

3. DEVELOPMENT OF AN INTEGRATED NETWORK AND ZONING SYSTEM

3.1. INTRODUCTION

This section will outline the various tasks undertaken to develop the basic detail of the transport model. This includes sections on the highway network, public transport networks and services, and the zoning system.

3.2. DATABASES FOR NETWORK MODELLING

3.2.1 Digital Road Network

The basis for the road network was a digitised map of the United Kingdom commercially available from Navtech. Within the GIS MapInfo a pre-selection of links was made to give an initial selection of appropriate network density. The GIS data structure was converted from the MapInfo format into the VISUM format. Transport model related link properties were then added and the network refined to a configuration suited to the transport model requirements.

3.2.2 Public Transport Route Definitions

Public transport route definitions and service schedules have been taken from the official timetables of the transport system operators in written or in electronic form. This information was enhanced by local personnel having a detailed knowledge of the study area.

The stops in the public transport systems have been identified from bus network maps, local knowledge and timetable information. Grid reference co-ordinates for the heart of the modelling area were obtained by site inspection using a global positioning system.

3.3 ZONES

3.3.1 Introduction

For the transport model a zoning system has been defined with zones varying in size according to their level of influence on movements within the study area. Parameters defining the size of zones included the nature and density of land use, transport characteristics and access to networks and influence on the scale and pattern of movements in the study area. Small zones have therefore been defined within the core study area and central area of Nottingham, the size grows larger with distance from and hence diminishing influence on the study area. Zone types have been allocated to a simple classification system to facilitate identification of particular areas:

- 1 Inner Modelling Area: Zones for which the study is targeted
- 2 Greater Modelling Area: Enhancement of study area to include Zones for which travel demand is being synthesised
- 3 Remote Modelling Area: Zones which are external and where movements are represented using data from the traffic and public transport screenline surveys.

The definition of these areas is shown in Figures 2.1 and 2.2

3.3.2 Coding of the Zones

The zone boundaries have been digitised to a grid reference base and integrated into the network model. In addition, the digitised zone boundary file was used in the allocation of zone numbers to trip origins and destinations recorded during the travel surveys. The system of 192 model zones is illustrated in Figures 3.1 and 3.2 for the IMA and the GMA.

Outside the GMA, zoning of the RMA comprising the remainder of mainland UK, is provided by coarse zoning reflecting the main external centres of population and access routes to the IMA.

3.3.3 Generation of Zone Connectors

Zone connectors define the loading of traffic or public transport movements onto the model networks. Initially, the connector links between the zones and the network links were generated automatically using algorithms. The criterion was the minimum distance between the "centroid" of a zone and an adjacent suitable node in the network. Since public transport can only be connected through stops on bus or train lines, in general different connectors were generated for both private and public transport.

During the process of model development and calibration this automatic allocation process was checked and revised to ensure that the correct loading of each zone onto both networks had been achieved. In many cases several connectors were defined for each zone to ensure a realistic distribution of demand onto the networks. This was verified during validation. This realistic distribution of demand onto the network was achieved through both zone apportioning and by using centroids in path building. The zone proportioning method was applied to private transport only. Public transport access times were used to distribute travel demand to the specific preferred stops.

3.3.4 Aggregation of Zones to Sectors

To simplify and to clarify the presentation of the results of movement analysis, 30 sectors were defined as aggregations of the 192 zones of the transport model. The definition of sectors generally relates to the zone types defined in section 3.2, is summarised in Table 3.1 and illustrated in Figure 3.3.

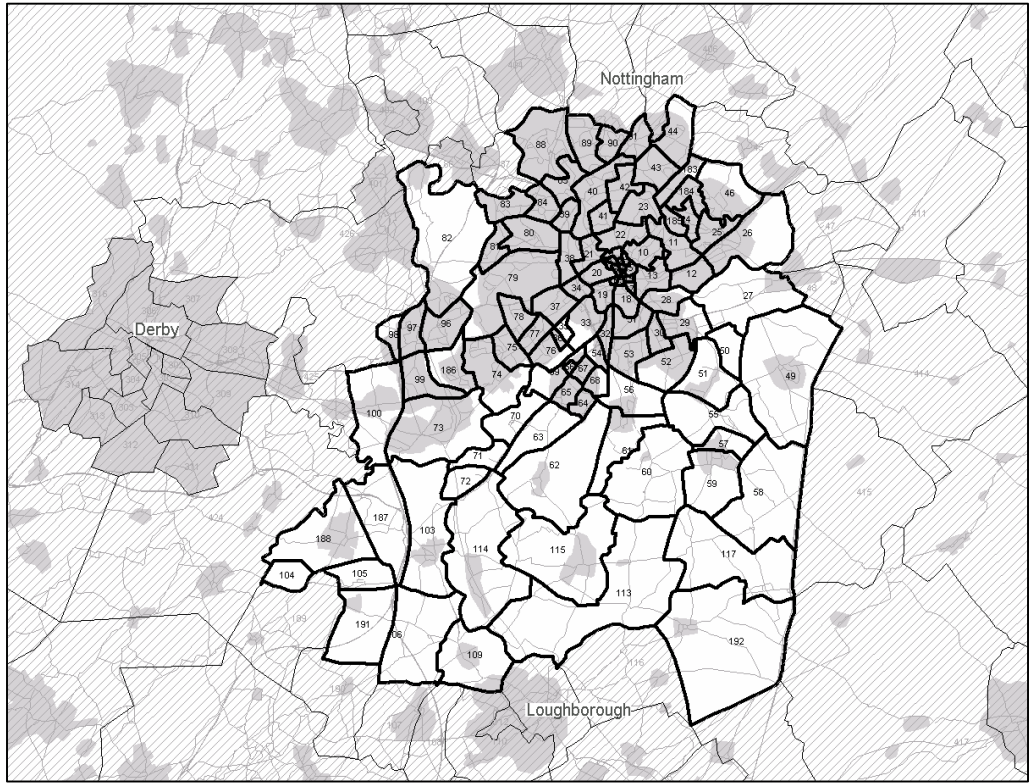


Figure 3.1: Zones (Inner Modelling Area)

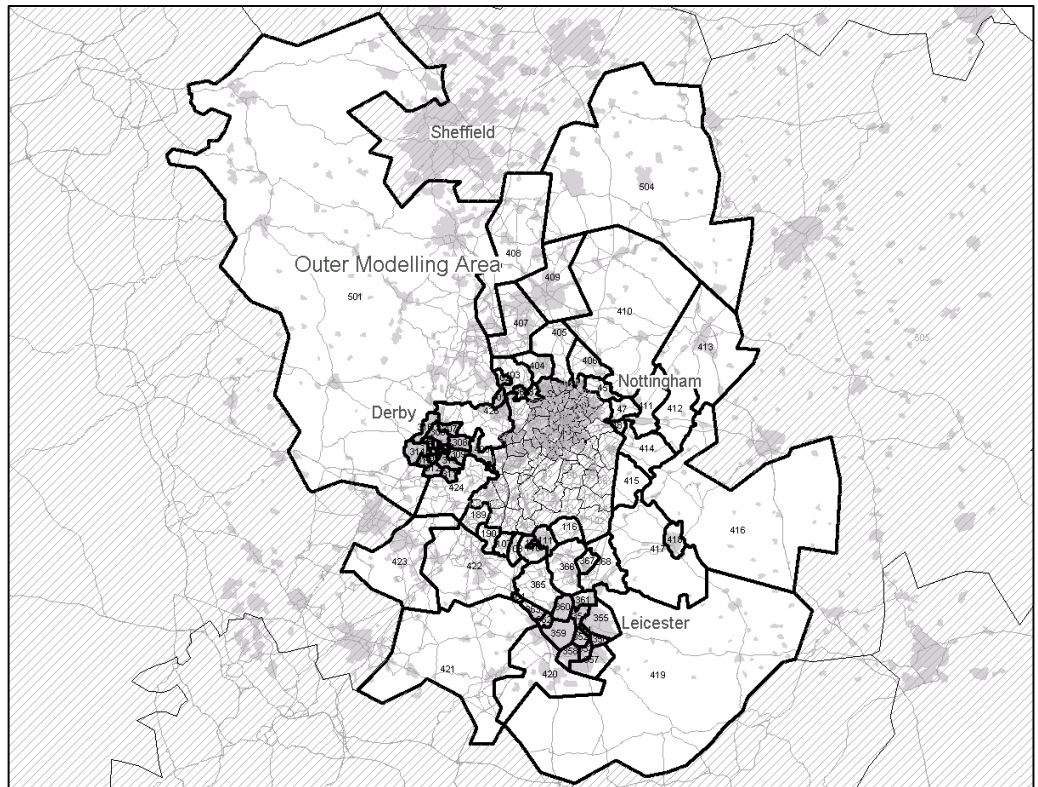


Figure 3.2: Zones (Greater Modelling Area)

Table 3.1: Sectors and Model Zones

Sector Number	Location	Transport Model Zone Corresponding numbers
1	Nottingham Centre	1, 2, 3, 4, 5, 6, 7, 8, 9, 14, 15, 16
2	Nottingham South Central	17, 18, 19
3	Wollaton	79
4	Lenton	37
5	Rylands	33, 35, 36
6	Beeston	75, 76, 77, 78
7	Nottingham W	74, 96, 186
8	Clifton	54, 64, 65, 66, 67, 68, 69
9	Nottingham SE	28, 29, 30, 31, 32, 52, 53
10	Nottingham NE	10, 11, 12, 13, 22, 23, 24, 25, 26, 43, 44, 46, 91, 183, 184, 185
11	Nottingham N	39, 40, 41, 42, 80, 81, 83, 84, 85, 87, 88, 89, 90
12	Nottingham West Central	20, 21, 34, 38
13	Nottinghamshire N	45, 403, 404, 405, 406, 407, 408, 409, 410, 504
14	Nottinghamshire E	27, 47, 48, 49, 50, 411, 412, 413, 414
15	Nottinghamshire S	51, 55, 56, 57, 58, 59, 60, 61, 62, 63, 70, 71, 72, 113, 114, 115, 117, 415
16	Derby	301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316
17	Derbyshire N	501
18	Heanor and Eastwood	82, 86, 401, 402
19	Ilkeston and Borrowash	100, 425, 426
20	Long Eaton and Sandiacre	73, 97, 98, 99
21	Derbyshire S	423, 424
22	Leicester	351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362
23	Loughborough	110, 111, 112
24	Leicestershire W	103, 104, 105, 106, 107, 108, 109, 187, 188, 189, 190, 191, 363, 364, 365, 420, 421, 422
25	Leicestershire E	116, 192, 366, 367, 368, 416, 417, 418, 419
26	The South East	507
27	The South West	508
28	The West	509
29	The North	502, 503, 510, 511
30	The East	505, 506



Figure 3.3: Sectors

3.4 NETWORK LINKS

From the Navtech database a preliminary network was imported into VISUM. The first task in processing was the reduction of the network. The GIS network consisted of a large number of links, far more than were needed in remote areas to give an adequate network description. Removal of unnecessary cross routes created the opportunity for adjacent links of similar characteristics to be merged. After this step the network consisted of some 27,000 links and 9,000 nodes.

To reflect the structure of the transport network Link Types were introduced in order to define the role and characteristics of each link within the integrated network and to allocate standard speed flow relationships to traffic links with similar characteristics. Relevant parameters in the classification of links included:

- Permission of transport systems or demand segments
- Initial speed
- Capacity and speed at capacity
- Locational characteristics

The link types adopted for the A453 MMS are given in Table B1 in Appendix B.

The capacity in the road network is defined as vehicles per time period and has therefore different values in the models for the whole day and for one hour periods. The categorisation has been derived from the UK design standards.

The sequence of the link types defines a hierarchy in the network. This is important in connection with the introduction of node types, where turning penalties can be defined to reflect the priority of one road against another.

Furthermore link types are used to apply individual speed-flow functions in the traffic assignment process. There is no specific junction modelling other than in terms of link turning penalties, however, the speed flow relationships on the short links defined at complex junctions emulate the junction delay affects.

3.5 NODES

Nodes are network elements connecting links. In areas with low levels of detail of network modelling a single node may represent a junction. If higher accuracy is required, a junction can be modelled precisely with a node for every possible conflicting point in vehicle movements. Links within the junction have been allocated a capacity and speed flow relationship from link types defined in Table B1. An example of coding using this procedure may be found in Appendix B.

An important node attribute is the concept of turning penalties. These are constant values and not dynamically derived from congestion. The influence of congestion is reflected in the increasing link journey times in the node access roads due to the speed-flow relationship. Turning penalties reflect the priority situation in the road network and can be used to improve the road network hierarchy modelling through node classification. A summary of this classification is given in Table B2 in the Appendix B.

Data from the City of Nottingham have been used to identify circa 190 nodes with traffic signals to allow for a node categorisation and hence a better representation of traffic control in the assignment process.

Some 40 roundabout junctions in the Inner Modelling Area have been provided with detailed coding similar to the example in Figure B3.

According to the information from the public transport operators and local knowledge the bus stops and the train stations have been integrated as nodes in the network model.

3.6 PUBLIC TRANSPORT LINES

The line definitions and the timetables of the regional rail system and the relevant local and regional bus services have been entered into the network.

3.6.1 Railways

From the timetable information produced by the Train Operating Companies (Midland Mainline and Central Trains) the relevant services were identified and the necessary data extracted. These include a number of regional and long distance services, for which the following sections form a small part of the route.

- Nottingham – Derby
- Nottingham – Leicester
- Nottingham – Langley Mill
- Nottingham – Thurgarton
- Nottingham – Hucknall (Robin Hood Line)
- Nottingham – Bingham
- Derby – Leicester
- Melton Mowbray - Leicester

3.6.2 Bus

All bus services above a basic community services frequency were considered for inclusion in the transport model, however it was appropriate to include all bus services in the Inner Modelling Area. The following definitions were used to define relevant services,

- if their frequency is less than 30 minutes, or
- if they serve the wider A453 corridor.

This also includes combinations of different lines serving the same connection. The model includes the services operated by the following bus operators

- Nottingham City Transport / South Notts
- Trent Buses / Barton Buses
- Arriva
- **Public Transport Network Statistics**

The following Table 3.2 gives an overview of the modelled Public Transport lines, their variants and the number of services per day.

Table 3.2: Public Transport Services in the Model

Operator	Lines	Line Variants	Services
Midland Mainline	6	30	204
Central Trains	10	54	318
Nottingham City Transport	60	148	5063
Trent Buses	6	12	378
Barton Buses	6	18	537
Arriva	1	2	114