M.R. Wigan

GREATER LONDON COUNCIL

Research Memorandum

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GOODS VEHICLE ACTIVITY IN GREATER LONDON

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RM 491

As part of the GLTS studies of 1971/72 goods vehicle traffic was covered by two surveys, one collecting vehicle logs for vehicles based in London and the other based on questionnaires from externally based vehicles that crossed the cordon into London. Overall the sample provides 24 hour travel data on about 3% of all goods vehicles operating in Greater London. This memorandum summarises the major characteristics of goods vehicle activity indicated by the survey.

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Any views or conclusions contained in this memorandum are not to be taken as statements of GLC policy.

1 INTRODUCTION

1.1 The goods vehicles on the roads of London comprise both London-based vehicles and those from elsewhere. An estimated 181,000 goods vehicles were in use on roads within the GLC boundary on a normal weekday in the Spring of 1972. This paper presents selected information on the characteristics and operations of this fleet of vehicles.

1.2 The Greater London Transportation Study of 1971/2 (GLTS) included two surveys directed to goods vehicles: one for vehicles normally kept in London (ref. 1) and another for those crossing the external cordon inwards (ref. 2). The position of the cordon in relation to the GLC boundary is shown on the map at Appendix 2. The basis of each was a questionnaire in the form of a log-book in which the driver of each selected vehicle recorded his movements and operations. Resident vehicles reported on a 24-hour period and visiting vehicles reported their operations in London. A combined sample of 5,715 completed log-books provided the data for journeys wholly or partly within Greater London and this sample was expanded to represent the activities of the 181,000 vehicles in daily use (refs 3 and 4).

1.3 The GLTS surveys collected information on vehicle size and on their movements during the day: the addresses of premises visited, together with the land use at each and the purpose of the vehicle's stop there, its time of arrival and departure and the mileage of each journey. If goods were delivered at a stop they were described and their weight estimated.

1.4 The GLTS was designed partly as an up-date to the London Traffic Survey of 1962 (LTS). In goods traffic the most notable development between 1962 and 1972 is the increased number of very heavy vehicles, and in particular the growth in heavy vehicle traffic from outside London. These changes are explored in Section 2. The LTS did not attempt to quantify commodity tonnage, so no direct comparison of tonnages is possible, but the overall growth can be inferred from the increased vehicle capacity (ref. 5).

1.5 In 1967-8 the Department of the Environment conducted its Road Goods Transport Survey (RGTS), covering the national movement of goods by road (ref. 6). Since it distinguishes journeys ending in London it complements GLTS to some extent. The two surveys give consistent results for total goods vehicle movements related to London, but the RGTS estimates of tonnage carried are generally higher than the GLTS figures for tonnage delivered. RGTS selected a sample of 3-4% and collected data for a specific week, whereas GLTS used a similar sampling fraction but studied only one typical working day for each vehicle. The results of both surveys are used in Section 3 to describe commodity flows.

1.6 Only a selection of the results available from GLTS are presented in this paper and the computer tabulations from which they derive will usually yield more detailed information for specific purposes. They have been extensively used in the development of the GLC freight policy. For example, the quantification of desire lines for lorries of different weights has been used in assessing the probable effects of area bans and restrictions for diverting heavy vehicles; the overal findings on collection and delivery of goods provide one basis for the assessment of proposals to increase consolidation and improve distribution. These analyses are available in the series of London Freight Conference Background Papers (ref. 7).

2 GOODS VEHICLES IN LONDON

Goods are normally carried by road in vehicles licensed under the Vehicles Excise Act as 'Goods Vehicles', that is, 'mechanically propelled vehicles constructed or adapted for, and used for, the conveyance of goods or burden in the course of trade or business'. For the purposes of this paper, goods carried by other road vehicles, such as private cars and vans, are regarded as insignificant.

The licensing records provide a sampling frame for the vehicles concerned. For the nation as a whole, the number of goods vehicles currently licensed represents the number available for the carriage of goods. But within a defined area such as Greater London, with vehicles passing freely in and out, the number of vehicles licensed by the GLC is not a true indication of the number based in or operating in the area under its jurisdiction.

Annual totals of goods vehicles currently licensed by the GLC are available for the nine years 1966 to 1974 inclusive. (For earlier periods licensing was in the hands of the various predecessors of the GLC, and in 1975 the National Licensing Centre at Swansea began to take over.) During those nine years the number registered varied from a minimum of 257,898 in 1968 to a maximum of 276,841 in 1970. But these figures are much greater than the number of goods vehicles on the roads of London at any time, firstly because the GLC offered a bulk registration service for fleet operators, so that vehicles licensed by the GLC were not necessarily based in London, and secondly because not all registered vehicles are used every day.

To assess the overall magnitude of goods vehicle operations in London it is clearly necessary to define and estimate the vehicle population with which we are concerned. Such estimates were made, using sampling techniques, in 1962 and again in 1972. Both estimates were based on survey areas which are almost identical in extent, with boundaries

1962 the London Traffic Survey published a figure of 190,800 goods vehicles based in its survey area, and the corresponding figure from the GLTS of 1972 was 192,130.

The total fleet serving addresses in London, however, includes those non-resident vehicles which cross the cordon bound for London destinations. In-bound crossings by non-resident vehicles increased from 33,800 a day in 1962 to 43,700 in 1972. Thus, while the number of London-based vehicles changed little, non-resident vehicles serving London increased 30% during the decade.

Although fairly constant in number, in its composition by weight the resident fleet changed considerably between 1962 and 1972. In particular those over 5 tons unladen showed a marked growth while those between 2 and 3 tons declined (Table 2.1).

The effective fleet (including non-resident vehicles) operating daily to and from addresses in the survey area increased from 192,200 in 1962 to 207,500 in 1972. The various totals applicable to London's goods vehicles in these two years are summarised in Table 2.2. Within Greater London (defined as the area subject to GLC control under the Local Government Act 1963) the number of vehicles operating on a normal weekday in 1972 was 181,400, and this is the goods vehicle fleet with which this paper is concerned.

Table 2.1 Analysis of London's resident goods vehicle fleet in 1962 and 1972 (at the time of survey)

Percentage by unladen weight

Unladen weight	1962	1972	Change
0 - 1 ton	40.2	32.4	- 20%
1 - 2 ton	22.5	31.7	+ 14%
2 - 3 ton	19.1	10.2	- 47%
3 - 5 ton	13.8	18.2	+ 32%
over 5 ton	4.4	7.5	+ 68%
	100.0	100.0	

Table 2.2 Goods vehicles operating in London in 1962 and 1972 (at the time of survey)

Number

	1962	1972	Change
Registered by GLC	-	268,400	
Based in survey area	190,800	192,130	+ 0.7%
Resident vehicles in daily use	158,300	163,800	+ 3%
Non-resident vehicles			
Inbound cordon crossing			
Light	16,600	17,400	+ 5%
Heavy	17,200	26,300	+52%
	33,800	43,700	+30%
Total vehicles operating daily in survey area	192,100	207,500	+11%
Total vehicles operating daily in Greater London	-	181,400	

The number of goods vehicles based in Greater London is 24 for every 1,000 people in the population, but the proportion varies between boroughs (Table 2.3). Another 6 vehicles per 1,000 people serve London from outside each day. These figures compare with a national average of about 30 licensed goods vehicles per 1,000 head of population.

Goods vehicles cover such a wide range in size that any analysis which failed to differentiate between them would be misleading, reflecting unduly the characteristics of small vans, which predominate numerically. For many purposes however there is greater interest in larger vans and lorries, whose importance in terms of freight or environment is disproportionate to their numbers. At least three size categories should be distinguished - Light, Medium and Heavy Goods Vehicles: these are conveniently defined according to the number of tyres and axles, thus:

LGV - not more than 4 tyres (i.e., no twin tyres)
MGV - 6 tyres (i.e., 2 axles with twin tyres at rear)
HGV - 3 or more axles, including articulated and trailer-drawing vehicles.

All these categories can be used for classified counts of vehicle flows at the roadside. More complex schemes, recognizing the difference between body types, can be but in fact were not used in GLTS. The probable disposition of the London fleet by body type, as shown in Table 2.4(d), is derived from the national statistics for body type by gross weight category (ref. 8).

The composition of the fleet by various classifications is shown in Table 2.4. The likelihood of a vehicle being based outside the GLC area increases with size: 83% of the LGV are London-based but more than half of the HGV are non-resident.

In number, LGV are closely equivalent to vehicles of up to 30 cwt unladen or 3½ ton gross weight. These are light vans and pick-ups (up to about the size of a Ford Transit or Bedford CF van), which can be run without an operator's licence and are exempt from gross weight testing and plating.* Although they comprise 55% of the fleet numerically they account for only 22% of its unladen weight and for only 7% of the tonnage delivered. The carrying capacity of the 100,000 LGV in the London fleet is estimated to be:

0 - 5 cwt	capacity	42,000 vehicles
5 - 15 "	"	20,000 "
15 - 20 "	"	25,000 "
over 20 "	"	13,000 "

MGV fall into two main weight categories. For vehicles up to 3 tons unladen (or, since 1975, 7.5 tonnes gross vehicle weight) the driver does not require a heavy goods licence, and the vehicles are predominantly box vans of up to about 3 tons pay-load. Typically a 3 ton van would be 15 ft long: 6 ft for the cabin and 9 ft for the box, giving it a capacity of about 300 cu. ft.

* The Goods Vehicle (Plating and Testing) Regulations 1968 made under the Road Safety Act 1967 (S. 8 & 9) requires load-carrying commercial vehicles of more than 30 cwt unladen to be tested at Government testing stations. After testing they are issued with a plastic laminate plate approximately 6" x 4" which is required to be fixed in a conspicuous and accessible position (usually in the driver's cab) and which shows the weight limits under which the vehicle must operate.

For vehicles above 3 tons unladen (now 7.5 tonnes gross) the driver requires a heavy goods licence and the vehicle will be fitted with reflective markers. MGV in this category are the larger 2-axle vans and lorries, making the bulk of deliveries to food and other retail outlets in the urban area; vehicles of 13 to 16 tons gross carry between 6 and 10 tons. Typically such a vehicle, carrying, say, 8 tons, would be about 24 ft long: 6 ft for the cab and 18 ft for the box or platform.

Table 2.3 Goods Vehicles in the London boroughs: vehicles based and stops made per thousand population

Number

	Vehicles based in borough	Stops made in borough
Barking	24	116
Barnet	24	161
Bexley	18	100
Brent	26	141
Bromley	19	120
Camden	29	309
Croydon	23	130
Ealing	28	147
Enfield	30	157
Greenwich	26	135
Hackney	24	151
Hammersmith	26	166
Haringey	24	152
Harrow	19	170
Havering	23	112
Hillingdon	30	194
Hounslow	34	164
Islington	28	208
Kensington	12	134
Kingston	21	110
Lambeth	19	103
Lewisham	16	93
Merton	26	150
Newham	28	111
Redbridge	24	128
Richmond	23	128
Southwark	41	172
Sutton	16	81
Tower Hamlets	44	242
Waltham Forest	19	115
Wandsworth	19	110
Westminster	18	443
Greater London	24	158

thousands

Table 2.4 Goods vehicles operating in Greater London daily in 1972:

(a) Base, by type

Vehicle base	Vehicle Type			
	LGV	MGV	HGV	All types
Based in GLC area	81	40	12	133
Visiting GLC area	18	12	12	41
Passing through GLC area	1	2	3	6
All bases	100	54	27	181

(b) Unladen weight, by type

Unladen weight	LGV	MGV	HGV	All types
Up to 30 cwt	93	6		99
1½ to 3 tons	5	16	2	23
3 to 5 tons	2	25	13	40
5 to 8 tons		7	8	15
Over 8 tons			4	4
All weights	100	54	27	181

(c) Gross weight, by type

Gross weight	LGV	MGV	HGV	All types
Up to 3½ tons	93	6		99
3½ to 8½ tons	5	23	2	30
8½ to 16 tons	2	22	7	31
16 to 24 tons		2	10	12
Over 24 tons		1	9	10
All weights	100	54	27	181

Continued...

(d) Gross weight, by body type

Gross weight	Body type					
	Small van or pickup	Rigid box van	Rigid flat or sided	Other rigid	Artic.	All types
Up to 3½ tons	98					98
3½ to 8½ tons		16	12	2		30
8½ to 16 tons		6	19	4	2	31
16 to 24 tons			3	3	6	12
Over 24 tons			1	1	8	10
All weights	98	22	35	10	16	181

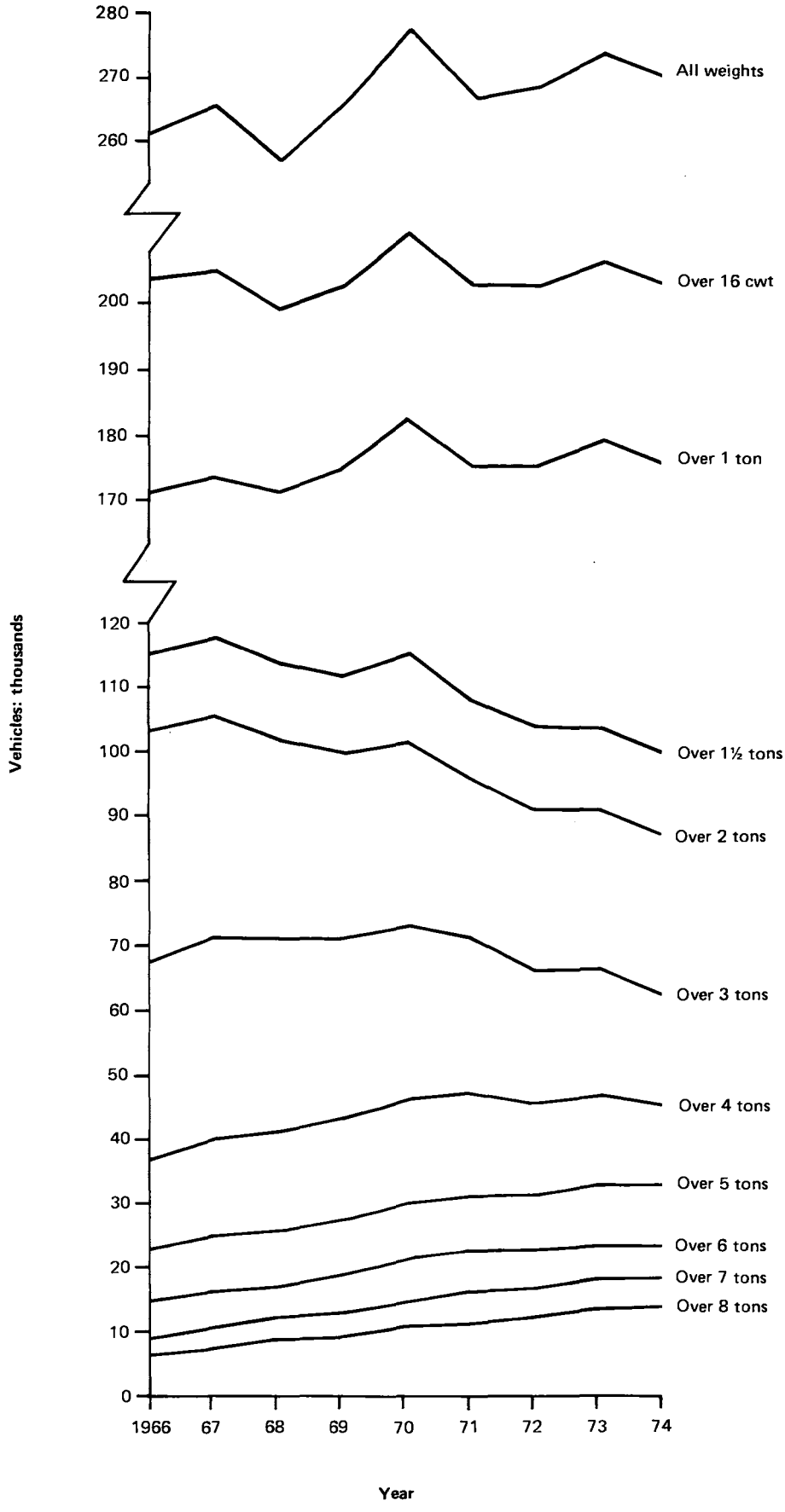
(e) Unladen weight, by age of vehicle

Unladen weight	Age of vehicle in years						
	0-2	2-4	4-6	6-8	8-10	Over 10	All ages
Up to 30 cwt	36	28	17	11	4	2	99
1½ to 3 tons	6	6	4	4	2	1	23
3 to 5 tons	9	12	9	7	3		40
t to 8 tons	4	5	4	2			15
Over 8 tons	2	1	1				4
All weights	57	52	35	24	9	4	181

Most vehicles weighing over 16 tons gross (about 5 tons unladen) have more than two axles. These HGV are articulated and trailer-drawing, often used on long-haul delivery, together with rigid multi-axle bulk carriers and tankers. Owing to differences in construction there is no strict relationship between weight and length. Vehicles of 13 m (42'6") in length are required to display a 'long-vehicle' sign on the back, but some rigid vehicles, such as tippers, may be of the maximum permitted weight but only about 32 ft long. On the other hand a comparatively light articulated van of 25 ton gross may achieve the maximum permitted length of 49 ft.

Changes in the composition of the vehicle fleet between 1962 and 1972 are indicated in Table 2.2. There was a growth in the heaviest categories (over 3 tons unladen) at the expense of the middle range (2 to 3 tons), and a growth in the 1 to 2 ton category at the expense of the under 1 ton. These trends are reflected in the GLC registration figures for 1966 to 1974 (Fig. 2.1). There has been a further marked growth in vehicles over 5 tons after 1972, with a further decline in those between 2 and 5 tons.

Figure 2.1 Goods vehicles currently licensed by the GLC from 1966 to 1974



Larger vehicles give more years' service according to the age structure shown in Table 2.4(e), which is based on the registration records. Of HGV and MGV 43% were more than 4 years old, against 35% of LGV. A delay between the GLTS sample selection and the conduct of the survey enables the annual scrapping rates to be estimated as 11% for HGV/MGV and 17% for LGV.

3 GOODS MOVED BY ROAD

Comparisons from different surveys

The two sources of data available for commodity flows are the RGTS of 1967-8 and the GLTS of 1971-2. The results are broadly comparable and the total commodity movement figures are in fairly good agreement, but for drop sizes and vehicle types the GLTS is the sole source.

Table 3.1 shows the daily tonnages delivered in Greater London according to GLTS and RGTS. The RGTS figures have been reduced from a yearly to a daily basis by division of 250. The exact specifications of each major category differ between the surveys, and so any direct comparison of tonnages across categories is necessarily of limited precision.

There is good agreement between the two surveys on the daily delivery of $\frac{1}{4}$m tons of the main bulk materials - that is, crude minerals, petrol products, chemicals and building materials. The dominant role of food as a single commodity group is apparent.

Table 3.1 Daily tonnages delivered by road in Greater London: RGTS 1968 and GLTS 1971 data

Commodity grouping	1968 RGTS**	1971 GLTS	GLTS as % of RGTS
Food	150,000	100,000	67
Crude minerals, etc.	99,000	102,00	102
Building materials	99,000	90,000	92
Petrol products	29,000	34,000	118
Chemical products	20,000	23,000	113
Coal	23,000	11,000*	47
Manufactures	145,000	82,000	57
Other	75,000	15,000	30
TOTAL	639,000+	457,000	72

* Known to be low owing to strikes in 1971

** Daily tonnages based on an assumed 250 day year.

\+ Total not equal to the elements owing to rounding.

Manufactures are badly matched in the two surveys due to the enormous variety of goods covered by this category. The potential for consolidated deliveries is greatest in this category and that of food, where this type of distribution is extensively used by major retailing chains. The contributions to total delivered tonnage of the 13 heaviest individual RGTS commodities are shown in Table 3.2.

Petrol and chemical products use large and specialised distribution systems which are conditioned to the special safety and health hazards involved. At a much finer level, medical and pharmaceutical supplies are similarly specialised in their requirements, and widespread services exist to provide for them. Building materials, coal and crude minerals are all suitable for trunking, that is, they can be brought into London in large unit loads, then broken down into smaller loads for distribution. Building aggregates are increasingly dealt with by local distribution from wharf or railhead depots.

A clear idea of the importance of food distribution in London can be obtained from an analysis of the daily deliveries of commodities per head in both London (GLTS) and Swindon, where a similar survey was carried out by Atkins Planning, for the Transport and Road Research Laboratory (TRRL) (ref. 9) in 1973. The results are summarised in Tables 3.3 and 3.4. The manufacturing role of Swindon is clearly predominant, and, while the consumption of food is remarkably similar in the two towns, the levels of building, construction and manufacturing activities are far higher in the smaller town. Swindon was actively rebuilding parts of the town centre at the time of the survey.

The four groups concerned with industrial and building activity show how London differs from Swindon in its overall character, and suggest that transhipment and concentration depots for primary materials would accommodate a larger proportion of the total flow in Swindon compared to London.

The proportion of non-retail food deliveries points towards the substantial use already made of trunking full loads to distribution warehouses. While food may well offer the best potential for increased consolidation, it must be remembered that, owing to its intrinsic suitability, it is being handled this way already in many areas.

The close correspondence between the London and Swindon data on the total food deliveries per head and the 'other commodities' per head suggests that the GLTS data may well be more useful at a detailed level than the RGTS. This measure of agreement is sustained at a finer level.

Table 3.2 Proportion of total delivered tonnage attributable to the 13 heaviest commodities in 1968 (RGTS)

RGTS (CSTE code)	Specification	% of total daily tonnage carried
265	Non metallic mineral manufactures such as pumiceous agglomerate, pieces of concrete or cement and other fabricated building materials (except clay and glass)	9.7
133	Crushed stones, macadam, pebbles	4.6
155	Crude minerals such as earth (excluding chalk or slag)	4.0
007	Fresh milk and cream	3.7
131	Non-industrial sand and gravel	3.7
329	Used packaging	3.5
077	Food preparations (other than meat, fish, tea, coffee, fats)	3.3
339	Unclassifiable goods in small lots	3.3
317	Electrical machinery apparatus appliances and spares	3.1
343	Rubbish	2.9
043	Fresh and frozen vegetables (other than potatoes)	2.8
311	Specified miscellaneous metal manufactures	2.7
177	Coal	2.2
	These 13 commodity groups account for	49.5% of the road tonnage

Note: Department of the Environment Road Goods Transport Surveys classify goods according to the 'Commodity Classification for Transport Statistics in Europe (CSTE) issued by the Economics Commission for Europe, Inland Transport Committee (1965).

Table 3.3 Daily deliveries of commodities in London and Swindon: kilograms per head

	Swindon 1973	London 1971
Crude minerals	25.1	7.7
Lime and cement	24.2	8.7
Machinery	18.3	4.1
Metals, etc.	16.6	7.7
Total food deliveries	13.0	13.5
Other commodities	21.3	21.0
Total	118.5	62.7

Table 3.4 Daily deliveries of food in London and Swindon: kilograms per head

	Swindon	London
Fresh fruit and vegetables for retail sale	0.87	0.44
Other food for retail sale	2.06	2.75
Total retail food deliveries	2.93	3.19
Food deliveries non-retail	10.06	10.31
Total food deliveries	13.00	13.50

The significance of different commodities

The nature of the goods moved is of great importance in the choice of a distribution operation: equally important from the environmental point of view is to pick out the most important commodities. The RGTS data have been put into a suitable form in Table 3.5. The data only relate to road movements.

As the importance of each commodity to London can broadly be rated by the total tonnage collected and delivered within the GLC area, all commodities have been ranked in decreasing order of this total internal tonnage. The amount of information to be handled is substantial, and in order to reduce it to a usable form the internal trips, the internal loaded miles, the imported tonnage, and the exported tonnage have been expressed as a percentage of all internal trips, the total internal loaded miles, and so on. If a given commodity class covers over 5% under any of these headings, it is coded '1': for lower

proportions (as shown in the Table) codes 2, 3, 4, 5 have been used. The mean length of vehicle haul is given for all commodities without processing. By using a ruler, all commodities at a given level of importance (in terms of miles, trips, imported or exported tonnage) can be directly read off. This table can be used to adduce a number of conclusions. Three examples are given of how to use the table:-

Coal (177) is very important in terms of internal tons moved, but is not very important in terms of trips, loaded road vehicle miles, or even imported or exported tonnage by road. The road haul is short and it is quite clear that most of the major movement of coal is by rail, only local distribution being by road.

Aggregates (133,131) are major commodities in both 1968 and 1972 tonnage and are important imports (over 5% of total tonnage). Both internal loaded road trips and internal loaded vehicle miles are low. This indicates that average tonnage per vehicle is relatively high and that most trips are short, as befits a low value commodity. The important tonnage represents a fairly wide distribution of trip length, ranging from short cross-border trips from neighbouring aggregate sources to relatively long trips by large vehicles. The future development of low value, high density commodities of this sort will reflect the increasing advantages of bulk rail and water transport, as gravel sources in and near London are worked out.

Rubbish and waste (343) follow the same indicators to confirm the style of collection and disposal of rubbish as being one of local hauls to depots within the GLC area for subsequent bulk shipping by road or rail or water. The greater contribution to internal trips (rank 3) than to loaded miles (rank 4) shows how the smaller capacity vehicles used for collection dominate the total pattern of road movement of rubbish.

London is a net importer of goods by road, as the 1968 figures in Table 3.5 demonstrate, but some goods are relatively more important as exports by road than as imports, many of these being goods manufactured in London from raw materials imported by rail or water. Examples are prepared cereals, manufactured wood, beer and sugar products. The commodities where imports are of greater relative significance than exports include vegetables, sand and gravel, transport equipment, cement, petrol, plastic and potatoes.

Commodities where trips are numerous and mileage relatively low are very broadly of a type where local distribution or collection is by road, while the longer hauls are suited to pipeline, rail or water. They include rubbish, crushed stone, pebbles, sand, gravel, cement, coal, petrol. The mean haul by road is less than ten miles, pointing to the increased trunk haul role of other modes. The reverse is true for commodities more likely to be trunked by road, such as miscellaneous and metal manufactures, beer, paper, board, furniture, dairy products, travel goods, lubricating oils, sugars, basic chemicals, non-alcoholic drinks; for these goods internal mileage is high and trips relatively few, and the mean haul (which includes import/export trunk hauls) is uniformly greater than 20 miles.

Table 3.5 may be useful to delineate where markets for trunk haul transhipment depots may be found, although it also shows how this style of operation is already dominant. In commodities where the road-borne import and export tonnages are of approximately similar importance, or where trips and miles are of similar rank, there is comparatively little potential for increased transhipment.

The commodities for which increased rail or water transport would be expected to produce most environmental benefit are those with a substantial import (i.e., 1) or export (i.e., 2) significance. Most of these are also highly rated on internal trips and loaded miles for delivery within Greater London. Consequently improved depot locations would also be needed if landowners were to benefit from such alterations in the distribution system. In order to go further and deduce the likely markets for greater consolidation, it is necessary to bring in further information on the style of carriage and delivery of the internal tonnages. Some of the distortion in the overall picture of commodity movements shown in Table 3.5 could be attributed to other modes: petrol (193) represents less than 2% of all internal road tonnage, but between 2% and 5% of internal road trips. This might well be due to pipeline distribution or to substantial water and rail movements, but certainly shows that Table 3.5 cannot be used for detailed analysis of individual commodity characteristics at this level. It is more likely that this merely reflects drops of smaller than average size, and is certainly due partly to the location of many of the major distribution depots just outside the boundary of Greater London.

Some 1972 GLTS data on commodity movements

Planning for transhipment and break-bulk operations in Outer London naturally depends on the amount of goods traffic entering London from different directions. While the DoE 1968 survey (RGTS) can shed some light on this for vehicle movements rather than commodity movements, the best data source available is the 1971 GLTS goods survey. Table 3.6 shows the long distance external movements into Greater London deduced from both surveys.

RGTS records the whole journey and all its drops as a single unit, while GLTS records each movement between stops. Consequently the shorter sectoral movements are higher in GLTS terms, and the longer are lower. The overall levels and patterns are evidently substantially the same. Both surveys are based on vehicle samples of the order of 3%.

The GLTS survey covered vehicle movements in addition to commodity movements. Consequently it is possible to pick out the distribution of trip and vehicle sizes used to deliver different commodities in London. Table 3.7 lists the major GLTS commodity groups in decreasing order of internal tonnage moved, on the same basis as used for the RGTS information in Table 3.5. The deliveries and the types of vehicles making drops are listed both for the total traffic and the external components of these traffics. The median drop size differs markedly between these two categories, and the number of drops above 5 and above 10 tons are also given to pick out the extent of direct bulk delivery for each commodity class. The ratios of the median drop size of overall to external sources pinpoint break-tonnage and break-bulk distribution styles quite clearly. Direct delivery by road is also picked out by the 'heavy drops' and frequently differs for external and internal hauls.

Table 3.5 Commodities moved by road in London

Commodities are ranked in decreasing order of internal (London to London) tonnage moved by road (see note at end of table).

Commodity group specification	CSTE Code	Internal loaded vehicle trips Rank	Internal loaded vehicle miles involving a drop or delivery Rank	Mean length of all hauls or distribution rounds in, out or within London Miles	Imported tonnage by road Rank	Exported tonnage by road Rank
Concrete products (1)	265	1	1	8.5	1	1
Other crude minerals	155	3	3	11.0	2	1
Fresh milk and cream	007	4	4	10.9	2	2
Rubbish, street cleaning	343	3	4	7.4	4	1
Other mixed groceries	077	2	2	16.5	2	2
Crushed stone, tarmac, pebbles	133	3	4	9.2	1	
Unclassified goods in small lots	339	2	2	18.0	2	2
Used packaging	329	2	2	11.2	2	2
Vegetables (non potatoes) fresh/frozen	043	2	2	8.2	3	4
Electrical machinery, appliances, parts	317	1	1	15.7	2	2
Other metal manufactures	311	2	1	23.4	3	3
Coal	177	3	4	9.3	4	3
Sand and gravel	131	4	5	7.5	1	3
Other non-electrical machinery, parts	315	2	3	6.5	2	2
Meat: chilled, fresh, frozen (2)	003	2	2	14.2	3	3
Other fresh fruit, nuts	039	2	3	6.8	3	3
Transport equipment, parts	319	2	2	14.7	2	3
Cereals: preparations, flour & vegetables	035	2	2	15.3	4	3
Beer	083	4	3	27.7	4	3
Textiles, fabrics, ready made materials	259	2	2	17.4	3	4
Coke, semi-coke or coal	187	5	5	10.9	5	5
Printed matter	325	2	2	13.1	3	5
Sawn wood, railway sleepers	103	3	4	12.4	4	2
Miscellaneous manufactures	327	2	1	20.5	4	3
Paper and board	255	5	3	18.8	2	2
Used building equipment	331	2	3	5.0	4	4
Furniture	321	3	2	24.5	5	3
Distillate fuel	197	5	5	17.7	3	3
Wood manufacturing	253	3	3	21.2	4	3
Milk (evap.) butter, cheese (3)	009	4	3	18.4	4	4
Cement	263	4	*	4.6	2	3
Petrol and gasolene	193	2	5	19.6	3	4
Other basic chemicals	221	5	3	45.6	3	3
Slag, ash dross (not for resmelting)	151	5	*	6.4	*	4
Articles made of paper and pulp	257	3	3	9.3	4	4
Travel goods, knitted goods	323	3	2	28.1	*	*
Other non-alcoholic beverages	079	*	4	39.1	*	5
Iron and steel scrap	163	5	5	12.3	*	3
Fuel oils - heating, and heavy industrial	199	*	*	17.1	5	5
Lubricating oils, greases	201	5	4	37.9	4	4
Sugars, syrup, honey	061	5	3	21.9	5	4
Iron, steel castings (4)	295	*	5	30.7	4	3
Other alcoholic drinks	085	5	5	22.9	5	4
Old and waste paper	109	*	*	5.8	*	4
Furniture remove equipment	333	5	4	19.8	5	4
Glassware, pottery, other minor manufactures	271	5	4	26.8	4	4
Other wood in logs	101	5	5	13.7	*	4
Medicines, pharmaceuticals	241	4	4	19.3	4	4
Refined sugar	057	*	*	13.8	*	4
Shapes, sections of iron/steel	283	*	*	19.6	4	4
Laundry, dry cleaning	341	4	3	22.6	*	*
Plates, sheets: iron/steel (5)	285	5	4	30.2	4	4
Flour, meal, cereals, groats	031	*	*	22.7	4	4
Kerosene, white spirit	195	5	*	10.7	5	*
Tea, spices	073	*	*	10.9	*	4
Potatoes	041	5	5	18.0	4	5
Meat: dried, preserved	005	5	4	39.9	3	5

Table 3.5 (continued)

Commodity group specification	CSTE Code	Internal loaded vehicle trips Rank	Internal loaded vehicle miles involving a drop or delivery Rank	Mean lenth of all hauls or distribution rounds in, out or within London Miles	Imported tonnage by road Rank	Exported tonnage by road Rank
Rubber	251	4	4	19.7	4	4
Dried, dehydrated preserved fruit	047	*	*	9.1	5	4
Glass	269	5	5	13.5	4	*
Other crude animal/vegetable materials	175	4	3	19.7	4	*
Dyeing, tanning, colouring materials	239	5	4	30.9	5	5
Clay	267	*	*	8.8	3	4
Plastics	237	5	5	32.9	4	5
Pitch, Mineral Tar, other crudes	225	*	*	16.2	5	5
Non-ferrous metal scrap	173	*	*	6.5	5	4
Other non-energy petrol derivatives	205	*	*	9.3	5	5
Animal, vegetable fats, oils derivatives	209	*	*	28.6	5	5

Annual overall values	112,600,000 tons	54,060,000 tons	799,970,000 miles	14.8 miles	48,016,000 tons	40,948,000 tons

Note: The rankings are based on the percentage of vehicle trips, vehicle miles, etc., for which the commodity group accounts. The rankings are:

1	2	3	4	5
5%+	>2%-5%>	>1%-2%>	>0.5%-1%>	>0.25%-0.5%

Transhipment of goods from external sources will show up in terms of large numbers of heavy drops from external trips, and cannot be distinguished from direct delivery as this would require the separation of drops at a depot from those at the final destination. For commodities where the median size of drop exceeds 5 tons, direct delivery is clearly important.

Table 3.7 Delivery vehicles for GLTS 1972 commodity groups (ranked by internal tonnage)

Key: All deliveries
Vehicle base or origin of goods outside London

Commodity	GLTS Code	Number of deliveries daily	Modal* drop-size (tons)	Delivery Vehicles			Number of heavy drops	
				Light (4 tyre)	Medium (6 tyre 2 axles)	Heavy (3+ axles)	10t	5-10t
Sand, gravel aggregates	84	10 300	5.	1 200	6 7000	2 400	2300	2600
		2 300	15.	170	1 500	660	850	890
Refuse waste	00	6 600	5.	800	4 900	920	1000	2300
		200	4.	0	0	0	40	40
Cement lime concrete	83	8 300	5.	1 100	3 300	3 900	1270	3020
		1 900	12.	80	600	1 200	1040	510
Drinks	19	21 200	0.2	3 900	12 300	5 000	700	270
		800	12.	10	140	700	150	0
Milk and milk products	14	9 200	0.1	32 100	3 700	2 200	600	600
		800	6.	80	200	500	100	400
General, mixed groceries	18	31 500	0.1	12 500	15 000	4 000	340	970
		1 400	2.	150	700	500	210	210
Fuel oils	X6	2 900	2.	0	1 900	1 010	440	350
		300	10.	0	35	290	125	0
Timber	85	12 200	0.3	4 000	7 000	1 150	190	490
		1 200	1.	320	650	330	140	200
Steel	33	10 300	0.2	4 800	4 100	1 400	320	590
		1 700	0.5	450	1 000	280	270	140
Bulk paper	91	5 000	0.25	1 600	2 800	650	280	180
		490	2.	210	110	170	0	130
Furniture	86	12 900	0.2	3 900	8 300	725	10	280
		1 500	0.2	500	920	70	0	80
Processed Cereals	12	42 200	0.025	11 800	30 000	400	40	330
		2 400	0.5	200	2 000	200	40	110
Meat, fish, eggs	13	37 900	0.025	19 800	16 700	1 400	470	130
		2 600	0.25	600	1 700	300	200	70
Laundry	70	14 200	0.025	5 700	8 500	0	0	260
		750	0.5	200	550	0	0	20
Fresh fruit, vegetables	16	18 500	0.075	6 300	8 800	4 400	70	200
		1 200	1.	270	270	140	70	70
Mail, parcels	9X	62 200	<0.01	29 800	32 000	1 120	0	140
		900	0.025	730	150	70	0	50
Mixed building and decorative materials	8Y	9 500	0.2	6 400	2 500	480	0	50
		130	0.4	70	0	60	0	0
Textiles and fabrics	73	13 000	0.025	4 400	7 700	930	0	0
		300	1.	30	200	50	0	0
Stationery	93	19 100	0.01	1 400	4 500	250	0	30
		400	0.1	100	1 300	30	0	30
Newspapers	94	19 400	0.01	18 300	1 020	40	0	40
		200	-	200	0	40	0	40

* The most commonly occurring drop size. The measurement module is indicated by the quoted mode size.

4 GOODS VEHICLE FUNCTIONS

Of the goods vehicles normally garaged in Greater London 80% are in use on the roads of Greater London on a given weekday, and a further 3% temporarily in use outside London. Of those not in use about half are being maintained, serviced or repaired; the other half are out of use for reasons such as having no work or lacking a driver. The larger the vehicle, the more days it spends on servicing and the more likely it is to be in use outside London (Table 4.1).

The number of stops or calls made daily by a vehicle in performing its functions varies widely, depending on whether it is on long haul, shuttle or multiple-drop distribution. On average an HGV makes less than 5 stops a day; at the other extreme a milk float could make over 500. It is convenient to classify any vehicle which makes more than 30 stops daily as a 'roundsman'. Only 8% of the fleet are in this category and they account for only 6% of the vehicle mileage, but they make two-thirds of all goods vehicle stops. It is best to exclude them from the general analysis of goods vehicle operations because their journeys are atypical, consisting of numerous very short trips at slow speeds, largely on residential streets.

The major land uses served by roundsmen are:

(a) residential - mainly milk but also bread and other foodstuffs and parcels
(b) postal services - the emptying of pillar boxes
(c) shops and catering establishments for food deliveries, newspapers, laundry, etc.

Table 4.3 quantifies the relative importance of these types of traffic.

Excluding the roundsmen, goods vehicles amke 1,157,000 calls each day at addresses in Greater London. Of these stops 66% are for collecting or delivering goods. If LGV are excluded, then 84% of the stops are for goods purposes. (The LGV is used quite extensively to provide non-goods service or personal transport.) On average three deliveries are made for each collection, reflecting the importance of multi-drop distribution, even when roundsmen are excluded. Shops and residences together account for 44% of the calls but residences attract predominantly LGV, while HGV are prominent at industrial and commercial sites (Table 4.4). The daily stops within Greater London average 158 for every 1000 people in the population, but GLTS shows considerable variation in this figure in indivisual boroughs (Table 2.3). About half the stops made by goods vehicles are outside the borough in which they are based. The larger the vehicle, however, the less local is its operation; HGV make 69% of their calls outside the home borough (Table 4.4).

Table 4.1 Goods vehicles based in Greater London

	LGV	MGV	HGV	All
Number of vehicles: 000	105	52	18	174
Percentage				
Used in Greater London	84	79i	74	82
Used outside only	2	3	10	3
Being serviced	6	8	13	7
Not used - other reason	8	10	3	8

The total movement of goods by road within Greater London is estimated at 7.5 million ton-miles daily. Foodstuffs account for 25% of the ton-miles and construction materials to almost 30%. The distribution of ton-mileage by internal and external demand for goods is shown in Table 4.6.

Table 4.2 Goods Vehicles based and used in Greater London

	LGV	MGV	HGV	All
Number of vehicles: 000	88	41	13	142
Daily trips:	Percentage of vehicles			
1-2	17	11	22	16
1 - 2	24	25	38	26
3 - 6	29	25	26	28
6 - 10	19	27	13	21
11 - 30	6	10	1	7
31 - 120	6	1	0	7
Over 120	100	100	100	100

Table 4.3 'Roundsmen'* in Greater London

	LGV	MGV	Total
Vehicles (thousands	10.2	4.5	14.7
Stages (thousands)	1910	292	2202
Miles (thousands)	214	170	384
Stages by type of work			
Delivery to residences	86%	47%	81%
Post Office mail collection	3%	17%	5%
Other rounds	10%	35%	14%
Stages per vehicle			
Delivery to residences	250	95	237
Post Office mail	75	60	69
Other rounds	70	64	73
All work	195	65	150
Miles per vehicle			
Delivery to residences	17	40	20
Post Office mail	27	42	35
Other rounds	39	44	41
All work	21	38	26
Miles per stage			
Delivery to residences	0.07	0.4	0.08
Post Office mail	0.4	0.7	0.5
Other rounds	0.6	0.7	0.6
All work	0.1	0.6	0.17

*A 'roundsman' is defined as a vehicle making more than 30 stops in a day.

Table 4.4 Goods vehicle stops within Greater London (excluding roundsmen)

	LGV	MGV	HGV	All
Daily stops (1000s)	696	383	78	1157
Purpose (per cent)				
Deliver goods	32	57	55	42
Collect goods	16	18	20	17
Collect and deliver	6	8	10	7
Other purpose	45	16	15	34
	100	100	100	100
Land use (per cent)				
Shops	20	27	21	22
Residential	27	15	7	22
Industry	10	14	20	12
Commerce	10	13	21	12
Offices	10	7	2	8
Other	23	24	29	6
	100	100	100	100
Location of base (per cent)				
Same borough	49	38	32	43
Elsewhere in Greater London	46	61	65	52
Outside Greater London	6	1	4	5
	100	100	100	100

Table 4.5 Goods vehicle daily destinations by base of vehicle thousands

Base Sector	No.	Destination Sector										Total
		0	1	2	3	4	5	6	7	8	O/S	
Central	0	86	5	7	7	1	1	3	3	1	7	122
Inner South	1	25	67	8	10	12	11	5	4	3	17	163
North West	2	15	3	41	4	1	1	5	9	1	7	87
North East	3	20	5	9	81	3	1	6	17	15	21	178
South East	4	5	9	1	2	58	3	1	1	1	11	92
South West	5	6	9	4	1	3	61	4	2	1	13	103
West	6	8	5	12	3	1	5	101	11	1	30	175
North West	7	12	3	8	16	1	3	12	81	2	21	159
North East	8	7	2	1	11	1	1	1	4	66	17	110
Outside Greater London	-	13	7	5	11	7	12	13	34	12	6	114
Total		195	115	96	146	88	98	151	165	103	151	1308

The boroughs in each Sector are:-

0. Central: City of London; parts of Southwark, Lambeth, Kensington and Chelsea, Westminster, Camden, Islington, Hackney, Tower Hamlets.
1. Inner South: Lewisham, Wandsworth; remainder of Southwark, Lambeth
2. Inner North West: Hammersmith; remainder of Kensington and Chelsea, Westminster, Camden
3. Inner North East: Haringey, Newham, remainder of Tower Hamlets Islington, Hackney
4. South East:L Bexley, Bromley, Greenwich
5. South West: Croydon, Sutton, Kingston, Merton
6. West: Richmond, Hounslow, Hillingdon, Ealing
7. Outer North West: Brent, Harrow, Barnet, Enfield
8. Outer North East Havering, Barking, Redbridge, Waltham Forest

Table 4.6 Ton-miles daily by road within Greater London (millions)

	Ton miles (millions)	Mean delivery (tons)	Mean mileage in Greater London
Internal delivery			
Into Greater London	2.0	4.0	13
Within Greater London	3.3	0.5	11
External delivery			
Out of Greater London	1.4	3.0	13
Through Greater London	0.8	4.0	32
Total	7.5	1.0	13

5 THE EFFECTS OF GOODS VEHICLE OPERATIONS

In meeting the demand for goods the vehicles inevitably affect the environment in which they operate, since they occupy road space not only while travelling but often while loading and unloading, or while parked for other purposes.

Half of London's goods vehicles are on the road by 8.30 a.m. and half of them are still operating at 5 p.m. The peak hour is between 11 a.m. and 12 noon when about 160,000 vehicles are in use. Less than 10,000 vehicles start work before 6 a.m. The number then starts to build up steadily to the morning peak, and falls away slowly in the afternoon (still 130,000 vehicles in use at 4 p.m.) and rapidly in the evening, dropping to below 10,000 by about 9 p.m. (Figure 5.1)

Similarly, the rate of delivery of goods begins to build up after 6 a.m. and rises to a peak about 11.30 a.m.: 14% of the day's deliveries are made during the hour before noon, compared with only 4% during the twelve overnight hours between 6 p.m. and 6 a.m. Deliveries drop off rapidly after the morning peak; they are down to 7% between 1 p.m. and 2 p.m. rise again to an afternoon peak (9%) between 2 p.m. and 3 p.m., and fall away rapidly towards the evening. (Figure 5.2)

The daily delivery cycle varies for different commodities, land uses and origin of goods. Thus goods from outside London are delivered slightly later, although the peak hour coincides with that for internal vehicles, 14% of the drops being made in the hour before noon. (Figure 5.3 and Figure 5.4)

For deliveries to shops (Figure 5.5 and Figure 5.6) the morning peak is earlier (10 a.m. to 11 a.m.) and the afternoon peak is only half as high. Food deliveries shown no resurgence in the afternoon; after 11 a.m. they drop away steadily for the rest of the day. (Figure 5.7) For food deliveries to grocers and provision merchants the peak is still earlier, between 9 a.m. and 10 a.m.

Paper goods peak earlier than average (Figure 5.8) in the morning (10 - 11 a.m.) and later in the afternoon (4 - 5 p.m.). These are clearly timed deliveries of paper to newsagents (Figure 5.7) with high peaks about 12.30 p.m. and 4.30 p.m. and lesser peaks at 10.30 a.m. and 5.30 a.m.

Tonnage delivered during the day (Figure 5.9) reflects the number of deliveries but indicates changes in average drop size in the course of the day. There is a tendency for heavier loads to be dropped during the 'build-up' hours, 6 a.m. to 9 a.m., and for the average drop size to be lower (down 30%) during the peak delivery hours, 9 a.m. to 12 noon. Tonnage rises again in the afternoon, and the comparatively small number of deliveries made in the evening (when heavier vehicles begin to predominate) are above average weight.

Since externally based vehicles drop larger loads on average than resident vehicles, their share of total tonnage is greater than that of deliveries. Between 6 a.m. and 8 a.m. they deliver almost as much as resident vehicles, and in the evening they deliver more. Through much of the day tonnage delivered by external vehicles is about half that delivered by internal but contributes more of the morning total than the afternoon. External tonnage peaks later than internal in the morning but drops off earlier and more steeply in the afternoon.

Figure 5.1 Number of goods vehicles operating: by time of day

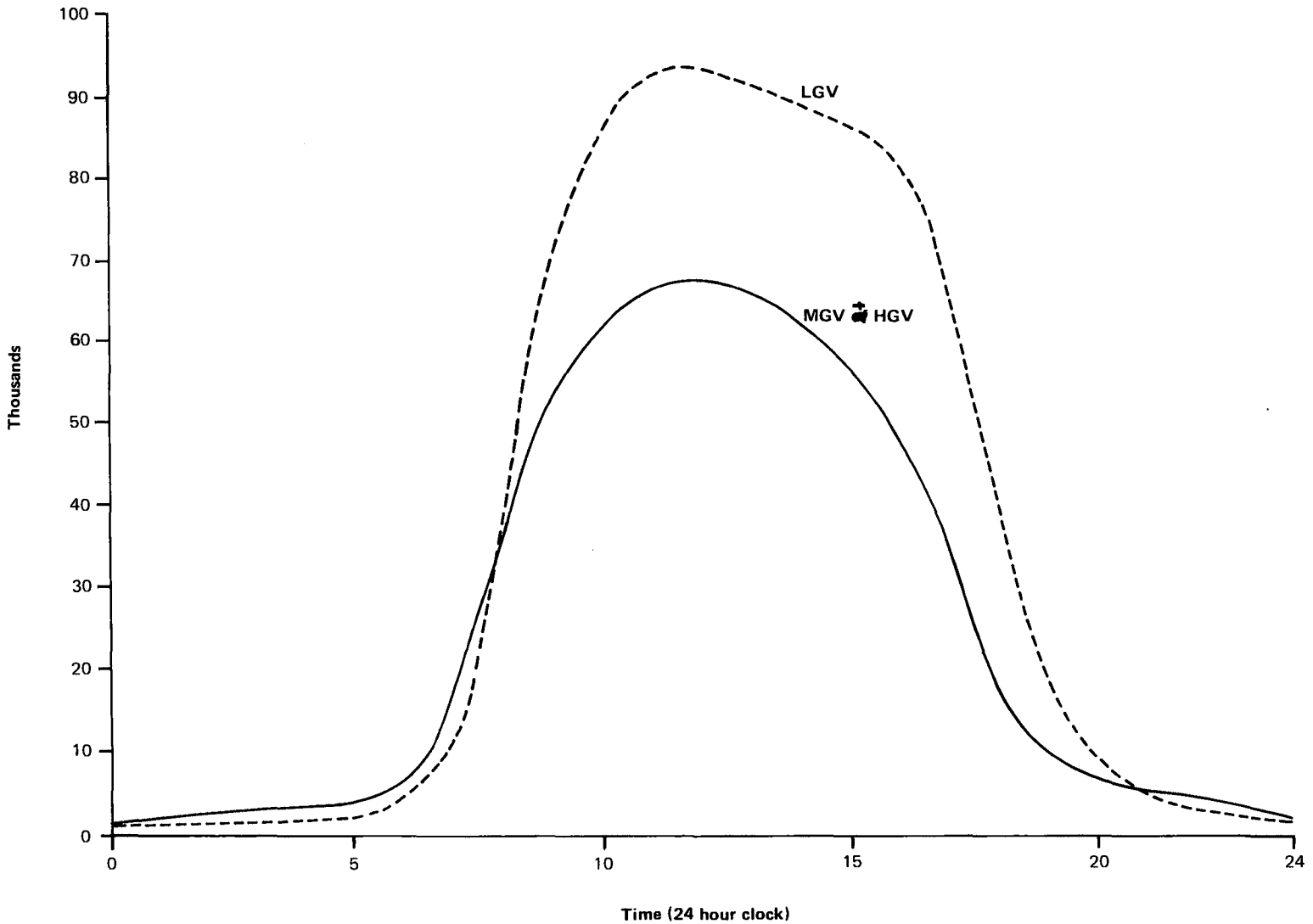


Figure 5.2 Deliveries and tons delivered per hour: by time of day

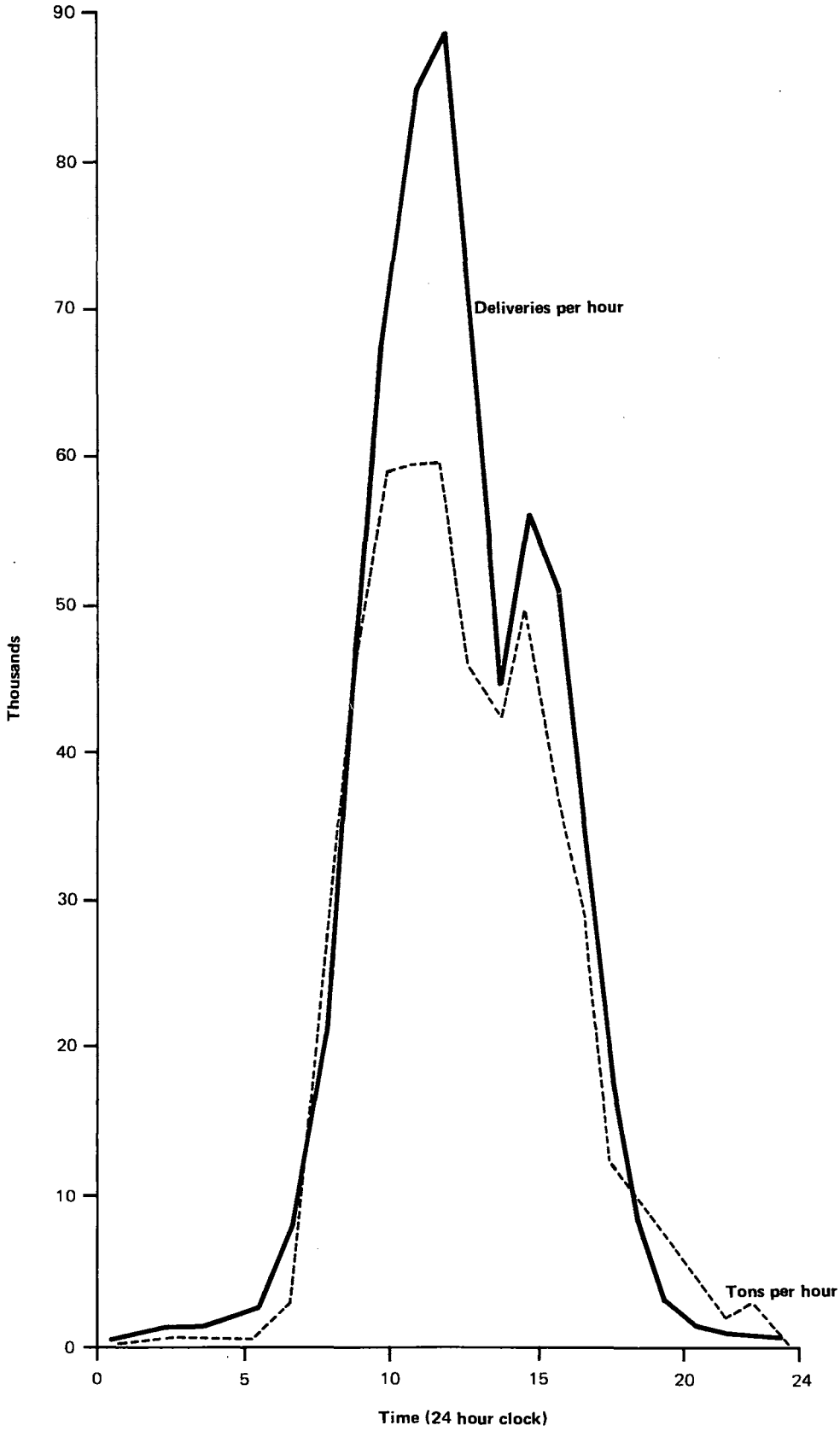


Figure 5.3 Deliveries per hour of goods originating within and outside London: by time of day

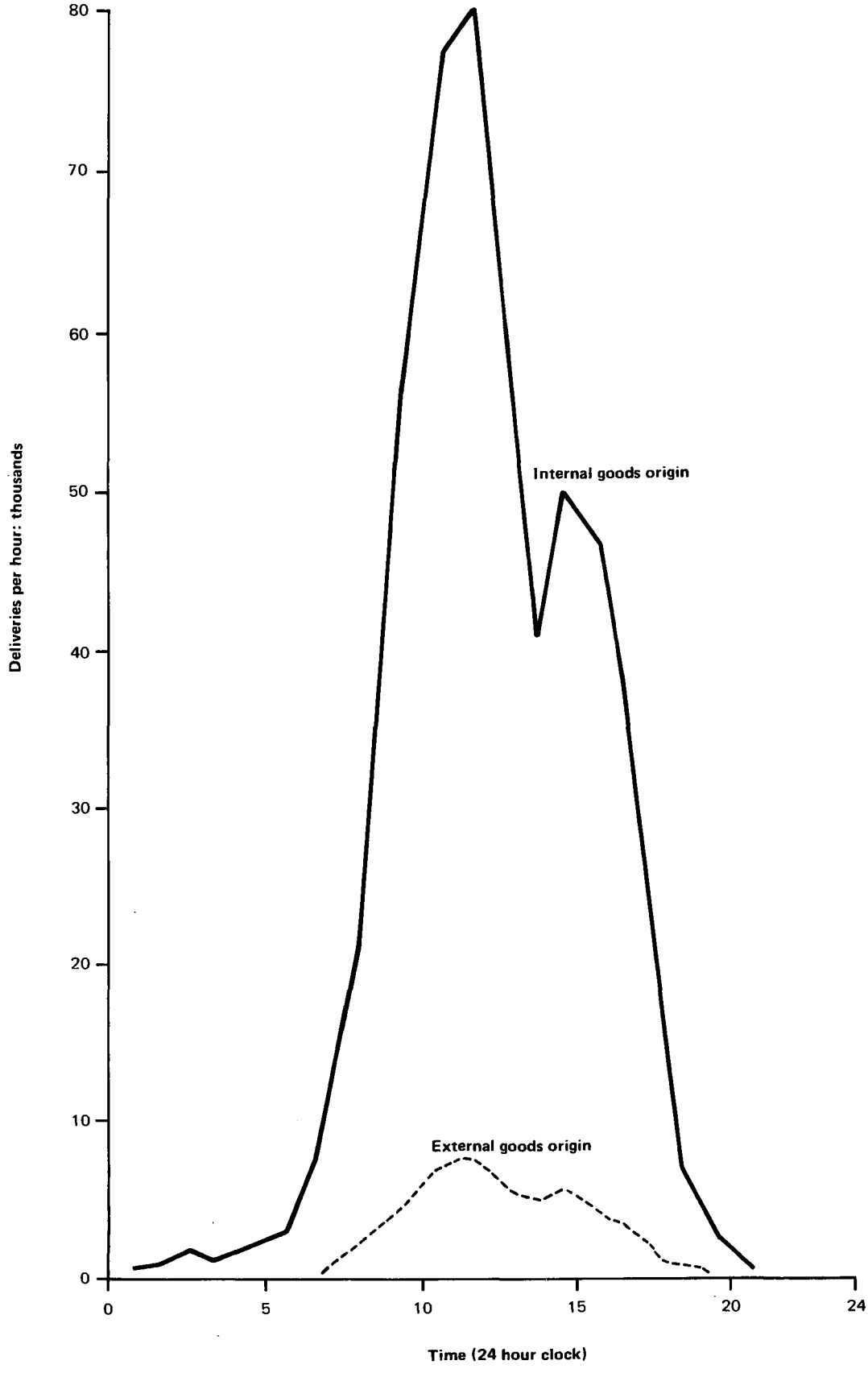


Figure 5.4 Tons delivered per hour of goods originating within and outside London: by time of day

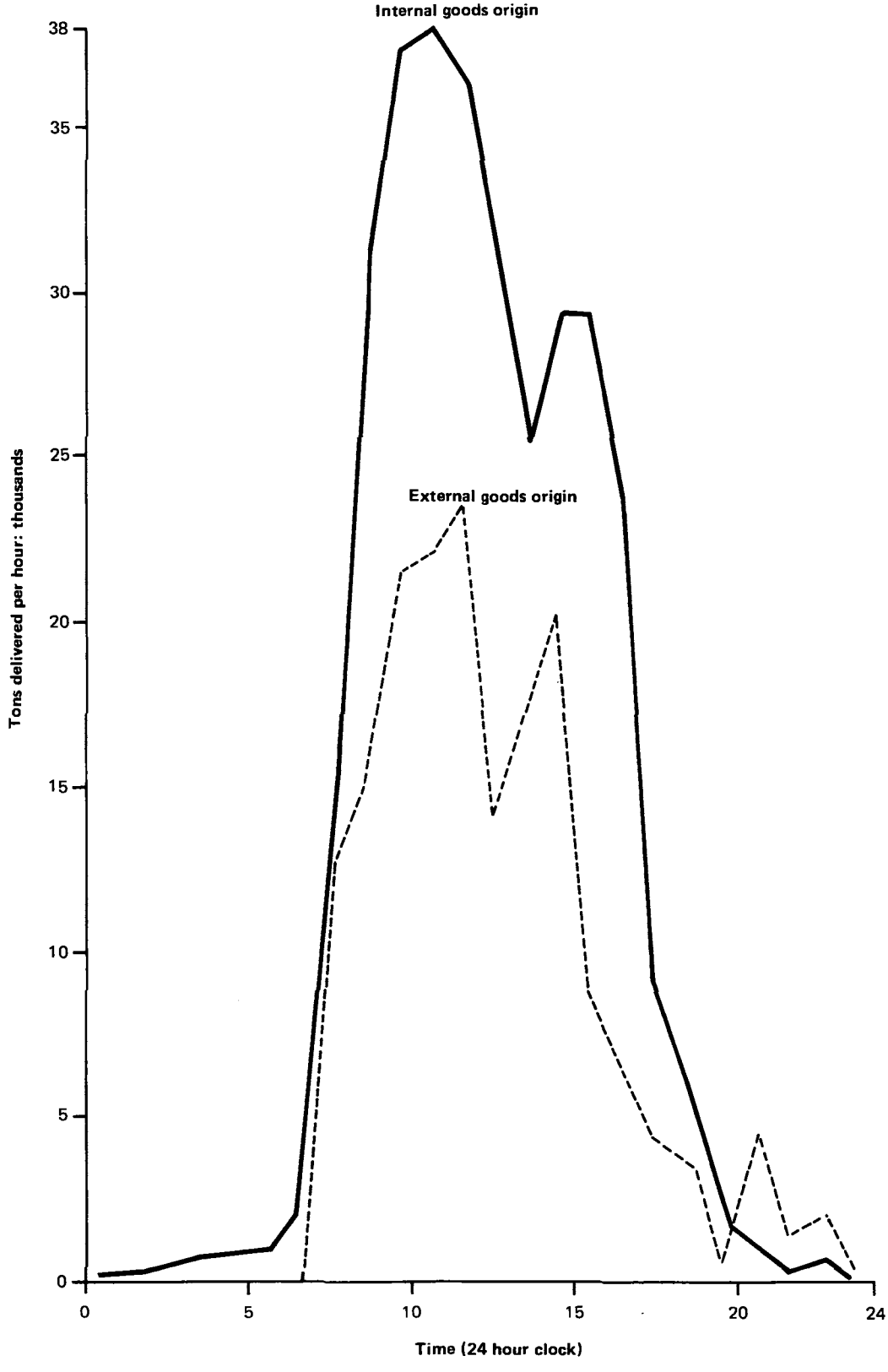


Figure 5.5 Deliveries per hour to certain types of destination: by time of day

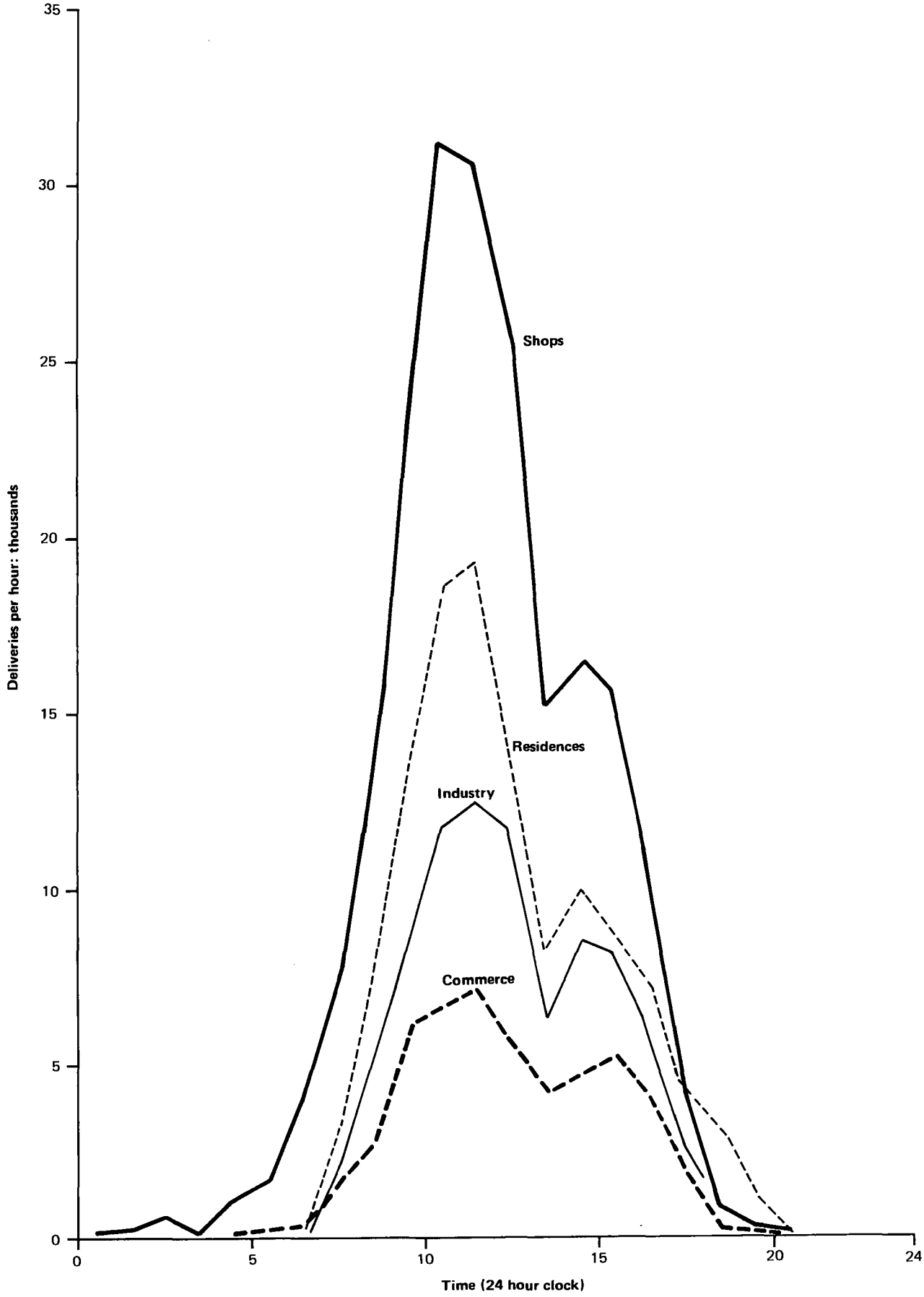


Figure 5.6 Tons delivered per hour to certain types of destination: by time of day

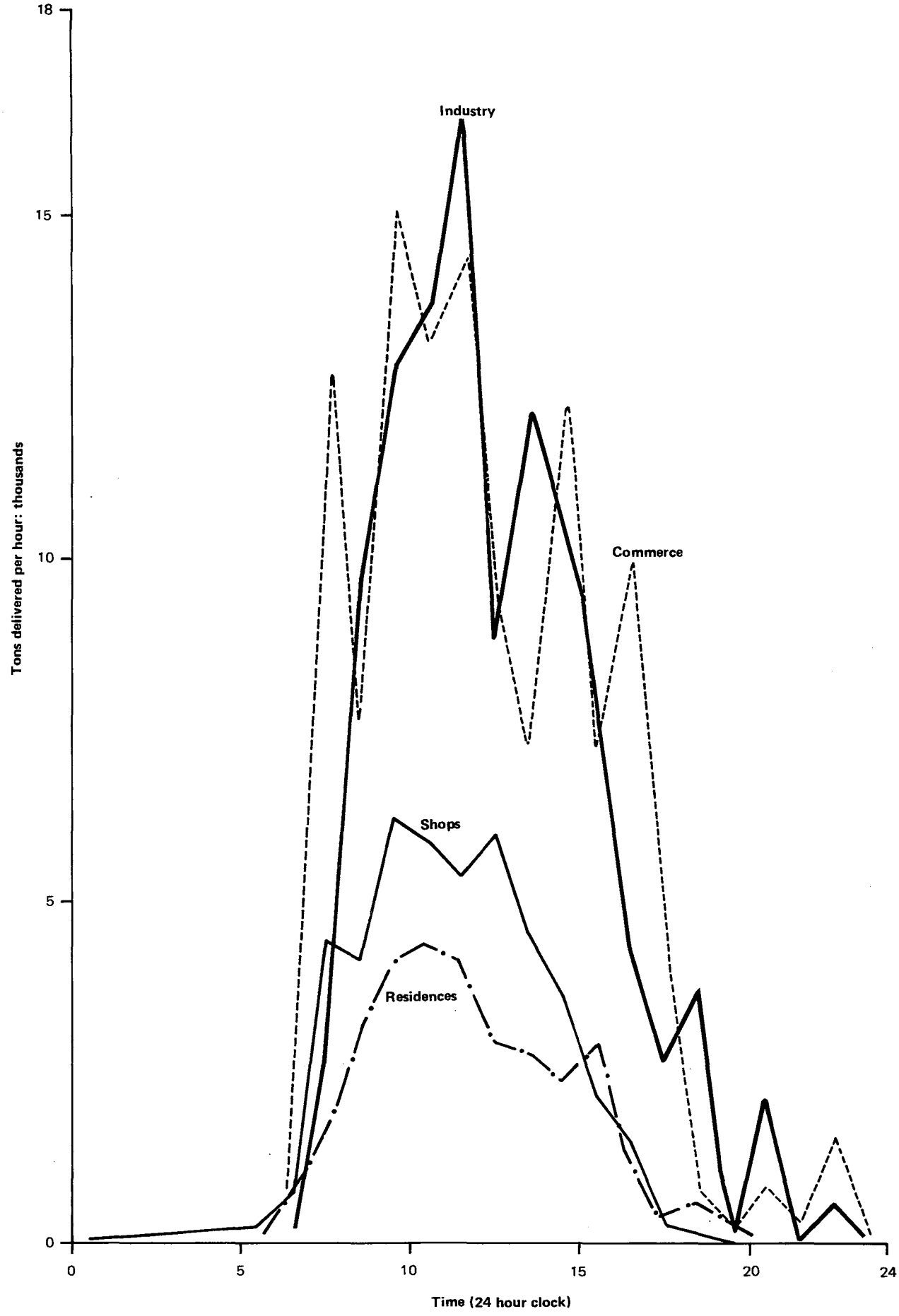


Figure 5.7 Deliveries per hour of certain types of goods for certain destinations by time of day

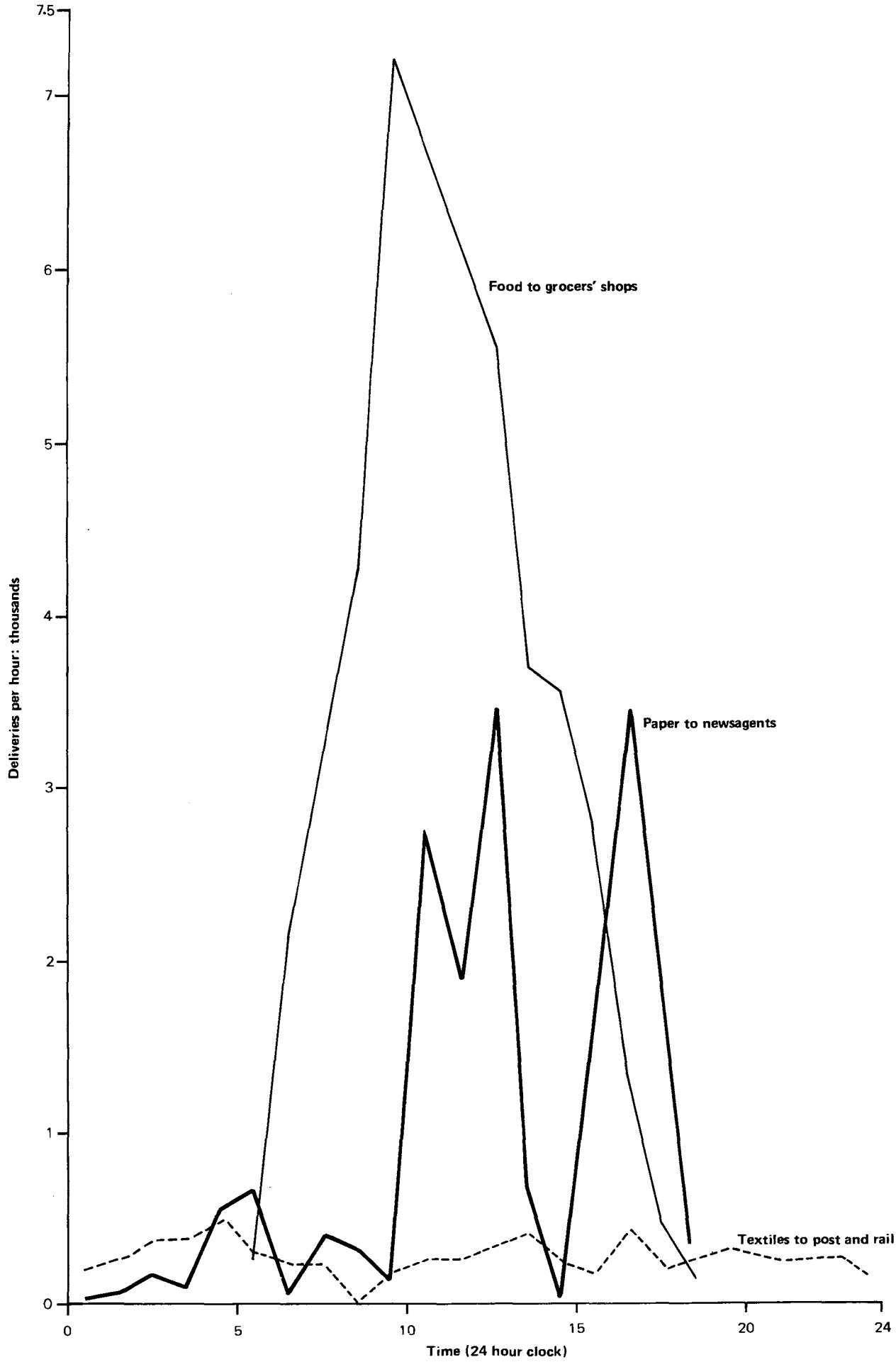


Figure 5.8 Deliveries of certain merchandise: by time of day

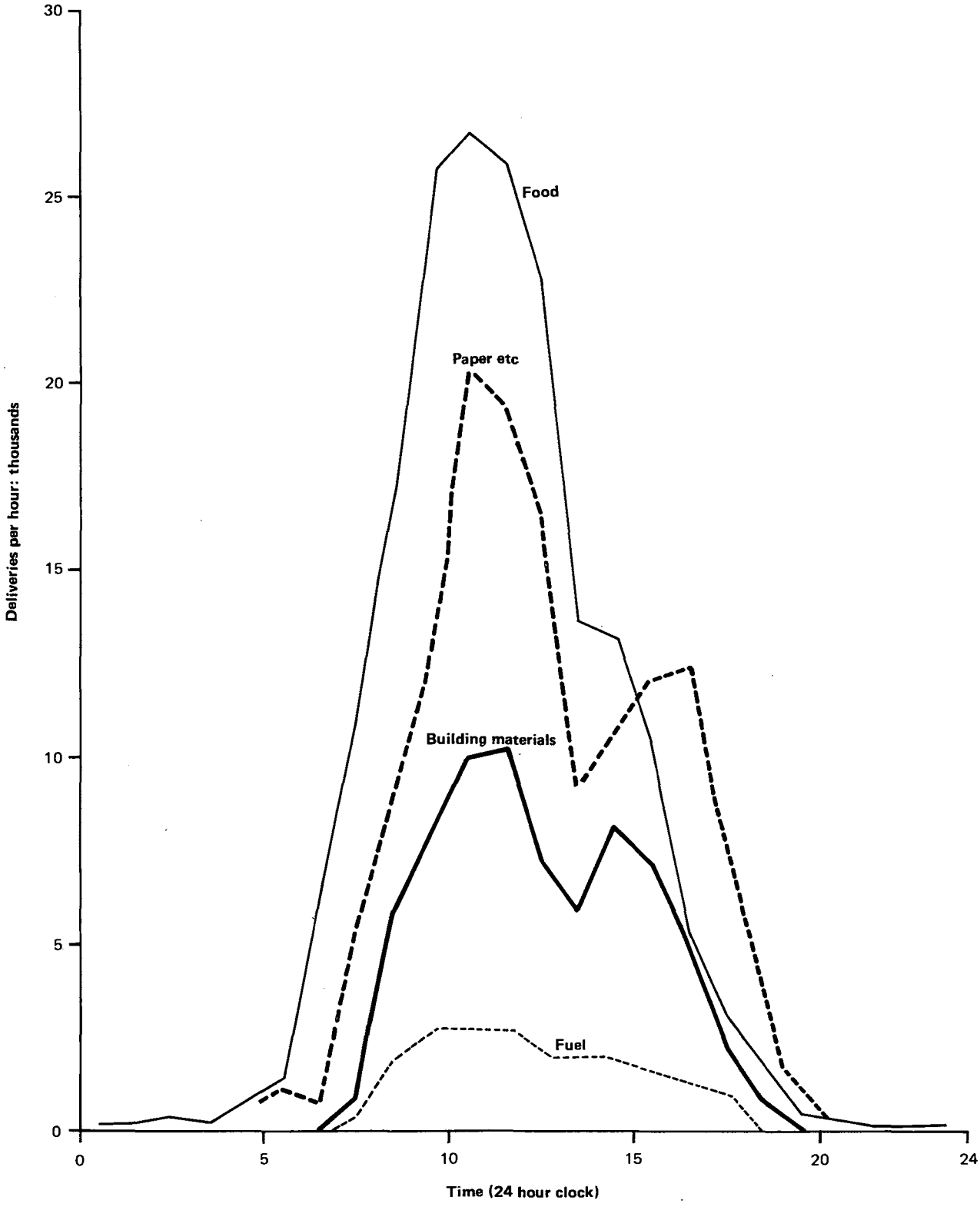
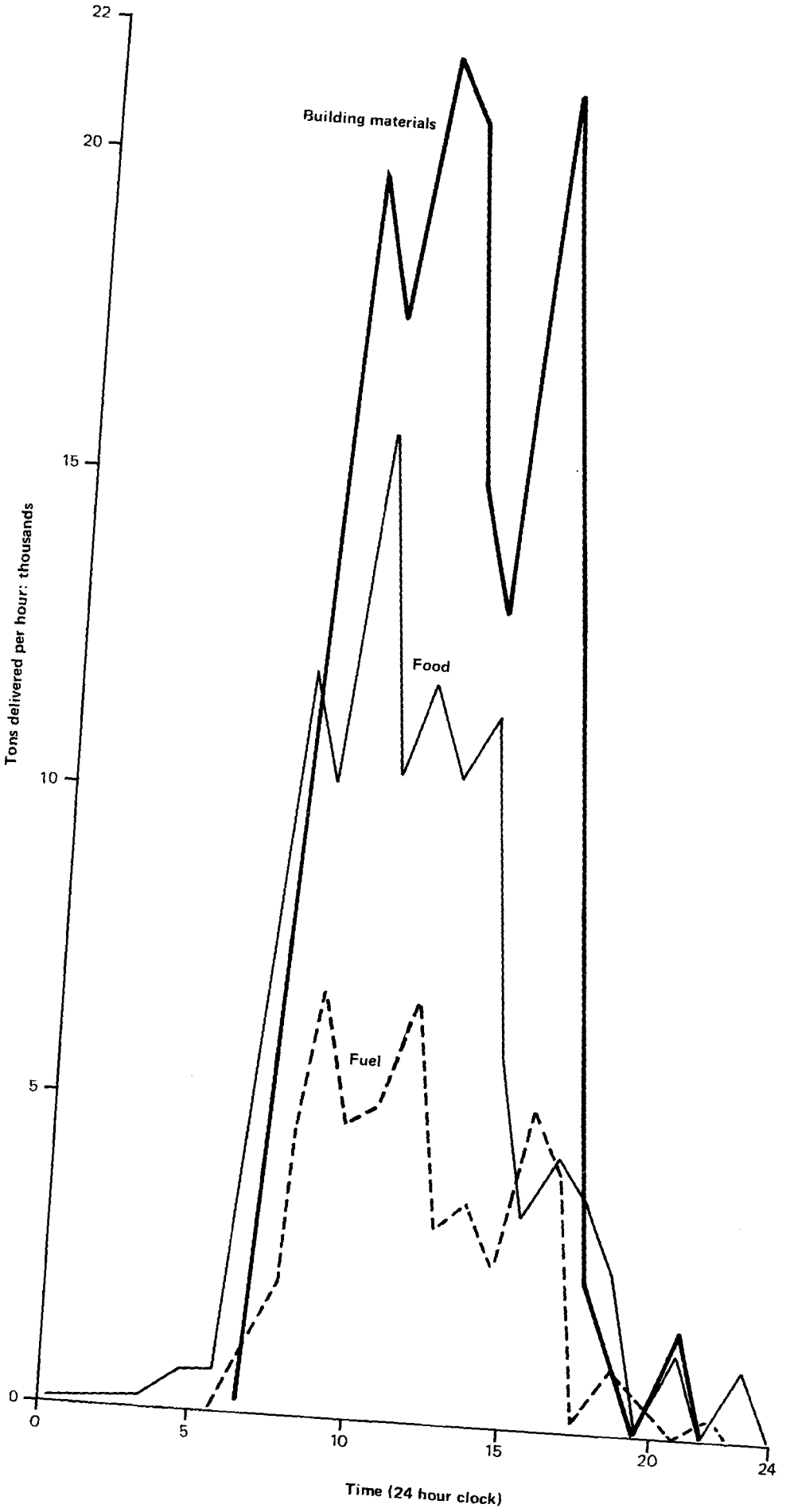


Figure 5.9 Tons of certain merchandise delivered: by time of day



For some commodities and land uses it is apparent that certain times of day are preferred for delivering the heavier loads. Thus shops and commerce have a tonnage peak about 7.30 a.m., which drops off again before rising to the day's peak later in the morning. In the commodity groups, food, fuel and building materials show this double peak in the morning.

For the average goods vehicle the time from starting work to finishing is about $9\frac{1}{2}$ hours. During this period it is travelling for $3\frac{1}{4}$ hours and covering a distance of about 35 miles. For $6\frac{1}{4}$ hours it is stationary, and for $2\frac{1}{4}$ of these it is stopped on the street. When LGVs are excluded, however, running time exceeds stopped time, and 80% of the stopped time is for loading or unloading.

The number and duration of stops made by different sizes of vehicles are summarised in Tables 5.1 to 5.6. Roundsmen making more than 30 deliveries per day are excluded from the calculated averages. It will be noted that the MGV is more likely to stop on-street than lighter or heavier vehicles, but that on-street stops are generally much shorter than the corresponding off-street stops.

The daily mileage by goods vehicles within Greater London is 6,246,000, of which just over half is by LGV. Of this, 30% is attributable to vehicles entering or departing from London and about 3% to non-stopping through vehicles. (Table 5.7)

It is noteworthy that 40% of the vehicle mileage is performed within the area bounded by the North and South Circular Roads, a further 40% within outer London north of the river and 20% in outer London south of the river.

Table 5.1 Trips and stops per vehicle

	London based			Visiting and through		
	LGV	MGV	HGV	LGV	MGV	HGV
Vehicles operating (thousands)	82.3	39.7	12.1	18.6	14.1	14.5
Daily trips (stages) per vehicle	8.1	10.2	6.2	2.6	2.5	2.0
Daily stops per vehicle						
Goods stops						
On-street	2.7	5.1	1.8	0.4	0.5	0.2
Off-street	1.6	3.4	3.0	0.5	0.9	0.8
Non-goods stops						
On-street	1.7	0.4	0.1	0.3	-	-
Off-street	1.1	0.3	0.2	0.4	0.1	-
All stops	7.1	9.2	5.2	1.6	1.5	1.0

Table 5.2 Time spent daily on trips and stops (minutes per vehicle)

	London based			Visiting and through		
	LGV	MGV	HGV	LGV	MGV	HGV
Running time	161	246	289	136	180	177
Stopping time						
For goods						
On-street	60	74	45	14	14	15
Off-street	60	119	160	28	46	51
Other purposes						
On-street	106	19	5	28	1	2
Off-street	120	28	15	66	4	6
Total stop time	346	240	225	136	66	74

Table 5.3 Average running time per stage (minutes)

	LGV	MGV	HGV
Resident vehicles			
Internal stages	18	19	27
In or out stages	48	73	105
Non-resident vehicles			
Internal stages	29	28	34
In or out stages	66	91	93

Table 5.4 Average duration of stop (minutes)

	LGV	MGV	HGV
Resident vehicles			
Goods stops			
On-street	22	15	24
Off-street	38	35	52
Other stops			
On-street	61	43	44
Off-street	110	82	78
Non-resident vehicles			
Goods stops			
On-street	35	30	93
Off-street	58	53	68
Other stops			
On-street	88	41	82
Off-street	159	61	108

Table 5.5 Percentage of stops by land use

	LGV	MGV	HGV
Shops	21	31	23
Residences	25	15	7
Commerce	9	11	18
Industry	11	14	20
Other	34	30	32
	100	100	100

Table 5.6 Percentage of time stopped by land use

	LGV	MGV	HGV
Shops	17	20	12
Residences	25	11	4
Commerce	10	19	26
Industry	14	18	27
Other	33	32	31
	100	100	100

Table 5.7 Vehicle miles within Greater London

Thousands

Trip type	LGV	MGV	HGV	Miles/trip
Intra-zone	96	51	7	0.7
Inter-zone	2455	1256	335	4.7
In/out	724	637	492	10.7
Through	25	73	97	31.8
Miles/trip	4.5	4.8	9.3	5.0

APPENDIX 1: MODELLING GOODS MOVEMENTS

The data collected in the GLTS have been used to examine the problems of deriving modelling techniques to predict future levels of goods and goods vehicle movement. This work was carried out by D.M. Chatterton and is fully described in a thesis submitted to the University of London*. In this chapter a summary of the work is given.

Objectives

The study had two objectives. These were, first, to review those existing techniques for modelling goods and goods vehicle movements which had developed in other studies, to see whether they were appropriate to service current planning and freight policy development needs, and, second, to develop the more promising of the methods in making use of data for London.

The review of available techniques

These broad conclusions were reached concerning modelling techniques:-

1 To be meaningful goods movement modelling needs to take place at the (disaggregate) level of the land use or the establishment producing or attracting trip, rather than at the traffic zone level, as is generally used in current modelling techniques.

2 At a disaggregate level both category analysis and simple regression techniques appear to be equally suitable, and both are capable of further development.

3 The scope for further development of techniques relies critically on data of sufficient quality being available.

The data available for London

The data available precluded the study from following up a strict category analysis approach. Information on movements was taken from GLTS and was available only at the land use rather than the establishment level. Sample regression techniques were used, therefore, and the relationships between movements and explanatory variables examined for a chosen set of land use groups. Relationships were examined (i) for strength of association and (ii) for similarity in form. Data for the explanatory variables were taken from the 1966 GLC Land Use Survey.

Eleven broad land use groups were used in the research. These formed the basic units of the initial disaggregation, and were identical with the broad land use classes used in the GLTS. They were further disaggregated to obtain 66 detailed land use groups. For each group site area was adopted as the variable used to explain the goods and goods vehicle movement associated with the land use, except for industrial land use where site area was not available at the detailed land use level. Employment data from the 1966 Sample Census was used as the explanatory variable in this case.

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* Goods Movement Production and Attraction in London (1975) - D.M. Chatterton, Imperial College, London

...ie GLTS sectors.

. London Transportation Survey 1971-2
.e III Goods Vehicle Survey Report (Ed Garrett)

.reater London Transportation Survey 1971-2
Volume II External Cordon and Screen Line Survey Report (Ed Garrett)

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5. London Traffic Survey 1964 Volume I. Existing traffic and travel characteristics in Greater London. London County Council

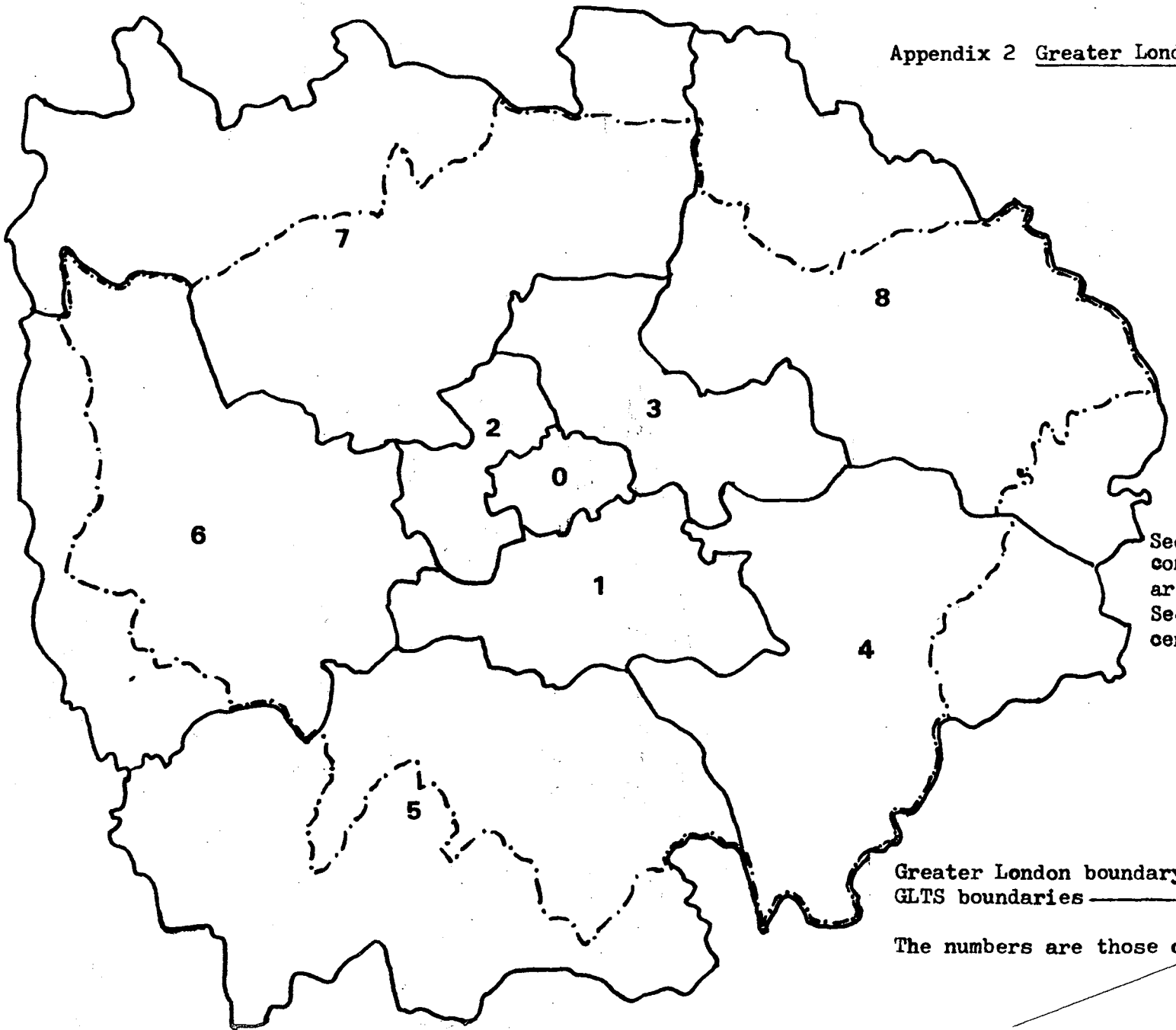
6. Road Goods Transport Survey 1968 Department of the Environment

7. Freight in London (1975). background papers of the London Freight Conference (available from GLC Department of Planning and Transportation)

8. Heavy Goods on Operators Licences (1973). Directorate of Statistics, Department of the Environment

9. Hitchcock, Christie, Cundill. Urban Freight: preliminary results from the Swindon Freight Survey. Transport and Road Research Laboratory, SR 126 UC (1974)

Appendix 2 Greater London and the GLTS area



Sectors 1,2,and 3 comprise the inner area.
Sector 0 is the central area

Greater London boundary —·—·—
GLTS boundaries ————————

The numbers are those of t