not even uniform throughout the line. While the scheme exceeded expectations on the amount of relief to other underground lines, and on the growth of traffic on its central section, it fell short of the expectations of traffic congestion relief on the roads in its immediate corridor, and of the growth rate expected along it in general.

7.41 In terms of road traffic, the reduction expected (8,000 trips per day in the Central Area) was at least twice the relief found in the 'after' study. The May/June 1970 survey showed that whilst 5,500 'car only' journeys representing some 4,000 vehicle trips per day had been eliminated, 4,900 new journeys involved the use of the car with 1,400 of these being 'park–and–ride' or 'kiss–and–ride' journeys which were reported to have been over much shorter distances and affected less congested areas. The few details available on traffic counts carried out by the GLC and by LT also made it difficult to interpret independently any changes in that period. Nevertheless, both counts indicated a general trend of declining use of public transport in general and for buses in particular (the net reduction in bus passenger trips amounted to 32,400 representing 40 per cent of the 'before' total of 84,600, compared with a drop of 5.5 per cent in the annual number of bus passengers from 1969 to 1970). It has been shown that the counts also showed a growing trend in the use of private cars increasing by the largest percentage immediately before opening the line (1968) and falling after (1969) only to rise sharply in 1970, one year after the opening of the line.

7.42 In addition to this, the 1958 and 1969 forecasts of the total percentage share of 'traffic new to public transport', i.e. traffic generated by the new line plus traffic diverted from private transport was estimated, in terms of Victoria Line 'passenger miles' to be 30 and 31 percent, respectively. The after surveys, however, were in terms of 'passenger journeys' , and the May/June 1969 survey showed that the total percentage share of 'passenger journeys' 'generated' and 'diverted from car only' amounted to 9 per cent at that time, rising to 22 per cent in May/June 1970. Clearly, the category of traffic 'diverted from car only' cannot be directly compared with the earlier estimates. The Study Report acknowledged that inaccuracies can result from comparing passenger miles with passenger journeys and the possibility that there had been some over–estimation of the expected relief. The over–estimation was seen,

however, to be more of the rate at which the traffic would accrue to the line after opening rather than an over estimation of the total 'generated' and 'ex-motorist' traffic. From all this, and with it being unfeasible to convert passenger journeys of the category 'diverted from car only' to passenger mileage, as was possible for traffic on the Victoria Line, the findings of the 'after'study clearly could not substantiate the predicted levels of relief, or in other words the number of drivers expected to divert to the new line.

7.43 The 'after' surveys also showed that the major impact of the new line had been that of a redistributionary one especially amongst the various forms of public transport with the most significant shift coming from buses on to the new line. Italso showed that only 20 per cent of the total traffic using the line in May/June 1970 was new or 'generated' while the remaining 80 per cent was 'diverted', the method used in estimating the 'generated' element was 'somewhat arbitrary'and might have erred on the generous side. Nevertheless, the actual 'generated' traffic element and that 'diverted from car' (20 per cent of the total traffic on the line) accounted for far less than predicted by the 1958 and 1969 forecasts (30 and 31 percent respectively.) Of the 80 per cent share of 'diverted' traffic, the number of trips that involved cars 'before' was only 500 more than those 'after', in other words it was much less than anticipated by earlier forecasts.

7.44 In the case of a new Underground railway which passes through a central business district already served by a number of similar lines, the effect of the new line in terms of traffic diversions might be expected to be most significant in relation to other lines and other modes of public transport in the area. This is indeed what happened in the case of the Victoria Line. It brought much needed relief to certain sections of other Underground lines. This relief was most significant on the District Line between Victoria and Charing Cross; on the Piccadilly Line between Finsbury Park and Green Park; and on the Northern Line between Euston and Charing Cross. The line has also brought some relief to other lines. On the other hand, the new line even induced traffic on the Bakerloo Line. The Victoria Line also had considerable impact on British Railways traffics. In some cases a sizeable proportion of the traffic has been diverted from British Rail lines on to the Victoria Line, e.g. Eastern Region lines into Liverpool Street, Chingford Line and the Enfield Town Line.

7.45 The main concern of this research is whether this major improvement to the public transport system has had any significant impacts on road traffic and whether it has attracted people away from their cars and on to the public transport system. From the discussion presented earlier, and by further examination of the surveys and

studies carried out since the line was opened, it is clear that the forecasted degree of relief to road congestion, or as a matter of fact, the reduction in traffic by private vehicles was over-estimated. The relief that was expected by attracting motorists away from their cars and on to the new public transport service was not on the scale expected. The largest reduction in road-borne traffic was that of buses, however, this can not be simply seen as a purely Victoria Line influenced trend since the general trend had been a continued reduction in the buses share of traffic.

7.46 The household surveys which were carried out in the catchment area of the Victoria Line indicated that the growth in private car traffic was higher than that of any other mode of transport for all purpose trips. Private transport also increased its share of the total work trips after the Victoria Line was opened. This lends further support to the findings in the Berlin case study where the new improvement to the Underground system in that city apparently led to a greater use of the private car. This can be attributed to the availability of the car released by a member of the household and used for journeys that had not been made before. Any capacity released on the road network is taken up by the suppressed demand, and the provision of a public transport system, is not a sufficient measure to by itself to reduce private car usage or counter the effect of suppressed demand. The hypothesis put forward in Chapter 2 thus stands, and is confirmed by the findings of this case study and that from Berlin.

7.47 The main conclusion from this case study is that major improvements to the public transport system alone are not the solution to the problem of highway congestion. Even with a segregated rail system, as the Victoria Line, the demand for travel by car continued to grow and has increased vastly over the last 20 years. The area served by the Victoria Line is a well developed area. With congestion levels as in most parts of London, the new line had a very marginal impact on car traffic on the roads influenced, which continued to carry almost the same levels of traffic as before the Victoria Line. The relief offered was marginal and temporary as illustrated in the early paragraphs. On the other hand, the line has certainly improved conditions for the public transport user and caused a redistribution among other underground lines. It also attracted some bus passengers away from the buses and onto the underground. But it is mainly cars that contribute most to the congestion problem on the roads and not, so much, the buses. The provision of better public transport alone, therefore, is, once more, not the answer.

INTRODUCTION

7.48 Since this case study was completed, major political changes have taken place in Germany. These have directly affected the city of Berlin, in particular, the removal of borders between the two parts of the city. These are certainly going to have different implications for the traffic patterns in Berlin especially after a complete reunification between the two Germanies is completed in October of this year. The information presented here and the analysis made therefore applies strictly to the situation as it was prior to any political changes in 1989. This West Berlin study is of a particular interest (and different from most of the others) in that detailed 'before' and 'after' information is available for the changes in modal split.

7.49 This case study examines the congestion relieving effectiveness of a new major improvement to a public transport system. It is the first of the two case studies on the German experience in this respect, and it entails an assessment of the impacts associated with the provision of a new U-Bahn link in West Berlin. This link, which was carried in two stages, serves Spandau, one of the urban districts which previously had no direct connection with the rapid rail network serving the rest of the city. Prior to the extension, travellers to this area from the city and other parts had to use the buses to complete their journeys. A comprehensive 'before' and 'after' study was carried out immediately before any of the two extensions was completed, and after they were both opened. To achieve a better understanding of the wider impacts of the system, the study also included a comparative analysis with a suburban area in West Berlin, namely Lechtinrade which already had a direct S-Bahn connection. The situation 'before' and that 'after', in each area, will be presented in this study with an appraisal of the changes that took place and their implications.

BACKGROUND

7.50 The city of Berlin is Germany's largest city. It is also one of the eleven *Lands* or States which constitute the Federal Republic of Germany. Before the Second World War Berlin was the capital of the Third Reich. After the War, the city was

divided into Berlin (East) and West Berlin with the two parts following the German Democratic Republic and the Federal Republic of Germany respectively. The city is actually located in what is now East Germany (Figure 7.11). The only surface connections for passenger traffic to it are via East German roads and rail, goods traffic can also use waterways.

7.51 West Berlin houses around 2.1 million people while 1.3 million live in Berlin (East). The western part of Berlin covers 54 per cent of the city's overall area (883 km^2 with a north/south axis extending over 38 km, east/west an even 45 km). The whole area is comparable in number of inhabitants to the entire Ruhr area (2,000 km^2), making it therefore more densely populated. In 1920 the city's 'urban commune' was made of eight distinct towns, fiftynine suburbs and twenty seven rural districts. Atthe time (1920), the city was an important meeting point between Eastern and Western Europe. Today, the city is divided into twenty three urban districts. These are cities within cities, and not only do they each have their own town hall, but also distinct shopping areas and neighbourhoods.

7.52 Like other cities worldwide, West Berlin has seen a continuous increase in urban traffic over many years. At present (1988 figures), there are about 730,000 vehicles (approximately one for three (3) inhabitants), of which 650,000 are private cars. Compared with 1980 figures (600,000 vehicles, including 500,000 cars), this denotes increases of 22 and 30 per cent in vehicle and car ownership respectively, over an eight year period. In the course of these years, the total traffic mileage increased by about 12 per cent only, as private cars are used less the more licensed cars there are. Despite this increase in traffic, the number of accidents involving personal injuries is reported to have decreased slightly despite an increase in the total number of accidents.

7.53 In 1985 (last count available), about 79 per cent of the total traffic flow in the city has been concentrated on major roads comprising roughly 23 per cent of the total network of urban roads. *Autobahns* account for about 1.5 per cent of the overall road system, nevertheless they carry about 15 per cent of the overall traffic. With the awkward political situation of the city, many plans for new roads have been postponed, as it is sometimes necessary to have them pass through areas in East Berlin which is not possible (at least yet). However, road-borne traffic has the largest share of total passenger mileage in Berlin (74.2 per cent), while the rail's share is under 10 per cent. The roads are also used to carry the bulk of goods traffic (about

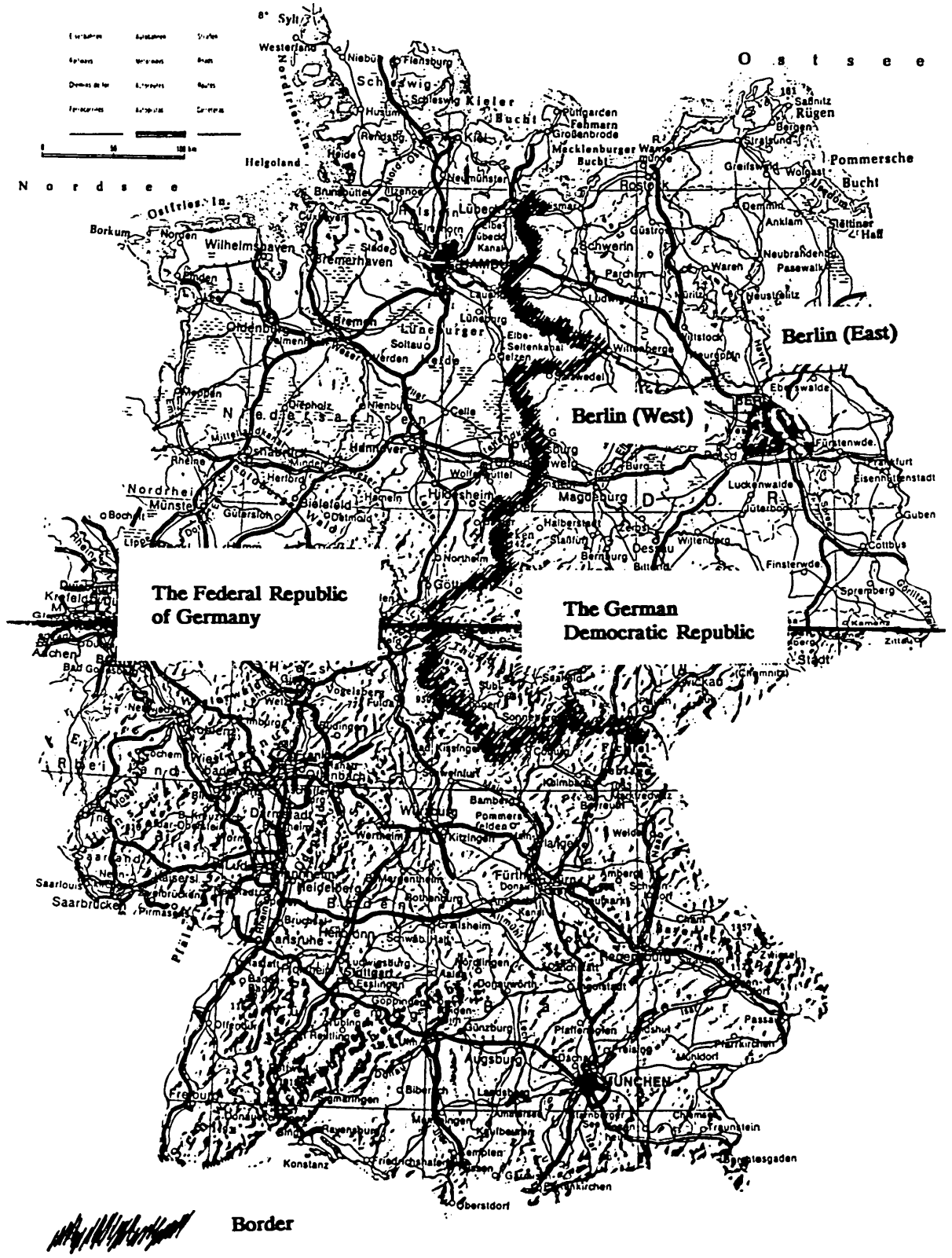


Figure 7.11 The location of the city of Berlin.

67 per cent), with the rail accounting for some 15 per cent of this traffic. Table 7.7 presents the road and rail shares of total passenger and goods traffic in 1975 and 1986.

Transport Mode	1975	1986
Passenger Surface Transport		
By Road	67 %	74.2 %
By Rail	11 %	9.7 %
Goods Surface Transport		
By Road	54.8 %	66.9 %
By rail	18.5 %	15.1 %

Table 7.7 **The share of the transport modes used for Passenger and goods surface transport in Berlin in 1975 and 1986.**

As can be seen from the table, the main mode of travel in Berlin is the motor vehicle.

CURRENT POLICY

7.54 Recent improvements to the road network (doubling the capacity of the network) have apparently resulted in the maintenance of, and sometimes improvement of travel speeds for twice the traffic load[67]. Traffic planning and traffic management, as will be seen later, have helped traffic flows. However, road and traffic engineers in Berlin face new difficulties and problems due to the environmental issues and legislation associated with it. With growing awareness of environmental effects, and the ever decreasing spaces available for constructing new roads due to the city's position, new measures and strategies combining traffic and residential planning and land use (e.g. residential buildings on top of Autobahns) are implemented rigorously in the city.

Traffic Management

7.55 Traffic management plays an important role in the City's transport policies and in ensuring the best utilisation of the available capacity on the City's roads. State

of the art techniques are being developed and tested in Berlin to achieve this objective. Today, 94 per cent of Berlin's 1287 traffic signals are connected to a central control computer and 36 traffic computers in 19 local centres with links to variable electronic traffic signs (e.g. red lights, lane directives, congestion warnings, parking guidance etc.) which are part of a comprehensive motorist information system. These signals cater for the different needs of traffic and pedestrians with special considerations for the disabled. With some 60 'intelligent' units (actuated according to the demand), 340 others had already been equipped with micro-computers. For several years now, fire department vehicles and ambulances in some areas of the city have been able to request clear red light intersections via infrared. This priority system is being steadily extended across the city.

7.56 Daily traffic flow on the city's Autobahns is quite heavy. Monitoring and channelling this traffic is essential. This is done via an automatic monitoring system which covers some six kilometres including a heavily used section of the Autobahn ring (up to 220,000 vehicles per day), and a tunnel of about 1.1 kilometres branching out under Tegel airport. Ninety observation points along this system register the number and type of vehicles, their speed, intervals and general traffic density. Based on this data, information to 58 signals are sent to ensure the most efficient use of available capacity, and the least possible disruption to the traffic flow.

7.57 Along the lines of its policy to improve traffic safety and to better utilise the general capacity of the road network, variable message signs already on the roads will be supplemented by individual route guidance in the future. A large scale experiment is currently underway in Berlin where approximately 700 vehicles are equipped with an on-board navigation system developed by Siemens. The system's on-board computer receives the information and recommendations from 2000 infrared transceivers at some 220 traffic lights and along the *Autobahns*, and in turn reports travelling and waiting times in the respective areas back to the central computer. In addition to the display screen available, the on-board system has a synthesised human voice to inform the driver of the recommendations and to cause the least possible distraction while driving. Future plans for the system include making use of the data reported from individual vehicles to reprogramme traffic signals to respond to the actual traffic situation at a given time.

Traffic Calming

7.58 With the increased safety of pedestrians being one of its main objectives, the city has initiated many changes, both, in the design of residential streets and in terms of traffic rules. Among these is the implementation of traffic calming along many residential streets. These streets are designed for reduced traffic using what is referred to in Germany as 'street furniture'. These vary from simple width restrictions and speed humps to planted areas effectively placed to reduce vehicle speeds. These changes are seen by the city not only as safety improving measures, but also as an effective way to reduce vehicle emissions and thus improve the environment and the quality of life in the respective areas. An area-wide traffic reduction is seen in Berlin to be an effective counter-measure to the negative impacts associated with urban traffic, and in particular its spillage over onto less adequate local streets (rat-running). The view in Berlin is that car traffic should and can be concentrated on the major arteries to avoid adverse environmental conditions along residential and more local streets.

7.59 For Berlin's residential streets, the solution has been to reduce the maximum speed area-wide to 30 kilometres per hour in many residential areas. This is done in conjunction with reasonable changes in residential street design. In such areas, the layout of particular sections of a street with 'sensitive' functions such as schools, daycare centres or old people's homes may be redesigned to permit no more than pedestrian speed for vehicles. It is expected that drivers' behaviour, in response to such measures, would change accordingly. However, the needs and interests of all parties concerned (industry and commerce, public services, and fire departments etc.) are carefully weighed in each case. The agreement of all parties concerned, and the understanding of their different needs provides the best results with the least disruption of daily life and essential traffic needs.

THE PUBLIC TRANSPORT SYSTEM

7.60 It is recognised in Berlin, as in most German cities, that the quality of urban life depends in large part on the compatibility between private and public transportation. The approach in Berlin is that 'public transit entails something more than just the technical and organisational aspects of subways, of rapid transit and bus systems. It means, above all, that passenger needs set the standard of service'[68]. This is known as the 'Public Transport Concept', which speaks for itself, and which,

one may say, seems to characterise the public transport services in West Germany in general. The Berliner-Verkehrs-Betriebe (BVG) (Berlin Public Transit Authority), is the largest communal transit organisation in Germany with a 100 years of experience behind it. From the start, the City had a very good rapid rail transit system. The original city railway used steam traction in 1882; the electric tram was introduced in 1896; the building of the electrified Underground commenced in 1902; and the electrification of the S-Bahn in 1924[69]. The system (Underground and buses) carries about 1.4 million passengers per day, while the S-Bahn caters for 100,000 passengers daily in West Berlin.

7.61 The public transport system in Berlin consists of its rapid rail systems, namely the S-Bahn (overground suburban rail), and the U-Bahn (underground rail typically within the centre), together with the bus system. The rapid rail modes are the backbone of the public transport system in Berlin since they are independent of road and traffic conditions, and offer a fast reliable and inexpensive service. The city is served by a total of 12 lines (Figure 7.12) with a total length of 179 km between the S-Bahn and the U-Bahn (71 km and 108 Km respectively). The system, like all others in German cities, is subsidised by the city. Figure 7.13 shows the yearly subsidy absorbed by the *BVG* in German Marks. It is clear from this figure, that subsidy for the system has continued to increase during the period between 1965 and 1986 where it increased by some 18 fold. This is consistent with the general policy in Germany which started to pay particular attention to the public transport system after 1965, and in line with the 'Public Transport Concept' referred to earlier.

7.62 Up to 1984, the S-Bahn had been run by the East German railway authorities *'Deutche Reichsbahn'* (even in West Berlin). The BVG took over the operation in 1984, but incorporating the system into a highly developed public transport system still requires considerable effort. This is needed to offset the decades of neglect and lack of modernisation the system went through under the East German authority. The system when BVG took it over had only a mere 21 km in track length and only 15 stations. By 1985, the system had 71 km of tracks and 39 stations with future plans to increase the numbers to 117 km and 65 stations respectively. Immediate plans are, also, to have the trains travel at speeds of up to 50 km per hour in the future. The U-Bahn system, on the other hand, is one which is highly developed.

7.63 The bus lines cover the city's entire area. The bus network is coordinated with the rapid rail transit systems. The bus's role is that of a feeder from outer

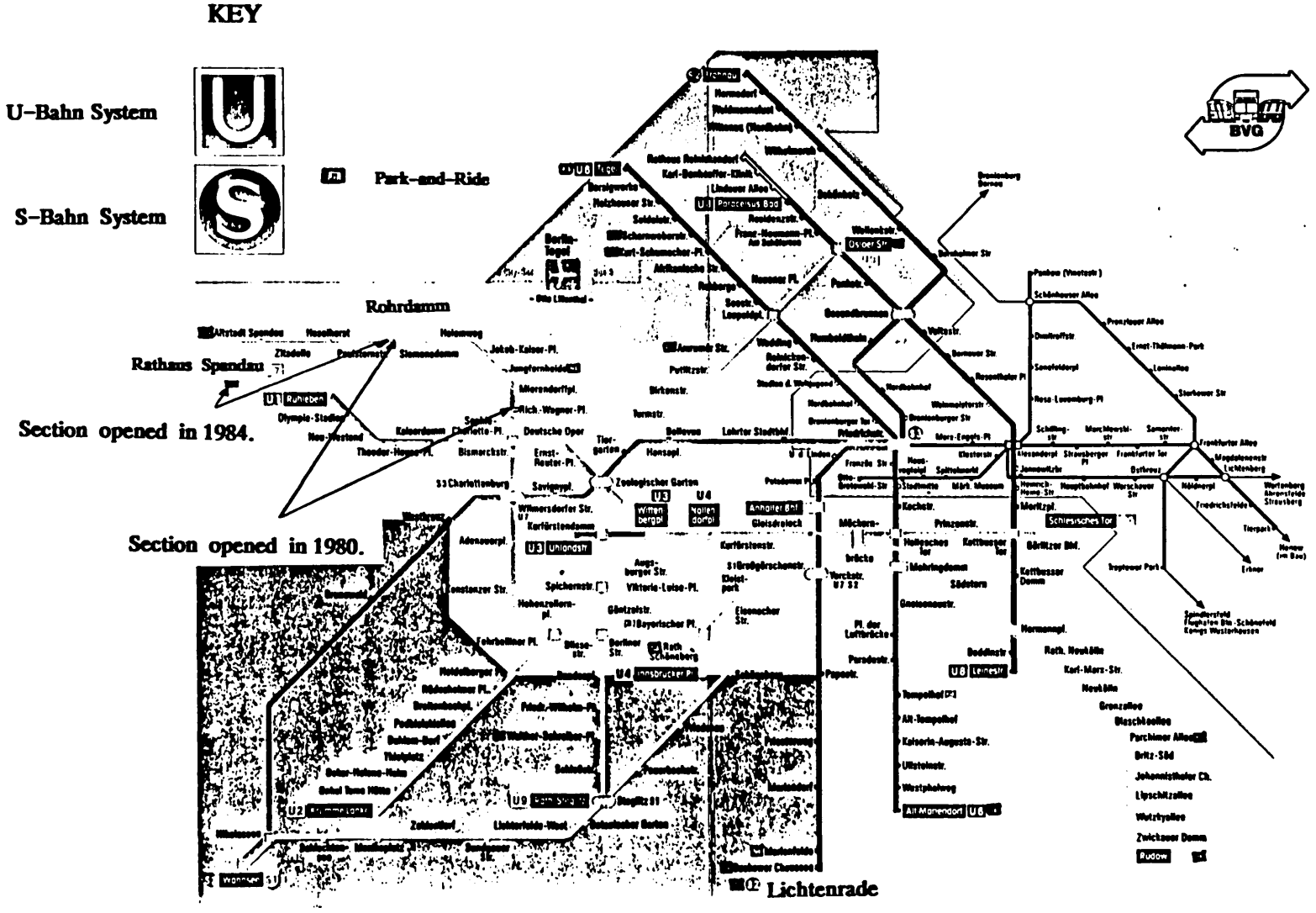


Figure 7.12 The rapid rail system in Berlin and the two U7 extensions to Spandau.

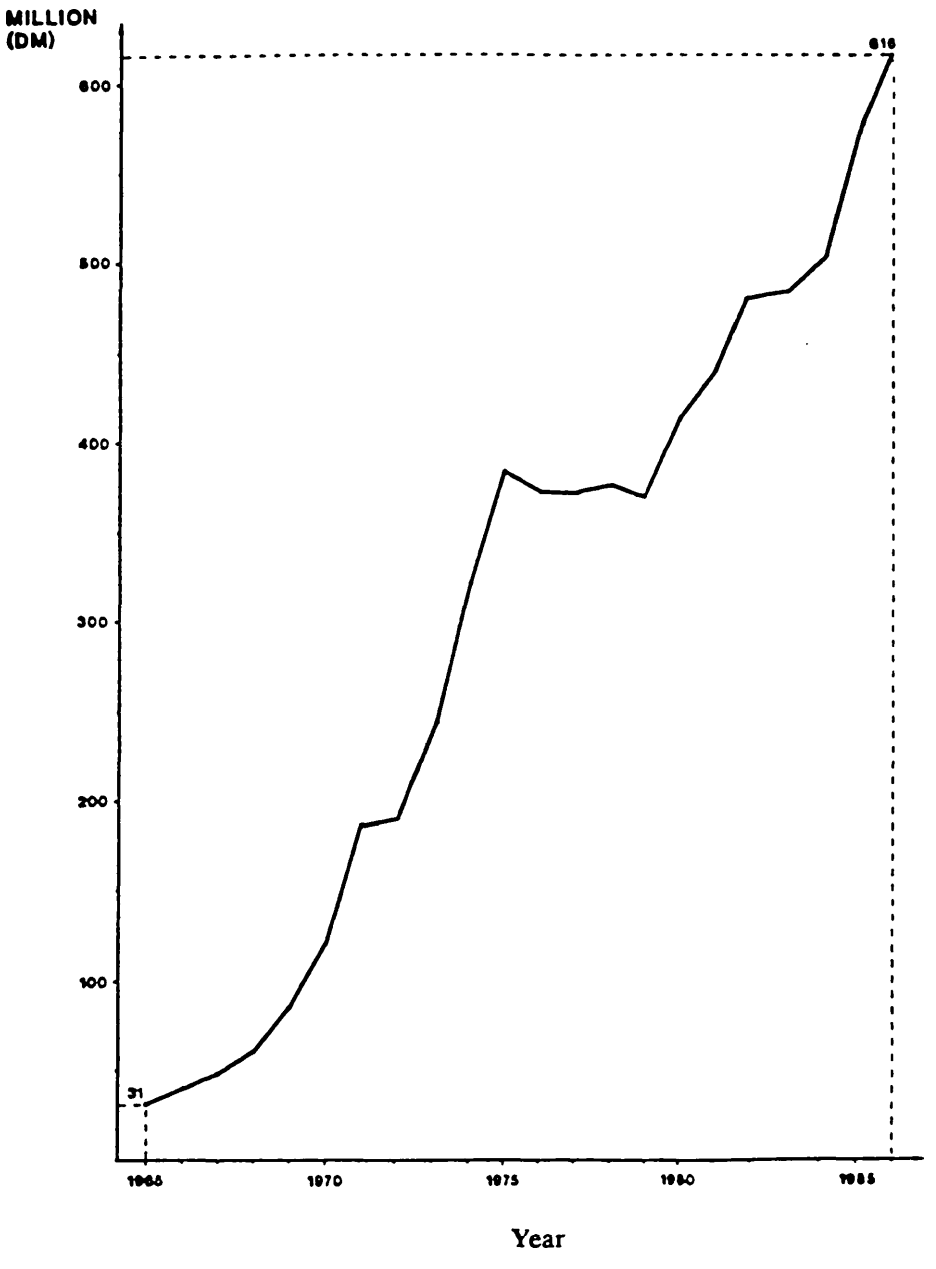


Figure 7.13 **Public transport subsidy in Berlin (West) (1965–1986).**

Source: Der Senator für Verkehr und Betriebe.

regions and areas into rapid rail stations which move the passengers into the city. This is part of the overall planning programme for bus services which is directed towards the aim of reducing congestion in the city, and avoiding parallel services.

7.64 With a well coordinated marketing strategy which is acknowledged as vital to the system's success and performance, new forms of service make public transport more attractive. These include collaboration between the BVG and taxis which join evenings and nights services within a specified area to provide a service to the passenger's doorstep, adding therefore to the system's attractiveness for late travellers especially women. This is in line with the marketing for the system which are designed to encourage more people to use it.

7.65 Park-and-Ride facilities are also one of the measures used to encourage more usage of public transport. To date (1987 figures), there are 18 Park-and-Ride facilities serving S-Bahn and U-Bahn stations with 1,528 parking places. Since 1984, the number of Park-and-Ride facilities has more than doubled. There are a further 25 rapid transit stations with Park-and-Ride facilities planned. As can be seen from the figure, these stations are well spread in the system with plans to build more. A problem facing the city now is that about 80 per cent of these spaces are used by local residents to park their cars without necessarily using the system[67]. Lichtenrade has three Park-and-Ride facilities while Spandau has only two.

7.66 Another mode of transport which is looked upon favourably in Berlin's transport policies is that of the bicycle. At present, there are 656 kilometres of bicycle paths separated from road traffic. Plans call for the extension to a total of 900 kilometres. Other plans also call for safe, fast, and attractive long distance 'bicycle routes' (or what would be equivalent to motorways in motor vehicle terms) between major locations in the city. Bike-and-Ride facilities are also gaining ground all over the city. In realising their role in feeding the public transport system with passengers, the authorities make a point of providing bicycle parking along many of its stations. Riders are then transferred via one of the public transport modes to their destinations in the city. The provision of Park-and-Ride and Bike-and-Ride is seen as an important way in attracting passengers onto the public transport system and away from the private car.

THE CASE STUDY

Background

7.67 The scheme considered in West Berlin is that of an extension of the U-Bahn network of Berlin to the district of Spandau . This provided a direct rapid rail connection between Spandau and the rest of West Berlin for the first time. Prior to this new service, buses served the link between Spandau and the rapid rail network. However, and with the increasing demand for travel and with traffic levels building up on the roads, the U-Bahn link was envisaged by the authorities to link Spandau with the rapid rail network of the city.

7.68 Spandau is a much larger urban area with a larger population than Lichtenrade which is a small local suburban district in Tempelhof, one of Berlin's 23 urban districts. The accessibility of public transport stations in Spandau was such that nearly every household had access to a bus stop by foot. The walking distance was hardly ever more than 10 minutes which indicates a good availability of buses. With the new U-Bahn service, 44 per cent of the households now have an U-Bahn station within a walking distance. However, for half of these households an U-Bahn station is more than 10 minutes away. This means that only 20 per cent of the households have a direct access (by walking) to an U-Bahn station[69]. Since the area of Lichtenrade is connected to the S-Bahn system, the changes in the public transport system had no significant impact on the accessibility to the system here. Compared with Spandau, only minor changes in the bus network have taken place in Lichtenrade.

7.69 Since it is generally possible that for one journey more than one form of transport is used, therefore, two approaches were used in the study to determine transport choice. This involved looking at the choice of transport and considering: a) the main form of transport used per journey; and b) all forms of transport used per journey. For the purposes of this research it was decided to limit the examination to the changes in the main used form of transport to see how the introduction of this new public transport service has affected people's choice when they travel. This refers to the share of each mode of the total journeys made (total daily all purpose journeys).

Scheme Objectives

7.70 The scheme was justified on strategic and operational grounds. These were:

- Strategic: To provide an extension of the rapid rail system in the form of the U-Bahn to link the district of Spandau. Except for the bus services, this was cut-off from the rest of the city and the rapid rail network.

- To add to the reliability and effectiveness of the system as a whole.

- Operational: To cater for more of the travel demand on this route via public transport and to relieve some of the existing roads in the immediate corridor which were beginning to show signs of traffic congestion.

The area of Spandau was connected to the *U-Bahn* network of West Berlin by the introduction of two successive extensions of the *U7*:

- Richard Wagner Platz to Rohrdamm in 1980 (Figure 7.12).
- Rohrdamm to Rathaus Spandau in 1984 (Figure 7.12).

7.71 The empirical before/after study (1979/1985) based on household interviews[69] was carried out by the Department for Transport and Public Works of Berlin (Der Senator für Verkehr und Betriebe). This study was a complete and thorough study aimed at: a) investigating the impacts of this new service on the transportation behaviour of the *Spandau* population; b) examining the qualitative causes of change; and c) evaluating the new supply and the new situation resulting from it in terms of its effect on other modes of transportation in the city.

7.72 Another area in West Berlin, namely Lichtenrade, was chosen as a control area with which to compare the changes with those taking place in Spandau. Lichtenrade is a major suburban settlement in West Berlin and had been connected to the rapid transit system (S-Bahn) for some time. The study therefore was aiming at comparing the changes in the transportation behaviour of residents of both areas after a major improvement of the public transport system. In order to do this, and study the actual impacts of the improvements, the social structure of each area was surveyed and the basic information collected. The survey examined the changes in

the availability and use of the different transport modes and the personal opinions of those directly affected in both areas.

Impacts of the Scheme

Spandau

7.73 In 1979 and prior to the opening of the U-Bahn extension, the mainly used mode of transport in Spandau, was the car accounting for 41 per cent of the modal share, mainly as car drivers (32 per cent). The second highest share was that of travel by foot which accounted for 27 per cent. This was followed by the bus at 19.5 percent, the U-Bahn at 5.1 per cent and the S-Bahn at 0.7 per cent. It must be remembered that there was no direct rapid rail connection with Spandau then, and that journeys to Spandau using the U-Bahn had to be completed via the feeder buses. The S-Bahn played a minor role in people's choice of mode due to the fact that there was no easy access to the system from Spandau. The total public transport share as the main mode of transport used was 25 per cent, significantly less than the share of the private car. Table 7.8 presents the detailed breakdown of the different modes share as the main mode of transport used in Spandau 'before' and 'after' the opening of the U-Bahn.

7.74 From the same table, the figures after the opening of the U-Bahn (1985) indicate a similar situation. Private transport still dominates as the main mode of transport used with a share of about 43 per cent of all journeys, slightly higher than the 'before' percentage. The bus's share has dropped to 15 per cent, while the U-Bahn share increased to around 12 per cent. The S-Bahn share was slightly reduced to just 0.6 per cent. Altogether, the public transport share was around 27 per cent representing a similar increase (2 per cent) to that of private traffic. This can be explained from the table where non motorised modes seem to have lost some of its share to the car and public transport. Clearly, therefore, the motor vehicle has remained the main mode of transport used in Spandau despite the extension of the U-Bahn system.

Lichtenrade

7.75 As seen in Table 7.9, the private vehicle was, in 1979, the main mode used for all journeys with a 43 per cent share (drivers and passengers). The bus accounted

Mode of Transport	Spandau	
	1979 (%)	1985 (%)
By Foot	27.0	25.9
Bicycle	5.1	3.6
Motorcycle	1.8	0.4
Private Vehicle (driver)	31.8	36.4
Private Vehicle (passenger)	9.0	6.4
Bus	19.5	15.0
U-Bahn	5.1	11.7
S-Bahn	0.7	0.6
Total	100.0	100.0

Table 7.8 The main mode of transport used in Spandau in 1976 and 1979.

Mode of Transport	Lichtenrade	
	1979 (%)	1985 (%)
By Foot	19.6	17.4
Bicycle	4.9	5.6
Motorcycle	0.7	0.4
Private Vehicle (driver)	34.6	42.3
Private Vehicle (passenger)	8.4	9.3
Bus	16.0	11.5
U-Bahn	14.6	9.6
S-Bahn	1.2	3.5
Total	100.0	100.0

Table 7.9 The main mode of transport used in Lichtenrade in 1976 and 1979.

Source: Verkehrsuntersuchung Spandau, Senatsverwaltung für Arbeit, Verkehr und Betriebe, Berlin 1987.

for 16 per cent of all journeys made, followed by the U-Bahn with about 15 per cent share, and a 1.2 per cent by the S-Bahn, making the total public transport share around 32 per cent. In 1985, the motor vehicle share was by far the largest with around 52 per cent. The bus and the U-Bahn shares fell to some 11 and some 10 per cent respectively (Table 7.9), making the total public transport share around 25 per cent. It is clear from these figures that a modal shift has taken place, however, this was a shift from public transport to the private vehicle. There has also been other shifts from non motorised modes, but these do not account for the increase in private traffic, confirming therefore that the shift has been, largely from public transport to the private vehicle. It cannot be said that this shift was the direct result of the new public transport improvement, but its clear that the use of the motor vehicle was even higher than before.

7.76 When looking at the percentage of car ownership in Spandau (Table 7.10) it can be seen that while about 29 per cent of the population in Spandau owned a car in 1979, this figure increased by 7 per cent to 36 per cent in 1985. In Lichtenrade, the picture is similar as can be seen in Table 7.11. From this table, it can be seen that in 1979, 33 per cent of the population owned a car. The corresponding figure in 1985 was some 40 per cent indicating a change of 7 per cent. The figures in Lichtenrade are clearly higher than those in Spandau but this is explained by the more suburban character of Lichtenrade. The increase in car ownership in Lichtenrade may partly explain the shift which took place from public transport to the car as a main mode of transport. The change in Spandau, however, has not been as significant as that in Lichtenrade.

7.77 The comparison of the role of public transport, in both areas, shows that the new supply in Spandau had different impacts on the different public transport modes. In Spandau, the increase in the U-Bahn share appears to be, to a large extent, on the expense of the bus (Table 7.8), indicating that the increase in the U-Bahn ridership was largely due to a shift from the bus. It must be mentioned that some changes in the bus routes in Spandau accompanied the opening of the U-Bahn to avoid parallel services and encourage the use of the underground rapid rail system.

7.78 In Lichtenrade the bus has a smaller significance as the mainly used form of transport whereas the percentage of the S-Bahn is higher than in Spandau (Tables 7.8 and 7.9). The latter is due to the S-Bahn connection in Lichtenrade. The fall in the U-Bahn's share in Lichtenrade is partly accounted for by the increase in the S-

Bahn share which increased by two fold, but still only accounted for 3.5 per cent of the total journeys. There was, however, a drop in the bus's share in Lichtenrade. Together with the increase in the private transport share, the modal shift discussed earlier is further substantiated.

7.79 In examining the modal split, in Spandau and Lichtenrade, 'before' and 'after' the provision of the U-Bahn in Spandau, it can be seen, from Table 7.12, that the modal changes in the district of Spandau have been rather marginal. The private transport share increased only slightly, while that of public transport went up by just 2 per cent over the period between 1979 and 1986. This shows that the provision of a new public transport service in Spandau had no significant effect on the modal split in the area. The share of the private car went up, however, this was a slight change (0.6 per cent) given that there has been a 7 per cent increase in car ownership. In Lichtenrade, the situation was rather different. From Table 7.13, a significant drop in the share of public transport can be seen. This corresponds to a similar increase in the share of private transport. During the same period, there was an increase in car ownership corresponding to 7 per cent, which is similar to the increase in Spandau.

7.80 This demonstrates an important fact, namely that the provision of the new U-Bahn in Spandau had a more significant impact in its immediate area. This is clear from the fact that there was only a slight increase in the private car share of total traffic, and a small increase in the public transport share. Its impact on Lichtenrade was different. The share of the private car in total traffic continued to increase with the growth in car ownership. Furthermore, the public transport share of the total traffic was reduced. It can be concluded therefore that the provision of public transport improvements does not lead to a significant shift from private to public transport, and that while such improvements may have the effect of slowing down the growth in the use of the private vehicle, this impact is rather marginal. The more considerable impact such provisions have, especially those of rapid rail, is to create a redistribution within the public transport network, with the bus and other less efficient systems losing part of their share to the new and more efficient system.

7.81 The study[69] also found that there is a connection between development of public transport where people live and the choice of transport. It was shown from the study that the accessibility of public transport stations is not the only factor

	1979 (%)	1985 (%)
People with a car	29.3	36.2
people without a car	70.7	63.8
Total	100.0	100.0

Table 7.10 The percentage of car owners and non car owners in Spandau 'before' and 'after' the opening of the U-Bahn.

	1979 (%)	1985 (%)
People with a car	33.0	40.2
people without a car	67.0	59.8
Total	100.0	100.0

Table 7.11 The percentage of car owners and non car owners in Lichtenrade 'before' and 'after' the opening of the U-Bahn.

Mode of Transport	1979 (%)	1985 (%)
Non-Motorised Traffic	32.1	29.5
Motorised Traffic	42.6	43.2
Public Transport	25.3	27.3
Total	100.0	100.0

Table 7.12 The modal split in Spandau 'before' and 'after' the opening of the U-Bahn line.

Source: Verkehrsuntersuchung Spandau, Senatsverwaltung für Arbeit, Verkehr und Betriebe, Berlin 1987.

connected with each other, such as: the supply network; density of settlement; and structure of population play an important role and have an impact too.

7.82 Table 7.14 presents the figures for all modes of transport in 1976, 1979 and 1985. From the table, it can be seen that the share of buses as the main form of public transport used in Spandau has been declining. Whereas this development was leading to large public transport losses between 1976 and 1979, it has been compensated for since 1979 by the increasing use of rapid rail transit. It was assumed, in the study, that a direct relation existed between the increase in the *U-Bahn* rate since 1979 and the improvement in the supply, which had been made in the meantime. While from 1976 to 1979 the *U-Bahn* share remained constant at 5 per cent, it has more than doubled since then. The use of the *S-Bahn* in *Spandau* , however, is on a very low level since 1976. This can be attributed to the fact that the S-Bahn system does not serve the area directly.

7.83 The assessment of the impact of the U-Bahn on the 'without' case of the year 1985, that is, on the modal split which could have been in effect in 1985 had the extension of the U-Bahn not been built, was also part of the study. It showed that in Spandau, the improvement of the U-Bahn network did, on one hand, stop the increase in individual transport, and had, on the other hand, generated a profit for public transport. In Lichtenrade, the increase in S-Bahn use had diminished the negative trend in development for public transport as well as the increase in car usage.

7.84 Considering only those journeys in Spandau which were directly affected by the extension of the U7, that is 37 per cent of all journeys[69], the picture is somewhat different. The changes of behaviour and the shifts caused by the new rapid rail supply was seen by the study to be more obvious. From Table 7.15, it is clear that the U-Bahn tripled its percentage share in the period from 1979 to 1985 (from 10.6 per cent to 30.1 per cent), whereas the percentage share for buses diminished from 26 per cent to 11 per cent. This shows the strong change in emphasis within public transport where the bus lost 57 per cent of its share to the U-Bahn. The share of car drivers decreased in the 'affected relations' by about 3 per cent in favour of the U-Bahn. This means that every 17th journey, which in 1979 had been made by a car driver was now being made by U-Bahn. Such a change, however, is very minor. Despite the contrary development, which existed because of a changed car availability, the car driver share decreased from 45 per cent to 43 per cent or rather

Mode of Transport	1979 (%)	1985 (%)
Non-Motorised Traffic	24.5	23.0
Motorised Traffic	43.7	52.4
Public Transport	31.8	24.6
Total	100.0	100.0

Table 7.13 The modal split in Lichtenrade 'before' and 'after' the opening of the U-Bahn line.

Main Form of Transport Used	1976 (%)	1979 (%)	1985 (%)
By Foot	31.0	27.0	26.0
Bicycle	3.0	5.0	4.0
Motorcycle	1.0	2.0	0.0
Private Vehicle (driver)	30.0	32.0	37.0
Private Vehicle (Passenger)	7.0	9.0	6.0
Bus	22.0	19.0	15.0
U-Bahn	5.0	5.0	12.0
S-Bahn	1.0	1.0	0.0
Total	100.0	100.0	100.0

Table 7.14 The development of the main form of transport used in Spandau.

Source: Verkehrsuntersuchung Spandau, Senatsverwaltung für Arbeit, Verkehr und Betriebe, Berlin 1987.

Mode	Foot	Bike	Car Driver	Car Passenger	Bus	U-Bahn	S-Bahn	immobile	Percent Share 'After'
By Foot	3.6%	-	-	-	-	-	-	-	3.6%
Bicycle	-	2.8%	-	-	-	-	-	-	2.8%
Car Driver	-	-	42.7%	-	-	0.2%	-	0.1%	42.9%
Car Passenger	-	-	-	7.9%	-	-	-	-	7.9%
Bus	-	-	-	-	11.1%	0.1%	-	-	11.2%
U-Bahn	-	1.4%	2.6%	-	14.9%	10.2%	0.3%	0.7%	30.1%
S-Bahn	-	-	-	-	-	-	1.3%	-	1.3%
Percent Share 'Before'	3.6%	4.2%	45.3%	7.9%	26.0%	10.6%	0.9%	0.9%	100.0%

Table 7.15 Comparison of the modal share for 'affected journeys' in Spandau 'before' and 'after' the opening of the U-Bahn and the percentage of journeys diverted from other modes.

5 per cent within the affected relations. The public transport share, however, increased by about 12 per cent and reached, by 1985, a percentage of 43 per cent. Give the percentage of these 'affected relations' (37 per cent) of all journeys, it can be said that the impact of the new U-Bahn has been very marginal on road traffic. The increase in the U-Bahn use is largely the result of lost bus ridership, further encouraged by the city by rerouting the bus services in the area.

7.85 In assessing the improvements felt by public transport users in Spandau, as a result of the U-Bahn improvement, the reduction in journey time in public transport was considered. 59 per cent of the questioned people said that there has been an improvement in their journeys duration. 35 per cent said that the U-Bahn (U7) had no direct influence on the journey duration, and for 7 percent, the duration per journey deteriorated with public transport. This element was seen as a result of the reduction of the bus network.

7.86 The opinions of Spandau residents about the general changes associated with the new improved supply of public transport was also reported by the survey. This involved the evaluation of the changes which have occurred for the area of Spandau through the extension of the U7. The findings are presented in Table 7.16. From this table, it can be seen that the questioned people see, in particular, an increase in the 'value of the area' of Spandau (86.6 per cent) with only 3.8 per cent disagreeing. An improvement to the quality of public transport, as a result of the extension of the U7, was reported by 77.3 per cent, with only 7.8 per cent disagreeing. The improved accessibility of shopping areas in Spandau, as well as in the centre of Berlin is also evaluated positively. However, the effects of the U7 in relieving the parallel roads were evaluated much lower. These results were further assessed on an assessment scale to determine the significance of the responses, the results of this are also reported in Table 7.16. The lower significance of relief effects for car traffic is evident from the responses. Of the two relief effects examined the statement 'relief of roads from scheduled traffic', that is bus traffic, finds higher approval (58.8 per cent). Nearly half of the questioned people (43.6 per cent) see relief effects from the car traffic, 28.8 per cent, however, do not share this opinion. 38.7 per cent believed in a reduction of pollution but 34.3 per cent did not agree with this statement which means that the rate of approval for the last two statements were relatively low.

Aspects of Change	Agree (%)	Neutral (%)	Disagree (%)	Rate*	Value**
Improvement of Quality of Public Transport	77.3	14.8	7.8	+69.5	+1.7
Relief on Roads from Car Traffic	43.6	27.6	28.8	+14.8	+0.2
Increase in Value of The Spandau Region	86.6	9.6	3.8	+82.8	+0.2
Relief on Roads from Scheduled Traffic+	58.8	19.0	22.2	+36.6	+0.8
Improvement of Townscape	62.1	22.1	15.9	+46.2	+1.0
Decrease of Traffic Pollution	38.7	27.0	34.3	+4.4	+0
Improved Connection to Shopping Centres in Spandau	65.3	21.3	13.4	+51.2	+1.2
Improved Connections to Shops in the City	71.1	17.8	11.1	+60.0	+1.4

Table 7.16 **The findings of the evaluation of the general changes associated with the extension of the U-Bahn(U7)to Spandau as seen by the residents.**

* **Rate:** (+) % Proportion of improvement
(-) % Proportion of worsening

** **Value:** Mean value on Assessment Scale as shown below

Completely Agree — No Significance (Don't Know) — Completely Disagree

+3 +2 +1 0 -1 -2 -3

Scheduled Traffic: Bus traffic.

7.87 This lends further support to the hypothesis put forward in Chapter 1, namely that on the effect of public transport improvements on road traffic. From the study, it was seen that the provision of the new underground service in Berlin did not relieve traffic conditions on parallel roads. Its main impact was to divert bus passengers onto the rapid rail system assisted by the rerouting of bus services in Spandau. The survey found that the relief experienced on the roads was largely confined to the elimination of previous bus services. The actual relief extended to other road users was rather marginal.

REMARKS AND CONCLUSIONS

7.88 This case study from West Berlin which was based on household interviews, examined the situation resulting from a major improvement to the public transport network. This was in the form of a rapid rail extension to the district of Spandau in 1984 which, until then, did not have any rapid rail service. The survey investigated the changes associated with this improvement in the areas of Spandau and also that of a control area, Lichtenrade. The area of Lichtenrade is served by an S-Bahn service. The S-Bahn is a rapid train with relatively long distances between the stations (800-1,000 metres), whereas the U-Bahn stops every 500-600 metres. Both systems are part of the Berlin rapid rail transit system and are managed and run by the BVG.

7.89 During the period between 1979 and 1985, which is the period before and after the building of the new U-Bahn in Spandau, several changes in the traffic behaviour took place in Spandau . Only the number of personal trips per day remained constant at about 2.0 trips per person per day. The main differences associated with the building of the U-Bahn were as follows: the percentage of walking decreased (this was a 'general trend' observed in the whole of the city); the percentage of bicycle riding increased (general trend; the percentage of private car use decreased slightly; the percentage of bus use remained constant (while the length of bus trips decreased); obviously, the percentage of U-Bahn use went up (immediately after introducing the new service). These events took place during a period of general transit decline (about 8 per cent in West Berlin from 1980 to 1985). The Spandau bus network was also reorganised in 1984, so that the buses could serve as feeders to the U-Bahn stations. With the reorganisation, the number of bus trips remained stable much the same but with journey lengths reduced in an entirely different pattern of journeys.

7.90 The City's study of the situation, found the response of the people to the new service to be overwhelmingly positive. The share already held by public transport in Spandau, has been stabilised. The increase in the private transport share was not as much as that experienced in Lichtenrade. This, however, was due to other factors in addition to the new service (e.g. more retired people, less young people, lower car ownership) In Lichtenrade, the fall in public transport use from 1979 to 1985 was slightly slowed down by the increased use of the S-Bahn, however, the increase in the car's share as the main mode of transport during the same period is rather substantial.

7.91 The bulk of the U-Bahn share was clearly due mainly to a transfer from bus to U-Bahn,that is, a major shift within the public transport systems. This shift was facilitated via the amendments to the bus network which were carried out. Transfers from private cars to the U-Bahn have been, clearly, much fewer. Around Spandau there has been a reduction of about 3 per cent in favour of the U-Bahnin the motor vehicle share of journeys directly affected by the improvement (37 per cent of all journeys) indicating a very marginal change. This, however was compensated for by new journeys being made by people who now had a car available to them. The results of the survey were to be interpreted as an indication that there is further market potential for the new U-Bahn service which has to be developed by changing people's attitudes to public transport. Users responses in the survey indicate that the new U-Bahn is seen to be offering a definite advantage over the S-Bahn system in the city. The positive aspects of the U-Bahn are seen as shorter journey times, more comfortable journeys and more pleasure in travelling. In general it is regarded as a step in contributing to an improvement in public transport. It is also seen as an upgrading of the Spandau district.

7.92 The study also found that, in general, great importance is attached in principle to public transport by the man in the street (both, user and non-user). With regard to the future developments they looked for, the people questioned were clearly in favour of better public transport services. On the basis of the results of the survey the following sequence of priorities was set for the developments that are wanted:

- -further improvements in the public transport system,
- -more financial resources for continued construction of public local train facilities,

7.93 From all of the above, the areas studied in West Berlin appears to have that 'happy balance' witnessed in the other German cities studied so far. As in other German cities, this is the result of strong and coordinated policies for both the road network and the public transport system. Public transport is a public service, subsidised heavily in order to achieve the results associated with the 'Public Transport Concept'. The system is independent from the road network in the sense that improvements are largely made to maintain and attract passengers rather than to compete with the road network. Marketing strategies are in full swing to promote the service and attract passengers. The comprehensive policy with unified management of all the different modes of public transport seems to be yielding positive results. An example of this good coordination can be seen clearly from the changes made to the bus network so that parallel services are avoided, with buses serving efficiently as a feeder to the rapid rail system.

7.94 Policies regarding roads are in favour of providing additional capacity on major roads and Autobahns to transfer traffic from roads less capable of handling it. With traffic calming measures and restrictions on relieved and residential roads, it is ensured that traffic is confined to roads outside the environmentally sensitive areas. Traffic management techniques also have a major role to play in Berlin. These are evident on many of the major roads and critical sections resulting in more efficient use of the available capacity, and less disruption to the flow (e.g. warning signs etc.).

7.95 This case study has, once more, showed that the improvements of public transport systems do not necessarily lead to a significant reduction in the motor vehicle usage on the roads influenced by the improvement. However, the amount of relief achieved was minimal. Car ownership increased by about 7 per cent between 1979 and 1985 in both Spandau and Lichtenrade. In Spandau, the private vehicle still maintained its dominance as the main mode for travel. An increase in the car's share in the modal split was also observed in Lichtenrade (52.4 per cent in 1985 compared with 44.3 per cent in 1979) and that was seen as an increase in the number of journeys made by car drivers.

7.96 The findings in Berlin, together with the case study on the Victoria Line in London lend further support to the hypothesis put forward in Chapter 1 of this thesis. That is that any improvements to the public transport system, even in conditions of suppressed demand as are evident in Berlin, have only a marginal effect on removing car traffic from parallel roads. It was not possible to examine the actual changes in

traffic speeds on roads in the immediate corridor of the improvement, however, the general findings of the study carried out by the city of Berlin suggest that there was no significant change in traffic levels or the use of the motor vehicle as shown earlier.

7.97 This demonstrates, once more, that public transport improvements, alone, are not the solution to traffic problems on the roads. Improved, reliable and affordable public transport is only a part of a more comprehensive programme of better supply and demand management by means of land use management. The changes associated with major public transport improvements mainly affect other modes of the public transport system, as was seen in the case study. The increased ridership on one public transport mode is the result of passenger transfer from another. Additional journeys attracted on to the system are usually those that were made by a non-motorised form of transport before. With plans for further improvements to the transport system in Berlin, the city acknowledges the need for roads to work in connection with the public transport system to provide better accessibility and cater for the increased demand for mobility.

CHAPTER 7 PART C: THE STUTTGART CASE STUDY

INTRODUCTION

7.98 The city of Stuttgart lies in the southwest of the Federal Republic of Germany. It is the capital of the Land Baden-Württemberg one of the 11 Lands that constitute the Federal Republic. The Land Baden-Württemberg, is the most industrialised of the federal states. Stuttgart, is the centre for many world-renowned products such as cars from Daimler-Benz (Mercedes), and Porsche AG in addition to its being the German base for many other foreign companies such as IBM, and Hewlett Packard.

7.99 The Stuttgart population (within the city boundaries) is 565,000 people. The whole region has about 2 million inhabitants. The city centre is home for the administrative authorities and commerce and finance offices and institutions. The city also has many sub-centres and in the recent years, a drop in population within the city boundaries has been the result of people moving out of the city to live in the many suburbs which have flourished outside the city limits (Figure 7.14).

THE EXISTING SITUATION AND CURRENT POLICIES

7.100 With the continuing prosperity of the region in general, and the city's administrative and local position, a great demand for travel exists within the city . The demand for travel to the centre is even increasing with people moving to live in nearby suburbs. Stuttgart is served by a network of Autobahns and roads which connect the city with the rest of the region and the country. These Autobahns are usually tangential to the city. New roads, when built, are usually designed to divert heavy vehicles and through traffic away from busy and residential roads. They are intended to serve operational and strategic objectives while at the same time improving the environmental conditions along residential and densely developed road sections.

7.101 The City's policy has always been to cater for the demand associated with the growth in car traffic, by improving the road network to maintain economic prosperity and growth, which depends, to a large extent, on mobility due to the nature

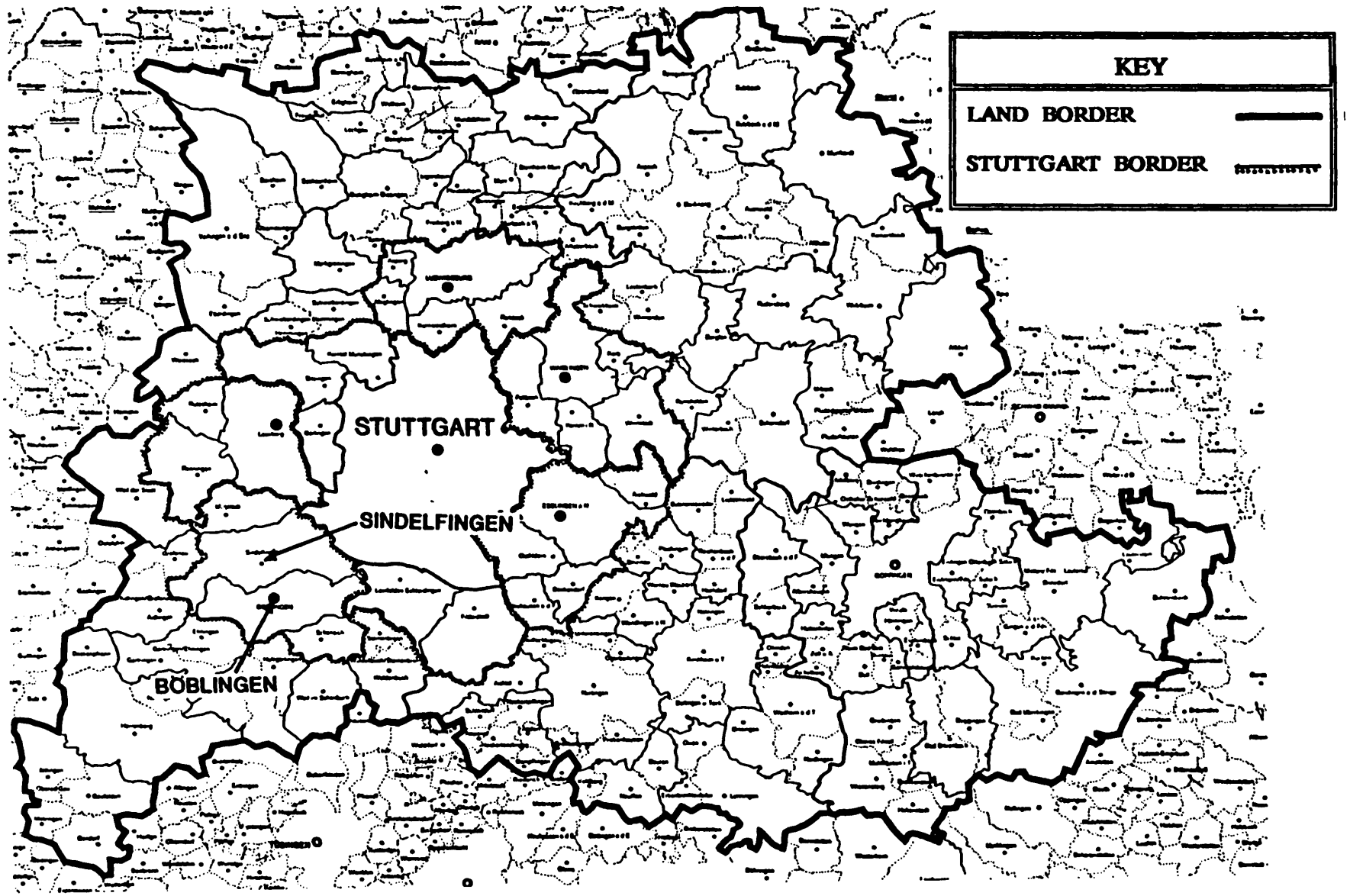


Figure 7.14 The Greater Stuttgart Area and Surrounding Regions.

of the industries[70]. At the same time, however, a stringent parking policy has been vigorously enforced. Most of the products manufactured are transported by road to other towns and cities and sometimes to other factories within the same industry. This creates a heavy demand for travel and the city has always been faced with maintaining the necessary infrastructure to cater efficiently for this demand[70]. Traffic calming has also been introduced in Stuttgart with speed limits of 30 kilometres per hour or less, being enforced on residential roads to reduce the noise and other environmental impacts and improve the safety for residents and pedestrians. Some of the city centre's roads are pedestrianised and the rest adopt a one-way system for the most part. The inner ring road in Stuttgart is similar to that of other German cities and serves to carry traffic away from the centre making the introduction of pedestrianisation schemes possible.

THE PUBLIC TRANSPORT SYSTEM

7.102 The city is served by a number of different modes. The main mode is the rapid rail transit available in its two forms, the S-Bahn and the trams or the U-Bahn in the city centre (Figure 7.15). A Cogwheel railway, and a Cable railway still serve particular parts of the city. The buses are also a mode in transport in Stuttgart, however, their role is mainly as feeder to the rapid rail system, especially in outer suburbs. The whole of the public transport system is managed and co-ordinated by the VVS (Verkehrs - und Tarifverbund Stuttgart GMBH). The company is responsible for co-ordination between the different modes of transport and is in charge of operating the system and making the financial arrangements (subsidies etc.). The system, as in all other German cities, is subsidised by the city which pays about 45 per cent of the operating costs. There were no figures available on the modal split, but city officials reported that for travel into the centre the public transport system has by far a larger share. The motor vehicle, however, is the main mode of transport used in the city for passenger travel[70]. This is very similar to the situation in most German cities.

PARKING

7.103 The city's parking policy is to cater for the essential business demand. Most of the spaces provided were in the form of multi-storey parking garages, but a number of on-street parking places are still available. Parking control is seen by the city to be the major restraining measure on car traffic to the centre. However, as 50 per cent

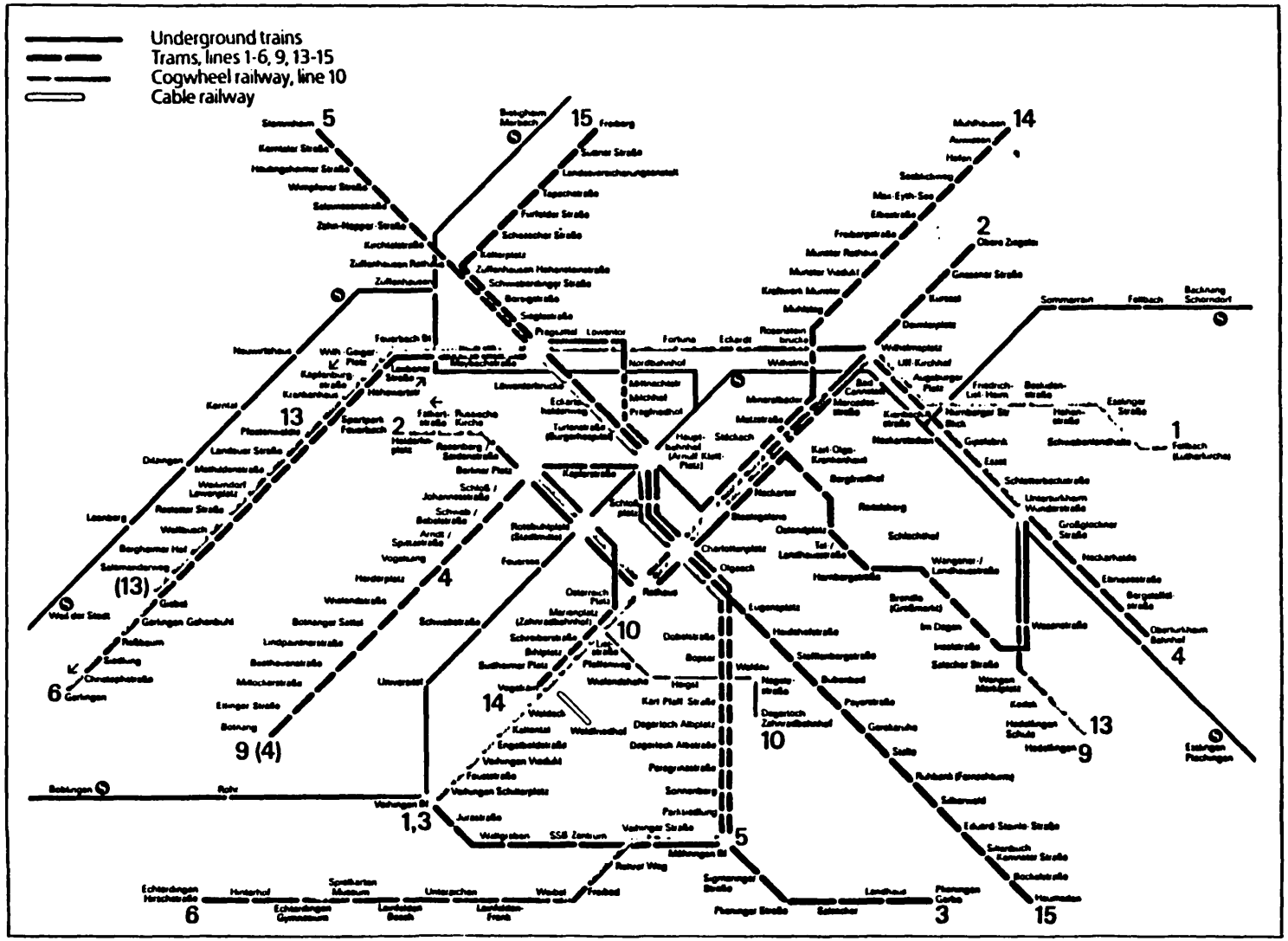


Figure 7.15 **The Stuttgart local public transport system.**

of the parking garages in the centre are owned by private enterprise, the city's powers are limited in setting the tariffs or controlling the use of these garages. Current political debate in the city is concerned with this issue since it hinders the effective implementation of related policies.

THE CASE STUDY

Background

7.104 The case study from Stuttgart is a unique one. With the increased demand for travel to the city from the booming outskirts suburbs, the local authorities decided to improve the public transport system, namely the S-Bahn along one of the busiest corridors. This was to serve the heavily travelled route between the city centre and the industrialised area of Vaihingen/Bo¨blingen (Figure 7.14). Bōblingen is the site for many manufacturing industries including Daimler-Benzwho make the car bodies in Bōblingen and ship the engines, by trucks, from other plants across the City of Stuttgart. IBM and Hewlett Packard are some of the other industries, only to name a few. Bōblingen is also the District Capital. Sindelfingen (Figure 7.14), in the proximity of Bōblingen is a town with 50,000 inhabitants and 50,000 workers. This town is one of the richest in Germany, and most workers commute to their jobs in both Bōblingen and Sindelfingen by car. When working for Mercedes, workers qualify for a 20 per cent reduction on the retail price of the cars they manufacture.

7.105 This case study is of immediate relevance to this research project since it is clearly the other side of the coin. That is, it is a demonstration of what actually happens when major public transport rail improvements are implemented with the partial objective of reducing traffic on parallel roads.

The Scheme

7.106 On the 28th of September 1985, the S-Bahn line between Schwabestrasse and Vaihingen/Bo¨blingen was opened (Figure 7.16). The objectives for building this extension were : a) to bring about a brake on the growing use of the motor vehicle, and b) to improve the public transport system in general[70]. In order to assess the changes in traffic flow as well as the changes within the public transport system, a 'before' and 'after' study was carried out, by the city's planning department, to determine what had actually happened[71]. The study compared figures pertaining to

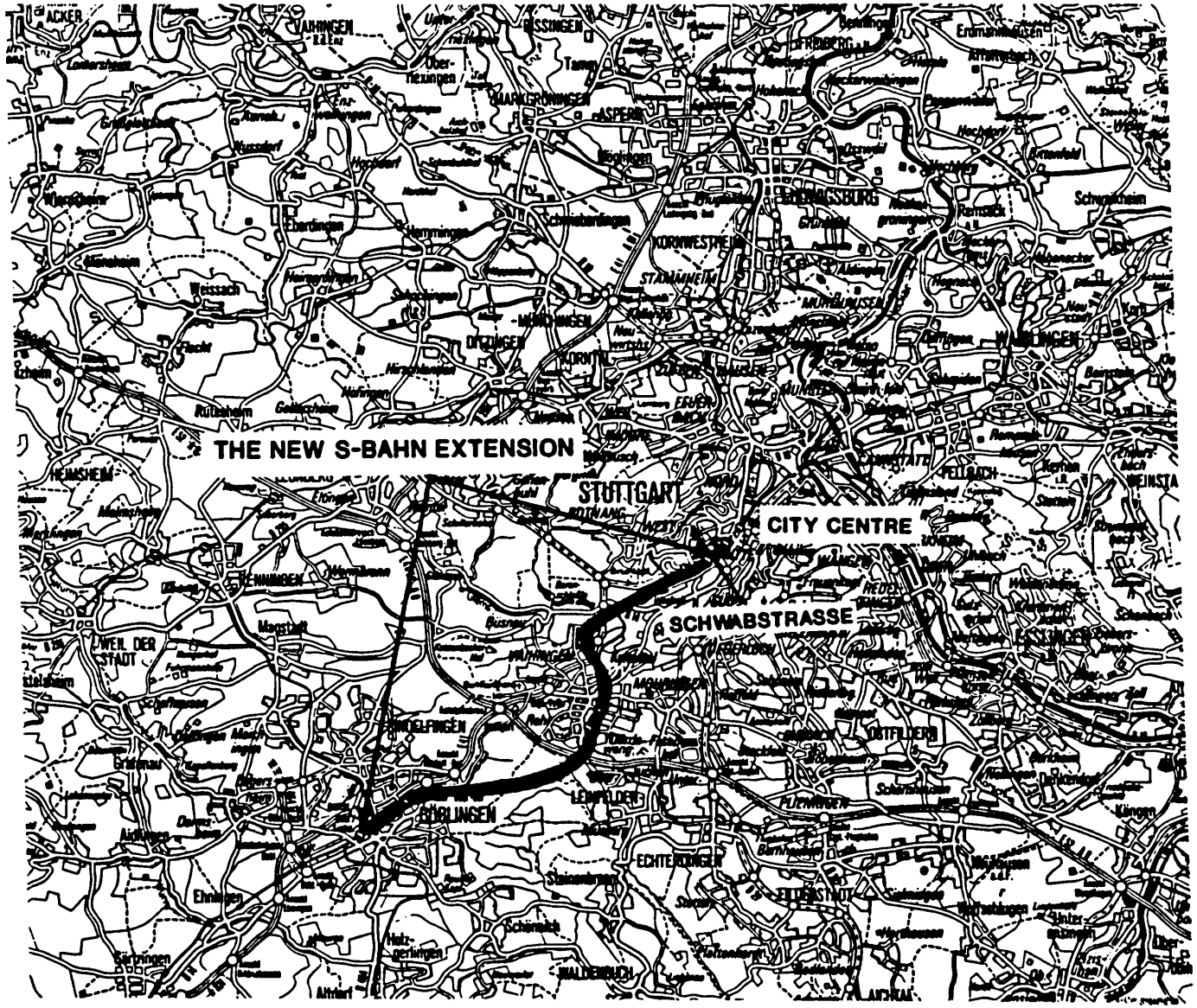


Figure 7.16 **The new S-Bahn extension between Stuttgart City Centre and the district of Böblingen.**

traffic on the roads and traffic on the new line for May 1984 (before the opening of the new S-Bahn) with those for April 1986 (after it had come into operation). Another investigation by the VVS was to determine the redistribution and other changes within the whole public transport system.

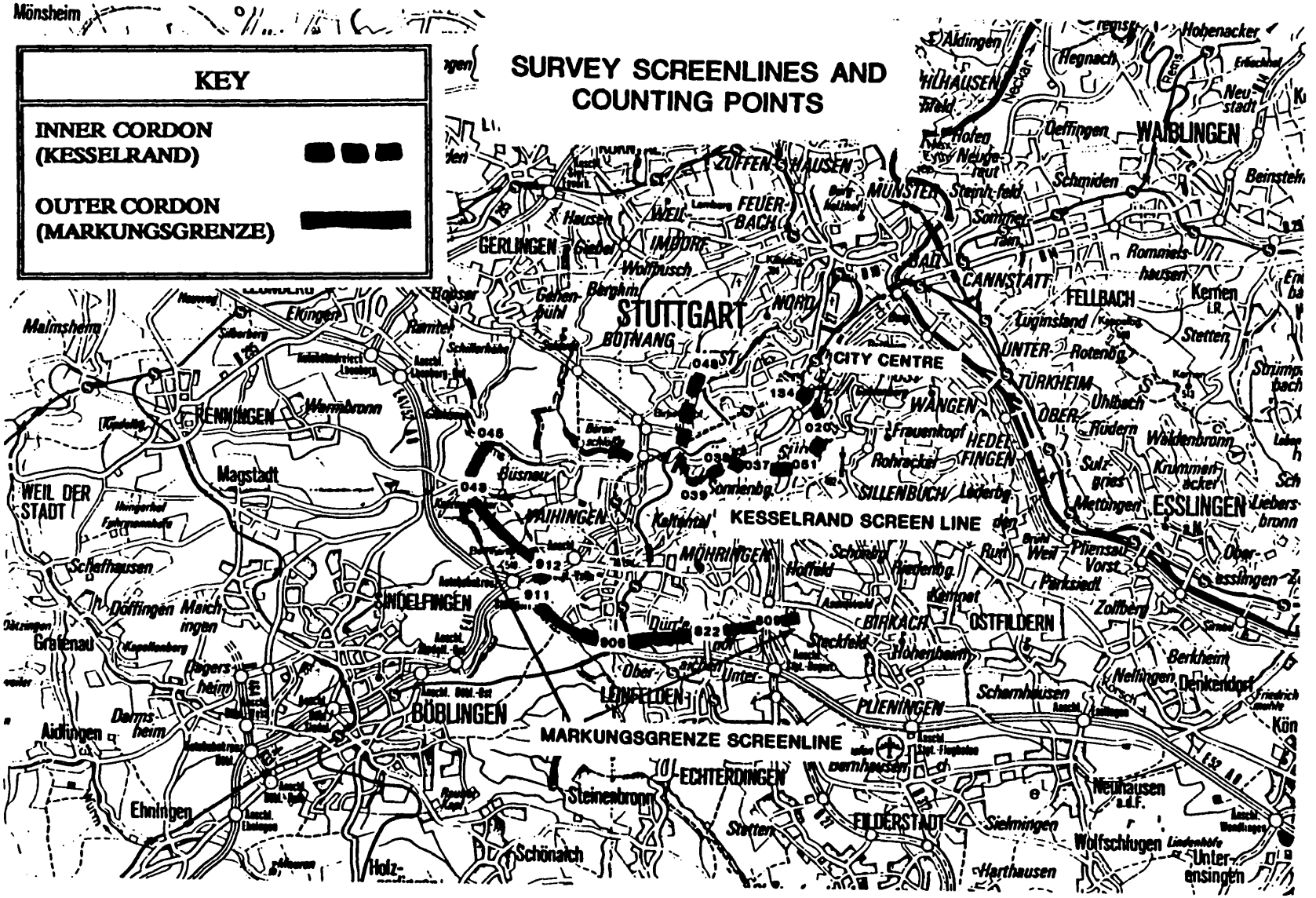
The Traffic Impacts of the Scheme

The 'Studied Area'

7.107 The study area (referred to the 'studied area') was defined as shown in Figure 7.17. This area was determined by two cordons: an 'inner cordon' and an 'outer cordon' namely the Kesselrand and Markungsgrenze, respectively. The area followed the 'outer cordon' on the south and west, the B27 on the east and along the inner cordon to the city centre. Counting points were selected on the roads of both screenlines, the Markungsgrenze and Kesselrand. The choice of these points allowed observation of traffic growth , in conjunction with the counting being carried out by the Stadtplanungsamtes (City Planning Department) every two years over a long term. On the following roads, the whole of the private vehicle traffic was counted and classified according to the type of vehicle (bicycle, moped, motor-cycle, private car, vans, buses, lorries, articulated lorries and special vehicles). The roads in each of the screenlines are listed in Table 7.17, and the count points are also shown in Figure 7.17.

The Surveys

7.108 The surveys were carried out in a selected 'representative' day each time. These days excluded holidays, or special events (e.g. football matches etc.). The surveys were carried out either on a Tuesday or a Thursday. Wednesday is not a 'representative' day since many businesses in Germany have early closing hours on Wednesday. Traffic counts were carried out over a period of 16 hours (0600-2200). These counts were further examined alongside the figures from the City Planning Department for long term growth, before being compared and analysed. The results of the traffic counts carried out for the study[71] purposes are found in Tables 7.18 and 7.19 for the 'inner' and 'outer' cordons, respectively.


KEY
INNER CORDON (KESSELRAND)
OUTER CORDON (MARKUNGSGRENZE)
SURVEY SCREENLINES AND COUNTING POINTS
KESSELRAND SCREEN LINE
MARKUNGSGRENZE SCREENLINE
STUTTGART
CITY CENTRE
ESSLINGEN
LEINFELDEN
ECHTERDINGEN
FILDERSTADT
PLIENINGEN
BÖBLINGEN
SINDELFINGEN
RENNINGEN
WEIL DER STADT
MÖHRINGEN
BIRKACH
OSTFILDERN
FELLBACH
WAIBLINGEN
CANNSTATT
UNTERTÜRKHEIM
OBERTÜRKHEIM
HEDELFINGEN
SILLENBUCH
WANGEN
BOTNANG
MÜNSTER
GERLINGEN
ZUFFENHAUSEN
FEUERBACH
IMMDORF
HILHAUSEN
Mönsheim
Malmsheim
Magstadt
Grafenau
Aidlingen
Ehningen
Schönaich
Steinenbronn
Stetten
Sielmingen
Neuhausen a.d.F.
Wolfschlugen
Unterensingen
Harthausen
Schlaifhausen
Döffingen
Maichingen
Dagersheim
Darmsheim
Holzgerlingen
Hausen
Weil
Gebersheim
Wolfbusch
Berghm.
Hoppenlau
Ekingen
Ramtel
Schillerhöhe
Wernbronn
Büsnau
Kaltental
Frauenkopf
Rohracker
Sonnenbg.
Lederbg.
Mettingen
Pliensau
Vorst
Parksiedl
Zollberg
Kemnat
Hofen
Neuhaus
Oeffingen
Schmiden
Steinfeld
Sommerrain
Hegnach
Aldingen
Hohenacker
Neustadt
Beinstein
Rommelshausen
Kernen i.R.
Stetten
Luginsland
Rotenbg.
Uhlbach
Rüdern
Waldenbronn
Krummenacker
Sulzbries
Liebersbronn
Obertürkheim
Untertürkheim
Hohenheim
Scharnhausen
Neilingen
Denkendorf
Berkheim
Friedrichsruhe
Kön
Hofen
Ruit
Weil
Schönbg.
Hoffeld
Asemwald
Stockfeld
Ober-
Unter-
Dürr
Lanschl. Stgt.-Degerloch
Lanschl. Stgt.-Flughafen
Lanschl. Stgt.-Ost
Lanschl. Böbl.-Ost
Lanschl. Ehningen
Lanschl. Leonberg-Ost
Lanschl. Leonberg-West
Lanschl. Weil
Lanschl. Ehningen
Lanschl. Sindelfingen
Lanschl. Böblingen
Lanschl. Leonberg
Lanschl. Ludwigsburg
Lanschl. Kornwestheim
Lanschl. Esslingen
Lanschl. Plochingen
Lanschl. Wendlingen
Lanschl. Kirchheim
Lanschl. Nürtingen
Lanschl. Metzingen
Lanschl. Reutlingen
Lanschl. Tübingen
Lanschl. Herrenberg
Lanschl. Sindelfingen
Lanschl. Böblingen
Lanschl. Leonberg
Lanschl. Ludwigsburg
Lanschl. Kornwestheim
Lanschl. Esslingen
Lanschl. Plochingen
Lanschl. Wendlingen
Lanschl. Kirchheim
Lanschl. Nürtingen
Lanschl. Metzingen
Lanschl. Reutlingen
Lanschl. Tübingen
Lanschl. Herrenberg
048
134
020
035
037
051
039
043
012
011
008
022
006
Ausk.
Ausk.
Ausk.

Counting Point No.	Street
Kesselrand 'inner cordon'	
020	Neue Weinsteige
037	Karl-Kloss-Strasse
038	Leonberger Strasse
039	Böblinger Strasse
048	Botnanger Sattel (direction Birkenkpf to city centre)
051	Alte Weinsteige
134	Rotenwaldstrasse
Markungsgrenze 'outer cordon'	
043	Mahdentalstrasse
045	Wildparkstrasse
809	B27-Süd
822	Hechinger Strasse
906	Schonbuchstrasse
911	Pascalstrasse
912	B14-West/A831

Table 7.17 Counting points on the two Screenlines (Number and Street).

Source: The 'before' and 'after' survey on the impacts of the new S-Bahn service in Stuttgart.

Count Point Number	May 1984 (KFZ) Total Two-Way	April 1986 (KFZ) Total Two-Way	Changes 86/84 (%)
020	36,778	37,359	+ 1.6 %
037	18,088	19,399	+ 7.2 %
038	17,385	20,453	+ 17.6 %
039	22,634	23,503	+ 3.8 %
048	3,112	1,655	-53.2 %
051	3,656	3,785	+ 3.5 %
134	24,129	22,571	-6.5 %
Total	119,014	123,285	+ 3.6 %

Table 7.18 The total two-way all vehicle traffic (KFZ) on all 'inner cordon' streets 'before' and 'after' the introduction of the new S-Bahn service between Stutgart City Centre and Böblingen (1984, 1986).

Count Point Number	May 1984 (KFZ) Total Two-Way	April 1986 (KFZ) Total Two-Way	Changes 86/84 (%)
043	4,939	5,926	+ 19.9 %
045	18,786	21,983	+ 17.0 %
809	50,704	57,136	+ 12.7 %
822	9,498	10,613	+ 11.7 %
906	13,502	13,838	+ 2.5 %
911	5,074	5,624	+ 10.8 %
912	50,342	57,871	+ 15.0 %
915	9,103	10,421	+ 14.5 %
Total	161,948	183,421	+ 13.3 %
^{X}Total	87,519	98,367	+ 12.4 %

^{X}Total refers to the total excluding streets which may not be influenced by the scheme.

Table 7.19 The total two-way all vehicle traffic (KFZ) on all 'outer cordon' streets 'before' and 'after' the introduction of the new S-Bahn service between Stutgart and Böblingen (1984, 1986).

Source: The 'before' and 'after' survey on the impacts of the new S-Bahn.

All Vehicles Traffic

7.109 Table 7.18 shows an increase, for the whole of the 'inner cordon' streets counted of 2.3 per cent. From the total*, the growth in motor vehicle traffic was calculated to have been 3.6 per cent between 1984 and 1986. The amount of traffic on the individual roads along the 'inner cordon' is shown by the histogram in Figure 7.18. From this figure, the change in the amount of traffic on individual roads is shown quite distinctly. It varies from 2 per cent increase on Neue Weinsteige (counting point 020) to 18 per cent increase on Leonberge Strasse (counting point 038), while on Rotenwaldstrasse (counting point 134) a decrease of 6 per cent was recorded.

7.110 Table 7.19 shows the figures for counts taken on the 'outer cordon' at the same time counts were made on the inner cordon. In view of the high growth of 13.3 per cent, for the 'outer cordon' screenline, an amendment to the number of streets was made. This involved the elimination of counts taken on roads which were thought to be possibly too far away to feel the effect of the S-Bahn. This is illustrated in the table by two totals, 'Total'is the total for all roads on the screenline, while the total marked with X (^{X} Total) is that for the amended screenline. The new consideration indicated a somewhat lower increase of 12.4 per cent as shown in Table 7.19, which is still a considerable increase reflecting the increase in traffic growth which has taken place after the opening of the line on parallel roads in the corridor. The changes on the individual roads all showed a trend towards an increase in traffic (Figure 7.19). The increases ranged between 2 per cent (counting point 906) and 20 per cent (counting point 043). In the area considered a 15 per cent increase was the largest recorded (counting point 912). It is clear from these figures that even after excluding the points which were thought irrelevant the growth rate on the 'outer cordon' streets was considerable.

Private Vehicles Traffic

7.111 The change in the availability of public transport had an effect on private car traffic. This, however, was surprisingly the counter effect expected by the new improvement. Table 7.20 shows the 'before' and 'after' figures for private car traffic on the roads of the inner cordon counted over a period of 16 hours (0600-2200). On

* This total excludes count points 048 and 051 which were discarded for accuracy since there were no figures available from earlier counts to compare them to.

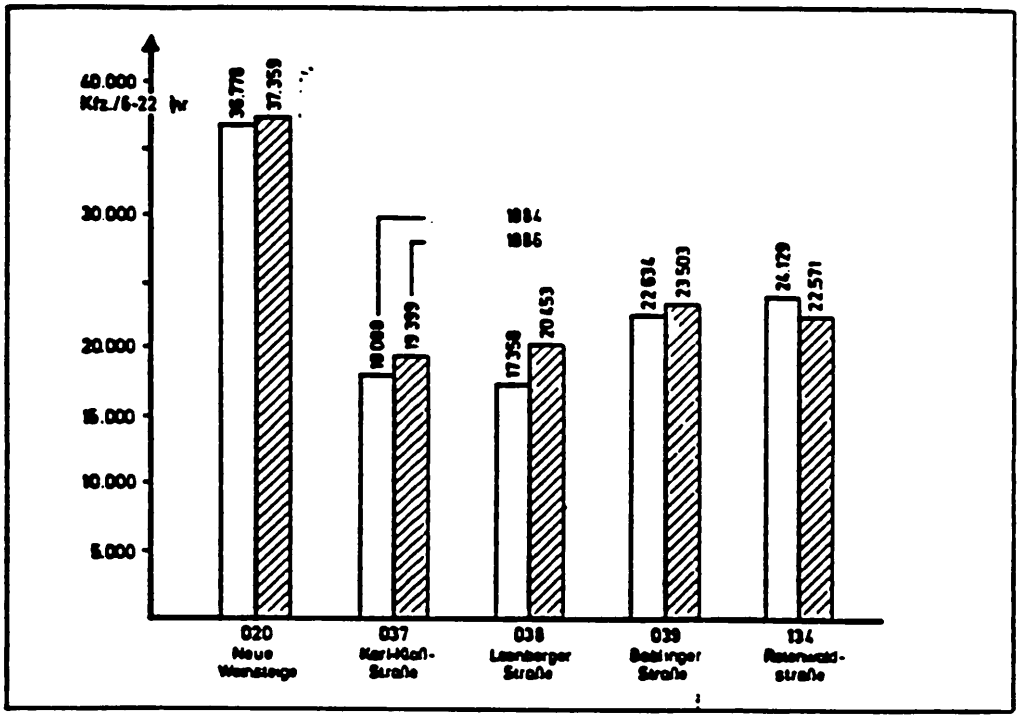


Figure 7.18 The changes in traffic flow on 'inner cordon' streets between 1984 and 1986 (two-way 16-hour counts).

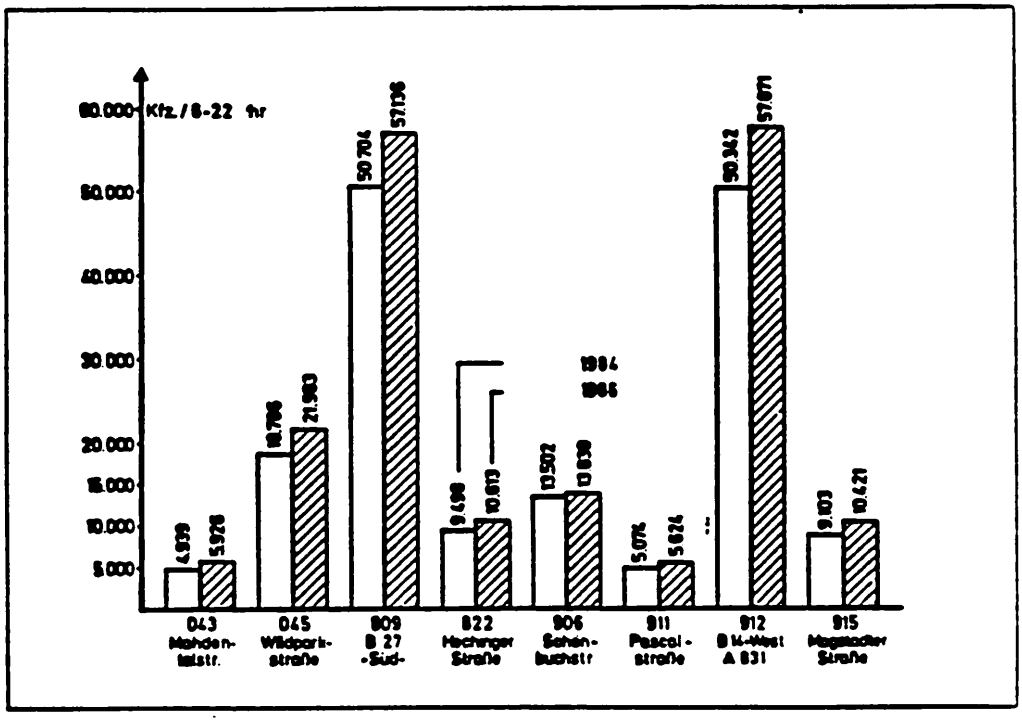


Figure 7.19 The changes in traffic flow on 'outer cordon' streets between 1984 and 1986 (two-way 16-hour counts).

Source: The 'before' and 'after' survey on the S-Bahn impacts.

Count Point Number	May 1984 (PKW) Total Two-Way	April 1986 (PKW) Total Two-Way	Changes 86/84 (%)
020	34,369	35,130	+ 22.0 %
037	17,016	17,975	+ 5.6 %
038	15,009	17,594	+ 17.2 %
039	20,391	21,856	+ 7.2 %
134	22,817	21,124	+ 9.26
Total	109,602	113,679	+ 3.7 %

Table 7.20 The total two-way private vehicle traffic on all 'inner cordon' streets 'before' and 'after' the introduction of the new S-Bahn service between Stutgart City Centre and Böblingen (1984, 1986).

Counting Point Number	May 1984	April 1986
020	1.36	1.37
037	1.32	1.30
038	1.41	1.36
039	1.32	1.29
134	1.34	1.26
Total	1.35	1.32

Table 7.21 Car occupancy rates (number of people per car) at the selected points of comparison on the 'inner cordon' between 0600-2200 hours.

Source: The 'before' and 'after' survey on the impacts of the new S-Bahn.

the most important roads along the inner cordon, private car traffic showed an increase in 1986 of 3.7 per cent over 1984. In order to determine any changes in the characteristics of this private traffic, vehicle occupancy was examined. The results are presented in Table 7.21. From the table, it is clear that there was a slight drop in the degree of occupancy between 1984 and 1986 from 1.35 people per car to 1.32 people per car. This drop is insignificant in relation to the 3.7 per cent increase in private cars during the same period. A comparison of the number of cars and passengers showed the following:

	1984	1986	Change (per cent)
Private Cars (Thousands)	109,602	113,679	+3.7
Passengers (Thousands)	147,963	150,056	+1.4

Table 7.22 **Comparison of private cars and passengers numbers on 'inner cordon' streets.**

This table shows that the number of cars increased at a greater rate than the number of people carried. The study suggested that this could be linked to the increased number of two and three car households. On the other hand, it acknowledged that this might have been the result of the improved public transport service. Since these vehicles are used inside the built-up area, the relatively short journeys they make result in traffic being particularly heavy along inner cordon streets.

7.112 Table 7.23 presents the traffic counts for private vehicles along the outer cordon. From this table, it can be seen that the growth in private car traffic on all outer cordon roads of 13.9 per cent or 13.5 per cent (^{X}Total) is proportionally greater than the growth in total traffic of 13.3 per cent (Table 7.19). Considerations of vehicle occupancy figures were not taken for the outer cordon. This indicates that the growth is particularly in private car traffic. In other words, more people are using there cars since the opening of the new S-Bahn, which, again, is contrary to the results expected.

Heavy Vehicles Traffic

7.113 Heavy vehicle traffic counts for the 'inner cordon' were also taken over the same 16 hours period and are shown in Table 7.24. From the table, it can be seen that heavy traffic grew from 7,304 in 1984 to 8,318 in 1986. This meant an increase of 13.9 per cent, or, in terms of the proportion of total traffic, an increase from 6.1 per cent to 6.75 per cent . This increase, however, could not be estimated accurately due to the difficulty in estimating the heavy vehicles serving a large construction site in the area from Spring 1985, and Spring 1986. The particular changes associated with these projects can be best seen from counting points (037, 038 and 134). A summary of the changes in private and heavy vehicles is presented in Table 7.25. From this table, it can be seen that while the proportion of private cars has remained practically the same and lorry traffic has grown, for the reasons stated earlier, while the number of two-wheeled vehicles has dropped. This was explained by seasonal factors, since the count taken in April 1986 was during bad weather.

7.114 Heavy vehicles traffic along the 'outer cordon' in 1984 and 1986 is shown in Table 7.26. Comparative judgement was also difficult to make along this screenline due to the strong influences of the major construction sites in Stuttgart at the time of the survey. Because of the construction work, these roads (denoted by ^{0} in the table) were carrying exceptionally heavy traffic loads. From the table, the total for all roads, including those with the exceptional increase, shows an increase of 14 per cent which corresponds with the figure for the 'inner cordon' (13.9 per cent). Excluding the roads with the exceptional increase the increase in HGV traffic is 11.3 per cent which is still a substantial one. Table 7.27 is a summary of motor vehicle traffic on the outer cordon. From this table it can be seen that the increase in total vehicles traffic on all outer cordon roads between 1984 and 1986 is 11.7 per cent, a rather considerable increase.

Traffic Growth on the 'Inner Cordon' (Kesselrand)

7.115 In order to be able to judge the effect of the newly opened S-Bahn stretch to Böblingen on the growth of traffic on inner cordon streets, changes in the last few years, on the roads compared, were taken into consideration. Table 7.28 presents the figures and the percentage change. From the table the following can be seen:

- -a reversal phase between 1981 to 1983 with a fall of 2.3 per cent ,
- -an almost stationary position between 1984 and 1985,

Count Point Number	May 1984 (KFZ) Total Two-Way	April 1986 (KFZ) Total Two-Way	Changes 86/84 (%)
043	4,155	4,797	+ 15.0 %
045	17,876	20,997	+ 17.0 %
809	46,780	52,905	+ 13.0 %
822	8,773	10,017	+ 14.0 %
906	12,547	12,955	+ 3.0 %
911	4,567	5,317	+ 16.0 %
912	44,698	51,966	+ 16.0 %
915	8,321	9,310	+ 12.9 %
Total	147,717	168,264	+ 13.9 %
[x]Total	78,906	89,565	+ 13.5 %

Table 7.23 The total two-way private vehicle traffic on all 'outer cordon' streets 'before' and 'after' the introduction of the new S-Bahn service between Stutgart City Centre and Böblingen (1984, 1986).

Counting Point Number	May 1984	April 1986	Changes 1986/1984 (%)
020	1,828	1,889	+ 3.3 %
037	814	1,242	+ 52.6 %
038	2,069	2,635	+ 27.3 %
039	1,720	1,329	-22.7 %
134	873	1,223	+ 40.1 %
Total	7,304	8,318	13.9 %

Table 7.24 Heavy goods vehicle traffic at selected 'inner cordon' roads between 0600-2200 'before' and 'after' the opening of the S-Bahn line to Böblingen (1984, 1986).

Source: The 'before' and 'after' survey on the impacts of the new S-Bahn.

Year	Private Cars		Heavy Vehicles		Motorcycle & Moped		Total Vehicles
	Number	(%)	Number	(%)	Number	(%)	
1984	109,602	92.1	7,304	6.1	2,108	1.8	119,014
1986	113,679	92.2	8,318	6.7	1,288	1.0	123,285

Table 7.25 Summary of motor vehicle traffic on selected 'inner cordon' streets between 0600–2200.

Count Point Number	May 1984	April 1986	Changes 86/84 (%)
°043	596	945	+ 58.0 %
°045	658	823	+ 25.0 %
x809	3,330	3,651	+ 10.0 %
x822	538	462	−14.1 %
x906	720	773	+ 7.0 %
x911	355	233	−34.4 %
x912	5,104	5,644	+ 11.0 %
xo915	526	952	+ 81.0 %
Total	11,827	13,483	+ 14.0 %
xTotal	7,243	8,064	+ 11.3 %
°Total	1,780	2,720	+ 52. 8 %

0 Roads under the influenece of major construction works (exceptional HGV traffic).
xTotal Total excluding roads with exceptional traffic.

Table 7.26 The total two-way heavy vehicle traffic on outer cordon streets 'before' and 'after' the introduction of the new S-Bahn service between Stutgart and Böblingen (1984, 1986).

Year	Private Cars		Heavy Vehicles		Motorcycle & Moped		Total Vehicles
	Number	(%)	Number	(%)	Number	(%)	
1984	147,717	91.2	11,827	7.3	2,404	1.5	161,948
1986	168,264	91.7	13,483	7.4	1,655	0.9	183,402

Table 7.27 Summary of motor vehicle traffic on selected outer cordon streets between 0600–2200.

Source: The 'before' and 'after' survey on the impacts of the new S-Bahn service in Stuttgart.

-two strong growth phases between 1983 and 1984 with 4.6 per cent, and from 1985 to 1986 with 3.7 per cent.

The increase between 1984 and 1986 (before/after S-Bahn was 3.6 per cent, that is 1.8 per cent on average per year. From these figures, it can be seen that following the stagnation period between 1984 and 1985, traffic growth increased by 3.7 per cent immediately after the opening of the S-Bahn in 1985. It was expected that the opening of the new S-Bahn line would relieve road traffic, but this clearly did not happen.

Traffic Growth on the 'Outer Cordon' (Markungsgrenze)

7.116 In recent years, there has been a growth in traffic across the 'outer cordon' as well as the 'inner cordon' implying a general trend, as well as particular changes following the opening of the S-Bahn which are important, and are discussed in the following paragraphs. The detailed figures and the percentage changes in the flows are listed in Table 7.29 which also shows the percentage changes. From the table, the following is obvious:

- A period of uniform increase in traffic between October 1980 and May 1984 with a total growth of 9.2 per cent,

- a period of strong growth of 14.9 per cent steadily between May 1984 and October 1986.

One can also note the following points in particular:

- From October 1982 to May 1984 there was an increase of 3.2 per cent ,

- from October 1984 to April1986 (an almost equal period), the increase was 9.9 per cent or more than 3 times.

This increase in traffic after the opening of the S-Bahn line which was three times that recorded before shows that the opening of the line did not contribute to the reduction of traffic growth across the outer cordon. In fact, and from the pattern presented in the table, it appears as if the new line has encouraged the growth in motor vehicle traffic.

Year	All Vehicles (KFZ)06–2200 hours	Changes (per cent) Relating To			
		1981	1983	1984	1985
1981	116,526	–	–	–	–
1983	113,798	-2.3	–	–	–
1984	119,014	2.1	4.6	–	–
1985	118,889	2.0	4.5	-0.1	–
1986	123,285	5.8	8.3	3.6	3.7

Table 7.28 Growth of all motor vehicle traffic on the 'inner cordon'.

Year–Month	All Vehicles (KFZ)06–22 hours	Changes (per cent) Relating To				
		1980 Oct.	1982 Oct.	1984 May	1984 Oct.	1986 April
1980–October	148,339	–	–	–	–	–
1982–October	156,931	5.8	–	–	–	–
1984–May	161,948	9.2	3.2	–	–	–
1984–October	166,925	12.5	6.4	3.1	–	–
1986–April	183,412	23.6	16.9	13.3	9.9	–

Table 7.29 Growth of all motor vehicle traffic on the 'outer cordon'.

Source: The 'before' and 'after' survey on the impacts of the new S-Bahn service in Stuttgart.

7.117 The aim of the study, as stated earlier, was to examine the effects of the extension of the S-Bahn as far as Vaihingen/Bo¨blingen on individual traffic. This new rapid rail connection between Stuttgart and the area of Bōblingen/Sindelfingen or between the city centre and Vaihingen should have lead to a reduction in private transport or at least to a slow down in the rate of increase. The study's results, yielded by the traffic figures, were very surprising. By comparing the 'before' and 'after' figures along the 'studied area' screenlines and the city total the following increases were noted: on the inner cordon, the growth from May 1984 to April1986 was 3.6 per cent, while from May 1983 to May 1985 it was 4.5 per cent ; on the 'outer cordon' the figures between May 1984 to April 1986, and October 1984 to October 1986 were 13.3 per cent and 11.5 per cent respectively; In the whole built-up area* the following increases were compared: for the 'inner cordon' 2.2 per cent from May 1983 to May 1985. For the 'outer cordon' a 6.3 per cent from October 1984 to October 1986. Table 7.30 presents these figures.

7.118 From the table, it can be seen that the growth in vehicle traffic in the corridor of the improvement ('studied area'), 'after' the opening of the S-Bahn, has been somewhat less than the rate of increase over a similar period 'before' the improvement (3.6 and 4.5 per cent respectively). This was attributed to the fact that the streets in this corridor have already reached their practical capacity limits leaving therefore very little room for added growth[70]. Nevertheless, the growth in traffic over this corridor was more than twice that for all central roads 'before' (4.5 and 2.2 per cent respectively), an indication of the heavy traffic load on city centre roads throughout the day, and shows that these streets have reached their capacity limits. This phenomenon is also a reflection of the effect of the policy to restrict traffic by means of a reduction in long stay parking facilities in the city centre. These results also confirmed the findings of previous surveys, carried out by the city, which indicated that much small increase in traffic was noted on the roads around the Kesselstadt following increases in efficiency and improved public transport services. Increased private car traffic, however, was noted on roads along the outer cordon.

* The built-uparea is actually divided by outer and inner screenlines along the Markungsgrenze and Kesselrand. These screenlines, however, include all roads in the built up area and not only the roads in the immediate corridor of the new S-Bahn .

Area	Cordon	1984		1986		Changes (per cent)	
		May	Oct.	April	Oct.	Apr 86 May 84	Oct 86 Oct 84
Studied Area	Inner	119,014	-	123,285	-	3.6	-
	Outer	161,948	166,925	183,412	186,128	13.3	11.5
City Total	Outer	-	580,019	-	616,686	-	6.3
		May 1983		May 1985		May 1985 May 1986	
Studied Area	Inner	113,798		118,889		4.9	
City Total	Inner	388,587		396,956		2.2	

Table 7.30 **Summary of the Daily 16-hours traffic count results and the percent changes 'before' and 'after' the opening of the S-Bahn to Böblingen.**

Source: The 'before' and 'after' survey on the impacts of the new S-Bahn service in Stuttgart.

7.119 The increase over city roads has been significantly less than that for outer roads. From the table, it can be seen that traffic growth was 13.3 per cent in the immediate corridor of the improvement ('studied area') 'after' the new S-Bahn line was opened (Spring counts). Autumn counts show that the increase was 11.5 per cent which is substantially larger than the rate for all outer roads in the city (City total), which was only 6.3 per cent over the same period (October 1984–October 1986). This is an indication of the considerable increase in the use of private vehicles along the corridor of improvement. It clearly shows that if the public transport improvement had any impact, then it was that of encouraging even more vehicle usage. City officials, however, have a different view. They accept the surprising results but argue that the extent of suppressed demand along this particular corridor caused this situation. Figures from the other surveys compared favourably with the observation of increased private vehicle use, on outer roads, 'after' public transport improvements and indicated that the same phenomenon was true for the peak hour traffic. The counting points chosen for the study were selected because it was possible to compare them with the regular surveys made by the City Planning Department, therefore ensuring a greater security against errors in the results.

7.120 The car ownership factor cannot be ignored when examining the general growth in traffic over the same period. On 1 January 1984, there were 250,589 licensed vehicles in Stuttgart that is 440 vehicles per 1,000 inhabitants. On 1 January 1986, licensed vehicles were up by 5.3 per cent to 263,756 in spite of a fall in the population of the city, this meant a car ownership rate of 473 vehicles per 1,000 inhabitants or a growth of 7.5 per cent[72]. This indicates a general increase in the mobility of the population and increased motorisation. The number of two and three-car households probably contributed to this increase as well. With such levels of high car ownership, the motor vehicle remains the main mode of travel in Stuttgart. Despite a public transport system which is improved regularly, the demand for the motor vehicle is increasing, with vehicle occupancy rates continuing to fall.

THE IMPACT ON PUBLIC TRANSPORT

7.121 To be able to assess the growth in public transport use in the studied area, figures were obtained from the traffic and fares group in the VVS. The figures of immediate relevance to the study were those taken on the 'outer cordon' and the 'inner cordon' in the Spring of 1984, and in Winter/Spring 1985/1986. A comparison

of passenger-journeys over the same 16 hour period (0600-2200) in both directions showed the following :

Cordon	Year		Change (per cent)
	1984	1986	
Outer (Markungsgrenze)	13,500	15,000	+11.0
Inner (Kesselrand)	30,000	46,000	+53.0

Table 7.31 Comparison of passenger-journeys on the S-Bahn between 1984 and 1986 (0600-2200, both directions).

From this table, it can be seen that after the opening of the new S-Bahn service, public transport ridership went up by 53 per cent in the 'inner cordon' (central area). The corresponding change in the outer area was far less at only 11 per cent. This is clearly the reverse trend to that with respect to the motor vehicle. While the percentage increase in vehicle traffic on the 'outer cordon' roads was four times that on the 'inner cordon' streets, the public transport ridership showed the complete opposite trend with the percentage increase in the ridership figures in the central area being around five times that for the outer area. Of the 46,000 passengers now using the S-Bahn between Schwabstrasse and the University, 33,000 (72 per cent) are on the new S-Bahn line.

7.122 The study concluded that[71]:

> 'in spite of the opening the new S-Bahn stretch to Vaihingen and Böblingen , the road traffic in the area immediately affected showed an above average increase. The yearly rates increases between 1984 and 1986 were higher than corresponding figures for the whole of the built up-area'.

It also concluded that

> 'measures to restrict traffic in the city centre and a definite improvement in public transport services (the new S-Bahn and city rapid transit routes) means that the increase in traffic was lower around the city centre (inner cordon) than on the main roads around the edge of the city. In contrast, public transport services around the inner cordon

7.123 A survey[73], recently concluded by the VVS, investigated the redistribution, modal shift and the changes in individual routes and means of transport within the whole area of public transport. This survey, which was carried out in November 1988, measured the traffic load for the whole of the S-Bahn network following those previously carried out in 1985 and 1986. The survey showed that there was still a growth in demand over 1986. Between 1986 and 1988, the new section of the S-Bahn (S1) showed an increase of 28 per cent, the highest for all the network. While some other sections showed a slight drop in their loads during peak hours, the Böblingen section maintained an increase. Overall, the survey concluded that a positive growth in demand for the S-Bahn had been maintained. This applied particularly to day-time traffic while a definite fall-off in demand had been recorded at peak hours except for the Schwabstrasse-Bo"blingen section. The survey also found that only a marginal shift has occurred from the private vehicle onto the new line with these journeys becoming park-and-ride journeys.

7.124 It is clear, therefore, that the new S-Bahn line has created a shift within the public transport network. Although the study did not examine bus routes, it was expected that a large proportion of bus traffic shifted to the new S-Bahn service. This, once more, illustrates that while public transport improvements may improve conditions within the public transport network by means of redistribution and modal shifts, especially from buses, their impact on private vehicle traffic on parallel roads is rather marginal. It is also clear that any spare capacity, which may have been made available on the corridor roads, is taken up by the suppressed demand.

REMARKS AND CONCLUSIONS

7.125 With the provision of this new improved public transport service, from the city of Stuttgart to Böblingen, it was hoped that this would stop or at least slow down the growth in motor vehicle traffic along that corridor. This project is a very old one. The objectives for building this S-Bahn stemmed from discussions with the inhabitants of West Stuttgart where people were complaining about increasing motor traffic and congestion levels. The government said that building the S-Bahn , and employing traffic management techniques, would improve the situation. However, the 'before' and 'after' surveys and studies presented in this case study showed some unexpected results. From these comparative figures and tables, it was shown that in the two year period, May 1984 to April 1986 (between 0600-2200 hours), motor vehicle traffic on the roads in the area immediately affected by the S-Bahn

improvement (the Studied Area), has grown by 2,000 vehicles per day (3.6 per cent) on city centre roads,; and that the increase in motor vehicles traffic on outer roads in the Studied Area was more substantial at 21,000 vehicles per day (13.3 per cent).

7.126 On the other hand, and for the whole of the built-up area (all City roads), the surveys showed relatively lower increases: In the City Centre the increase was approximately 8,000 vehicles per day (2.2 per cent); the increase on the outer area roads was approximately 37,000 vehicles per day (6.3 per cent). This means that the motor vehicle traffic in the corridor affected by the S-Bahn improvement in the direction of Vaihingen/Bo¨blingen, for both inner and outer cordon roads has clearly grown more strongly than on all roads (inner and outer) in the whole built-up area. It is also evident from the survey, that the tendency is for traffic to grow stronger on outer roads than on inner roads (City Centre). This is probably the result of these inner roads having reached their capacity limits which is, as mentioned by local city officials, is the main factor together with restraining measures (mainly parking control) which may have also played a role. The great increases on the new line were seen to be the result of shifts within the public transport system, mainly from buses[70].

7.127 The assessment of public transport development in the 'studied area' (based on figures provided by the local public transport authority), indicate that from 1984 to 1986 public transport ridership increased by approximately 16,000 journeys per day (53 per cent) along the corridor in the city centre. The increase in ridership on the outer part of the route was less significant at approximately 1,500 journeys per day (11 per cent). This was the opposite to the trend observed with respect to motor vehicle traffic which increased by four folds in the outer area compared with the increase on roads in the inner area.

7.128 The general increase in motorisation, together with the city's development and associated construction, as well as land use management have all had a further powerful effect on increasing road traffic especially on the border of the 'outer cordon' of the Studied Area. These resulted from the increase in population (development of suburbs), work places (industrialised areas) and educational development (the university). The figures for the 'outer cordon' (rounded) show that in 1986, the number of private vehicles was 283,500 vehicles per day compared to 162,000 vehicles per day in 1984, an increase of 13.3 per cent.

7.129 Traffic restraining measures in the city centre and the improvement in the public transport system lead to a lower increase in traffic around the City Centre (inner cordon streets) than on the main roads around the edge of the city. The S-Bahn service around the 'inner cordon' appeared very attractive as the growth in their use showed quite clearly. The figures for the 'inner cordon' (rounded) show that in 1986, the number of private vehicles was 123,300 per day compared with 119,000 in 1984 (an increase of 3.6 per cent). Public transport carried 46,000 passenger journeys compared with 30,000 in 1984 (an increase of 53 per cent). Compared with the increase in ridership along the outer area section (1,500 passengers only or 11 per cent) the increase in ridership along the section serving the city centre is considerably more. This shows that the impact public transport improvements have is largely that of creating a redistribution and local shifts within the whole public transport system, with the bus system losing a large proportion of its traffic to the rapid rail system. It also shows that a good quality, high value public transport service in the city centre, coupled with restricting measures, can partially absorb the increase in traffic on roads in the city centre, but it has a very marginal effect in reducing the demand for motor vehicle travel on outer roads. In this particular instance, and as shown in paragraph 7.122, these outer roads in the immediate corridor of such improvements have shown 'an above average increase'. This was contrary to the intended objective of reducing traffic on these roads, or in other words, this improvement has not been effective in this respect.

7.130 Additional count figures for 1988 were provided by the City Planning Department, and are presented in Figures 7.20 and 7.21. It is clear from Figure 7.20, which also presents the changes 'before' and 'after' the opening of the new S-Bahn, that traffic continued to grow, even stronger, on all roads between 1986 and 1988. Figure 7.21 shows that the growth in traffic along the new S-Bahn corridor was 15.7 per cent on outer roads. This was also accompanied by a similar trend on inner roads. Traffic on all roads in the city grew as well, by almost double the rate between 1984 and 1986. On the 'inner cordon' roads along the S-Bahn corridor a slight drop was evident after April 1986, but traffic grew after that by 9.0 per cent or by 4.9 per cent from its level in 1986.

7.131 All of the above serves to show, once more, that improvements to the public transport system alone have not slowed or stopped the growth in traffic and in travel demand. The example from Stuttgart is a clear case where the travel demand associated with the industrialised area of Böblingen continued to grow in spite of

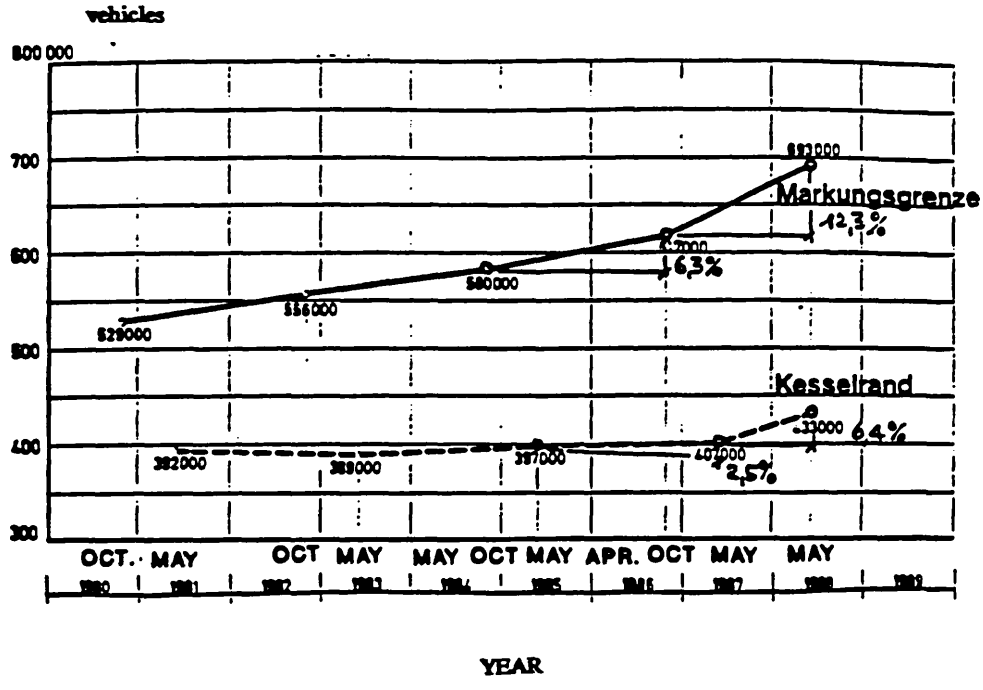


Figure 7.20 The growth of 'all vehicles' traffic on all roads 'before' and 'after' the opening of the S–Bahn to Böblingen (two–way 16–hours counts, 1980–1988).

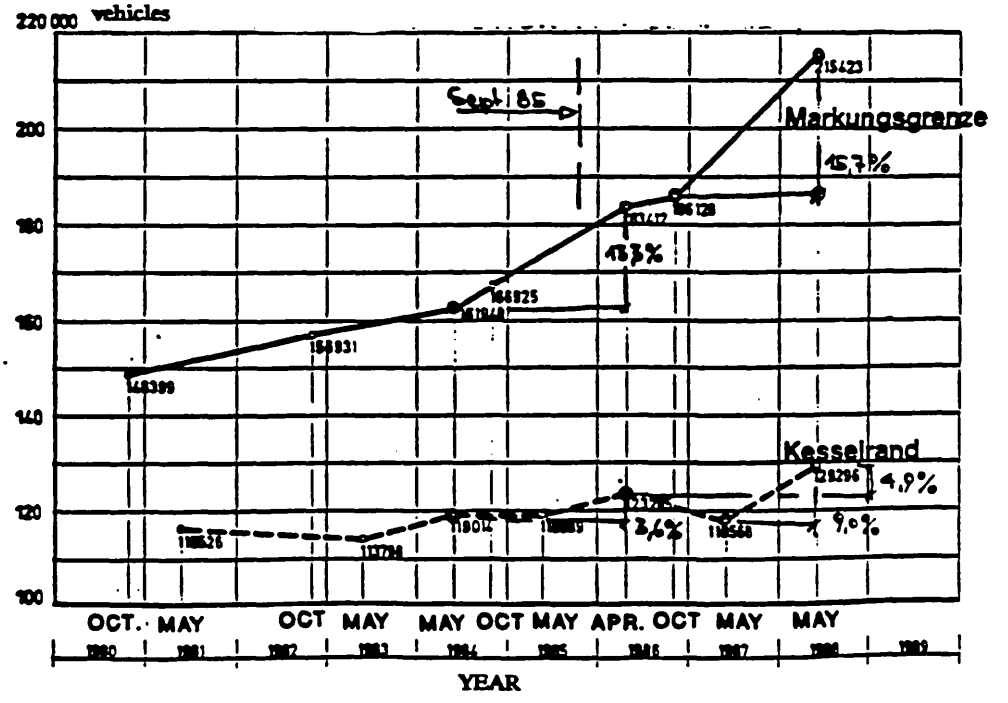


Figure 7.21 The growth of 'all vehicles' traffic on roads in the 'studied area' 'before' and 'after' the opening of the S–Bahn to Böblingen (two–way 16–hours counts, 1980–1988).

Source: Stuttgart Plannungsamt, 1988.

the improved public transport supply. The growth in traffic in the immediate corridor was much more than the growth for all city streets together. As shown in the other cases of the Victoria Line in London, and the Underground extension in Berlin, improvements to public transport lead to major shifts and redistributions within the different modes of the public transport system. Such improvements lead to major shifts from bus passengers on to the new rapid rail service. Its impact on motor traffic, however, is marginal.

7.132 This further stresses the need to cater for essential traffic via a road network capable of handling the demand. Worsening congestion, deteriorating environment and jeopardised economic welfare can be the results of inferior road networks. Through traffic should be catered for via a well connected network of high capacity roads and motorways, while traffic calming measures and restrictions should be imposed on residential and city centre roads. The example also indicates, again, that parking control is also a major element in combating traffic congestion and eliminating unnecessary traffic from the centres. A well planned programme is needed to co-ordinate the different transport needs and cater most effectively for the demand.

7.133 A concluding remark from the Stuttgart study[71] states the following:

> ' The assumption from the investigation tends to strengthen the belief that particularly by transport availability, both for private and public transport, there is an especially intensive use of the roads resulting in a significant increase in traffic'.

What this seems to suggest, is that in cases of suppressed demand, public transport improvements cannot control the growth in the use of the motor vehicle. Even more, the effect of these improvements can lead to a greater use in the roads in the immediate corridor. This lends further support to the hypothesis of this research put forward in Chapter 1, and goes even further by suggesting that public transport improvements can have an adverse impact on parallel road traffic.

CHAPTER 8 LESSONS TO BE LEARNED AND GENERAL CONCLUSIONS

INTRODUCTION

8.1 The purpose of this chapter is to draw on the findings of the case studies examined in the various countries. The different approaches and their effectiveness in respect of the road building experience, in particular, will be reviewed, and the suitability of these within the British context appraised. It must be taken into consideration that a comprehensive comparative analysis is restricted by the fact that the case studies were limited by the availability of data. The selection was based, to a large extent, on the availability of information, and the readiness of the concerned authorities to cooperate. Each case, therefore, is unique and has its own merits since very little similarities exist between the different cases. On the other hand, this in itself provides a broader experience with a wider range of examples. This chapter also contains suggestions for further research in this subject.

8.2 When available, information from local highway authorities was minimal and insufficient. A lot of local authorities have only recently started collecting data on traffic flows on certain arterials and corridors. There also seems to be, a general lack of organisation and even filing of such information. This could be attributed to the lack of, or the delay in introducing advanced traffic technology at these authorities. There is an apparent interest in keeping the relevant information on files for future use. Also, the contentions of Mogridge were not readily testable in the case studies considered, since only Kingston-upon-Hull had carried out journey time surveys. These, however, could not be used to test Mogridge's claims since the city was not considered to have a high level of suppressed demand.

THE CASE STUDIES

Examples From Britain

London

8.3 The most significant case study taken in Britain is, without a doubt, that of the A2 Rochester Way Relief Road. This is so because it was possible in this case

to investigate an important element besides the figures and data provided by the traffic counts, namely that of the local attitudes and the area residents views on the question of effectiveness. As can be seen in Chapter 3, the scheme was a much needed scheme which went through a number of modifications and consultations before it was finally implemented. It was the result of pressing environmental concerns and operational inadequacy in a major link of the strategic road network in London, but it was some 20 years before it was delivered as it stands today.

8.4. Because of its imminent need, its well thought out design and minimal environmental impact, the scheme was the subject of a short and crisp public inquiry. Today, the road serves a very important link between London and the rest of Europe, as it is part of the major route to the Channel Ports. The study showed that the RWRR has improved the environmental conditions on many of the local roads which previously suffered from a number of adverse environmental impacts (e.g. heavy goods vehicles, rat-running etc.). Understandably, properties in the immediate vicinity of the new road are now more conscious of increased traffic noise, but the overall benefits extended appear to overweigh the disbenefits. Today, more people enjoy the reduced nuisance from HGV traffic and rat-running, especially residents along the old Rochester Way.

8.5 A number of traffic management measures were introduced since the introduction of the scheme. These range from simple and crude road closures to banned turns. The idea was to maintain the benefits and relief extended to local roads by the implementation of the RWRR. These measures, however, do not seem to have the approval of the local residents as voiced in the Questionnaire Survey carried out as part of this study. The reason, it seems, is that these measures while restricting rat-runningand through traffic are also impeding the local movements and affecting the local traffic patterns. The closure of a local street appears to shift the residual through traffic on to less adequate and narrower parallel streets, and banned turns only seem to entice people to make erratic manoeuvres. This is probably the result of the basic nature of the package, and the lack of funding necessary to introduce more comprehensive packages as those introduced in Germany and Holland (*'Verkehrsberuhigung und Wohnumfeldverbesserung'* and *'Woonerven'*, respectively).

8.6 On the critical question of 'generated' traffic, the traffic counts showed that traffic across the three different screen lines increased only by the average expected

growth over the period considered. There are no indications of any sudden increase in traffic across the corridor despite a 50 per cent increase in capacity. While in this case it may be argued that the forces of inner London congestion and capacity limitations may have prevented a surge in traffic (i.e. traffic congestion having a restraining effect), it must be remembered that the original intended function for the road was a redistributional one. This was indeed the case, and while removing extraneous traffic from other main east–west roads, the scheme has given much needed relief to local and busy streets making the environmental conditions there more favourable and much improved. Its economic impact may best be inferred from the point of view of regular users. These, representing local and national firms, provided a picture indicating much improved travel conditions and lesser journey times resulting in more reliable operations and better time keeping.

8.7 The public transport issue with regard to this scheme could not be readily answered due to the lack of necessary data and information. Both British Rail and London Buses were unable to provide information on passenger loadings 'after' the opening of the scheme. This was attributed to the change in some bus services and the fact that no major surveys have been carried out yet to assess these changes. The impression of both operators, however, is that there has been no indication of any negative impacts. On the contrary, both expressed the view that there may be an increase in ridership and in the use of public transport in the area. This may not, however, be the result of local modal shift as much as it is due to the use of the new Rail/Bus interchange by commuters into London from surrounding areas.

8.8 Overall, the scheme has proved effective in delivering its intended objectives while having minimal adverse environmental impacts on the area. Its engineering design and the associated landscape measures have resulted in it mixing very well with the surroundings. Its being largely in cutting throughout most of its 5.5 km length has immensely reduced visual and aural intrusion. The scheme, the latest major improvement to the road network in London, shows that when careful planning and design coupled with environmental safeguards and an understanding of the most effective role for a scheme, even major capacity increases in situations of suppressed demand do not necessarily lead to worsened traffic conditions, as claimed by some opponents of new roads in urban areas.

Kingston-upon-Hull

8.9 The example from Hull was that of a 9 km road link passing through the old docks area. These docks had been neglected and largely deserted except for some small fishing operations. With Hull planning to be one of the major ports for trade with the European partners in the Community, the need to develop and regenerate this area was pressing. The traffic conditions along many of the local roads, especially the main east-west routes, which largely went through residential and built up areas were worsening with the growth in traffic and the demand for travel. The construction of Humberside Bridge also contributed to additional traffic entering the city across the river. The City also had plans to pedestrianise the city centre and reduce through traffic. This through traffic was mostly that heading to east Hull, where most of the port activity and the industrial area is, and, therefore, a large proportion of it was HGV traffic.

8.10 The worsening traffic conditions along city centre streets and other main east-west radials in the city, and with the plans to regenerate the old docks and improve the Hull Port function, it was necessary to consider a comprehensive solution. The South Docks Road or the Clive Sullivan Way as it is called today was the answer. It provides a radial link between the motorway network to the west of the city leading to the port and industrial regions in east Hull. The road was a carefully planned, dual carriageway with limited access to ensure no spilling of traffic onto local streets if the road was to become congested. Together with traffic management measures introduced in the city centre (one way systems and some pedestrianisation) the road appears to be effective in catering for the traffic movement along the east-west corridor, leaving much improved traffic conditions along previously congested local roads. The most significant impact was the reduction in the HGV element which previously used the local roads in Hull. The road was opened to traffic in 1985 but it was not until 1989 that the city introduced some capacity reducing measures and provided parking along Anlaby Road, one of the main east-west radials in the city which previously suffered from traffic congestion.

8.11 The scheme also proved effective in encouraging development and appears to have helped to improve the function of the port by the improved accessibility. This can be seen in the amount of traffic 'generated' in the immediate corridor. This 'generated' element, however, is that of development traffic which was sought when the scheme was implemented, and is therefore a good impact of the road.

8.12 When examining the impact the road had on journey times, it was clear, from the limited data available in the city, that the road has improved travel conditions and journey times along the parallel streets in its corridor, namely Anlaby and Hessle roads. This resulted in improved environmental conditions for many of the residents along these local roads, reduced vehicle/pedestrian conflict, and improved safety. In Hull, the degree of suppressed demand is probably not as high as that in larger urban areas. The road was therefore able to cater for the additional demands while relieving existing roads. The scheme was complemented by another scheme where a southern orbital link and a new bridge took the traffic through east Hull. Had this earlier improvement not been provided, the benefits achieved by the road may have been somewhat reduced.

8.13 The effect of the scheme on public transport services, which is basically a bus service, was difficult to quantify. Meetings with the local public transport operator indicated that their services along the relieved parallel roads has certainly improved. Journey times for the buses have been reduced resulting in a more reliable service and, better time keeping. Although ridership figures could not be made available due to fear of competition as a result of the 1986 deregulation and the fact that a couple of competitors have entered the market, officials in the company reported no changes in the levels of passengers reflecting no modal shift.

8.14 The Hull example of road building in a medium size urban area in Britain shows no signs of 'counterproductivity'. On the contrary, it indicates that the scheme has met its intended objectives of relieving traffic congestion and improving environmental conditions along local roads; allowed the transfer of HGV traffic onto a better link enabling quicker journeys, and time savings; and opened up the area of the old docks assisting in its regeneration and development. Today, there is a new picture of change along the Clive Sullivan Way. Many new developments have been completed on the previously deserted docks and others are underway. The city centre is restricted to car traffic by means of traffic management measures and parking controls which have been facilitated by the new scheme.

Portsmouth

8.15 The geographic location of the city provides a unique example in the sense that all traffic entering the city is destined to a point in the Portsea Island. The major traffic movement is the north–south one with traffic coming into the city via Eastern

Road to the east, or by crossing Portscreek at Portsbridge or via the M275. The scheme considered in Portsmouth was that of the North-South Route. Built in three different stages, the scheme provided a major and much needed link into the city. For many years prior to the opening of Stage 1 of the scheme (1976), namely the M275 section, the only two links between the mainland and Portsea Island were provided via Eastern road and Portsbridge across Portscreek. With the growth in car traffic, the two links became inadequate and the fact that Portsbridge branched into three local roads which passed through busy residential and shopping areas created environmental concern.

8.16 The M275 link was opened to traffic in 1975 providing a high capacity motorway standard road. This resulted in the removal of much of the traffic, especially that which previously used the Portsbridge crossing, and provided much improved conditions along the three main radials branching from Portsbridge. The North-South Route was extended further in stage 2 (1980), and Stage 3 was the latest stage to be built (1983,1984). This link (Holbrook Road), provided a bypass to one of the busiest shopping streets in Portsmouth (Fratton Road) where previously congested and dangerous conditions have been relieved. This, however, involved the demolition of some 400 houses which had been determined beyond repair by the city authorities. A recent addition was that of the Rudmore Flyover which goes over the Rudmore Roundabout known to be a blackspot for accidents in the city. The scheme was one of the latest improvements in the city and together with the North-South Route provide a very essential link in catering for the demand.

8.17 The scheme has not proved to be 'counterproductive' in any way. Even though its impact on public transport was also difficult to determine (for reasons similar to those in Hull), the scheme does not seem to have generated so much more traffic -at any of its stages -whereby any benefits achieved were cancelled out. The fact that Portsmouth is a rather small urban area with very little suppressed demand is certainly an important factor, the other is that of the city geographic location where very little traffic other than that destined for the city uses the roads. Nevertheless, even within this limited local context, the experience of urban road building indicates improved operational conditions along the road network, and a betterment of environmental conditions along some of the previously congested and hazardous roads.

The Victoria Line

8.18 This case study on the implementation of the Victoria Line in London examined the actual impacts after the opening of the line against its intended objectives and forecasts. As demonstrated in the study, the new line offered a much needed relief to some of the heavily congested sections of other underground lines in London. Its redistributional impact within the public transport system in general, and the underground network in particular, was very significant. The line diverted some of British Rail's traffic and to a much larger degree traffic from buses. Its impact on private road traffic, however, was far less than that anticipated in the Foster Beesley Report.

8.19 The study carried out by London transport after the opening of the line found that the actual reduction in car traffic was less than had been anticipated. The line resulted in the diversion of some journeys to park and ride type journeys, however, the number of generated journeys which did not previously involve the motor car was more than expected. The share of 'generated' and 'diverted' traffic on the new line was also much less than that forecasted, at least in the first year, and it was evident that the main function served by this new line was a redistributional one which mainly affected public transport services leading to modal shifts within the public transport system. The scheme, therefore, did not deliver the benefits claimed in terms of reduced car traffic along the parallel roads in its corridor, despite serving the city centre and being a major addition in conditions of high suppressed demand.

Examples From Germany

8.20 In pursuing the main research's objectives, namely those of investigating the actual experience and effectiveness of new urban road building in other countries on the continent, case studies were taken in Germany. The overall aim was to see whether or not the German experience is different from the one in this country, and if so, why and how does this translate in terms of overall traffic conditions and particularly the impact of new roads in urban areas. Germany was selected for a number of reasons including the fact that the transportation system is well renowned and their experience is regularly cited in the context of better traffic conditions and environment, and the somewhat similar starting points after World War II.

8.21 The choice of German cities was based primarily on the availability of data and the readiness of the responsible local authorities to co-operate with this research. Selection was also made on the recommendations and established contacts with Professor Robert Schnu"ll of the Institute of Town Building and Traffic Economics (*Institut Für Verkehrswirtschaft, Strasenwesen Und Städtbau)* of the University of Hannover. As a result, five case studies have been investigated in German cities namely: Hamburg, Düsseldorf, Duisburg, Berlin and Stuttgart. Examples of urban road building were studied in the first three cities while the latter two covered examples of improvements to the public transport system.

8.22 The variety of these cities, in terms of urban structure, population, economic and industrial structures in addition to their geographic location resulted in each case study being, once more, a unique example by itself. It also provided examples from different Länder with different policies and planning practices which, in a way, makes it possible to draw on the similarities, follow the developments and reach a general impression and conclusions with respect to Germany as a whole.

Hamburg

8.23 The policies adopted in Hamburg have for a long period emphasized on a strong parking control policy in the centre, where a ceiling for the total number of parking spaces available at any one time was set in the early sixties. The city also operates one of the most efficient public transport systems in Germany where the government subsidy is one of the lowest, as far as the major German cities are concerned, but is high by British standards. This is made possible by a number of policies and strategies which involve the control of new development and land use. Money from developers is obtained to cover for the land act requirements of parking spaces. This money is then used to build park and ride facilities outside the centre and encourage the use of public transport. The city's public transport system is a mixed rail and bus system controlled by a unified body in charge of the coordination between the modes.

8.24 The Hamburg example was of the an *Autobahn* link bypassing a major busy area in the Greater Hamburg Area. Based on the figures and data plus the official views in Hamburg, the assessment of the scheme's objectives and its actual impact indicated no signs of counterproductivity. On the contrary, improved conditions for traffic were felt, to different degrees, throughout the whole area and even in nearby

regions. The scheme clearly proved to be effective with respect to the overall policies and strategies in Hamburg. It improved traffic conditions along the roads in its immediate corridor and did not result in worsening of congestion despite its radial nature, leading to the city centre.

8.25 In Hamburg, the second largest of German cities with some 2.5 million inhabitants in the region, this scheme appears to have fulfilled its objectives and improved traffic conditions along the parallel roads in its corridor. It joins a number of other motorways serving the city at a motorway interchange and assists in delivering German policies of carrying traffic growth on high capacity *Autobahns* .

Duisburg

8.26 Duisburg, a major industrial city in the Rhein Ruhr region is a city built for the car. Motorways sprawl around and inside the city, with many high capacity roads having been built. Until recently, the city has catered for the full demand for travel by car and facilitates it to the extent that free parking is allowed in the city centre and on city pavements. The transport policies have thus been orientated towards the motor vehicle, primarily due to the industrialised nature of Duisburg which relied heavily on the use and operation of the motor vehicle. There are, however, plans now to restrict car traffic in the centre, by means of parking control and parking charges, and the encouragement of the use of public transport.

8.27 The case study is that of a north–south motorway which passes through the city centre. The scheme was planned in the 1920's but its first stages were only realised in 1958/59 with two final stages being recently completed at both ends. The scheme proved effective in relieving a number of parallel roads along its corridor and delivering environmental and operational benefits via its different stages.

Düsseldorf

8.28 Düsseldorf, the capital of the Rhein Ruhr region plays an important role in communication between the different cities and towns in the region. Its central location exposes it to a lot of traffic between the different regional centres. The scheme considered in Düsseldorf was namely that of improvements to the road network in the city. These improvements were in terms of providing new links and upgrading existing ones. These measures were necessitated, primarily, by

environmental concerns but it also had operational and strategic significance in the area and the rest of the network. The scheme improved considerably the conditions on the residential roads that previously suffered from traffic related noise, pollution and visual intrusion amongst other environmental and safety impacts resulting from vehicle/pedestrian conflict. The building of the new road here was the only option available to take traffic out of the environmentally sensitive areas and improve the overall efficiency of the road network in general.

8.29 The overall impact of the scheme indicates improved environmental conditions and the realisation of the scheme objectives. Nevertheless, traffic grew on certain local roads in the immediate area of the scheme but that was attributed, by city officials, to road works associated with a complementary tunnel scheme in the area. The policies in Düsseldorf favour a reduction of traffic on local roads and pedestrianisation in the centre with priority given to the public transport system. Like most other German cities, the need for orbital and tangential bypassing roads is not overlooked, but environmental concerns and safeguards are not disregarded. An impressive example in Düsseldorf is that where a dual 3-lane section of the A46 is built in a tunnel with the covered and landscaped top used for recreational purposes by nearby residents.

Berlin

8.30 The examples from Berlin and Stuttgart were of the other side of the coin. Namely, two cases involving the improvement of the public transport system with the provision of a high capacity segregated rail public transport. This was in line with the other objectives of the research to see if public transport improvements had a significant impact on road traffic in their immediate corridor.

8.31 The Berlin example is a study of the impacts associated with the extension of the *U-Bahn* system to the district of *Spandau* which had been served perviously by buses only in terms of public transport. This extension linked *Spandau* with the other districts *in West Berlin*. This case study clearly demonstrates that public transport improvements, and in particular the provision of rail public transport, lead to a modal shift within the public transport system. Its impact, therefore, is largely redistributional within the system. Buses appear to be the mode mostly affected, loosing a large proportion of their ridership to the new *U-Bahn*.

8.32 The line's impact on car traffic along its corridor was very marginal. It is shown in the study that an increase in the use of the motor vehicle in Spandau and the control area Lichtenrade seems to be associated with this improvement in public transport. This may be due to the fact that any additional capacity freed by those transferring to the line has been taken up by trips made by people who previously had no access to a car. Although the increase in the private transport share in Spandau was not as high as that in Lichtenrade over the same period, this was attributed to other varying factors, such as car ownership, age group, employment and the social structure in both areas. The situation in Berlin, at the time of the study, was rather unique in the sense of the political situation and the resulting geographical implications. In the case of Berlin, the city was cordoned off and was effectively an island with very little movement across the Wall. The new situation now will most certainly lead to significant changes in trip patterns and journeys, but it should also remove any restrictions which once hindered the development of the transport networks and systems.

Stuttgart

8.33 With the forces of suburban sprawl affecting Stuttgart, there has been a shift to live in suburbs around the city. Being one of Germany's most affluent cities and with many industrial and prosperous centres in the region, the demand for travel in Stuttgart is continuing to increase. With one of Germany's higher car ownership rates, the city has had to deal with a problem of congestion along some of its roads. Roads leading to the centre have more or less reached their saturation capacity during peak periods.

8.34 The Stuttgart case study of a new *S-Bahn* linking the city of Stuttgart with the industrialised region of *Böblingen* has some surprising findings. Based on in depth surveys and studies carried out by both the city and the local public transport authority, it is clearly shown that the growth in motor vehicle traffic along the corridor of the new *S-Bahn* has increased substantially since it was opened and this increase was significantly more than the increase in traffic for all roads in the city.

Examples From Sweden

8.35 In line with the research objectives, It was decided to investigate the experience of urban road building in Sweden to see how different it has been and to try to establish the factors governing any differences that may exist with the experience in Britain. The two largest Swedish cities, namely Stockholm and

Göteborg, were selected for case studies which also covered the overall policies and developments of the various policies over the last forty years or so.

Stockholm

8.36 The location of Stockholm over fourteen islands gives it an advantageous position to control access via the causeways linking it with the mainland from all directions. The city has long adopted a policy of controlled parking space in the centre and has put a great emphasis on public transport. The nature of Sweden makes public transport a viable option in city centres only with the car being the main mode for travel within and from the outer regions.

8.37 The building of the scheme in question virtually doubled the capacity of the water crossing at *Skanstull*. The scheme, nearly 2 km in length and consisting of a bridge and a road in a tunnel through the city, did not, however, lead to much more traffic than would have been anticipated from annual growth. The scheme provided an improved radial link to the centre, and allowed the relief of the two parallel roads bypassed. Traffic levels on the older roads had exceeded practical capacity and were threatening further environmental and traffic deterioration along the roads. The old road, which went through a largely residential and busy area, was relieved of more than 60 per cent of its traffic.

8.38 On the subject of public transport, there was an immediate shift from public transport across this crossing point, but this was mainly due to the reestablishing of traffic patterns which had been affected by the road works associated with the construction of the scheme. In general, the share of public transport remained slightly higher than before across *Skanstull*. This clearly shows that the provision of this additional capacity helped improve conditions along other local roads and also improved the operational conditions along the network as a whole.

Göteborg

8.39 The case study of Göteborg was somewhat different from the other case studies. The city offered an example of the changes associated with a number of improvements to the network. The traffic development in the different areas in the city was largely influenced by the policies adopted to restrict traffic growth on local streets in the centre and allow it on orbital and tangential roads around the city.

These policies were complemented by the provision of new links and the upgrading of a number of others in the city.

8.40 The case studies present an overview of the existing transport situation in each of the cities, and the related transport policies adopted and deployed. This serves to shed some light on the different policies adopted, the similarities and the outcome of these policies. In the remaining paragraphs, the lessons to be learned will be outlined in the general context of this research.

THE LESSONS

8.41 The preceding chapters give a picture of the developments which took place in the countries considered over the past 28 years, where examples of new road schemes built in urban areas have shown that the different strategies and planning policies deployed have resulted in unique and different outcomes in each. Today, with the socioeconomic changes and their effect on land use and travel demand, many a country is faced with the increasing problems associated with traffic congestion. This research has attempted to determine how effective new urban road schemes have been in relation to their intended objectives, and whether or not it is still worth building new roads in urban areas. Another equally important objective was that of examining the experiences of other countries, namely the Federal Republic of Germany and Sweden, to see whether or not their experience in this respect has been any different, and if so, to try and determine why. In addition to these objectives, it was decided to investigate the actual impact major public transport improvements have on urban areas, in general, and the impact on directly affected road traffic in particular.

8.42 The case studies provided unique examples from the recent urban road building experience. A number of findings were reached based on factual data, personal surveys and observations, and discussions with officials and policy makers in the different countries. As explained earlier, there are very little similarities between the cities considered in terms of size, geographic location or transport system, however, they are all urban areas which have implemented, within the last 15 years, a new road scheme or a major public transport improvement. In the following paragraphs, lessons from the similarities and differences will be drawn.

8.43 Considering the examples of road provisions in the different areas, it is evident that none of the schemes considered has generated so much more traffic that it has lead to worsened conditions of traffic congestion and environmental deterioration, or in other words turned 'counterproductive'. On the contrary, the schemes considered have all been justified on environmental and operational grounds and as far as could be seen, they have certainly delivered their intended benefits. The degree to which these benefits were delivered varied from one case to another. This was due to a number of specific factors which also varied from one case to another.

8.44 From the earlier review of traffic development and associated road building in the different countries, it is evident that the German approach has differed completely from that in Britain. The Swedish experience has been very similar to that of Germany, but the elements of vast area and small populations create a different situation altogether there. After World War II, the extent of damage to German cities and their infrastructure provided the Germans with a unique opportunity to reorganise their towns and cities. At the time, Germany had a fraction of the road network Britain had, and an even smaller portion of vehicle ownership and numbers. In rebuilding their cities, the Germans were particularly influenced by the American views and approaches in city planning. This approach, with the car being an essential element, favoured the construction of extensive high capacity motorways and road networks. The Germans, however, also decided to rebuild their public transport systems in city centres, and even improve them and extend them further out.

8.45 Even before the War, Germany had nearly 3000 km of motorways, a very remarkable number given that Britain did not have a single kilometre of motorways then. Under reorganisation, German cities started to cater for the motor car and new roads sprawled to match the increase in car and vehicle ownership. Particular emphasis was on the motorway network which was expanding very rapidly. By the early 60's, traffic congestion began to appear on German streets. This lead to mounting concern and to transport and planning authorities facing demands of immediate solution to these problems.

8.46 Transport planning in Germany took a different route following the publication of the German report[13] in 1965. This was inspired by the Traffic in Towns Report published a couple of years earlier in Britain[5]. The Buchanan report was studied very carefully in Germany with seminars held for German planners all over the country

leading to the formation of Germany's own team to look into the difficult issues facing the transport system in Germany. The German report addressed the different issues and recommended a number of counter measures. These were taken by German planners and included: i) the removal of through traffic from city centres by means of improved public transport and parking control, and ii) the building of high capacity orbital and tangential roads around the cities to bypass busy centres and cater for the traffic growth.

8.47 Following this report, the Germans continued to build their motorway network at a much higher rate than the rest of the network which had by then surpassed its British equivalent. Between 1968 and 1983 the motorway network was doubled to more than 8000 kilometres or four times the British motorway network which stood at just over 2000 kilometres. In the late 60's the Federal Government decided to contribute to the public transport system by means of subsidy to promote these systems and encourage their use. A number of policies favouring these systems and giving them their own right-of-way were also adopted. A major step was also to unify the agencies controlling the different public transport modes under one authority. Today, most German cities have an authority responsible for overseeing the operation of the different public transport modes, and developing suitable policies to increase their ridership.

8.48 These policies include a unified price system, season tickets and self explanatory time tables. The success of public transport systems in German cities is also credited, to a large extent, to the marketing strategies and techniques devised by the authorities. Such strategies involve the promotion of the services via improved security and convenience (e.g. in Hamburg, taxi service is arranged at destination if requested). This has lead to the reduction of the high subsidies with many cities today at least recouping a larger part of the operating costs from the passenger revenue.

8.49 While improving the road network and public transport systems, German planners appear to have been aware of the implications of parking availability in city centres. Their policies therefore, and from as long ago as the early 1960's, have limited that availability and reduced long term parking, especially on-street parking, while catering for the essential business traffic with short term parking. Environmental awareness which also seem to have started earlier in Germany was an important factor in shaping city centre policies. British planners as early as the

'Traffic in Towns' report have also emphasized the importance of parking availability as a controlling measure for traffic in the centre. What appears to be absent in Britain, at least from personal observation, is the enforcement of parking restrictions. Without the adequate enforcement of parking regulations these cannot deliver their intended objectives. As part of their parking policy, the Germans appear to carry out the enforcement more effectively.

8.50 While the policies for city centres were geared at limiting the number of cars and improving public transport, high capacity motorways and roads were continuing to be built to cater for the increasing demand for travel by road which dominated the largest share of all inland surface passenger transport. Today vehicle and car ownership rates in Germany are amongst the highest in the world. Travel by road accounts for the largest proportions of passenger and goods mileage.

8.51 In Britain, the situation is rather different. In the early 50's, Britain had a much higher number of cars and roads than Germany. This however, was reversed in less than a decade. Britain had no motorways until 1958 when the first 8 mile link was completed. Afterthe War, British cities abandoned their tram systems and substituted them with buses as the main public transport system. Transport studies were made for British cities by American consultants who recommended the provision of vast and extensive road networks to cater for the increasing demand for travel by road. These, however, were largely abandoned in the early seventies leaving a far less extensive road network than in Germany. The construction of the inter-city motorway network progressed but at a much slower rate than in Germany, today it stands at nearly one third that of Germany.

8.52 In 1963 the Buchanan report delivered a vision of the future and put forward a number of recommendations for a balanced policy of urban road building and public transport improvements while maintaining environmental safeguards. In the event, very little has been done in line with these recommendations and the fears projected in that report are now realised in many of the British cities where congestion is becoming a daily event. Despite lower car ownership rates and less extensive road networks, the majority of passenger and goods mileage is covered by road transport. This is the only similarity with the situation in Germany.

8.53 In Sweden, the approach was similar to that in Germany. Sweden, however, had a significantly higher car ownership rate than Britain or Germany. The nature of

the country's vast area and small population, however, meant that a large proportion of travel was road based with public transport systems viable only in city centres. The country still maintains a high car ownership rate with travel by road accounting for the majority of passenger goods mileage covered.

8.54 The specific examples highlight specific lessons to be learned, there are a number of lessons which can be identified from the research in general. It is evident that the building of new roads in urban areas does not necessarily generate so much more traffic so that any benefits gained are countered by a 'counterproductive' impact. Even in conditions of suppressed demand (e.g. London) carefully planned schemes can enhance the capacity and traffic conditions while extending environmental benefits to the area (e.g. the Rochester Way Relief Road).

8.55 In Germany, it is obvious that the present system is better balanced than that in Britain. This is due to a number of factors including : i) a better and more extensive road network in general; ii) a well connected high capacity motorway network linking the whole country and providing high capacity bypasses to major cities and centres; iii) the coordination of different public transport modes under unified agencies; iv) the promotion of public transport by subsidies, traffic priority measures (e.g. own right-of-way),good marketing and complementary city centre policies; and v) the quick implementation of major schemes with built in environmental safeguards. The German system seen today, is the result of well balanced policies resulting from a well proportioned mixture of road building and public transport. The necessity and effectiveness of public transport in city centres is promoted and encouraged by means of traffic management measures. This, however, is not done on the expense of accessibility but is facilitated through improved accessibility of through traffic which in turn relieves congested centres. A number of associated measures are also needed to attract passengers on to the systems such as park and ride facilities outside the centres and enforced control of parking regulations.

8.56 Surely, one of the reasons for the greater progress in improving both the road and public transport systems has been the almost unerring continuity of transportation policies, free of the sudden political reversals which have been the plague of transportation planning in British cities.

8.57 The lessons from Sweden are not much different. Orbital and tangential high capacity roads enable the removal of through traffic from busy centres without hindering accessibility. Public transport plays a major role in city centres where it caters for the largest proportion of travel within the centres. As in Germany, recent environmental concerns have initiated the formation of study groups and advisory committees to look into ways of countering traffic congestion and improving environmental conditions. Cordon pricing is considered a viable option in major city centres. This may be feasible in Stockholm, for example, due to its geographic location and the ease with which access to the centre can be controlled. The growth in vehicle ownership has been surpassed by German levels but it remains higher than that in Britain.

8.58 In Britain the development of urban road networks has been much slower than that in Germany and Sweden. The growth in car and vehicle ownership was also slightly slower. In addition, public transport systems which were abandoned after World War II are only beginning to make a slow reappearance in some of the major British cities. While German cities have carefully planned their city needs and have developed the best suited systems to serve the particular needs of different cities, some British cities are only beginning to examine the feasibility of alternative systems. During the seventies, policies to encourage the use of public transport in the UK were directed at providing cheap public transport with most of the allocated subsidies going towards this goal. In Germany, however, subsidies were used to modernise the system and improve it while providing a reasonably priced service to the public. Recent policies in Britain expect public transport systems to be self efficient and to operate without subsidies; in Germany public transport is seen as a public service and an important tool to ensure the success of other transport policies and planning objectives. In some German cities, revenues from other profitable services (e.g. water, electricity etc.) may be diverted to compensate any losses accrued by the public transport operator.

8.59 It was certainly easier for the Germans to implement their policies favouring rail-based solutions to traffic problems in the city centres because they had maintained their tram systems after the War. Britain, on the contrary had scrapped its trams and substituted these with buses performing the public transport role. The situation is, as put in by Hall and Hass Klau[11]:

> 'So Germany has built generously while Britain has built relatively little. Twenty-one German cities have essentially new transit systems; Britain, stretching some definitions, has three.'

8.60 The balance existing in Sweden is also a relatively 'happy balance' based on the particular needs for the different cities and regions. This all points to the fact that public transport alone is not the panacea for all our traffic problems today. The prescription needs to be a well proportioned mixture of both road building and public transport where and when needed. The role of public transport is that within a wider transport policy which makes provisions for adequate road networks and sees that they are implemented with little delays. Public transport and road building are the ingredients in a more comprehensive package of supply and demand management techniques.

8.61 As demonstrated in the case studies of major public transport improvements, these alone have a very marginal effect on improving travel conditions by road. For such measures to operate effectively, other provisions within the wider policy context must be made. The public transport customer's needs should also be catered for adequately and public transport must be considered an independent system which serves important roles. It should not be seen only as a measure to relieve traffic congestion as it is very ineffective in this respect. Improvements to the system in terms of reliability, efficiency and security can result in maintaining its ridership and even attracting additional passengers.

8.62 What appears to be absent from all dialogues and arguments today is an understanding of the scale of the problem facing urban areas today. The issue is not simply that of roads turning 'counterproductive' and public transport being the better system, nor is it possible to cater for all the demand for travel by car. A balanced approach is needed to ensure the maintenance of good efficient systems and the improvement of those which are less effective.

8.63 The critical question is whether or not it is worthwhile building new roads in urban areas. All kinds of qualifications must of course be entered. It is not possible as a result of this particular study to give a definite answer, if for no other reason that the data available were not as good as one would have liked. The lack of cooperation made it difficult to obtain the data in the first place, and when it was available, it was fragmentary and sometimes not uniform. The timing of some of these figures is sometimes unfortunate in relation to the dates of opening of the new scheme, be it a new road or a public transport improvement. The number of cases studied is far too small to allow precise statistical conclusions, and the cases are not comparable in terms of size and character. Nevertheless, it is only fair to say that, even from

casual observation, new roads built in urban areas can improve environmental and traffic conditions along less adequate roads of the network, only, and only if, environmental safeguards are carefully incorporated with them. From the case studies considered, it is clear that the road schemes appraised have indeed been effective in delivering their objectives and living up to their expectations. The public transport improvements studied, on the other hand, have had no significant effects on road traffic. In fact, and as seen in the Stuttgart study, their apparent impact can be a negative one, with more traffic using the roads after the improvement. At the end of the day, it must be accepted that the phenomenon of urban congestion has deeper and subtle causes which are so far imperfectly understood. Public transport improvements have in large measure no significant impact to solving the problem, though it may have a marginal effect in some cases. The major impact of such improvements is a 'redistributional' one within the whole of the public transport system, which results usually in buses losing a large proportion of their share to the new rail transit. New road schemes in urban areas can be effective, and are necessary to implement a balanced policy which caters reasonably for the more essential traffic demands with the least environmental impact, or may even have the objective of improving the environment in specific areas.

SUGGESTIONS FOR FURTHER RESEARCH

8.64 The lack of information available clearly shows the need for a lot more work to be done in order that a better understanding of the congestion phenomenon, and the question of new roads 'generating' more traffic. On their part, local authorities should do more to maintain a data base of the road conditions in their areas. Traffic flows should be regularly monitored and consistent records need to be kept. In addition, records of the changes (e.g. land use, petrol prices, new public transport service etc.) which may have taken place over a certain period that may explain certain trends. In addition, records of the roads directly affected by the construction works should also be kept for future reference.

8.65 More comprehensive follow up studies are needed to assess the actual impacts of new road schemes. It may even be worth introducing a stipulation in awarding grants for major road schemes whereby full scale studies looking at the stated objectives; the environmental impact; the quality of life for the residents of the area etc; are an essential part of the scheme. The 'before' information should also be collected beforehand to ensure a successful outcome of the 'after' study. Origin-

destination surveys should be an essential part of any such studies, so that the changes in travel patterns are perceived. This in turn can enable a better understanding of the role played by new road schemes.

8.66 Journey time surveys are a good indication of traffic conditions on road sections. Regular surveys of the journey times and travel speeds need to be carried out by the local authorities to enable, and be part of, a thorough examination of the impacts of road schemes. These surveys should also be carried out over the same period to avoid seasonal variations. In addition to these, modal split figures should also be maintained by the local authorities who can cooperate more closely with public transport operators to ensure the best utilisation of resources in this respect, or to check the findings.

8.67 In comparing situations in Germany and Britain it is important to try and establish a better understanding via a more comprehensive picture of the conditions in both countries. One way of doing this would be to establish an inventory of roads by type and area, that is urban and rural. To be in a position to analyse further the inner forces controlling traffic conditions and congestion, a comprehensive study of comparable British and German cities (in terms of size; urban character; land use; and the quality of the transportation system) is no doubt necessary.

8.68 The research findings in respect to public transport improvements indicated that the impact of such improvements on road traffic has been marginal. However, and in order to reach more conclusive results, it is necessary to carry out specific comprehensive studies which involve measurements of journey times and travel speeds, as well as travel patterns for the system users 'before' and 'after' such improvements. It is also necessary to take into consideration all the relevant issues. From the data available, it was evident that even the most comprehensive study, namely that made 'before' and 'after' the Berlin improvement was not all that comprehensive when it came to the issue of relief afforded to road traffic. The study did not cover the traffic flows on affected roads. A comprehensive public transport study, should include this element to establish firmly the extent of relief, if any offered to the roads. It is also important to try and establish why only little change is experienced on the roads, and to try and determine where the new traffic, if it is new, comes from. More in depth studies are also needed to understand the underlying forces controlling modal split, and to try and identify the different underlying elements.

8.69 Comprehensive studies are also needed to appraise the effectiveness of the various public transport marketing strategies. This was an element often referred to in Germany as an essential part of having a good public transport system. These techniques can be assessed to see how applicable they can be in this country. Also, studies of subsidy levels for public transport and its long term implications are necessary for the implementation of suitable transport policies.

8.70 Another area of research is namely that of the parking regulations in the different countries and the extent of enforcement. The rate of infringements, to see how rigorously parking controls are being enforced, at what cost and whether it is worth it. That is, whether the results achieved are effective in the context of urban congestion and transport policy.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

8.71 To sum up, the research's general findings can be summarised as follows:

- The extent of the congestion problem varies from one city to another depending, of course, on the city 's size and urban character as well as the land uses and the transport policies. There is, however, no standard measure to assess the magnitude of the problem. The problem is most evident during peak periods. However, transportation policies should be aimed at dealing with the bulk of traffic carried during the off-peak period to ensure the maximum efficiency of the transport systems. In Germany, they cater for the 'essential business traffic' identified as that between 0900-1500 hours (e.g. Hamburg).

- New roads in urban areas offer relief to adversely affected environmentally sensitive areas. Carefully planned and well designed roads (e.g. RWRR) can be an effective solution to environmental problems in busy local streets. However, to ensure the continued removal of extraneous traffic from these streets, adequate traffic management measures may well have to be applied to the relieved sections to safeguard against a repeat of previous conditions. In areas of high density, new road schemes may have to be built in tunnels where their costs are offset by the public's acceptance and benefits derived from the significant reduction of the visual impact (e.g. Düsseldorf).

- The provision of orbital and tangential routes, preferably with connections to the high capacity network (motorways), can divert traffic from local streets onto these higher standard roads (e.g. Göteborg, Düsseldorf etc).

- Parking control, strictly enforced, does appear to be a reasonably effective measure in controlling city centre traffic. Strict enforcement is however essential, together with careful consideration of the types of demand in different areas and the extent to which those regulations can be justified. Hamburg, and Stuttgart do appear to be exemplary in this respect.

- The application of effective policies requires good coordination between the different authorities responsible for road and traffic planning; land use planning; and public transport management. The control of the different public transport modes under one body also helps to improve the efficiency of the system as a whole and reduce the conflict between the different modes (e.g. Berlin). Major public transport improvements have only a very marginal effect in relieving traffic conditions on parallel roads. They do, however, improve the general situation within the whole public transport system due to their redistributional effect. Their major impact on road traffic is in causing a shift from the bus to the new system leading therefore to less buses on the roads (e.g. Berlin, London).

- The road schemes appraised, in the case studies considered, have all fulfilled their objectives without showing signs of becoming congested immediately after opening. Even after a considerable number of years after they have been opened (e.g. in Duisburg, Stockholm, and Hull), the roads continue to provide improved links and extend environmental benefits and relief to areas previously plagued by extraneous traffic.

- The German cities considered vary in size and urban character. However, they all have similar characteristics such as extensive road networks with many Autobahn links, and strong orbital and tangential roads; and a strong public transport system serving the centre. The policies adopted for the centres emphasize the importance of having a first class public transport system. This usually is in the form of rapid rail services going underground in the city centre, with buses serving a feeder role from the outlaying areas and nearby regions.

– Public transport, in Germany and Sweden, is considered as an essential public service which needs to be given public support, both in terms of financial and operational assistance. In both countries, very substantial subsidies are provided by the government (Federal and local) to maintain high standard systems. Special policies are also adopted in the centre to give the systems an edge over the motor vehicle as a mode of travel.

8.72 From the information obtained in Germany and Sweden via discussions and meetings, from the specific case studies, and by simple observation, it can be seen that the Germans, and the Swedes, have approached transportation issues in rather different ways than in Britain. The Germans have continuously maintained and improved their public transport systems particularly within the centres. A strong marketing strategy has always backed these systems providing incentives and improved safety and comfort for the patronage. The road networks, as shown in Chapter 2, were considerably extended and improved to meet the growth in the motor vehicle while taking into account the environmental considerations.

8.73 Another important fact is that there appears to have been much more consistency in the development and implementation of the transportation policies in both Germany and Sweden. These policies do not seem to have been so affected by political dogma and changes in governments. This has certainly not been the case in Britain. Transportation planning has been more of a political shuttlecock than in Germany and Sweden. It has therefore suffered with every change in the political body, leading to the poor travel conditions that are experienced everyday in practically all the major cities. The scrapping of plans promoted by previous governments has plagued the field and has lead over the years to the conditions we experience today on many urban roads. Public transport has also suffered adversely with no consistent and supportive government policies or marketing strategies to promote the systems and continually upgrade them. The state of urban transportation systems in Britain has become a major issue which requires immediate attention. A lot of work has to be done, and at a fast pace to make the necessary changes to the way things are today. A lot of the German policies were influenced by the 'Traffic in Towns' report and by the German version of this report[13]. The ideas put forward in the reports have been pursued and modified accordingly to suit the different needs of different cities, and to reach the balance needed for the best results in terms of efficiency and effectiveness.

8.74 It can therefore be said that in order to achieve the 'happy balance' referred to, the following points must be taken into consideration:

- To achieve the objectives outlined and cater adequately for the essential demand, there is a need for continuity in transportation planning .

- Better roads, carefully planned and well-designed, are needed to improve travel and environmental conditions. These should incorporate safeguards to prevent adverse impacts on the surrounding area. There is a particular need for more orbital roads and better connectivity with the national road network.

- Much better public transport systems are needed, in terms of reliability, comfort and safety, backed by a strong marketing strategy which allows them to compete with the private car. In city centres, special policies are needed to make the public transport system more attractive (i.e. better services, higher standards, improved reliability and priority over other road based modes). This approach will probably require the reintroduction of light rail systems. Finally, public transport should be considered a public service and not a profit making enterprise. It should be provided even on the grounds to cater for the essential travel needs of people with no access to cars. With public support, the public transport system can contribute effectively to an improved overall transportation system.

- When considering public transport, a thorough study and understanding of the particular needs is required to determine the most suitable system to serve these needs. A combination of different modes may be needed to achieve the best possible results.

- A unified body is required to coordinate policies for the different public transport modes and ensure that the systems are managed in the most efficient way. Public transport should also be viewed as a public service and not as a self-sufficient, profit making enterprise. A rather long term strategy is needed to improve the ridership by improving the conditions and reducing the customers' costs.

CHAPTER 9 SUMMARY AND CONCLUSIONS

9.1 The objectives of this research were to examine first hand the effectiveness of new roads in urban areas. This was done by means of investigating what has actually happened to traffic levels, environmental conditions and when possible travel times and people's attitudes, when a new scheme had been implemented. Roads built within the last 15 years were considered so as to provide an up-to-date picture of the situation. Attempts were made to obtain information as to the road impacts on the public transport services, particularly within the corridor of influence. Some of the author's contentions were put forward together with other contentions made by people like Downs and Mogridge, which were reviewed. The research set out to assess the validity of these contentions in the research context.

9.2 In order to give the research a wider horizon, it was decided to cover not only examples from this country but also examples from Europe and in particular Germany and Sweden. It was rather obvious that Germany, well renowned for superior road and public transport systems should be considered in order to ascertain what factors or elements govern such advanced systems, and whether the problems in Germany are much different from those experienced here. Examples from Sweden were made especially attractive in the light of the specially appointed Parliamentary Committee which is looking into future policies and statutory changes needed to implement a revised transport policy which responds to growing concern over traffic conditions and the environment.

9.3 It is not just examples of road building that have been considered, but also examples of major improvements to the public transport system. This was to see whether such improvements had the expected effect of relieving traffic congestion and improving travel speeds on parallel roads. Examples were provided from London, Berlin and Stuttgart. The first two cases were of new underground links in the centre, and the last was of a new suburban railway (*S-Bahn)* link between a suburb and the city centre. Altogether, the study examined 10 cases, seven of which were examples of recent road schemes implemented in urban areas of various sizes. The remaining three examples were of improvements to the public transport system. The transport policies adopted in each of the cities considered are also reviewed, together with the

views of local officials. Conclusions are drawn as to how these policies affect the outcome of the schemes implemented.

9.4 The lack of the necessary 'before' and 'after' information was, to a variable degree, a common feature in all the authorities approached in the different countries considered. The selection of the case studies therefore was simply based on the suitability of the scheme in terms of the data available and the local authority's willingness to help. This in turn resulted in each case study being a unique example in itself with the assessment undertaken being based on different elements in the different cases.

9.5 The first and by far most comprehensive case study is that of the Rochester Way Relief Road in London. This latest addition to the strategic road network in London has been thoroughly appraised in terms of its operational, environmental and economic impacts. The study examined the traffic flow changes within the corridor, the environmental impacts felt in the area and a more comprehensive questionnaire survey which assessed the local attitudes, both before and after the opening of the road was carried out. Based on the evidence available, the study demonstrates that the scheme has been effective and worthwhile in so far that its intended objectives have been largely realised. Its overall impacts on the area resulted in more people enjoying improved environmental conditions (as inferred by the reduction in traffic flows along the relieved roads) than those adversely affected. The scheme itself is a feat of engineering with built-in environmental safeguards.

9.6 It may be inferred from the different strands of evidence presented (e.g. DTp cordon and screenline counts, Questionnaire etc.) that this London case study showed that the addition of a 50 per cent more capacity within the corridor did not 'generate' all that much more traffic than what would have been expected as a result of traffic growth. This is contrary to suggestions that new roads fill up with traffic and lead to worsened conditions. Traffic growth along the corridor has been no more than what would normally be expected in that area during the time period considered. Nevertheless, a full assessment of this may require a more detailed approach and in-depth surveys.

9.7 However, The traffic management measures implemented with the scheme, do not seem to be particularly satisfactory, probably because they are not as comprehensive as the traffic calming measures adopted in some residential areas in

Germany or Holland (*'Verkehrsberuhigung* and *'Woonerven'*, respectively). This has lead to complaints by residents whose local journeys and travel patterns have been affected. This points to the need for more comprehensive traffic management packages and more financial resources to carry them out.

9.8 The schemes considered in Kingston-Upon-Hull and in Portsmouth equally provided examples of effective urban road building in small and medium size British cities. In Hull, the new road has certainly attributed to the relief of traffic congestion along other main east-west radials in the city, leaving more favourable conditions for the public transport operation in the city. The scheme is also assisting in the redevelopment of the docks area in Hull. The situation in Portsmouth is somewhat different since the majority of traffic, on the scheme considered, is destined to points within the city due to its island nature (Portsea Island). Nevertheless, the relief offered to parallel roads within the corridor has been considerable. Public transport operations, in both cities, do not seem to have been adversely affected, but a more thorough investigation of this issue was restricted by the lack of cooperation from the operators due to fear of competition (resulting from bus deregulation). It can therefore be inferred that the market which provides conditions for operators to compete cannot be adversely affected by road building. The contentions put forward by Downs do not apply in either city.

9.9 In Britain, the implementation of new road schemes is a very lengthy process. The need for the schemes considered had been identified many years before they were finally implemented. The Rochester Way Relief Road, for example, was realised some 20 years after plans for it were more or less finalised. This slow process of implementation does not take into consideration the changing needs and the additional growth in traffic. This may explain why some roads seem to fill up with traffic not long after they are opened, if this is the case. Also public transport in these cities (Hull and Portsmouth) is road borne which makes it more vulnerable to modal shifts, however, the information available from discussions and correspondence with officials in the different agencies, indicates no significant changes or loss of passengers. If we take Downs' Law in this context, it does not hold good. With respect to the Mogridge conjecture, the impression given by public transport operators is that the relief afforded to the roads parallel to a new road has improved the reliability and time keeping of the operation significantly. This in turn has lead to the system being more attractive and, in some instances, to more people

using it along improved routes. This suggests that the Mogridge Conjecture in its basic form does not hold good here either.

9.10 The examples considered in Germany indicated no sign of 'counterproductivity'. The schemes examined have met their intended objectives and improved environmental and operational conditions along their corridors of influence. The cases also shed further light on German policy towards road building and public transport. The tendency now in Germany is to build high capacity bypasses to relieve congested sections of the network. These new links are usually connected to the motorway network providing much improved accessibility. The Hamburg example is a clear demonstration of this principle. The scheme was implemented at the first signs of congestion and before any worsening of traffic conditions. In addition to relieving congestion, it also created a major redistributional effect within the whole region and even beyond that.

9.11 The example from Duisburg clearly shows that the implementation of a motorway, through the city centre, has contributed to the removal of through traffic from other local roads and has reduced traffic congestion. It has also provided a strategic link with the rest of the motorway network around Duisburg. Duisburg, however, is a city built for the car. The road network serving Duisburg and its surrounding region is very extensive with a large proportion of motorways. Until recently, the emphasis in Duisburg has been to cater for the car even by providing free parking in its centre. The changing face of the industry in Duisburg and environmental concerns nowadays are pressing the city to adopt a more favourable approach to public transport especially in the centre.

9.12 The Düsseldorf case study displayed the important role new roads still play in relieving congested areas and improving environmental conditions. The scheme in Düsseldorf was the only solution to remove the high proportion of heavy goods vehicles from residential streets where the vehicle intrusion and environmental impact was rather threatening. In Düsseldorf, the policies were in line with those in the rest of Germany with respect to providing high capacity orbital and tangential routes around the city. The city's location also contributes to the traffic flow along its arterials.

9.13 Swedish examples showed no sign of counterproductivity. On the contrary, the scheme implemented in Stockholm has relieved the busy parallel residential and

shopping street. It has provided an improved and environmentally safeguarded link leading to the city centre. The doubling of the capacity at the major water crossing did not lead to so much generated traffic, or to a significant modal shift from public to private transport. The public transport share remained higher than before the construction of the road. In Göteborg, the situation in general indicated the effectiveness of new road schemes in urban areas when coupled with other traffic management policies and measures.

9.14 The examples of improvements to the public transport systems in different cities provided us with a picture not very different from one place to another. Although the Victoria Line in London was the latest addition to the Underground Network in some sixty years serving the central area, and under conditions of suppressed demand its impact was largely redistributional, and was largely confined to the public transport system. The impacts varied from one mode to the other; considerable relief was afforded to congested sections of other underground lines; a number of journeys involving British Rail were diverted to the Victoria Line; and buses lost a large proportion of their share to the line. The impact on private road traffic was far less than forecast in earlier studies, with only a small number of journeys diverted to the new line.

9.15 The Berlin example showed similar results with the greatest impact of the new U7 line being on bus patronage. The impact on private transport was rather marginal. In Stuttgart, the provision of a new S-Bahn service between the industrialised region of Böblingen and the city centre had no outward effect whatsoever on private transport on roads in its immediate corridor. Surprising findings which emerged from studies carried out by the city planning department and the public transport operator show that traffic growth on these roads was much higher than that on other roads in the city.

9.16 The evidence from theses cases confirms that the building of new road schemes in urban areas can still be effective and does not lead to adverse and worsening conditions when coupled with suitable overall transport policies; efficient public transport; and traffic management measures to prevent the situation from reverting to the previously unsatisfactory conditions. It also shows that the improvement of public transport without any further measures (to promote the system) has a marginal effect on road traffic. In cases of suppressed demand (e.g. Stuttgart) some surprising results confirm this. Its major impact is a redistributional

one within the public transport system and its different modes. The most significant effect appears to be on buses, which tend to lose a large proportion of their share to a new rail improvement. In Germany and Sweden, the public transport systems are considered on their own merit, as well as an essential part of more comprehensive transport policies.

9.17 The Mogridge Conjecture may not be applicable to the case studies covered in this research simply because they are, in general, medium size cities. None of these cities nor their centres are comparable in size to London. To examine the Mogridge Conjecture in detail, further in-depth research of large cities is needed. This however was beyond the scope of this study.

9.18 All the aforementioned conclusions lead us to try and establish how well founded earlier hypotheses presented in Chapter 1 have been. The first hypothesis was in relation to what has actually happened when a new road has been built in an urban area to improve traffic conditions, particularly those designed to relieve traffic congestion and promote higher speeds and shorter journey times. In this respect, the research hypothesis was that such provisions will not necessarily lead to a situation where so much more traffic is generated that any benefits achieved are cancelled out because the level of congestion would remain much the same or even worse, with no improvements to overall travel times. From the available evidence, the case studies have demonstrated that the amount of traffic on all the roads studied which were implemented 5 years ago or more has not increased by more than would have been expected as a result of normal traffic growth. Those cases also showed that the improvement in traffic and environmental conditions on parallel roads in the corridor were not short lived ones. All this lends further support to the hypothesis made earlier.

9.19 The second hypothesis related to the impact of a new road on public transport services in the corridor of influence. In this respect, the contention was that with a properly designed and managed highway and traffic system, there should not be a significant shift in the mode of travel. This has been demonstrated in the case studies, (in so far as it has been possible) and there were no indications of an adverse impact even when the public transport system was road borne. The second hypothesis, therefore, holds true in the cases investigated.

9.20 With regard to the Mogridge Conjecture for car use in conditions of suppressed demand, the third hypothesis was that, any improvement to the public transport system may significantly improve accessibility for the public transport user, however, its effect on improving traffic speeds on congested network roads would be marginal. This has clearly been the case in the three cases considered. The provision of major public transport improvements in situations where a large degree of suppressed demand for car use existed had very little impact on private transport on parallel roads. When these conditions of suppressed demand were very high, as in Stuttgart for example, the growth in traffic along the roads influenced by the new line was much higher than on other city roads. The studies thus lend support to the hypotheses put forward in Chapter 1.

9.21 Each of the specific case studies presents a unique and different example on urban road building and public transport improvements in Britain, Germany and Sweden. Overall, the collective findings of all the cases seems to indicate that the building of new roads in urban areas is worthwhile and often very necessary, especially when environmental and operational improvements are achieved as a result. The provision of new roads in urban areas does not simply tend to generate more traffic, and thus aggravate existing traffic problems, provided safeguarding measures are taken to ensure that previous conditions of traffic congestion and adverse environment do not return to the roads and areas relieved.

9.22 The building of new roads in urban areas does not lead to adverse traffic and environmental conditions when appropriate safeguarding measures are taken. This, however, is not a suggestion that all road building is effective, or that it is the only answer to current traffic problems. What is needed in this respect is a well balanced policy to provide adequate road capacity while promoting reliable and efficient public transport in city centres and dense urban areas. A full solution to current problems may be far away pending more advanced technologies and research, but until then more research into the actual impacts of new roads in urban areas is needed to establish effective measures to counter any adverse effects.

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APPENDIX A (CHAPTER 1)

THE LAW OF PEAK-HOUR EXPRESSWAY CONGESTION

A.1 From as early as the 1960's, large American cities were experiencing the discomforts of traffic congestion on main roads and arterials. With the majority of the work force commuting to work via the motor vehicle, traffic conditions were worst during the morning and evening rush hour periods. Despite the building of new highways and 'super roads' to connect the downtown business district with outlying areas, traffic congestion characterised the morning journey inwards and the evening journey outwards.

A.2 To Downs, the building of additional roads did not do much to solve the problem because of the 'traffic equilibrium' forces. This was put in the form of Downs' Law of Peak-Hour Traffic Congestion, which is really Parkinson's Second Law adapted to traffic, which stated:

> *'On urban commuter expressways, peak-hour traffic congestion rises to meet maximum capacity'.*

Downs' model of commuter-decision making was based on the following assumptions:

a) commuters seek the minimum journey time to and from work, they are constrained by income, transportation costs, place of residence and personal comfort.

b) commuters follow the law of inertia: commuters follow selected means of transportation and specific routes until some alteration in the environment forces a change.

c) an alteration in a commuter's environment is an event which convinces the commuter that a shift in route or mode could reduce his travel time.

4) commuters are classified into two basic categories:

i) explorers: aggressive drivers constantly in search for new routes with minimum travel times.

ii) sheep: Placid drivers, who will travel the same route unless a sudden change in their environment occurs.

A.3 An example of the 'traffic equilibrium' is given whereby two routes (A and B) are assumed to be connecting two points (a city centre and a suburb for example) say (C and D). These routes pass through other suburbs and a 'typical' time is consumed going on route A, and another 'typical' time is consumed by going on route B. If these two times are equal, then a balance is established. If they are not equal, an imbalance exists. Explorers shifting from one route to another in search of

minimum travel time will discover that one (say, Route A) takes less time. It will then become their normal route. With this shift continuing from B to A, the level of congestion on Route A rises as that on B falls, leading to an increase in the total time required on Route A and a decrease in the time on Route B. When the two travel times become equal, equilibrium has been established.

A.4 An analysis of the effect of a new expressway upon commuter congestion is presented by Downs who goes on by assuming that traffic equilibrium has been reached prior to the building of the expressway. The new highway (non stop, limited access, multiple lanes in each direction, linear length less than the length of any alternative route) is opened linking the downtown business district' with outlying suburban areas. Hence, travel time between the city centre and the residential areas served by the new road is much less than on previously existing routes. The impact on commuter congestion is seen to depend, to some extent, upon what forms of public transportation are operating in the city concerned. Downs considers three separate cases and assumes that both the total number of commuters and automobile ownership among them remain the same before and after the new expressway is opened. These cases are considered briefly hereafter.

Case A: A City with Auto-Driving Commuters Only

A.5 The opening of a new expressway would reduce peak-hour traffic congestion on many previously existing streets as a result of large numbers of commuters shifting onto the new expressway. This shift continues until the time required for commuting on the expressway rises (due to increasing peak-hour congestion) and that on alternate routes falls as traffic on them decreases. When these two times become identical, equilibrium is restored. However, route shifting onto the expressway will continue until the average speed on the expressway is reduced to below the average speed on alternate routes. Downs says that 'congestion on the expressway has risen to surpass its optimal capacity'. This is seen as necessary outcome of the forces of traffic equilibrium. In this particular case considered (a new expressway serving the city centre of a city in which all commuting is done by the automobile), a new expressway is seen to have the following effects:

1) reduce traffic on existing streets (before the opening of the new road), thereby decreasing the average journey time on these streets,

2) carry heavy traffic loads during peak hours, heavier than its optimal capacity. As a result serious congestion will be created. However, using the expressway, commuters will still have faster trips than they did before it was opened,

3) shorten the duration of the peak traffic congestion.

The question of cost incurred, and benefits achieved could not be addressed in this case since it depends upon particular factors involved in each city.

Case B: A City With Both Auto-Drivingand Bus-Riding Commuters

A.6 Bearing in mind the same assumptions made for Case A, the opening of the expressway relieves congestion on all existing streets, hence enabling buses as well as cars to move faster at peak hours. Even though better service to bus riders is now available, in relative terms, bus service does not speed up as fast as commuting by automobile due to the nature of the service (stopping, loading passengers etc.). A modal shift from buses to private cars occurs, leading to a rise in congestion thus offsetting the initial improvement in travel speed achieved by the new road. Many factors determine the extent to which this shift tends to return traffic congestion on city streets to its pre-expressway levels, these include:

a) the percentage of commuters who used the bus service on parallel routes before the new road was opened,

b) the incomes of bus commuters,

c) parking cost and availability at the final destination.

A.7 Another impact of this modal-shift would be reflected on the cost of bus travel per person which will increase as passenger revenues fall. Pressure on the public transport operator will lead to a reduction in service, or an increase in fares or both. Either measure will have an effect (reduced desirability for public transport) leading to another modal-shift, hence an even worse bus revenue situation. As a result of this second modal-shift there would be two possible outcomes: i) a vicious circle which would eventually cause the bus operator to go bankrupt and ceases operation, or ii) a very slight fare increase over the whole bus system would probably compensate for a very large withdrawal of customers in the section the competing with the new road, and this is seen as a more reasonable outcome.

A.8 The completion of a whole series of new roads in one city may produce a very devastating effect on the city's bus system. Assuming that some bus service still existed after a new equilibrium point had been established, this new equilibrium will have the following characteristics in relation to the situation before the new road was opened:

a) travel times will be less than before opening the new road,

b) a large proportion of commuters will use automobiles and a smaller proportion will use the bus,

c) an increase in fares, a reduction in the total bus service or even both may have occurred due to the reduction in the number of passengers,

d) the benefit obtained (improvement in traffic congestion and hence a reduction in travel time) will be less than what it would have been without the increase in automobile use.

Case C: A City with Segregated Track Public Transit and Auto-Driving Commuters

A.9 The forms of transportation referred to here, are those with segregated tracks. That is, systems with rails or roadways which have their own right-of-way (by means of elevation, depression or fencing). These include: underground trains and elevated trains. A crucial characteristic these systems have in common, is that their segregation from other forms of transport means that they are speed or efficiency are not directly affected by the level of automobile congestion.

A.10 The effects of a new road in a city served by such systems are initially the same as those in the two preceding cases. Traffic congestion falls on city streets, heavy peak-hour congestion is experienced on the new road, however, all street based commuters experience an improvement reflected by reduced travel times. This improvement, however, does not affect the speed of a segregated track system, and therefore, users of this system will experience no change in travel times. A shift to the more desirable automobile takes place. This shift extends beyond peak-hour commuting to off-peak hour commuters. Shopping trips, and other journeys that usually take place outside the peak-hour periods, will now be made more and more using the new road and the motor vehicle. This will lead to a concentration of the total load on fixed-rail segregated track system in peak hours. This drop in off-peak hours commuting, is more significant than the drop experienced during peak-hours. The loss of passengers would increase the operating costs and lead to an increase in fares, or a reduction in services or both. As a result of more people commuting by automobiles, the level of traffic congestion begins to return to what it used to be prior to the opening of the new road.

A.11 Since there had been no change in travel times by rail, it would seem that the original equilibrium would appear when the initial automobile travel time was again restored. However, the original situation could never return because the new road has absorbed a great many former riders of segregated track transit. The number of passengers using such transit has been permanently lowered. With the deterring effect of increased fares or reduced services, congestion on the network may have to become slightly worse than it was before the opening of the new road, before automobile travel becomes equally undesirable (as segregated track transit). Furthermore, only the marginal equality of these two undesirabilities can establish a new equilibrium. As a result, Downs arrives at the 'paradoxical conclusion' where he states that

> 'the opening of an expressway could conceivably cause traffic congestion to become worse instead of better, and automobile commuting times to rise instead of fall'.

A.12 This outcome is seen as 'almost a certainty' if the segregated track operator is caught into the vicious circle leading to bankruptcy and to the withdrawal of services altogether. This would cause all former ridership to shift onto buses and automobiles, and congestion on the streets will rise to record levels. Even with the introduction of a new equilibrium the expressway will be heavily loaded during peak hours and almost certainly beyond its optimal capacity. Downs concluded that his law (congestion rises to meet maximum capacity) still holds true.

A.13 Assuming a new equilibrium is finally established, it will have the following characteristics in relation to the situation which existed before the opening of the new road:

a) a larger proportion of travellers will use automobiles. Only a smaller proportion will use segregated track transit,

b) passengers ridership on the segregated track transit will be smaller and the load will be more heavily concentrated during peak hours,

c) the above mentioned changes will increase the cost of providing segregated track transit (per person per mile),

d) adjustment to the higher costs and lower revenues made by segregated track transit facilities are made by: i) increasing fares; ii) reducing services; iii) reducing the profit margin or accepting larger losses; iv) a combination of the above; or v) going out of business,

e) peak-hour congestion and average travel time per trip on city streets other than the expressway may be less than, equal to or greater than it was before the expressway was opened. It all depends upon the shift of commuters from the high capacity system to the private automobile,

f) 'peak-hour congestion on the new expressway will surpass its optimal capacity, therefore the average speed of commuters using it will probably be lower than the average speed of those using alternative routes on older city streets (although total commuting time for both will be the same), even if the average commuting time for all auto-driving commuters has fallen'.

A.14 It should be noted that the preceding analysis was based on the assumption that both the number of commuters and automobile ownership among them did not change and were the same before and after the expressway was opened. It is obvious that the similar analysis taking into account the increase in car ownership, and the total, and population distribution enforces the probability that a new expressway will be congested during peak hours. With automobile ownership expected to continue rising, especially if real incomes continue to increase, then peak-hour traffic congestion on commuter expressways is likely to increase throughout the foreseeable future. The shift to automobiles, as shown by statistics from American cities, is caused by:

a) the increasing car ownership rates and car use, especially during the postwar period,

b) the lack of public transport systems in new areas of population growth (low-density suburban residential areas).

A.15 All of the preceding analysis by Downs was based upon the assumptions concerning commuter behaviour stated early in the appendix. If those assumptions accurately describe the way commuters behave in the real world, Downs's analysis leads to the following conclusions:

a) peak-hour congestion rises to surpass the optimal capacity provided,

b) building new roads to reduce congestion is not an effective measure in large metropolitan areas due to forces of traffic equilibrium,

c) congestion on expressways should be expected every day. However, improved travel times may exist,

e) different design goals should be employed, with more emphasis on designing for low congestion and optimal speeds during off-peak hours,

e) in cities where a high proportion of commuter traffic is carried by segregated track transportation modes before the expressway was built, the opening of an expressway may lead to worsened peak-hour traffic congestion than before the expressway was opened,

f) programmes of expressway planning and construction must be integrated with similar programmes concerning other forms of transportation in the area.

REMARKS AND CONCLUSIONS

A.16 Downs's law which was introduced in some detail in the few previous pages, is a hypothesis based upon a pattern of logical events sequence in different cases and under different circumstances. It attempts to present a reasonable prediction of what the transportation situation in general, and the peak-hour traffic congestion in particular may look like as a result of an increase in the road network capacity.

A.17 The cases taken to show how 'traffic equilibrium' forces operate, tend to agree on the general issue of improved travel times. It is only in the case of cities in which a high proportion of commuter traffic is carried by segregated track transportation that a peak-hour traffic congestion worse than before the expressway was built may occur. In general, it seems that a benefit of some kind will still exist for commuters in general reflected by improved travel times. Even though it may not be to the extent expected or sought, still it remains an improvement.

A.18 The assumptions made by Downs in his work may not always represent what may really happen. It assumes no change in car ownership or the number of commuters before and after the opening of the new road. Even though this assumption was used to strengthen his argument of the probability that a new road will be congested during peak hours, still it does not take into account a reduced car ownership factor, or a less number of commuters (loss of jobs, a change in the area structure, or even more opportunities in other suburbs rather than in the city centre).

A.19 Downs's hypothesis may apply to large metropolitan areas. Furthermore, it can be said that it is valid for the specific case of an enhanced capacity in the form of an expressway of certain specifications (limited access, multi lanes in both directions, higher speed limit etc). The hypothesis ignores a number of important factors when it assumes a large modal-shift just as a new road is opened. It does not take into consideration the issue of parking availability and cost at the final destination (city centre), and seems to indicate available unlimited parking for all those who wish to shift. It is also very hard to imagine a modal-shift large enough to have the devastating effect of shutting down a public transport operator especially in a city like London with the restricted car parking availability.

A.20 It would be interesting to see if Downs' Law applies in real life to smaller cities (e.g. any of the case studies). It must also be remembered that the increase in peak-hour traffic congestion when capacity is improved is the natural outcome of people's changing their travel habits (more people want to travel in peak-hours). This however should not affect our perception of the advantages gained by off-peak traffic, which is the major constituent of the traffic bulk. Another important point to make here is that Downs's law does not necessarily claim that new roads generate more traffic. It only describes the changes associated with the opening of a new road through the changes in traffic patterns, and under the influence of traffic equilibrium forces during the specific peak-hours period. The traffic equilibrium discussed in Downs' Law refers to travel times on different routes, and three is no indication of travel times becoming reduced to worse than before except for that one particular case with segregated public transport.

A.21 The speed of public transport is only affected when road based transport (buses) is considered. According to Downs' conclusions, congestion could rise to record levels, with speeds falling drastically. Only in the case of a complete withdrawal of essential segregated track transit services, would such a situation arise. This would be due to the former ridership shift onto buses and automobiles.

APPENDIX B (CHAPTER 1)

THE MOGRIDGE CONJECTURE AND FURTHER ARGUMENTS

B.1 The work of Martin Mogridge with some relevance to the research is that on travel speeds by car and by public transport. He examined travel speeds in Central London by using the Greater London Transportation Surveys (these are household interview surveys which were carried out in 1962, 1971 and 1981 and covered some 40,000 randomly chosen households throughout Greater London).

B.2 The basic contention[1], with much credit given to Michael Thomson, was stated as follows:

> *'in conditions of suppressed demand the speed of the road network is determined by the speed of the high-capacity network (rail, bus, etc.)'*

where suppressed demand for car travel was defined as those who use public transport despite having the choice of using their cars.

B.3 This contention suggests the existence of 'trafficequilibrium', the forces of which are demonstrated in travel speeds by road traffic and those by road borne or segregated public transport. To improve travel speeds on the road, these of public transport must be improved first. The opposite is, however, not true and only leads to a shift of enough car owners from the high capacity network onto the roads until speeds were in equilibrium again. The contention went further to include:

> 'a) if services are then reduced on the high-capacity system road speeds will be lower than before,
>
> b) in conditions of suppressed demand the way to improve road speeds is to improve the speeds of the high-capacity systems,
>
> c) the way to increase bus speeds is by removing road capacity from cars and running high-capacity bus lanes'.

B.4 Subsequent work by Mogridge went even further in arguing the validity of improved road capacity. Mogridge states that attempts by road traffic engineers to solve congestion and delay in urban road networks by increasing capacity (e.g. computer control of traffic signals, traffic management, junction design and by building new or improved roads is not the answer. He argues that:

> 'such increases in capacity do not increase traffic speed if traffic demand is sufficiently high, but do increase the risk of traffic jams when blockages of the network and especially of junctions occur, since there is increased traffic on essentially the same network as before'[2].

Therefore, the only answer, or prescription, in Mogridge's view is that :

> 'we should build a substantial amount of new railway, especially underground in the centre linking the national networks; we should also reduce the central road space used by the inefficient user of space, the car, and reassign it to the efficient user of space, the bus and tram'[2].

B.5 It is clear from all the above, that Mogridge and, of course, others who believe the same way, see that the building of new roads does not improve travel speeds for road traffic. On the contrary, they contend that with time it can have the opposite effect of reducing travel speeds of both road traffic and the existing high-capacity transport system.

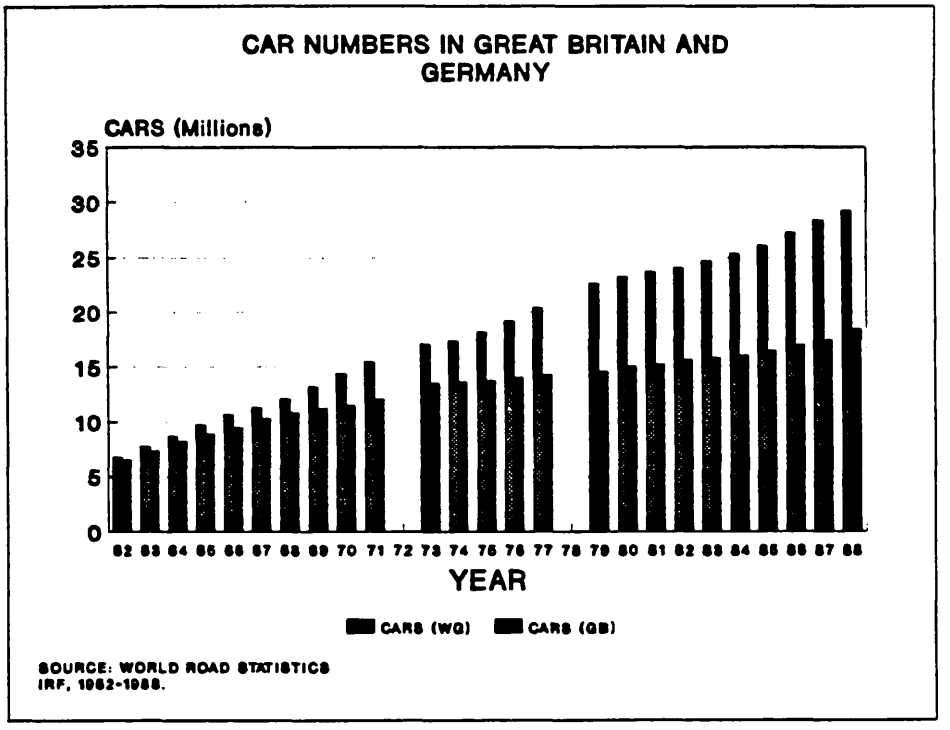


Figure C.1 The development of car numbers in Great Britain and Germany (1962–1988).

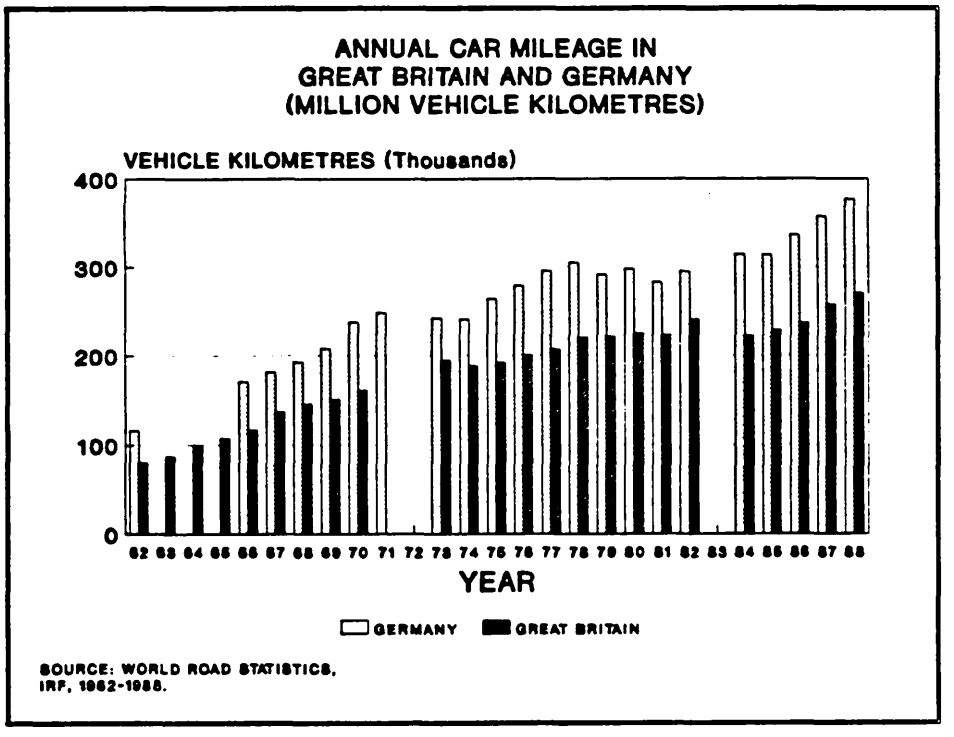


Figure C.2 The development of annual car mileage in Great Britain and the Federal Republic of Germany (1962–1988).

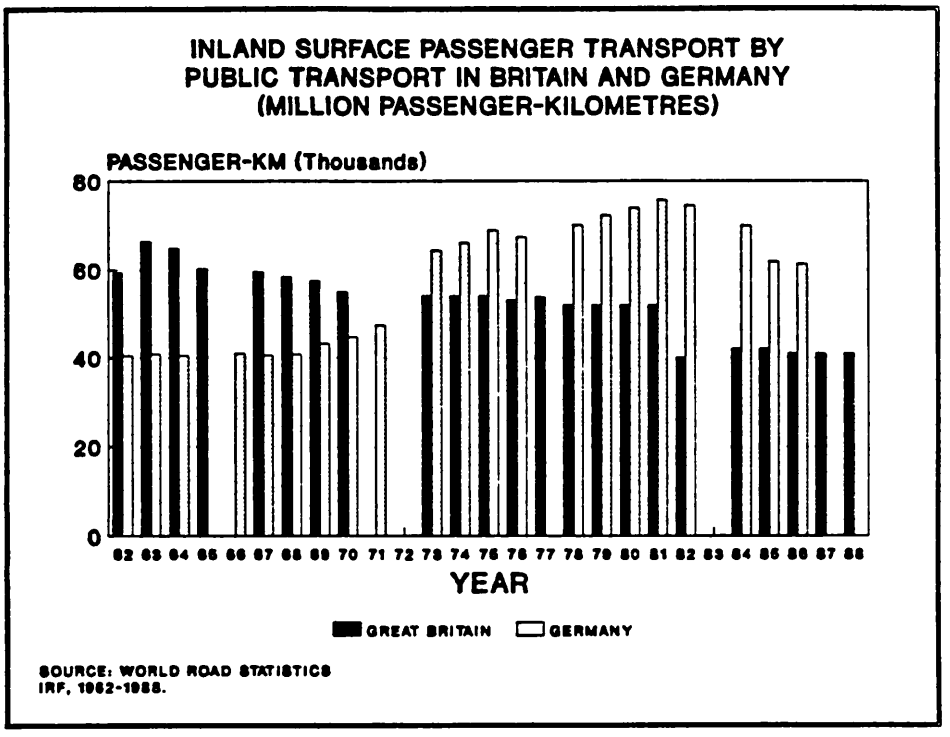


Figure C.3 The development of inland surface passenger transport by public transport in Great Britain and the Federal Republic of Germany (1962–1988).

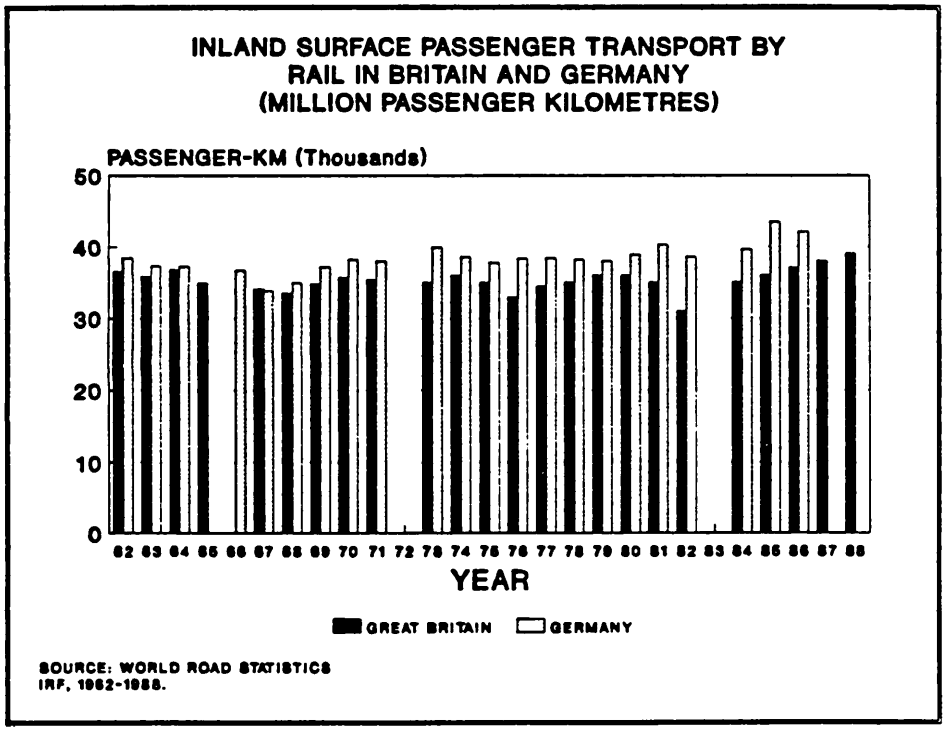


Figure C.4 The development of inland surface passenger transport by rail in Great Britain and the Federal Republic of Germany.

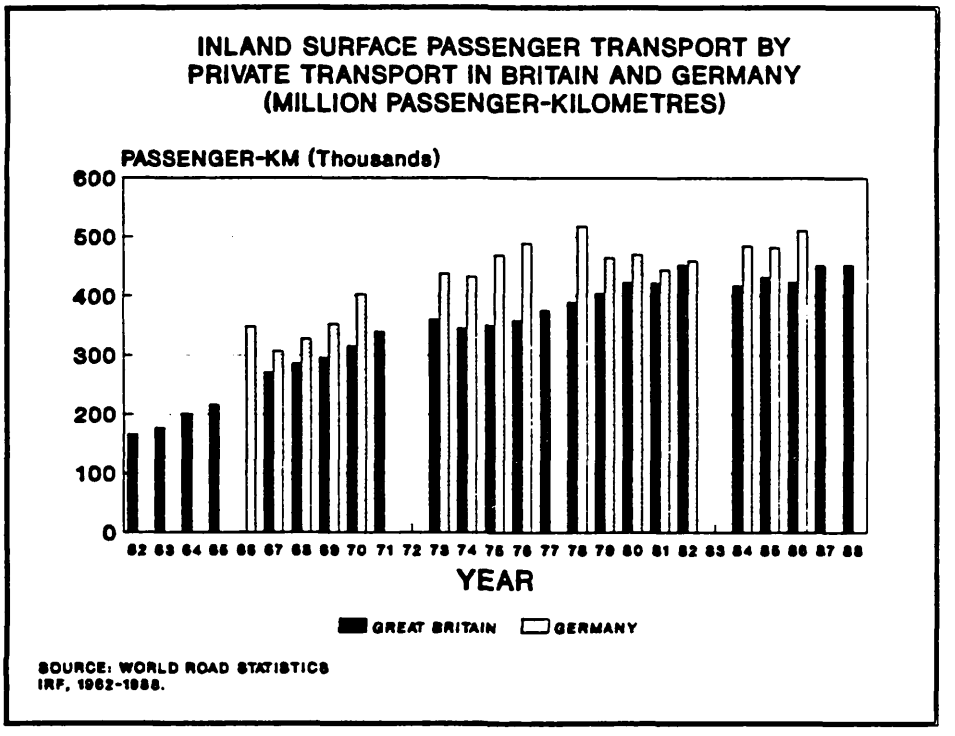


Figure C.5 The development of inland surface passenger transport by private transport in Great Britain and the Federal Republic of Germany (1962–1988)

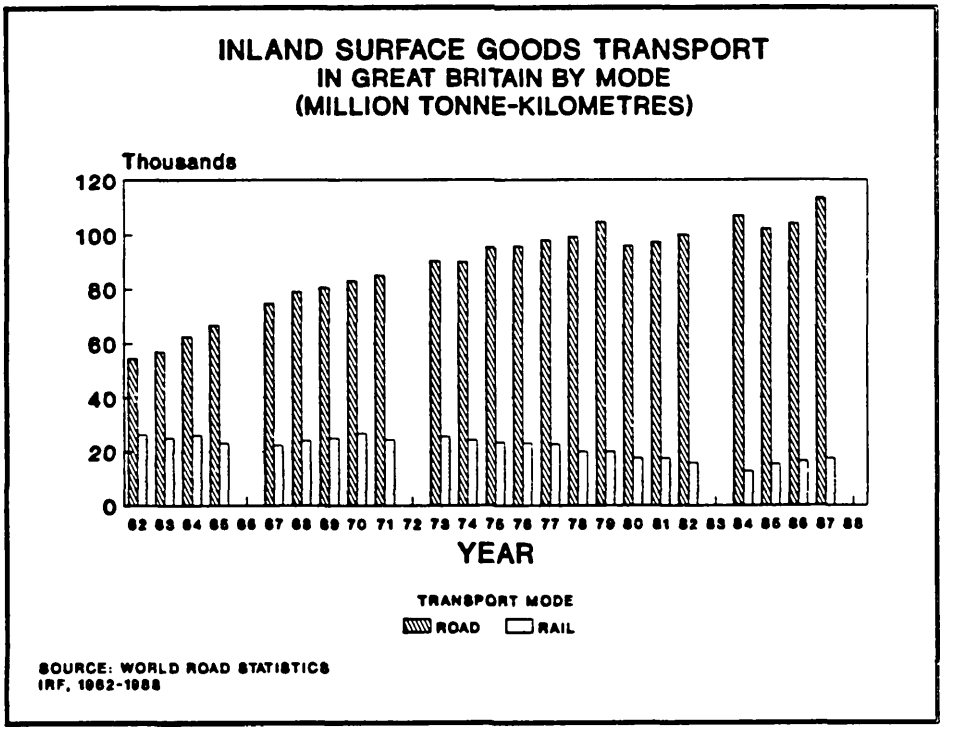


Figure C.6 The development of inland surface goods transport in Great Britain by mode (1962–1988).

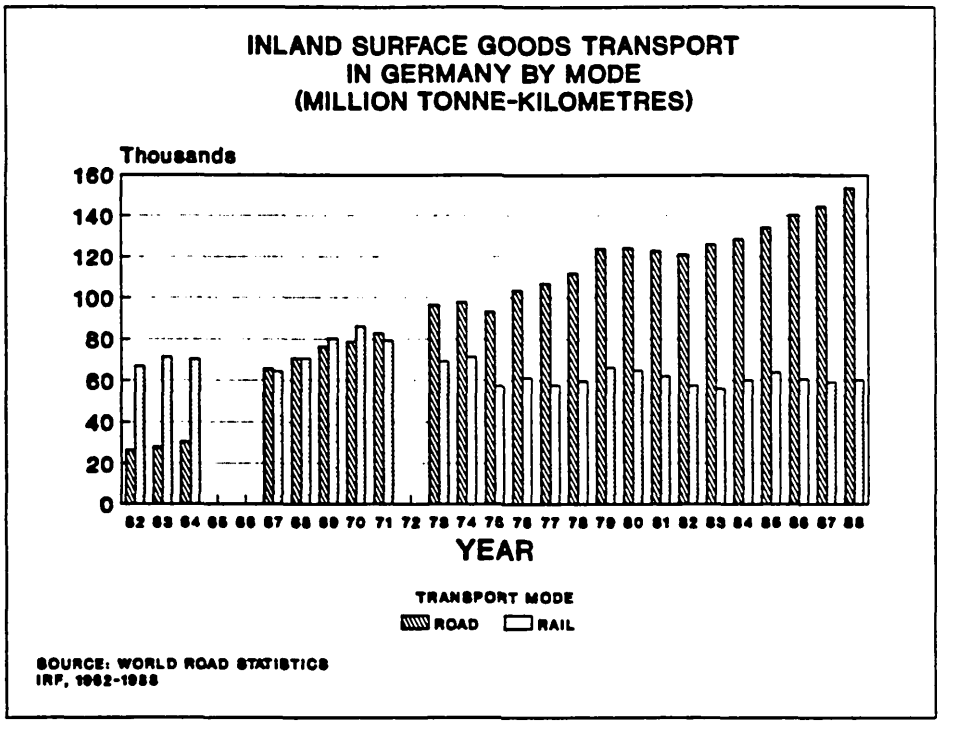


Figure C.7 The development of inland surface goods transport in the Federal Republic of Germany by mode (1962–1988).

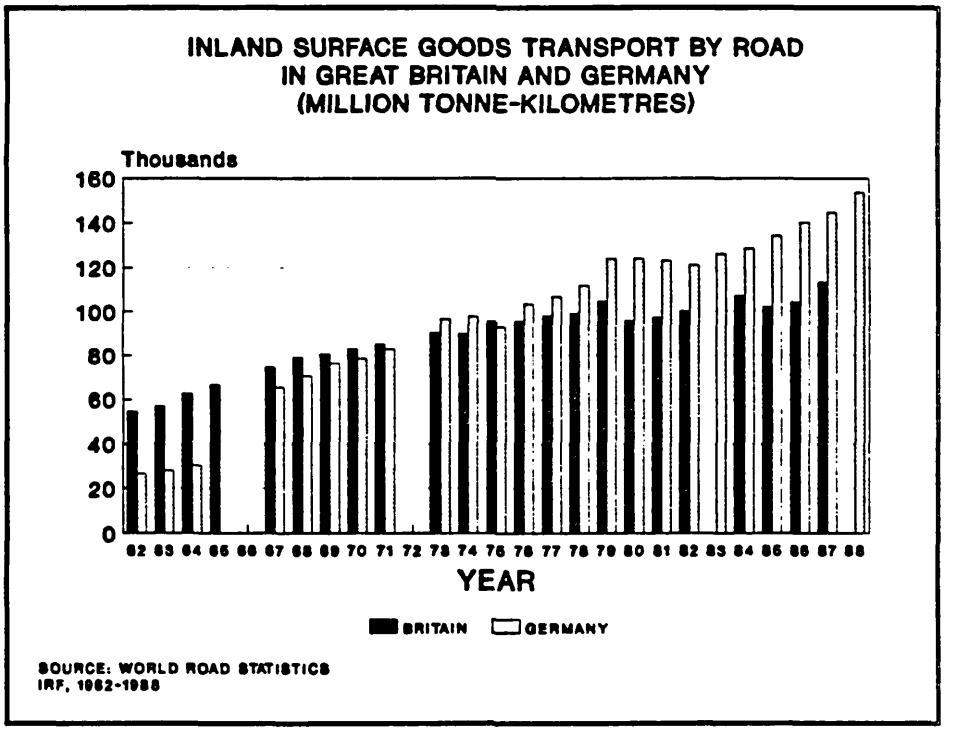


Figure C.8 A comparison of the development of inland surface goods transport by road in Great Britain and the Federal Republic of Germany (1962–1988).

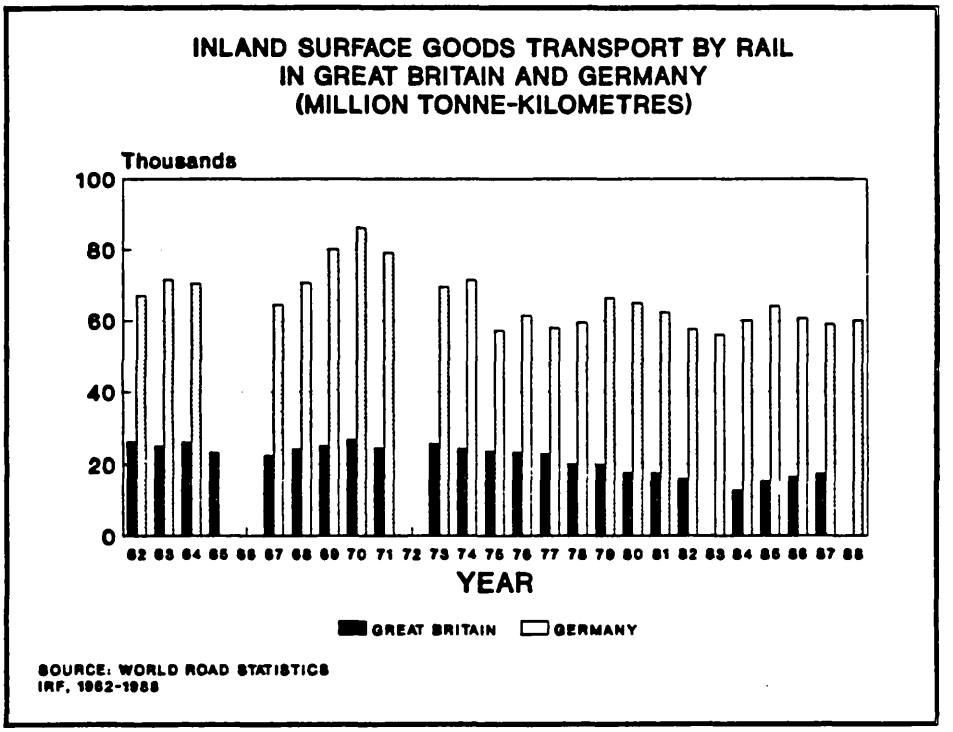


Figure C.9 Acomparison of the development of inland surface goods transport by rail in Great Britain and the Federal Republic of Germany (1962–1988).

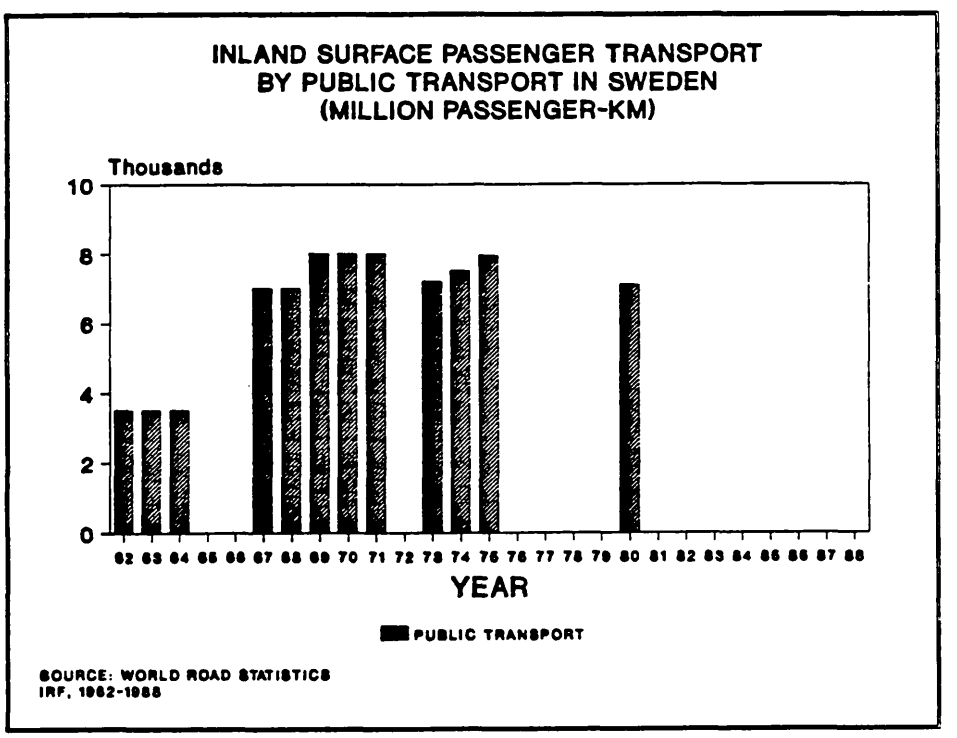


Figure C.10 The development in inland surface passenger transport by public transport in Sweden (1962–1988).

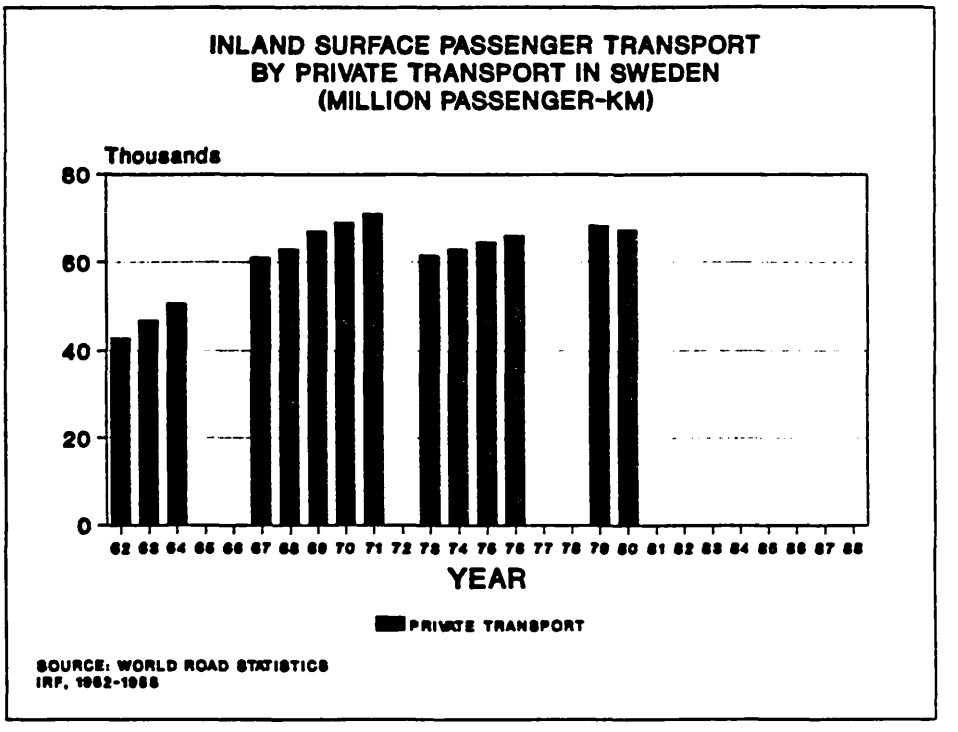


Figure C.11 The development in inland surface passenger transport by private transport in Sweden (1962–1988).

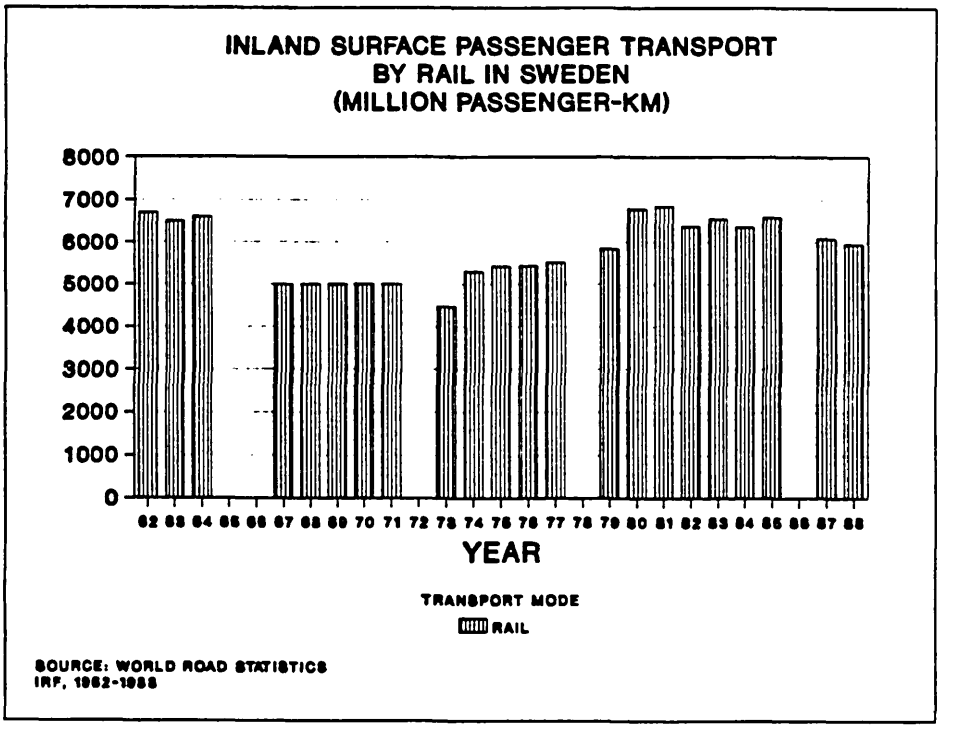


Figure C.12 The development in inland surface passenger transport by rail in Sweden (1962–1988).

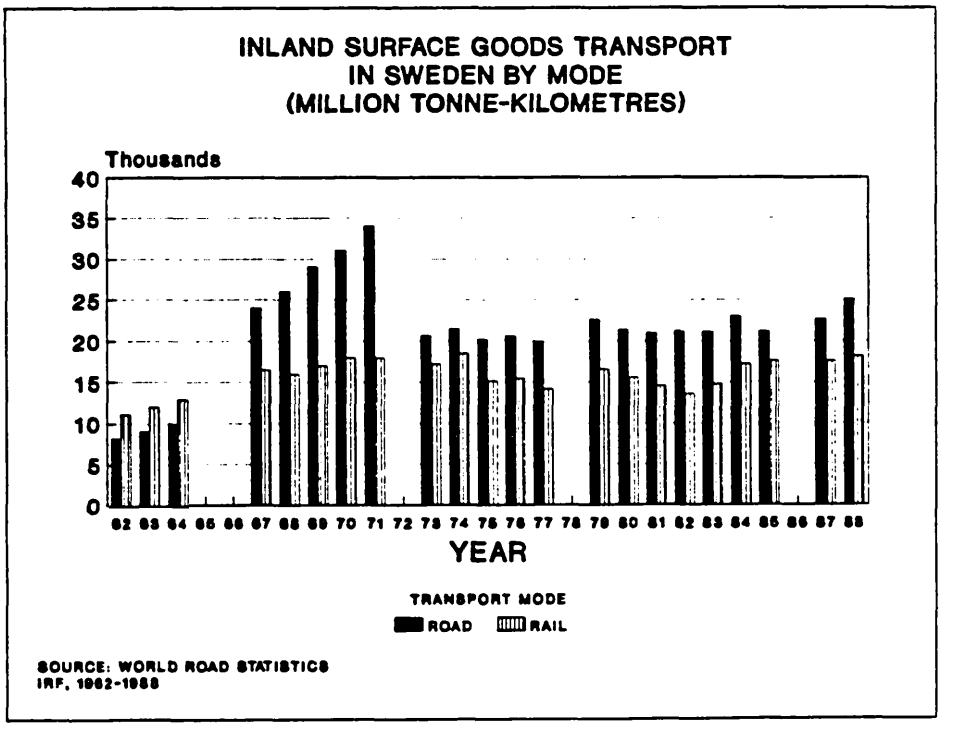


Figure C.13 The development in inland surface goods transport by mode in Sweden (1962–1988).

APPENDIX D (CHAPTER 2)

THE PRESENT ROAD SYSTEM IN GERMANY: FACTS AND FIGURES

D.1 To understand better the characteristics of this road system, the following paragraphs will present a picture of the existing system today and the future plans.

D.2 Today, with approximately 500,000 km of roads, about 175,000 km of which are outside urban areas. The Federal Republic of Germany has a very well developed road network. The network density (2.1 km/km^2) for all roads including local roads is only surpassed in Europe by the Benelux countries (Holland, Belgium and Luxembourg).

D.3 The main arteries of this network are the federal trunk roads (including the Autobahns or Federal motorways) which , while accounting for only 8 percent of the total network length, carry half of the total mileage travelled on all roads. Table 2.2 presents the network lengths, mileage travelled and values of traffic on public roads in the Federal Republic of Germany in 1986.

D.4 Of the Autobahns network of about 3,860 km that was built between 1929 and 1942 in the territory of the then German Reich, 2,175 km were situated in the territory that is now the Federal Republic of Germany. The construction of new Autobahns was resumed in the mid-fifties and continued according to systematic plans thereafter.

D.5 Today, the Autobahn network has a total length of about 8,600 km. Future plans are to extend it to 10,000 km by the end of this century. The new sections are intended to complete missing links and provide accessibility to areas which still don't have adequate lengths with the economic centres of the country.

D.6 In addition to new construction, plans also involve the widening-by adding another two or four lanes to the present four and as part of a programme to meet the increase in traffic demand-of about 1,500 km of existing Autobahns.

D.7 The Federal Autobahns are connected to other road networks by about 1,400 junctions. They (the Autobahns) are seen to be important and valuable means of drawing traffic away from local and regional networks and relieve residential areas. This process is encouraged by the toll-free use of the Autobahns. Figure 2.8 is an illustration of the development of the Autobahn network in terms of length and average daily traffic volumes.

APPENDIX E (CHAPTER 2)

PUBLIC TRANSPORT MODES IN GERMANY

U-Bahn (Underground Railway)

E.1 This term usually refers to a newly constructed system with its exclusive right-of-way. These systems are mainly urban systems serving the city centres. In some cases, usually in larger cities, they are built underground to avoid conflict with other street traffic and run free of other traffic related obstructions. It is a high capacity system with a typically close spacing of stations. The system usually extends no more than 15 miles from the city centre.

Stadtbahn (Light Rail)

E.2 The capacity of this system's trains is less than that of the *U-Bahn*. The system always has its own segregated right-of-way from other traffic, but it sometimes crosses streets at grade. The system runs in shallow cut-and-cover tunnels in central and inner city stations. The system is slower than the *U-Bahn* and is very much an urban transit system extending more than 13 miles from city centres. In the Rhein-Ruhr region, the system travels over longer distances to connect main cities.

Tram Systems

E.3 A system which still exists in most of the German cities even where an *U-Bahn* or a Stadtbahn may exist. It has been modernised and kept its reserved right-of-way. In some cities, the system may have priority at signalised junctions. It serves mainly the city centre and its capacity and speed are less than either the two previous systems. The tram system differs from the *Stadtbahn* in that it does not always have its own right-of-way, as does the *Stadtbahn*.

S-Bahn

E.4 This is a term referring to main line trains which serve the suburban regions of major cities. The system is run by the German Federal Railways (Deutsche Bundesbahn). In recent times, new underground stretches under the city centre allow the trains to serve the centre directly without transfer within the public transport network. the trains are faster than those of other modes and are able to serve more extended areas of up to 25 miles and more from city centres. Their capacity is higher than any of the other systems.

E.5 In large cities with rapid rail systems the *S-Bahn*, and *U-Bahn* systems are built underground in the city centres. Smaller conurbations are served by different forms of light rail and trams. The tram systems still exist in all but two German cities with over 500,000 inhabitants, namely Hamburg and Berlin. Less dense urban areas are served by the bus which is also heavily used as a feeder for rapid rail systems in cities which have such a system.

APPENDIX F (CHAPTER 3)

ROAD NETWORK, TRAFFIC FLOWS AND PUBLIC TRANSPORT BEFORE CONSTRUCTION OF RWRR

The Road Network

F.1 Figure F.1, shows the road network in the area prior to the opening of the RWRR. The roads in the area were defined according to their traffic functions and fell into the following categories:

a) Main Roads: These are roads of primary importance in the road network hierarchy for South East London as a whole. They are used by traffic between the Study Area and the rest of London, and by through traffic. These roads are generally characterised by heavy traffic loads (1,500–4,000 vph in the morning peak) with a high proportion of medium and HGVs (10–25 per cent). This category covered the Rochester Way, Shooters Hill Road, Kidbrooke Park Road, Eltham High Street/Bexley Road, Westhorne Avenue, Well Hall Road and Sidcup Road. The four main east/west routes in the Study Area were Shooters Hill Road, Rochester Way, Eltham High Street/Bexley Road and Sidcup Road. There were three main north/south routes, namely Kidbrooke Park Road, Westhorne Avenue, Well Hall Road.

b) Borough Distributor Roads: These act as links between main roads and perform a more local distribution function. They can be attractive alternatives for traffic trying to avoid congested main roads, and hence carry a fair amount of traffic (1,000 vph in the morning peak with 10 per cent being HGVs). They included: Riefield Road, Westmount Road, Glenesk Road and Broad Walk.

c) Local Roads: This category covers the remainder of the road network. The main role of these roads is to give access to houses, but in some cases they carried rat running traffic trying to avoid the congested major roads. The traffic flow on these roads sometimes reached about 350 vph in the morning peak with 8 per cent of the traffic being goods vehicles.

Traffic Patterns

F.2 A comprehensive GLC/LBG survey of traffic showed the variation of traffic flow along the A2. The data was collected via an origin–destination survey in October/November 1978, together with concurrent full classified traffic counts. A journey time survey was also carried out between April and July 1979.

F.3 The origin–destination survey (October/November 1978) consisted of: i) road–side interview survey : traffic crossing a north–south screenline in the eastern part of the Study Area was surveyed and one driver in four was interviewed. The roads covered were: Rochester Way, Shooters Hill Road, Sidcup Road, Bexley Road, and Footscray Road; ii) fully classified traffic counts were carried out concurrently with the road–side interview survey. The detailed composition of traffic crossing the screenline is presented in Table F.1. From the table, it can be seen that total traffic flows on the

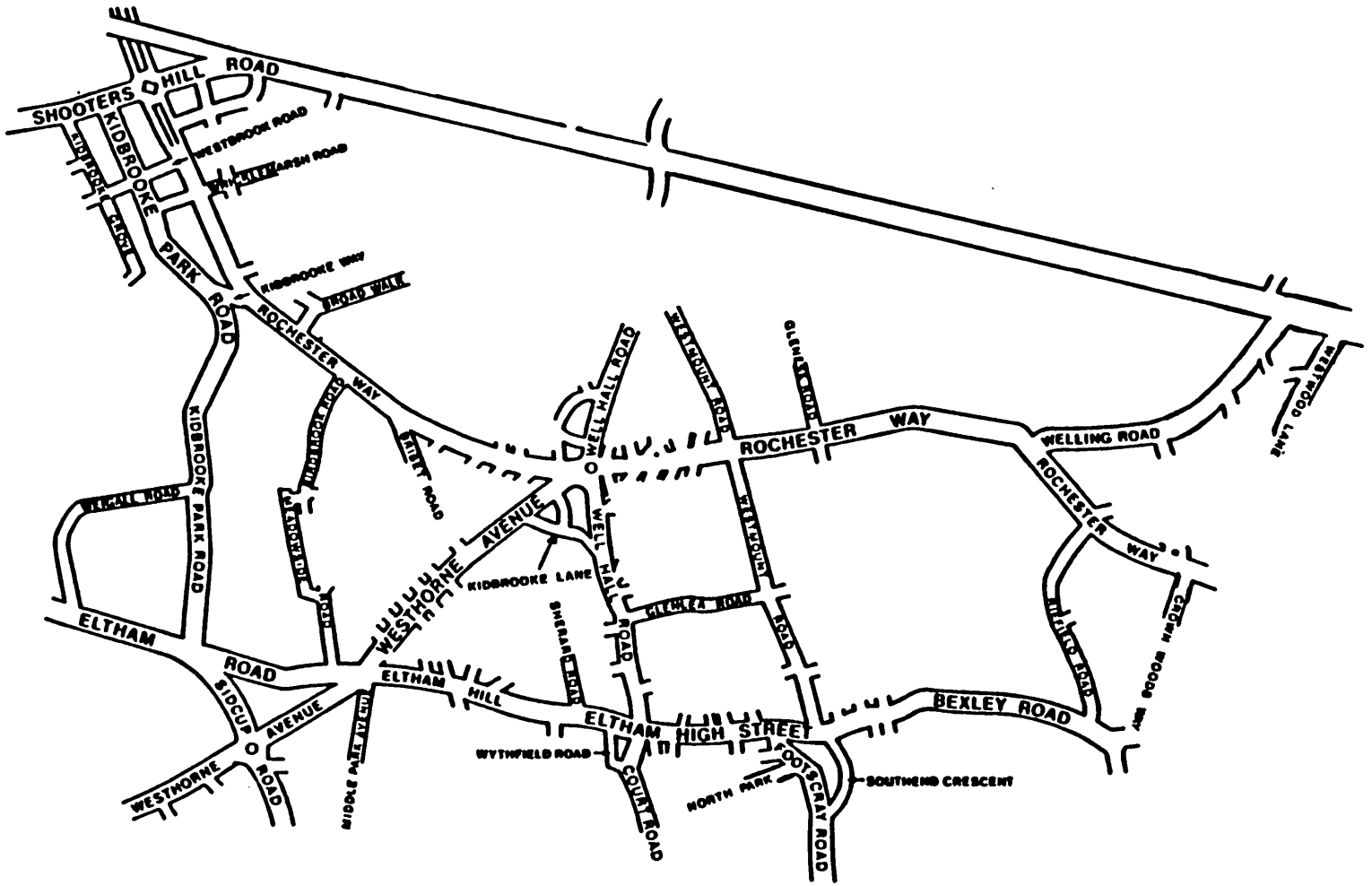


FIGURE F.1 The Area Road Network Before The Rochester Way Relief Road

Source: RWRR Report of Studies, GLC, 1980. (Table 4.6)

ROAD	AVERAGE FLOW (veh/hr)	TRAFFIC COMPOSITION (% OF ALL TRAFFIC)				
		Motor Cycles	Cars & Taxis	Lights goods	Medium & Heavy Goods	Buses & Coaches
AM Peak Hour (0800-0900hrs)						
Sidcup Road - inbound	2,200	9	78	7	6	0
Sidcup Road - outbound	1,200	2	74	7	17	0
Footscray Road - inbound	1,300	5	85	6	2	2
Footscray Road - outbound	350	1	78	13	2	6
Bexley Road - inbound	2,350	5	87	6	1	1
Bexley Road - outbound	600	3	82	9	4	2
Rochester Way - inbound	1,350	9	71	5	14	1
Rochester Way - outbound	1,200	1	61	10	26	2
Shooters Hill Road - inbound	1,400	9	81	8	2	0
Shooters Hill Road - outbound	600	4	76	11	8	1
All Screen Line - both directions	12,550	6	78	7	7	2
All Greater London(1)		4	77	9	8	2
Off Peak (1000-1600 hrs)						
Sidcup Road - both directions	2,050	2	68	9	20	1
Footscray Road - " "	900	2	77	12	7	2
Bexley Road - " "	1,200	3	75	12	8	2
Rochester Way - " "	1,950	2	57	9	31	1
Shooters Hill Road - " "	1,200	4	75	13	7	1
All Screen Line - " "	7,300	3	68	11	17	1
All Greater London(1)		3	68	13	14	2

(1) This is the average composition of traffic crossing all cordons and screen lines regularly surveyed by the GLC

TABLE F.1 Traffic Composition : Main Roads In Study Area (1977)

Source: RWRR Report of Studies, GLC, 1980. (Table 3.2)

major roads were between 2,500–3,500 vph, in general, with heavier inbound flows during the morning peak. On the Rochester Way, however, outbound traffic flows were very similar to those inbound, indicating that the road had reached its maximum practical capacity.

F.4 The study also found that extensive rat running was evident on many of the residential streets in the area. Particular roads were cited where the problem was widespread throughout the day. These included:

i) roads located between Eltham High Street/Eltham Hill and Rochester Way (e.g. Glenesk Road, Glenlea Road, Kidbrooke Lane and Briset Road),

ii) roads between Rochester Way East and Blackfen Road such as Crown Woods Way and Riefield Road which were used by traffic diverting from the A2 in order to avoid the narrow section and hence the reduction of capacity at Falconwood,

iii) roads used by traffic seeking to avoid congestion on Eltham High Street (e.g. North Park and Wythfield Road),

iv) roads used by traffic avoiding a congested section of Shooters Hill Road (A2) (Westwood Lane).

F.5 From Table F.1, it is clear that the composition of the traffic crossing the screenline was similar to that in London's traffic in general, except that at off–peak times, the proportion of medium and heavy goods vehicles was slightly higher. Traffic composition on different roads varied from one road to another. A particular road of interest was the old Rochester Way, as it had an exceptionally high proportion of medium and HGVs. These made up 21 per cent of all traffic during off–peak time compared to 17 per cent on the screenline as a whole. At peak times, the proportion was 12 per cent for inbound traffic and 38 per cent of outbound traffic. These peak hour proportions are high compared with the figure for the screenline as a whole which is only 8 per cent.

F.6 In investigating the journey purpose and the origin and destination of traffic along the Rochester Way, it was found that the road carried a large proportion of journeys on employer's business (over 60 per cent of all traffic in the off–peak hours). It also carried the lowest proportion of local traffic and a very high proportion of longer distance traffic (two thirds of all traffic travelled over 25 km). Compared to other roads the Rochester Way was clearly the main road most used as a through route by long distance and heavy goods traffic. The percentage of trips longer than 10, 25, 50 and 100 km on all the screenline roads are shown in Table F.2.

F.7 The journey time survey provided information on traffic speeds and delay for the morning peak period, off–peak period and the evening peak period. Speeds were generally slower and delays higher in the westbound direction in the morning peak, with a similar situation for the eastbound traffic in the evening peak. The greatest fall of speed was recorded on the Rochester Way. Here, traffic was often at a standstill and the average measured speed was 14 kph on the narrowest section. This compared with an average of 30 kph on the same section during other times. Other sections of the Rochester Way were reported to have average travel speeds of 57 kph. This clearly indicates the severity of the bottle neck formed by the section of the old Rochester Way through the Progress Estate. Travel speeds remained relatively low on Eltham High Street and on Rochester Way throughout the day. Delays experienced by traffic were longest on Rochester Way approaching the Well Hall Roundabout during both, morning and evening peak periods and averaged 2–3 minutes. Table F.3

Road	Percentage of trips longer than			
	10 km	25 km	50 km	100 km
Sidcup Road	76	44	19	7
Footscray Road	33	9	2	0
Bexley Road	48	17	5	1
Rochester Way	89	67	33	12
Shooters Hill Road	53	13	4	2

TABLE F.2 Trip Length Distribution : Main Roads in Study Area (1977)

(Representative of 12 hour traffic flows between the hours of 0700 to 1900)

Source: RWRR Report of Studies, GLC, 1980. (Table 3.5)

ROUTE		JOURNEY TIME (MINS.) AM PEAK	OFF PEAK
Falconwood to Blackwall Tunnel Southern Approach			
via	(a) Rochester Way (A2) (direct route)	14.2	7.6
	(b) Rochester Way/Welling Way/Shooters Hill Road (alternative main roads)	13.9	10.2
	(c) Riefield Road/Bexley Road/Westmount Road/Dunvegan Road/ Kidbrooke Lane/Briset Road/Rochester Way ('rat runs').	11.1	9.1
Falconwood to the Yorkshire Grey Roundabout			
via	(a) Rochester Way/Westhorne Avenue	11.0	6.2
	(b) Riefield Road/Bexley Road/Eltham High Street/Eltham Hill	8.1	6.1
Footscray Road to Blackwall Tunnel Southern Approach			
via	(a) Eltham High Street/Well Hall Road/Rochester Way	9.0	6.0
	(b) Westmount Road/Dunvegan Road/Kidbrooke Lane/ Briset Road/Rochester Way	8.0	6.6

TABLE F.3 Journey Times For Alternative Routes Through The Study Area (1979)

Source: RWRR Report of Studies, GLC, 1980 (Table 3.6)

provides an idea on varying journey times, via alternative routes, throughout the Study Area.

The Old A2 Rochester Way

F.8 From its junction with the Shooters Hill Road and the A102(M), the A2 road extended generally eastwards for some 5.3 kms. East of Falconwood, it continues as Rochester Way East and widens to provide a 3-lane dual carriageway built to near motorway standard. Between these two sections, the Rochester Way had, and still has, a carriageway of varying width providing between two and four traffic lanes and being no more than 7.5 meters wide at its narrowest section. This length of road has junctions with about forty side roads, three of which are classified roads (A2213 Kidbrooke Park Road, the A205 South Circular Road and the A209 Welling Way).

F.9 While part of the road is fronted by open land (in the vicinity of Sheperdleas and Oxleas Woods), most of its length is fronted by residential developments, nearly all with direct vehicular access. The Rochester Way is fronted by some 550 properties along the section between Shooters Hill Road and Crown Woods Way. 160 of these are more than 20m from the kerb; 250 are between 10-20m; and 130 are between 5-10m only from the kerb. Many of those (5-10m from the kerb) are situated between Grangehill and Glenesk Roads.

F.10 Along the Rochester Way during the off-peak periods, marginal reductions in peak traffic flows were experienced leading to lesser congestion and hence less rat running. Nevertheless, the road always operated at or near practical capacity over the narrower sections. At peak periods, traffic conditions on the Rochester Way were very congested to the east of Chester Road, near Falconwood and to the south of BTSA. Westbound morning flows were around 2,800 vph, reducing to a rate of about 1,350 vph during the worst congested periods. With travel speeds falling from 48 to 14 kph or less at this time, many drivers were seeking alternative routes to avoid delays, with the resulting rat running leading to much annoyance and adverse environmental conditions along local streets.

Public Transport in the Study Area

(a) <u>The Situation 'Before'</u>

F.11 Prior to the opening of the Rochester Way Relief Road the area was served by some 14 bus services with many passing through Eltham High Street. These services were, of course, affected by the same delays and congestion experienced by other road traffic. The area was also served by rail from four stations along the Bexley Heath line, which runs directly through the area on an east west axis. The stations served within the area were from east to west : Falconwood, Eltham Park, Eltham Well Hall and Kidbrooke. Each of these stations catered for some 1,000-2,000 passengers during the morning peak period. The stations had a service to Central London of 12 trains/hour in the peak period and three trains/hour off peak to Central London. Eltham Well Hall was the most heavily used station in the area, and of the passengers using it during the morning peak period, 600 arrived by bus.

F.12 The 14 bus and several coach services also linked the area to all the main centres nearby (Lewisham, Greenwich, Woolwich, Plumstead, Bexleyheath, Sidcup and Bromley). These catered for work, shopping and leisure journeys with nearly all bus services in the area going to Eltham Town Centre which is the shopping centre for the area.

(b) The Situation 'After'

F.13 The RWRR brought about a considerable number of changes to the public transport services in the area. Two of the old stations, Eltham Park and Eltham Well Hall, were replaced by the present new railway/bus interchange station at Eltham. Some of the bus services were rerouted as a result of the new station. The station replacement and some realignment of the tracks was necessary to make room for the new road. The intention was to provide improved public transport facilities and more parking spaces at the station, with the object of reducing the impact of kerbside parking in neighbouring residential streets.

F.14 Information obtained from the Market Analysis Office of Network Southeast provided some indication on the changes in patronage along a number of years before and after the opening of the station. Figures from the BR Origin and Destination Survey 1971–1972 were also used. The figures represent a normal weekday and refer to the morning peak period, i.e. times between which trains leave the stations to reach the London termini between 0700 and 1000 hours. The figures are presented in Table F.4. As can be seen from this table, the rail patronage has generally been declining. The opening of the new road may have encouraged some people to use the road instead of rail but this cannot be adequately quantified as no post 1988 figures are available.

F.15 Group Planning of London Buses were contacted for information on the bus services in the area and the changes influenced by the new road, but data on bus patronage is not kept for more than two years, and no special studies or surveys were carried out in relation with the changes in the area. It was explained that, during the construction period, bus services in the area suffered disruption and increased journey times as a result of the diversions and road works associated with the building of the new road. With the changes in traffic patterns in the area, including the introduction of a new mini bus service, it is not possible to assess the changes resulting from the new scheme. Throughout the area however travel speeds have improved for the majority of routes and there are indications that more journeys are being made by those who are dependent on public transport. This is mainly due to the time savings incurred from free flow conditions along the old roads relieved from through traffic by the RWRR. It is thought that the conditions prevailing at present encourage the use of buses even for longer journeys within the area.

F.16 It may be tentatively concluded from the comments and observations obtained from London Buses, that the new road has improved the level of service provided by the buses in the area. Even with certain changes to accommodate the traffic management measures introduced in the area, buses take less time to complete longer journeys. The improved conditions along Eltham High Street, and the improved journey times have encouraged shoppers to travel by bus. In general, therefore, the new RWRR does not seem to have any negative effects on the public transport services in the area.

	Up		Down	
	Joining	Alighting	Joining	Alighting
Eltham Park				
1971–72	1,430	50		
April 1980	1,344	20	14	19
March 1981	1,304	N/A	12	N/A
March 1984	1,104	9	11	18
March 1985	1,059	2	19	10
(Closed 1985)				
Eltham Well Hall				
1971–72	2,040	130		
May 1980	1,809	148	25	45
March 1981	1,840	N/A	24	N/A
May 1984	1,784	52	21	53
(Closed 1985)				
Falconwood				
1971–72	1,270	50		
Nov 1980	1,540	176	14	193
March 1981	1,472	N/A	12	N/A
March 1987	1,596	N/A	N/A	N/A
Kidbrooke				
1971–1972	1,660	280		
March 1981	1,604	N/A	96	N/A
April 1984	1,272	36	73	95
Eltham Station (After 1985)				
December 1986	2,432	183	30	N/A

TABLE F.4 Number of Passengers Using Eltham Stations During the Morning Peak–Hour (0700–0959)

F.17 Perhaps the most disappointing aspect is the under-use of the new parking spaces (over 150) provided at the station. This is attributed firstly to the parking charge; and secondly to the incidence of vandalism, due to the inadequate surveillance of the parking area. This has resulted in unwelcome intrusion of commuter cars parked nose to tail along the kerbsides of nearby streets.

APPENDIX G (CHAPTER 3)

FURTHER DETAILS OF THE EVIDENCE GIVEN AT THE PUBLIC INQUIRY

G.1 At the inquiry, nearly all the different parties concerned agreed in principle that a new road was needed to relieve the old Rochester Way and improve the environmental conditions for the area as a whole. The case for the new road was put to the Inspector variously by the GLC, the London Boroughs of Greenwich and of Bexley and a number of residents associations and individuals living in the area. The inquiry considered a number of alternatives. These varied from a minimum improvement to the old Rochester Way to building the scheme in a tunnel. Table G.1 indicates the possible alternatives that were discussed in the 'RWRR Report of Studies' presented by the GLC, and details the costs to the community (e.g. lost houses, public open space...etc.) associated with each. The 'proposed scheme' is the one built (with minor ammendments); the 'A2 minimum' and 'A2 maximum' involved an on-line widening of Rochester Way to 4 lane undivided, and dual 2-lanes respectively; and the final two columns represented more grandioze schemes for the RWRR.

The Case for The New Road

G.2 The case presented by the GLC was supported by the comprehensive studies made in conjunction with the Borough councils of Greenwich and Bexley. These studies, submitted to the public inquiry, suggested a whole range of improvements on the then existing situation. It estimated that the proposed scheme would substantially reduce the traffic flow on local roads and reduce accidents, and that this would make up for the fact that the scheme did not appear to be quite justifiable on cost-benefit grounds alone. Traffic benefits compared to the costs, were estimated by two ways, namely : 1) the First Year Rate of Return and 2) the Net Present Value. Benefits in both estimates did not in themselves fully justify the cost of the scheme, but other environmental and economic factors, which had not been incorporated in both assessments, were foreseen as to increase the traffic benefits. These other factors included:

-benefits received by traffic remaining on existing roads relieved from congestion,

-savings in accidents,

-time savings for bus passengers due to improved bus operation,

-benefits to staff and passengers resulting from improved comfort and convenience from the new rail/bus interchange,

- changes in future traffic levels as a result of traffic growth. The net effect of incorporating traffic growth in the economic analysis was seen to increase the annual traffic benefits at a greater rate than the predicted growth of traffic.

	PROPOSED SCHEME	POSSIBLE ALTERNATIVES			
		A2 MINIMUM	A2 MAXIMUM	RWRR DUALS 3	RWRR TUNNEL
Housing lost	244 dwellings	92 dwellings	343 dwellings	246 dwellings	154 dwellings
Employment lost					
- shopping	631 sq m/32 jobs	100 sq m/4 jobs	100 sq m/4 jobs	631 sq m/ 32 jobs	212sq m/ 10 jobs
- offices	8178 sq m/111 jobs	nil	2886 sq m/23 jobs	8178 sq m/111 jobs	8008 sq m/ 81 jobs
- industrial/commercial	7245 sq m/ 245 jobs	nil	nil	7245 sq m/248 jobs	4000 sq m/236 jobs
Schools lost	nil	nil	nil	nil	nil
Other buildings, etc. lost	Well Hall Nursery 3 elec. sub stations	nil	Rochester Way Social Club(Eriset Road)	Well Hall Nursery 3 elec. sub stations	Well Hall Nursery 1 elec. sub stations
Open Space lost					
- public	3.5 ha	nil	3.8 ha	3.8 ha	3.2 ha
- private	1.6 ha	nil	nil	1.5 ha	0.9 ha
Listed Buildings lost	nil	nil	nil	nil	nil
Conservation Areas affected	none	Progress Estate CA (22 houses lost)	Progress Estate CA (52 houses lost)	none	none
GLDP Areas of Special Character (ASC) affected	passes thro' ASC No.16	passes thro' ASC No.16	passes thro' ASC No.16	passes thro' ASC No.16	Possible ventilation Structures in ASC no.16
GLDP Areas of Architectural or Historic Interest (AANI) affected	passes near AANI No.207	passes near AANI No.207	passes near AANI No.207	passes near AANI No.207	passes near AANI No.207
Major land uses within 50m of edge of road					
- Dwellings	556	1026	789	556	338
- Shopping Centres	4	3	3	4	2
- Office Centres	nil	2	1	nil	nil
- Ind/Comm Sites	2	1	1	2	2
- Schools	nil	1	1	nil	nil
- Other Bldgs etc.	2	5	4	2	2
- Parks	4	4	3	4	2
- Sports Grounds	2	2	1	2	2
- Golf Courses	1	nil	nil	1	nil
- Cemetery	1	1	1	1	1
- Listed Bldgs	1	nil	nil	1	nil
Capital Cost (November 1979 prices)					
- construction	£45.0m	£10.5m	£45.0m	£54.0m	£160.0m
- property	7.4m	2.9m	9.6m	7.4m	6.2m
- environmental	2.3m	0.6m	2.7m	3.1m	1.7m
Total	£54.7m	£14.0m	£57.3m	£64.5m	£167.9m

TABLE G.1 Comparative Impacts of Alternative Schemes

Source: RWRR Report of Studies, GLC, 1980. (Table 4.6)

G.3 It was also calculated that noise and air pollution levels on existing roads generally would be significantly reduced, especially on the section between the BTSA and the 'Dover Patrol' where noise levels at the time exceeded 73 dB(A) (the Council's recommended levels were 68 dB(A)). It was stated that only a few dwellings would suffer noise levels above the Council's guideline level of 68 dB(A). However, higher noise levels (up by 2–5 dB(A)) were predicted along the line of the proposed road.

G.4 In addition to the proposals of traffic management measures included with the proposed scheme, it was intended to introduce a complementary package of further traffic management measures, designed in conjunction with Greenwich Council to maintain environmental improvements in the area. The Council estimated that the implementation of the new road and the introduction of further traffic management measures, made possible by the relief afforded by the new road, would enable more than 20,000 people to enjoy an improved environment.

G.5 People in favour of the new road came from a wide section. The MP for the area had been an advocate for the new road for a long time. He presented the case on basis of reduced severance and reduced accidents. He also supported the scheme on the grounds that it would lead to an improved general economy. The Local Boroughs of Greenwich and Bexley both supported the proposals in concept. While acknowledging that the proposals 'offer the best and most appropriate solution', Greenwich, however, had certain reservations on two issues. The main issue was the vertical alignment of the proposed road between BTSA and the 'Dover Patrol' Public House.

G.6 The London Borough of Bexley who had 'consistently supported the principle of improving the A2 road to the west of Falconwood area', had different worries. They disagreed on points of detail and expressed reservations that some of the traffic management proposals contained in the scheme could adversely affect traffic conditions in certain areas in the Borough. They were particularly concerned about the proposed ban on the left turn movement of traffic from the westbound slip road at the junction of the then proposed RWRR and Reifield Road, and the proposed closure of Crown Woods Way at its junction with the A2. The scheme proposal provided for the maintenance of the then existing left turn ban at the A2/Riefield Road by curving the alignment of the westbound slip road towards the right at its junction with Reifield Road. This feature was designed to limit the volume of traffic (especially HGVs) which could use Riefield Road. Crown Woods Way which had been subject to a 7 ft width restriction was still used by much through traffic during the morning peak period. It was proposed to close the junction of this road with the A2 to vehicles to prevent rat running. The measures have been implemented.

G.7 Other supporters of the scheme included the Dover Radial Action Group, which had campaigned for the scheme over the years. They saw the proposed scheme as 'the best means of solving these problems within the shortest time'. The Road Haulage Association also supported the proposals and indicated the savings in journey times to and from the Channel ports that would be incurred.

The Case against the scheme

G.8 This was presented by a combination of pressure groups, residents associations and individuals from the area. The objections ranged from the very simple expression of uncertainty over certain traffic management measures, to detailed arguments in favour of other alternatives. It is only fair to say that none of

the objectors contested the need for a quick relief to the bad conditions along the old Rochester Way and the spill-over effect onto other local roads in the area.

G.9 The case presented by EARR (Environmentalists Against Radial Routes), an umbrella group opposed to the building of any motorway inside the proposed Ringway 3, argued that 'the need for the proposed RWRR in terms of environment or traffic has not been proved'. They said that the new road would lead to increased noise and pollution, severance and the loss of over 1,000 trees. The scheme, in their view was 'over designed and costly'. They suggested the return of goods traffic to the railways and the River Thames and the removal of the toll at the Dartford Tunnel as an answer to the area's problems. They did agree, however, that if the scheme were to go ahead, the tunnel option 'would be preferable'.

G.10 These views were similar to those put forward by the Homes Before Roads Group. They accepted 'the need for some relief to Rochester Way', and acknowledged that the widening of the old Rochester Way may not provide the answer. However, the proposed scheme was not seen as the right solution either. Their view was that a road in a tunnel should be sought. Nevertheless, they maintained that 'homes, hospitals, education and people should be given priority over roads'. Some residents associations as well as individuals from the area in the immediate vicinity of the proposed new road argued for the widening of the old Rochester Way option. They thought that this option 'would show greater benefits in terms of cost, environmental gain and speed of construction'.

G.11 The loss of British Rail's Eltham Park station was also presented in the arguments against the proposal. This loss was a by-product of the scheme, involving the construction of a new upgraded bus/rail interchange at Well Hall Road, with parking facilities for commuters (a measure seen as an alternative for kerbside parking). An objection by letter was made by residents concerned about additional noise and overlooking. In response to this objection, a renewal of particular properties fences was offered, and assurance given that further screening of the new station platforms, to prevent overlooking, would be considered. In relation to this matter, the Inspector found the site chosen for the proposed new rail/bus interchange acceptable. In his view 'the new facilities would provide the area with an improved level of service for train and bus passengers and they could encourage the greater use of public transport'. He, however, questioned whether they would reduce the present level of uncontrolled kerbside parking which occurred in the neighbourhood.

G.12 The weight of the objections, however, was mainly on a design detail rather than against the principle of the scheme. By far the most important of all objections was the issue of the elevated section of the proposed road between BTSA and the 'Dover Patrol' Public House. Greenwich Council and a number of different residents associations and local residents argued against it. Residents of Kidbrooke Park Estate and other residents associations were concerned that the elevated section of the proposed new route would lead to a further deterioration of the local environment because of increased noise, fumes and filth from the road in addition to it being visually intrusive. Fears of possible disastrous accidents on this section which would be carrying nearly 4,000 vehicles per hour, as well as the loss of amenity to local residents who feared using subways, the only means for crossing with this design, because of violence and vandalism.

G.13 The Inspector at the time of the inquiry ruled this objection out, and recommended the scheme as proposed in the Planning Application. In making his decision, he referred to a previous public consultation which had shown a general preference for subways rather than overbridges, and that these could be straight 'see-through' ones at ground level underneath the road embankment. The local residents

groups argued that the public consultation referred to did not take place in relation to the proposals being considered. They demanded that the particular section be placed either in cutting or at ground level. Local pressure and campaigning, however, which had lasted for four years (since the plans were first announced) translated, eventually, into action by the GLC Transport Committee who in 1982 approved their alternative proposal. This was building the road in a cutting, with pedestrian bridges at ground level near Dursley and Wricklemarsh Roads.

G.14 Other objectors were in favour of the provision of a dual 3-lane carriageway road on the proposed alignment. It was argued that such provision would be more compatible with the A102(M) and trunk road A2 at either end, offering more capacity to accommodate future traffic growth and additional relief to other roads in the area. The Inspector found such claims to be 'questionable' and considered that 'such advantages would be outweighed by the prospect of increased congestion occurring on this and other routes as traffic neared the inner London areas'. In general, even though alternative schemes might have delivered greater economic benefits, these had been rejected by the Council because the environmental returns would be less.

G.15 While writing his report the Inspector felt impelled to describe the existing road and traffic conditions as 'appalling and intolerable whether judged from the point of view of traffic, the environment, or road safety.' He concluded his report with the the following statements :

> i) ' in general terms the route selected for the proposed new road is the one likely to cause the least damage to the amenities of both the built-up and open areas through which it would pass '.
>
> ii) ' Regarding the effect of the proposals on the area and the neighbouring land uses, in general terms I accept that for residents who would live alongside or close to the proposed new road and rail/bus interchange, environmental conditions could be less pleasant than at present. However, I consider that the removal of through traffic from Rochester Way and the reduction in the use of other local roads by extraneous traffic would result in substantial environmental gains for the area as a whole '.
>
> iii) '..although consideration of traffic management measures of the kind referred to is clearly beyond the scope of these inquiries, it seems to me that the implementation of such measures would ensure that the best advantage was taken of the opportunities for environmental improvements offered by the relief road proposals '.

He thus recommended that planning permission be granted for the construction of the proposed Rochester Way Relief Road.

Source: The Rochester Way Relief Road, An Appraisal of The Operational, Environmental and Economic Impacts, Rees Jeffreys Road Fund, Transport and Society, July 1990.

APPENDIX H (CHAPTER 3)

THE RWRR QUESTIONNAIRE SURVEY

1. Responses from Residents in the Immediate Area Of Impact (Study Area).

Total Number Affected by RWRR= 126

A: GENERAL CHANGES

Changes	Respondents	(%)
Better Travel Conditions	67	62
Worse Travel Conditions	23	21
Better Environmental Conditions	46	42
Worse Environmental Conditions	31	28
Other	11*	10
Total	109**	

Table H.1 Changes influenced by the Rochester Way Relief Road.

* Some of those answering this question had also indicated other changes

** This total represents the actual number of people who answered this question. Some had indicated more than one change and that is why the total is not the direct sum of all respondents as they appear in the table. The percentages are taken with respect to this total and will not add to 100.0%

	Yes	(%)	No	(%)	Total	(%)
Regular Travel in Area	114	(90)	12	(10)	126	(100)
Changed Travel Mode	9	(7)	117	(93)	126	(100)

Table H.2 Changes in travel conditions.

Conditions	Respondents	(%)
Much Better	51	(41)
Slightly Better	23	(18)
The Same	8	(6)
Slightly Worse	25	(20)
Much Worse	18	(14)
Total	**125**	**(100)**

Table H.3 Travel conditions for local journeys by road.

Conditions	Respondents	(%)
Much Better	46	(43)
Slightly Better	23	(20)
The Same	23	(22)
Slightly Worse	11	(10)
Much Worse	6	(5)
Total	**109**	**(100)**

Table H.4 Travel conditions for longer journeys by road.

Cause	Respondents	(%)
The New Road	3	(6)
T/M Measures	40	(78)
Both	8	(16)
Total	**51**	**(100)**

Table H.5 Reasons for worse conditions.

Change	Respondents	(%)
Improved	36	(29)
Worsened	30	(24)
No Change	59	(47)
Total	**125**	**(100)**

Table H.6 Direct access to Home.

B: CHANGES IN ENVIRONMENTAL CONDITIONS IN LOCAL STREETS

Change	Respondents	(%)	Unexpected	(%)
Large Increase	28	(23)	7	(5)
Small Increase	18	(15)	-	-
The Same	25	(20)	-	-
Small Decrease	28	(23)	1	(1)
Large Decrease	22	(18)	1	(1)
Don't Know	1	(1)	-	-
Total	**122**			

Table H.7 Traffic noise.

Change	Respondents	(%)	Unexpected	(%)
Large Increase	18	(16)	4	(4)
Small Increase	8	(7)	-	-
The Same	37	(32)	-	-
Small Decrease	23	(20)	-	-
Large Decrease	14	(12)	-	-
Don't Know	15	(13)	-	-
Total	**115**	**(100)**		

Table H.8 Air pollution from traffic.

Change	Respondents	(%)	Unexpected	(%)
Large Increase	25	(22)	4	(4)
Small Increase	16	(14)	-	-
The Same	42	(37)	-	-
Small Decrease	17	(15)	-	-
Large Decrease	13	(12)	1	(1)
Don't Know	0	(0)	-	-
Total	**113**	**(100)**		

Table H.9 Speeding vehicles.

Change	Respondents	(%)	Unexpected	(%)
Large Increase	24	(21)	6	(5)
Small Increase	13	(11)	1	(1)
The Same	38	(33)	-	-
Small Decrease	15	(13)	-	-
Large Decrease	22	(19)	1	(1)
Don't Know	2	(2)	-	-
Total	**114**			

Table H.10 Risk while crossing roads.

Change	Respondents	(%)	Unexpected	(%)
Large Increase	12	(11)	2	(2)
Small Increase	5	(4)	-	-
The Same	32	(29)	-	-
Small Decrease	19	(17)	-	-
Large Decrease	39	(35)	1	(1)
Don't Know	4	(4)	-	-
Total	**112**	**(100)**		

Table H.11 Heavy goods vehicles traffic.

Change	Respondents	(%)	Unexpected	(%)
Large Increase	29	(24)	13	(12)
Small Increase	17	(14)	3	(3)
The Same	24	(20)	-	-
Small Decrease	16	(13)	-	-
Large Decrease	23	(19)	1	(1)
Don't Know	10	(8)	-	-
Total	**110**			

Table H.12 Rat-running in local streets.

Attitude	Respondents	(%)
In Favour	89	(71)
Opposed	9	(7)
Indifferent*	28	(22)
Total	**126**	**(100)**

Table H.13 Attitude before the RWRR was built.

* Three of the people 'indifferent' to the scheme had no access to a car.

Attitude	Respondents	(%)
Yes	101	(80)
No	12	(10)
Indifferent*	13	(10)
Total	**126**	**(100)**

Table H.14 Has the RWRR been worthwhile?

AFTER / BEFORE	Worthwhile	Not Worthwhile	Indifferent	Total
In Favour	83	3	3	89
Opposed	2	5	2	9
Indifferent	16	4	8	28
Total	**101**	**12**	**13**	**126**

Table H.15 Changes in attitude 'before' and 'after' the road.

Car	Households	(%)
Access	113	(90)
No Access	13	(10)
Total	**126**	**(100)**

Table H.16 Car availability.

2. Response From Residents Living Outside the Study area to the East and West.

Respondents Total = 54 (all with access to a car).

	Yes	(%)	No	(%)	Total	(%)
Regular Travel in Area	44	(82)	10	(18)	54	(100)
Changed Travel Mode	1	(2)	53	(98)	54	(100)

Table H.17 Changes in travel conditions.

Conditions	Respondents	(%)
Much Better	23	(46)
Slightly Better	15	(30)
The Same	8	(16)
Slightly Worse	1	(2)
Much Worse	3	(6)
Total	50	(100)

Table H.18 Travel conditions for longer journeys by road.

Cause	Respondents	(%)
The New Road	0	(0)
T/M Measures	4	(57)
Both	3	(43)
Total	7	(100)

Table H.19 Reasons for worse conditions.

Attitude	Respondents	(%)
In Favour	35	(65)
Opposed	2	(4)
Indifferent*	17	(31)
Total	**54**	**(100)**

Table H.20 Attitude before the RWRR was built.

Attitude	Respondents	(%)
Yes	48	(89)
No	4	(7)
Indifferent*	2	(4)
Total	**54**	**(100)**

Table H.21 Has the RWRR been worthwhile?

Source: The Rochester Way Relief Road, An Appraisal of The Operational, Environmental and Economic Impacts, Rees Jeffreys Road Fund, Transport and Society, July 1990.

THE A2 ROCHESTER WAY RELIEF ROAD (RWRR)

QUESTIONNAIRE

PLEASE RETURN QUESTIONNAIRE
BY APRIL 19, 1990 (NO STAMP REQUIRED)

IMPERIAL COLLEGE
DEPARTMENT OF CIVIL ENGINEERING
TRANSPORT STUDIES SECTION

1 Have you been directly or indirectly affected by the new road and other associated changes ?

YES ☐ NO ☐

(tick as appropriate)

2 If yes, in what general way(s) has the new road affected you ?

a) Better travel conditions by road ☐
b) Worse travel conditions by road ☐
c) Better environmental conditions ☐ *(tick as appropriate)*
d) Worse Environmental conditions ☐
e) Some other effect *(Please write below)* ☐

.....
.....

In the following section, you are asked to indicate the nature and degree of the changes that you have experienced as a result of the opening of the new road and other associated works.

A CHANGES IN TRAVEL CONDITIONS

3a Do you regularly travel to, from or through the area around the new road (as defined in the map overleaf)

Yes ☐ No ☐

3b If yes, have you changed your mode of travel for regular journeys since the road was opened?

Yes ☐ No ☐

3c If you have changed, please indicate mode of travel 'before' and 'after' (excluding walking) by ticking one box in each column

	Before	After
Rail only	☐	☐
Bus only	☐	☐
Car only	☐	☐
Car and Bus	☐	☐
Car and Rail	☐	☐
Bus and Rail	☐	☐

3d If you have indicated a change, please explain briefly below the factors which most influenced your choice

.....

4a Based on your experience, how do you rate the following:
(Please tick the most appropriate box in each line)

	Much Better	Slightly Better	The Same	Slightly Worse	Much Worse
Travel conditions for local journeys by road	☐	☐	☐	☐	☐
Travel conditions for longer journeys by road	☐	☐	☐	☐	☐

4b If travel conditions have become worse, in your opinion is this because of the new road or because of the associated local traffic management (T/M) measures (for example, one way system, banned turns etc.) ?

New Road ☐ T/M measures ☐ Both ☐

The next two questions 5 & 6 are for residents within the defined area only

5a Has direct vehicular access to your own home been improved or worsened since the opening of the RWRR?

Improved ☐ Worsened ☐ No Change ☐

5b If you have experienced a change, please explain why briefly below

.....

.....

B CHANGES IN ENVIRONMENTAL CONDITIONS

6 Based on your experience 'before' and 'after' the new road, what environmental changes, if any, have you noticed in your street. Please indicate the extent of change in relation to each of the factors listed.

(Please tick the most appropriate box in each line)

	Large Increase	Small Increase	The Same	Small Decrease	Large Decrease	Don't know
Traffic Noise	☐	☐	☐	☐	☐	☐
Air Pollution from traffic	☐	☐	☐	☐	☐	☐
Speeding Vehicles	☐	☐	☐	☐	☐	☐
Risk while crossing roads	☐	☐	☐	☐	☐	☐
Lorry traffic	☐	☐	☐	☐	☐	☐
Traffic avoiding congested main roads (Rat Running)	☐	☐	☐	☐	☐	☐

(Please circle the tick if the change was unexpected)

C GENERAL INFORMATION

7 Before the new road was built, were you :

In favour ☐ Opposed ☐ Indifferent ☐

8 Now that the road has been built, do you think that it has been worthwhile?

Yes ☐ No ☐ Indifferent ☐

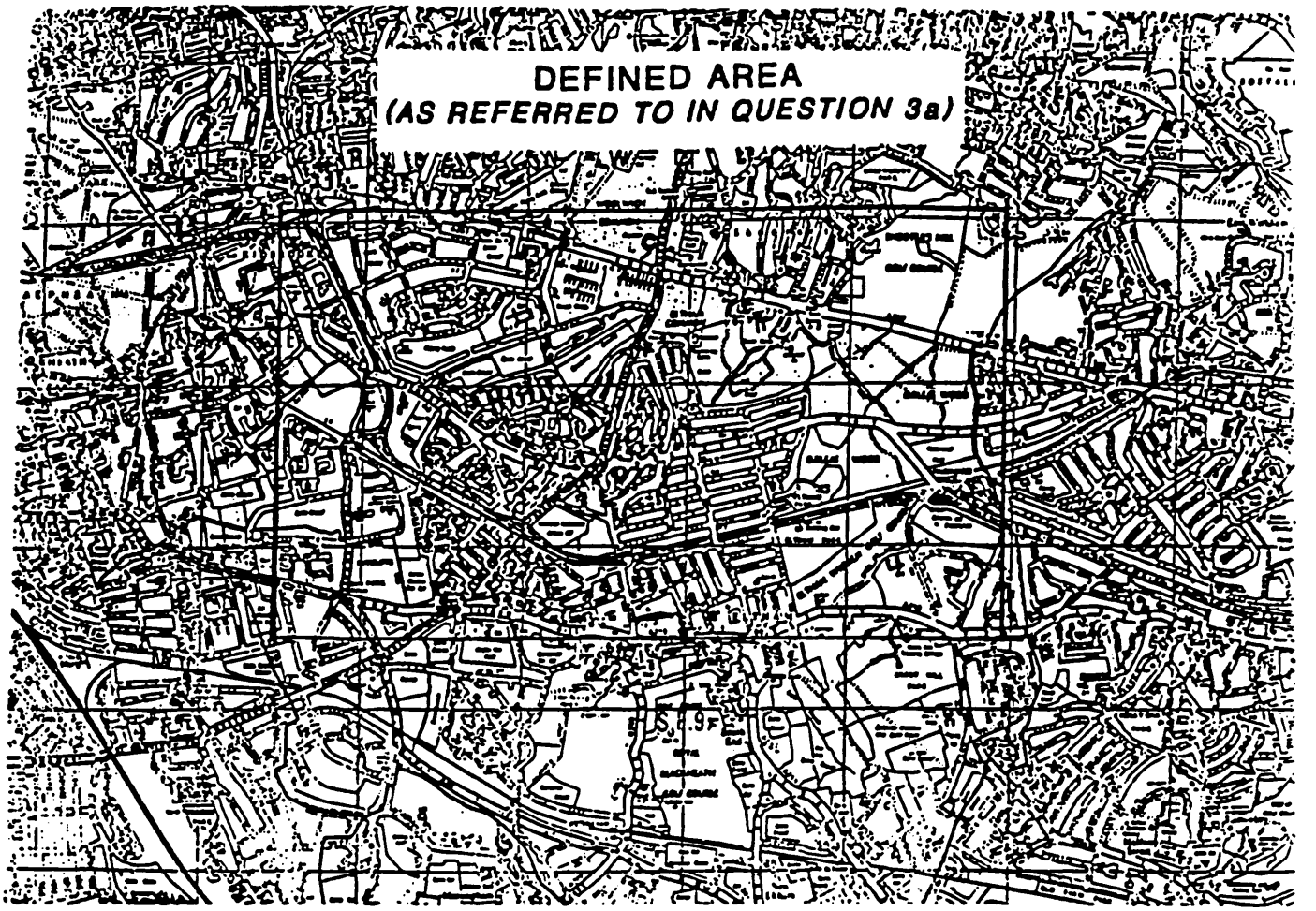
9 Does your household have access to a car ?

Yes ☐ No ☐

10 To assist us further with our analysis, would you please write down your home address (or street name only if you don't wish to be entered in the prize draw) in the space below (all information will be treated in confidence).

.....

.....



To encourage people to participate, 2 prizes each of £ 25.00 will be awarded to the winners of a special prize draw associated with the study. If you wish to be entered in the draw we will need to know your full address or a telephone number where you can be notified if you win.

Please write down the complete address and/or telephone number where you may be notified

Address:

_____

_____

_____

_____

Telephone:

_____

Please make sure that the questionnaires are received by us no later than April 19, 1990 *(No Stamp Required)*.

APPENDIX I (CHAPTER 3)

THE SURVEY OF NATIONAL FIRMS (REGULAR USERS)

I.1 The survey results do appear to indicate that the RWRR has fulfilled its objectives as far as improving accessibility is concerned (at least up to the present). But to shed more light on this question, the views were sought of a number of firms which have regular road freight or coach movements through the study area. The local transport firms contacted were not very forthcoming with details of their operations, but the responses clearly indicated that they appreciated the benefits stemming from the new road in terms of improved conditions and travel times. Of six national firms, regularly using the route, all but one expressed complete satisfaction with the new road.

I.2 The National Express Coach Lines regularly use the A2/M2 for their services between London and Thanet/Canterbury/Dover. They say that the RWRR has been advantageous in terms of maintenance of time keeping standards. They are, of course, in direct competition with rail services, and hence good timekeeping is an extremely important factor to them. On some of the more congested routes in and out of London, the company has had to inject additional resources in order to improve reliability. The route in question, the A2/M2 no longer falls into this category, now that the RWRR has been built.

I.3 B R S Southern operating out of Maidstone and who now regularly use the RWRR and Blackwall Tunnel, report much improved accessibility to customers. They say that 'the old A2 route through Well Hall roundabout was always a bottleneck causing delays at all times of the day' and was 'always a place to avoid'. They could not quantify the effect of the improvement in economic terms, but felt that they 'must be making a saving in fuel and drivers time'. The area operations manager states that when told that they would be delivering to North London his first fear was the Blackwall Tunnel approach roads. He was glad to report, however, that 'we have had no such problems up until this moment in time'. He was thus clearly satisfied with the improved level of accessibility, up until now, but was perhaps a little worried about what the future holds.

I.4 Sainsbury's are also regular users of the A2 from their main distribution depot at Charlton (close to the BTSA). They were very helpful and provided much useful information. On average they deal with 1,900 own vehicle movements at the depot, and another 1,700 per week by suppliers delivering to the depot. About 8 per cent of their own movements are via RWRR, (which previously went by Kidbrooke Park Road and the old A2 Rochester Way). The Depot Manager reported that 'without doubt there have been significant improvements in accessibility to the Depot both for our own vehicles and for those of suppliers..., in particular those from Kent and those who use the Southern Sector of the M25'. Again, they could not quantify the overall benefits because of other changes that have also taken place in their operations. He did mention, however, that the opening of the new route has allowed them to properly implement one of their policies, which is to maximise the use of main roads and avoid residential roads. Since 1988, depot drivers have had strict instruction to use the new road and avoid any of the old ones. He also pointed out that the limited capacity and substandard dimensions of the Blackwall Tunnel do cause problems, including the back up of traffic approaching from RWRR, and this sometimes affects their Kent operations.

I.5 The same kind of response came from the manager of Tate and Lyle Sugars Thames Refinery. The RWRR has helped to reduce delays and thereby assisted them to achieve delivery times. No precise quantification of the benefits has been possible, but they are sure that the new road has been extremely useful in providing good service to their customers.

I.6 An extremely favourable opinion of the RWRR came from the Transport Manager of the International Distribution Centre of the Royal Mail Parcel Force. After consultation with some of his drivers, he expressed the view that the opening of the bypass section immediately south of the Blackwall Tunnel resulted in savings on running times (on daily journey to Dover and back) of 45 minutes during peak periods! This seems incredible, though not perhaps when all the other recent improvements to the 'Dover Road' are taken into account.

I.7 Only one firm expressed reservations about the Relief Road. These came from the operations Manager of Coca-Cola & Schweppes Beverages. He reported that vehicle drivers from the depot in Greenwich (which is very close to the southern end of the Blackwall Tunnel) prefer, when going south east, to use the A20 Sidcup Road, rather than the Relief Road and A2. The reasons for this are not altogether clear. He stated that 'drivers find it quicker to use the old road, following the Eltham turn off on to the A2 (especially at peak times). This, however, runs contrary to the evidence of the recent surveys made of peak period journey times on the alternatives, which show that travel by the new road is much quicker. He also implied that drivers prefer the A20 route because of 'this being a three lane construction' whereas the RWRR 'is only a two lane construction and encourages traffic congestion'. He thought that this could be alleviated 'with the addition of a third lane (to the RWRR), but whilst more viable routes exist it has little part to play in cost/time effective route planning'. This is difficult to understand, for the A20 Sidcup Road is, in fact, only a dual *two lane* carriageway. It is however of the old 'arterial' road type constructed at the same level as the development on either side (except for a short improved stretch further out on the Sidcup bypass). This is in contrast to much of the RWRR which is in deep cutting with vertical walls. Psychologically, therefore, the Sidcup Road may appear wider.

Source: The Rochester Way Relief Road, An Appraisal of The Operational, Environmental and Economic Impacts, Rees Jeffreys Road Fund, Transport and Society, July 1990.

City Centre (CBD)	1976	1982	1983	1984 *	1985	1986	1987	1988
1. Torsgatan	17000	16000	16000	17000	20000	22000	22000	20000
2. Dalagatan	8000	7000	7000	8000	11000	12000	12000	11000
3. Västmannagatan	7000	5000	5000	5000	5000	6000	6000	5000
4. Upplandsgatan	7000	5000	5000	5000	5000	5000	5000	4000
5. Drottninggatan	3000	3000	3000	3000	3000	3000	3000	3000
6. Holländargatan	2000	1500	1500	1500	1500	1500	2000	2000
7. Sveavägen	26000	27000	28000	29000	29000	31000	34000	32000
8. Luntmakargatan	1000	500	1000	1000	1500	1500	2000	2000
9. Döbelnsgatan	10000	2000	2000	2000	2000	3000	3000	4000
10. Johannesgatan	1000	1000	1000	1000	1000	500	1000	500
11. Regeringsgatan	10000	8000	8000	8000	8000	9000	10000	11000
12. Birger Jarlsgatan	20000	15000	15000	16000	17000	17000	18000	18000
13. Engelbrektsgatan	10000	13000	13000	13000	14000	14000	15000	14000
14. Sturegatan	19000	14000	15000	16000	17000	17000	15000	15000
15. Grev Turegatan	5000	2000	2000	3000	4000	3000	4000	4000
16. Sallandsgatan	1000	500	1000	1000	500	500	1000	500
17. Hybrogatan	1000	500	500	500	500	1000	1000	1000
18. Sibyllegatan	4000	4000	4000	5000	6000	6000	5000	6000
19. Strandvägen	38000	28000	29000	29000	32000	32000	32000	33000
20. Strömbron	38000	36000	29000	33000	31000	32000	32000	2000 **
21. Norrbro	16000	closed	12000	15000	15000	16000	16000	31000 **
22. Riksbron	1000	closed	closed	closed	closed	closed	closed	closed
23. Vasabron	17000	20000	20000	23000	19000	21000	20000	19000
24. Herkulesgatan	8000	13000	13000	11000	20000	17000	17000	29000 **
25. Söderkopplet	12000	15000	16000	17000	20000	16000	21000	32000 **
26. Vattugatan	1000	3000	3000	3000	2000	3000	3000	4000
27. Klara Hälarstrand	24000	21000	21000	23000	27000	26000	27000	28000
28. Klarabergsviadukten	19000	14000	14000	13000	18000	15000	18000	20000
29. Ingegatan	14000	14000	15000	16000	closed	closed	closed	4000
Total	340000	289000	300000	318000	331000	331000	345000	355000

TABLE J.1 Traffic Development on City Centre Streets

* New Scheme opened (October, 1984).
** Repairs on *Strömbron*.

Source: *Stockholms gatukontor.*

Inner City (South)	1976	1982	1983	1984 *	1985	1986	1987	1988
1. Danviksbron	35000	36000	37000	38000	40000	42000	42000	44000
2. Stansbron	24000	20000	20000	21000	closed	closed	18000	19000
3. Stanstullsbron	65000	51000	52000	53000	35000	35000	31000	32000
4. Johanneshovsbron	-	-	-	-	50000	61000	62000	66000
5. Liljeholmsbron	49000	39000	41000	42000	40000	40000	43000	44000
6. Marieberasbron	10000	9000	10000	10000	10000	10000	11000	11000
7. Fredhällsnotet Ramp 105	12000	11000	11000	12000	11000	13000	12000	12000
8. Fredhällsnotet Ramp 101	10000	9000	9000	10000	10000	10000	9000	9000
9. Hellgrensgatan Ramp 151	4000	3000	3000	3000	3000	4000	4000	4000
10. Hellgrensgatan Ramp 154	3000	3000	3000	3000	3000	4000	4000	4000
11. Essingeleden v H Stationsg	41000	42000	42000	46000	44000	48000	48000	50000
Total 1-11	253000	223000	228000	238000	254000	267000	284000	295000

Inner City (North)	1976	1982	1983	1984 *	1985	1986	1987	1988
12. Lidingöbron	34000	33000	35000	36000	37000	38000	40000	41000
13. Roslagsv norr Bergsusv	55000	50000	52000	53000	56000	57000	65000	66000
14. Uppsalav vid Norrtull	72000	72000	73000	78000	81000	83000	86000	85000
15. Solnabron	23000	21000	22000	22000	25000	26000	26000	23000
16. Tomtebodav norr Tvreportsb.	8000	6000	6000	6000	7000	7000	7000	9000
17. Pampasliaten norr Klarastrandsl	-	-	10000	12000	14000	13000	13000	16000
18. Ekelundsbron	16000	13000	7000	8000	8000	9000	9000	9000
19. Hellgrensgatan Ramp 152	4000	5000	5000	5000	5000	6000	6000	6000
20. Hellgrensgatan Ramp 153	3000	3000	4000	5000	5000	6000	6000	6000
21. Brottningsholmsv Ramp 145	25000	22000	22000	23000	23000	25000	25000	26000
22. Brottningsholmsv Ramp 146	23000	21000	20000	20000	21000	23000	23000	23000
Total 12-22	264000	248000	256000	268000	282000	293000	306000	310000

Inner City Total								
Total 1-22	517000	471000	484000	506000	536000	560000	590000	605000

TABLE J.2 Traffic Development on Inner City Streets

* New Scheme opened (October, 1984).

Source: *Stockholms gatukontor.*

Greater Stockholm (North)	1976	1982	1983	1984 •	1985	1986	1987	1988
N 1. Bockebybron	13000	13000	14000	15000	15000	16000	16000	18000
J 2. Skälbyvägen	8000	6000	7000	7000	7000	8000	8000	8000
J 3. Ävestagatan	14000	13000	13000	12000	13000	12000	12000	14000
J 4. Enköpingsvägen	24000	26000	25000	30000	32000	35000	38000	38000
J 5. Norrtäljevägen	9000	10000	11000	12000	12000	13000	13000	14000
S 6. Tunebergsleden	26000	24000	25000	27000	26000	32000	32000	32000
S 7. Lyalingelänken	-	14000	16000	20000	21000	23000	24000	27000
8. E4 Sörentorp	56000	59000	63000	69000	71000	82000	81000	84000
9. Stockholmsbron	61000	59000	61000	67000	68000	73000	74000	76000
L10. Lidingöbron	34000	33000	35000	36000	37000	38000	40000	41000
Total 1–10	246000	257000	270000	295000	302000	332000	338000	352000

Greater Stockholm (South)	1976	1982	1983	1984 •	1985	1986	1987	1988
S11. Danvikabron	35000	36000	37000	37000	40000	42000	43000	44000
S12. Sickla Kanalbro	23000	22000	23000	25000	24000	28000	28000	30000
T13. Tyresövägen	26000	22000	23000	25000	26000	26000	28000	29000
S14. Stortorpsvägen	3000	2000	2000	3000	3000	3000	3000	3000
S15. Nynäsvägen	20000	25000	26000	30000	30000	35000	36000	37000
S16. Perstorpsvägen	2000	2000	2000	2000	2000	2000	2000	2000
S17. Hagelungsvägen	9000	14000	14000	15000	15000	15000	17000	18000
S18. Ågestabron	7000	8000	8000	8000	9000	9000	10000	10000
S19. Huddingevägen	30000	28000	31000	32000	33000	35000	34000	34000
S20. Torkelkroven	2000	2000	2000	2000	2000	2000	2000	2000
S21. G:a Södertäljevägen	11000	5000	6000	7000	6000	6000	6000	7000
S22. Häradsvägen	-	9000	11000	12000	12000	12000	13000	13000
S23. Södertäljevägen	67000	69000	68000	71000	70000	75000	69000	62000
S24. Snättavägen	6000	7000	6000	8000	9000	10000	11000	12000
S25. Värbergavägen	12000	13000	13000	14000	14000	14000	15000	15000
S26. Skärholmsvägen	4000	4000	4000	4000	5000	4000	5000	6000
S27. Svanholmsvägen	4000	4000	4000	4000	4000	4000	4000	4000
S28. Ekholmsvägen	7000	7000	7000	7000	7000	8000	9000	10000
Total 11–28	270000	279000	289000	306000	311000	330000	340000	358000

Total Greater Stockholm (North and South)	516000	536000	559000	601000	613000	662000	686000	710000

TABLE J.3 Traffic Development on Greater Stockholm Area Streets

• New Scheme opened (October, 1984).

Source: *Stockholms gatukontor.*

APPENDIX K (CHAPTER 6)

The Development of The Road Network in Göteborg (1971–1987)



FIGURE K.2 The Changes in The Major Roads Network in Goteborg (New Schemes and Major Improvements) 1971–1975



FIGURE K.1 The Major Roads Network in Goteborg (1971)



FIGURE K.3 The Major Roads Network in Goteborg (1975)

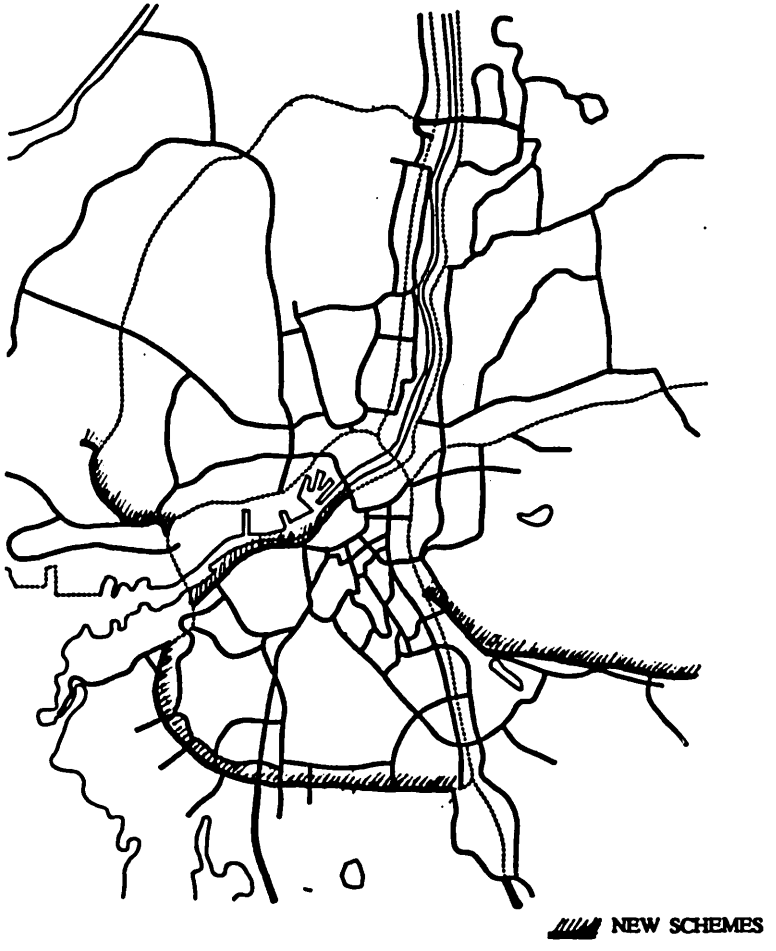


FIGURE K.4 The Changes in The Major Roads Network in Goteborg (New Schemes and Major Improvements) 1975–1979



FIGURE K.5 The Major Roads Network in Goteborg (1979)



FIGURE K.6 The Changes in The Major Roads Network in Goteborg (New Schemes and Major Improvements) 1979–1983

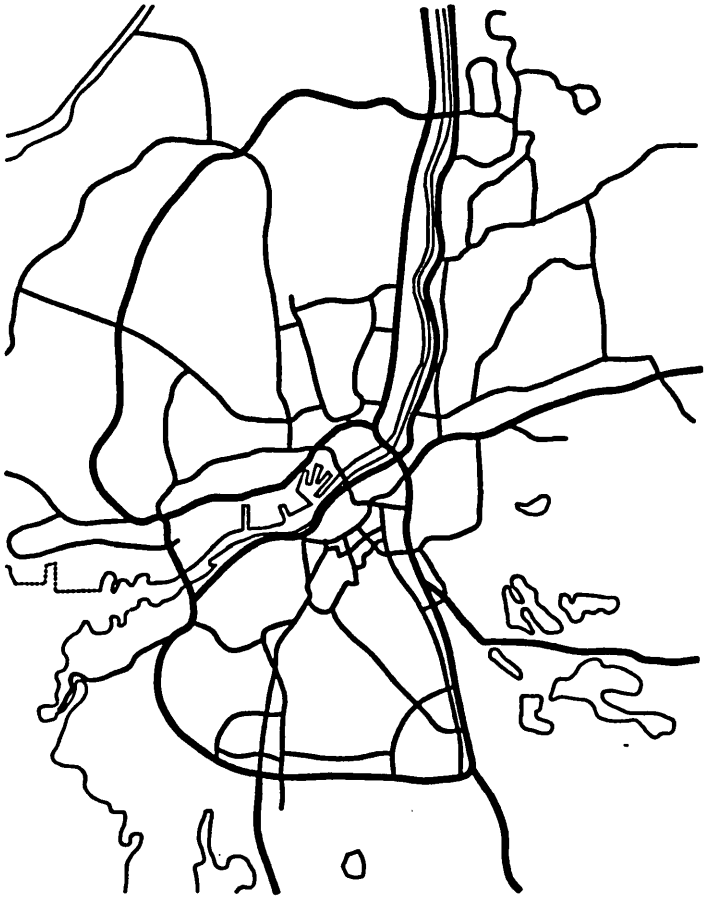


FIGURE K.7 The Major Roads Network in Goteborg (1983)

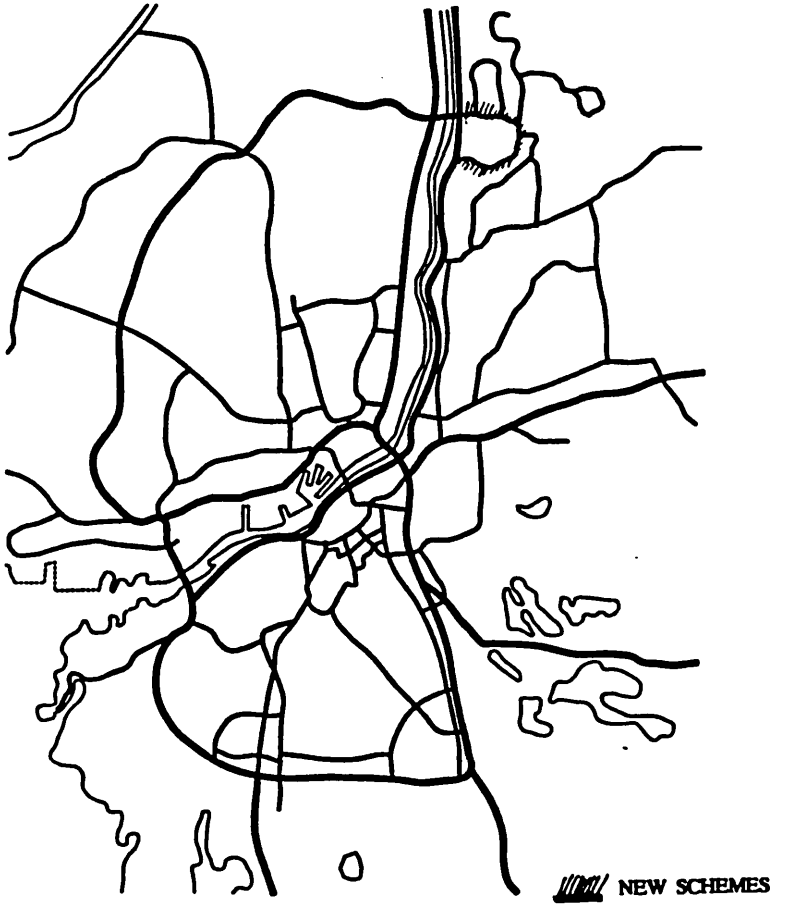


FIGURE K.8 The Changes in The Major Roads Network in Goteborg (New Schemes and Major Improvements) 1983–1987

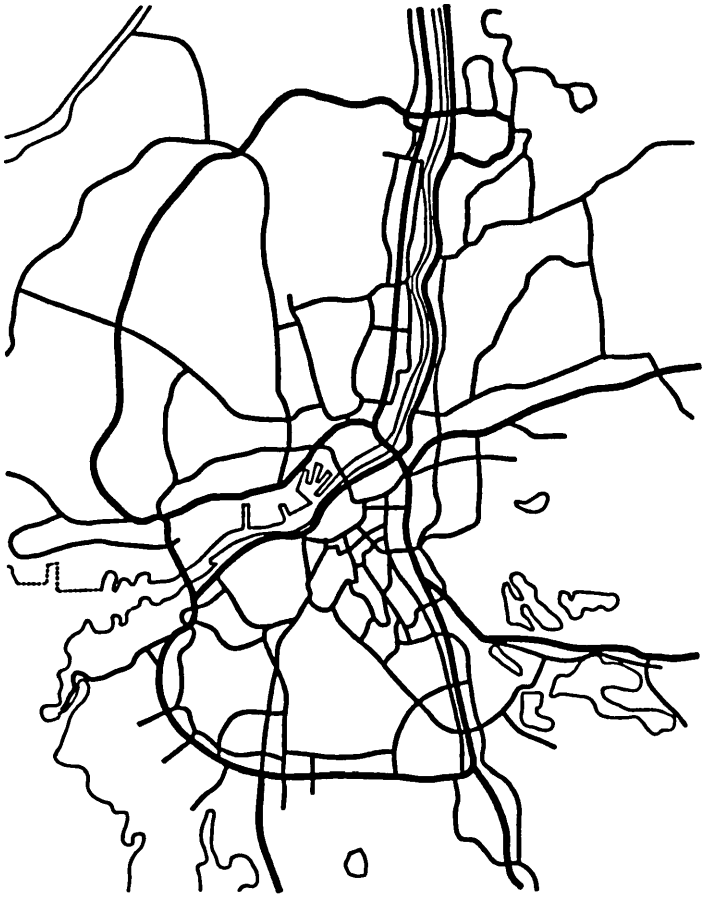


FIGURE K.9 The Major Roads Network in Goteborg (1987)

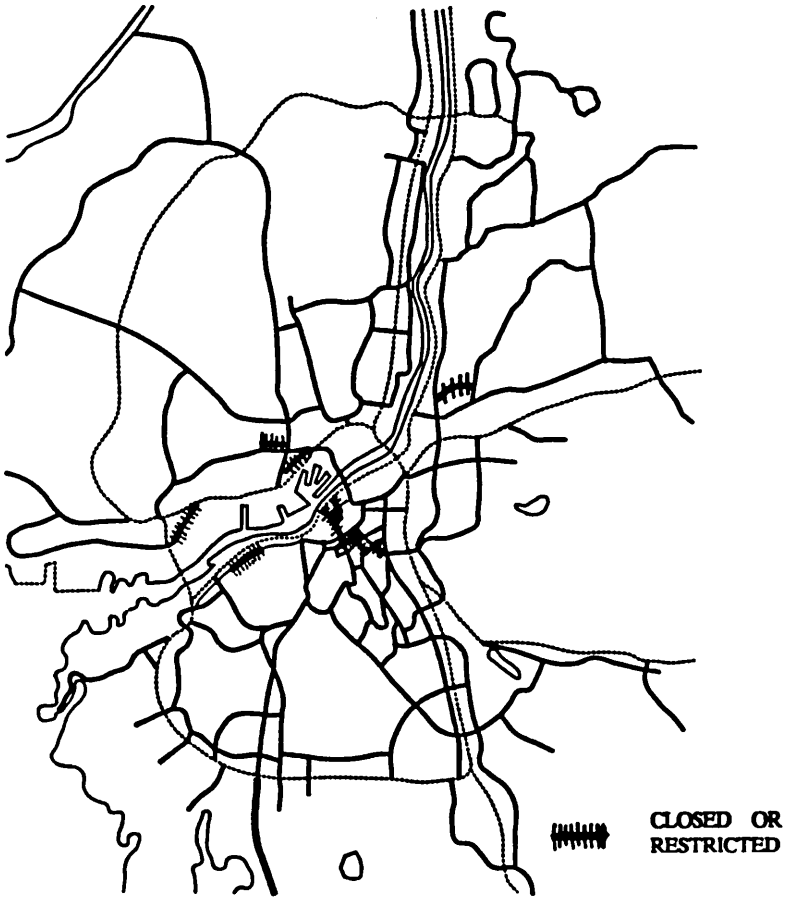


FIGURE A11 Major Road Closures/Restrictions in Goteborg between 1971–1983

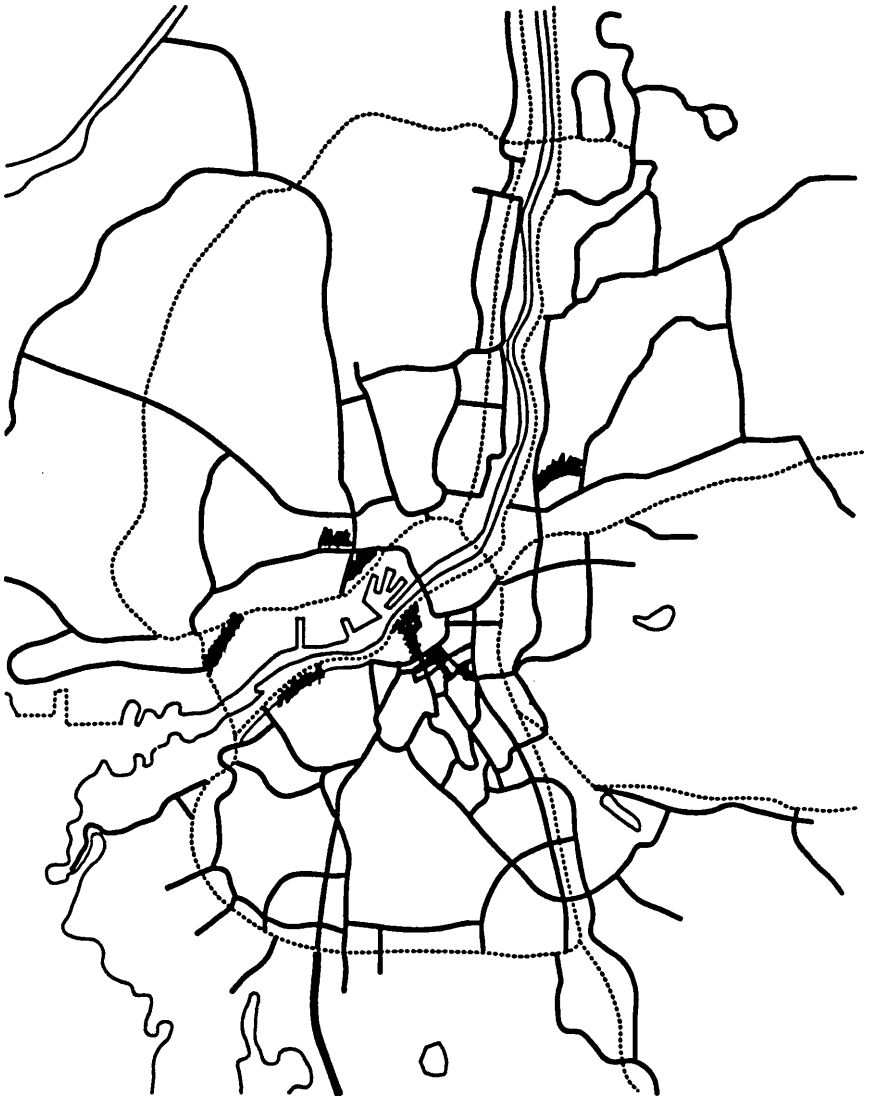


Figure K.11 Roads closed or restricted in Göteborg between 1971–1983.

The CBD Traffic Development in Göteborg and The Development of Car Ownership

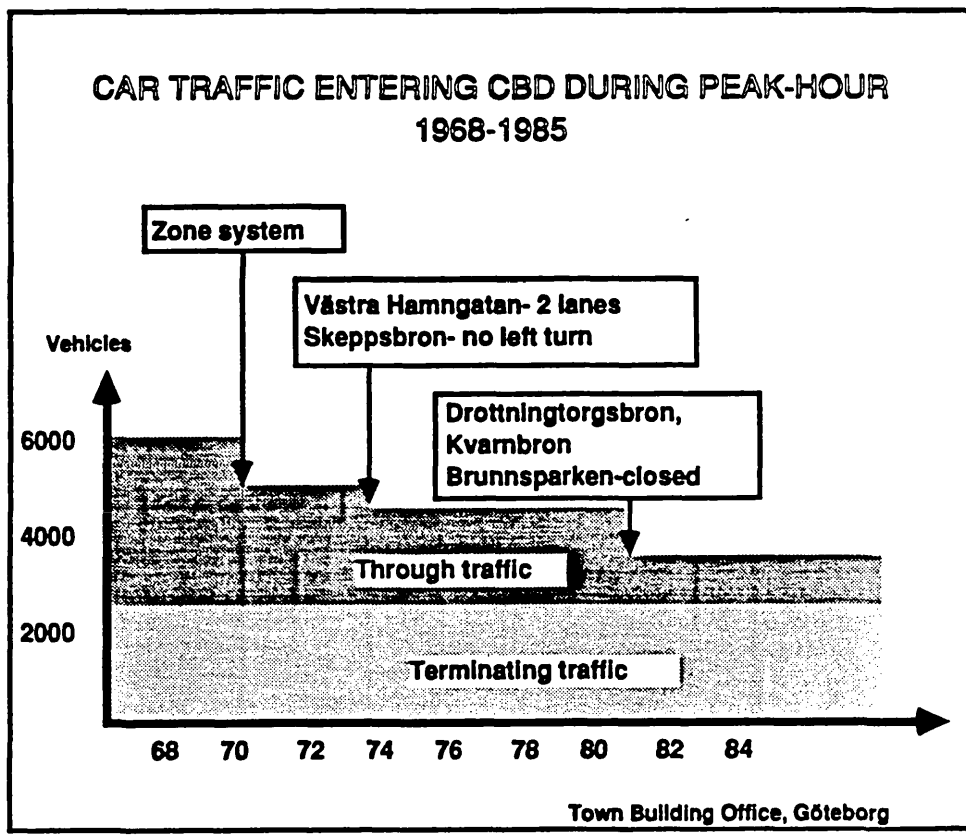


Figure L.1 The morning peak-period daily traffic flows entering the CBD in Göteborg.

Count Station	1981	1982	1983	1984	1985
Norra Hamngatan	3 600	3 800	4 100	4 200	4 200
Södra Hamngatan	3 300	3 500	2 500		
Östra Larmgatan	3 000	2 800	2 300		
Stora Nygatan	4 300	4 500	4 600		
Kvarnbron				3 400	3 400
Slussgatan				6 400	6 600
Södra Vägen	7 600	7 500	7 900	7 700	7 900
Kungsportsavenyn	3 500	3 600	3 500	3 600	4 000
Vasavägen	12 000	12 500	12 000	12 000	12 000
Viktoriabron	4 400	4 700	5 000	5 000	5 400
Rosenlundsbron	5 700	6 400	6 600	6 400	7 100
Östra Pusterviksbron	4 800	5 800	6 500	6 300	5 500
Surbrunnsgatan	7 800	8 800	9 000	9 200	11 500
Södra Hamngatan	3 700	4 000	4 100	4 500	1 900
Norra Hamngatan	5 500	5 100	5 500	5 800	6 200
Smedjegatan	1 200	1 100	1 300	1 300	1 300
Östra Hamngatan	8 600	9 100	9 000	9 100	8 000
TOTAL (IN+ OUT)	79 000	83 200	83 900	84 900	85 000
Increase/Decrease from the year before (%)	-3.1	+5.3	+0.8	+1.2	+0.1

Count Station	1985	1986	1987	1988	1989
Norra Hamngatan	4 200	4 600	5 400	5 700	5 100
Kvarnbron	3 400	4 000	3 800	4 400	4 700
Slussgatan	6 600	7 900	9 500	9 500	9 600
Södra Vägen	7 900	8 100	8 100	8 300	8 400
Kungsportsavenyn	4 000	4 500	4 000	3 800	4 200
Vasavägen	12 000	12 000	13 500	13 000	8 900
Viktoriabron	5 400	4 900	4 900	5 200	5 800
Rosenlundsbron	7 100	6 900	5 800	6 300	7 000
Östra Pusterviksbron	5 500	5 700	6 900	6 100	5 800
Surbrunnsgatan	11 500	11 000	10 500	10 300	10 900
Södra Hamngatan	1 900	1) 2 900	4 800	5 000	5 400
Norra Hamngatan	6 200	6 300	6 500	6 100	6 800
Smedjegatan	1 300	1 000	1 400	1 500	1 400
Östra Hamngatan	8 000	9 000	10 000	11 000	8 600
TOTAL (IN+ OUT)	85 000	88 800	95 100	96 200	92 600
Increase/Decrease from the year before (%)	+0,1 %	+4,5 %	+7,1 %	+1,2 %	-3,7 %

TABLE L.1 **Daily Traffic Flow on CBD Streets (1981–1989)**

Source: Traffic Development in Göteborg (TRAFIKUTVECKLINGEN I GÖTEBORG) (T.O.M 1985 & 1989)

	number of private vehicles				private Veh per 1000 inhabitants			
	1986	1987	1988	1989	1986	1987	1988	1989
Göteborg	151242	157228	160924	162880	352	364	373	377
Kungsbacka	22206	23482	24798	25639	445	462	477	483
Härryda	10366	10838	11284	11619	412	424	431	440
Partille	10906	11284	11716	12111	371	381	389	397
Öckerö	2987	3169	3434	3578	288	304	325	332
Stenungsund	7754	8186	8599	8807	449	467	483	486
Tjörn	5429	5768	6057	6347	429	446	457	463
Mölndal	19285	20095	20851	21416	385	398	408	414
Kungälv	13497	14215	14793	15338	422	442	454	463
Ale	9165	9568	9870	10174	392	407	419	427
Lerum	12327	12868	13600	13953	392	405	420	428
Greater Göteborg	265164	276701	285926	291862	373	386	397	402
Total Suburbs	113922	119473	125002	128982	404	419	432	439
TOTAL	3253601	3366571	3482656	3578042	388	400	412	420

TABLE L.2 **Number of Private Vehicles in Göteborg and the Suburb (1986–89)**

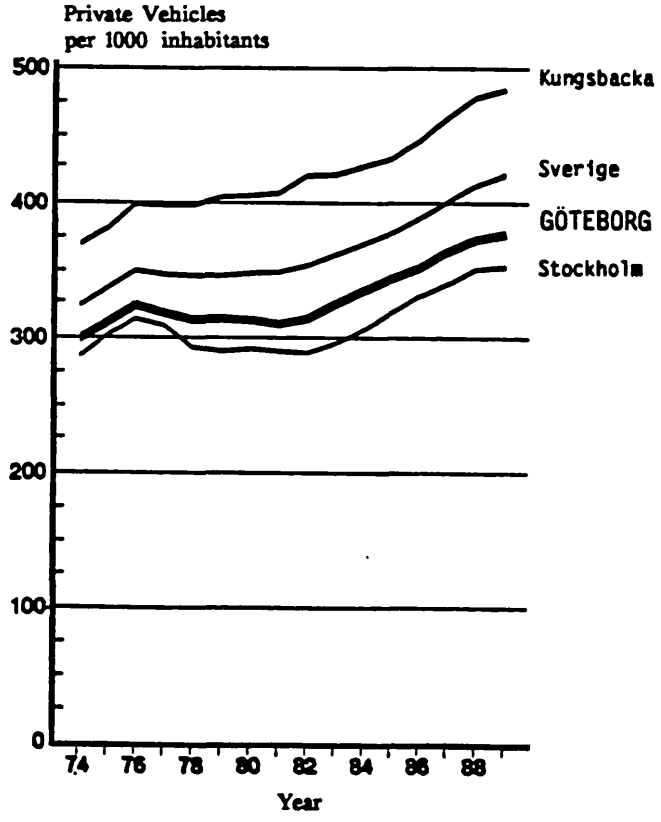


FIGURE L.2 **Car Ownership Rates in Göteborg, Stockholm, Göteborg+Suburbs and the Suburb of Kungsbacka**

Source: Traffic Development in Göteborg (TRAFIKUTVECKLINGEN I GÖTEBORG) (T.O.M 1989)

APPENDIX M (CHAPTER 7)

Background to the London Transport and GLC private transport counts (1961–1971)

Introduction

M.1 The public transport operators continuously monitored their peak period Central London traffic on annual basis, for management purposes, from 1949 onwards. One omission was travel into Central London by private vehicles due to its relatively low level in the early post war period. London Transport instituted surveys of private traffic commencing in 1957 (cars only) and 1958 (cars, motor cycles and pedal cycles) in the morning peak period (07:00–09:59) making the annual counts cover all modes of travel into Central London. A new definition of the 'Central Area' was adopted, and used for statistical purposes in the 1961, 1966 and 1971 Censuses, after agreement between the Ministry of Housing and Local Government, the L.C.C., London Transport and London University.

M.2 The extension of the defined area of 'Central London' to the West and South meant that additional private transport count points had also to be devised. In the Spring of 1961 It was agreed for London Transport to continue to count at the smaller former cordon while the L.C.C. carried out counts at the new cordon where this differed from the old. This procedure was instituted in July 1961 and continued until 1971 with the counts taken on two weekdays in July in the 07:00–09:59 period with the first day being devoted to a count of private cars and occupants and the second to motor cycles and pedal cycles. In order to overcome the apparent discrepancy in the published figures between the GLC/LT joint survey (as published by the public transport operator) and the GLC's own surveys, an agreement was reached between the GLC and London Transport on a new series of private transport counts. Up to and including 1970, the Central Area Counts were carried out by LT for the 50 busiest roads only (there are approximately 90 entry points to Central London in total). From 1971 onwards, additional data were obtained from a similar GLC survey in September covering 'all roads' entering Central London, but at a slightly different set of cordon points to those used by LT before 1971. This GLC survey was for sample periods of time in each hour and was carried out every two years.

M.3 By reconciling the GLC and LT surveys, an estimate of the number of vehicles on all roads entering Central London was obtained. To facilitate this reconciliation, from 1971 onwards, the LT survey points were moved to the corresponding GLC survey point where the two points differed, and the LT survey was carried out in Autumn, rather than Summer. This explains the nominal discrepancy between the GLC Table and the LT tables. The discrepancy between the figures used in the Report of the study in 1973, and the figures presented in Table 3 was attributed to be the result of the adjustment, in 1971, of the previous years in an attempt to 'make them broadly compatible with the results for 1971 onwards'. Since 1985, LT have surveyed all 90 or so entry points.

The GLC Surveys

M.4 These surveys have also provided a record of the number of people entering Central London by private transport, and were later reconciled with the LT counts (as

explained earlier). The first of these counts was taken by the RRL (Road Research Laboratory) in 1965, but the following surveys of 1968, 1971 and 1972 were taken under the auspices of the GLC . In 1968, the cordon was changed by an extension to the east to include the whole of the Inner Ring Road while the western boundary was drawn in to compensate. This meant that neither the 1965 and 1968 survey areas were compatible with the Conurbation Centre used for the bus and rail counts.

M.5 The search in old London Transport files produced a number of tables and documents on the traffic counts by both, the GLC and the LT. These figures were examined in closer detail with particular emphasis on the London Transport counts to avoid the disparity of the GLC counts caused by the alteration of the survey cordon as mentioned earlier. The figures are for all modes of transport entering Central London during the morning peak period. A number of Tables and Figures are presented throughout the text.

M.6 Table 5 enables us to look at the trends developing in the period between 1961–1971. From the table, it is clear that the trend has been that of declining number of passengers entering Central London in the morning peak. This trend is evident for the London Transport Buses patronage and the users of motor and pedal cycles where the percentage change between 1961–1971 was –30.2per cent, –72.8per cent, and –82.8per cent, respectively. The trend for passengers travelling by car was the opposite with a percentage change of +23.2 per cent for the same period. This was also characterized by an increase in the number of cars entering Central London of +22.6 per cent over the same period.