Social sustainability in the city: the relationship between density and social interaction

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Abstract

Compact city development is regarded as the future model of sustainable urban development. However critiques have long pointed out that such development could adversely affect social cohesion. This research addresses this issue by considering the impact of density on one indicator of social cohesion, social interaction. The research addresses three principle issues:

1. The relationship between social interaction and the density of the neighbourhood
2. The extent and nature of social interaction, and how various aspects of density influence them
3. How the spatial features of high-density housing may encourage a sense of community and positive social interaction

The research was done using six neighbourhoods in the Southeast of England. Analysis focussed on questionnaire and observation surveys, complemented by a variety of statistical and spatial models, using space syntax, GIS and statistical packages.

Social interaction was found to have a complex relationship with density. There are some significant differences in the patterns in which people socialise in higher (100-300hh/ha) and lower (up to 50hh/ha) density neighbourhoods. That is, the lower density neighbourhood had weak ties between residents but significant levels of informal interaction between neighbours; in higher density neighbourhoods it was the opposite. Even with the low response rate to the questionnaire, and variation in the socio-economic characteristics of the neighbourhoods, by using triangulation of data, this research found that the neighbourhoods with a density of 70-80 households per hectare had more social interactions within them than did neighbourhoods of higher and lower densities. The number of social interactions was also influenced by the social conditions of the neighbourhood as well as its physical layout. The spatial layouts of the neighbourhoods were found to have a significant impact on socialising patterns and social cohesion; this was even more pronounced in high density neighbourhoods.

Based on the findings of the research, positive policies and guidelines are proposed to achieve more socially sustainable communities, including a recommendation to build at higher densities than the UK government currently advocates.

Contents

LIST OF FIGURES V

LIST OF TABLES VI

DEFINITIONS VIII

ACKNOWLEDGEMENTS XII

1 INTRODUCTION 1

1.1 RESEARCH QUESTIONS 3

1.2 THE SUSTAINABLE DEVELOPMENT DEBATE - AN OVERVIEW 5

1.2.1 Achieving urban sustainability 6

1.2.2 Sustainable urban form 8

1.3 SOCIAL SUSTAINABILITY: FUTURE AND DIRECTIONS 10

1.3.1 The problem of spatial determinism in built environment research 11

1.4 SCOPE AND LIMITATIONS 12

1.5 OVERVIEW OF CHAPTERS 13

1.5.1 Chapter 2: Measuring density 13

1.5.2 Chapter 3: Defining and measuring social interaction 13

1.5.3 Chapter 4: Methodology 13

1.5.4 Chapter 5: Case studies and fieldwork data 14

1.5.5 Chapter 6: Density and social interaction 14

1.5.6 Chapter 7: Space and social interaction 14

1.5.7 Chapter 8: Designing sustainable communities: a social perspective 14

2 MEASURING DENSITY 15

2.1 INTRODUCTION 15

2.1.1 Complexity in simplicity 16

2.1.2 Spatialising density 18

2.1.3 Criteria for density indicators for this research 20

2.2 DENSITY MEASUREMENTS: A REVIEW 22

2.3 CONCLUSIONS 30

3 DEFINING AND MEASURING SOCIAL INTERACTION 32

3.1 INTRODUCTION 32

3.2 DEFINING SOCIAL INTERACTION FOR THIS RESEARCH 33

3.3 MEASURING SOCIAL INTERACTION FOR THIS RESEARCH 36

3.3.1 Criteria for measures 36

3.3.2 Measuring social interaction in the public space 38

3.3.3 Measuring socio-cultural aspects of social interaction 40

3.3.4 Measuring the spatial aspects of social interaction 45

3.4 MEASURING THE FACTORS THAT EXTERNALLY INFLUENCE SOCIAL INTERACTION 49
3.5 CONCLUSIONS 52

4 METHODOLOGY 54

4.1 INTRODUCTION 54
4.1.1 Literature review 55
4.2 EMPIRICAL RESEARCH 55
4.2.1 Development of research tools 56
4.2.2 Selection of case study areas 57
4.2.3 Fieldwork 59
4.2.4 Observation survey 60
4.2.5 Questionnaire survey 61
4.3 DESK-BASED RESEARCH 62
4.3.1 Measurement of density 62
4.3.2 Quantifying the spatial configuration and built form 63
4.4 DATA ANALYSIS 65
4.4.1 Statistical analysis 65
4.4.2 Spatial analysis 66
4.5 CONCLUSION 67

5 CASE STUDIES AND FIELDWORK DATA 68

5.1 INTRODUCTION 68
5.2 INTRODUCTION TO CASES 68
5.3 DENSITY 73
5.4 FIELDWORK DATA 75
5.4.1 Observation survey 80
5.5 SPATIAL DATA FROM ANALYTICAL COMPUTER MODELS 81
5.5.1 Axial maps: 81
5.5.2 Depth maps 82
5.5.3 Data from secondary sources 84
5.6 CONCLUSION 84

6 DENSITY AND SOCIAL INTERACTION 86

6.1 INTRODUCTION 86
6.2 STATISTICAL ANALYSIS PROTOCOLS 87
6.3 SUMMARY OF OVERALL FINDINGS 89
6.4 DESCRIPTION OF ANALYSIS 90
6.4.1 Is there relationship between density and the amount of social interaction in urban neighbourhoods? 90
6.4.2 Extent and nature of social interaction 102
6.4.3 Intervening variables and social interaction 107

6.5 CONCLUSIONS 115

7 SPATIAL CONFIGURATION AND SOCIAL INTERACTION 118

7.1 INTRODUCTION 118

7.2 GENERAL SPATIAL CHARACTERISTICS OF CASE STUDIES 120

7.2.1 Locations 120

7.2.2 Layout 121

7.3 SPATIAL QUALITIES OF NEIGHBOURHOODS AND SOCIAL INTERACTIONS 128

7.3.1 Influence of built form on social interaction 129

7.3.2 Influence of spatial configuration on social interaction 130

7.4 CONCLUSION 146

8 DESIGNING SUSTAINABLE COMMUNITIES: A SOCIAL PERSPECTIVE 148

8.1 INTRODUCTION 148

8.2 SUMMARY OF RESEARCH FINDINGS 150

8.3 LIMITATIONS OF THE RESEARCH 152

8.4 CONTRIBUTION TO THE SUSTAINABLE COMMUNITIES DEBATE 153

8.5 CONTRIBUTION TO DEVELOPMENT OF SPATIAL RESEARCH 155

8.6 IMPLICATIONS FOR FUTURE POLICY 157

8.7 IMPLICATIONS FOR FUTURE DESIGN PRACTICE 162

8.8 IMPLICATIONS FOR FUTURE MANAGEMENT OF URBAN AREAS 164

8.9 THE FUTURE 165

BIBLIOGRAPHY 167

APPENDICES 186

List of figures

Fig. 2.1 Physical density and perceived densities (Alexander, 1998) 18
Fig. 2.2 Comparisons of FAR, Density and Coverage 19
Fig. 5.1 Layout and general view of New Marston 69
Fig. 5.2 Layout and general view of Thames Street 69
Fig. 5.3 Layout and general view of Holybrooks 70
Fig. 5.4 Layout and general view of Dalgarno Gardens 71
Fig. 5.5 Layout and general view of Parkview Estate 72
Fig. 5.6 Layout and general view of World's End Estate 73
Fig. 5.7 Distribution of different types of social contact in each neighbourhood (without outliers) ... 79
Fig. 6.1 Scattergram neighbourhood's building density and social interactions in public and semi-private spaces during weekends 96
Fig. 6.2 Building density of neighbourhood and normalised social contact per household (Cubic) ... 99
Fig. 6.3 Net building density of sub-zones and normalised social contact per household, excluding World's End Estate 100
Fig. 6.4 Social interaction and density 101
Fig. 6.5 Scattergram of normalised social interaction and density 105
Fig. 6.6 Sense of satisfaction with the neighbourhood as a place to live and social networks 110
Fig. 6.7 Perceptions of safety and social networks 111
Fig. 7.1 Axial maps of neighbourhoods (500m radius) 124
Fig. 7.2 Scattergrams: Intelligibility (global integration v local integration) 125
Fig. 7.3 Scattergram: global integration v pedestrian movement 126
Fig. 7.4 Global integration of public spaces and quantity of pedestrian movement 126
Fig. 7.5 Local integration of public space and amount of pedestrian movement 127
Fig. 7.6 Scattergram of floor level of front door v total number of household contacts 130
Fig. 7.7 Scattergram: visual integration against total social contacts 132
Fig. 7.8 VGA maps of neighbourhood 133
Fig. 7.9 Dalgarno Gardens: social activities in public space adjoining pedestrian routes 145
Fig. 7.10 New Marston: social activities in public spaces which are next to most active pedestrian routes 145
Fig. 7.11 Parkview: large number of family congregations and social activities in public spaces next to most active pedestrian routes 145

List of tables

Table 2.1 Classification of density measures 24
Table 2.2 Common net and gross density measures used in UK 25
Table 2.3 Measures of perceived density 27
Table 2.4 Measures of built form 29
Table 4.1 Fieldwork and measures 60
Table 4.2 Indicators and methods of measuring social interaction and density 67
Table 5.1 Building density 74
Table 5.2 Molecular density or household crowding (persons / dwelling) 74
Table 5.3 Molar density (persons/hectare) 75
Table 5.4 Case study locations, no of households, and response to the questionnaire 75
Table 5.5 Responses to the questionnaire survey 77
Table 5.6 Average social contacts and standard deviations 78
Table 5.7 Average social contacts (excluding outliers) 78
Table 5.8 Number of observed social interactions, activities and pedestrian movements between 8am and 7pm 80
Table 5.9 The global and local integration, intelligibility and synergy values for each neighbourhood 82
Table 5.10 Average values for variables from visibility graph analysis 83
Table 6.1 List of key variables of density 86
Table 6.2 List of key variables of social interaction 87
Table 6.3 List of interfering variables 87
Table 6.4 Different types of social contact per household 91
Table 6.5 Normalised social contacts per household and average informal contacts/household 92
Table 6.6 Population densities 93
Table 6.7 Relationship between density and social contacts 94
Table 6.8 Total Observed social interaction, activities and pedestrian movement between 8am to 7pm 94
Table 6.9 Observed social interaction, activities and pedestrian movement between 8am to 7pm (normalised by area of public space observed in fieldwork) 95
Table 6.10 Summary: result of correlated statistical test between density and social interaction variables 97
Table 6.11 Percentage of various types of social contacts within each neighbourhood 102
Table 6.12 Percentage of formal and informal contacts 103
Table 6.13 Observed social interaction, activities and pedestrian movement between 8am to 7pm (normalised by number of households in the neighbourhood) 105
Table 6.14 Density of social activity v density: Pearson's correlation coefficient 106
Table 6.15 Average social contact of various socio-demographic groups 108

Table 6.16 Length of residence and average social network, community sprit and perception of friendliness 109
Table 6.17 Social contacts, friendliness and community spirit 109
Table 6.18 Indicators of quality of life and total number of social contacts 112
Table 6.19 Multiple regressions analysis and R^2 values 114
Table 6.20 Summary result of partial correlations between social network and density by controlling interfering variables 115
Table 7.1 List of spatial variables 119
Table 7.2 Space syntax terminology and definitions 119
Table 7.3 Syntactic properties of spaces within 10 minute walking model 123
Table 7.4 Syntactic properties of all spaces in the neighbourhood (cut-out model) 123
Table 7.5 Average VGA variables 128
Table 7.6 Percentage of contacts within visual field and 1, 2 and 5 minute walking distances 135
Table 7.7 Summary of correlation test between social contacts and VGA variables 136
Table 7.8 Percentage of contacts within 1, 2 and 5 minute walking distances 139
Table 7.9 Percentage of contacts within visual field of entrance spaces 140
Table 7.10 Mean depths and social contacts 141
Table 7.11 Size of neighbourhood, density and layout 143
Table 7.12 Average social interaction and pedestrian movement in public space 144
Table 8.1 Policies for urban intensification to addr ess urban growth without compromising factors that affect quality of life 161
Table 8.2 Design recommendations for urban neighbourhoods 163

Definitions

Connectivity: the absolute number of spaces with which a particular space is directly connected.

Control: Control picks out visually dominant areas. For control, each location is first assigned an index indicating how much it can see, this is the reciprocal of its connectivity (also see space syntax and visual integration).

Controllability: Variable from visibility graph analysis. Controllability picks out areas that may easily be visually dominated. Controllability 'for a location it is simply the ratio of the total number of nodes up to radius 2 to the connectivity (i.e., the total number of nodes at radius 1)' (Turner, 2004 p 16) (also see space syntax, visibility graph analysis and visual integration,).

Density: see chapter 2

Floor Area Ratio (FAR): Ratio of total built-up area to the area of the plot. Its usually used to control the open space to building height ratio.

Global integration: Relationship between every space to every other space in a system. In mathematical terms it is normalised mean depth, normalised using a constant called d-value. (Hillier and Hanson, 1984). Expresses the how integrated or segregated the space is in relation to all other space (also see space syntax).

Intelligibility: Correlation between global integration and connectivity. This is found to be very useful measure in quantifying the legibility of space in previous research (Peponis et al., 1989) (also see global integration and connectivity).

Local integration: Normalised mean depth, taking into account all the spaces which are a few steps depth away from each space rather than all space. A typical local integration value is calculated by taking all spaces which are within three-step way

from a space. Expresses how well spaces are connected, integrated or segregated in relation to its immediate locality.

Mean depth: Average step depth from every space to every other space.

***Neighbourhood*:** a socio spatial construct rather than an administrative boundary. In this research 'Neighbourhood is the bundle of spatially based attributes associated with clusters of residences, sometimes in conjunction with other land uses' (Lancaster, 1966 p163). A neighbourhood consists of structural, demographic, public service, environmental, proximity, political and social interaction characteristics, which are unified by space (Galster, 2001).

Normalisation: statistical process in which the variable is multiplied by a factor to make some associated quantity (such as an integral) equal to a particular value, to enable them to be compared with a series of data from different experiments of cases. It is similar to standardisation, but in standardisation the intention is to standardise the unit of measurement.

Social cohesion: refers to the attachment people have to their neighbourhood. This includes social ties between people and attachment to place.

***Social interaction*:** see chapter 3

Social network and social contacts: while social contact expresses just the number and type of relationship one have, social network include the quality and significance of the relationships.

Social ties: network of social contacts people have, and their commitment to it.

Space Syntax methodology: various data collections and analytical methods commonly used in research based on space syntax. These include methods of observation of use of space and representation of that data geographically as well as representation of space for analysis with space syntax tools.

Space Syntax tools: computer applications developed by University College London to analyse the configurational properties of spaces. These analyses can be used at the scale of a building to a city

Space syntax: the system by which space is arranged to create meaning to make sense by the people who use it. A theory based on the configuration of space.

Spatial variables: mainly variables derived from spatial analysis and models constructed using space syntax tools, such as Axman and Depthmap. These methods use graph analysis to quantify the relationship of each space to all other spaces within the area considered for a study.

Step depth: number of intermediate spaces that a space is from a particular space. This is the relationship between two spaces and not an average. The steps are calculated by the connections between spaces rather than the actual metric distance.

Synergy: Correlation between global integration and local integration (also see space syntax, global and local integration).

Visibility graph analysis: method first proposed by Benedikt (Turner et al., 2001) where space itself is subdivided into to smaller tiles of one to eight meters square, depending on the scale of analysis. This uses the idea of the isovist from each space to quantify the mean depth, rather than the direct physical connection, thus taking into account visual connections between each tile (also see space syntax).

Visual clustering co-efficient: variable from visibility graph analysis. The Clustering coefficient is a local measure calculated from Depthmap analysis by applying small world analysis to spatial systems. The clustering coefficient was introduced by Watts and Strogatz to help assess whether or not a graph is a 'small world' or not. A 'small world' is one that has tightly clustered groups of friends but surprisingly low mean depth (Turner, 2004 p 16).

Visual integration: calculated in the same way as global integration, but instead of taking into account of physical connection, it connects all the spaces that are visually connected and uses visual mean depth. This is a variable derived from visibility graph analysis.

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Chapter 1

Introduction

1 Introduction

> Social interaction is the very stuff of human life. The individuals of all societies move through life in terms of a continuous series of social interactions. It is in the context of such social encounters that the individual expresses the significant elements of his culture, whether they are matters of economics, social status, personal values, self-image, or religious belief. (Goldschmidt, 1972 p.59)

Social interaction is regarded by many as the foundation for communities, societies and economic activities (Bellair, 1997; Erickson, 1997; Fahey, 2000; Goldschmidt, 1972; Handzic and Low, 2002; Riger and Lavrakas, 1981). Interactions which individuals have with families, friends, co-workers, neighbours and groups (religious, political, social or other) are vital for the formation of social ties and cohesion (Hinde, 1979), thus contributing to quality of life (Percival, 2001). Social cohesion and attachment to a place are often necessary for the participation of individuals in the community (Forrest and Kearns, 2001; Murtagh, 2001; Stone, 2000), and thus integral aspects of achieving a socially sustainable community.

The effect of social interaction on society and neighbouring is multi-layered; greater interaction often underlies better social networks, which in turn result in even further interaction (Argyle, 1991; Hinde, 1979). Previous studies have also found social networks and social interaction to have a profound influence on individual behaviour, especially in economic matters (Conlisk et al., 2001).

There are many interesting theories and concepts on how and why social interaction occurs; some phenomena such as gossip circles (Dunbar, 1996; Putnam, 1993) and conflicts (Deutsch, 1969) have been argued as being both positive for the social relationship and interaction between residents, as well as dividing them, and deterring neighbours from socialising. However, these community bonds and neighbourhood relationships are generally considered helpful in improving participation in the community, which underpins sustainable communities (Iyer-Raniga and Treloar, 2000; Llewelyn-Davies and Cag Consultants, 1999), and the achievement of social sustainability in urban areas (Agrawal and Gibson, 1999; Robb, 2006).

The current sustainable development debate has resulted in proposals about the most suitable urban form for the future development and growth of cities. One of the most important among them is the compact high-density model (Jenks et al., 1996). But there are opponents who argue in favour of spread low-density development (Webber, 1998).

Many of the arguments in favour of compact city models are based on their environmental and economic benefits (see Section1.2.3). Those against this model mention the studies which indicated that it may not be socially sustainable, as high density development often fails to provide a good quality of life and a healthy and sociable community (Sufian, 1993). They argue that higher density developments cause environmental stress (Taylor, 1982) and create 'behavioural sink' (Wilson, 1975) affecting the social structure of a community, and create social tensions in neighbourhoods (Winsborough, 1965).

While much of the debate on advantages of compact development are centred on its environmental and economic benefits, there is much work to be done in looking at its social benefits. Most of the claims of the advantages of the spread city are based on local community, social interaction and quality of life (Webber, 1998). Social commentators identify 'suburbs as hotbeds of participation and wellsprings for the outgoing life where the chief features of life are compulsive, frenetic, outgoing, social life-togetherness, belongingness, Kaffeeklatsches, PTA, back fence gossip confabulation, cocktail parties, car pools, and the "open door"' (Dobriner, 1963 p6). Supporting this, spread city proponents point to the work of sociologists such as Durkheim, Simmel and Wirth who suggested higher densities lead to weak social bonds (Baldassare, 1976). Some studies have shown that many higher density as the reason for creating 'sink' estates (Hall, 1966) due to their social and physical conditions. These studies suggest that density and overcrowding may hamper any positive communication, which they argue will result in a lack of social ties and community cohesion (Lock, 1991), and are some of the causes of social decline in such areas. Most of this research points to higher density itself (Mitchell, 1971; Unwin, 1912) as the reason for their decline. Based on these warnings, the current polices and guidelines, at least in the UK, are cautious about supporting a higher

density of development than the present 30-40 households/hectare (DETR, 2000b; Falk and Rudlin, 1999).

Baldassare (1976) found no evidence to support the claim that social networks weaken in denser neighbourhoods. A critique of Baldassare's work suggests that the census boundaries which were used for calculating density may not reflect the real experience of density. In any case, there is no empirical evidence to show that density is directly responsible for the claimed poor quality of life and social decline in high density neighbourhoods. The intention of this research is to look at the issue of built density and social interaction in urban neighbourhoods, to seek definitive evidence of the social impact of higher density development.

There are some suggestions that housing forms, layout and location could influence the socialising patterns of inhabitants (Williams, 2005). While the stereotyping of suburbs as 'hotbeds of participation' may be an exaggeration, evidence tends to show that neighbouring and other local activities increase with distance from the city centre (Fischer and Jackson, 1976).

This research looks at social interaction, a key indicator of quality of life and the social well-being of the community, to assess higher density neighbourhoods and their suitability as a future model for sustainable development.

1.1 Research questions

The broad questions this research seeks to investigate are: 1) Is there is any relationship between density and social interaction? 2) Is higher density development a better and more socially sustainable option for the future form of the city? And 3) Does the compact city model, while more environmentally and economically sustainable, improve social relationships, thus being a socially sustainable model as well?

To answer these research questions, three specific questions were addressed:

- Is there a relationship between the density of the built environment and the amount of social interaction in residential areas of cities?
- If so, what is the extent and nature of social interaction, and how far is it influenced by various aspects of density?
- What spatial features of high-density housing encourage a sense of community and positive social interaction?

In other words, does spatial nearness of neighbours brought about by higher density development necessarily enhance social interaction in these neighbourhoods? If so, what level of density (or spatial proximity) brings positive social interaction and thus a more socially sustainable community? Do all types of configuration and form within a particular density type have the same effect on social interaction? Finally, is higher density development, such as that proposed in the compact city model and promoted in policy by the UK government, socially sustainable?

The literature indicates that while higher density development could bring people closer together and enable social interaction to take place (Argyle and Dean, 1965; Bottero and Prandy, 2003; Milgram, 1972; Zipf, 1949), such development could also discourage positive social contacts and could act as a deterrent to good neighbourhood relationships, mainly due to environmental stress, and a sense of over crowding, along with the social and demographic problems associated with high density neighbourhoods (Winsborough, 1965). Therefore, it is hypothesised that social interaction may be low in higher density neighbourhoods due to social problems associated with such development and low in lower density neighbourhoods due to a greater physical distance between neighbours, but also that there may be an optimum level of density between the two extremes that provides favourable levels of social stimulation.

The perception and acceptability of the optimal density for positive interaction could also be different in different cultural and regional settings depending on the social norms and environmental characteristics, such as climate (Argyle, 1986).

1.2 The sustainable development debate - an overview

The second half of the 20th century saw an increased focus on and emergence of research related to the connection between human activities and environmental degradation. As a result many governments and organisations adopted policies deemed sustainable for future developments (CEC, 1990; The UK Government, 1994; United Nations, 1993). Though sustainability is a vast topic, covering distinct but interconnected issues such as rural and urban sustainability or environmental, economic and social sustainability, a large body of work about the built environment, owing to the increase in urbanisation and urban populations is focused on urban sustainability. Early research in the field was focused on the relation of urbanisation and human activity to environmental problems such as pollution, depletion of natural resources (Department of the Environment and Transport, 1994a), deforestation and so on. This has resulted in further research and policy developments related to transport planning (Department of Environment, 1994) and land use planning (Jacobs, 1993). Lately, research has begun to address the relationship of economic issues such as employment opportunities (Burton, 2001) and industrial development to urban form and layout, as well as to social issues including health, education and equity (Daily and Ehrlich, 1996).

Although academics, policy makers and much of the general population agree on the benefits of and need for adopting principles of sustainable development, the word 'sustainability' itself is interpreted in different ways. The definition that is widely accepted and inclusive of all research areas is the Brundtland Commission's definition, which says that:

> Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs (The World Commission on Environment and Development, 1987 p43).

This definition, while inclusive, is very general and only applicable at a global and philosophical level. Girard suggested sustainable development consisted of:

> the intentional construction of a dynamic balance between the different logics of the private, public, social (or civil) and natural economic systems, through new organizational rules (Girard, 1998 p163).

While emphasising the dynamics of stakeholders, coordination between them and the ethics of economic transition that could make it possible, Girard, however, failed to

recognise the social implications of future growth and development. In the context of urban development, Pearce, Barbier and Markandya argued that achieving sustainable development:

> involves devising a social and economic system, which ensures that these goals are sustained, i.e. that real incomes raise, that educational standards increase, that health of the nation improves, that the general quality of life is advanced (Pearce et al., 1990 p2).

These social objectives are now recognised as important in achieving the broad aims set out by Brundtland Commission and therefore form part of the aspirations and objectives of communities and government:

> Most societies want to achieve economic development to secure higher standards now and for future generations. They also seek to protect and enhance their environment now and for their children. Sustainable development tries to reconcile these two objectives (The UK Government, 1994 p6).

In general there is agreement that to achieve sustainable development, it is necessary to address environmental, economic and social sustainability (CEC, 1990; Jenks et al., 1996; United Nations, 1993). Knowing that urban areas now contain half of the world's population and activities (United Nations, 2005) it is evidently important to achieve sustainable urban development to achieve global sustainability.

1.2.1 Achieving urban sustainability

World population has more than doubled in the last 50 years and is about 6.5 billion today. It is predicted to grow further to about nine billion by 2050 (United Nations, 2005). Latest figures show that about 50% of the total population live in urban areas. This is predicted to increase to more than 60% in the next 25 years (United Nations, 2005). Hence, it is widely agreed that achieving sustainable development in cities is the key to achieving sustainable development in general (Holman, 1991). While the growth of population is a major problem in many cities in developing countries, it is its decline that renders it unsustainable in some developed countries (Girardet, 1992).

The increase in urban population, especially in developing countries, is argued to accompany a reduction in average household size, and rise in traffic and congestion,

thus creating chaotic and unliveable cities. This in turn results in further urbanisation of rural and greenfield areas, creating more environmental problems (Benfield et al., 1999). There are two approaches to addressing this scenario: one, to control the urban population and urban growth; and two, to ensure future developments are more sustainable (Claudio, 1996; Hardi and Zdan, 1997).

In relating the ever-growing population in urban areas to consumption and pollution, it is obvious that some of the most polluting and, thus, the most dangerous and most unsustainable areas in which to live are in fact these highly populated urban areas (Fenger, 1999; Forsberg et al., 1997). It was observed that consumption patterns of cities of developed countries create not only local problems but can cause severe stress on the global ecosystem (Weatherley and Timmis, 2001), while settlements in the developing world need more raw materials, energy and economic development simply to overcome basic economic and social problems (United Nations, 1993). Nevertheless, cities are not inevitably unsustainable as a habitat for humans (Girardet, 1992); if they are of the right size and form, they could contain and modify human activities, thus protecting biodiversity (Wang, 2004).

This leads to a very important question: how do we achieve sustainable urban development? Many studies on sustainable urban form agree that urban developments should be designed to reduce waste (Jenks et al., 1996), to meet the growing transportation requirements of the future more effectively, reduce pollution (DTLR and CABE, 2001), use fewer non-renewable resources (Department of the Environment and Transport, 1994a), and protect greenfield land and biodiversity (DETR, 1998a) thus providing a healthy and safe place to live. Policies are needed to enable and deliver such designs and developments and to restrict unsustainable growth.

Moreover, in a sustainable development all the stakeholders, from individuals to service providers, policy makers and the implementing authorities, should work as a team with every member, group or organisation playing its part to achieve these objectives. One of the prerequisites for this to happen is effective communication among stakeholders, individuals and the community as a whole (Iyer-Raniga and

Treloar, 2000; Williams and Yanoshik, 2001). Positive social networks and the integration of communities are vital to achieve this. These interactions at grassroots level could raise general awareness, introduce new issues to the debate, and ensure participation of the individual in society to modify behaviour and take a responsible role in the community.

The historical use of urban form to define community, and to create memory and images of places (Boyer, 1994; Lynch, 1960) is well documented. Good urban form, along with land use planning, are argued to be key factors in achieving sustainable objectives (CEC, 1990; Jacobs, 1993). This is because an optimal form can increase the efficiency of the supply chain system and the infrastructure, protect the countryside, and provide a communally and socially safe place to live.

1.2.2 Sustainable urban form

The intention to create a sustainable urban form has resulted in many theoretical and practical models, especially in the context of developed world. There is lot to be learned about the developing countries. Work is still in progress on policies to enable design and development to proceed in a sustainable way; practitioners and academics working with sustainability principles debate the form a city should take to achieve sustainability. There are two principal lines of thought on sustainable urban form. They are 1) suburbia-type spread city development, with a low-density form, and 2) the high-density compact city form.

The advocates of low-density suburban development sometimes called spread cities or sprawl (U.S. Department of Housing and Urban Development, 1999) point out the virtues of this model, for instance, spaciousness (Fyson, 1995; Staley, 1999), non-polluted environments, more accessible open spaces (Staley, 1999) better neighbourly relationships (Kearns and Parkinson, 2001), as well as avoidances of the environmental stress related to overcrowding, (Crothers, 1976; Krupat, 1985; Lock, 1991) which, they argue, will improve quality of life (Sturm and Cohen, 2004; Webber, 1998). Spread city advocates argue for formless continuous settlements, arguing that the form of cities is less important than the quality of life of its inhabitants. A contradiction to this line of thought is that there is plenty of evidence

to show that the form of cities *does* affect the quality of environment (Benfield et al., 1999), access to facilities and transport (The Sierra Club, 1999), all of which are some of the indicators used to assess quality of life. Moreover, such formless never-ending sprawl also results in damaging more of the natural environment and farmed and forest land.

Others arguing for a low-density suburban city model base their ideas on the theory that recent developments in information and communication technology (Mitchell, 1999) eliminate the need for spatial proximity for communication and interactions for social or business purposes. These speculations look realistic, with early ideas of email and websites developed into more recent forms such as video chats, videophones, and Virtual Reality Modelling Language or VRML-based virtual worlds for interaction. However, one of the defects of this proposed future model is that it probably overlooks the effectiveness of personal contacts for meeting social needs, for building the trust to do business, or for the better quality of life that is achieved by living in a clustered social community. Moreover, statistical evidence of migration to urbanised areas does not support the claim that urban areas or clustered living is now less attractive (United Nations, 2005).

Those opposing spread city ideas have argued that such lower density developments create a demand for spread-out infrastructure and public facilities, increasing their cost or reducing their quality (Handy et al., 2005). Danzig and Saaty's proposal (1971), a 'Compact City' with high-density development is claimed to have various benefits (Elkin et al., 1991; Jenks et al., 1996). It is argued to reduce travel distance (Gordon and Richardson, 1997; Newman and Kenworthy, 1989) and thus transportation needs (Barrett, 1996; Farthing et al., 1996), which of course will result in lower CO_2 emission (Goodwin et al., 2005; Newman and Kenworthy, 1989), reduced air pollution, lower demand for land (Tong and Wong, 1997), improved efficiency, optimised infrastructure (Nijkamp and Perrels, 1994; Owen, 1986; 1992) and conservation of natural resources (Fulford, 1996), as well as social benefits such as equity in revenue distribution (Burton, 2001). Hence those supporting compact cities argue them to provide an environmentally and economically sustainable model for the future growth and development of cities (Fulford, 1996). Compact city

advocates also argue that many of the claimed advantages of suburban low density development as a reaction to negative perception of density rather than real advantage of such development (Breheny, 1998).

There are other theories and concepts about urban form which draw on aspects of the different arguments presented above, such as new urbanism (Dunham-Jones, 2000; Moudon, 2000) and the garden city model (Howard, 1946). However, this research focuses on the sustainability of the compact city model and its antithesis, the spread city.

Alarmed by the UN population growth reports, the Rio summit in 1992 adopted *Agenda 21* (United Nations, 1993) which participating countries agree to use as guidelines for sustainable development. While some countries including the US and Australia adopted policies for a spread city model (Sudjic, 1992), those cities and countries that are constrained by available land for development, including the UK, have adopted policies which implement high-density development (e.g. (CEC, 1990; DETR, 2000b; Morrison, 1998). These policies embrace concepts such as urban intensification or consolidation (Department of the Environment and Transport, 1994b; Jenks, 2000; Williams et al., 1996; Williams et al., 1998), brownfield development and infill development (CEC, 1990; Department of the Environment and Transport, 1994a; DETR, 1998a; 2000a; b).

1.3 Social sustainability: future and directions

It is clear that most of the body of work on sustainability focuses on environmental and economic issues. Comparatively less work has been done on the effects of urban form on local communities and social cohesion. Of the little empirical research carried out in the field of social sustainability, most has investigated equity and access to public facilities, healthcare and education (Burton, 1997).

However, as discussed earlier, social interaction could be a key building block of a community, and therefore it is important to understand the nature and relationship of the built environment, especially at the scale of cities and neighbourhoods, with the

social life of its inhabitants. An otherwise good model for development will be unsustainable if it constantly causes social problem for individuals and communities. While some social impacts of the built environment are well researched, for example the relationship of crime and safety to urban layout (Hillier and Shu, 2000; Jeffrey, 1971; Newman, 1972; Shu, 1999), much less is known about the effect of the layout or urban form on social relationships and community cohesion.

Previous studies have concluded that social climate is one of the significant predicators of urban and suburban differences in neighbouring (Fischer and Jackson, 1976; La Gory and Pipkin, 1981) . Some suggest that social problems may have been initiated by the location and design of the neighbourhood. Therefore it is critical to study the relationship of location and spatial design on neighbouring.

Although extensive work has been done in the field of social sustainability, much of the work has focused on equity in the distribution of services, tax revenue and provision for education and health. Little or no progress has been made in identifying the relationship between the built environment, especially in an urban context, and how people interact with each other. While there is some evidence to link social behaviour to qualities of the built environment in lab conditions (Conroy, 2001; Sonnenfeld, 1972), there is little known about human social behaviour in the real world, which is complicated because we know that this behaviour is influenced by personal characteristics as well as social and built environment quality of the neighbourhoods.

1.3.1 The problem of spatial determinism in built environment research

Design of the physical environment obviously can not solve all the problems of sustainability on its own, but previous research has shown that it does have a major impact on psychological (Ross and Sung Joon, 2000) social (Feldman, 1966; Gans, 1968; Hillier, 1996a) and health (Kirmeyer, 1978) aspects which contribute to well-being and quality of life. For example, a study of 2484 Illinois residents in 1995 showed a high correlation between people who characterise their neighbourhoods as having crime, vandalism, danger, noise, dirt and drugs with those who have high

levels of fear and mistrust. Yet the study found that an individual's alliances and connections with neighbours could buffer the negative effects of living in a neighbourhood characterised by disorder or fear and mistrust (Ross and Sung Joon, 2000). This indicates that the physical environment can change the subjective judgments and social conditions of a society.

Hillier and Hanson argue that:

> Society can only have lawful relations to space if society already possesses its own intrinsic spatial dimension; and likewise space can only be lawfully related to society if it can carry those social dimensions in its very form (Hillier and Hanson, 1984 p26)

There is evidence that social interaction in particular is affected by the form of residential areas (Low, 2001) and their layout (Bottero and Prandy, 2003; Gans, 1961; Kuper, 1953; La Gory and Pipkin, 1981). Hence this study focuses on the physical space, form and layout of neighbourhoods, often overlooked in social research, in order to identify their importance and contributions to generating social activity, social networks and thus a socially sustainable community.

1.4 Scope and limitations

Most sociological study into urban neighbourhood underestimated the relevance of physical environment, size of neighbourhood and perception of density. This study investigates social interaction and its relationship with density at a neighbourhood level only. In this study neighbourhoods were defined to reflect perception of it by the users, rather than by adopting administrative boundaries such as census districts, which are normally used in sociological research. While care was taken to ensure selected cases were located in areas of comparable density, other variables such as layout, economic background, demographic characteristics and property ownership could not be controlled. It was envisaged early in the study that there would be variations in the perception of density in different cultural and regional settings. To control for this, the study was carried out in neighbourhoods with a comparable mix of cultural and ethnic groups, selected using census database and site visits. The final six neighbourhoods selected for this study had many comparable cultural and social characteristics. The implications of cultural variations for social interaction,

potentially a very interesting subject, were not considered in this research project due to limitations in time and resources.

1.5 Overview of chapters

1.5.1 Chapter 2: Measuring density

Measuring density is rather complex and often confusing due to the lack of clear definitions. This chapter examines the complexities inherent in the concept of 'density' (measured and perceived density as well as built and population density) with the aim of developing a reliable and working definition for this research. Various methods of measuring density are critically reviewed to identify appropriate measures for calculating and comparing density in the context of neighbourhoods, and for making comparisons with other databases generally used in the UK.

1.5.2 Chapter 3: Defining and measuring social interaction

This chapter examines the different ways in which social interaction can be defined, especially in the context of a non-laboratory environment as in the case of this research. It also outlines the possible ways in which social interaction can be measured and quantified, identifying the key measures that are important in the context of this research or the built environment of neighbourhoods.

1.5.3 Chapter 4: Methodology

Chapter 4 introduces the methodology used for this research, which involves study of six neighbourhoods in the southeast of England. The methods include a literature survey and the development and piloting of research instruments for the case study, fieldwork, as well as the statistical and spatial analysis. The fieldwork included measuring perceptions of density, quality of built environments and quantifying various types of social contacts, using a questionnaire as well as an observation survey to verify the physical attributes of chosen neighbourhoods, and patterns of visible social interaction in the public spaces. This chapter also explains the protocol

for modelling the neighbourhoods, using space syntax tools to quantify the spatial attributes which are used in the analysis.

1.5.4 Chapter 5: Case studies and fieldwork data

This chapter presents the data collected in the fieldwork in the six case study areas. This data arises from the questionnaire survey, observations and spatial modelling using space syntax tools and Geographical Information Systems, as well as from the background information collected from literature and data sources such as the census and the Survey of English Housing (Mew et al., 2003).

1.5.5 Chapter 6: Density and social interaction

This chapter describes the statistical analyses carried out in the research to examine the relationships between density and social interaction as well as the extent and nature of social interaction in various density types, This chapter addresses the first two research questions.

1.5.6 Chapter 7: Space and social interaction

Combining spatial variables derived from the computer models of the neighbourhoods with the survey data on social interaction, this chapter addresses the final question of the study: the spatial factors that may affect social interactions in neighbourhoods.

1.5.7 Chapter 8: Designing sustainable communities: a social perspective

This final chapter discusses and reviews the evidence from the empirical research in the light of other findings and discussions on sustainable urban form and sustainable communities, to formulate recommendations for achieving socially sustainable urban neighbourhoods. This chapter also outlines the contribution of the research knowledge and identifies further research needed on the subject.

Chapter 2

Measuring density

2 Measuring density

2.1 Introduction

The aim of this chapter is to discuss the various concepts and contradictions in the definition and the use of the term density in order to identify appropriate definitions, for this research. To do this, a critical review of the different concepts and measures of density from literature and previous research was carried out. The chapter addresses density, form and layout, the three key physical qualities of the built environment and often entangled concepts, to establish the differences between them.

It is generally agreed that during the mid to late 19th century, due to the rapid industrialisation of British cities, policy makers and the public in general became aware of density as an issue (Jenks and Dempsey, 2005). By the end of the 19th century, a variety of indicative factors, such as plot size (Howard, 1946), were used to specify the density of developments. By the beginning of 20th century, more definitive measures and figures, such as persons or dwellings or habitable rooms per hectare, began to emerge (Woodford et al., 1976).

The concept of density is claimed to be of central importance in planning, urban design and architecture (Rapoport, 1975). It is used to express morphology, to define the built environment of a new development, to express the built form of existing development, and to estimate infrastructure requirements (Addenbrooke et al., 1981; Owen, 1986). Density, when used appropriately, is arguably a central tool in land use regulations (Fu and Somerville, 2001). Density is constantly referred to in land use and infrastructure planning to express, model, visualise and compare proposals (Department of Environment, 1994). Density is also used by sociologists, psychologists, economists and environmental scientists in studying or expressing the quality of the built environment in their efforts to identify the relationship of the physical environment to social and cultural aspects of cities (Baldassare, 1976; Carnahan et al., 1974; Galle et al., 1972; Mitchell, 1971; Winsborough, 1965), the effects of crowding on individuals or groups (Baldassare, 1976; Carnahan et al.,

1974; Nagar and Paulus, 1997) and environmental and economic sustainability (Burton et al., 1996; DETR, 1999; Senecal and Hamel, 2001).

Density measures are argued to be 'a key element in the design professional's "kit of tools"' (Alexander, 1993 p1). They are now increasingly used to describe, predict and control land use for human habitat from the scale of a small neighbourhood to that of a city by architects, planners and governments (Department of the Environment and Local Government, 1999; DETR, 1998b; c; 2000b).

Density can be described as the presence of people (or things) and their distribution in space (Rapoport, 1975). Hence its measurements can be defined mathematically to express the intensity of something within a space or a concentration of things within an area. It is expressed as:

$$D = d/A$$

(D= density; d= unit of calculation (dwelling, person etc)

A= area in km^2, hectare etc)

So, what are density measures in the context of the built environment? Here, the interest is in calculating or expressing the intensity of the presence of people, dwelling units, or habitable rooms within a piece of land, to enable planners and designers to estimate provision or suggest built form. Therefore in the equation above the numerator could be number of dwelling units, people, habitable rooms, or bed spaces, while the measurement of the area which forms the denominator could be in hectares, square kilometres or square miles. These expressions were used for planning and designing housing and urban areas as early as the period after the First World War (Jenks and Dempsey, 2005).

2.1.1 Complexity in simplicity

Since the '70s there has been renewed interest in clarifying and redefining concepts of density (Alexander et al., 1988; Churchman, 1999; Forsyth, 2003; Rapoport, 1975). This is because, although it appears to be a simple, non-partial, objective and rational tool at the outset, the concept of density lacks clarity due to an absence of

agreement on what should be considered and what should not in measuring or calculating it (Churchman, 1999; Forsyth, 2003). This lack of clarity stems from the fact that the two variables used in the calculation of density are not standardised. The consequent complications are 1) differences in the unit of area used (hectares, km^2), 2) difference in land uses that are included in the calculations, 3) difference in objects measured (for example, households, habitable rooms, or number of persons). Lehman et al. (1995) point to variations in units of area used in density calculations even within municipalities in Canada. It is even more complicated when different countries around the world, where the two variables are defined and used differently, are considered and compared.

Confusions in the concept of density also arise from its frequent use to express different concepts such as building density and population density, as well as for similar concepts such as crowding (Churchman, 1999). In his seminal paper, Rapoport (1975) attempts to distinguish density from crowding. He argues that density, as it was used until then, was a mathematical expression of people within an area, whereas crowding is better defined as a perception of excessive density. While crowding is a personal and thus a subjective judgement (Alexander et al., 1988; Rapoport, 1975), density is more objective measurement. At the same time, the two concepts are intertwined because when an individual feels crowded he or she is making a perceptual judgement of the physical environment in reference to cultural or social norms as well as to personal preference (Rapoport, 1975). Therefore, Rapoport defines density as experiential rather than just as a physical measure.

In an attempt to separate the experiential concept of density from the objective measurement, Alexander et al. (1988), differentiate between perceived and physical densities. While Rapoport's experiential density closely defines the perceived density, the physical density is further divided into measurable densities and the qualitative aspects of building (such as building form and ratio of open space to built-up), which are argued to influence the experience of density. While the measured density can be easily calculated from a mathematical expression using appropriate areas and objects, the features used in qualitative evaluation of the built environment can also be objectively measured and represented from maps and

surveys of building heights and land use (open space). Alexander and his colleagues, in agreement with Rapoport on the inter-relationship between perceived and physical density, offer a conceptual model to explain their links (Fig. 2.1). The figure clearly shows how the measured and qualitative aspects of the built environment such as building form and spacing between buildings are connected to its physical density, which, along with individual and cultural factors, can influence the experience or perception of density.

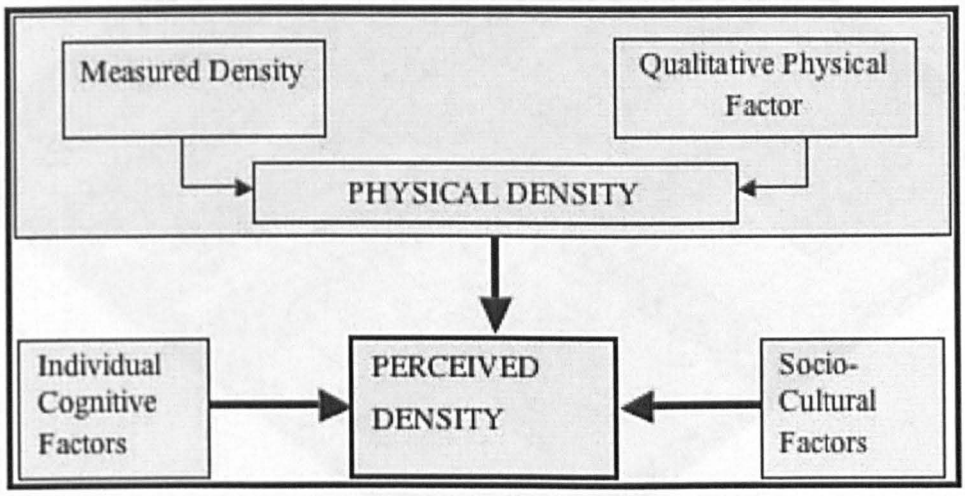
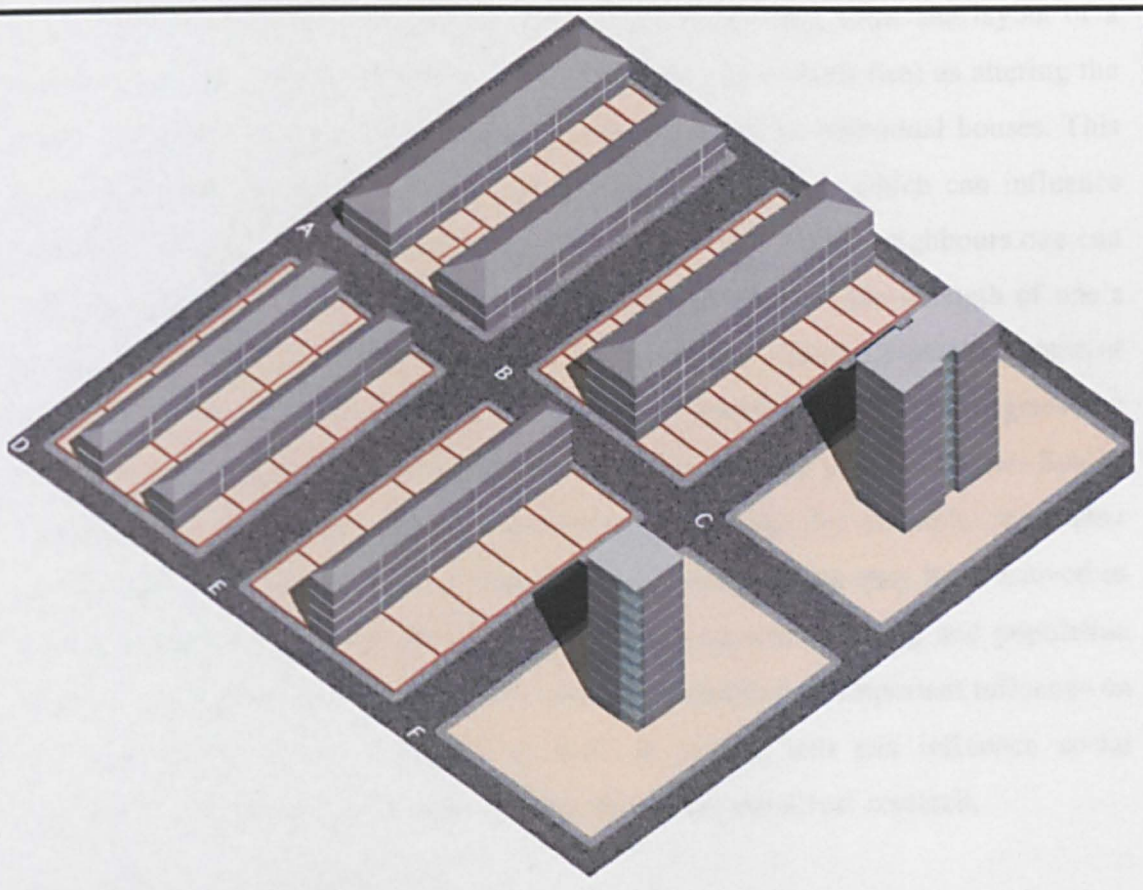


Fig. 2.1 Physical density and perceived densities (Alexander, 1998)

2.1.2 Spatialising density

Qualitative factors such as building form or spacing between buildings can be important in the perception or experience of density. However, previous research has shown that measured density and other physical aspects of buildings are independent of each other (Alexander et al., 1988; Diamond, 1976; Holloway, 1971; Keeble, 1969; Martin and March, 1966). Therefore a particular building density can be manifested in different building forms, and / or spatial layouts (see Fig. 2.2) by a simple manipulation of unit configuration and spacing. Hence, it is possible to plan low-density development as high-rise or conversely, high density can be low-rise. Therefore certain built forms such as high rise and layouts such as compact could have an exponential effect on the perception of density because 1) such forms and compact layouts are mostly used in high density developments and 2) high rise forms

are often perceived as higher density, even if the contrary is the fact. They can intensify the experience of density.



no of household: 20 floor area/ hh: 100m2 block area: 1500m2: 0.15ha area including 50% of road width: 0.249ha *for gross density a 30% area in the neighbourbood is earmarked for non residential landuse and open space	no of household: 10 floor area/ hh: 100m2 block area: 1500m2: 0.15ha area including 50% of road width: 0.249ha *for gross density a 30% area in the neighbourbood is earmarked for non residential landuse and open space
A: Two storey terraced housing- high density low rise net density block density: 133.33 hh/ha residental density: 80.32 gross density: 56.23 FAR: 100*20/1500: 1.33 coverage: 66.67%	**D: Two storey floor terraced housing**- medium density low rise net density block density: 66.67hh/ha residental density: 40.16 gross density: 28.11 FAR: 100*10/1500: 0.67 coverage: 33.33%
B: Four storey duplex-terraced housing high density medium rise net density block density: 133.33 hh/ha residental density: 80.32 gross density: 56.23 FAR: 100*20/1500: 1.33 coverage: 33.33%	**E: Four storey duplex-terraced housing** mid density medium rise net density block density: 66.67hh/ha residental density: 40.16 gross density: 28.11 FAR: 100*10/1500: 0.67 coverage: 16.67%
C: Ten Storey tower block high density high rise net density block density: 133.33 hh/ha residental density: 80.32 gross density: 56.23 FAR: 100*20/1500: 1.33 coverage: 13.33%	**F: Ten storey tower block** high density high rise net density block density: 66.67hh/ha residental density: 40.16 gross density: 28.11 FAR: 100*10/1500: 0.67 coverage: 6.67%

Fig. 2.2 Comparisons of FAR, Density and Coverage

Independent of density, spatial configuration, that is the relationship of a space to other spaces of the neighbourhood, can also influence where and how people socialise, as a layout can present physical connections or barriers to movements of people (Hillier, 1999a). For example, the design of building form and layout of a typical high density neighbourhood is realised (low rise or high rise) as altering the relationship between the shared spaces and their relation to individual houses. This can create barriers through distance or complexity of routes, which can influence how many people one can reach by an easy walk, or how many neighbours one can see and approach (Festinger et al., 1950). Both can influence the strength of one's social contacts (La Gory and Pipkin, 1981; Zipf, 1949). Chapter 3 presents some of the current views and arguments from recent research which investigates the configuration of spaces and its influence on behaviour and patterns of use. Spatial configuration could also affect the perception of density; for example one higher density area laid out in a certain built form and configuration may be perceived as having a higher density than the other. Hence, along with building and population density, spatial configuration and built form are considered an important influence on the way people perceive density, as well as aspects that can influence social interaction. For these reasons they are included in this empirical research.

2.1.3 Criteria for density indicators for this research

Because this research is investigating the effects of densities on social interaction it is necessary to measure both perceived and physical density as well as the aspects of building form and layout. Stress and related problems of higher density living are well documented (Crothers, 1976; Krupat, 1985; Parkes et al., 2002). There are also suggestions that the density of neighbourhoods can affect the social interaction between neighbours, strength of social contacts and social capital (Baldassare, 1976; Fox et al., 1980; Paulus and Nagar, 1987; Rapoport, 1975; Saegert). While some research indicates that higher densities improve social interaction due to the proximity of neighbours (Krupat, 1985; Kummer, 1971; Mitchell, 1971; Rapoport, 1973), other research seems to imply that too high a density can result in negative perceptions or overcrowding (Rapoport, 1975; Yeung, 1977), a consequence of which is over socially stimulation, deterring people from participating socially in a

community (Rapoport, 1977). Interestingly, the perception of crowding or isolation is also argued to be related to individual expectations and cultural variations.

While some of these studies depended on regional level data obtained from randomised questionnaire surveys, others used indicators based on the psychology or sociology of social interactions, and estimated density values from databases such as the census. It was felt that both of these methods resulted in less precise information about density or its manifestations within a neighbourhood than a normal density calculation made from actual site visits. Therefore the findings on the significance of density for social interaction, and the social ties at a micro scale of a neighbourhood, are disputed. Moreover, recognising the experiential nature of density which involves the perception of built environment by the individual, as seen in earlier sections of this chapter, it was felt that measures or indicators of density should include those which can describe both physical and perceived density. As a result, this research uses multiple indicators of density to describe the precise physical conditions within each neighbourhood, as well as the perception of density by its residents.

Spatial configuration, though not a density measure per se, has implications for how density is realised on site (see Section 2.1.2). Spatial configuration could become an integrator or segregator of a community by presenting permeability or barriers to the movement of people. This aspect is discussed in detail in Chapter 3.

As discussed earlier, negative perceptions of density or crowding (Rapoport, 1977) could deter people from participating in the community. This negative perception is influenced by physical density and its manifestations such as layout and building form. While physical density is quantifiable and objective, perceived density as it is experiential is expected to vary with individuals. Perceived density could effect overall social interaction and social relationships in a neighbourhood if there are too many people who have negative perceptions or feel crowded in a neighbourhood. Hence, to examine whether levels of social interaction or strength of social contact in an individual's case are related to his or her perception of density, it is important to measure perceived density.

Consequently, it is important to identify or develop measurements to express both physical and perceived density, as well as other physical qualities such as layout, built form and ratio of built to open space. Therefore, criteria used to identify measurements appropriate to this research are:

1. Aspects of density most likely to have an impact on social interaction in a neighbourhood should be selected. Therefore, density indicators will measure perceived and physical density, as both claimed to be important in influencing social interaction
2. Differentiate building and population density as they may have different impacts on social interaction. While population density is related to perception of crowding, building density is related to proximity.
3. Measurements must be possible to calculate, within the limits of the research, for all types of layout and built form
4. Measurements need to be standardised in order to compare different neighbourhoods and to be compatible with data from previous research.
5. They must be appropriate for expressing the density of residential areas rather than of whole cities or regions.
6. They should reflect the density of the residential area of a neighbourhood only- that is, they should include all land uses, such as internal roads and public spaces, but exclude those non-residential land uses within or adjoining the neighbourhood which cater for a larger population.

2.2 Density measurements: a review

In selecting appropriate measurements of density for this research, it was also necessary first to review the variety and nature of existing measurements used in research and practice around the world. There are hundreds of density measures currently in use. Density measurements in the context of the built environment and its planning can be grouped as molecular (density within a dwelling unit) and molar (density of space outside dwellings), and those focusing on qualitative features such as built form, footprint and spacing between buildings (Alexander et al., 1988 p6). While density within a dwelling unit is generally used to express overcrowding (Rapoport, 1975), molar measures are used for design and planning purposes.

Measurements of qualitative features are usually employed by planners and urban designers to control the built form. Although most research on urban crowding has considered molecular density, it is evident that the perception of density- that is, the perception of crowding-can also be influenced by density outside the dwelling.

Physical density

This section presents an overview of measures of physical density to identify the differences and similarities, and their potential to express density effectively for this research. From the plethora of density measures and definitions that emerged after the surge of interest in the topic in the '60s and '70s (Alexander et al., 1988; Forsyth, 2003) it was apparent that there were in many cases only very minor differences between them. While some were developed purely due to the practicality of calculating or measuring in a particular situation (Forsyth, 2003), others were developed to create a specific measure for particular social or economic studies.

The key differences in molar density measures used around the world relate to variations in the land areas included in the calculation, variations in what is being measured (for example people, households or bed spaces) and variations in the unit of area used (for example square kms or miles, hectares, acres). While units of area can easily be converted from one to another, such transformations are difficult to make by changing land area included, or to convert the units that are being measured, for example dwelling units to persons or to habitable spaces. Errors can occur due to differing assumptions (for example in the average size of a typical family, or the average floor area of a dwelling) in such conversions. Hence it is important to select the most appropriate measurements to fit the criteria established in section 2.1.3 above.

Density measures can generally be classified by considering the type of land use included and excluded in the area calculation. Broadly speaking, an inclusion of a specific land use is usually termed a net density measure and an all-inclusive inclusion of land use is called a gross density measure. Classifications of density measures can also be made on the basis of the scale of land included (from block or street to city). Alexander et al. (1985) reviewed and classified density measures used

in different parts of the world by comparing the definitions used in a variety of documents and studies (Ibid p11). Reviewing the measures proposed by different authorities and government bodies on the topic, they identified four categories, namely 1) Net Dwelling Density 2) Gross Residential Density 3) Neighbourhood Density and 4) City Density (See Table 2.1 for definitions).

Density measure	Numerator	Denominator	What is included
Net Dwelling Density	Person or dwelling unit	Net residential area	Total land area devoted to residential facilities
Gross Residential Density	Person or dwelling unit or household	Gross residential site area	Net residential area + 50% perimeter roads+25% intersections
Neighbourhood Density	Person or dwelling unit or household	Total neighbourhood land	Residential land, streets, and other land uses for neighbourhoods, such as schools, recreation, religion, culture and neighbourhood retail
City density	Person or room or dwelling unit or household	Total urban land	All land use

Table 2.1 Classification of density measures

source:(Alexander et al., 1988)

Keeping in mind that, for this research, density calculations are needed for the scale of a neighbourhood, the aim was to identify the density measures that best reflect the building density of neighbourhoods and their openness or compactness. Hence most measures of building density which are used for the density calculation of the whole city or districts were not suitable, as they include all types of land uses other than residential and related functions. Similarly, most of the gross residential density measures such as gross dwelling density (American Public Health Association, 1960), net housing density (Cameron, 1980), gross density (Federal Housing Administration, 1971) and net neighbourhood density (Gibberd, 1967) were found to be unsuitable. Including land uses that are not accessible or useful to residents of a neighbourhood could skew the calculation of density. It was also noticed in many cases measurements were made complex by the use of different units (for example family as opposed to person or area of habitable room). Similarly, most measures classified as neighbourhood density measures, for example the gross neighbourhood density measure (Gibberd, 1967), still included all land uses rather than residential and related land use, although they were developed exclusively for measuring

density of neighbourhoods. Hence they are considered unsuitable for measuring density for this research.

Net density	**Dwellings or people or room/residential land area**
Net Residential Density	Land covered by residential development+ any garden and other spaces that are physically included in it, and usually 50% of the width of any adjacent road
Housing Density	▪ No. of dwellings per hectare ▪ Useful in calculation of land allocated for housing in a development
Street Density	▪ Residential land use+ half the area of abutting street ▪ Net residential area can be defined as: ▪ Gross site area minus: o Area of green space larger than 0.2ha, district distributor roads, special landscaped area, non residential uses (DETR 1998) ▪ Useful in describing densities of developments on the scale of neighbourhoods
Net site density	▪ Overall building density, including land use for associated functions rather than just housing (e.g. roads, garden, car parking, children's play areas) ▪ Useful where only residential uses are planned for a site (DETR 1998)
Habitable room density	▪ Number of habitable rooms per hectare ▪ Useful in providing broad indications of the intensity or form of the development
Gross density	**Dwelling or people or room /total land area, incl. other land uses**
Net residential density	All as in net residential density+ certain nearby non-residential land use in order to reflect the provision of services and amenities such as schools and parks that are needed to support the housing element.
Gross development density	▪ Overall density of a big development (individual sites still not identified). 'Appropriate where residential development is to take place in a number of adjoining sites' (DETR, 1998c)
Neighbourhood density	▪ Takes into consideration residential land as well as that for supporting functions like schools, and shops etc in calculating density ▪ Appropriate where a residential neighbourhood or urban quarter is planned. ▪ Makes allowance for provisions of facilities/services (such as open spaces, play areas, primary school and local shops) (DETR, 1998c)

Table 2.2 Common net and gross density measures used in UK

In contrast, some net dwelling density measures used for calculating building density are very exclusive, since they include only residential land and exclude even the street and public space, while others, for example, net residential density (TCPA, 2003) include all the street systems and public open spaces but not other non-residential land uses. Thus, in general, net residential density measures seem most suitable for this research. Many net density measures include 50% of adjoining streets, which arguably is intended to reflect the density of the surroundings without distorting the calculation one way or the other. Table 2.2 lists some density measures commonly used in the UK today, along with their definitions; it shows that the most common density measures in the UK are calculated in hectares. Hence, net

residential density, as defined by the TCPA, is the most appropriate in this research to express building density as it 1) allows the data to be compared with national datasets 2) is relatively easy to calculate in all the neighbourhoods selected for this research, with their variety of built form and land ownership patterns, and 3) is appropriate for the residential scale of this research.

For population density, a net population density measure similar to the net residential density would have been ideal, provided 1) it were possible to get reliable population data for the chosen neighbourhoods from alternative sources as their boundaries may not coincide with those of administrative boundaries such as a census enumeration district or electoral ward 2) that the neighbourhoods themselves may be so isolated that people from neighbouring areas do not contribute to perceived density or social networks. On the other hand, with a 98% response rate, census data provides reliable data for the population (National Statistics, 2005b). Moreover from the current GIS based data set at the level of a electoral ward, postal district, or censes enumeration district in the UK, a reliable gross population density can be calculated for these divisions of urban areas.

After comparing various types of administrative boundary within chosen neighbourhoods, it was decided to use census boundaries to calculate gross population density. This could then be compared with net density if more specific data for just the neighbourhood were acquired from fieldwork. Thus it was also decided to include in the research instruments a way to quantify the number of people per household, from which net residential population density (person/ha in the land area included for residential building density calculation) could be calculated, in addition to molecular density (persons per household) which indicates levels of crowding. Hence the population density measures used in this research were derived both from the fieldwork for this research (net density) as well from census data (gross density), and both are used for comparison of the chosen case study areas.

Perceived density

The perception of density is argued to be related to cultural and psychological factors along with the actual physical density of the built environment (Alexander et al.,

1988; Rapoport, 1975). However, measuring perceived density effectively and objectively is a challenge, resulting in the development of various methods, measurements and indices (for example Nagar and Paulus, 1997). While some of the indices have attempted to combine a way to internalise both formal and spatial aspects of the built environment in one measure, others have tried to define an appropriate parcel of land within which actual physical density is measured, which then corresponds to the perception of density by its users (Richardson et al., 1998). However, it was felt that most of these measures were either too complex to calculate, or included contentious assumptions such as land parcel size.

Considering the subjectivity in the perception of density, a simpler way to estimate it would be to gauge the opinion of the users by structured questionnaire methods used in many previous studies of crowding (Booth and Edwards, 1976; Carnahan et al., 1974; Fischer, 1975; Freedman, 1975; Kirmeyer, 1978). A variety of scales such as Residential Crowding Experience Scale (Nagar and Paulus, 1997) use simple sets of questions about the perception of the built environment and crowding. Hence a simple interview or questionnaire survey with structured questions to indicate or assess perception of density was adopted for this research. Findings from the questionnaire are compared with actual measured density and built form. To develop the precise questions or indicators, previous questionnaires were reviewed and those appropriate for residential neighbourhoods and perceptions of density, crowding or building form, as well as levels of privacy and annoyance with neighbours, were considered for use in this research.

Measure	Definition
Crowding	A negative perception of the degree of density
Inside the house (Molecular)	Measured as either number of people per habitable room or number of people per dwelling unit
Outside	
Perception of built environment	Indicators such as building height, spacing between the buildings, open space to built-up ratio

Table 2.3 Measures of perceived density

Spatial configuration, layout and built form

Although not direct measures of density, spatial configuration or layout and built form are argued to have multiple effects on the perception of density and on social

interaction. Hence it was considered important to include the measurements of physical characteristics of the built environment, such as building height and ratio of open to built-up space, as well as the characterises of layout, mainly the spatial configuration in this research.

In this research, to investigate the relationship between density and social interaction, where density could be spatially manifested in various ways (see Section 2.1.2) the spatial layout and its implications for accessibility and proximity between neighbours are examined. Although there are lots of spatial analytical tools available today in the form of Geographic Information Systems (GIS), space syntax is one of the rare measures developed specifically for investigating spatial configuration. Space syntax measurements such as global and local integration values which measure the relative depth of spaces in relation to other spaces in a system are found to be very useful in quantifying spatial configuration in previous research that looked at the effect of configuration on human activities (Hillier, 1996b; Hillier and Hanson, 1984). Well-developed syntactic measures like global and local integration, mean depth and control are used along with newly developed measures such as visual integration in this research.

Various methods have been developed and used around the world after the Second World War to control building form and its relation to land area. The most commonly used measurements for controlling building envelopes or volumes are Floor Area Ratio (FAR), Floor Space Index (FSI) and building density (see Table 2.4 for definitions). All three measures use the rationale of comparing the site area with the total built up area. While they are generally used in controlling development by defining maximum volumes or building envelopes on particular sites, their effectiveness is limited to a single parcel of land rather than a collection of varying parcel sizes. Thus their use in describing the built form of large neighbourhoods is incorrect unless land parcels are all of same size. That is, FAR, FSI and building density values can effectively describe the built form and possibly population density (assuming a standard area and family size per dwelling unit), but they are less applicable to a large collection of land parcels with varying sizes, as is the case in many neighbourhoods. Moreover, measures are more labour-intensive to

calculate when the built form and density ranges from detached houses in independent plots to complex blocks of flats with bridging blocks and shared land ownership. Fig. 2.2 shows a simple exercise where FAR, density and coverage of a hypothetical block with three built form /layouts of two different densities were compared. The exercise shows the inadequacy of the FAR as a measure of built form: its value remains the same in the case of three different built forms of the same building density.

It is argued that a simpler way to measure the amount of open space and building form would be to measure the land 'coverage' as well as building height. Land coverage is simply the percentage of an area of land that is built upon and thus can provide a measure of quantity of open space. Moreover it is very easy to calculate from a detailed ordinance survey map. Furthermore, a detailed map could also be used to look at the distribution of open space in relation to the layout of housing. Criticism of the use of 'coverage' arises from the lack of clarity in the land uses included for the calculation of 'coverage' (similar to the 'density' problem) and thus a variety of coverage measurements are used, ranging from net coverage to gross coverage. For this study it is appropriate to take land uses similar to those included for built density itself.

Density measure	Definition
Floor Area Ratio (FAR)	Ratio of total built-up area to plot area. Better in predicting building footprints, and thus forms of development
Floor Space Index (FSI)	Calculated by dividing total floor space by the area of site plus half the width of adjoining roads Useful to identify building envelope (DETR, 1998c) American system
Coverage	Percentage built up on a parcel of land. Useful in identifying the built/un-built ratio, as well as open space provision.
Building density	(Site coverage X number of storeys)/total site area French system (DETR, 1998c)

Table 2.4 Measures of built form

Other deductive and descriptive methods such as 'Deductive Density Schema' (Diamond, 1976), which combines the physical and perceived density along with built form into a single index, were found to be either too complex or an over-simplistic rationalisation of the three concepts. Hence it was felt that the three should

be measured separately. In summary, the measures considered relevant and appropriate for this research were:

Building and population density (physical density)

1. Net residential density (household/ha including all residential land + internal roads + 50% of adjoining streets but excluding all other land use)
2. Gross population density (person/ha calculated from the census) and net population density (person/ha calculated from the fieldwork to include only those land uses and areas used to define net residual density)

Perceived density

1. Neighbourhoods density as perceived by the participants in the research, This can be compared with other responses as well as with the quantitative measures mentioned above (Q6 in questionnaire, appendix A)
2. Qualitative aspects of building, such as building form (Q7)
3. Participants' perception of privacy (access crowding- Q24-25)

Building form

1. Coverage: proportion of land used for building (excluding garden sheds and other temporary buildings) to open space
2. Building height (in number of storeys)
3. Spacing between buildings

2.3 Conclusions

A density measure is a simple concept that is made complex by non-standardised ways of calculating it, as well as inconsistent use of the idea to express a variety of concepts, including the perception of crowding. While crowding is an experiential factor that is modified by individual perceptions and norms, actual physical density is an objective and measurable feature of a built environment. However, both perceived density (crowding) and physical density are intertwined and are argued to influence social interaction. Hence it was decided to include both in this research as separate indicators of density.

Looking at the variety of density measures used around the world to calculate physical density, it was decided to use net residential density as it was found 1) appropriate to use at the neighbourhood scale, 2) easy to calculate 3) can be used in a variety of building layouts, forms and land ownership situations, and 4) takes into account the openness of surrounding area better by including 50% of the surrounding streets in its calculation. For population density, which could also indicate crowding, it was felt that the census was the most reliable data source. However, as the selected neighbourhood boundaries may not match the census or other administrative boundaries for which they are available in the UK, it was decided to use the gross density of the census enumeration district. It was also considered appropriate to measure built form and layouts for this research, even though they may not be directly related to physical density. This is because much previous research suggests they could significantly influence the perception of density, as well as influence social interaction. After reviewing various density measures, eight different measures and indicators (see end of section 2.2) were selected for use in this research.

Chapter 3

Defining and measuring social interaction

3 Defining and measuring social interaction

3.1 Introduction

In general, all types of relationship are regarded by many as a sequence of interactions (Hinde, 1979). Social interaction in particular is argued to be the building block of community cohesion (Goldschmidt, 1972) and neighbourhood social ties (Fine, 1994; Gravelle, 1989), resulting in people's participation in the community (Bell and Boat, 1957; Fahey, 2000) and thus increasing the social capital in the community (Putnam, 2000). These community relationships and participation are regarded as important aspects of quality of life (Kavanaugh et al., 2005; Percival, 2001) and therefore to some extent contribute to the social sustainability of neighbourhoods (Iyer-Raniga and Treloar, 2000; Putnam, 2000). In this research, therefore, the focus is on the social interactions that happen between the members of different households rather than those within a household. This is because it is assumed that a household works as a single unit and that the inter-household interactions contribute the most towards social ties (networks) and community cohesion.

Definitions and meanings of social interaction depend on the context within which it is discussed whether psychology or communication studies or sociology and social psychology or business studies. The intention of this chapter is to define social interaction in the context of this study, that is, within urban residential environments, as well as to identify the factors which may influence the extent and nature of social interactions in urban neighbourhoods. This chapter also reviews methods previously used to quantify social interaction, in order to identify measures that are appropriate for the purpose of this research and is context of urban neighbourhoods.

There is some evidence from previous studies to suggest that a neighbourhood's physical and social characteristics can influence the strength and nature of social interaction within it. The aim of this research is to investigate the relationship between density and related physical characteristics of the built environment of a neighbourhood and social interaction. To achieve this it is important to define social

interaction, and consider various factors which may influence it, especially in the context of urban neighbourhoods.

3.2 Defining social interaction for this research

> Social interaction, as commonly viewed, implies theories of reciprocity, complementarity, and mutuality of response. For example: a question implies an answer, a statement implies acknowledgement of communication. (Bargotta, 1965, p27)

This research concerns social interaction rather than other types of interaction. Social interaction is a fairly commonly used term but it has many connotations, meanings and definitions in linguistic studies, communication studies, sociology, social psychology, psychology and urban research. In the '60s and '70s of the last century, there was a great deal of interest in social interaction and most of the research and literature on the topic came from social psychology, sociology and from communication studies. Social interaction is a term often used in psychology in debates over communication theory, social psychology and in sociology in debates about community relationships, social ties and social capital. In communication theories such as symbolic interactionism (attaching meaning to language or gestures called symbols (Blumer, 1969), social interaction is regarded as one of the mediums which enhance association between participants.

So, what are social interactions? According to Rummel:

> Social interactions are complex in their manifestations and interrelationships. These interactions can involve smiling, talking, or winking; threatening, fighting, or debating; and negotiating, discussing, or litigating. The interactions can be overt or covert, active or passive, brief or long-lived. They can be organized, unorganized, or disorganized, direct or indirect, shallow or intense, narrow or universal and so on. There is clearly a diversity of characterizations, processes, forms, types, and the like. How can we make sense out of this complex? (Rummel, 1976)

There are clearly many facets to social interaction; this creates challenges in carrying out research on the subjects.

In general terms, social interaction is described as the interaction between two or more individuals that is social in nature (Argyle, 1969). Weber (1947) defined social

interaction as a behaviour to which participants attach a certain meaning, take account of each other's behaviour, and is therefore 'oriented' in its 'course'. Many commentators noted the ambiguity in the term 'orientation' (Schutz, 1967). Rummel later clarified 'this ambiguity by considering the constituents of social behaviour' (that is its agents, vehicles and meanings), 'kinds of behaviour' (that is reflex, action, act, and practice), and 'what is distinctively social about social behaviour'. Therefore, by classifying interaction according to its actors, medium (face-to-face or correspondence), meaning attached to it, and type (reflex or reaction), Rummel tries to clarify whether an interaction is social in nature or not. He defines social interactions as an act, action, or practice of two or more people that takes in to account of each other's subjective experiences or intentions - an action which needs mutual orientation (Rummel, 1976).

According to Rummel, the parties to social interaction must be aware of each other, but it is not necessary to have physical co-presence in same space. Thus actions including writing letters and other forms of communication can be social interaction, as long as they are social in nature, whereas action such as spying, or behaviour between guard and prisoner, are not, as they tend to be of a reactionary or reflex type. In short, according to Rummel, cases where actions are cause-effect phenomena may be regarded as interaction but not as social interaction.

Therefore, the next question is what specific behaviours can be considered social interaction if they are not simply interpersonal, face-to-face and verbal interaction (Duncan and Fiske, 1977), especially in this research? While a face-to-face chat could indicate a strong form of interpersonal interaction between the participants (Argyle, 1969), interaction could happen in other forms such as smiles, gestures, eye contact and so on (Argyle, 1972; Graham and Argyle, 1975; Montepare, 2003). Argyle and Dean (1965) argue that these non-verbal signals such as eye contact, physical proximity, intimacy of topic, quantity of smiles are some of the critical factors in developing 'intimacy' (p176). However, unscrambling what could be considered 'social' is even more problematic due to the complexity and variations of human behaviour (Argyle, 1972).

Implicit in Argyle and Dean's work is a process of identification or recognition of an individual, which can be acknowledged by verbal or non-verbal communication (NVC) such as symbols or gestures. Hence if gestures are considered social interaction, it could be argued that this process of recognition can also be seen as social interaction, as it could lead to a stronger face-to-face social interaction later (Argyle, 1973). Therefore in this research recognising a neighbour and showing this can be regarded as social interaction.

However, including all types of interaction such as personal communication, especially those that happen behind closed doors, would be extremely difficult and unnecessary to this research. This research is concerned with the social interactions between neighbours rather than those within the same household (personal), or those that happen between larger communities (non-spatial), as the former help to develop social ties in the neighbourhood. Details regarding the content, frequency or behavioural aspects of a social interaction are difficult to attain or validate, and they are not likely to bring any clarity to the debate on social interaction and density in this study.

There is a need to define social interaction with a view to the practicality of collecting data, as methods of recording social interaction in detail in social psychology or sociological research, including the use of CCTV footage or diary keeping, is neither practical nor important in this research. A detailed measurement which gives information on the topic of discussion, nature of behaviour (Tse and Bond, 2001), length of eye contact (Argyle and Dean, 1965) and so on is important in understanding the psychology of an individual in social interaction, but as mentioned above, is less important in understanding the general nature or strength of social interaction.

Thus, in this research, social interaction is defined as all verbal and non-verbal communication with neighbours that are social and cordial in nature as well as spatially located within their neighbourhoods. This includes visible non-verbal gestures such as the smiles and winks by which one acknowledges the recognition of a neighbour.

3.3 Measuring social interaction for this research

3.3.1 Criteria for measures

Due to the complex definitions and interlinked factors that influence it, measuring social interaction is tricky. Therefore a variety of indicators and proxy measures were identified to measure it. For example, measuring behavioural patterns can be challenging, and therefore mutual recognition can be used as an indicator of social interaction. Therefore, considering the scope and focus of this research as well as the factors that influence social interaction discussed before, the measures and indicators of such interaction should focus on

- Social not personal interactions, that is, inter-household interactions
- Interaction that are between neighbours and not further afield or virtual in nature.
- Appropriate indicators: those most likely to be influenced by the built environment and its density.
- Positive interactions, which result in better social relationship between neighbours and not those involving public confrontation and conflicts.
- Measures must be appropriate for use in the context of neighbourhoods rather than in controlled environments such as laboratories.
- Measures need to be easy to use and obtain, given the limited time and resources available for this research.
- And finally those social interactions which can be measured without being intrusive or obtrusive, and do not require personal data.

Social interaction is influenced by many intrinsic characteristics of the individual, groups (society, community) and culture. These influences can be generally classified as those which influence the act of social interaction, and those which can affect participation in social interaction. The act of social interaction is shaped by personal and thus subjective matters such as 1) the psychological condition of the participant or potential participants, 2) the cultural norms of the society, 3) the physical environment; whereas participation is affected by 1) social, economic or demographic factors as well as 2), physical qualities of the environment.

The main focus of this research is on the factors that affect participation in social interaction rather than on personal or behavioural (psychological) aspects that characterise these interactions. This is because it is likely that the physical environment can influence participation in interaction and in community in general, and therefore could be modified by careful planning and design to increase the quantity of interactions to the desired level.

Due to the inherent complexities in social interaction as an act of an individual, as a collective behaviour and as a spatial behaviour due to its relationship with proximities, social interaction is to be understood as a socio-cultural phenomenon, as a spatial phenomenon, as well as an outcome of other intervening factors that result in social relationships.

However, before reviewing the methods of measuring social interaction, a key issue relating to data collection needs to be discussed: that is, the problems related to measuring social interaction. As argued in Section 3.2, identifying the qualifying behaviours of social interaction is problematic, thus measuring social interaction is a difficult task, as found in previous studies (Argyle, 1969; Bakeman and Gottman, 1997; Ghuman et al., 1998; Hinde, 1979; Sasso et al., 1998). There has long been debate over measuring social interaction in natural, artificial, or simulated environment (laboratories). Some argue that behavioural data collected from laboratory environments are flawed, due to over-stimulation or the artificiality of situations (Argyle, 1969; Heen, 2005; La Gory and Pipkin, 1981). Those using the laboratory environment to collect data point out its merits, such as the ability to control participants, control external influences, and intervening variables, as well as its ability to record behaviours in detail.

In a different debate over overt and covert methods of collecting data on social interaction and social network, while some prefer to employ methods where participants are actively involved in the research, as in ethnographic research. Others dispute this, due to its subjectivity and suggest covert observation techniques that remove the subjectivity of the observer and behavioural changes due to consciousness of being observed.

In controlled spaces such as psychology laboratories or indeed in buildings such as offices or hospitals, use of a paper trail or close working groups, CCTV footage, full cooperation from all users in questionnaires or interviews, make it possible to get detailed data on the length and nature of interactions as well as patterns of behaviour. Data of this detail was considered to be too difficult to obtain for this research which focuses on larger systems, urban neighbourhoods, due to:

1. Lack of incentive or compulsion to participate in the research could result in a low response rate
2. Limited resources available
3. The size of the neighbourhoods chosen for this research; at least 250 households (that is 750 people). Controlled environment experiments usually observe less than 50 people

Moreover, detailed information on behaviour during an interaction, its length or topic of discussion is not relevant to this study, as it concentrates on the approximate number of social interactions or the potential for them offered by the density and design of the built environment. Simply to assemble the detailed data from detailed date collection techniques such as CCTV footage or diary keeping would be too time consuming.

To record and quantify social interactions effectively in the context of this research required a number of strategies. These included recording obvious interactions such those visible in public spaces, recording proxy variables or indicators such as social contacts and community cohesion, and quantifying the intervening variables such as favourable social and spatial conditions that may produce better neighbouring.

3.3.2 Measuring social interaction in the public space

A considerable amount of social activity in neighbourhoods is found to happen in public spaces and semi-pubic spaces (Gehl, 2001; Whyte, 1980). This activity could consist of casual chats with someone you recognise or know while gardening or washing the car, or active participation in a conversation or social activity by going to a communal space within the neighbourhood.

After the Second World War, researchers in the built environment started to look at ways to record and map urban spaces and social behaviour. Many unobtrusive observation techniques were developed to quantify visible social activities in public space. Examples of most popular techniques include simple counting and tabulation of types of activities, mapping activities using codes and symbols on a detailed map (Gehl, 2001; Grajewski and Vaughan, 2001), and more detailed recording of social activities by time-lapsed photos (snapshots), or video recording of public spaces (Whyte, 1980). Most of these methods record activity over time and space, allowing one to search for patterns of use of space. The snap-shots of a full day or period of time can be overlaid to analyse overall patterns of space use, location of congregation, most common routes of residents as well as quantifying the number of different observed activities in each public space to use in statistical analysis. While simple tabulation or mapping can be labour-intensive in collecting the data and has fewer details on individual behavioural patterns, it is an inexpensive way to collect data and easy to transcribe and use it in statistically or spatial analysis. In contrast, video recordings and snapshots are full of details about behaviour but require intensive transcription before use in analysis. Because the focus of this research is on the intensity of social interaction rather than the behavioural characteristics during interactions, the simple and inexpensive methods of recording social activities and their location, using maps of the neighbourhood, were found more useful for this research.

There are many tools developed by psychologists to observe behaviours in laboratory conditions. A typical and more recent one of these methods is the two-dimensional social interaction scale or 2DSIS (Tse and Bond, 2001). The method uses a checklist of 20 items in four categories (active participation, active non-participation, passive participation and passive non-participation) to classify and quantify detailed observations made of a one-to-one interaction. Even though such a detailed psychological scale was not found to be practical in this research, key ideas, such as categorising active and passive participation, were useful in developing the methods for observation techniques used in this research.

3.3.3 Measuring socio-cultural aspects of social interaction

Social interaction is a socio-cultural phenomenon, the nature and extent of which is related to the characteristics of society, community and culture of a place (Jeong, 2005). As social interaction can't be accurately and effectively quantified, it is the indications of good neighbouring, or indication of larger social network (Forrest and Kearns, 2001) in a community and neighbourhood that can be used as the measure of social interaction as in many previous studies (Hedges and Clemens, 1994; Skjaeveland, 2001). To do this, it is important to examine concepts such as community, social cohesion and social capital and how they are argued to be related to social interaction.

Inherent in the description of communities as a 'complex system of friendship and kinship networks and formal and informal associational ties rooted in family life and on going socialisation processes' (Sampson and Groves, 1989 p 777) is the idea that 'community' is formed and grown by social networks, cohesion and social interactions (Hinde, 1979; Putnam, 2000).

Social relationships as a measure of social interactions

It is generally thought that social actions can be either reactionary to the environment (Coleman, 1974) or structured choices (Fischer et al., 1977). In the case of the latter, these relationships are formed by exchanges of goods, services and emotional support (Simmel, 1907; Thibaut and Kelley, 1959). Social relationships in a neighbourhood can be seen as a consequence of both forms of social action. Hinde (1979 p 15) states that interactions are the overt behaviour of any relationship and therefore it could be inferred that social interaction is the overt behaviour of social relationships in a neighbourhood. Hence social relationships in a neighbourhood (social networks or social contacts) can be seen as an evidence of social interaction. The nature and type of social relationships, that is, intimate, strong or weak, was used in previous studies to indicate the number of social interactions people have (Ross and Sung Joon, 2000; Warner and Rountree, 1997). Some studies indicated that larger network of informal relationships or passive contacts (Festinger et al., 1950) (that is week ties) accounts for better perception of sense of community,

community spirit and social cohesion (Festinger et al., 1950; Li et al., 2005; Sampson et al., 2002).

Social ties and community cohesion have a significant multiplier effect on social interaction (Argyle, 1969; Kavanaugh et al., 2005). That is, interactions can strengthen the associations between individuals, and stronger association results in more interactions. It is also evident from the body of work on the topic that social ties and social cohesion are recurring themes and are viewed as strong indicators of social interaction.

Representing and analysing social relationships: social network analysis

Much research on community, sociology, social ties and social interaction uses social network analysis (Ajrouch et al., 2001; Bott, 1971; Frank, 1996; Kiesling, 1999; Mitchell, 1969) to explore the type and characteristics of social contact (or social networks) that characterise the community, society or cultural group. The method employs a simple idea, representing individuals and their relationships by using dots and lines to form a graph (sociogram), and analysis (network analysis) based on graph theory explores the strength and character of a network (Borgatti, 2005; Leinhardt, 1977; Wasserman and Faust, 1994).

Representing social relations using sociograms allowed researchers to discuss and represent the social structure and cultural traits of communities. This idea of representation and analysis of social relationship using sociograms was developed in the early part of the 20th century, and since then has generated significant knowledge about the characteristics of social relationships formed in neighbourhoods. Network analysis is the study of social relations among a set of actors which focuses on relationships between actors rather than on the attributes of actors, and on their sense of interdependence rather than on individual relationship (Hanneman, 2001). One of the more important findings from research using social network analysis is that the strength and structure of a network in most cases is a good indicator of the quantity of interactions the participants have (Ajrouch et al., 2001; Frank, 1996; Wasserman and Faust, 1994).

Over the last century, social network analysis has become one of the important tools to analyse characteristics of social networks (Borgatti, 2005; Wasserman and Faust, 1994). It is often used to analyse the characteristics of professional associations in organisations (Neff, 2005; Spiliopoulou and Penn, 1999). As argued in earlier section (3.3.1), social networks or social contacts can effectively indicate the state of social cohesion, and hence interaction in an urban neighbourhood. To analyse the properties and strength of social contacts, they are mapped as a series of links between people (nodes), which are called sociograms.

There are two types of network analysis developed from this idea: an ego network analysis and a complete network analysis (Borgatti, 2005; Everett and Borgatti, 2005; Hanneman, 2001). Ego network analysis can be used to analyse data from a traditional survey where each respondent is asked about the people he/she interacts with. This will not give the full network of relationships that exist in a community, as the sample is usually randomly selected from a larger population. In the analysis of ego networks, an assessment is made about the quality of a person's networks (for example size, diversity and average income). In contrast, a complete network analysis links up all relationships, creating a full set of relations, such as all the friendships among employees of a given company. Methods used in complete social network analysis are well developed and many computer-based tools exist to identify patterns and properties of networks. Social network analysis focuses on patterns of relations among people, organisations and states (Berkowitz, 1982; Wasserman and Faust, 1994; Wellman, 1988). However, as mentioned before, obtaining full network data in an uncontrolled environment such as an urban neighbourhood is not practical, and hence in this research some of the ego network measures such as size of network were used. Using validated means to measure associations and friendships in the community, this research used a traditional survey, simply asking the participants to categorise the type of social contact they have with other people, for example strong or weak and formal or informal, to assess the strength of a relationships.

Social capital as an indicator of social interaction

Social capital is the degree to which a community or society collaborates and cooperates (through such mechanisms as networks, shared trust, norms and values)

to achieve mutual benefits (Putnam, 2000). Social capital is described as a resource that is realized through social relationships (Coleman, 1988; Forrest and Kearns, 2001; Leventhal and Brooks-Gunn, 2000). Therefore social capital has a strong relationship with the social cohesion of a community. To achieve this social cohesion, social networks, social trust, coordination and cooperation for mutual benefit (or shared values) are necessary (Putnam, 2000). Therefore, social capital or its indicators such as friendliness, participation, community cohesion and community sprit along with social network can be seen as an indicator of social interaction,

Research on neighbourhoods has shown that friendliness, perceptions of friendliness, community spirit, and satisfaction with the neighbourhood environment have positive impacts on social ties and cohesion (Fine, 1994; Forrest and Kearns, 2001; Gravelle, 1989; Stone, 2000). The social capital thus generated in neighbourhoods can increase people's participation in the community, and attachment to a place or sense of belonging, thus further improving perceptions of friendliness, community spirit and satisfaction in the neighbourhood (Forrest and Kearns, 2001). Therefore it could be argued that perception of friendliness and a higher community spirit indicates higher social interaction. Similarly, visible social activities that can characterise neighbourhoods as a friendly place can also positively enhance community sprit and thus social interaction (Low, 2001; Skjaeveland, 2001; Talen, 1999). It could thus be safely assumed that these social attributes can result in higher amounts of social interaction.

Some argue that differences and disputes among neighbours can prevent people from engaging in the community (Paquin and Gambrill, 1994). Ideas such as stratification theory support this argument, as they suggest that social relationships are formed between people of equal status or shared values, to avoid conflicts (Bottero and Prandy, 2003). There is also some empirical evidence to show that only weaker social ties exist between individuals or groups which are economically or culturally dissimilar (Bottero and Prandy, 2003). Similarly there are also some studies which show that noise and annoyance from neighbours could lead to withdrawal from participation in the community (Levy-Leboyer and Naturel, 1991) . Interestingly, there are some who argue that 'conflicts could be constructive' (Deutsch, 1969); a dislike relationship or conflicts between a set of individuals in a group can result in

higher levels of communication between others (Paquin and Gambrill, 1994). Proponents of this dislike theory point out that its productive nature will only come about if the incompatible goals or conflicts are trivial. They also suggest that social phenomena such as gossip circles are often a result of dislike relationships (Dunbar, 1996; Fine, 1986; Gambetta, 1994). In all of these, social interaction is seen as the cause or effect of the social network and social ties. Therefore it is safe to say that conflicts can have an impact on the size and nature of social networks and interaction, and thus are regarded as an indicator of social interaction in this research.

Various measures and indicators have been used to measure social capital in previous studies. These include measuring the friendliness of neighbours (Hedges and Clemens, 1994), community spirit, participation in community (measured by memberships in voluntary associations and community activity), social trust, shared values, attachment to place, and negative measures such as conflicts and social tension to measure social cohesion. Many of these measures have been developed and validated over a long time and mostly consist of series of multiple-choice questions about people's perceptions. In this research these questions relating to the above-mentioned measures of social capital are measured using the established tools used in the Survey of English Housing (Mew et al., 2003), Housing Attitude Survey (Hedges and Clemens, 1994) and Hong Kong Neighbourhood Survey (Forrest et al., 2003). Most of the questions used in these studies can be found in the ESRC Centre for Neighbourhood Research database (ESRC Centre for Neighbourhood Research).

Various tools have been specifically developed to measure the different aspects of neighbouring such as attachment, social network, social capital, for example the Multidimensional Measure of Neighboring or MMN (Skjaeveland et al., 1996) and the Multiple Measure of Neighbourhood Attachment (Woldoff, 2002). All of these measures typically use multiple questions to obtain information on each of the above aspects answers are later weighted to give a single score for each individual or neighbourhood. This approach allowed the easy comparison of different datasets. However, there was no such single tool to measure social interaction and its indicators, and therefore the research tool was developed from generic questions validated in the previous studies mentioned above.

Although this research focuses on the characteristics of spatial layout that help to foster spatial community relationships, obvious a-spatial groups and their membership that can increase social contacts beyond the immediate neighbours are also investigated.

Direct measures of social interaction

The main indicators and measures used in this research to quantify the extent and type of social interactions are:

- **Social interaction:** the amount of social interaction in public spaces and the nature of interaction based on the type of participants (for example children or adults).
- **Social contact:** the amount of social contact (or ego network) of households. The quantity or strength and the type of social contact (formal and informal) was used as an indicator of social interaction and type of interaction (formal and informal).

Indicators of social interaction

The indicators chosen based on the discussions above for social interaction, the socio-cultural phenomenon, include

- Social capital:
    - Friendliness of neighbourhood and friendly neighbours
    - Community spirit
    - Voluntary associations and community activity or membership in community groups that are local
    - Attachments to place, shared values and sense of belonging
    - Negative factors, such as problems with neighbours: conflicts, social tension, and annoyance with neighbours.

3.3.4 Measuring the spatial aspects of social interaction

Social networks are formed for various reasons, starting from shared values of the participants resulting in membership groups (Argyle, 1969; Putnam, 2000), to informal groups formed by spatial closeness of neighbours (Argyle and Dean, 1965;

Hillier and Hanson, 1984; Knowles, 1979; Krupat, 1985). Here the groups formed by shared values and membership of an association can be a-spatial, that is, unrelated to space (e.g. clubs, guild). Informal contacts with immediate neighbours are often formed due to their spatial nearness as they bump into each other frequently, and thus they can be called spatial group or communities. While a formal organisation structure characterises a-spatial communities, spatial groups are non-hierarchical and often cluster around well-connected physical spaces (Hillier and Hanson, 1984).

'Neighbourhood' is often described as a socio-spatial phenomenon (Galster, 2001; Kearns and Parkinson, 2001) it is 'the bundle of spatially based attributes associated with clusters of residences' (Lancaster, 1966). Favourable spatial attributes of neighbourhoods, such as its layout and configuration are considered vital for its existence. Therefore a 'neighbourhood' consists of structural, demographic, public service, environmental, proximity, and political and social interaction characteristics which are unified by space (Galster, 2001).

Physical environmental factors that can influence social interaction are well researched (Sonnenfeld, 1972). Important research findings indicate the impact of formal and spatial characteristics of neighbourhoods on the sense of community (Mitchell, 1971; Talen, 1999), social cohesion and social ties (Skjaeveland, 2001). Rapaport (1975) concluded that physical density and perceptions of it can affect social stimulus and therefore influence the amount of social interaction (see Chapter 2) Reinforcing this, empirical evidence suggests overcrowding (negative perceptions of density) has a negative impact on social interaction (Knowles, 1979). The effect of density on social interaction in urban neighbourhoods is also dependent on spatial characteristics of a neighbourhood layout, such as layout and building form. For example, a low density, spread-out layout could create physical barriers to social contact by increasing the distance between neighbours, whereas in a high density neighbourhood, issues such as crowding become a psychological barrier to people socially engaging in their neighbourhood. Conversely, a complex spatial configuration of high density, a result of land or economic pressures, could also be seen as a physical barrier; the placing of dwelling units in the resultant compact form, while packing houses closely, could be separating neighbours spatially or

physically. The outcome can be a perceived lack of opportunity for informal meetings and social contacts between immediate neighbours. As argued in Section 2.1.2, the layout or spatial configuration can influence the nature of social interaction as well as the perception of the built environment, especially of crowding. Hence, in this research, measures of spatial configuration are used as indicators to examine its potential to bring about social interaction, and as an intervening variable to compare density with perception of density.

It is necessary to understand the physical characteristics of neighbourhoods to study social phenomena such as social interaction. Lefebvre stressed that 'space is "vital" for "social", but it is the production of space that provides the parameters of and relations of social' (Lefebvre, 1991). Lefebvre argued that analysis of the production of space is an important tool for understanding a society and its present culture. Thus, space can be seen as a product as well as a raw material of culture and society. Its nature and organisation affects not only individuals, but also groups and wider society.

There seems to be an interesting relationship between the quality of the built environment and neighbouring. Forrest and Kearns found qualities of neighbouring help people to overcome the unsatisfactory quality of their physical environment in disadvantaged neighbourhoods, while in more affluent areas, neighbourhoods and their physical qualities become more important (Forrest and Kearns, 1999). This could also be seen as the effect of economic groups on social ties. Therefore it is important to assess perceptions of the physical qualities of the built environment, because they could indicate the reason for a particular social behaviour and the nature of neighbouring.

Spatial configuration creating potential for social encounter

Social interaction can be seen as a function of spatial configuration. A considerable number of studies have linked physical proximity or distance to social interaction and formation of social ties (La Gory and Pipkin, 1981). The key paradigms such as proximity, and distance decay, or the principle of least effort, all indicated that the shorter distance one must move to perform a certain activity, the more likely that

activity is to result (La Gory and Pipkin, 1981; Zipf, 1949). Zipf's (1949) suggest that human behaviour (such as social interaction) decreases as the distance between the activity and potential participant increases. Therefore, both configuration and physical size of neighbourhood can affect neighbouring.

Social behaviour such as social interaction can also be seen as spatial behaviour, a behaviour that is affected by space and its structure, and a behaviour that can modify space. Space can enhance social behaviour by creating opportunities for encounters (Hillier and Hanson, 1984; La Gory and Pipkin, 1981; Zipf, 1949), which can result in social interaction. That is, permeable configurations of spaces in a neighbourhood can provide proximity and / or opportunistic encounters between neighbours (Hanson and Hillier, 1987; Hillier and Hanson, 1984), and therefore influence the formation of social relationships and number of social interactions between them. Previous studies in office environments provided empirical evidence for this relationship between opportunistic encounters, proximity that is due to spatial configuration and social and work relationships (Penn et al., 1999; Spiliopoulou and Penn, 1999).

Measuring spatial configuration has developed a long way and various methods and measures have been developed for specific purposes. One of the important developments in this field is the development of tools and theory of space syntax. Space syntax is a method of representing and analysing spatial configuration, especially when its related to human activities as in settlements and cities (Hillier, 1999b; Hillier and Hanson, 1984).

As mentioned before, social activities thrive in public spaces and semi-pubic spaces within neighbourhoods. Therefore the provision, accessibility and location of these communal open spaces, along with their characteristics such as privacy level and safety features, can positively impact on the extent of social cohesion within a neighbourhood. There is also some evidence to show that social cohesion, social ties and quality of life are related to qualities of public spaces in the neighbourhood (Fortuna et al., 1998). Having accessible communal space is shown to create the opportunity to increase networks through informal communication or activities (Peponis et al., 1989). Therefore, in this research, provision of public open space, its

characteristics, and the relationship of large common space to all other spaces within the neighbourhood (accessibility) are regarded as significant. These can be measured simply by recording the land use of the neighbourhood, as well as mapping the potential participants such as pedestrians, or static activities either through a physical survey or from other databases such as ordnance survey's OS Mastermap.

Identified interfering variables of social interaction

Potential for social interaction: Spatial configuration, the proximities of neighbours, mapping the pattern and interrelationship of pedestrian and static activity and the socio-demographic characteristics are all identified features of neighbourhood that can influence social interaction and number of social contacts. Even though these spatial characteristics are not a direct measure of social interaction, and in that sense are an interfering variable, they are considered to be more important than other interfering variables discussed in section 3.4. This is because layout or configuration is related to both density and social interaction externally and because one of the aims of this research is to develop guidelines for designers. Spatial configuration, that is, layout and built form, were investigated in detail for their implications on social interaction.

3.4 Measuring the factors that externally influence social interaction

Social interaction can be affected by various social, economic and physical characteristics of the neighbourhood. For example physical distance or spatial layout, as discussed above, could influence how many people one might know or form social relationships within a neighbourhood. These are the aspects which are neither a measure of density nor an indicator of social interaction, but are those which can influence either of them independently. Along with the direct indicators of social interaction, it is important to identify these interfering variables that have been established to have a relationship with social interaction. This section examines these interfering variables and their relationship with social interaction, as well as identifying appropriate measures to use in this research.

Socio-demographic characteristics such as age groups and employment are relatively independent of a neighbourhood's density, but these factors were previously reported to have important influences on social contacts and social interaction. There is some evidence to show that phenomena such as selective social ties (Guest and Wierzbicki, 1999; Prandy, 1999) are often seen in social groups of people of similar ages (for example children's groups and older people's groups) - people with more time to invest in the community (Fahey, 2000). The presence of children is also seen as a major factor in forming new layers of social networks in the neighbourhood (Hill, 1989), as the parents of children start forming friendships. In this light, it is easy to see ideas such as the formation of selective ties as functions of social characteristics of neighbourhoods, as argued in some studies (Moorer and Suurmeijer, 2001). Selective ties are also formed between economically or culturally similar groups, as suggested in research on social stratification (Prandy, 1999).

Hence, while investigating the relationship of social interaction with density, it is important to examine the socio-demographic context of the neighbourhood, which is argued to influence the nature and intensity of social relationship and interactions.

Based on stratification theory the Cambridge Social Interaction and Stratification Scale (CAMSIS) uses socio-economic indicators such as occupation to correlate the strength of associations among socially or culturally similar and dissimilar individuals. It assumes frequent interactions between persons who are socially close and infrequent ones between socially distant individuals. The CAMSIS scale scores, calculated from the social and economic characteristics of respondents, represent an occupational unit's relative position within the national order of social interaction and stratification, by comparing the number of such associations to national averages (Bergman et al., 2002). The indicators used in this scale are similar to those used by many other stratification measures; they include levels of social cohesion and social ties within neighbourhoods. In comparison with these indicators of employment and social status, as well as from other national surveys such as the Survey of English Housing (ESRC Centre for Neighbourhood Research), census, a set of measures of socio-economic status was developed for use in the questionnaire in this research.

People who have spent a long time in one neighbourhood obviously have a larger social network on average than newer arrivals (Martineau, 1977). This is argued to be due to their strong sense of attachment or belonging to the community (Li et al., 2005). Similarly, longer tenancy gives a chance for a larger social network to develop.

Other than length of stay, economic reasons such as ownership of properties are also seen as incentives to invest in a community and feel attachment to places (Wiens-Tuers, 2004). Hence, along with other socio-economic characteristics, tenancy could also interfere in the relationship between density and social interaction.

Social psychological factors such as fear of crime, lack of trust or sense of safety are also not a direct measure of social interaction, but they are often found to erode a sense of belonging, attachment to place and therefore participation in community (Li et al., 2005). Similarly, unfriendly neighbours, annoyance with neighbours and lack of privacy from neighbours and passers-by could also affect the social capital of a neighbourhood, and therefore social interaction.

Previous research has shown the influence of an individual's state of mind and psychological condition (or 'mood') on participation socially in the community (Nezlek and Leary, 2002; Yackel, 1992), variations among different cultural groups in the norms of participation (Argyle, 1986; Depeau, 2001; Farver et al., 1995; Shimoda et al., 1986; Tan-Niam et al., 1998), and differences in social gestures in various cultural groups (Graham and Argyle, 1975). However, apart from the environmental stress of high density living (Baldassare, 1976; Taylor, 1982), there is no evidence to indicate that psychological and cultural factors are related to neighbourhood density. Therefore these aspects are not looked at in detail in this research.

Many other common methods employed in social research, such as participants keeping a diary or logbook of their everyday activities (Tidwell et al., 1996) were found to be unsuitable, due to lack of incentives and time constraints in collecting and simplifying the data.

In conclusion, it can be argued that socio-demographic characteristics of a neighbourhood such as age groups, cultural groups and economic groups, as well as social psychological characteristics of individuals and groups, such as fear of crime or sense of safety, sense of attachment, shared values, and need for privacy may influence social interaction indirectly, as they have established relationships with social capital or social ties.

Identified interfering variables of social interaction

The interfering variables which may promote social interaction in a neighbourhood include:

- **Socio-demographic and economic characteristics:** age groups, employment, presence of children and type of tenancy of neighbourhoods.
- **Psychological factors:** perception of friendliness, sense of safety, attachment to place
- **Length of residence:** in the neighbourhood

The methods of measuring these variables are elaborated in chapter 4, methodology.

3.5 Conclusions

Social interaction can be the cause as well as the effect of social cohesion and social networks within urban neighbourhoods. Therefore it is regarded as the building block of social relations. Through an examination of various concepts and theories of social interaction, this chapter defines social interaction specifically for this study. It also identifies suitable measures to quantify social interaction in the context of the urban neighbourhood.

Social interaction in this research is defined as verbal and non-verbal communication between neighbours that is social in nature, and within the neighbourhood. This is regarded as a social behaviour and includes both formal and informal interaction, as well as manifested behaviours including social visits or recognition of a neighbour or participation in group social activities, such as playing or chatting. It also includes gestures such as smiling or other means of expressing recognition or closeness.

By examining the literature on social interaction, this chapter identifies the factors which influence social interaction. This includes individual psychological aspects (states of mind) and social and cultural aspects, as well as the physical environment. Various methods and measures were explored effectively to represent both direct measures of social interaction and indicators of social interaction, such as good community spirit. Intensity of social interaction was affected by a variety of intervening variables, such as social and psychological factors and the physical conditions of the environment within which social interaction is taking place.
Measures used in sociology and psychology were reviewed with the intention of adopting them for this research, taking into account the conditions of fieldwork such as the scale and uncontrollable nature of urban environment. In most cases, methods and measures were unsuitable for use as they were, but some of the methods and indicators could be adapted to develop the final research instruments for the fieldwork. The intention was to develop or adopt measures that are easy to administer/use in urban neighbourhoods, uncomplicated, unobtrusive and non-invasive to residents.

The direct measures of social interaction include the observed interactions and number of social contacts (ego network). Indicators of social interaction include aspects of social capital, such as friendliness, community spirit and participation in community.

Spatial configuration because of its direct relationship to built form and layout are related to social interaction and density; therefore it is identified as an important factor in creating the opportunity for social interaction and perceptions of density.

While a set of demographic and socio-economic indicators was identified as interfering variables because of their influence on social interaction, they are independent of density.

Measures and methods identified range from observing social interaction in public spaces to mapping ego social networks to quantifying social interaction in neighbourhoods.

Chapter 4

Methodology

4 Methodology

4.1 Introduction

This chapter discusses and describes the methodology used in this research, including a literature review, development and piloting of research instruments, fieldwork and analysis. The fieldwork included mapping the physical attributes of neighbourhoods, observing the socialising patterns in public spaces, and administration of a questionnaire survey assessing perceptions of density, perception of quality of environments, noting general demographic qualities of neighbourhoods and mapping various types of social contact. Desk-based research calculated the density and syntactic properties of neighbourhood layouts using space syntax tools and Geographic Information System (GIS). The description of the analysis includes the protocol for statistical analysis and a description of the spatial analysis methods used.

The methodology was formulated according to the key research questions (see Section 1.1). It was clear that the best method for investigating the issues was through case studies of neighbourhoods of differing density, then comparing findings from these case studies. The research methods chosen for this research include:

1) Reviewing the literature, with a view to understanding, formulating and, where applicable, adopting key concepts and theories about social interaction and density.
2) Developing research instruments to measure density and social interaction, along with other socio-economic variables of the neighbourhoods.
3) Developing criteria for selecting case studies.
4) Developing methods for data collection, based on the strategic decisions already taken.
5) Piloting the questionnaire in order to validate the structure and presentation of questions.
6) Fieldwork to collect primary data on type, nature, and extent of social interaction, density, building form, layout and other physical aspects of a neighbourhood.

7) Desk-based research to model (using axial maps and VGA maps) and analyse the spatial configuration of neighbourhoods, as well as to derive spatial data from these models.
8) Analysis of the data and formulation of conclusions.
9) Identifying implications for architects, urban designers and planners.

4.1.1 Literature review

In the initial stage, a review of literature was carried out with the aim of understanding the basic concepts, theories and methods for measuring social interaction and density (see Chapters 2 and 3). Key issues, theories and methods thus identified were adopted for this research, and used to develop the research methodology explained below in this chapter. It was found during the initial stages of this research that there is a significant gap in the research and understanding of social interaction and its relationship to density, especially in case of urban residential areas.

4.2 Empirical research

> 'The **quantitative** is termed the traditional, the positive, the experimental, or the empiricist paradigm. The quantitative thinking comes from an empiricist tradition established by such authorities as Comte, Mill, Durkheim, Newton and Locke (J. Smith, 1983). The **qualitative** paradigm is termed the constructivist approach or naturalistic (Lincoln & Guba, 1985), the interpretative approach (J. Smith, 1983) or the post positivist or post-modern perspective (Quantz, 1992).' (Creswell, 1994 p4)

Empirical research includes the task of quantifying social interaction and density as well as identifying the physical qualities of the built environments within which this research was conducted. Various methods used in previous research to quantify social interaction (Chapter 3) and the built environment (Chapter 2) was identified from literature. The selected measures and methods for their use in this research include a mixture of qualitative and quantitative methods to quantify the physical and perceived density of the neighbourhood and actual and perceived social networks and social contacts by respondents within each neighbourhood.

4.2.1 Development of research tools

Chapters 2 and 3 identified the variables that need to be considered and measured in the fieldwork. Development of research instruments for this study was led by the nature of the variables to be studied. The instruments consist of a questionnaire (see Appendix A) and a set of codes for mapping social activity (Appendix B). Questions to elicit information such as socio-economic status of the residents and their perceptions of density, built form, friendliness, and social networks were incorporated into a questionnaire.

Based on the literature and theories discussed in Chapters 2 and 3, the final questionnaires (see Appendix A) had 40 questions (14 pages) in three sections including questions on:

1. Residents' perceptions of the physical qualities of their neighbourhood.
2. Perceived neighbourhood size. Where respondents were asked to draw the boundary of their neighbourhood on a map.
3. Perceptions of the social qualities of neighbourhoods, including strength of friendships, community spirit, conflicts and membership of formal social groups.
4. Social networks, in which case respondents were asked to map by marking predetermined symbols (see page 9 of questionnaire, Appendix A) representing type of social contacts on a detailed ordnance survey map.
5. Commonly used social spaces and routes respondents took on their way out of the neighbourhood.
6. Basic socio-economic and demographic details of respondents' household, including members, age, occupation, household income and length of stay (See Appendix A for full questionnaire).

While some of the general questions on the neighbourhood and quality of the built environment were based on previous questionnaires used in the UK (for example, Survey of English Household and Census Survey), others were questions specifically designed for this research, for example delineating the neighbourhood boundary (question 12), route trails (question 31), and mapping the social network (question 30).

4.2.2 Selection of case study areas

Neighbourhoods for study were initially short-listed from a study of the literature, land use maps, aerial photographs and ordnance survey maps, as well as by pilot surveys (visits) of the neighbourhoods. Six case study areas were selected from a shortlist of 25, primarily because of their building density and built form. Other criteria considered for the selection of cases were:

Location:

Case studies were selected from locations within an urban centre (core), and suburban locations in large to medium-sized town/cities. Final selections were of neighbourhoods from three different cities in the south east of England, namely London, Reading and Oxford. Locations were restricted to those with a comparable geographical and cultural location (the southeast of England) to control for interfering variables such as regional variations in perception and attitudes towards density or cultural variations, which have been found to have a significant influence on social networks (Loo, 1984; Mulholland Research and Consulting, 2003; Stokols et al., 1973; Taylor, 1981). Furthermore, the logistics of primary data collection methods adopted for this research, such as intensive observation of social activities, questionnaire delivering and collection, and a visual survey of built form, made it practical to choose locations within one region.

Size:

Size of neighbourhood was an important criterion for the selection of a particular neighbourhood from the short-listed case study areas. Final neighbourhoods selected had a minimum of 250 and a maximum of 700 households. This size is equal to one to two census enumeration districts. The physical size ensured that the neighbourhood was big enough to contain sufficient social contacts and neighbourhood relationships within the area for the purpose of the study.

Boundary, Building Form and Land Use:

Each neighbourhood finally selected for the study had a relatively homogeneous building form and density. 'Neighbourhood' is defined as a socio-spatial construct (Galster, 2001; Kearns and Parkinson, 2001; Lancaster, 1966) and therefore has a

well-defined physical boundary (man-made or natural), limiting the areas for detailed observation. This was because in previous research heavy vehicular traffic (Appleyard, 1981) and other physical barriers were found to affect and cause diminishing social contacts across them.

Defining neighbourhood in such a way also reduced the risk of using administrative boundaries, often the cause of misleading results in studies examining social and economic equity, such as a study on postcode poverty (Alston, 2002; Danesh et al., 1999). A well-defined and identified neighbourhood also prevents the possibility of contaminating data by clubbing contrasting communities or clusters together, as in case of post code or other types of administrative boundary. These administrative boundaries, while reasonable at the scale of a city or region, become too generalised to absorb the social, cultural or physical characteristics of communities and neighbourhoods.

The neighbourhoods were selected to represent a range of densities and a variety of built form, from low density low rise, medium density low rise, medium density medium rise, high density medium rise and two examples of high density high rise, with different spatial layouts. The neighbourhoods were also primarily residential areas, with only a few other supporting land uses (for example commercial, recreational or educational).

Period of development:

All the selected neighbourhoods were built or completely refurbished between 1950 and 1990. This meant they had existed for sufficient time for social contacts to be formed, as there was evidence in the literature linking social ties and social network to period of residence in a neighbourhood (see Chapter 3). For the same reason, neighbourhoods dating from earlier than the 1950s were not selected, as they could contain a fair number of people who have lived in the neighbourhood for generations. Comparing them to those living there for less than 10-15 years would not be appropriate for the objectives of this research. This decision ensures that a considerable number of people lived in a neighbourhood for long enough, but did not assume that all of them have lived there for long periods. Neighbourhoods selected

had a large proportion of owner-occupied housing, or featured other forms of long-term tenancy (for example council estate, housing association).

Some of these criteria were in place to ensure a higher response rate for the questionnaire, while others ensured neighbourhoods were comparable in size, age, and some physical and social characteristics, to reduce the number of interfering variables.

4.2.3 Fieldwork

The aim of the fieldwork was to collect all the primary data (density and social interaction variables) discussed in Chapters 2 and 3. The methods used for this are listed in Table 4.1. The main fieldwork including all these methods consisted of two activities: first, an observation survey of the neighbourhood to map social activities and to document building layout and form; and second, a questionnaire was distributed and collected to map the social networks of individual households and to quantify perceptions of social networks, spaces, and physical qualities of neighbourhoods, as well as to obtain some background information on the socio-demographic characteristics of the households. The sections below describe the methods used for the fieldwork in more detail.

All the fieldwork was done in the summer, to control for the effect of climate on socialising patterns. Observation surveys were carried out on a weekday and over a weekend from 8am to 7pm, mapping the different types of users and activities on a detailed Ordnance Survey map. In most cases the survey was done on a sunny day for consistency and ease of recording activity on a map, though there were a few instances of light rain.

Activity	Variable	Measure
Questionnaire survey	Social interaction	Indicators of social interaction ▪ Mapping different types of social contacts ▪ Measures of community cohesion ▪ Community spirit ▪ Friendliness ▪ Participation in community ▪ Attachment to place
	Density	Perception of density and built form Building height
	Satisfaction	Quality of built environment, infrastructure, public facilities Sense of safety
	Socio-economic and demographic background	Indicators of demographic characteristics ▪ Size of family, age groups Socio-economic ▪ Employment, economic groups ▪ Tenancy, length of stay in the neighbourhood
Observation survey	Social interaction in public space	▪ Mapping social activities according to type of social activities, age of groups involved, on both weekdays and weekends ▪ Mapping of socially active spaces
	Density/ built form/ layout	Verifying the building and neighbourhood layout for recent changes not reflected in base map
		Mapping relevant landscape features, open spaces, physical barriers etc
		All details of layout and footprints of building to calculate density, coverage, and FAR

Table 4.1 Fieldwork and measures

4.2.4 Observation survey

Inclusion of inductive methods such as observations not only allowed triangulation of the data on social activity in a neighbourhood with the strength of social contacts, but also a defence against the criticisms of deductive methods, such as the questionnaire survey (Whyte, 1984). Observation sessions recorded the social activities of people (meeting, passing through, playing, relaxing) in the public spaces (and observable in semi-public space, such as front gardens) within the neighbourhood. Observation was conducted on a working day as well as on a weekend in each of the neighbourhoods. Data was recorded on a detailed ordnance survey map (1:1250 scale), using symbols (see Appendix B) for different activities, from 8am to 7pm.

Various observation techniques to measure social activities have been developed in the past two decades. One important method is mapping of social activities in public spaces by observers, as used in much space syntax research (Major et al., 1997).

This method has its origin in those used by Gehl, Whyte and others (Gehl, 2001; Whyte, 1984) who used various recording techniques, including video camera and timed photographs, to quantify the spatial behaviour of people.

To record activity the observer walked a predetermined route that passed through all the observable spaces within a neighbourhood. A circular route was developed to allow observation of all spaces with minimum effort, to minimise the walking distance for the observer. The observer stopped at regular intervals to record a snapshot of activity within the visible spaces around him or her. This included observing, classifying and then mapping the number and type of users and their activity on a large-scale map. The observer made rounds through the abovementioned route once every hour between 8am and 7pm, enabling mapping of variations in social activity at different times of the day, as well as allowing quantification of different activities within different spaces in the neighbourhood. This method of observation is extensively used in space syntax research (Grajewski and Vaughan, 2001; Major et al., 1997) and thus there was no need for piloting of the method.

During the observation exercise, social interaction in public space and aspects of building density, layout and built form was measured. Social activities were mapped to show the type of these activities, their location, and the age group of participants involved, on a weekday and at the weekend. During the same survey, all relevant information on qualitative aspects of the built environment such as building heights, number of storeys, and land use were marked on a large map of the area, and the ordnance survey base map was validated for accuracy. This was later used to calculate the density in desk-based research.

4.2.5 Questionnaire survey

As it was a new tool, the questionnaire was piloted in two stages. Initially it was distributed within Oxford Brookes University to a cross-section of staff and students, to gauge the intelligibility of the language used. Later it was piloted in a neighbourhood to assess the nature of responses and problems which might arise in the 'drop and collect' method. New Marston within which it was piloted was later

used as the first case study for low density, low rise typology. Barring a minor redesign of the layout, the content of the final questionnaire remained the same as the one that was piloted.

The survey protocol essentially used a drop and collect method. A questionnaire along with an information leaflet on the research was dropped at the households on a weekend for residents to self-complete. Initially, 200, or a maximum of 50% of households in the neighbourhood were given a questionnaire. The information leaflet mentioned that the questionnaire would be collected over the following weekend, in person by the researcher. In all cases an attempt was made to collect the completed questionnaire over the same weekend of drop. In the case of a non-response, a further effort was made to collect the questionnaire over the next two weekends. The aim was to get a response of about 50-60 questionnaires from each case study area. To obtain any possible late responses, a reply paid envelope was distributed while contacting the respondents personally for the last time on the fourth week after dropping the questionnaire.

4.3 Desk-based research

4.3.1 Measurement of density

Measurement of physical density was mainly from desk-based research, using ordnance survey maps, and information on the development and history of a neighbourhood, but observations on building height, number of storeys and land use made during the various visits to the case study areas were used to supplement the desk research. Essentially three types of density model were generated from this data, based on the discussions in Chapter 2. These were:

1. Net residential density: expressed in households/hectare, including all residential land, internal road + 50% of adjoining streets but excluding other land use.
2. Gross population density: from the census UK database expressed in persons/hectare including all land use.
3. Site coverage: percentage of land used for residential building compared to open space.

To calculate the above densty measures, base maps (1:1250) from Ordnance Survey acquired through Digimap service, information from the 2001 Census (National Statistics, 2005a) and the information collected from the observation survey (see Table 4.1) was used. Information regarding built environment characteristics such as building heights, land use and the quality of built environment, which were collected during the observation survey, was collated and mapped on to GIS models for analysis.

4.3.2 Quantifying the spatial configuration and built form

It was important to quantify and represent the spatial qualities of neighbourhood for this research for two reasons. Firstly, because density, as discussed in Chapter 2, can be manifested spatially in many different ways. Secondly, differentiating them is important; spatial layout was envisaged as one of the possible factors that could affect social interaction and formation of social ties.

Space syntax methods and tools formed the major means for measuring and quantifying spatial qualities of the neighbourhoods as a whole, as well as locations within each neighbourhood. Using a graph analysis method, space syntax tools analysed spaces that are represented as topological graphs to quantify the relationship between them. The analyses used in this research rest on the concept of space as axial space (visible and accessible lines of sight) and isovist (field of vision from a particular point in space). The underlying presumption in the use of these tools for this research is that space and its structure manifest, or are related to, human behaviour, such as pedestrian movement and navigating a street network (Conroy, 2001; Hillier and Iida, 2005; Hillier et al., 1993). Interestingly, Hillier argues that social interaction and human behaviour have geometrical implications. This natural geometry, when represented in formal spatial analysis, as in case of Space Syntax tools, is successful in helping to analyse behaviour. In general, this analysis uses a series of graphs to represent extrinsic qualities, such as the relationship between spaces (Hillier, 1996b; Hillier and Hanson, 1984), to which values can be assigned to distinguish and differentiate them.

These methods for analysing spatial configuration are well established and, along with a set of computer-based tools, can show the effect of the configuration of spaces on pedestrian movement in public space (Hillier et al., 1993; Peponis et al., 1989) land uses and to some extent the spatial behaviour of people (Campos, 1999; Haq and Zimring, 2003; Penn, 2003). In this research some of the new tools such as 'Depthmap', which analyse the configuration of space based on the extent of visual field from them, are used along with more extensively used tools such as 'Axman' (for axial analysis), to analyse the space qualities of neighbourhoods.

Spatial models and analysis used in this research were:

1. Axial map (Axmap): areas around each neighbourhood within 10-minute walking distance were studied to quantify the spatial relationship of the neighbourhood to its immediate local area. This model was used to quantify the axial integration of spaces within a neighbourhood and to analyse its relation to those outside the neighbourhood. Spatial variables such as global integration, local integration, mean depth, and control were derived from the axial maps to compare the spatial qualities of each neighbourhood.
2. Visibility Graph Analysis (VGA) maps: these includes all the spaces within each neighbourhood that are public as well as the immediate streets around it. The model was analysed using the visible graph analysis method in Depthmap. This computer model looked at accessible public spaces within each neighbourhood and their visual relationship to other spaces within the neighbourhood. Spatial variables such as visual integration, mean depth, visual control, controllability and clustering coefficient (see Defintions) were derived from these models, and were later used to compare and contrast the qualities of each neighbourhood as well as the specific locations within neighbourhoods.
3. VGA maps were also used in calculating the metric walking radius of each house (see Appendix H) than approximation it by drawing a circle around the house.

Visibility graphs were used in this study because, in comparison to axial maps, they enable a finer-grained analysis, distinguishing the importance of locations within a

larger space. In this research, ability to look at spaces in such detail, both in terms of spatial and metric properties and their visual and physical relationship to other spaces, proved to be invaluable in comparing the number and types of social contact in relation to specific locations within a neighbourhood.

In contrast, specialist social network analysis packages such as UCINET, Multinet, Inflow and Krackplot (Richards, 2003) were not used, due to the unavailability of detailed social network data. As identified in chapter three, these network analysis methods rely on a 100% response rate, which was not possible in this research. For this reason, simpler concepts, such as total social contacts and type of social contacts normally found in ego-network analysis method were used.

4.4 Data analysis

4.4.1 Statistical analysis

After excluding outliers from the dataset (a standard practice in such analysis), the initial analysis using Kendall's and Person's correlation tests identified all significant linear relationships between variables, using SPSS. While Pearson's two-tailed correlation analysis was used for significance testing in the case of scale variables, both Pearson's and Kendall's correlation analyses were used in the case of all other types as well as combinations of scale and non-scale variables. Later these relationships were manually screened for their relevance to this research. As in most built environment research, a *p*-value of less than 0.05 was accepted as an indication of a significant relationship. Further detailed investigations were conducted using scattergrams and curve estimations to explore the exact nature of some non-linear relationships. During the analysis, neighbourhoods with distinct spatial or formal qualities were grouped to identify the relation of social interaction to the form. For more detailed analysis, in some of the neighbourhoods where there was more than one type of form or layout, these were subdivided and compared with each other as well as with other neighbourhoods. Individual responses were examined as part of a neighbourhood or as a part of sub-zones within those neighbourhoods.

The key social interaction and density indicators were then examined using statistical testing to identify patterns in the data that would provide answers to the research questions.

Methods

1. Neighbourhoods were looked at case by case as well as collectively, to compare and contrast the nature and extent of social interaction as the density of the neighbourhood increased.
2. Statistical tests were conducted to find both linear and non-linear associations between important variables
3. Multiple regression and partial correlation test were used to study the effect of interfering variables identified as being potentially important in chapters two and three

4.4.2 Spatial analysis

Spatial variables derived from the syntactic models (see section 4.4.5) such as visual and axial integration, connectivity, intelligibility and mean depth of spaces were tested for significant relationships with social interaction variables, using both SPSS and the GIS program (MapInfo). Some of the analysis methods used at this stage also involved visual comparison and descriptive analysis of patterns of social ties, and spatial configuration.

Methods

Methods used for developing spatial model and analyses were as follows:

1. Observation and social network data were digitised using a computer aided design package (CAD), which is then transferred to the GIS platform.
2. Values for spatial variables (given above) were derived from axial and visible graph analysis, which was later integrated into GIS
3. The table of questionnaire responses of each respondent were integrated with spatial layout and spatial data in GIS.
4. Visual and statistical analysis methods in GIS and statistical programs were used to identify regional and local variations in social interaction (and related variables) within each neighbourhood, and their correlation with spatial variables.

4.5 Conclusion

This chapter outlined the methods used in the research to measure social interaction and density in light of the discussions in Chapters 2 and 3. Table 4.2 summarises the methods and measures used to quantify social interaction and density in this research.

Variable	Measure
Social interaction	Indicators of social interaction ▪ Mapping different types of social contact ▪ Measures of community cohesion ▪ Community spirit ▪ Friendliness ▪ Participation in community ▪ Attachment to place
Density	Perception of density and built form Building height
Satisfaction	Quality of built environment, infrastructure, public facilities Sense of safety
Socio-economic and demographic background	Indicators of demographic characteristics ▪ Size of family, age groups Socio-economic ▪ Employment, economic groups ▪ Tenancy, length of stay in the neighbourhood
Social interaction in public space	▪ Mapping social activities according to type of social activities, age of groups involved, on both weekdays and weekends ▪ Mapping socially active spaces
Density/ built form/ layout	Verifying the building and neighbourhood layout for recent changes not reflected in base map
	Mapping relevant landscape features, open spaces, physical barriers etc
	All details of layout and footprints of building to calculate density, coverage, and FAR

Table 4.2 Indicators and methods of measuring social interaction and density

This chapter also described the criteria used for the selection of case studies such as density boundedness, age, and size. This was followed by a description of the analysis that aimed to answer the research questions. This analysis includes spatial and statistical analysis methods. The statistical analysis identified for use includes correlation tests, multiple regression analysis and partial correlation tests. A combination of GIS tools and space syntax tools and methods were used for spatial analysis with the aim of identifying the spatial qualities of a neighbourhood that could relate to the amount of social interaction within it and its density.

Chapter 5

Case studies and fieldwork data

5 Case studies and fieldwork data

5.1 Introduction

This chapter simply describes the data collected through the fieldwork and desk-based research, as well as providing a brief description of conditions and qualitative aspects of the physical environment, social conditions and experiences during the fieldwork. The intention of this chapter is to separate the description of data from the more complex analysis and inferences which are dealt with in Chapters 6, 7 and 8.

5.2 Introduction to cases

Six neighbourhoods were selected from three cities in Southeast England, using the criteria set out in section 4.2.2, for comparative study. They were:

- New Marston and Thames Street housing, Oxford
- Holybrooks Estate in Reading
- Dalgarno Garden, World's End Estate in London
- Parkview Estate in Thamesmead, London

This section gives a short description of each of the neighbourhoods. More details on location, and history, and maps, photos and data on land use of each neighbourhood are included in Appendix D.

New Marston consists mainly of 1960s semi-detached and terraced housing on one to two floors. There are about 522 households in the neighbourhood within 20.89 hectares. While the northern area of this estate consists mostly of semi-detached houses, the southern part mainly has terraced houses, arranged in a grid layout. This neighbourhood has a small shopping area with a couple of shops and a pub. The western and southern sides the estate are bounded by a meadow and two primary schools and their grounds. The main public transport to Oxford city runs along the Oxford Road, which forms the eastern boundary of the estate.



Fig. 5.1 Layout and general view of New Marston

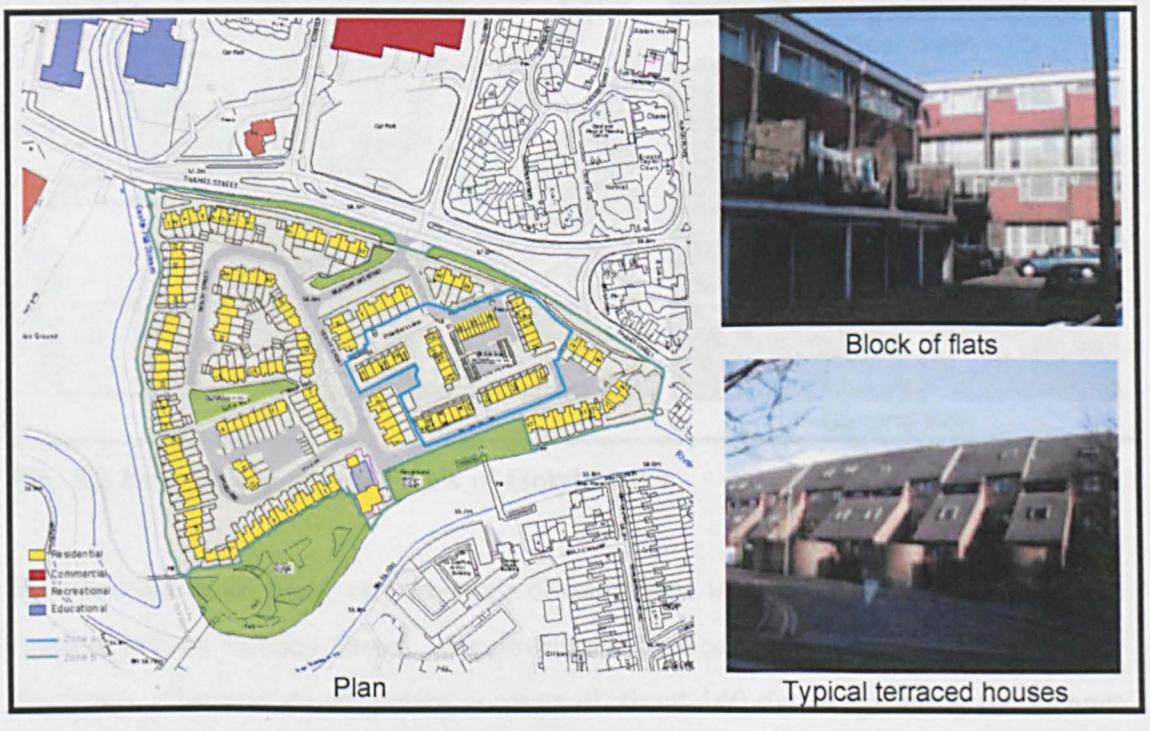


Fig. 5.2 Layout and general view of Thames Street

Thames Street housing is on a triangular site with a busy street (Thames Street) on its north side, the river Thames on its south and a large stretch of recreational green land on its west. Thames Street housing has two distinct areas within the 5.45 hectare site. The neighbourhood contains six block of flats totalling 86 flats, built in the

1960s on the east side, and a second area consisting of 171 terraced houses built in the 1980s. Most of the flats in the earlier development are of the duplex type and are accessed either from the ground floor or from a second floor walkway. The terraced development consists of a variety of house sizes ranging from two to five bedrooms. There is a national bicycle path running thought the centre of the estate and it has a pedestrian bridge connecting the estate to the south bank of the river. The neighbourhood also has a small play space for children and a quieter green space adjoining the river.

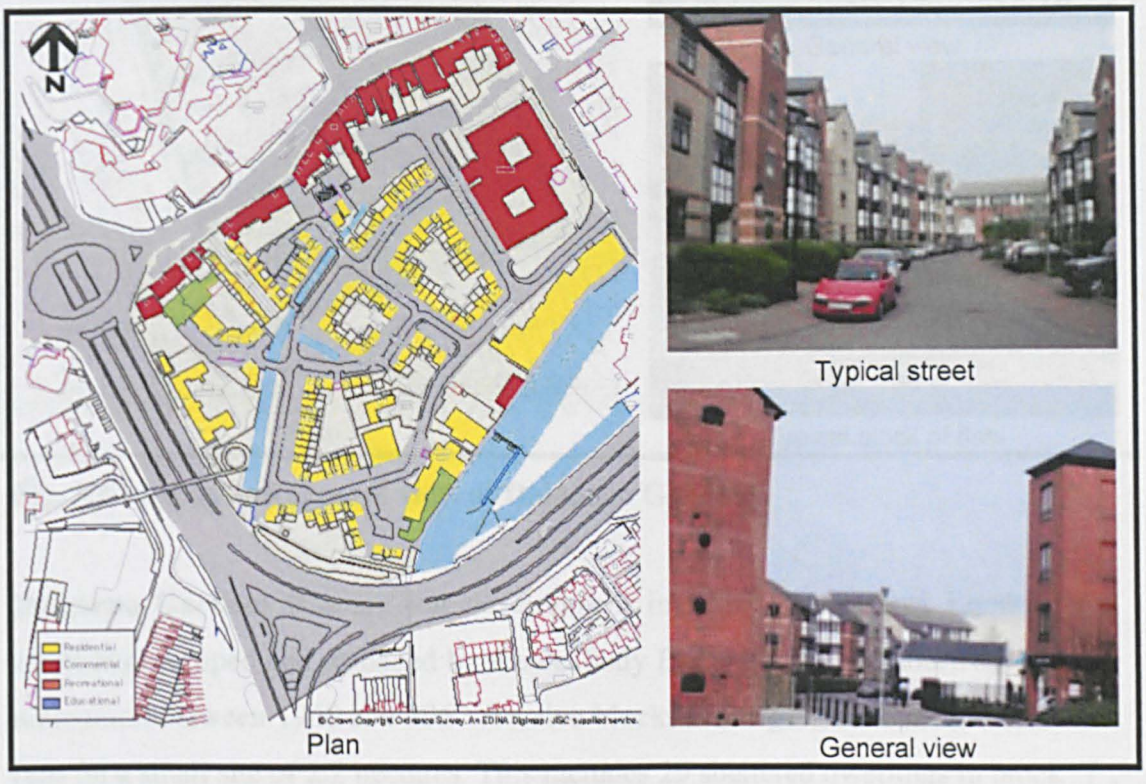


Fig. 5.3 Layout and general view of Holybrooks

Holybrooks is an inner city housing development in Reading. The older housing section, behind Fobney Street, was developed between 1980-85 and has about 264 dwellings. The new development consists of about 140 dwellings along the Kennet River, some of which were still under construction during the period of this study. They were not included in this research for the reasons explained in the criteria for the selection of case studies in Chapter 4. The 1980s housing consists of three to four storey high blocks of flats wedged between terraced houses. The block of flats and terraced houses together form perimeter blocks with back entrances through courtyards and front entrances from the streets. The car parking for residents is

mainly in these courtyards. The housing mix in this neighbourhood ranges from single-bedded flats to five-bedded terraced houses.

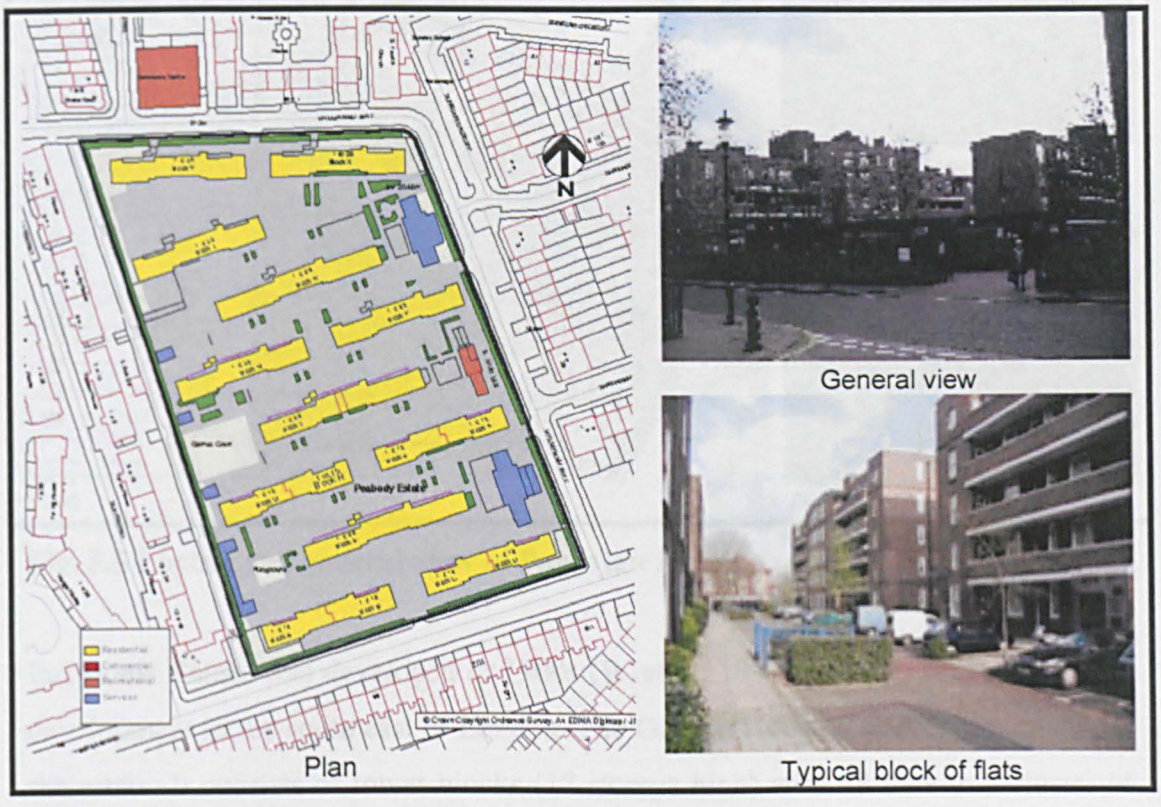


Fig. 5.4 Layout and general view of Dalgarno Gardens

Dalgarno Gardens is a pre-war development in North Kensington, London. The estate is developed and managed by the Peabody Estate Trust and underwent a major renovation between 1960 and 1967. Twelve blocks in Dalgarno Gardens contain 361 flats on a small site of 2.2 hectares. This includes 29 sheltered dwellings in block 'T'. The four to five storey blocks accommodate between 25-38 small to medium size flats (one to two bedrooms). There are mainly two types of block; the shorter blocks (A-B, C-D, G-H, J-K, N, P, T, V and X), have 25-35 flats, accessed by two disconnected walkways at each level, while the three longer blocks (E, L and R) have 38 flats accessed by a continuous walkway. Each block has two staircases and in some cases a lift (lifts were added in the 1980's during a renovation). The blocks are arranged in a staggered pattern with no continuous vehicular streets running through the estate. Hence the street system works like a series of cul-de-sacs accessed from the peripheral roads. The estate has a social club and some children's dedicated play spaces.

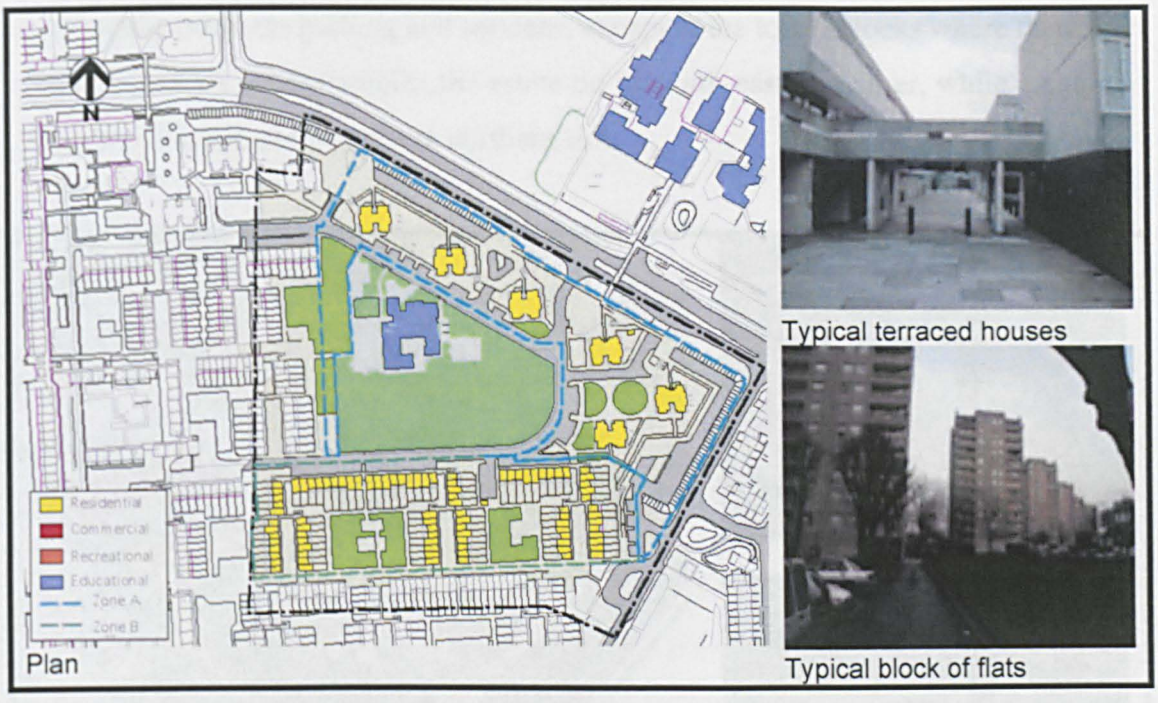


Fig. 5.5 Layout and general view of Parkview Estate

Parkview Estate was developed in 1960s (Wigfall, 1997) as a part of Thamesmead development in the south east of London. The Gallion Housing Association manages the estate. It consists of tower blocks (12 storeys high) with 48 flats in a cluster of four flats per floor and also terraced houses. The area selected for this research is on the eastern corner of the estate and consists of six towers (288 flats) and 132 terraced houses. The flats in this estate are of the two-bedroom type, while the terraced houses are four-bedroomed dwellings. The area selected also has a middle school in its centre. There is an upper level walkway parallel to Yarton Way (the road which forms the northern boundary), connected to the first floor of the tower blocks (at first floor level).

World's End Estate was developed by Kensington and Chelsea City Council in the 1970s (Pellings, 2001) on the Kings Road adjoining the river Thames. The World's End Estate has seven tower blocks (16-19 floors), connected by bridging blocks which are five floors high. Each tower houses four flats on each floor. The general layout of the blocks is in the shape of the number '8', with two courtyards at first floor level. The housing type consists of flats of a range of size from bed-sits to four bedrooms. The majority of the flats in the bridging blocks are of the duplex type. Most of the area at ground level, including that below the first floor landscaped

courtyards, is for car parking and services, except in the tower blocks where there are flats. A primary school adjoins the estate on its north-eastern corner, while a church and shops occupy the rest of the northern side.



Fig. 5.6 Layout and general view of World's End Estate

5.3 Density

Building and population densities were calculated for each of neighbourhoods. While detailed ordnance survey maps and data on the number of dwellings (collected by walk-by observation method) were used to calculate building density, population density was calculated from answers to the questionnaires (Appendix A) and from census data sets (from www.statictics.gov.uk) were used for comparison. Table 5.1, Table 5.2 and Table 5.3 below sum up the documented and calculated data for building and population density respectively.

The terms 'higher', 'medium' and 'lower' density used in the analysis chapters (Chapters 6 and 7) indicate the neighbourhoods among the six case studies with highest, medium and lowest density. Therefore Dalgarno Gardens and World's End Estate are denoted as high density neighbourhoods, Parkview and Holybrooks as medium density and New Marston and Thames Street housing as low density. It

should be noted that the terms high, medium and low density housing used in UK government guidelines are different (DETR, 1998c; 2000b)

Cases	Density and form	Location	Dwellings (N)	Average density Dwellings/ ha	Site coverage %
New Marston	Low density low rise	Oxford	522	25	15
Thames street	Medium density low & medium rise	Oxford	264	48	17
Parkview	High density high & medium rise	London	420	95	10
Holybrooks	Medium density med-high rise	Reading	404	108	26
Dalgarno Gardens	High density medium rise	London	361	162	25
World's End	High density high rise	London	744	271	56

Table 5.1 Building density

Cases	No. of dwellings	Site area (in hectares)	Crowding (Form survey)			Crowding
			Adult	Children	Total	(2001 census)
New Marston	522	20.88	2.21	0.5	2.71	2.4
Thames Street	264	5.46	1.83	0.43	2.23	2.2
Parkview	420	3.98	1.56	0.67	2.22	2.4
Holybrooks	404	3.75	1.63	0*	1.63	1.9
Dalgarno Gardens	361	2.23	2.00	1.0	3.00	2.3
Worlds End	744	2.75	2.00	0.13	2.13	2.0

Table 5.2 Molecular density or household crowding (persons / dwelling)

New Marston in Oxford, a low-rise neighbourhood, has the lowest density of the six case study areas, with an average building density of 25 dwellings/ha. The high rise World's End Estate in London, with 271 dwellings/ha, has the highest density. Population follows a similar trend, starting with 67.6 persons/ha in New Marston, rising to 576.87 person/ha in World's End. Population density was calculated from answers to Q32 of the questionnaire, and was found to be comparable to that calculated from census data.

According to the questionnaire responses, the percentage of children in a neighbourhood (molar density) was found to be highest in Parkview and Dalgarno Gardens, at 30% of the total population, whereas in Holybrooks none of the respondents had children (Table 5.3). However, to verify child population density in Holybrooks by comparing it with census data was not possible as the boundaries of census enumeration districts include other housing areas on the west side of the

estate, which may give a false picture. Children's molecular density or the densities of children per household are also comparable, being highest in Parkview and Dalgarno Gardens (Table 5.2).

Cases	Molar density		Children's molar density
	Based on the survey	Calculated from Census 2001	Survey
New Marston	67.63	59.89	12.48 (19%)
Thames Street	107.90	106.45	20.81 (19%)
Parkview	210.75	227.84	63.61 (30%)
Holybrooks	175.84	204.97	0* (0%)
Dalgarno Garden	485.29	372.06	161.76 (33%)
Worlds End	576.87	541.66	35.21 (6%)

Table 5.3 Molar density (persons/hectare)

(* none of the respondents had children)

5.4 Fieldwork data

The aim of the fieldwork was to collect all the primary data (density and social interaction variables) discussed in chapters 2 and 3. This was done through two main methods: first, an observation survey of the neighbourhood to map social activities, and documentation of building layout, land use and form was conducted; second, a questionnaire to map social networks and to assess perceptions of social networks, spaces, and physical qualities of neighbourhood was carried out.

Cases	Density and form	Dwellings	Total number of questionnaires	No. of call back	Responses	
		(N)	(N)	(days)	(N)	%
New Marston	Low density low rise	522	181	2	59	33
Thames Street	Medium density low & medium rise	264	172	3	54	31
Parkview	High density high & medium rise	420	191	2	19	10
Holybrooks	Medium density med-high rise	404	182	2	36	20
Dalgarno Gardens	High density medium rise	361	153	3	27	18
World's End	High density high rise	744	372	2	12	3
Total			**1251**		**207**	**17**

Table 5.4 Case study locations, no of households, and response to the questionnaire

Table 5.4 shows the number of questionnaires dropped in each neighbourhood and the response rate in each case. It also shows that the response rate was generally lower in neighbourhoods of higher density in larger cities compared to that in suburbs and small towns.

Table 5.5 shows the general trends and feedback from the questionnaire. While there is much similarity among the neighbourhoods in terms of perception of quality of the built environment, respondents from Holybrooks, Dalgarno, and World's End estate referred to their neighbourhoods as being of higher density, or medium or high rise area. In the perception of friendliness of neighbourhoods there were some distinct differences; for example Holybrooks residents reported less community spirit and more unfriendly neighbours than those in other neighbourhoods. Residents in this estate recorded a lower number of perceived social contacts and friendships within the neighbourhood. There were also noticeable differences in income and length of stay in the six neighbourhoods. While Holybrooks reported the highest average household income among the six neighbourhoods, Dalgarno Gardens and Parkview estate had the lowest. Holybrooks also had the shortest average length of stay in the neighbourhoods (between 1-2 years) while New Marston had the highest (between 20-30 years).

Question 30 in the questionnaire asked respondents to map their social contacts, based on type of contact (strong contacts with each other, informal contacts, stop and chat, or recognise them in street etc) within the neighbourhood. Table 5.6 shows the average number of social contacts and their standard deviation in each neighbourhood.

	Marston	Thames Street	Holybrooks	Dalgarno Gardens	Parkview	World's End	Total	
Quality of built environment								
Quality of built environment	4	4	4	4	3	4	4	4=high 1=low (Median)
Satisfied with neighbourhood	4	4	4	4	4	4	4	
Safety of neighbourhood	3	3	3	3	2	3	3	
Quality of life	4	4	4	3	4	4	4	
Quality of housing	4	4	4	3	4	4	4	
Condition of buildings	4	4	4	4	4	3	4	
General appearance of neighbourhood	4	4	4	3.5	3	3.5	4	
Condition of public spaces	2	3	4	3.5	3	4	3	
Public transport	4	4	4	3	3	4	4	
Public facilities	3	4	3	2	4	4	4	
Sports and recreational facilities	3	3	2.5	2	3	4	3	
Facilities for children/young people	2	2	2	2	2	3.5	2	
Local shops	4	4	4	3.5	3	4	4	
Density of neighbourhood	3	3	4	4	3	4	3	
Height of local buildings	1	2	2	2	3	2	2	
Friendliness of neighbourhood								
Community spirit in neighbourhood	1	1	0	1	1	1	1	1= yes 0 = no (Median)
Importance of community spirit	1	1	1	1.5	1	2	1	
Friendliness of neighbourhood	3	3	2	3	3	3	3	3= high 1= low (Median)
Feel at home	1	1	1	1	1	1	1	
People you know in neighbourhood	3	2	1	2	2	2	2	
Friend and relatives in walking distance	2	1	1	1	1	1.5	1	
Friend and relatives in the neighbourhood	1.5	1	0	1	2	2	1	
Friends made by living in this neighbourhood	2	2	0	1	1	2	1	
Neighbours you visit	1	1	0	1	0	1.5	1	
Neighbours you chat with on the street	2	2	1	2	2	2	2	
Neighbours you greet in the street	3	2	1	2	2	2	2	
Privacy from neighbours	3	2	3	2	3	3	3	
Privacy from passers-by	2	2	3	2.5	3	2.5	2	
Irritated by neighbours	0	1	0	1	0	1	0	1= yes, 0 = no
Tenants' association	0	1	0	1	0	1	1	
Membership of tenants' association	0	1	0	0	0	1	0	
General information								
Household income	20	27	40	<15	<15	20	20	In £0000s (Mean)
Length of stay in this house/flat	20-30	5-10	<1	10-20	5-10	10-20	5-10	In years (Mean)
Length of stay in this neighbourhood	20-30	5-10	1-2	10-20	10-20	10-20	10-20	

Table 5.5 Responses to the questionnaire survey

Note: all the values shown are median score except in case of income, and length of stay where it is the mean value

Cases		Adults			Children		Household contacts (N)
		Social visits	Informal contacts	Recognisable neighbours	Social visits	Informal contacts	
New Marston	Mean	2.58	12.28	3.33	0.81	0.36	19.36
	N	36	36	36	36	36	36
	Std. deviation	2.687	15.349	6.178	1.833	1.199	18.268
Thames street	Mean	3.38	7.63	2.4	0.2	0.13	13.73
	N	40	40	40	40	40	40
	Std. deviation	5.123	9.689	4.319	0.648	0.516	14.295
Parkview	Mean	1.15	3.15	1.62	0.62	0.38	6.92
	N	13	13	13	13	13	13
	Std. deviation	1.068	4.16	3.015	0.961	0.65	8.026
Holybrooks	Mean	0.63	1.29	1.33	0	0	3.25
	N	24	24	24	24	24	24
	Std. deviation	0.875	1.681	1.926	0	0	3.124
Dalgarno Gardens	Mean	1.38	2.92	1.92	0.15	0.46	6.85
	N	13	13	13	13	13	13
	Std. deviation	1.121	3.546	3.662	0.376	1.127	8.061
Worlds End	Mean	1.44	1.89	0.89	0	0	4.22
	N	9	9	9	9	9	9
	Std. deviation	1.944	1.833	1.616	0	0	4.086
Total	Mean	2.14	6.47	2.24	0.35	0.21	11.41
	N	135	135	135	135	135	135
	Std. deviation	3.346	10.497	4.342	1.095	0.795	14.102

Table 5.6 Average social contacts and standard deviations

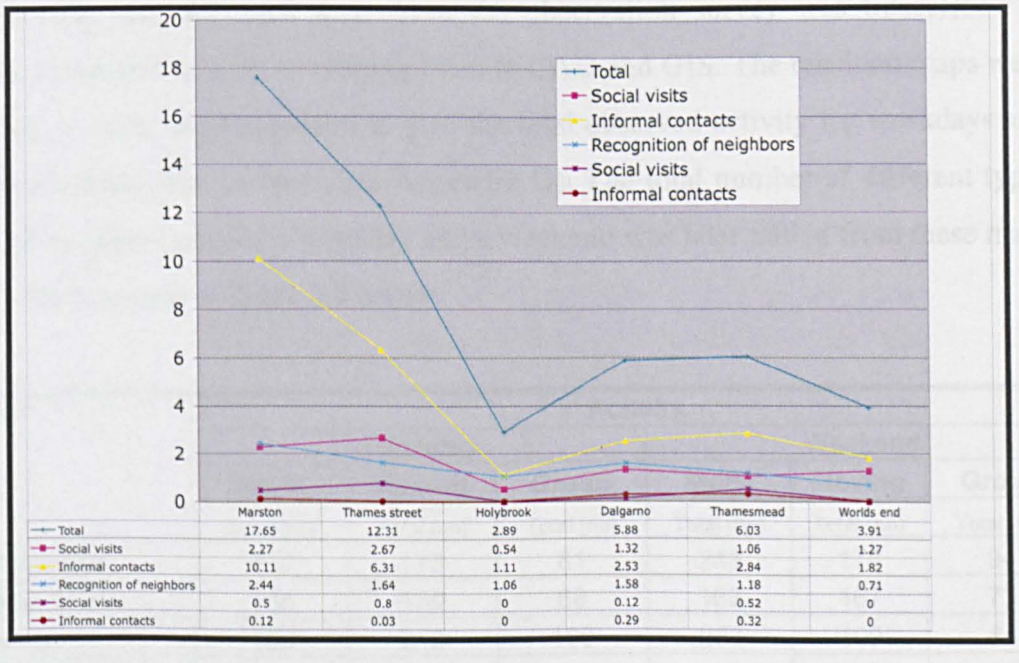
Cases	No of responses	Adults (Mean value)			Children's (Mean value)		Total no of social contacts
		Social visits	Informal contacts	Recognisable neighbours	Social visits	Informal contacts	
New Marston	36	2.27 (13%)	10.11 (57%)	2.44 (14%)	0.5 (3%)	0.12 (1%)	17.65
Thames Street	40	2.67 (22%)	6.31 (51%)	1.64 (13%)	0.8 (6%)	0.03 (0%)	12.31
Parkview	13	1.06 (18%)	2.84 (47%)	1.18 (20%)	0.52 (9%)	0.32 (5%)	6.03
Holybrooks	24	0.54 (19%)	1.11 (38%)	1.06 (37%)	0 (0%)	0 (0%)	2.89
Dalgarno Garden	13	1.32 (22%)	2.53 (43%)	1.58 (27%)	0.12 (2%)	0.29 (5%)	5.88
World's End	9	1.27 (32%)	1.82 (47%)	0.71 (18%)	0 (0%)	0 (0%)	3.91
Total	135	2.14 (19%)	6.47 (57%)	2.24 (20%)	0.35 (3%)	0.21 (2%)	11.41

Table 5.7 Average social contacts (excluding outliers)

Note: figure in the bracket indicate percentage of total social contact

Due to the high standard deviations, 5% of the top and bottom range of data were trimmed to get the values in Table 5.7. This trimmed dataset holds the key values used for further analysis described in Chapter 6. A simple distribution of the average total contacts (see last column in Table 5.7) shows that, in general, social contacts were fewer in neighbourhoods with higher densities (see Fig. 5.7).

The total number of social contacts was highest in the lower density neighbourhoods (between 12-18). It was also observable from the data that total number of all other types of contact except informal contacts (chats on the street) is relatively small; hence the total number of social contacts has a comparable pattern to that of informal contacts generally (see Table 5.7 & Fig. 5.7). In general, the higher density areas seem to have a larger percentage of stronger social ties (those who visit) than lower density neighbourhoods. In all the six neighbourhoods, number and percentage of contacts (both formal and informal) among children are relatively small (maximum 3%), and thus has little influence on the average social contacts per household.



	Marston	Thames street	Holybrook	Dalgarno	Thamesmead	Worlds end
Total	17.65	12.31	2.89	5.88	6.03	3.91
Social visits	2.27	2.67	0.54	1.32	1.06	1.27
Informal contacts	10.11	6.31	1.11	2.53	2.84	1.82
Recognition of neighbors	2.44	1.64	1.06	1.58	1.18	0.71
Social visits	0.5	0.8	0	0.12	0.52	0
Informal contacts	0.12	0.03	0	0.29	0.32	0

Fig. 5.7 Distribution of different types of social contact in each neighbourhood (without outliers)

From Fig. 5.7 it could be argued that the relationship of density to social interaction is linear and negative, but the reasons for this trend are not so clear-cut when this is looked at in relation to socio-demographic characteristics as well as spatial qualities

of the neighbourhoods. Chapters 6 and 7 look at this observed phenomenon more carefully through statistical and spatial analyses to ascertain how important are the physical qualities of a neighbourhood in comparison to socio-demographic characteristics for increasing social relationships and interaction in neighbourhoods.

Individual responses show a great degree of variation, especially in answer related to social interaction, social networks, contacts, and friendships. Due to this there are large standard deviations as previously mentioned. The category of contact with the highest standard deviation is informal contact (chats on the street, recognising people). The reason for this disparity in responses may be because these types of contact are likely to reflect individual personality traits and individual differences. Hence in this research these values were handled with caution, and individual cases were not used to draw conclusions.

5.4.1 Observation survey

Observation data for each hour from the observation survey was transcribed as electronic spatial data by converting them to CAD and GIS. The resultant maps were overlaid in each neighbourhood to give the total observed activity for weekdays and weekends from 8am to 7pm (See Appendix G). The total number of different types of activity observed over a weekday and a weekend was later tallied from these maps and is summarised in Table 5.8 below.

Cases	Activity					
	Weekday			Weekend		
	Static	Moving	Group	Static	Moving	Group
	Total (no)	Total (no)	Total (no)	Total (no)	Total (no)	Total (no)
New Marston	212	173	81	243	174	94
Thames Street	135	130	68	163	167	77
Parkview	363	212	130	237	109	84
Holybrooks	71	205	54	43	149	53
Dalgarno Gardens	122	117	31	154	184	43
World's End	279	389	99	218	248	92

Table 5.8 Number of observed social interactions, activities and pedestrian movements between 8am and 7pm

Total number of social interaction (groups) was found to be highest in New Marston, Parkview and World's End Estate (between 80-85 per day) during the weekend. In Parkview and Worlds End Estate a typical weekday had more social interaction (between 100-130) than weekends (between 85-90). These two neighbourhoods were also found to have the highest number of pedestrian and static activities on a weekday, and both were higher than at the weekend. In terms of comparison of number of weekday and weekend social activities (all types of observed activities) New Marston, Thames Street and Dalgarno Gardens have a higher number of activities during a weekend than on weekdays, whereas the other three cases it weekday activities were higher.

The observation survey also validated the accuracy of, and, at times, updated the ordnance survey maps. It was used to map building heights, land use and intricate pedestrian paths and common areas, especially in high density complex layouts. The maps thus updated were used for the spatial modelling and further analysis.

5.5 Spatial data from analytical computer models

5.5.1 Axial maps:

As explained in the methodology chapter, two axial models were developed in Axman for each case study: first a model to analyse each neighbourhood within its surroundings within a 10 minute walking radius (see Appendix I for axial maps), to analyse the spatial configuration and spatial linkages the neighbourhood has with its context; second a more detailed model to examine all the spaces within the neighbourhood and their relationships to each other.

From the axial models of global and local integration, intelligibility (correlation between connectivity and global integration) and synergy (correlation between local and global integration), values of each neighbourhood were calculated for their comparison with social variables.

From the second model where all the spaces within the neighbourhood that are accessible to the residents were modelled, the spatial variables give very different

results (Table 5.9 summarises the resulting global and local integration values along with intelligibility and synergy). For example, Dalgarno Gardens had the highest global integration value in the simplified axial model of a neighbourhood and its surrounding, but when all the spaces in all levels and the complex connections between them were modelled, the estate had the lowest global integration value among the six cases. The reasons for and implications of these results are discussed in Chapter 7.

Cases	Axial model of all spaces within 10 minutes walk from centre of neighbourhood				Axial model of spaces within neighbourhood				
	Space inside the neighbourhood		All spaces within a 10 min walk						
	Global Integration	Intelligibility	Global Integration	Intelligibility	Global Integration Rn	Local integration R3	Connectivity	Intelligibility	Synergy
New Marston	0.61	0.243	0.616	0.169	1.117	1.698	2.878	0.564	0.644
Thames street	0.74	0.302	0.714	0.290	0.889	1.655	2.850	0.408	0.629
Parkview	0.93	0.526	0.905	0.193	0.827	1.450	2.279	0.247	0.420
Holybrooks	0.80	0.239	0.868	0.419	0.697	1.195	2.189	0.324	0.621
Dalgarno Gardens	0.94	0.095	0.982	0.365	0.544	1.565	2.614	0.085	0.169
Worlds End	0.81	0.024	0.913	0.289	0.696	1.600	2.456	0.145	0.235

Table 5.9 The global and local integration, intelligibility and synergy values for each neighbourhood

In terms of configuration of main spaces within a neighbourhood, Dalgarno Gardens and Parkview Estate had the highest average global and local integration, but lower global integration values in detailed model of all spaces shows the spatial configuration of Dalgarno Gardens, World's End Estate and Holybrooks to be more complex.

5.5.2 Depth maps

The depth map program analyses the visibility graph (VGA) to model the visible integration of spaces within a neighbourhood. From the VGA model (see Appendix J for VGA maps for each neighbourhood) various spatial variables were derived to compare them with social interaction indicators. This comparison can be found in Chapter 7. The important variables identified for use in this research were visual

integration, controllability, mean depth, and clustering coefficient. Table 5.10 below shows the average value of these variables in each neighbourhood

Neighbourhood	Visual Clustering Coefficient	Visual Control	Visual Controllability	Visual Entropy	Visual Integration [HH]	Visual Mean Depth	Density (building)	Av social contacts
New Marston	0.8038	0.9999	0.2826	2.2017	4.6162	3.4841	25	17.17
Thames street	0.7892	0.9999	0.3186	2.8312	3.2133	5.2324	48	11.71
Parkview	0.7827	0.9999	0.3088	2.4846	4.3114	4.2677	95	5.55
Holybrooks	0.7995	0.9994	0.3180	2.8181	3.2284	5.1468	108	4.33
Dalgarno Gardens	0.7878	0.9999	0.3068	2.6472	3.7378	4.5698	162	2.80
World's End	0.7806	0.9999	0.3857	2.9541	2.4457	6.1222	271	4.22

Table 5.10 Average values for variables from visibility graph analysis

In terms of average visual integration of all spaces in the neighbourhood, World's End Estate had the lowest value while New Marston had the highest. World's End also had the highest mean visual depth, Whereas in terms of visual control and visual clustering co-efficient (see Table 7.2 for definitions) all six cases seem to be comparable.

Using the GIS (Mapinfo) program, all the data from the questionnaires, observations, and spatial models (Depthmap and Axman) were assembled to analyse the significance of the location of the dwellings within the neighbourhoods. In this analysis, various locations were analysed to show the type of responses people from particular locations gave to the questionnaire. This was overlaid on the observation survey data to show the intensity of visible social congregations in those locations. The final consolidated geographic dataset also consists of an overlay of spatial data from Depthmap and Axman. This computer-generated data, as explained before, show the significance of each location within the neighbourhood in terms of its relation to the other spaces (either physically or visually connected) within it and with the immediate locale of the neighbourhoods. The consolidated dataset was later used to identify correlations between the variables and their relationship to spatial attributes of locations.

5.5.3 Data from secondary sources

As mentioned before (Section 4.3), data was also collected from many secondary sources. The key sources include Ordinace Survey maps on a 1:1250 scale (Source: Digimap, www.edina.ac.uk) which form the base maps for surveys, calculations of density (Table 5.1), building form and open space to built form ratio or coverage (Table 5.1) as well as for spatial analysis, and 2001 UK Census data for population density (e.g. Table 5.2 and Table 5.3)

Detailed Ordnance Survey maps were also used as the base maps during the pilot surveys to select the case study neighbourhoods as well as to plan the fieldwork, observation survey and to map the social networks. To verify or triangulate the population and housing density figures, neighbourhood statistics data available from the 2001 Census (National Statistics, 2005a) were used. Other housing perception and opinion surveys, such as the English Housing Survey, were used to compare perception of the physical environment of local areas with responses to the questionnaires returned in this research.

5.6 Conclusion

The data from the both fieldwork and desk study is compiled and presented in this chapter. The data reflected general perceptions of the quality of built environment as well as the social characteristics of the neighbourhoods. There was some similarity in the social and physical characteristics of the neighbourhoods; there were also some distinct differences. The similarity was predictable due to the various criterion used for selection of the case studies, intended to control some of interfering variables.
Fieldwork generated a huge amount of data, therefore only the most relevant and simplified dataset is presented in this chapter. There was a good response to the questionnaire in Oxford and Reading, but the response rate from case study neighbourhoods in London were poorer. However, due to multiple indicators for social interaction, density and other social and demographic variables, the dataset was expected to be reliable.

In the questionnaire responses there were many similarities in the perception of density, quality of neighbourhood, and perception of friendliness within each neighbourhood, as well as in comparison to other neighbourhoods (see Table 5.5) However, there were considerable variations and differences in individual cases within each neighbourhood, especially in how many social contacts respondents had. These variations are predicted to be significant, as there were, in some case study neighbourhoods, very high standard deviations (Table 5.6), especially in the number of social contacts each household reported.

Social interactions in public spaces mapped through the observation survey were digitised to GIS and CAD platforms (see Appendix G) and collated (see Table 5.8). This data was analysed and correlated with spatial data from Axial and VGA models described in Table 5.9 and Table 5.10. In the spatial data there were some significant differences in global, local and visual integration pattern in the six case studies. Those with more complex layouts were found to be lest integrated locally and visually, but in two case studies where they had lower integration values, the configuration of spaces at ground floor level was higher in the axial model of all spaces within 10 minutes from the case study neighbourhoods.

Chapter 6 interrogates the data in more detail, to examine the relationship between the density of the six neighbourhoods and the degree of social integration Chapter 7 examines the spatial configuration and its influence on social interaction.

Chapter 6

Density and social interaction

6 Density and social interaction

6.1 Introduction

This chapter presents the findings from the first part of the analysis. The aim of this primary analysis was to establish the relationship between the key variables of social interaction and density, using statistical methods. Thus the intention was to answer two of the three research questions raised at the beginning of this research. These questions were:

- Is there a relationship between the density of the built environment and the degreee of social interaction in residential areas of cities?
- If so, what is the extent and nature of social interaction, and how far is it influenced by various types of density?

As discussed in Chapter 4 (methodology), the statistical analyses used for this research used SPSS and STATVIEW, both reliable statistical analysis programs often used in sociology, planning and psychology research. Key variables of density (see Table 6.1), social interaction (Table 6.2) and interfering variables (Table 6.3) were correlated in the analyses and tested for significant associations, as well as for their non-associations.

Density
Physical density
Neighbourhood density (building density of neighbourhood excluding all other land use but including internal road + 50% of adjoining street)
Population density (person/ha and) gross (census) and net (survey)
Coverage (ratio of built-up to open, exclude temp buildings such as garden sheds)
Perceived density
Perceived density (Q6)
Perceived building form (Q7)
Perception of privacy (crowding- Q24 and 25) Persons/household
Note: measurable aspects of crowding are included as part of other density variables for e.g. coverage, population density, and privacy.

Table 6.1 List of key variables of density

Social contacts
Quantity and type
Proportion of social contacts (Ratio: total social contact to total no of households)
Perceived contacts (Q17-23)
No. of people whom you know
No. of people you visit
No. of people you talk to
No. of people you recognise
Type of social network formed (friends or relatives)
Social interactions in public space
Group activities (standardised to unit area)
Static activities (standardised to unit area)
Friendliness of neighbourhood (to indicate how many people whom they might know)
Participation in community, membership in residents association

Table 6.2 List of key variables of social interaction

(Figures in the bracket indicate the question number on questionnaire see Appendix A and E)

Demographic characteristics
Number and age of residents
Household income
Employment
Length of stay in the neighbourhood
Ownership of property
Social capital
Satisfaction with neighbourhood
Community spirit
Annoyance with neighbours
Quality of life

Table 6.3 List of interfering variables

6.2 Statistical analysis protocols

The statistical procedures used in this analysis stage included:

- ***Elimination of outliers***: a standard practice in statistical analysis, outliers were identified and deleted from the dataset before the correlation tests (Dancey, 1999). The number of social contacts, quantified from the network maps was found to be one of the key variables of social interaction and was used to screen the outliers. After excluding all the cases with no response for the social networks maps, a further 5% of cases on each extreme, i.e. with the lowest and highest values, were also excluded from the dataset. Excluding these exceptional cases usually gives more reliable standard deviations and mean and median values for each variable.
- ***Correlation and significance testing:*** An initial investigation of correlations used two-tailed bivariate correlation tests to identify significant relationships

between all density, social interaction and interfering variables. Results from these tests were manually screened to exclude irrelevant correlations.

- ***Test procedure:*** Scale variables were tested with Pearson's correlation test, whereas ordinal variables or a combination of ordinal and scale variables were tested using both Pearson's and Kendall's correlation tests. In this research, a test resulting in a *p*-value of less than 0.05 was considered to be evidence of a significant relationship. This is the case in most built environment and sociology research.
- ***Selection of key indicators or measures:*** In all cases with more than one indicator for an individual factor (e.g. density: building, population, perceived), either the most reliable indicator or a general trend shown by all indicators was used. These are described in relevant sections in this chapter.
- ***Normalisation:*** normalisation, like standardisation, is a procedure to transform data to allow comparisons of different datasets. Unlike standardisation, which standardises the units of measurement, normalisation involves dividing or multiplying a variable by a constant to reduce the effect of large standard deviations. Some of the scale variables, such as social contact and social interaction, were normalised either by dividing them by the site area of the neighbourhood, or the land area of public and semi-private spaces, or by the total number of households. This removed the effect of size of neighbourhood from the dataset of each neighbourhood, allowing them to be compared across the datasets.
- ***Testing for nonlinear relations:*** when a significant relationship was not found where it was expected from primary analysis, tests such as curve estimation and non-linear regression tests were used to identify possible nonlinear relationships.
- ***Multiple regression:*** Multiple regression analysis and partial correlation tests were used to assess the influence of interfering variables on the relationship between social interaction and density.
- ***Partial correlation:*** This was used to examine the relationship between density and social interaction by controlling an interfering variable. This analysis provided an opportunity to assess the effect on social interaction of each interfering variable independently.

6.3 Summary of overall findings

Is there a relationship between density and social interaction?

The total number of social contacts a household had was found to be significantly lower in high density neighbourhoods than in low density neighbourhoods. However, when social contact was normalised using the site area of the neighbourhood, the relationship with density of the neighbourhood was not significant. Normalised social contact had a nonlinear relationship with density, and was found to be highest in neighbourhoods or parts of neighbourhoods with a density of 70-80 households per hectare. The analyses carried out to reach these findings are discussed further in Section 6.4.1.

Normalised social interactions in public spaces were found to show an opposite trend to social contacts: they tended to increase with density. However, when the total number of social interactions per household (normalised using number of households) were compared, the highest number of social interactions was found in medium density neighbourhoods. Analysis is outlined in more detail in Section 6.4.1.

What is the extent and nature of this relationship?

Looking at the nature of social contacts in the six neighbourhoods of various density, it was observed that residents of low density neighbourhoods had a high percentage of informal friendship within their total contacts, while residents in high density neighbourhoods had a high percentage of formal contact within their total contacts. Section 6.4.2 describe the analysis and data in more detail.

Observed social interaction in public and semi-private spaces showed different trends in lower and higher density neighbourhoods. Social activities appeared to be higher at weekends in high density neighbourhoods, in contrast to low-density neighbourhood where the opposite pattern was present. Section 6.4.2 describes the analysis in more detail.

Various interfering variables (see Table 6.3) were used as regressors in a multiple regression analysis to observe their effect on the relationship between density and social interaction. Accessibility to the property, community spirit and length of

occupancy in a neighbourhood were found to be the important factors that affected social interaction in a higher density neighbourhood. These factors were also found to be important in a partial correlation test, where the relationship was significantly changed from that found in using direct correlations (see section 6.4.3). Spatial factors such as access to property are discussed in detail in Chapter 7.

6.4 Description of analysis

6.4.1 Is there relationship between density and the amount of social interaction in urban neighbourhoods?

Total number of social contacts (Ego network data), visible social interaction, and other indicators of social interaction and density measures (see Table 6.1) from six urban neighbourhoods in the southeast of England (see Appendix D) were statistically analysed to verify the relationships between density and social interaction

Building density and social contact

This section examines the relationship between building density and the amount of social contact in the six neighbourhoods. On comparing the total number of social contacts in these neighbourhoods, those with higher building density had a significantly lower number of social contacts (see Table 6.4) within their neighbourhoods.

A correlation test showed a significant negative correlation (Pearson's correlation coefficient: -0.357, *p*-value: 0.0001) between density and number of social contacts. This negative significant relationship was rather surprising, being opposite to the positive relationship predicted by some of the literature on density and social contacts (see Chapter 2 and 3).

Case	Adults			Children		Total social contacts (mean)	Total informal social contacts (mean)
	Social visits (mean)	Informal contacts (mean)	Recognisable neighbours (mean)	Social visits (mean)	Informal contacts (mean)		
Marston	2.6	10.3	3.4	0.8	0.4	17.2	14.1
Thames street	2.8	6.3	2.3	0.2	0.1	11.7	8.7
Parkview	1.2	2.0	1.6	0.6	0.3	5.6	3.8
Holybrooks	0.6	1.2	2.6	0.0	0.0	4.3	3.8
Dalgarno Gardens	1.2	0.4	0.6	0.4	0.3	2.8	1.3
World's End	1.4	1.9	0.9	0	0	4.2	2.8

Table 6.4 Different types of social contact per household

Note: the difference in the number of social contacts from Table 5.7 is due to the elimination of outliers from the dataset used at this stage.

In light of this, the data was further refined by dividing it into measures for each well-defined area within those neighbourhoods that have different building densities and layouts (Marston, Thames Street and Parkview). This redistributed density variable was again correlated with the total social contact, but the result was found to be identical to that using average density for each neighbourhood (Pearson's correlation coefficient: -0.365, *p*-value: 0.001). The results thus indicate a significantly lower number of social contacts in higher density neighbourhoods in comparison to those in low-density neighbourhoods.

Building density and normalised social contact

In order to establish whether the relationship between building density and social interaction was affected by the size of the neighbourhood, the variables for total social contacts was normalised to match the size of the neighbourhood. This was done by dividing the total number of social contacts by the area of the site as well as by the total number of households in the neighbourhood (see Table 6.5).

When the social contact variable was normalised by dividing the number of social contacts by the number of households in the neighbourhood, (ratio of number of social contacts to the total number of households in the neighbourhoods) and compared with building density, the result was again consistent; that is, neighbourhoods of higher building density had a lower ratio of social contacts (Pearson's correlation coefficient: -0.374 *p*-value: <0.01). However, when the social

contact was normalised by the area of the site, the correlation test gave a Pearson's correlation coefficient: -0.083 (*p*-value: 0.38). The small R-value suggests that the relationship between normalised social contact (area of site) and building density is weaker.

	Total informal Social contacts	Site area	Normalised Social contacts	Total number of dwellings	Normalised Social contacts
	(N)	Hectare	(a)	(N)	(b)
Marston	14.1	20.88	0.93	522	3.71
Thames street	8.7	5.46	2.52	264	5.20
Parkview	3.8	3.98	1.74	420	1.83
Holybrooks	3.8	3.75	1.00	404	0.92
Dalgarno Gardens	1.3	2.23	0.75	361	0.46
World's end estate	2.8	2.75	1.54	744	0.01

Table 6.5 Normalised social contacts per household and average informal contacts/household

Note: (a): Social contacts normalised by site area
(b): Social contacts normalised by number of dwellings in the neighbourhood

Population density and social contact

The next set of analyses looked at the relationship between population density and social interaction. In this research, population density was estimated using data from the UK 2001 Census (National Statistics, 2005a) and from the responses to the questionnaire survey (see chapter 2). Both gross densities estimated from census survey and the net population density calculated from the questionnaire survey carried out for this research (net density) were initially correlated with the social interaction variable. Seen in their comparable values (Table 6.6), both indicators of population density gave similar results. Hence, in further analysis the gross population density measure from census data was mostly used as it represented a more reliable and comprehensive data source than the comparatively small survey carried out for this purpose of this research.

Cases	No. of Dwellings	Site area	Person per household (Questionnaire survey)			Person per household	No. of Children (Person/Ha)	Population density (Person/Ha)	
			Adult	Children	Total	2001 census (A)	Survey	Survey	Calculated from A
New Marston	522	20.88	2.2	0.5	2.7	2.4	12.5	67.6	59.9
Thames Street	264	5.46	1.8	0.4	2.2	2.2	20.8	107.9	106.5
Holybrooks	404	3.75	1.6	0	1.6	1.9	-*	175.8	204.9
Dalgarno Gardens	361	2.23	2.0	1.0	3.0	2.3	161.8	485.3	372.1
Parkview	420	3.98	1.6	0.7	2.3	2.4	63.6	210.7	227.8
World's End	744	2.75	2.0	0.1	2.1	2.0	35.2	576.9	541.7

Table 6.6 Population densities

(* no reliable data)

As discussed before (Chapter 2), population density an d building density can be independent of each other and thus social interaction can have different relationships with population density. To investigate this, population density was correlated with total social contacts. When population densities were correlated with social contacts, the results were comparable with those for building density (Pearson's correlation coefficient: -0.282, see Table 6.7) . Thus it was established that neighbourhoods with a higher population density had a lower number of social contacts per household; that is, the higher the population density, the lower the number of social contacts.

As the relationships between population and building density to social interaction indicators were found to be comparable or identical (Table 6.7) and the population density has a strong correlation with building density (R: 0.932, *p*-value: <0.01), building density, which is a net density measure, was used as the key density variable in the analysis and findings reported in the following sections. However, all statistical tests done in this research used both density variables, and any variations in findings between these variables are reported in relevant sections.

Social interaction	Total social contact	Normalised social contact	
		By no of dwelling	By area of the site
Building density	-0.357**	-0.374**	-0.083
Population Density	-0.282**	-0.336**	-0.047

Table 6.7 Relationship between density and social contacts

** *p*-value < 0.01

Density and visible social interaction in public space

As a part of the fieldwork, social interactions in public and semi-private spaces were mapped at every hour between 8am and 7pm on a weekday and on a weekend. The next stage in the analysis looked at the relationship between this mapped and quantified social interaction in visible spaces to the density of that neighbourhood, to verify that a similar trend emerges to that for social contacts. As described in Chapters 3 and 4, the social activities were mapped and quantified in public and semi-private spaces within the six neighbourhoods chosen for this research (Table 6.8). This mapping involved categorising the activity (sitting, standing, playing, moving), age of people (adult and child) as well as noting groups. While the groups involved in social activity are the most important indicator of social interaction in this research, individuals in static positions (sitting, standing) were considered individuals with potential for interaction. Hence they were also used in some of the statistical tests.

	Density	Area of public space	Weekday			Weekend		
			Static	Pedestrian	Social interaction	Static	Pedestrian	Social interaction
	Dwelling/ha	Hectares	(N)	(N)	(N)	(N)	(N)	(N)
New Marston	25	8.77	212	173	81	243	174	94
Thames Street	48	2.97	135	130	68	163	167	77
Parkview	95	3.36	363	212	130	237	109	84
Holybrooks	108	2.32	71	205	54	43	149	53
Dalgarno Gardens	162	1.53	122	117	31	154	184	43
World's End	271	2.65	279	389	99	218	248	92

Table 6.8 Total Observed social interaction, activities and pedestrian movement between 8am to 7pm

Before the correlation tests were carried out, the number of mapped social interactions (that is, observed of groups with two or more people in public and semi-

private spaces) was normalised by dividing number of social activities by the total area of the observed spaces. This converted these observed social interactions to the number of social interactions within a standard size of public space. This made possible comparison of the higher density compact neighbourhoods, which had less public open space, to more sprawling suburban neighbourhoods. These average normalised social activities are summarised in Table 6.9.

The figures appear to suggest that social interactions are highest in higher density neighbourhoods (Table 6.9). This pattern was confirmed in a Pearson's correlation test, which showed neighbourhoods with higher densities to have a significantly higher number of social interactions within a unit area of observed space on both weekdays and weekends (R: 0.712 on weekends and 0.653 on weekdays *p*-value <0.05). This strong relationship is clearly seen in the scattergram of density and social activities (Fig. 6.1). Both pedestrian and static activities were also higher in neighbourhoods of higher densities. However, it was noticed that some of the higher density neighbourhoods (Holybrooks and Dalgarno Gardens) had a lower number of social groups in general, more noticeably so on weekends. This implies a lower number of social interactions in these two estates.

	Density	Area of public space	Weekday			Weekend		
			Static	Pedestrian	Social interaction	Static	Pedestrian	Social interaction
	Dwelling/ha	Hectares	(N)	(N)	(N)	(N)	(N)	(N)
New Marston	25	8.77	24.17	19.73	9.24	27.71	19.84	10.72
Thames Street	48	2.97	45.45	43.77	22.90	54.88	56.23	25.93
Parkview	95	3.36	108.01	63.08	38.68	70.52	32.43	25.29
Holybrooks	108	2.32	30.62	88.41	23.29	18.54	64.26	22.86
Dalgarno Gardens	162	1.53	79.94	76.34	20.17	100.83	120.47	28.15
World's End	271	2.65	105.43	146.94	37.36	82.26	93.59	34.72

Table 6.9 Observed social interaction, activities and pedestrian movement between 8am to 7pm (normalised by area of public space observed in fieldwork)

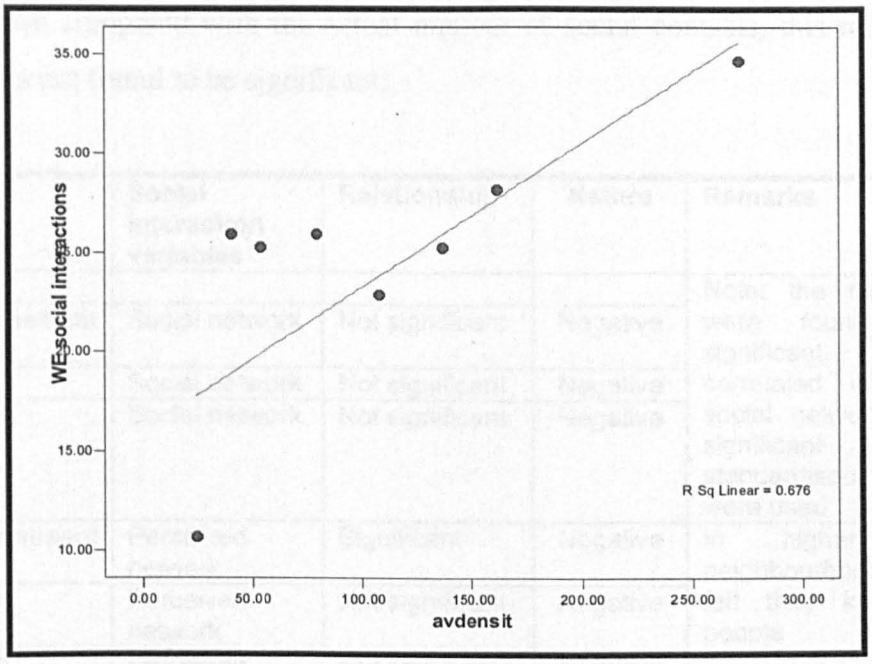


Fig. 6.1 Scattergram neighbourhood's building density and social interactions in public and semi-private spaces during weekends

Perceived density and social interaction

The literature on density suggests that the perception of density could be different from actual density and can affect social interaction (see chapter 2). Therefore statistical tests were performed to look at the correspondence between perceptions of density and social interaction and actual density and social interaction. Since perception of number of social contacts may be significantly different from actual social contacts, a simple correlation test between various perceived social contact variables and actual mapped social contacts was conducted. While there was some variation in individual responses, the correspondence between the set of responses was strong (p-value <0.05). To further support this, all the findings from correlation tests of perceived density and perceived social interaction showed a pattern similar to actual density and social contacts (see Table 6.10). The key observations are:

1. The perception of the number of people one knows in a neighbourhood seems to be reduced in neighbourhoods of higher density (R: -0.305 p-value: <0.01).
2. Correlations between perceived density and perceived social contacts were negative, but not significant.
3. Higher levels of privacy reported by individuals were found to correlate with perceptions of many social contacts (R: 0.191 p-value: <0.05). However,

when compared with the actual number of social contacts, this relationship was not found to be significant.

Density Variables	Social interaction variables	Relationship	Nature	Remarks
Physical				Note: the relationships were found to be significant when correlated with actual social network but not significant when standardised values were used
Built environment density	Social network	Not significant	Negative	
Coverage	Social network	Not significant	Negative	
Population density	Social network	Not significant	Negative	
Built environment density	Perceived network	Significant	Negative	In higher density neighbourhoods people felt they knew fewer people
Coverage	Perceived network	Not significant	Negative	
Population	Perceived network	Not significant	Negative	
Building	Observed social activity	Significant	Positive	Density of social activities increased in higher density neighbourhoods
Coverage	Observed social activity			
Population	Observed social activity	Significant	Positive	
Perceived				
Density (Q6)	Social network	Significant	Negative	Perceived higher densities seem to have a negative impact on actual number and proportion of social contacts
Building form (Q7)	Social network	Significant	Negative	
Privacy (Q24-25)	Social network	Significant	Positive	Encourages social network of formal type
Density (Q6)	Perceived network	Not significant	Negative	Only case of significant relationship is in perceived contacts within walking distance
Building form (Q7)	Perceived network	Significant	Negative	Higher building forms had more significant negative relationships with all types of perceived social contacts
Privacy (Q24-25)	Perceived network	Significant	Positive	Increased privacy seems to encourage higher social interaction
Density (Q6)	Observed social activity	Significant	Positive	Observed social activity in general is higher in higher density neighbourhood

Table 6.10 Summary: result of correlated statistical test between density and social interaction variables

(see Appendix E for significance test results and correlation coefficient)

Therefore it could be deduced that, while the actual number of social contacts seems to be lower in higher density neighbourhoods, the density of observed social interactions in public spaces seems to be higher in the higher density neighbourhoods. While this initial analysis looks contradictory and inconclusive, it was felt that further analysis might elucidate the findings. Furthermore, this test could also check the validity of the hypothesis that the number of social interactions may be a function of density. That is, social interaction increased in medium density neighbourhoods in comparison to low density neighbourhoods, but reduced in higher density neighbourhoods, due to perceptions of overcrowding and complicated social and spatial reasons associated with higher density neighbourhood layouts.

The optimum density for social interaction

This section examines the exact nature of the relationship between density and social contact, to establish whether the number of social contacts has a non-linear relationship with density, as hypothesised in Chapter 1. For this purpose, a detailed investigation of total social contacts and normalised social contacts was carried out by plotting each on a scattergram against density, in addition to computing curves for nonlinear relationships with cubic and quadratic equations to assess the type of relationship they might have.

From the scattergrams with normalised social contacts, it was evident that the relationship between total social contacts and density is not linear. To establish the exact nature of this relationship various types of regression lines (for example, linear, cubic, quadratic, and logarithmic) were considered to select the best fit (Fig. 6.2). On comparing the R^2 values it became evident that a regression curve with a cubic equation gave the best fit for the dataset.

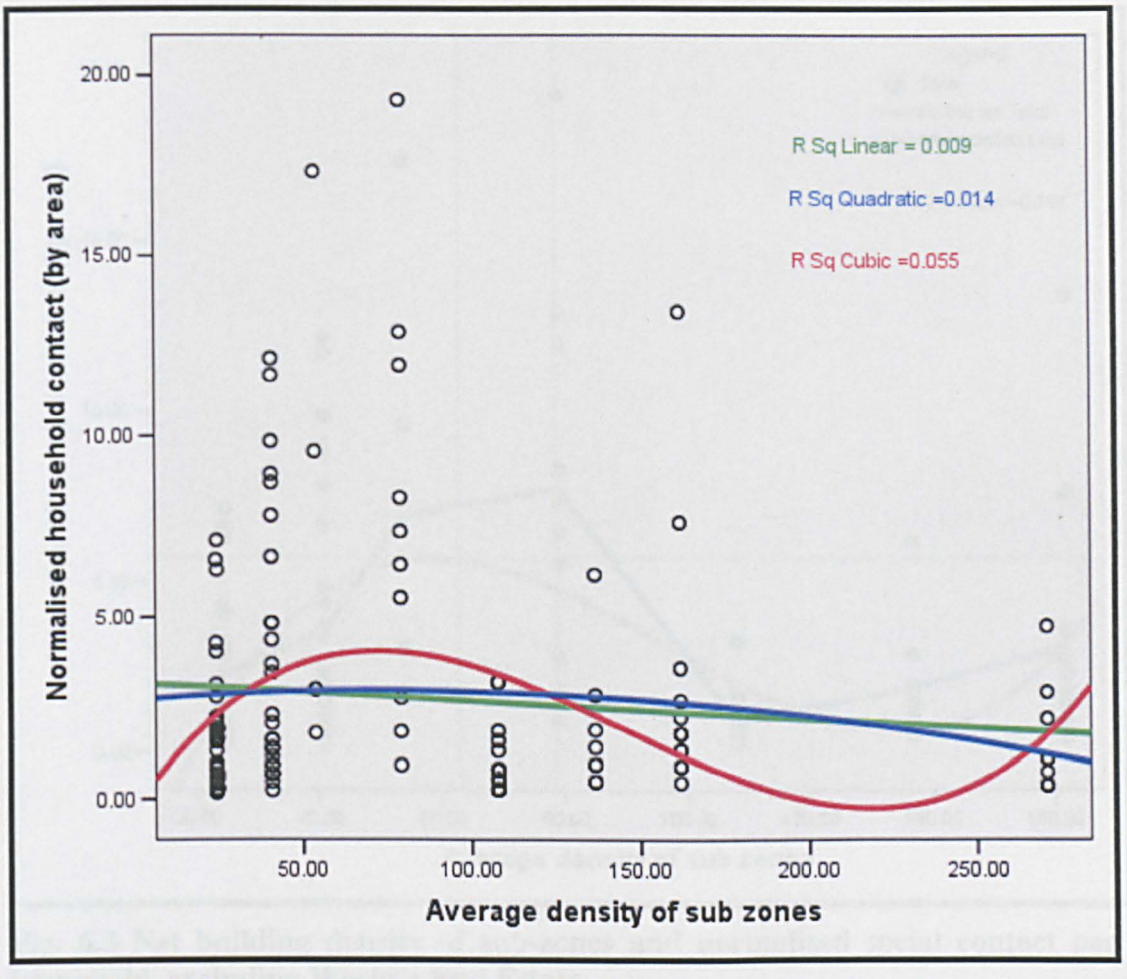


Fig. 6.2 Building density of neighbourhood and normalised social contact per household (Cubic)

Having established the nature of the regression equation, the next stage was to establish the optimal density, that is, the density that has the highest number of social contacts in the six neighbourhoods. The scattergrams suggested that the highest numbers of social contacts per household are in the medium density neighbourhoods or parts of them (Fig. 6.2), but a small number of cases from World's End Estate appear to create a confusing pattern. It can be noted that the trend line appears to go up again for the highest density. That is due to the limited and exceptional cases of responses to questionnaire (see chapter 5) from World's End Estate. Excluding these cases (Fig. 6.3), the trend becomes a better fit (R^2 value: 0.055 with World's End Estate, 0.181 without).

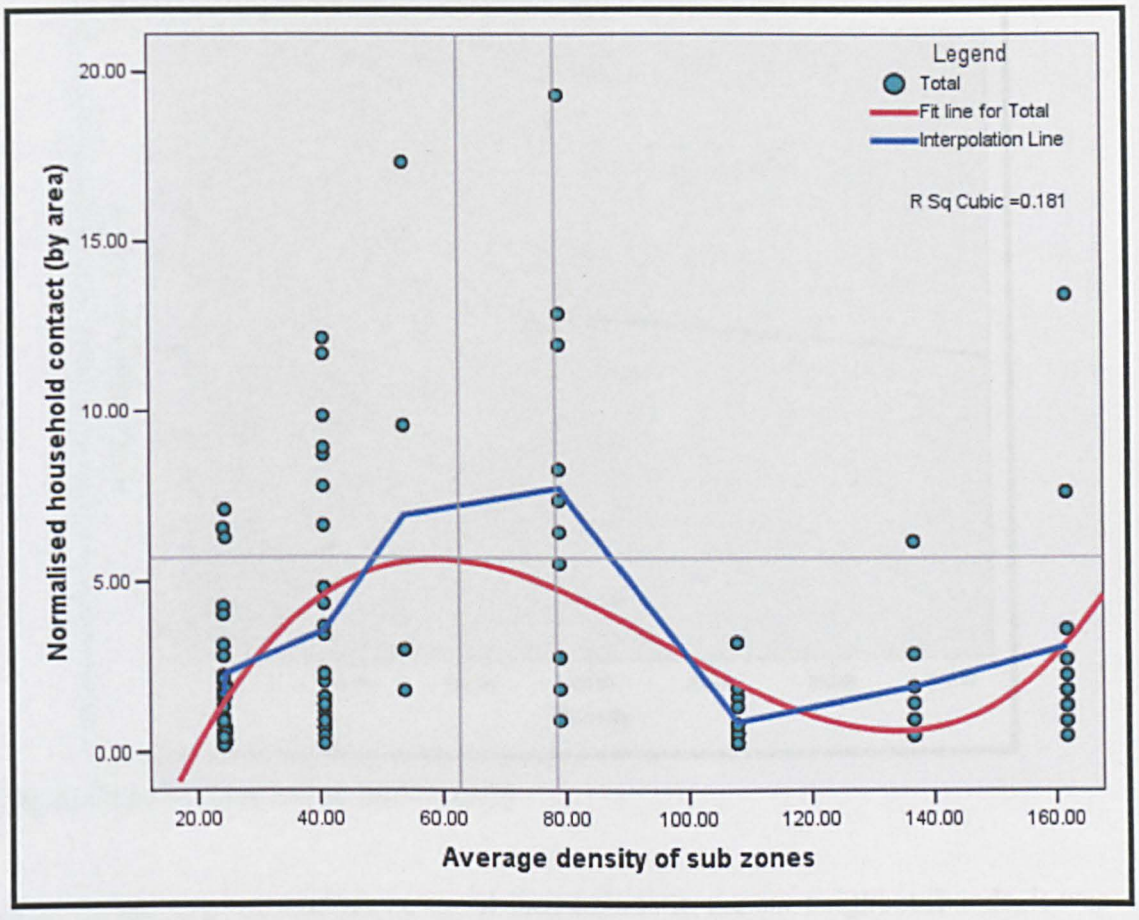


Fig. 6.3 Net building density of sub-zones and normalised social contact per household, excluding World's End Estate

When World's End Estate was removed from the dataset, data appear to be more consistent and a density of **70-80 households/hectare** was found to have the highest number of social contacts; extremes of densities seems to have fewer social contacts per household (Fig. 6.3). In considering this finding it should be kept in mind that there was a low response rate to the questionnaire in some of the very high density neighbourhoods and that some of the social and economic characteristics, such as average income and length of stay in the neighbourhood which could influence the formation of social ties in the neighbourhood, showed some differences among six neighbourhoods. Elimination of outliers and the location of respondents, which was spread within the neighbourhoods, made it possible to have confidence in the data.

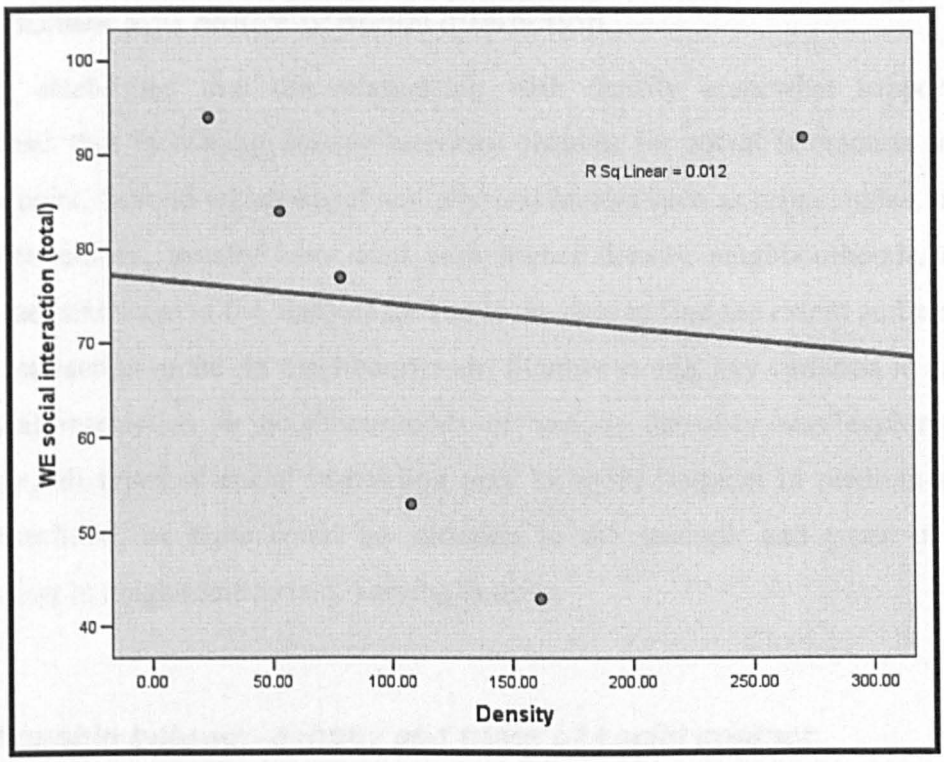


Fig. 6.4 Social interaction and density

After comparing the number of social interactions in the six neighbourhoods, it was noticed that with density above 100 households/hectare there was a considerably lower number of social interactions in public spaces. At weekends, the average number of social interactions was above 80 in neighbourhoods with a density below **100 households/hectare**. The value decreased considerably to below 55 interactions per day in neighbourhoods with a density above 100 households/hectare, with the exception of World's End Estate.

The comparison of the R^2 values of these curved regression lines showed that a cubic equation was found to fit the data better than a simple linear equation. The indications from two separate social interaction variables, that is, social contact and visible interaction in public space, made it possible to conclude that the relationship between density and social contact is not linear, and neighbourhoods in the six case studies with density between **70-80 households/hectare** seem to be the most conducive to social interaction.

6.4.2 Extent and nature of social interaction

Having established that the relationship with density somewhat supports the hypothesis that increasing density increases chances for social interaction up to a certain point, beyond which social and physical factors such as crime, noise, privacy and accessibility, usually associated with higher density neighbourhoods, reduce them, the next stage in the analysis looked at the data to find the extent and nature of social interaction in the six neighbourhoods. In other words, any variation in the type of social interaction in neighbourhoods of various densities was explored. For example, all types of social interaction may be more frequent in medium density neighbourhood, or there could be variation in the strength and types of social interaction in neighbourhoods of varying density.

Relationship between density and types of social contact

As seen before, the total number of social contacts per hectare (normalised total social contact) seems to be lower in high and low density neighbourhoods compared with medium density ones, in the six case studies (see Table 6.5). The weak association between density and normalised social contact may be due to lower number of informal contacts in neighbourhoods with either extreme of density.

Cases	Adults			Children	
	Social visit	Informal contact	Recognising neighbours	Visit	Chat in street
	% (A)	% (B)	% (C)	% (D)	% (E)
New Marston	13	64	17	4	2
Thames street	25	56	17	1	1
Parkview	16	46	23	9	6
Holybrooks	12	29	59	0	0
Dalgarno Garden	37	32	21	5	5
Worlds End	34	45	21	0	0

Table 6.11 Percentage of various types of social contacts within each neighbourhood

However, when different types of social contact, such as strong to informal contact, were compared in each neighbourhood, it was noticed that there were larger numbers of informal social contacts in lower density neighbourhoods (see Table 6.4). On comparing the percentage of total number of contacts each neighbour reported (Table

6.11), it became evident that lower density and more spread-out neighbourhoods had a higher percentage of informal contacts while the higher density and more compact neighbourhoods had larger proportion of strong relationships with neighbours among all contacts reported (see Table 6.12).

Cases	Total number of social contact within the neighbourhood (N)	Total formal contacts (N)	Total informal contacts (N)	Total formal contacts % (A+D)	Total informal contacts %(B+C+E)
New Marston	697	122	575	17	83
Thames street	549	144	405	26	74
Parkview	90	23	67	25	75
Holybrooks	41	5	36	12	88
Dalgarno Garden	19	8	11	42	58
Worlds End	38	13	25	34	66

Table 6.12 Percentage of formal and informal contacts

It also emerged that the layout of neighbourhoods was a significant factor that affects the number of social interactions. Neighbourhoods with a spread-out layout, such as Marston and Parkview reported about 15% (see shaded cells in Table 6.11) of their total contacts to be formal contacts between adults, whereas compact communities' formal contacts more than doubled to 37% (Dalgarno 37%; World's End Estate: 34%). An exception to this is Holybrooks Estate in Reading, where it was believed that the low response and low reported community spirit (see chapter 5) contributed to an exceptionally low number of social contacts per household (average household contact: 2.89).

In contrast, the percentage of total informal contact in spread-out neighbourhoods was more than three quarters of the total social contact (Marston: 83%; Parkview: 75%), whereas the figure for the compact neighbourhoods was found to be less than two thirds (Dalgarno 58%, World's End Estate: 66%). In low density neighbourhoods (both compact and spread layout), on average, adults had as much as, or more, informal contacts than they had formal contacts within the neighbourhoods (Marston: 64%; Thames Street: 56%), while in higher density neighbourhoods the adults' informal contacts accounted for less than half of total contacts (Dalgarno 32%, Parkview 46%, World's End Estate: 45%).

In summary, the evidence suggests a larger number of informal social contacts in low density neighbourhoods than in higher density neighbourhoods where social contacts were lower in number but with a larger portion of strong friendships among them. In high density neighbourhoods, it seems that people visit each other's homes for socialising, while in low density neighbourhoods they interact informally in public spaces. This might seem in contradiction to the earlier finding that higher density neighbourhoods had a larger number of social interactions in their public space, but it should be noted that the earlier finding considered the intensity of social activity per hectare of public space which is higher in a high density area, arguably due to a higher population in high density neighbourhood and the spread nature of public space in a low density neighbourhood.

Extent and nature of social interactions in public space

Social interactions during weekdays and at weekends were observed and then compared in various neighbourhoods. It was noticed that a slightly higher rate of social interaction happened in lower density neighbourhoods (New Marston and Thames Street) at weekends than weekdays, whereas higher density neighbourhoods generally saw a reduction in social interaction during weekends, with the exception of Dalgarno Garden where it increased (See Table 6.8, Table 6.9). The total number of static people showed a similar trend, that is, an increase during weekends in low density neighbourhoods and a reduction in high density neighbourhoods. This could be due to the fact that much of the social interaction in high density neighbourhoods may not be related to interaction between its residents, but between passers-by and other weekday users. Finding the increased rate of social interaction at weekends in Dalgarno Gardens supports this interpretation, as this estate does not have any important through route.

When the social interaction was normalised by the size of the neighbourhood, the average number of social interactions per household (observed social interaction divided by number of households in the neighbourhood) was found to be highest in New Marston, Thames Street and Parkview (between 0.18 to 0.20 interactions/household). On comparing it with the density of these neighbourhoods, it is obvious the neighbourhoods with densities between **50 and 100 households per**

hectare had the highest number of social interactions per household (see Table 6.13, Fig. 6.5). The figure was found to be lower on weekdays and weekends in both low and high density neighbourhoods in the dataset.

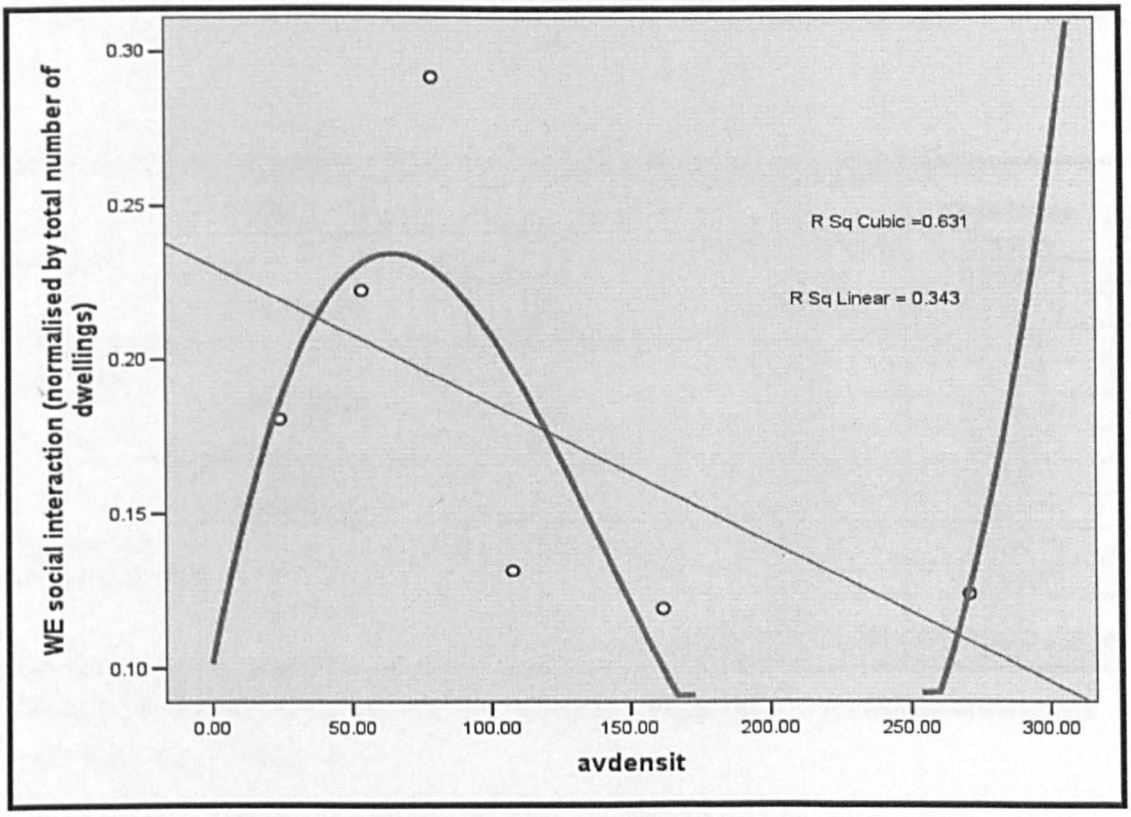


Fig. 6.5 Scattergram of normalised social interaction and density

Cases	Density	No. of dwellings	Weekday			Weekend		
			Static	Pedestrian	Social interaction	Static	Pedestrian	Social interaction
	Dwelling/ha	(N)	(N)	(N)	(N)	(N)	(N)	(N)
New Marston	25	522	0.41	0.33	0.16	0.47	0.33	0.18
Thames Street	48	264	0.51	0.49	0.26	0.62	0.63	0.29
Parkview	95	420	0.86	0.50	0.31	0.56	0.26	0.20
Holybrooks	108	404	0.18	0.51	0.13	0.11	0.37	0.13
Dalgarno Gardens	162	361	0.34	0.32	0.09	0.43	0.51	0.12
Worlds End	271	744	0.38	0.52	0.13	0.29	0.33	0.12

Table 6.13 Observed social interaction, activities and pedestrian movement between 8am to 7pm (normalised by number of households in the neighbourhood)

Further analysis using a test of significance revealed that total social interaction was found to have no significant relationship with density (Table 6.14). However, when normalised (by area of public space), social activity on weekends and on weekdays was found to have a significant relationship with density (Table 6.14). This suggests that social interactions were higher in high density neighbourhoods, as seen in Table 6.9.

	Day of observation	Activities	Av density of the neighbourhood	Population density
Total number of activities	Weekday	Static	0.246(*)	0.258(**)
		Pedestrian	0.805(**)	0.715(**)
		Social interaction	0.154	0.101
	Weekend	Static	-0.157	-0.075
		Pedestrian	0.524	0.536(**)
		Social interaction	-0.226	-0.246(*)
Normalised social activities	Weekday	Static	0.754(**)	0.768(**)
		Pedestrian	0.969(**)	0.901(**)
		Social interaction	0.696(**)	0.634(**)
	Weekend	Static	0.653(**)	0.744(**)
		Pedestrian	0.762(**)	0.794(**)
		Social interaction	0.712(**)	0.681(**)

Table 6.14 Density of social activity v density: Pearson's correlation coefficient

** p-value < 0.01, * p-value <0.05

Summary of findings

The key findings from the statistical analysis of social interactions in the neighbourhood are as follows:

1. Neighbourhoods with a density between **70-80 households per hectare** had the highest number of **social contacts** per hectare of land area.
2. Neighbourhoods with a density between **50-100 households per hectare** had the highest average number of **social interactions** per household.
3. Informal and loosely-knit social ties characterised the social relationships in low density neighbourhoods with a spread-out layout. However, in compact neighbourhoods, especially the one with least open space available within the neighbourhood, social interactions happened mostly indoors, probably through more frequent home visits (forming a higher percentage of visits, and a low number of interactions in public space).

4. While social activities seems to adapt to the conditions of a compact layout, including reduced public space in higher density neighbourhoods, the number of social interactions and social networks in general seem to be considerably lower in higher density neighbourhoods.

6.4.3 Intervening variables and social interaction

Chapters 2 and 3 discussed various social and physical factors that may influence the intensity and strength of social interaction in an urban residential area. The most important among them are (excluding individual factors):

Socioeconomic and demographic groups:

- Household income
- Employment
- Ownership of property
- Age groups (children/ adults)

Attachments and identity:

- Length of stay in the neighbourhood
- Sense of belonging
- Perception of safety

Social capital

- Satisfaction with neighbourhood
- Community spirit
- Quality of life
- Annoyance with neighbours
- Friendliness of neighbourhood

These variables could affect the result of a direct relationship between density and social interaction, as they affect one or the other density and social interaction variables. To verify the effects of the above interfering variables, number of social contacts, which was the key indicator of social interaction at an individual level, was correlated both directly and partially with these interfering variables. The second most important variable of social interaction, the observed social interactions in public and semi-private spaces, was not used for the analysis, due to the fact that

observed social interactions were quantified for the overall neighbourhoods and it was not possible to relate it effectively to individual households.

Influence of socio-economic and demographic characteristic of neighbourhoods on social interaction

In order to investigate any effects of these intervening variables, first of all correlation tests were done to verify the claims that social contacts are stratified and people form social contacts with others from the same social, economic or cultural groups. However, since the neighbourhoods were selected to control for as many interfering variables as possible, some of the effects may not be as significant as reported in cross cultural studies. Therefore, use of Kendall's and Pearson's correlation tests found no significant relationship between number of social contacts and household income or employment status . However, when the households of retired people were looked at in isolation, their average social contacts were found to be higher in number in comparison to other groups of residents (15.81 contacts to 9.90). Similar analysis of households with children found no variation in their average number of social contacts (11.44 contacts/household for those with children and 11.41 for those without). So while children's networks and their associated adult groups didn't seen to increase the total number of social contacts within a household, people who had more time to invest in the community, such as the retired respondents were found to have larger social networks within the neighbourhood (Table 6.15). However, other demographic and social variables such as ethnicity and gender were not considered, because 1) social contact data were collected for all the members of a household rather than of individuals within a household 2) care to have a reasonable mix of ethnic groups within each neighbourhood rather than just one group had been taken.

Socio-demographic groups	Average social contacts with in the group	Rest of the respondents
Household with children	11.44	11.41
Household of retired people	15.81	9.90
Income groups (below 25,000)	10.69	12.80

Table 6.15 Average social contact of various socio-demographic groups

Influence of attachment to place on social interaction

The next step was to investigate whether the large social network observed in retired groups was due to the longer time they had spent in the neighbourhood on a daily basis or longer period of stay in the neighbourhood. Social contact (perceived and actual), perception of friendliness and community spirit all appeared to increase considerably with length of time lived in the neighbourhood (Table 6.16). This relationship was also found to be significant in a Kendall's correlation test Table 6.17.

Length of stay in the neighbourhood	Average social contacts per household (Mean)	Community spirit (Median)	Friendliness of neighbourhood (Median)
Less than 6 moths	2.50	Very little	Unfriendly
6 months to 1 year	3.00	None	Unfriendly
1-2 year	3.38	Little	Fairly friendly
2-5 year	8.06	Little	Fairly friendly
5-10 year	11.19	Little	Fairly friendly
10-20 year	14.65	Little	Fairly friendly
20-30 year	19.00	Little	Fairly friendly
More than 30 years	12.55	Little	Fairly friendly

Table 6.16 Length of residence and average social network, community sprit and perception of friendliness

	Friendliness	Community spirit
Total number of social contacts	0.315**	0.327**
Perceived social contacts	0.322**	0.216**

Table 6.17 Social contacts, friendliness and community spirit

Therefore, the findings for Holybrooks, which appeared to be an outlier in this dataset, with lower number of social contacts (2.89/household), could be due to poor community spirit and low perception of friendliness reported here (see Table 5.5), in addition to the fact that it is populated by many short-stay residents (average residency less than two years). To examine this possibility the next issue to be explored was whether property ownership had any relationship to length of stay in the neighbourhood. While ownership of property seems to influence the perception of social contacts in the neighbourhoods, the actual measured social contact was not found to have any significant relationship to the ownership of property.

Influence of social capital on social interaction

Individually, sense of satisfaction with the neighbourhood as a place to live, as well as perception of safety within the neighbourhood, appeared to increase significantly in the cases of people with larger numbers of social contacts within the neighbourhoods (Fig. 6.6, Fig. 6.7). However, variations within a neighbourhood, due to the subjectivity of this measure, resulted in the median value for these indicators for each neighbourhood being comparable, giving a false sense of similarity. The test to find the relationship of social capital to visible social interaction was considered less reliable in light of this subjectivity.

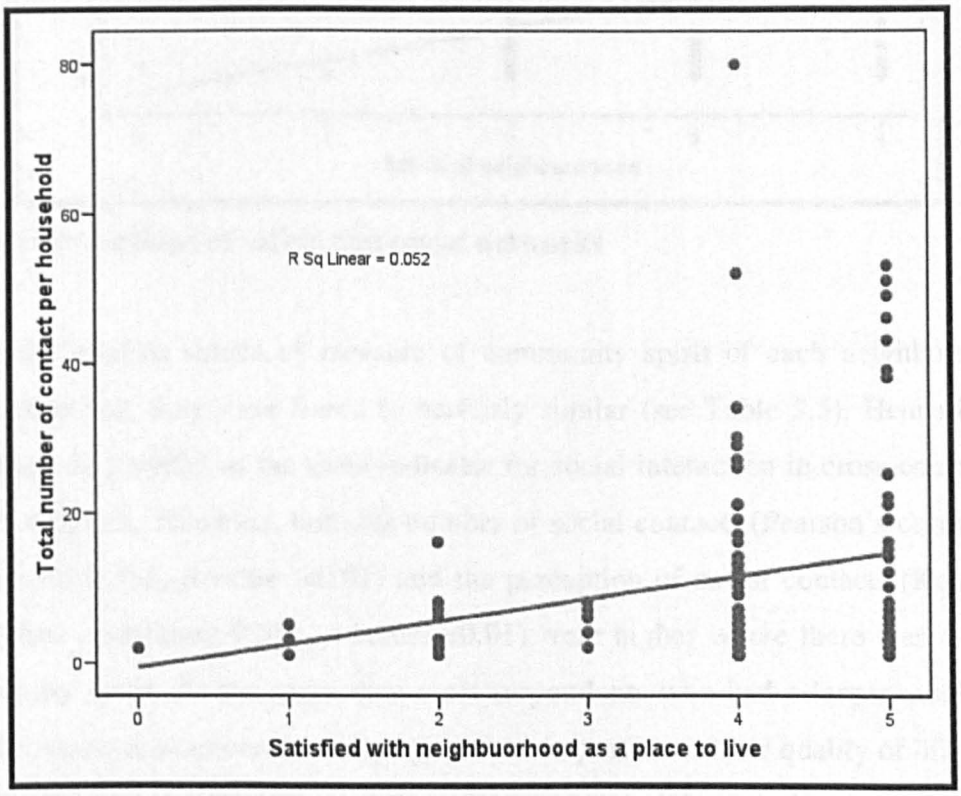


Fig. 6.6 Sense of satisfaction with the neighbourhood as a place to live and social networks

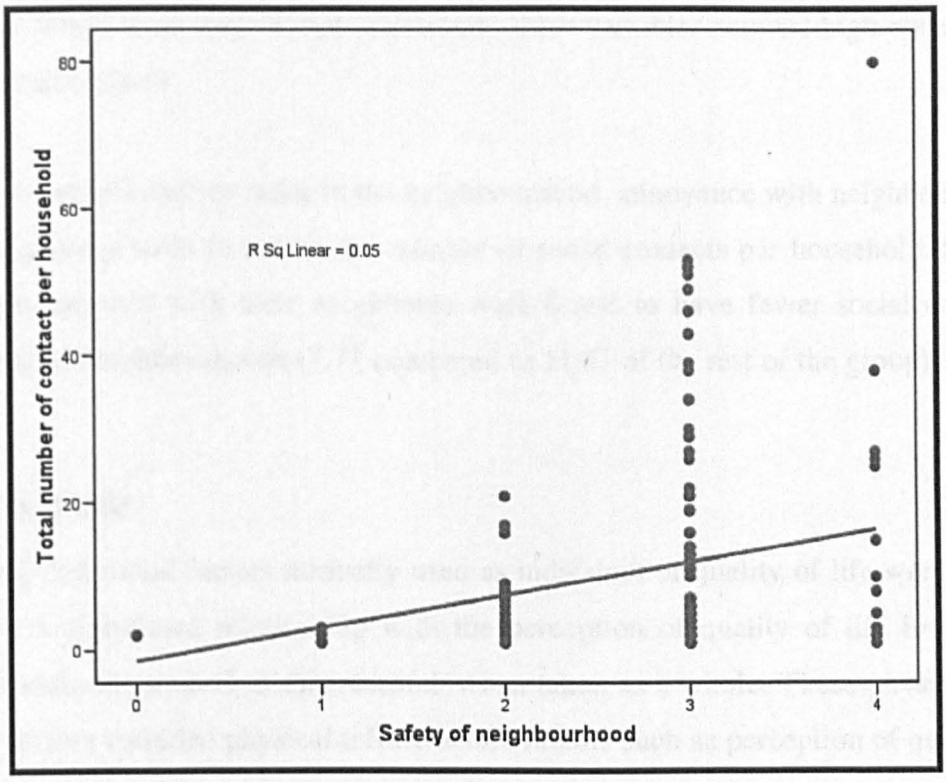


Fig. 6.7 Perceptions of safety and social networks

When the median values of measure of community spirit of each neighbourhood were compared, they were found to be fairly similar (see Table 5.5). Hence it was found not very useful as the main indicator for social interaction in cross-comparing neighbourhoods. However, both the number of social contacts (Pearson's correlation coefficient: 0.388, *p*-value: <0.01) and the perception of social contacts (Kendall's correlation coefficient 0.533, *p*-value: <0.01) were higher where there was a better community spirit. At the same time most respondents who had a larger number of social contacts also felt community spirit to be important to their quality of life. Most importantly, people with larger actual and perceived social networks reported a better quality of life in the neighbourhood. The evidence suggests that good community spirit corresponds to increasing social interaction. Hence perceived community spirit in the case of individual respondents was considered an indication of higher levels of social interaction.

Similarly friendliness (Kendall's correlation coefficient 0.315, *p*-value: <0.01) participation in community (Kendall's correlation coefficient 0.186, *p*-value: <0.05) and attachment to place (Kendall's correlation coefficient 0.139, *p*-value: <0.05)

were all found to increase social interaction; these variables showed high correlation with social contacts.

Negative factors such as noise in the neighbourhood, annoyance with neighbours and lack of privacy seem to reduce the number of social contacts per household. People who are annoyed with their neighbours were found to have fewer social contacts within their neighbourhoods (7.71 compared to 11.67 of the rest of the group).

Quality of life

Physical and social factors normally used as indicators of quality of life were found to have a significant relationship with the perception of quality of life in the six neighbourhoods studied in this research when taken as a whole. These physical and social factors included physical infrastructure factors such as perception of quality of built environment, access to facilities, transports links, as well as social factors such as social networks, sense of safety, community spirit and attachment to place. They were found to have strong correlations with an individual's perception of quality of life. Hence it can be concluded that along with the physical environment, social environment and social networks are important in people feeling that they have a better quality of life.

Indicators	Total social contact	Total social contact (normalised by site area)
	Correlation coefficient	Correlation coefficient
Quality of life	0.227**	0.181**
Quality of housing	0.146*	0.114
Public facility	0.137*	0.180**
Facilities for children	0.155*	0.182**
Sport and recreational facilities	0.121	0.141*
Safety	0.204**	0.113
Community spirit	0.418**	0.369**
Friendliness	0.405**	0.351**
Privacy	0.165*	0.104

Table 6.18 Indicators of quality of life and total number of social contacts

** p-value < 0.01, * p-value <0.05

These quality of life indicators individually were also found to have significant relationships with the number of social interactions and social contacts (Table 6.18). From this it can be concluded that social interactions and social contacts are vital

components in contributing to a better quality of life. The relative importance of each of these factors in fostering social cohesion is a potential area for further research; this research attempted only to establish interconnection between these factors, rather than look at individual relationships in depth.

Influence of physical characteristics of neighbourhood on social interaction

Spatial and physical properties of individual households, factors such as location and space forming the main access to property (R: 0.429, p-value: <0.01) appear to have a significant relationship with the amount of social contacts its residents have. Initial analysis indicated level of dwellings also influence the number of social contacts. Further analysis was carried out to identify the spatial characteristics of a neighbourhood that may influence social interaction. This is fully presented in the following chapter (7).

Combined effect of interfering variables on social interaction

Given that social interaction seems to have a negative relationship with density (Section 6.2.1, 6.2.2), and that many interfering variables may have stronger relationships with social interactions, the next stage of analysis tried to explore the combined effect of these intervening variables on social interaction and density. In addition, the aim was to explore whether the lower number of observed social interactions in higher density areas was a function of social and spatial conditions of the neighbourhood or of the density itself. To do this, a multiple regression analysis and partial correlation tests were carried out. In the multiple regression analysis, intervening variables were added progressively to net building density and normalised social contacts. Increasing correlation coefficients (Table 6.19) suggest that the relationship between density and social interaction is stronger where more favourable social and physical conditions exist in higher density neighbourhoods.

When total social contacts per household were analysed by multiple regression using the regressors mentioned above, regression generally provided a poor fit (R^2 : 0.418) and the overall relationship was also poor (*p*-value : 0.699). However, access,

household income, length of stay in the neighbourhood, satisfaction with the neighbourhood and community spirit were found to be critical factors that made significant differences to the R^2 value (Table 6.19). When normalised social contact was analysed by multiple regression with the same regressors, the above key variables as well as location were found to be most important. The social and personal variables, namely length of stay and community spirit, were found to be significant components (*p*-value: <0.05) in increasing social networks when density is controlled for.

Variable added (independent)	Total social contacts per household (dependent)		Normalised social contacts per household (dependent)	
	R^2	Difference in R^2	R^2	Difference in R^2
Building density	0.127		0.007	
Location of cases	0.135	+0.008	0.050	+0.043
Level of front door	0.143	+0.008	0.050	+0.000
Access from	0.200	+0.057	0.086	+0.036
No of people in household	0.212	+0.012	0.056	-0.030
Household income	0.237	+0.025	0.096	+0.040
Length of stay	0.336	+0.099	0.181	+0.085
Satisfaction with neighbourhood	0.364	+0.028	0.227	+0.046
Community spirit	0.397	+0.033	0.306	+0.079
Ownership of property	0.394	-0.003	0.313	+0.007
Safety in neighbourhood	0.408	+0.014	0.333	+0.020
Irritated by neighbours	0.417	+0.009	0.351	+0.018
Privacy from passers by	0.418	+0.001	0.351	+0.000

Table 6.19 Multiple regressions analysis and R^2 values

Due to the generally poor fit in the multiple regression analyses, the effects of these interfering variables were individually compared with social interaction and density, using a partial correlation test. For a partial correlation test, the interfering variables were kept controlled while the dependent (social network) and independent (density) variables were tested for significant correlations.

When the normalised social contacts were compared with density by controlling the same independent and interfering variables, in most cases the relationship was found to be negative, i.e. an increase in density seems to negatively influence how many people one knows per hectare of neighbourhood even when other social and spatial factors are kept constant. The only exception to this is the access variable, which, when controlled for, results in social contacts increasing marginally in

neighbourhoods with higher density (R: 0.096, *p*-value: 0.311). However this was only slightly better than the insignificant relationship normalised social network has with density when none of the interfering variables are controlled (R: -0.083; *p*-value: 0.380, Table 6.11). In a similar comparison with density, total social contact appears to have a significant negative relationship, even when storey of front door, number of people in the household, household income, length of stay in the neighbourhood, satisfaction in the neighbourhood, community spirit, ownership of the property, safety in the neighbourhood, irritation with neighbours, and privacy from passers-by were controlled for. However, when household income and length of stay in the neighbourhood were controlled, social interaction was found to reduce further in high density neighbourhoods (see Table 6.20). From this result one could speculate that in high density neighbourhoods with high-income group residents only and/or residents who have stayed in the neighbourhood for shorter periods, there may be lower average of household social contacts.

Without controlling interfering variables	***-0.357***	***0.000*****	***-0.083***	***0.380***
Variable added (independent)	**Total social contacts per household (dependent)**		**Normalised social contacts per household (controlled)**	
	R	*p*-value	**R**	*p*-value
Location of cases	-0.092	0.289	-0.223	0.017*
Level of front door	-0.309	0.000**	-0.099	0.300
Access from	-0.072	0.407	+0.096	0.311
No of people in household	-0.352	0.000**	-0.083	0.408
Household income	-0.394	0.000**	-0.093	0.377
Length of stay	-0.363	0.000**	-0.071	0.468
Satisfaction with neighbourhood	-0.326	0.000**	-0.048	0.609
Community spirit	-0.320	0.000**	-0.025	0.789
Ownership of property	-0.212	0.000**	-0.039	0.690
Safety in neighbourhood	-0.330	0.000**	-0.073	0.439
Irritated by neighbours	-0.359	0.000**	-0.102	0.279
Privacy from passers-by	-0.358	0.000**	-0.080	0.399

Table 6.20 Summary result of partial correlations between social network and density by controlling interfering variables

** p-value < 0.01, * p-value <0.05

6.5 Conclusions

The results from the statistical analysis were complex and sometime conflicting and inconclusive. For example, total social contacts appeared to have a negative relationship with density, meaning a lower number of social contacts in high density

neighbourhoods. However, when social contacts were normalised by using the size of the neighbourhood, density and social contacts had a non-significatant relationship. Further investigation revealed that density and social contact have a non-linear relationship, and the normalised number of social contacts was found to be highest in a neighbourhood of approximately **70-80** households/ha, contrastingly with higher or lower density neighbourhoods where the number of social contacts per hectare of land tends to be lower.

In contrast to this, social interactions in public and semi-private spaces were found to be higher in high density neighbourhoods. However, when the total number of observed social interactions was divided by the number of households, to obtain the average social interactions in public space per household, neighbourhoods with a density of between 50 to 100 households/ha had the highest number of social interactions in public spaces. Given this, it could be concluded that neighbourhoods with a density of 70-80 households/ha had not only the highest number of positive social contacts but also the largest number of social interactions in all neighbourhoods.

On examining the pattern of social contacts and social interactions in the neighbourhoods, it was found that in the low-density spread layout respondents reported higher informal friendships and interactions within the neighbourhoods, while in compact and high-density neighbourhoods respondents reported more mutual home visits than informal chatting in public spaces.

Literature on social interaction suggests that intensity and nature of interactions are affected by social and physical characteristics of the neighbourhoods as well as the personal and psychological make-up of the participants (see Chapter 3). Partial correlations to control the interfering variables, and multiple regression analysis using all the interfering variables, showed that given ideal social, demographic and physical conditions, the number of social interactions might be high even in higher density neighbourhoods. The three key variables that were found to significantly affect social interactions were access to the property, meaning the type of space, from which the property is accessed (e.g. streets, foyer), length of stay in the neighbourhood, and community spirit. When the length of stay and community spirit

were high in a neighbourhood, social interactions increased significantly, regardless of density.

Access to property and property location were also found to be important factors in having larger social networks. Households with easy access, or prime location in terms of physical or visual connections, appeared to have relatively more social contacts. For example, flats on upper levels of tower blocks were found to have a lower number of social contacts. Chapter 7 discusses the layouts of neighbourhoods with the aim of identifying important spatial characteristics that might encourage social interaction in neighbourhood.

Chapter 7

Spatial configuration and social interaction

7 Spatial configuration and social interaction

7.1 Introduction

This chapter aims to establish those spatial characteristics of a neighbourhood that might encourage a sense of community and social interaction, addressing the last of the three main questions posed at the beginning of this research. As stated in Chapter 3, spatial configuration, although not a measure of density or social interaction and therefore strictly speaking an interfering variable, can influence both social interaction and density, it was examined in more detail than any other interfering variable. Correlations, multiple regression analysis and partial correlation tests described in Chapter 6 showed some evidence that spatial layout and built form, along with many social and demographic factors, can encourage social interactions in a neighbourhood. To examine this, statistical analyses and spatial analyses were conducted, using space syntax and GIS tools. Spatial analysis consisted of two major sets of computer-based spatial models from which spatial variables were derived to compare with social interaction indicators. First global integration, local integration and intelligibility of spaces in the neighbourhood were derived from axial models of all spaces within a 10 minute walking distance from the centre of the estate. The intention of this axial analysis was to examine the spatial linkages each neighbourhood had with the immediate surroundings. Secondly, all spaces except the private spaces within the neighbourhoods were analysed for their visual integration, using the visible graph analysis method (VGA) in the Depthmap program. From the VGA maps, unique spatial fingerprints consisting of visual integration, clustering co-efficient, mean depth, controllability and visual controls were derived. These spatial measures are based on visual connections and the visual depth each one-meter square tile within each space has from all the other such tiles in the whole neighbourhood. Later the values of these spatial variables in front of each household were assigned to that household to analyse the implication of locations and layout on its social networks. Processed output in the form of coloured thematic maps from Depthmap models were used to compare the spatial integration pattern of spaces with the space

use or intensity of activity patterns within each neighbourhood, both visually and using GIS (MapInfo) program.

To examine the relationship between spatial configuration and social interaction, spatial measures identified in Chapters 2 and 3 are used. These include variables of building form, special configuration and other qualitative features (see Table 7.1)

Spatial configuration
Axial properties: global and local integration, mean depth, control, relation to surrounding and location of household within the neighbourhood
Visual properties: visual integration, controllability, visual links between house, and clustering coefficient
Building form
Height,
Storey of front door
Others qualitative features
Size of neighbourhood
Access and quality of public space

Table 7.1 List of spatial variables

Term	Definition
Spatial step	Indicates a change of direction in the context of axial maps
Mean depth	Average depth from every space to every other space
Step depth	The minimum number of spatial steps between two space
Global integration	Relationship between every space to every other space in a system. In mathematical terms it is the normalised mean depth using a constant called d-value. (Hillier and Hanson, 1984)
Local integration	Relationship between every space to all space which are within a specific step depth away (usually three steps)
Control	Control picks out visually dominant areas. For control, each location is first assigned an index of how much it can see, the reciprocal of its connectivity
Intelligibility	Correlation between global integration and connectivity
Synergy	Correlation between global integration and local integration
Visual integration [HH]/[p-value]/[Tekl]	Visual integration is calculated in the same way as global integration from an axial map. In case of visual integration [HH] the constant for normalisation is the same as global integration [D-value] and for visual integration [p-value] and [Tekl] it uses a p-value and alternate constant proposed by Teklenburg et al. (1993). (See Turner, 2001 for algorithms)
Visual depth	The minimum number of interconnected visual fields between two spaces
Visual mean depth	Average depth from any point in space to any other point in a VGA model. Visual 'Mean depth is calculated for each node much like the step depth. The shortest path (i.e., the fewest number of turns) through the visibility graph is calculated to each other node within the graph.' (Turner, 2004 p 14)
Visual control	Visual control picks out area that are visually dominant (Turner, 2004 p16)
Visual controllability	Controllability picks out areas that may be easily visually dominated. Controllability 'for a location it is simply the ratio of the total number of nodes up to radius 2 to the connectivity (i.e., the total number of nodes at radius 1)' (Turner, 2004 p16)
Visual clustering coefficient	Clustering coefficient is a local measure calculated from Depthmap analysis by applying small world analysis to spatial systems. Clustering coefficient is a measure introduced by Watts and Strogatz to help assess whether or not a graph is a 'small world' or not. A 'small world' is one that has tightly clustered groups of friends but surprisingly low mean depth. (Turner, 2004 p 16)

Table 7.2 Space syntax terminology and definitions

Some of the measures used to quantify spatial configuration are direct measures derived from spatial analysis, using space syntax tools. The meaning and definitions of these measures are given in table Table 7.2

Before discussing the main findings it is important to describe the general spatial characteristics and layout of each neighbourhood (section 7.1) to put the main analysis and findings discussed in Section 7.2 in context.

7.2 General spatial characteristics of case studies

7.2.1 Locations

As previously described, the six neighbourhoods chosen as case studies for this research were:

1. Part of a 1950s development in New Marston, Oxford
2. A housing development adjoining the river Thames in the centre of Oxford City, known as the Thames Street development
3. A 1980s development in the centre of Reading, called Holybrooks housing development
4. A pre-war development called Dalgarno Gardens in North East London which was refurbished in the 1960s
5. Part of the 1960s Thamesmead development known as the Parkview Estate in South East London
6. A 1960's high density development in Chelsea, called World's End Estate

In terms of their locations, while Thames Street, Worlds End and Holybrooks are in the centre of Oxford, London and Reading respectively, New Marston and Dalgarno Gardens are located in inner suburbs. Parkview is located in Thamesmead, a large suburban development from the 1960s' built to meet the housing needs of post-war London, and is often described as a new town within London (Greater London Council, 1967).

All the neighbourhoods chosen for the study, while having strong physical boundaries according to the criteria used for their selection, are also well-connected

to the city as a whole by public transport links. In many inner city locations there were often pedestrian routes cutting across them also.

7.2.2 Layout

The six neighbourhoods in the study had a variety of layouts. These range from a sprawling and spread-out configuration to a compact inner city type (see Appendix D).

- New Marston has a very spread layout with a simple but 'deformed grid'. The neighbourhood has a small shopping area and a pub in the centre as well as two small green spaces on the northern part.
- Thames Street consists of two separate developments with totally different spatial layouts. These are a number of 1980s terraces built along some winding streets and a set of blocks of apartments built around courts that was constructed during the '70s. The '80s terraces on the west side have a small linear landscaped space. Some of the courtyards in the '70s block developments are left as communal open space, while others are used as car parking spaces.
- Holybrooks has a compact layout with edge blocks around communal courtyards. Courtyards were spatially similar to cul-de-sacs with no through routes. Other than the segregated courtyards, the simple ring streets are the only notable communal spaces in the estate. This ring-shaped street system is connected to the city's street system via a series of pedestrian routes and a vehicular link.
- Dalgarno Gardens has staggered blocks, which visually disconnect the intra block spaces from one another. The through route in the estate is difficult to navigate but alternate intra-block spaces are directly connected to Dalgarno Way on the eastern side. There are two types of block: shorter and longer ones. These are laid out so that shorter blocks are arranged linearly and interspaced by a single, larger block. The small gardens and children's play spaces are located on either side of the longer single blocks, with the space between the shorter blocks acting as the vehicular link to the space between the blocks.
- Parkview has a simple street level layout with tower blocks on the northern edge of the estate and terraced houses around courts on the southern side. There are upper level bridges near the towers as well as interwoven pedestrian lanes in the terraced housing, making the layout initially very complex to understand. The

layout was originally intended to separate the pedestrians from the vehicular traffic, but the bridges and upper level walkways are used sparingly today. The primary school that separates these two types of housing has some communal open space and play space for children next to it.

- World's End Estate has an extremely compact layout with seven 16 to 18 storey tower blocks around two raised courtyards. These courtyards are surrounded by four-storey high bridging blocks. The estate has very limited space at ground level but two large communal open spaces are in the raised courtyard, while a small play space and club house are located at ground level on the south side.

At the beginning of the analysis, as previously mentioned, axial maps of all spaces within a 10 minute walk from the centre of the estates were developed. This was a relatively smaller radius than the usual two-mile one used in other studies, mainly due to limitations of time, which prohibited developing a larger model. But it was also assumed at the beginning of this study that the closest social networks would be closer to home that is, within this 10 minute walking distance. From these average axial maps, global and local integration values along with intelligibility were quantified for the whole model as well as for each neighbourhood, as they are embedded in its urban context.

Integration values are often compared to the quantity of pedestrian movement and have been found in previous research (Hillier et al., 1993; Peponis et al., 1989) to be predictors of pedestrian traffic volume. When the average global integration of ground level spaces within the estates as they are embedded in their context were compared, Dalgarno Garden (0.94) was found to be the most and New Marston the least integrated (0.61). New Marston had a single-sided link to its surrounding area, while all ground level spaces in Dalgarno Gardens were linked to Dalgarno Way, and thus to its surrounding area directly. However when the average integration values of each neighbourhood are compared with their surroundings, Holybrooks and World's End Estate were found in general less integrated than their surroundings (Table 7.3).

Cases	Description of density/form	Density (Dwellings/hectare)	Global integration value (Axial analysis)		Average pedestrian movement on weekend	Average social contacts (per household)	Intelligibility (Correlation between global and local integration)	
			Space inside the neighbourhood	All spaces within 10min walk			Space inside the neighbourhood	All spaces with in 10min walk
New Marston	Low density low rise	25	0.61	0.616	19.84	17.17	0.243	0.169
Thames street	Medium density low & medium rise	48	0.74	0.714	56.23	11.71	0.302	0.290
Parkview	Medium density high & medium rise	95	0.93	0.905	32.43	5.55	0.526	0.193
Holybrooks	Medium density medium rise	108	0.80	0.868	64.26	4.33	0.239	0.419
Dalgarno Gardens	High density medium rise	162	0.94	0.982	120.47	2.80	0.095	0.365
Worlds End	High density high rise	271	0.81	0.913	93.59	4.22	0.024	0.289

Table 7.3 Syntactic properties of spaces within 10 minute walking model

Cases	Description of density/form	Density (Dwellings/ha)	Global Integration (Rn)	Local integration (R3)	Connectivity	Intelligibility	Synergy
New Marston	Low density low rise	25	1.1168	1.6982	2.8784	0.5635	0.6437
Thames street	Medium density low & medium rise	48	0.8886	1.6554	2.8504	0.4076	0.6293
Parkview	Medium density high & medium rise	95	0.8266	1.4504	2.2791	0.2472	0.4204
Holybrooks	Medium density medium rise	108	0.6968	1.1953	2.1891	0.3239	0.6213
Dalgarno Garden	High density medium rise	162	0.5437	1.5650	2.6137	0.0847	0.1694
Worlds End	High density high rise	271	0.6961	1.5997	2.4557	0.1450	0.2351

Table 7.4 Syntactic properties of all spaces in the neighbourhood (cut-out model)

When all the public and semi-public spaces at all levels within the neighbourhood (similar to VGA in terms of inclusion of spaces) were analysed, New Marston (1.1168) was found to have the highest global integration value, followed by Thames Street (0.8886), while Dalgarno Gardens (0.5437) had the lowest. Therefore, neighbourhoods which have complex layouts were least integrated locally, although

in some cases (Dalgarno Gardens, Parkview, World's End Estate) public spaces on the ground level were found to have better integration between them.



Fig. 7.1 Axial maps of neighbourhoods (500m radius)

Note: for larger axial maps see Appendix I.

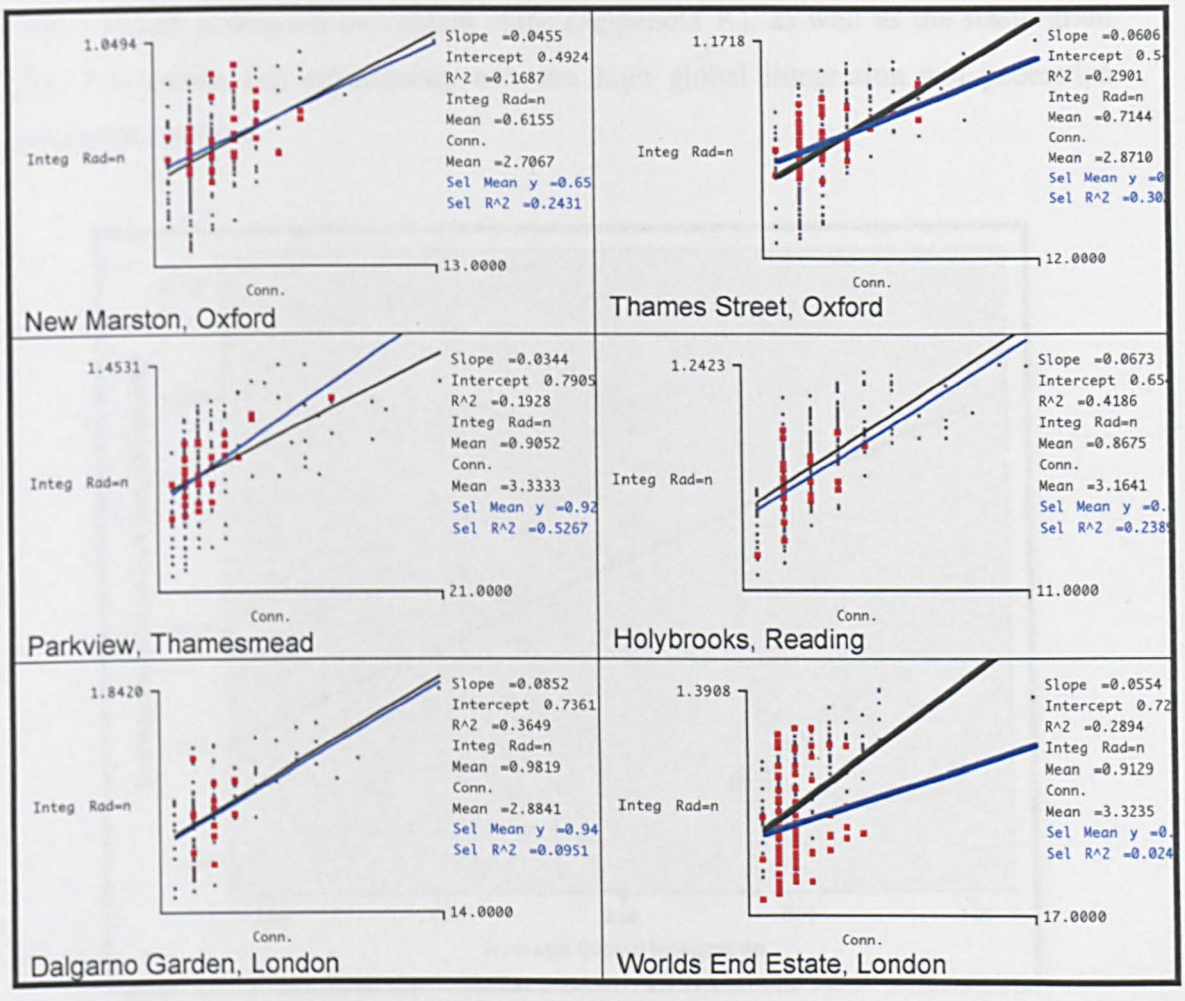


Fig. 7.2 Scattergrams: Intelligibility (global integration v local integration)

In terms of patterns of integration, in most cases the streets around the neighbourhoods were more integrated than the average integration value of the spaces inside them (see Fig. 7.1). Intelligibility, a term used to express the correlation between global integration and connectivity is often used in space syntax research as a good indicator of the legibility of spatial layout (Penn, 2003; Peponis et al., 1989). Intelligibility of spaces inside the estates was found to be generally comparable to that outside. New Marston and Parkview were slightly more intelligible than their surroundings, while spaces in World's End Estate were considerably less intelligible in than its surroundings (Table 7.3, Fig. 7.2). The complex layout of the World's End Estate means the space inside was found confusing to navigate. This quality of space was mentioned in some of the responses to questionnaires and was noted in personal experiences during the fieldwork. In general, highly integrated spaces were found to have high pedestrian movement in previous research (Hillier, 1996). A simple visual examination of the syntactic maps

(Fig. 7.1) and pedestrian movement maps (Appendix K), as well as the scattergram (Fig. 7.3) makes this relationship between high global integration and pedestrian movement obvious.

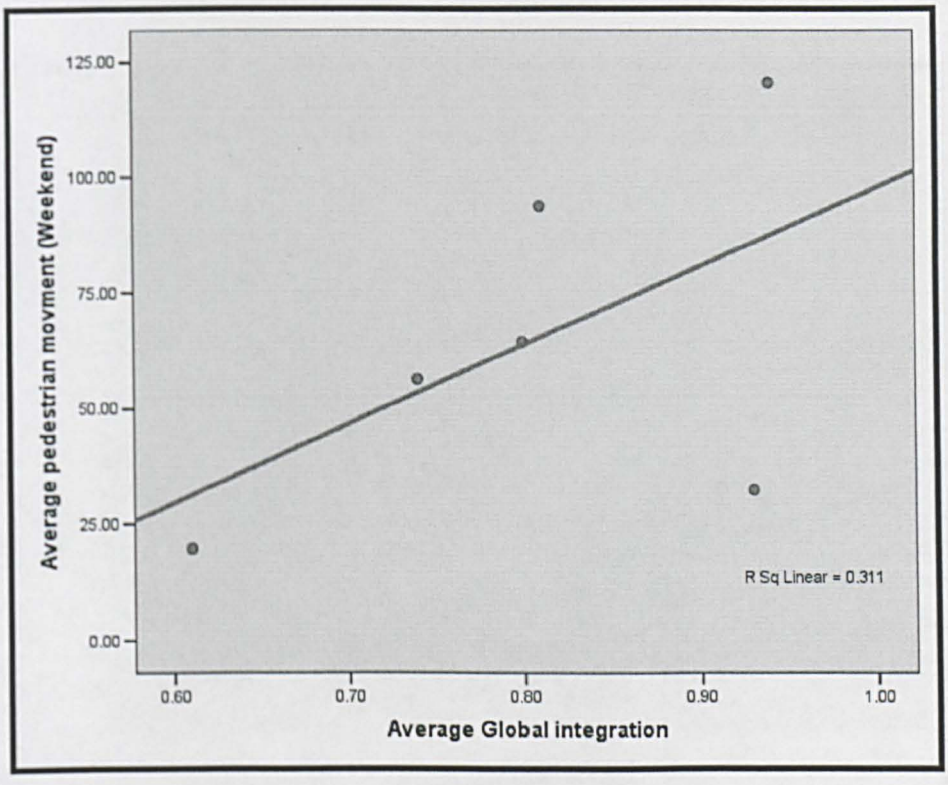


Fig. 7.3 Scattergram: global integration v pedestrian movement

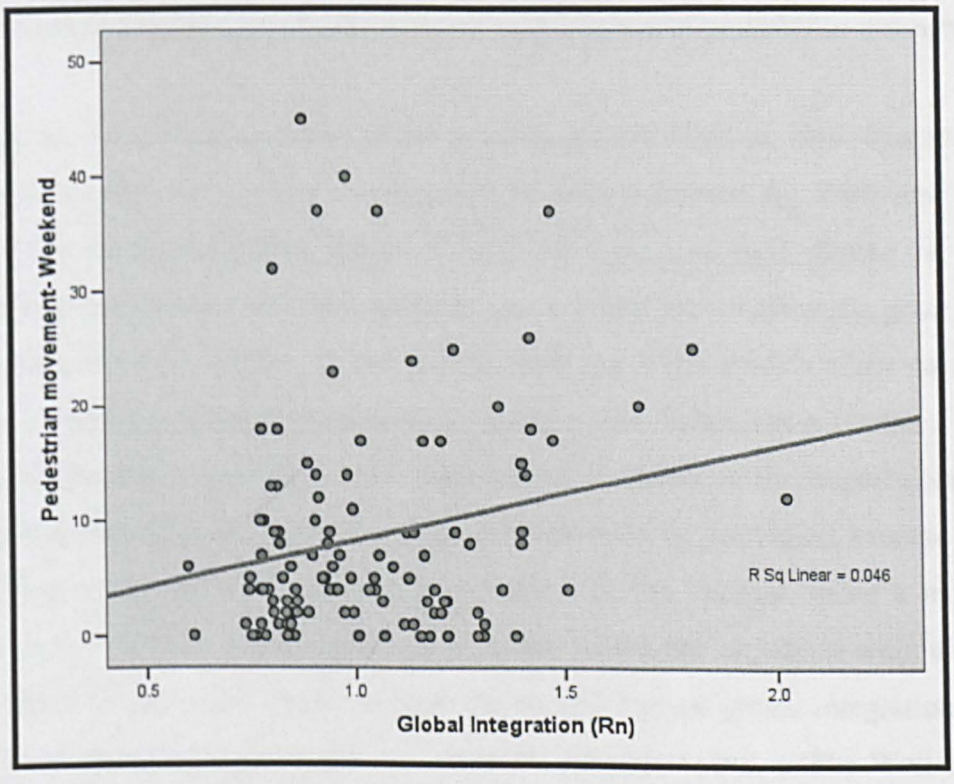


Fig. 7.4 Global integration of public spaces and quantity of pedestrian movement

When pedestrian moments within each estate were compared, they had a significant correlation with the global integration of communal spaces within the neighbourhood (R^2 : 0.046, Fig. 7.4). However the pedestrian movements within the estate had a better correlation with local integration of these spaces (R^2 : 0.092, see Fig. 7.5).

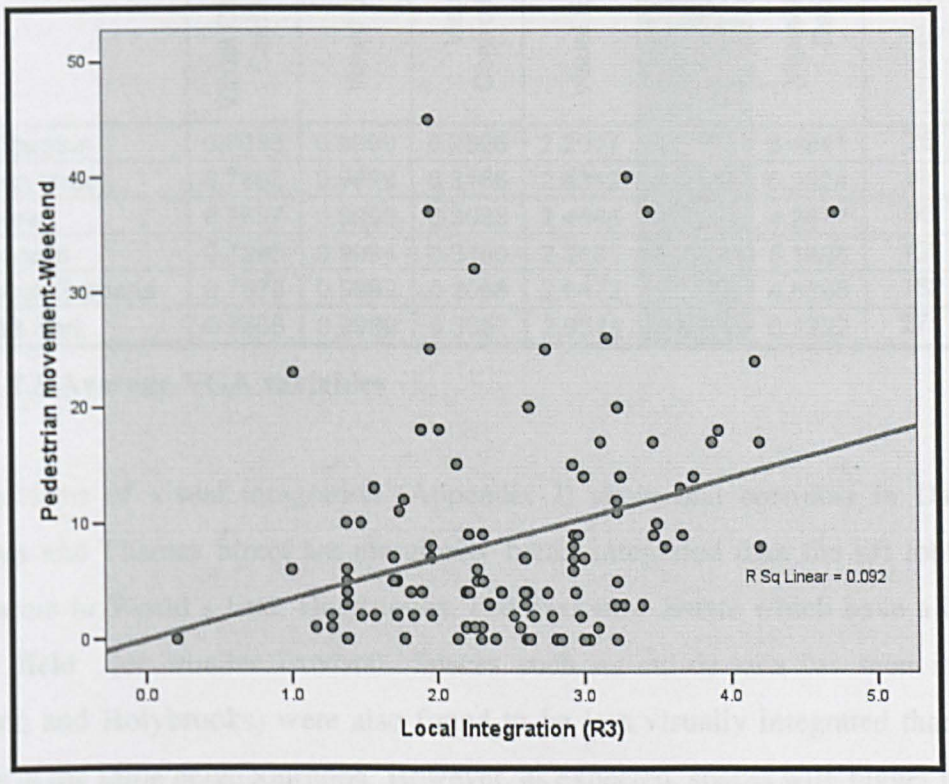


Fig. 7.5 Local integration of public space and amount of pedestrian movement

Turning now to visual qualities of the neighbourhood's layout, New Marston was found to be the most visually integrated (4.616) followed by Parkview Estate (4.3114) with World's End Estate having the lowest (2.445) degree of visual integration (see Table 7.5). New Marston has a spread layout allowing good visual connections between spaces, shown in both axial and VGA models when the spaces within a neighbourhood are considered. World's End Estate has a complex layout with very limited visual fields from most spaces, except from the largest communal spaces and ground level. This was again demonstrated by the higher average global integration value for public spaces. See Table 7.3, 5th column, using a model in which only important public spaces are included within the 10 minute walk distance. This shows World's End Estate to have the second highest global integration value. Parkview Estate has tower blocks like World's End Estate but, unlike World's End,

has a simple layout and entrances to the towers, visually better linked to each other as well as to most of the communal spaces and to the street system.

Neighbourhood	Visual Clustering Coefficient	Visual Control	Visual Controllability	Visual Entropy	Visual Integration [HH]	Visual Mean Depth	Density (building)	Av social contacts
New Marston	0.8038	0.9999	0.2826	2.2017	4.6162	3.4841	25	17.17
Thames street	0.7892	0.9999	0.3186	2.8312	3.2133	5.2324	48	11.71
Parkview	0.7827	0.9999	0.3088	2.4846	4.3114	4.2677	95	5.55
Holybrooks	0.7995	0.9994	0.3180	2.8181	3.2284	5.1468	108	4.33
Dalgarno Gardens	0.7878	0.9999	0.3068	2.6472	3.7378	4.5698	162	2.80
World's End	0.7806	0.9999	0.3857	2.9541	2.4457	6.1222	271	4.22

Table 7.5 Average VGA variables

The patterns of visual integration (Appendix J) show that corridors in Dalgarno Gardens and Thames Street are marginally better integrated than the lift lobbies in the towers in World's End, Holybrooks, and Parkview Estate which have a limited visual field (or smaller isovists). Spaces such as cul-de-sacs (as seen in New Marston and Holybrooks) were also found to be less visually integrated than other spaces in the same neighbourhood. However, as expected, spaces with bigger isovists such as straight streets or junctions of streets were found to be the visually most integrated locations.

7.3 Spatial qualities of neighbourhoods and social interactions

The preliminary analyses that examined aspects of building form and layout indicated a significant reduction in the number of social contacts in households with entrance above ground level (see section 7.3.1). It was also observed that people living in a street-type layout have higher levels of social contact than people living in blocks of flats. Therefore it was important to examine in more detail the significance of spatial configuration, location and layout in increasing social interactions.

Chapter 2 stated that manifestations of a typical density could take a variety of built forms as well as layouts. These variations in layout and form were captured in some of the syntactic measures such as global, local and visual integration, intelligibility, and mean depth. These then formed the bases for comparisons of locations of each household in their neighbourhoods with the number of their social contacts. Using visual analysis, GIS and statistical analysis integration patterns, spatial variables were compared to the use of spaces and social networks. Spatial analysis was followed by statistical analysis where possible, to verify the statistical significance of any relationship observed between spatial and physical variables to the number of social interactions observed in each neighbourhood.

7.3.1 Influence of built form on social interaction

Of the spatial and physical properties of individual households, factors such as location and the space forming the main access to property (R: 0.429, p-value: <0.01) appear to have a significant relationship with the number of social contacts its residents have. For example, people in properties that are accessed from spaces such as a lift lobby (as in the case of flats) or a cul-de-sac, which are not well connected, on average have fewer social contacts per household than (5.76 in case of dead-end spaces and 16.57 in others) people who live next to spaces that are more accessible or visible, such as a street or street corners. Further analysis, found that dwellings on upper levels (above third storey) resulted in a significantly lower number of household contacts (4.81/household) than dwellings on the ground to third storey (12.63) did. This relationship was found to be significant in a Pearson's correlation test (R: -0.201 *p*-value: 0.02, see Fig. 7.6)

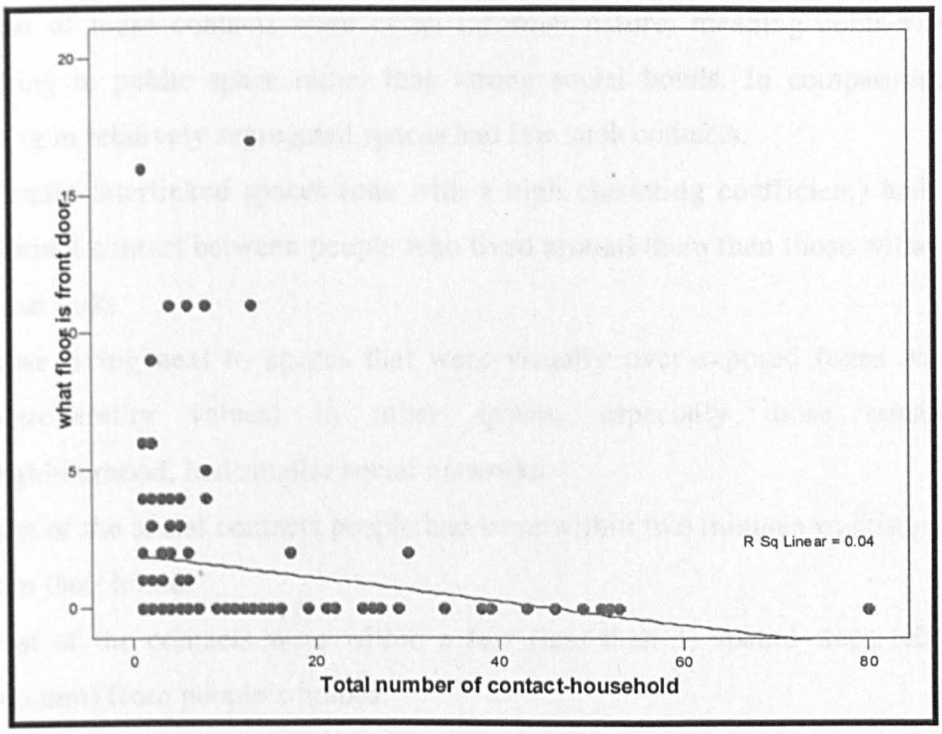


Fig. 7.6 Scattergram of floor level of front door v total number of household contacts

7.3.2 Influence of spatial configuration on social interaction

For this analysis, various spatial characteristics derived from axial and VGA maps of each neighbourhood were compared to the average social interaction in them. These spatial characteristics were global and local integration, visual integration, clustering co-efficient derived from axial and VGA maps of each neighbourhood. In the detailed analysis, spatial attributes assigned to each household (as described earlier) were correlated with the social contacts they have within their neighbourhood.

Preliminary analysis using syntactic characteristics of spaces showed both similarities and differences between the six neighbourhoods (section 7.2). For example, in terms of their relative integration value to that of their surroundings, the six were found to be comparable (Table 7.3), but the actual integration and intelligibility of the spaces in the neighbourhood which reflected their layout and form were distinct. The key findings from the detailed analysis are below. The analyses leading to these conclusions are described later.

1. People living next to highly integrated spaces were found to have larger social networks.

2. Most of these contacts were of an informal nature, meaning contact such as talking in public space rather than strong social bonds. In comparison, those living in relatively segregated spaces had few such contacts.
3. Visually interlinked spaces (one with a high clustering coefficient) had greater informal contact between people who lived around them than those without such visual links.
4. Those living next to spaces that were visually over-exposed (ones with high controllability values) to other spaces, especially those outside the neighbourhood, had smaller social networks.
5. Most of the social contacts people had were within two minutes walking distance from their home.
6. Most of the contacts were within a few (less than 3) spatial steps (change of direction) from people's homes.
7. In all six cases, most socially active spaces were next to other visually highly integrated spaces, but socially active spaces themselves had only medium levels of visual integration.
8. Accessible public spaces played an important role in fostering social ties in the neighbourhoods.

The following subsections elaborate the analysis that resulted in these findings.

Visual integration and social interaction

When the average number of social contacts in the neighbourhood was tested for significance for its relationship with the average visual integration, it was found not significant (p-value: 0.316) despite a relatively high correlation co-efficient (R: 0.497). This relationship was enhanced slightly when the normalised visual integration value or visual integration (p-value) was compared to average social network (R: 0.637, p-value: 0.173). Although it may not be considered statistically significant, in many built environment studies this p-value would be considered of considerable significance. However, when the households next to visually integrated locations were examined for their number of social contacts, those in highly integrated space were found to have significantly more social contacts. That is to say, visual integration values of location of households had a positive and significant relationship with total social contacts (R: 0.415 p-value: <0.01, Fig. 7.7). This means

that neighbourhoods with better visual links between spaces have more social contacts between neighbours and within those neighbourhoods. This is particularly true for those who live next to a more integrated space - they are more likely to have larger social networks than those in segregated spaces.

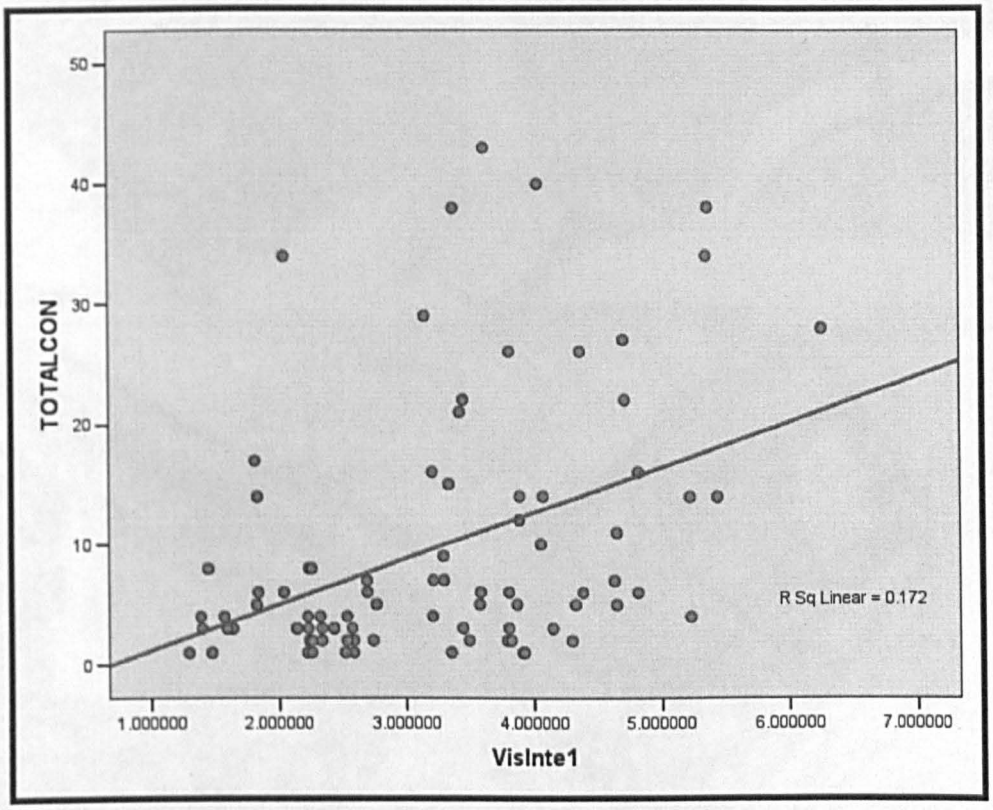


Fig. 7.7 Scattergram: visual integration against total social contacts



Fig. 7.8 VGA maps of neighbourhood

(See appendix J for larger VGA maps)

On considering the layout and social interactions in them, spaces were found to have higher levels of social activity or potential for it when they had medium to high levels of visual integration. Fig. 7.8 shows overlapped maps of social activity and VGA maps of the six cases. Warmer colours such as red and orange indicate spaces with higher visual integration, mild colours such as yellow and green indicates medium levels of visual integration and cooler colours such as green and blue indicates low visual integration. It can be seen that clusters of spaces with warmer colours have more pedestrian movement and those with medium visual integration have higher social interaction within them compared to spaces with cooler colour such as turquoise and blue.

Presuming this finding reflects reality; this raises the question of whether all types of social contact increase for people living in neighbourhoods with high visual integration or locations that are highly integrated. On comparing the various types of social contact, it was found that informal contact was the only type that was significantly related to visual integration of the location of households (R: 0.47, *p*-value: 0.01).

Previous research suggests that constant encounters between people might lead to the formation of social relationships. These encounters can happen due to people's presence in shared spaces such as streets. To check this, the numbers of social contacts within respondents' visual fields were compared to the total number of their social contacts. Later, various types of social contacts and total social contacts were compared to the visual clustering coefficient. This is a variable derived by applying 'small world analysis' usually used in social network analysis to spatial networks (Turner, 2004). This comparison allowed examination of the effect of visual clusters of spaces on the number of social contacts their users have.

	Visits (adult)	Chat in the street (adult)	Recognise (adult)	Visit (children)	Chat in the street (children)	Total-contacts	Remarks
Visual field	%	%	%	%	%	%	
New Marston	62	50	57	5	44	53	People living in low density neighbourhoods have a higher % of their social contact within the visual field of their front door
Thames St	51	37	49	58	11	40	
Holybrooks	13	37	41	-	-	46	
Dalgarno Gardens	17	19	15	50	50	21	
Parkview	14	22	0	50	25	24	
World's End	40	24	0	-	-	33	
Total	**39**	**36**	**37**	**37**	**31**	**39**	
1 minute walk							
New Marston	64	62	74	8	56	65	Low density neighbourhoods also have a higher % of informal contacts within 1min walk than higher density one
Thames St	73	62	65	88	33	64	
Holybrooks	31	7	100	-	-	81	
Dalgarno Gardens	61	62	73	50	50	68	
Parkview	14	48	50	50	50	40	
World's End	40	37	0	-	-	39	
Total	**54**	**59**	**70**	**46**	**47**	**63**	
2 minute walk							
New Marston	67	74	77	13	61	74	83 % of total contacts were within 2 min walk Compactness seems to influence where and how people socialize
Thames St	100	92	92	100	100	94	
Holybrooks	100	91	100	-	-	99	
Dalgarno Gardens	75	78	93	50	50	84	
Parkview	43	60	67	75	75	54	
World's End	70	69	33	-	-	72	
Total	**78**	**80**	**84**	**58**	**74**	**83**	
5 minute walk							
New Marston	93	94	80	78	100	94	Most of the social contacts within their neighbourhoods were within 5min walk
Thames St	100	100	100	100	100	100	
Holybrooks	100	91	100	-	-	99	
Dalgarno Gardens	100	89	100	100	100	98	
Parkview	93	100	100	100	100	98	
World's End	100	100	100	-	-	100	
Total	**97**	**96**	**96**	**93**	**100**	**99**	

Table 7.6 Percentage of contacts within visual field and 1, 2 and 5 minute walking distances

These comparisons show that about 40% of total social contacts were within the visual field from the front door in all six neighbourhoods (Table 7.6). This is a considerable percentage particularly when considered in the light of the fact that two of the six case study neighbourhoods had mostly flats with a very limited visual field. These two had on average just one other front door visible from each. Another three had a considerable number of flats that are accessed from long corridors or decks, and so had more visible front doors than the clusters of flats, but considerably less than those households located along streets. Predictably, New Marston, the only

case of a simple street layout, was found to have more than half (53%) of respondent's total contacts within their visual field.

	Type of contact/total	Clustering co-efficient	Visual control	Controllability	Visual integration	Visual integration (p-value)	Mean depth
Total social contact	S	-.265(*)	-.057	-.167	.170	.168	-.190
	T	-.196	.090	-.277(**)	.477(**)	.498(**)	-.386(**)
	K	-.071	-.047	-.080	-.014	.000	-.021
	Total	-.234(*)	.012	-.293(**)	.415(**)	.435(**)	-.364(**)
Social contact within visual field	S	-.289(**)	-.011	-.270(*)	.320(**)	.330(**)	-.303(**)
	T	-.056	.041	-.248(*)	.519(**)	.546(**)	-.420(**)
	K	-.115	-.105	-.067	.090	.109	-.143
	Total	-.149	.001	-.293(**)	.525(**)	.553(**)	-.451(**)
Social contact within 1 min walk	S	-.358(**)	-.056	-.242(*)	.207	.202	-.215(*)
	T	-.194	.023	-.343(**)	.572(**)	.598(**)	-.454(**)
	K	-.142	-.003	-.030	.094	.114	-.118
	Total	-.299(**)	-.014	-.346(**)	.518(**)	.540(**)	-.441(**)
Social contact within 2 min walk	S	-.330(**)	-.053	-.197	.142	.131	-.172
	T	-.221(*)	.093	-.282(**)	.457(**)	.473(**)	-.389(**)
	K	-.109	-.009	-.049	.024	.039	-.060
	Total	-.292(**)	.033	-.295(**)	.398(**)	.409(**)	-.367(**)

Table 7.7 Summary of correlation test between social contacts and VGA variables

Note:
S= formal contact; T= informal contact; K= recognisable neighbour
** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Households next to spaces with higher clustering coefficient were found to have significantly lower numbers of formal social contacts than those with which are not visually connected (R: -0.265, *p*-value: <0.05). When the clustering coefficient was correlated with informal social contacts, the relationship was still negative, but considerably weaker (Table 7.7). This implies that closely interlinked spatial clusters may not be necessary for strong social bonds, but it does indicate that people living next to visually linked clusters of spaces may have more informal contacts with each other than those who do not.

The next question addresses whether all types of highly visually integrated spaces show a high number of social networks. In the dataset, there was a considerable number of households that were located in visually integrated spaces and which reported a lower number of social contacts. To find out if there was any other spatial factor of highly integrated spaces which could affect social networks, all the spatial variables were statistically correlated to total social network. It was noticed in this analysis that people who live next to spaces that are highly dominated visually, or those with high 'controllability' (Turner, 2004) had lower numbers of social contact than those who did not (R: -0.293 *p*-value: <0.01). This was particularly due to a significant reduction in informal contacts (R: -0.277 *p*-value: <0.01) rather than to other types. The controllability value, calculated on the basis of overlapping isovists from other spaces, can be related to the space being visually over exposed, therefore having adverse implications for privacy. On further analysis, it was observed that people living next to spaces with higher controllability reported a lack of privacy from passers-by (R: -0.254 *p*-value: <0.05).

Finally, in a visual analysis, actual observed social interactions and social activities in public spaces were highest in spaces with a medium level of visual integration, situated next to a highly integrated space or route (see Fig. 7.8). However, due to limitations of the Depthmap program, testing statistical significance of these findings was not possible. This is because all the points inside a space should be selected to calculate the average integration value, but Depthmap presently does not allow selection of points inside non-orthogonal shaped space unless it is done manually, which is tedious and time consuming and, unfortunately, beyond the scope of this research.

Proximity and social interaction

Higher density neighbourhoods are argued to bring people physically closer to each other, providing more opportunities to form larger social networks. However, findings in Chapter 6 indicated a lower number of social contacts in higher density neighbourhoods. This may be partially due to other factors including privacy, demographic and cultural characteristics. Social contact was found to correlate highly with dwelling location and its spatial attributes with regard to other

households in the neighbourhood. The characteristics of location are related to spatial configuration which is related to density but is not necessarily a direct result of it. It is easy to find examples of both high and low density neighbourhoods that have either a complex or a simple layout. While a compact layout can prevent close neighbours from meeting each other, either because of the complexity of the route between their houses or because they do not share common spaces such as streets or foyers, in a spread low density neighbourhood physical distance can become a barrier. In other words, a complex layout can separate people due to the spatial and physical distance of routes between neighbours; while within a spread layout the physical distance between the homes forms the hurdle. Analyses presented in the previous section reported that the location of a household affects the strength of its social networks. It is also known from the literature that the location of a dwelling within a neighbourhood can significantly change the visual, spatial and physical relationship between it and all other dwellings in the neighbourhood. This leads to the next question: do these proximities (visual, spatial or physical) play a significant role in the formation of social networks?

To investigate this, maps of one, two and five minute walk distance, as well as the visual field from front the door of each house, were overlapped with their social network map to quantify the various types of social contact each household had within these walking distances and isovists. While visual and spatial distance can be calculated by the mean depth of the neighbourhood which gives the average distance between any space to all other spaces in a network system, the walking distances had to be calculated for each household individually. In this research, actual walking distance between the houses was used rather than the usual practice of approximating it from the two-dimensional distance radius as the latter gives inaccurate walking distances. This is especially true when considering distance between houses at ground level to those on upper levels.

The percentage of total contacts within one, two and five minute walking distance was examined. It was found that more than 63% of social contacts people have in their neighbourhood were within one minute's walking distance from their front door (Table 7.8), while more than four-fifths (83%) of social contacts were within a two

minute walk. Almost all the social contacts people reported in their locality were within a five-minute walk (99%).

	Visits (adult)	Chat in the street (adult)	Recognise (adult)	Visit (children)	Chat in the street (children)	Total-contacts
	%	%	%	%	%	%
1 minute walk						
New Marston	64	62	74	8	56	65
Thames St	73	62	65	88	33	64
Holybrooks	31	7	100	-	-	81
Dalgarno Gardens	61	62	73	50	50	68
Parkview	14	48	50	50	50	40
World's End	40	37	0	-	-	39
Total	**54**	**59**	**70**	**46**	**47**	**63**
2 minute walk						
New Marston	67	74	77	13	61	74
Thames St	100	92	92	100	100	94
Holybrooks	100	91	100	-	-	99
Dalgarno Gardens	75	78	93	50	50	84
Parkview	43	60	67	75	75	54
World's End	70	69	33	-	-	72
Total	**78**	**80**	**84**	**58**	**74**	**83**
5 minute walk						
New Marston	93	94	80	78	100	94
Thames St	100	100	100	100	100	100
Holybrooks	100	91	100	-	-	99
Dalgarno Gardens	100	89	100	100	100	98
Parkview	93	100	100	100	100	98
World's End	100	100	100	-	-	100
Total	**97**	**96**	**96**	**93**	**100**	**99**

Table 7.8 Percentage of contacts within 1, 2 and 5 minute walking distances

A similar comparison was conducted for social contacts and visual field from the entrance space of each household. It was found that 39% of total social contacts for each household in its neighbourhood were visible from its entrance spaces. However, when cases from towers and block type building form are excluded, this percentage increased further to 49% (see Table 7.9). It is obvious that tower and block-type layouts have very restricted visual fields in general, which is why it was thought worth excluding them to re-analyse the relationship of visual field and number of social contacts.

	Visits (adult)	Chat in the street (adult)	Recognise (adult)	Visit (children)	Chat in the street (children)	Total-contacts	Total-contact
Visual field	%	%	%	%	%	%	%
New Marston	62	50	57	5	44	53	
Thames St	51	37	49	58	11	40	49%
Holybrooks	13	37	41	-	-	46	
Dalgarno Gardens	17	19	15	50	50	21	
Parkview	14	22	0	50	25	24	26%
World's End	40	24	0	-	-	33	
Total	**39**	**36**	**37**	**37**	**31**	**39**	

Table 7.9 Percentage of contacts within visual field of entrance spaces

It should also be noted that the version of Depthmap program used for producing isovists from each front door is unable to model visual links in three dimensions or through a balcony and windows, limiting the isovist to within spaces that are both visible and accessible, rather than to visible spaces only.

When the social networks of adults in six neighbourhoods were looked at in the context of walking distance and visual proximities, it was found that about 37% of the people who responded reported simply to recognise those living within the visual field from their entrance spaces (Table 7.9). However, in the neighbourhood with higher visual integration, New Marston, this was found to be much higher, at 57%.

When comparing the various types of social contact with walking distances, about half (54%) of formal contacts were within a one-minute walk. Of informal contacts within a one-minute walk, the figure was about 65%. However, when the walking distance was increased to two minutes, these figures were similar at around 80% (78% of formal contacts and 81% of informal contacts).

In neighbourhoods with flats, the numbers of informal contacts for people were lower for than those who could see more households from their front door, as in a street layout. In fact people who live in houses with larger visual fields from the front door were found to have about four times more informal social contacts (2.66) than those living in flats (0.78), where on average they can see only three other doors

from their front door. It can be concluded from these findings that visual and physical proximities can improve the strength of social networks, since almost all social contacts are situated within a five minute walk from each other in a neighbourhood.

Neighbourhoods	Visual mean depth	Average mean depth between social contacts			
		Visit	Chat in the street	Recognise	Total
New Marston	3.484	2.7	1.3	1.1	1.65
Thames St	5.232	2.6	1.4	0.9	1.86
Parkview	4.268	2.3	1.7	0.5	2.1
Holybrooks	5.147	1.3	0.75	0.3	1.01
Dalgarno Gardens	4.571	1.98	1.6	0.3	1.7
World's End	6.123	4.72	1.15	0.73	4.02

Table 7.10 Mean depths and social contacts

Finally, the final question of whether the complexity of neighbourhood layout or ease of finding a neighbour affects the number of social contacts its residents have was addressed. To do this, spatial distances or step depth between households that have mutual social contact were compared. It was found that the mean depth between households in mutual social contact were very low in spread layout neighbourhoods such as New Marston (about 1.5), while in complex layouts it was much higher (see Table 7.10). The fact that New Marston, which has the lowest average mean step depth, has, on average, the highest number of social contacts per household, seems to suggest that lower mean step depth can increase the potential for social contacts within a neighbourhood. A correlation showed a significant relationship between mean step depth and social contact (R: -0.364, *p*-value: 0.01). That is, people living next to spaces with a higher mean step depth report lower numbers of social contacts. In a cross-comparison between neighbourhoods, all formal contacts were approximately about 2.3 steps away while informal contacts tended to be within 0.86 steps from a person's front door. Therefore informal contacts are found to be significantly closer spatially to the respondents while many of the formal contacts were spatially further away than the mean depth of the whole neighbourhood. It can also be concluded that locations from which all other locations are fewer steps away have larger numbers of social contacts. Therefore informal social contact is a phenomenon that is enhanced by physical, spatial and visual proximity.

When juxtaposed with the earlier finding, that there is a larger proportion of formal social contacts in higher density neighbourhoods (Table 6.12), this finding implies a distinctive pattern of the relationship of spatial relationships to social contacts in higher density neighbourhoods. That is, in higher density neighbourhoods, people overcome spatial depth, especially in complex layouts, by forming more formal social contacts. A high correlation between membership of formal organisations and formal contacts (R: 0.357, *p*-value: <0.01) especially in higher density neighbourhoods provides further evidence to support this. This indicates that strong social links, which might have resulted from shared values or memberships in formal organisations, may not be a spatial phenomenon and could be an attempt to overcome the lack of proximity.

Size of neighbourhood and social interaction

In the statistical analyses presented in the previous chapter (6), the average social contacts (normalised) were found to increase in neighbourhoods with larger numbers of households. However, in terms of actual numbers, they were found significantly lower than for low and medium density neighbourhoods. This brings us to the question of whether the lower number of social contacts in higher density neighbourhoods is a result of neighbourhood size. In higher density neighbourhoods, a significant number of people (56% of all respondents from such neighbourhoods) seem to perceive their neighbourhood to be larger than the one assumed in the research and marked in the questionnaire (Table 7.11).

It was found that about 56% of people living in high density and compact neighbourhoods perceive their neighbourhood to be bigger than that drawn in the questionnaire, while only 7% perceived their neighbourhood as smaller than drawn. In comparison, less than one third of the respondents in low and medium density neighbourhoods felt that the size of their neighbourhoods were bigger than those drawn in the questionnaire (32% in low density and 23 % in medium density). In a spread layout, such as New Marston and Parkview, 40 to 54% of people reported their neighbourhood as smaller than the pre-marked boundary. On examining the social contacts in questionnaire responses, it was also noticed that in some cases the respondents in the questionnaire from high density and compact neighbourhoods

marked some of their social contacts as outside the marked boundary of the neighbourhood area. These contacts were not included in the calculations for consistency's sake. In conclusion, it is obvious that people's perception of neighbourhood size is primarily a function of physical walking distance and accessible area, and is less connected to the actual density of the neighbourhood.

Density	Layout	Neighbourhoods	Smaller %	Same %	Larger %
Low density	Spread	New Marston	40	28	32
Medium density	Spread	Parkview	54	23	23
High density	Compact	World's End, Holybrooks, Dalgarno Gardens	7	37	56

Table 7.11 Size of neighbourhood, density and layout

It is possible that the observed lowering of actual social contacts in higher density neighbourhoods is due to the fact that they have most of their social contacts within five minutes walking distance, as was the case in low density spread layout neighbourhoods. This could not be investigated in the current research, as much of the neighbourhood was within a one or two minute walk in the compact neighbourhoods chosen for the study. This might mean that some of the respondents from the edge of the estate had lower number of accessible households within the predetermined neighbourhood boundary compared with to those who live in the centre of the neighbourhood. However, it should be noted that 1) most estates had strong boundaries (natural or man made) across which social contacts were found to be very weak in a previous study (Appleyard, 1981) and 2) the respondents were spread out within each neighbourhood, to give a fairly reliable and representative average number of social contacts for each neighbourhood.

Access to and quality of public space

During the observation survey of this research, it was noticed that there were higher numbers of social interactions in and around designated public spaces such as gardens and children's play spaces than in other spaces (Fig. 7.8) in high density neighbourhoods (Table 7.12). It was also notice that space with higher number of pedestrian movements had larger numbers of social activity (Table 7.12). This relationship between social interaction and pedestrian movements was found to be

significant in a Pearson's correlation test for significance (R: 0.454, *p*-value: 0.003). This indicated that general layout and location, and therefore accessibility, do influence the social interactions in public spaces. To examine the importance of location and accessibility of public spaces, a few examples of designated spaces and other types of public space from each case study were used to compare pedestrian movements, social interactions in the spaces, and their visual and global integration values.

Neighbourhoods		Number of pedestrians	Number of social interaction
New Marston	Other public space	14.7	9.0
	Designated pubic space	4.0	2.5
Thames Street	Other public space	13.3	5.33
	Designated pubic space	0.75	2.5
Parkview	Other public space	17.0	9.3
	Designated pubic space	4.2	6.8
Holybrooks	Other public space	23.67	7.33
	Designated pubic space	11.0	6.0
Dalgarno Gardens	Other public space	10.3	3.33
	Designated pubic space	0.67	3.7
World's End	Other public space	13.0	3.67
	Designated pubic space	11.6	8.4

Table 7.12 Average social interaction and pedestrian movement in public space

It was also observed that spaces, which are highly integrated globally, had a higher number of pedestrian movements (Fig. 7.4, Fig. 7.8). This relationship in a Pearson's correlation test had an R: 0.219, *p*-value: 0.175, which in space syntax research is considered significant. However, the relationship from this data set between visual integration and global integration to social interaction was not found to be significant. The reason is that spaces which are highly integrated, even though they have higher social interaction than the most segregated spaces, have less interaction than spaces which have moderate levels of visual and global interaction but are adjacent to a highly integrated space (see (Fig. 7.4, Fig. 7.8).

Evidence for this relationship between active communal space and active pedestrian route can be seen in Dalgarno Gardens (see Fig. 7.9), New Marston (Fig. 7.10) or in Parkview estate (Fig. 7.11). In most cases it is these socially active spaces, which themselves were found to be of moderate visual integration, which explain the poorer correlation in Pearson's test. Therefore it can be argued that spaces that are next to

routes with high pedestrian movement had more interactions than similarly sized but differently located spaces in the same estate.



Fig. 7.9 Dalgarno Gardens: social activities in public space adjoining pedestrian routes

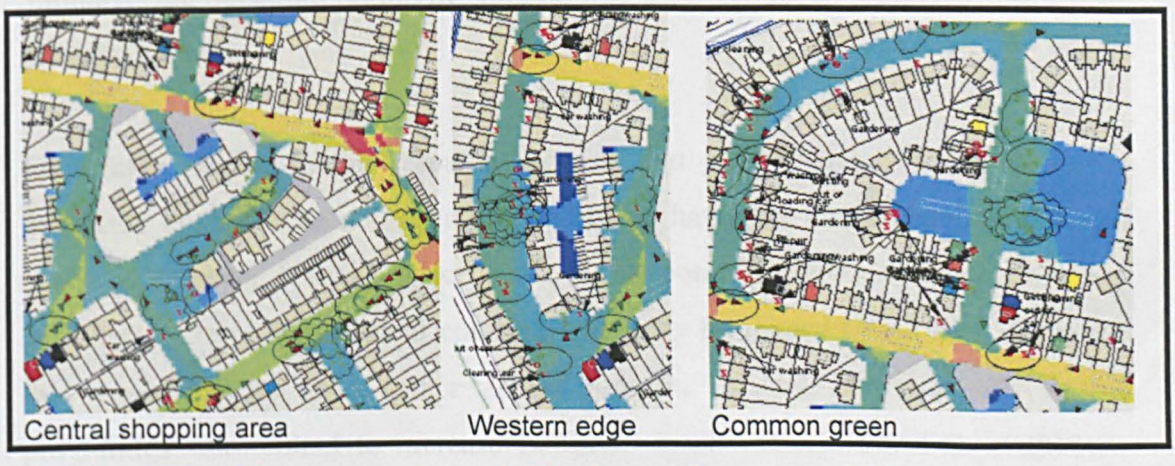


Fig. 7.10 New Marston: social activities in public spaces which are next to most active pedestrian routes

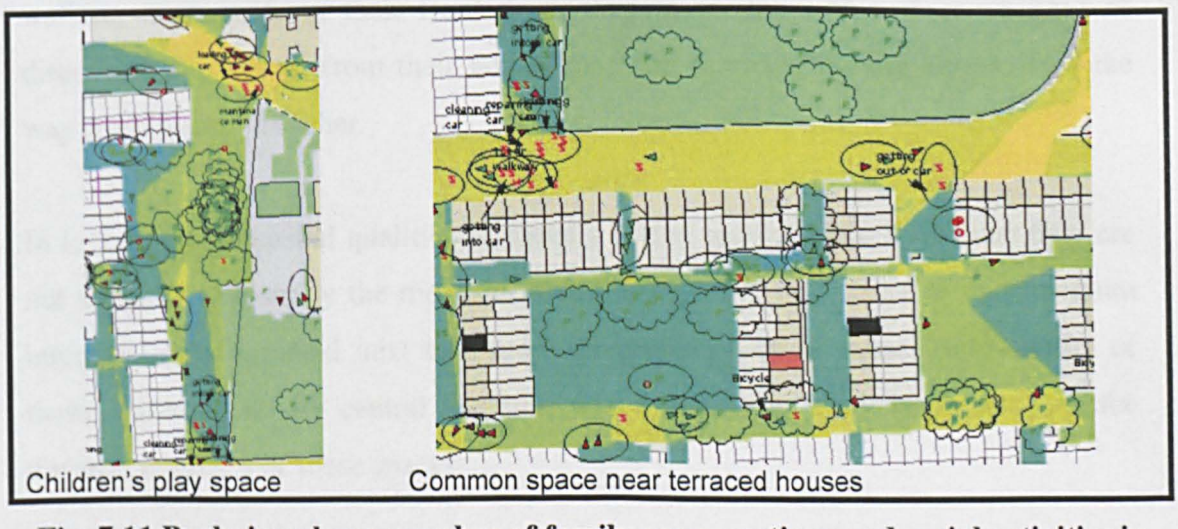


Fig. 7.11 Parkview: large number of family congregations and social activities in public spaces next to most active pedestrian routes

Further analysis using route choice maps, pedestrian density and spatial analysis was possible to investigate the relationship between pedestrian routes and social interactions in adjoining spaces but due to time limitations it was considered less important.

7.4 Conclusion

While density and layout are independent features of housing design, they are often entangled due to the associations of certain types of layout with certain densities. Layouts, and the resultant spatial configuration, directly account for the physical, spatial and visual proximities between spaces, and thus their spatial and visual integration. The evidence presented in this chapter clearly shows that location of a household influences the number of social contacts people in that household have. Similarly the location of public spaces was also found to influence the social activities in them.

Empirical evidence in this research suggests that people who live next to highly integrated spaces have a higher probability of having a larger number of social contacts. However, if such a space is also highly controllable from other spaces, they are likely to have fewer social contacts. This may be related to the lack of privacy that controllability from other spaces implies. Visual, physical and spatial proximities were found to increase informal social contacts between neighbours. While almost all of the social contacts which people have were within five minute walking distance from their front door, they were also within three changes of direction (step depth) from their house, meaning it was relatively easy to find the way from one to the other.

In looking at the spatial qualities of socially active spaces it was found that they are not necessarily visually the most integrated spaces, but tend to be of only medium integration and situated next to a more integrated space or route. Accessibility of these spaces (spatially central location) was found to be more important than the physical qualities of these spaces.

In conclusion, location and visual connection are important in fostering higher neighbourhood social contacts, irrespective of the neighbourhood density. Therefore careful layout and configuration of spatial structure can contribute to improving social interaction in neighbourhoods.

Chapter 8

Designing sustainable communities: a social perspective

8 Designing sustainable communities: a social perspective

8.1 Introduction

This final chapter discusses the findings of the research, with the aim of identifying implications and developing recommendations for designers and planners. The findings are discussed in the context of the current debate on sustainable urban form and government and research recommendations for urban and residential development. The chapter also discusses the limitations of this research, its potential to influence future policy and design guidance, and also identifies topics on which further research is required.

Compact development is regarded by many as the best model of future urban development (Breheny, 1997; Burton et al., 1996; Jenks et al., 1996; Williams et al., 2000) due to its environmental and economic benefits. Opponents argue that higher densities can be stressful to live in (Mitchell, 1971; Taylor, 1982; Webber, 1998), and can result in disintegration of communities. They advocate spread, low-density, development as most suitable to foster a good quality of life (Webber, 1998); they regard high density as a reason for social pathology (Baldassare, 1975). But there is little evidence to verify the social benefit or quality of life claims for low density suburban development.

Social interactions are vital in bonding a community together (Goldschmidt, 1972), and therefore it is regarded as important to have considerable frequency of social interaction to attain community cohesion, participation in the community and hence a viable and sustainable community. While some argue that density itself results in a higher number of social interactions, due to the proximity of people (La Gory and Pipkin, 1981), others claim that it can result in social disintegration, due to its implications of crowding. Investigations from previous research suggest that there

would be an optimal density within which a community would have desired levels of proximities, without the negative influence of over crowding. However, no research has investigated densities and their spatialisation (see Chapter 2), and their relationship to the formation of social networks and social relationships, to prove that high densities can cause social malaise.

This research specifically investigated social interaction and its relationship to density at a neighbourhood scale by taking into account how densities are realised spatially through the design of those neighbourhoods. This research aimed to contribute some empirical evidence to verify the claimed benefits and shortcomings in terms of community-building in high density urban neighbourhoods, to assess their potentials to create a sustainable community.

In this regard, proponents of high density claimed that proximity delivered by high density development can enhance social interaction in these neighbourhoods (see Chapter 3). To test these claims, six neighbourhoods of various of density were investigated by comparing the number of social interactions and social relationships in them with the aim of identifying the most suitable level of density (or spatial nearness) for bringing positive social interaction and thus a more socially sustainable community. The study looked at various types of configuration and form with a range of densities to assess their effects on social interaction. Statistical and spatial analysis carried out in this research therefore attempted to answer the following three specific questions:

- Is there a relationship between the density of the built environment and the frequency of social interaction in residential areas of cities?
- If so, what is the extent and nature of the social interaction, and how far is it influenced by various types of density?
- What spatial features of high-density housing encourage a sense of community and positive social interaction?

8.2 Summary of research findings

Relationship between the density of the built environment and the frequency of social interaction in residential areas of cities

In the analysis, total social contacts were found to have a negative relationship with density (see Section 6.4.1). However, when the social network was normalised by neighbourhood size, the relationship was found to be weak and insignificant. Moreover, detailed analysis found a non-linear relationship in which normalised social interactions were found to be higher in neighbourhoods with a density of between 70 and 80 dwelling/ha (see Section 6.4.1), above and below which they were lower. When potential interfering variables, such as socio-demographic characteristics of the population, were controlled, the relationships between the normalised social networks and density were found to be stronger. Multiple regression and partial correlation analysis were used at this stage to arrive at this conclusion (see Section 6.4.3). The most important interfering demographic and social variables were the co-presence of various user groups in the neighbourhood, attachment to place, sense of security and community spirit, while the most influential physical characteristics were building form and spatial layout. Here co-presence means the simultaneous presence of various user types, such as children and older people, in public spaces observed in the observation survey.

The extent and nature of social interaction, and the influence of density

Two significant findings from the analysis that examined the variations in social interactions across the various neighbourhoods were:

1. Low-density neighbourhoods were characterised by informal contacts and interactions
2. High density areas had more visible interaction per unit area of communal space

While all neighbourhoods were comparable in terms of number of strong relationships, there was a substantial difference in the number of informal interactions and friendships in them. Neighbourhoods that had a density below

80hh/ha had the highest number of informal contacts in the cases studied (see Section 6.4.2). In terms of percentages of different types of social contact, higher density neighbourhoods were found to have a larger share of formal than of informal contacts, than low density neighbourhoods.

Intensity of visible social activities in public space, conversely, was highest in high-density neighbourhoods. In low density neighbourhoods it tended to be spread out throughout the various types of spaces within the estate (See Appendix G and K).

Required spatial features of high-density housing to encourage a sense of community and positive social interaction

Total social contacts were considerably greater in the case of households nearer well-integrated spaces than in others (see Section 7.3.2). The former had significantly larger social networks. Therefore, people living next to segregated spaces in a neighbourhood, such as on higher storeys of high-rise buildings, had lower numbers of social contacts. From this, it was concluded that social interaction is positively enhanced by living in locations that are well integrated locally.

Interestingly, when the average integration of the whole neighbourhood was considered, those neighbourhoods that were highly integrated with their surroundings were found to have a lower frequency of social contacts. Possibly, over-exposure resulting in lack of privacy negatively affects social interactions between neighbours in these cases. However, further research is required to verify this hypothesis.

Visible social interactions were found to be highest in public spaces that are well connected and accessible from rest of the spaces in the estate. Social spaces that adjoin to well-connected pedestrian routes had the most number of social interactions. Social spaces and their locations were found to be most influential in facilitating informal interactions in high density neighbourhoods; such informal meetings are almost impossible if complexity of spatial layout often found in them to too great. In a detailed analysis using visibility graph analysis, the socially active spaces themselves were only moderately integrated, but often located next to a route or spaces with high visual integration, proving the importance of the location and

accessibility of communal space in facilitating community relationships. To support this finding the frequency of informal networks between immediate neighbours in lower density areas was greater than in high-density neighbourhoods which had fewer. The numbers of possible informal contacts in higher density areas seem to be limited, possibly due to the configuration of the dwellings and their form, as well as the nature and location of communal spaces. The variation in informal social contacts suggests that people living in higher density areas may be trying to overcome the problems of spatial segregation associated with that particular built form and layout by forming selective but strong relationships.

8.3 Limitations of the research

Although the main findings listed in Section 8.2 are significant, caution should be exercised in generalising from the findings, due to the limitations of the research. While care was taken to reduce the effect of interfering variables during the selection of case studies, identifying neighbourhoods in which social-demographic and spatial variables were similar in real life is challenging. The low response rate to the questionnaire was also a problem. Therefore complex statistical and spatial modelling was used to identify specific demographic and social characteristics. This can result in sampling errors, especially as response rates to questionnaires were low in some case study areas. However, all possible care was taken to achieve a reliable recommendation for optimal density. This included a comparison of findings from the questionnaire with those from observation of social interaction, as well as other indicators of social cohesion.

This was a neighbourhood level study, which looked at the physical attributes of the neighbourhoods and their relationship to social interaction. There was a lack of incentive for respondents to reply, and limitations on time and resources to increase the response rate, limited the possibility of triangulating all data. Due to this, analysis mainly focused on the spatial factors affecting the frequency of social contacts and interaction, rather than on exploring factors such as privacy and social tension. Modest response rates also meant that in-depth analysis using social network

analysis methods to identify the characteristics of social networks objectively was not possible.

To reduce the effect of cultural and regional variations, another potential interfering variable, this research was based in Southeast England. Therefore it is envisaged that the findings may be more relevant to Southeast England than elsewhere. One should be cautious in applying the findings to other regions of the UK or other parts of the world without cultural appropriateness.

8.4 Contribution to the sustainable communities debate

The relationship between social interaction and social and demographic variables is well established (Guest and Wierzbicki, 1999; Kirmeyer, 1978; Riger and Lavrakas, 1981; Schmidt, 1979; Schmitt, 1966). There is evidence that social interaction could be positively enhanced by community spirit, attachment to place (Tidwell et al., 1996) and sense of security (DTLR and CABE, 2001; Hourihan, 1979; ODPM and The Bartlett School of Planning, 2004; Pinto-Gouveia et al., 2003), and reduced by conflicts and social tension (Deutsch, 1969; Paquin and Gambrill, 1994; Sims et al., 1997). Similarly, Krupat (1985), identified three major 'glues' that bind people together and form communal ties are the family, proximity and common interest (p154). In various sociological studies on neighbourhood and neighbouring, informal contacts and interactions were found to enhance a positive perception of community cohesion (see Chapter 2).

Analysis showed that the intensity of social interaction and the frequency of social contacts were significantly affected by social demographic and cultural variations (Section 8.2). These social characteristics were mix of user groups, attachment to place, sense of security and community spirit. However, there is little research looking at the combined effect of spatial layout and these socio-demographic issues on social interaction. This research therefore identified the importance of these social and demographic issues at a local, neighbourhood level, and their relative relevance to density and spatial layout, in affecting social sustainability.

This research found that density by itself has least influence on social interaction; however, bring forward two major factors that are often entangled with density (see Chapter 2) as the most influential factors that affect social interaction and therefore social sustainability. These are 1) social/demographic characteristics and 2) spatial configuration of the neighbourhood.

In terms of social and demographic characteristics, analysis found co-presence of different age groups and user groups in the neighbourhood and in communal spaces to enhance the intensity of social networks and social activities in communal spaces. Neighbourhoods with larger social networks and social activities were also found to have a better sense of security, attachment to community, higher community spirit and therefore a positive community relationship. Thus it could safely be argued that co-presence of various user groups, by enhancing social relationships are vital in achieving a sustainable community. This need for integration of user groups for positive social cohesion has also other social benefits in terms of race-related crime, as reflected in some recent studies and opinions (Phillips, 2005; The Commission for Racial Equality, 2001). To achieve this inclusive community, neighbourhoods need to accommodate the needs of such user groups, which can be accomplished through careful and sensitive design.

In terms of spatial configuration of neighbourhoods, proximity is often mentioned in many studies as a vital component that binds people together (Krupat, 1985; La Gory and Pipkin, 1981; Zipf, 1949). However, the nature of these proximities was less well understood or used in identifying how and why certain high-density areas do not have the degree of social interaction and social cohesion that are claimed should generally be expected from the predicated proximity. In this research it was identified that not all high density neighbourhoods necessarily bring about optimal spatial and physical proximity, due to the complexity of the spatial layout often found in them which, as mentioned above, severely limits informal interaction. Therefore, the argument is to increase the density to achieve desired levels of proximity appropriate to the culture of the place, but not to a degree that will compromise privacy levels or bring negative perceptions such as overcrowding, to facilitate informal encounters. A previous study which looked at the perception of

privacy and density concluded that high density is most successful when the privacy of residents is supported by community spirit (Mulholland Research and Consulting, 2003). Community spirit as agued in Chapter 2, is related to social network and cohesion, thus it is agued that perception of privacy levels in high density neighbourhoods can be positive when they have appropriate social and spatial context. Spatial layout, independent of density, as argued in Chapter 2, could therefore be manipulated to achieve the levels of proximities to promote informal encounters or formation of strong ties. Therefore, this research argues that design of neighbourhoods has more potential to bring about community cohesion than it is currently credited with.

The findings in this research have therefore brought to the forefront the importance of spatial layout in the sustainable community debate. Along with optimum social and demographic characteristics, a more accessible spatial layout is vital for providing opportunity for ad-hoc or informal socialising and improving community relationships. Therefore, this research questions the argument that density is mainly responsible for 1) social problems and 2) the resulting lack of social cohesion and quality of life in many UK urban neighbourhoods, and argues that it is the spatial manifestations of density that are the real causes of problems, rather than density itself. In this context, it is argued that density can be increased without fear of creating socially problematic neighbourhoods by appropriate design of space to achieve desirable levels of social interaction, without compromising privacy, even in higher density neighbourhoods. Therefore, when the negative perceptions of density, such as compromising privacy or causing overcrowding are addressed by spatial and social means, there is a potential to create a sustainable community with better social cohesion within it.

8.5 Contribution to development of spatial research

Many previous studies have looked at social and demographic characteristics and their effect on social interaction/neighbouring, and there is some indication from them that spatial structure may affect social interaction; 'proximity' is often mentioned as a vital component in the formation of social relationships (Krupat,

1985; La Gory and Pipkin, 1981; Zipf, 1949). In a study which looked at office spaces, Penn et al (Penn et al., 1999) found spatial layout and proximities a means of forming working groups and working relationships. The relationship of proximity and spatial configuration in the formation of social relationships in urban neighbourhoods has been less studied and understood. There is also ample evidence from previous study at the neighbourhood level that housing layout, has a significant relationships to crime and vandalism (Hillier and Shu, 2000; Major et al., 1997; Shu, 1999). The recommendations from these studies suggest the importance of spatial layout in causing social problems in urban neighbourhoods, and that by manipulation of spatial configuration some of these problems can be addressed. This research adds to the argument that not only can space configuration be used in remedial actions for existing social problems, but also can proactively promote a suitable community, based on better social relationships between its members. By providing the evidence of the value of spatial configuration, this research demonstrates the importance of analysis of spatial configuration in social research and neighbourhood design.

In this study, spatial analysis found physical, spatial and visual proximities to be vital components in promoting higher levels of social contact and thus interactions, especially informal interactions, in urban neighbourhood; this is regarded as vital in enhancing social cohesion. Generally, neighbourhoods with locally well-integrated spatial structures were found to have better social networks, community spirit and sense of belonging. Centrality of communal spaces was found to beneficially influence the use people made of them. Therefore neighbourhoods with locally well-integrated spaces and structures were found to provide ample opportunities for social encounters, irrespective of their physical qualities, especially when they become part of or adjoin most-used routes. These findings and the methods of this investigation have important implications for research and design of urban neighbourhoods. It argues that some social problems are created by the spatial barriers, and therefore could be solved by sensitive design solutions. There is a need to investigate the spatial configuration of neighbourhoods to understand some of the social issues in them.

The research also identified some possible developments in use of the space syntax tool, which can be used in combination with social network analysis to look at a variety of issues in neighbourhood and urban social relationships, and to understand issues of privacy and community cohesion. These are listed in Section 8.9.

8.6 Implications for future policy

The need for sustainable urban development is outlined in Agenda 21 (United Nations, 1993). Taking into account the likely environmental, economic and social impact of human settlement, compact developments are highly recommended in many parts of the world, especially where land and resources are limited (see Chapter 1). In contrast, planning authorities and governments have long been promoting low-density development in countries such as the USA and Australia, where land constraints are not an issue. Even in such cases, experts agree that such development cannot go on forever (Song and Knaap, 2003) and there is opposition to and arguments against it. Proponents of the new urbanism argument with its unique urban character, are essentially presenting a case for higher density development (Dunham-Jones, 2000). Moreover, some new evidence from a research study carried out in the USA indicates that there is a popular reversal from suburban living because of which property values in so-called new urban developments have appreciated more than in low density suburbs (Song and Knaap, 2003).

The UK government's current guideline recommends a density of 20-30 households per hectare for green field development (DETR, 2000b). This is regarded as modest and is argued by many to achieve very little to conserve the land or resources or to achieve a sustainable urban form (Jenks et al., 1996). This 20-30hh/ha is lower than in pre-1930 housing (Jenks and Dempsey, 2005); in comparison, a typical inner London development has a density of 70 dwelling/ha and a typical Kensington and Chelsea street has about 200hh/ha, the most densely developed part of England (PRP Architects, 2002). The land and rental value of properties in Kensington and Chelsea shows that this high density did not make them undesirable locations to live; by contrast they are most sought after location in London.

The UK government in principle has adopted policies and strategies for densification, such as infill development (Jenks, 2000; Williams et al., 1996; Williams et al., 1998) and brownfield development (DETR, 1998a), and for denser and compact new developments (PRP Architects, 2002) to meet shortages of housing as well as to achieve long-term sustainability goals. It is generally agreed that there is a need for a step change in housing forms from the suburban semis of the 20th century (Falk and Rudlin, 1999). However, the recommendations of a density of up to 20-40 households per hectare as creating a high-density development on green field sites, and 40-60 households per hectare in inner city developments (DETR, 2000b) are rather modest approaches to achieving the desired step change. While most planning authorities, developers, and users agree that change is inevitable, the details of how to achieve this are contested.

This is mainly due to a cautious approach to densification because of apprehension that a higher density development will result in sink estates with the social problems often associated with such developments. Therefore planning policies today seek to protect housing and other development to ensure privacy and avoid excess densification and noise (Falk and Rudlin, 1999). One of the arguments against higher density always has been the social problems in such developments, reflected in lower community cohesion and relationships.

In the six cases studied in the South-East of England, it was found that a density of 70-80 households per hectare has the maximum potential to promote positive social interaction within a neighbourhood (see Section 6.4.1).

Analysis in Chapter 7 looked at various types of proximities in detail and their significance, to support the statistical analysis presented in Chapter 6, it shows that membership of associations and common interest were important in the formation of formal social ties. While proximity, which is related to spatial configuration, can therefore be considered independent of density (see Chapter 2), the two other factors (namely family and common interest) are understandably not directly related to density. This research argues that by sensitive policies and design, problems of proximity can be addressed and the desired levels of social interactions can be

achieved in a neighbourhood, producing positive social cohesion irrespective of density.

The spatial and statistical analysis in this research showed that through better spatial layout more opportunities can be provided for social interaction, and a better spatial structure can encourage the positive use of space and participation in the community. To make a consistent provision for ad-hoc encounters that can strengthen informal social interactions, there is also a need for mixed land use (with some retail or recreational uses along with residential) as well as easy-to-navigate spatial layouts; these encourage people to spend more time in their neighbourhoods. It is important to consider the implications for privacy and noise that may adversely effect neighbouring. But in general, mixed land use with some retail and recreation to support the local population, promoted in many sustainable development guidelines (DETR, 1998a; 2000b), can also have positive impact on neighbouring, and therefore should be part of the agenda to promote a sustainable community.

Length of residency has a strong correlation with social relations. Holybrooks, which had the lowest percentage of long-term residents, had the lowest level of community spirit and social cohesion, even though it was a mixed use and inner city development. Length of stay in a neighbourhood was related to community spirit and social networks (see Section 6.4.3). That is, longer periods of stay were found to increase community spirit, attachment to place and social network. This has implications for larger planning issues such as the relationships of travel patterns, employment, educational and other social infrastructure; when suitable, one can assume that people will stay in a neighbourhood for a longer period.

Housing areas with a lower number children or retired people were also found to have low levels of social interaction among neighbours. These are the sections of the population who use space more often, and were more visible in communal spaces in the neighbourhoods (see Appendix G). To encourage a variety of user groups to live in a neighbourhood, there is a need for a mix of housing types to encourage different user groups- older people and families with young children, owner-occupied housing and rental property- to avoid the problems of short stay residents, or clusters of

single socio-economic groups that can result in social decline. Some of these problems have been identified in previous research (Schmitt, 1966).

To bring about such a mixture of user types in a housing development, there should be a conscious attempt to provide spaces and social and physical infrastructure to support the needs of older people, families with young children and people with disabilities: a general principle for inclusive or universal design (Clarkson et al., 2003; DTLR and CABE, 2001; Preiser and Ostroff, 2002; Silverman et al., 2006). A recent study which looked at older people and people with dementia also recommended designs to tackle the needs of a large elderly population, (Mitchell et al., 2004; Mitchell et al., 2003) in order to allow people to continue living in their neighbourhood where they are most comfortable, rather than displacing them to special housing.

Similarly, some of the new evidence from research, and new theories about universal design and inclusive design strongly recommend mixed ownership patterns to encourage a mix of users, to promote their well-being and quality of life in general (Hinshaw, 2005; Neill and Schwedler, 2001). For example, new housing policy in Canada encourages mixing housing types to include older people's housing and special needs housing as part of the same development, rather than having separate blocks, buildings or campuses just for these users (Housing Connection, 2005). Such neighbourhoods, they argue, will support the needs of all users, rather than those of just one group.

In this context, greater density could be used positively, when manifested carefully, to create better opportunities for social interaction. This research recommends an optimal density, based on the statistical analysis, of 70-80 households per hectare to allow for such opportunities (see Section 6.4.1). However, the neighbourhoods should be carefully designed spatially to reduce the distance (spatial, physical and visual) between neighbours. Care should also be taken to increase neighbourhood densities gradually, since some user groups will find it difficult to cope with sudden change (Burton et al., 2004; Burton and Mitchell, forthcoming).

A summary of the recommendations for changes in development policies are listed in Table 8.1 below.

- Urban areas should promote increased densities gradually and consistently. The research findings tentatively suggest an increase to the 70-80hh/ha in SE of England. But this figure needs to be treated with some caution due to the nature of data from which it is derived. This density while recommended for the SE of England should be made culturally and socially appropriate when used in other parts of the world.
- Spatial configurations should carefully consider enhancing the potential for informal social interaction especially in higher density developments. Planning process should address the location of communal spaces, not just their quantity, in proposals for large-scale developments.
- Developments and redevelopments should promote socially active communities, therefore encourage accommodation of socially diverse groups. One possible way to achieve this is through mixed residential typologies (single bed to family houses) in larger developments, to allow a variety of user groups to settle in the neighbourhoods. This is recommended in some of the recent studies which look at families with children and new communities (Silverman et al., 2006)
- Spaces and physical infrastructure should have the ability to accommodate a variety of users, using principles similar to those of universal design and the liveable street. Strictly this is not a finding from this research; however, much previous research has indicated that if the required levels of social activities have to be achieved in public space, that space should support the needs of potential users (Clarkson et al., 2003; Preiser and Ostroff, 2002)

Table 8.1 Policies for urban intensification to address urban growth without compromising factors that affect quality of life

A sustainable development in general should try to promote positive social interactions, creating socially cohesive communities. This research provides a much-needed comprehensive overview of social and spatial factors that are vital in achieving a cohesive community. Some of characteristics of a neighbourhood that account for positive social interaction and community cohesion could be achieved by

appropriate policies; others could be achieved through sensitive design. Section 8.7 examines the implications of these findings on the future design of sustainable communities.

8.7 Implications for future design practice

Communal spaces were always regarded as vital in neighbourhoods (Appleyard, 1981; Boyer, 1994). This research found neighbourhoods with well-integrated communal spaces provide ample opportunities for social encounters. Even though provision for communal spaces was not questioned in previous policies and urban design guidelines, few have identified the significance of their location in achieving a successful and thereby well-used space. This research found two important pieces of evidence to show that communal spaces can be pivotal in promoting social cohesion. 1) Individual households located in a well-integrated area, that is one that is fewer steps away spatially from all other houses in the neighbourhood, were found to have larger social networks 2) communal spaces which are next to well-integrated pedestrian routes were better used and had more mixed user groups within them.

Proximity is often identified as vital in the formation of social relationships (Krupat, 1985; Zipf, 1949). The analysis in Chapter 7 showed that, along with spatial proximities, physical and visual proximities could enhance social cohesion in urban neighbourhoods. Almost all of the social contacts of respondents in this research were found to be within five minutes' walk from each other. Findings also indicate that higher density doesn't by proxy bring proximity; visual and physical proximity are pre-requisite to promoting social relationships. Physical and visual proximities can be achieved even in difficult circumstances when their need and importance are considered in the design process. While higher densities could easily provide better physical proximities than lower in a neighbourhood, care should be taken to design a simple layout to achieve both visual and spatial proximity. Failing in this could result in segregating people and spaces from one another, regardless of density.

The configuration of spaces can also accentuate local movement and social activity, especially when routes and communal spaces overlap. These movements and shared

activity spaces were found to provide ample opportunity for informal interaction. In some of the six case study neighbourhoods, there were too many choices and alternative paths, which effectively reduce the chance of ad-hoc social encounters. In others, communal spaces were located in a segregated corner of the estate, and soon became vandalised due to lack of natural surveillance. Therefore spatial centrality of communal spaces could increase the intensity of social activities, which in turn may encourage more people to participate in them.

- Developments should have spatial, visual and physical integration of spaces within a neighbourhood. Local integration of spaces is vital in achieving active social spaces in a neighbourhood. These are important in promoting social interactions and therefore social cohesion.
- Neighbourhood layout should avoid complexity, as this was found in previous research (Conroy, 2001) as well in this research, to be unfriendly for people to use or navigate by.
- Larger developments should avoid a spatial layout which segregates neighbours (such as gated developments); these create exclusivity and discourage ad-hoc social interactions.
- Accessible and centrally located communal spaces should be encouraged rather than those in segregated locations. Such spaces were found in this research to be more active than those in segregated locations.
- Location of all types of communal spaces should aim to achieve visual and spatial linkages to other public and semiprivate spaces. Communal spaces so located were found in this research to be important both for access and to generate intensity of social activity.
- Consideration should be given to privacy; the lack of it has some implications for the formation of social relationships and interactions, as found in this research.

Table 8.2 Design recommendations for urban neighbourhoods

The benefits of the presence of different user types to improve social cohesion have been discussed above. However, these can be realised only if the physical spaces are designed to accommodate a variety of users, including disabled, older and younger people. It is therefore important to think about usability, accessibility and

inclusiveness when designing the layout and spaces of a neighbourhood. Many previous studies have looked at the physical requirements of such spaces. These have resulted in recommendations and concepts such as universal design (Clarkson et al., 2003; Preiser and Ostroff, 2002), the liveable street (Appleyard, 1981) and neighbourhoods for life (Burton et al., 2004; Burton and Mitchell, forthcoming; Mitchell et al., 2003). This research, whilst accepting most of these concepts and principles, reiterates the importance of spatial layout to achieve them.

Local movement could be increased further if there were facilities and services such as shops and schools within the local area, as in three of the six neighbourhoods studied in this research. Therefore it is sensible to encourage mixed-use developments for both practical reasons well as the social benefits such land use could bring.

A summary of design recommendations arising from this research is listed in Table 8.2 above.

8.8 Implications for future management of urban areas

A general grievance picked up during the questionnaire survey was the poor maintenance and quality of public/communal space. There was a lot of unhappiness about how insensitive or slow to react the management system was, especially in high-density neighbourhoods. In these neighbourhoods people often felt helpless and that the management system was outside their control.

It would be simpler and more responsive if the management system were based on community participation. Not only would that empower the users who could thus take decisions based on their needs and perceptions, but it would also ensure participation in the community, and therefore help to increase social networks and memberships of informal groups. Such participation and empowerment could also result in increased social activities and events in the community. Active community participation in management would also ensure that funding is allocated for up-keep of the physical environment in which the community is most interested.

This research looked at the problem of lack of social ties in neighbourhoods by focusing on spatial and architectural issues. However, there are many critics of such architectural and spatial determinism. While this research accepts that architecture and design alone may not be enough to solve the problems of society, it argues that spatial aspects are an integral aspect of the answer, often overlooked in many social and social psychology studies.

8.9 The future

The research investigated six neighbourhoods in South-East England to answer specific questions. However, there is a need to expand this research to include a larger set of case studies to verify its findings, as well as to look further into possible regional and cultural variations. It is envisaged that there are likely to be variations in what is an acceptable density in different cultural and local settings. For example, the recommended density of 70-80 dwellings per hectare would be considered too low in the context of many South-East Asian countries. Further research is therefore required to establish cultural and regional variations in perceptions of density in order to form national and regional strategies for the design of higher density neighbourhoods that are sustainable communities.

The problem of overexposure may reduce the potential of neighbourhood contacts due to lack of privacy in semiprivate spaces. Further analysis of this is possible by the use of the dataset of this research to explore the relationship between spatial layout, privacy and social interaction.

While neighbourhoods with densities of between 70-80 households per hectare were found to have the maximum social interaction, additional research is required to verify the effects of various spatial layouts such as street and courtyard, as well as built form, from high to low rise, to identify their effects on social interaction within a particular density range.

On a broad scale, efforts are also required to develop a single repository of all principles of sustainable development from existing studies, as well as to collate other design principles such as universal design, which at the moment are only fragmented pieces of information.

One of the major problems which this research faced is modelling social and spatial variables together. While GIS tools to some extent combine syntactic data and social questionnaire data, spatial modelling of social networks was not possible. It is suggested that a lot could be learned by looking at the spatial distribution of social networks. This could start in earnest if there were an integrated tool-kit to model spatial and social networks, together with other variables. If developed, this could be effective in managing data and taking informed decisions as early as in the design stage of future developments and redevelopments.

The present version of Depthmap does not include a statistical module, normally a very useful tool, as found in the Axman program. There is also a need for some additional tools in Depthmap to quantify spatial characteristics of non-orthogonal spaces, at the moment a tedious and time-consuming task. The metric step distance calculation in three-dimensional models (linked floor plans) in Depthmap was a bit inconsistent, and needs to be addressed. There is a need to think about the potential for developing three-dimensional isovist analysis methods, assuming that the computing power of PCs will increase further.

While the proponents of low density development are critical of higher density development, the claimed social benefits of low density development are in fact related to their spatial quality. These benefits include a highly visible spatial structure, which not only gives a feeling of spaciousness but also ample opportunity to form social relationships with neighbours. Given the right social context, careful and sensitive design of a high density neighbourhood can achieve the same or more positive aspects which have been associated with low density development. Such high density neighbourhood design can promote social cohesion and spatial integration and provide a socially sustainable community.

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Appendix A: Questionnaire

Appendix B: Observation survey notations

Appendix C: Survey checklist

Appendix D: Introduction to case study areas

Appendix E: Correlation matrix of all variables

Appendix F: Short-listed variables and correlations tables

Appendix G: Collated Observation data

Appendix H: Example of isovist and metric distance calculations using Depthmaps

Appendix I: Axial maps of six case studies

10 minute walk model

Model of all spaces in neighbourhoods

Appendix J: Visibility Graph Analysis (VGA) models

Appendix K: Combined model

VGA, and social interaction

Axial maps with interaction

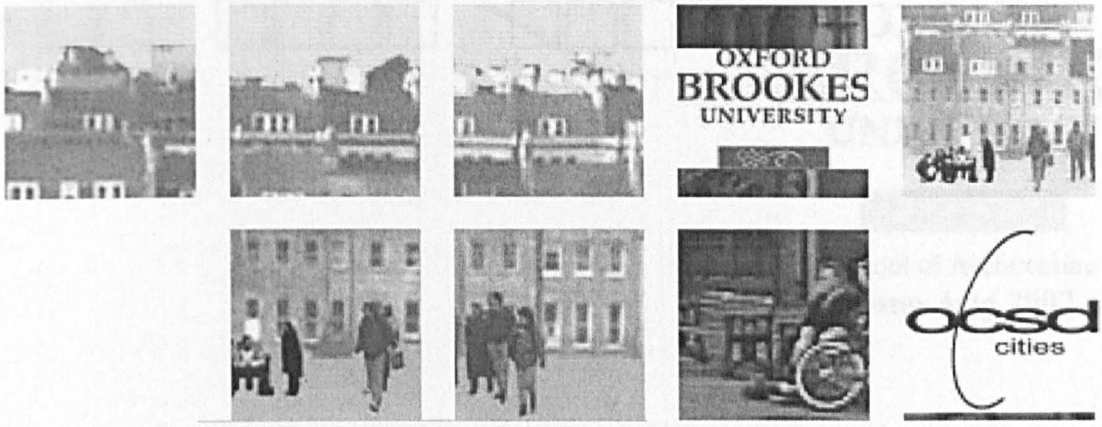
Appendices

Appendix A

Information leaflet

Questionnaire

Call back leaflet



Your local neighbourhood: is it a friendly place to live?

Dear Occupier
I am writing to ask you to help me with important research being carried out in the Postgraduate Research Shool of the Department of Architecture at Oxford Brookes University.

Purpose of this survey

Many people think that it is a good idea to build higher density, mixed use neighbourhoods to meet the needs of new housing. They say that people in higher density housing such as flats and terraces are more likely to know or bump into their neighbours. But are higher density areas really more friendly? This is what we intend to find out through this research.

We hope the research findings will be used to help architects, urban designers and planners create urban neighbourhoods that are friendly and enjoyable place to live.

How you were selected

We are asking all of the residents in a total of 10 neighbourhoods in the south east of England to participate in the questionnaire survey. The neighbourhoods were chosen to give us a range of types of houses, layouts and locations.

How you can help

We would be very grateful if you could spare 10 minutes to fill the enclosed questionnaire. I will call back next Saturday or Sunday to collect the completed questionnaire or answer any queries you might have.

Confidentiality and Anonymity

We can assure you that the information you provide will be treated confidentially, anonymously and that your name will not be associated with the completed questionnaire.

Further information

If you would like more information about the research please visit the survey website:

http://wwwusers.brookes.ac.uk/p0072955/survey/

Alternatively you may contact:
Shibu Raman School of Architecture Oxford Brookes University Gipsy Lane Campus Oxford OX3 0BP Tel: 01865 484296 Email: skraman@brookes.ac.uk

Thank you very much for your help.
We hope you will find the survey interesting.

Serial No ☐☐ Case study code ☐☐☐☐ Address ☐☐☐☐ Flat/House no

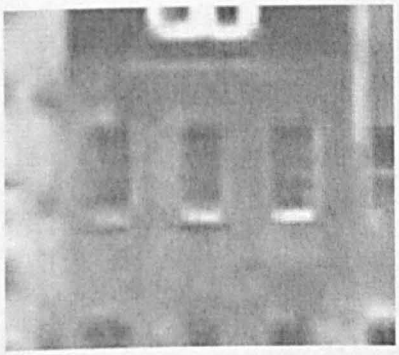
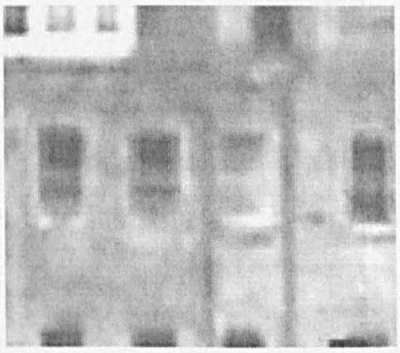
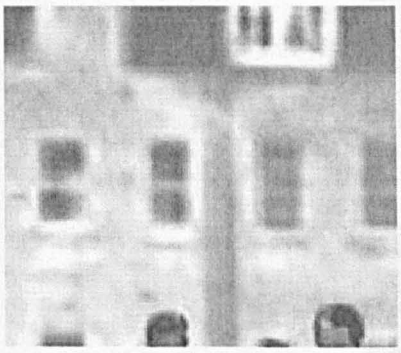
OXFORD BROOKES UNIVERSITY

School of Architecture

June-Aug 2002

Your local neighbourhood:

Is it a friendly place to live?




We can assure you that the information you provide will be treated confidentially, anonymously and that your name will not be associated with the completed questionnaire.

Please use ticks ☑

OXFORD
BROOKES
UNIVERSITY
School of Architecture

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First of all some questions about your neighbourhood

1. How would you rate the quality of the environment (including buildings, roads and pavements) in your neighbourhood?

Very good	☐	1
Fairly good	☐	2
Neither good nor bad	☐	3
Fairly bad	☐	4
Very bad	☐	5
Can't say	☐	6

Please tick one box

2. In general, how satisfied are you with your neighbourhood as a place to live?

Very satisfied	☐	1
Fairly satisfied	☐	2
Neither satisfied nor dissatisfied	☐	3
Fairly dissatisfied	☐	4
Very dissatisfied	☐	5
Can't say	☐	6

Please tick one box

3. How safe is your neighbourhood?

Very safe	☐	1
Fairly safe	☐	2
Not very safe	☐	3
Not at all safe	☐	4
Can't say	☐	5

Please tick one box

4. In general, how would you rate the quality of life in your neighbourhood?

Very good	☐	1
Fairly good	☐	2
Neither good nor bad	☐	3
Fairly bad	☐	4
Very bad	☐	5
Can't say	☐	6

Please tick one box

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5. For the local neighbourhood, how would you rate each of the following?

Please tick one box in each row

	Very good	Fairly good	Neither good nor bad	Fairly bad	Very bad	Can't say	
Quality of housing	☐	☐	☐	☐	☐	☐	1
Condition of the buildings	☐	☐	☐	☐	☐	☐	2
General appearance of the neighbourhood	☐	☐	☐	☐	☐	☐	3
Condition of the outside areas (such as roads and pavements) in the neighbourhood	☐	☐	☐	☐	☐	☐	4
Public transport	☐	☐	☐	☐	☐	☐	5
Public facilities (such as libraries, parks, playgrounds)	☐	☐	☐	☐	☐	☐	6
Sports and recreational facilities	☐	☐	☐	☐	☐	☐	7
Facilities for children and young people	☐	☐	☐	☐	☐	☐	8
Local shops	☐	☐	☐	☐	☐	☐	9

6. Thinking about the density of your neighbourhood, would you say your neighbourhood has a...

Please tick one box

- Very high density ☐ 1
- High density ☐ 2
- Medium density ☐ 3
- Low density ☐ 4
- Very low density ☐ 5
- Can't say ☐ 6

7. Thinking about the height of the local buildings, would you say your neighbourhood is...

Please tick one box

- Mainly high rise ☐ 1
- Mainly medium rise ☐ 2
- Mainly low rise ☐ 3
- Can't say ☐ 4

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8. On what floor level is your front door? _____

9. How many floors does your building have? _____

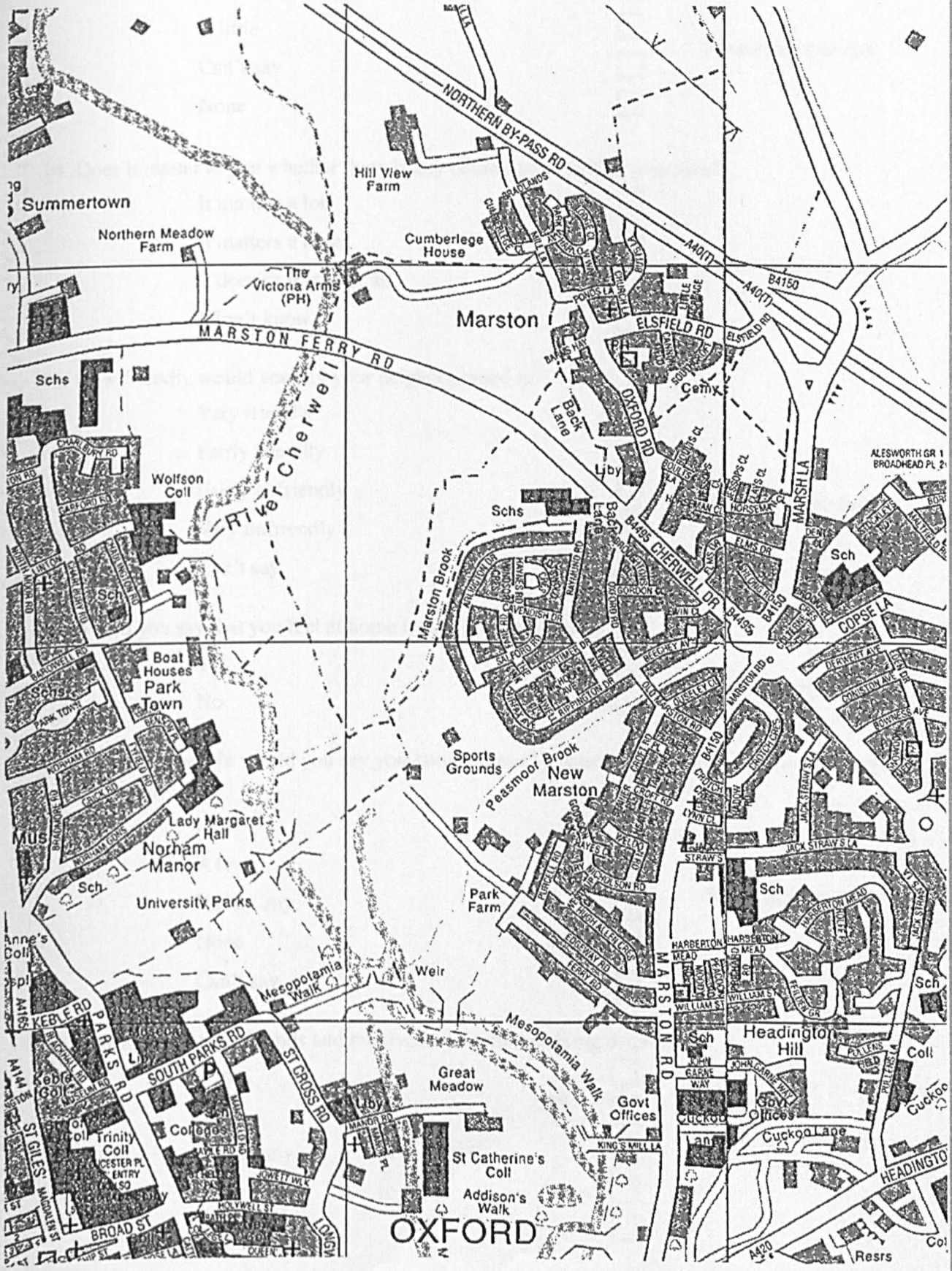
10. How many floors does your home have? _____

11. Does your house have any of the following

Please tick all that apply

- A garden ☐ 1
- A patio or yard ☐ 2
- A roof terrace or large balcony ☐ 3
- Other _____ (please specify) ☐ 4

12. This map shows a one mile area around your home. Can you draw a line around the area you consider to be your neighbourhood?



And now some questions about the friendliness of your neighbourhood

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13. How much community spirit would you say there is in your neighbourhood?

A lot	☐	1
A little	☐	2
Can't say	☐	3
None	☐	4

Please tick one box

14. Does it matter to you whether there is any community spirit in your area?

It matters a lot	☐	1
It matters a little	☐	2
It doesn't matter at all	☐	3
I don't know	☐	4

Please tick one box

15. How friendly would you say your neighbourhood is?

Very friendly	☐	1
Fairly friendly	☐	2
Fairly unfriendly	☐	3
Very unfriendly	☐	4
Can't say	☐	5

Please tick one box

16. Would you say that you feel at home in this neighbourhood?

Yes	☐	1
No	☐	2

Please tick one box

17. How many people would you say you know (either by name or you speak to) in your neighbourhood?

A lot	☐	1
A few	☐	2
Hardly any	☐	3
None	☐	4
Can't say	☐	5

Please tick one box

18. How many of your friends and relatives live within walking distance?

A lot	☐	1
A few	☐	2
Hardly any	☐	3
None	☐	4
Can't say	☐	5

Please tick one box

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19. On the whole, how many of your friends and relatives live within this neighbourhood?

A lot	☐	1
A few	☐	2
Hardly any	☐	3
None	☐	4
Can't say	☐	5

Please tick one box

20. How many new friends have you made by living in this neighbourhood?

A lot	☐	1
A few	☐	2
Hardly any	☐	3
None	☐	4
Can't say	☐	5

Please tick one box

21. How many neighbours do you visit now and then?

A lot	☐	1
A few	☐	2
Hardly any	☐	3
None	☐	4
Can't say	☐	5

Please tick one box

22. How many of your neighbours do you typically stop and chat to when you run into them?

A lot	☐	1
A few	☐	2
Hardly any	☐	3
None	☐	4
Can't say	☐	5

Please tick one box

23. How many of your neighbours who live near you say "hello" to you when you meet them in the street?

A lot	☐	1
A few	☐	2
Hardly any	☐	3
None	☐	4
Can't say	☐	5

Please tick one box

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24. How much privacy do you feel have from your neighbours?

I have plenty of privacy	☐	1
I have some privacy	☐	2
I have very little privacy	☐	3
I have no privacy	☐	4
Can't say	☐	5

Please tick one box

25. How much privacy do you feel have from passers-by?

I have plenty of privacy	☐	1
I have some privacy	☐	2
I have very little privacy	☐	3
I have no privacy	☐	4
Can't say	☐	5

Please tick one box

26. Thinking about the noise that your neighbours make, which of the following statements best describes your situation?

The noise that neighbours make is often a problem	☐	1
The noise that neighbours make is sometimes a problem	☐	2
Neighbours are occasionally noisy but it doesn't matter to me	☐	3
The neighbours are generally quiet - they don't disturb me at all	☐	4
I can't say whether or not my neighbours are noisy	☐	5

Please tick one box

27. How often do you get irritated with your neighbours?

Always	☐	1
Often	☐	2
Sometimes	☐	3
Never	☐	4
Can't say	☐	5

Please tick one box

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28. Is there a tenant or residents association in your neighbourhood?

Yes	☐		1
No	☐	*Please tick one box*	2
Don't know	☐		3

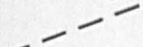
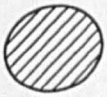
29. If YES, are you a member of this association?

Yes	☐		1
No	☐	*Please tick one box*	2
Not applicable	☐		3

30. On page 11 is a detailed map of the immediate neighbourhood of your house/flat. Can you kindly mark with the following letters the location of friends, relatives and people you know in the neighbourhood?

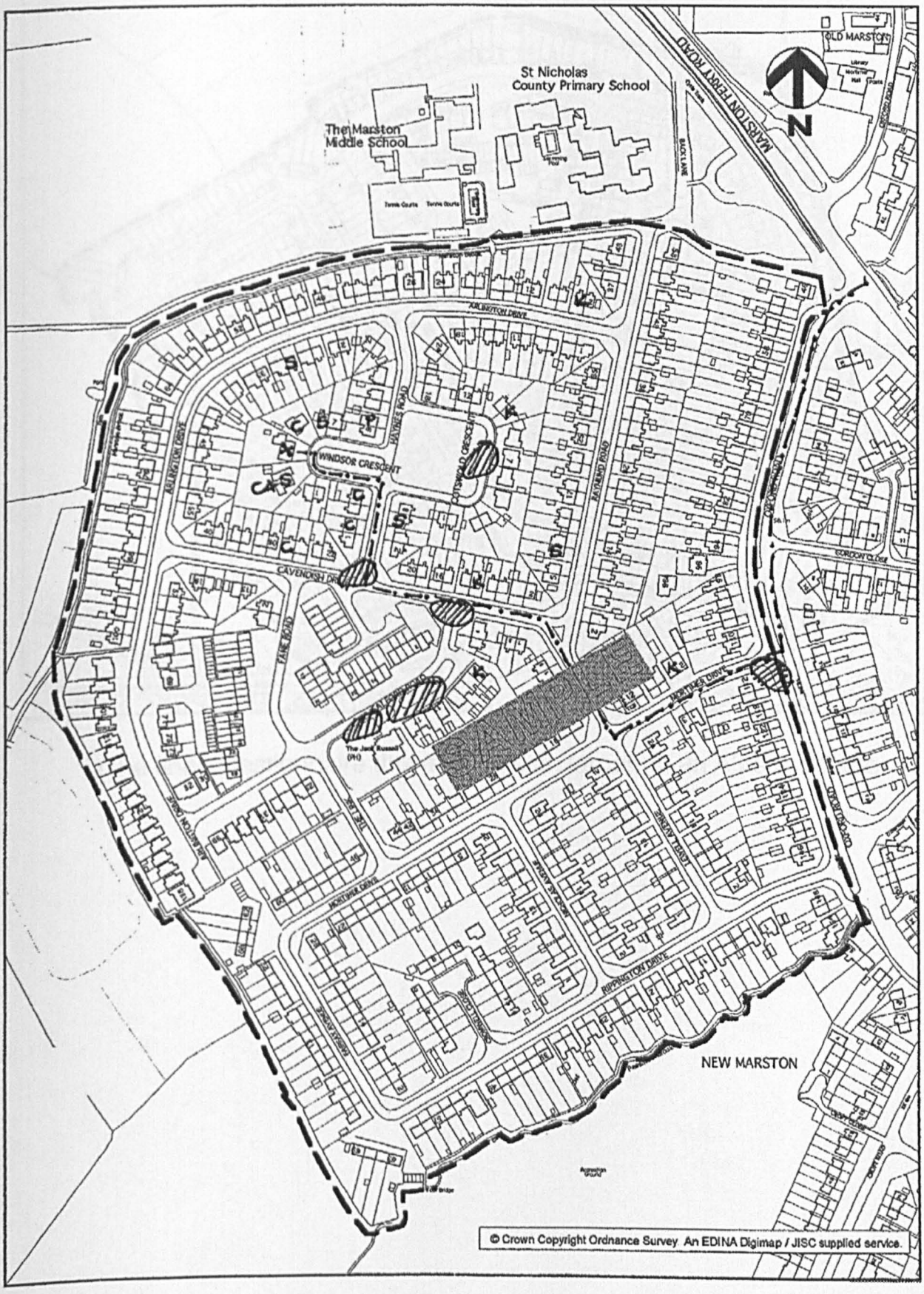
X	Location of your house
S	Someone you visit
T	Someone you chat to on the street
K	Someone you would recognise on the street but don't know well enough to visit or chat to
C	Someone your child/children visit (only if have child/children)
P	Someone your child/children chat to on the street (only if have child/children)

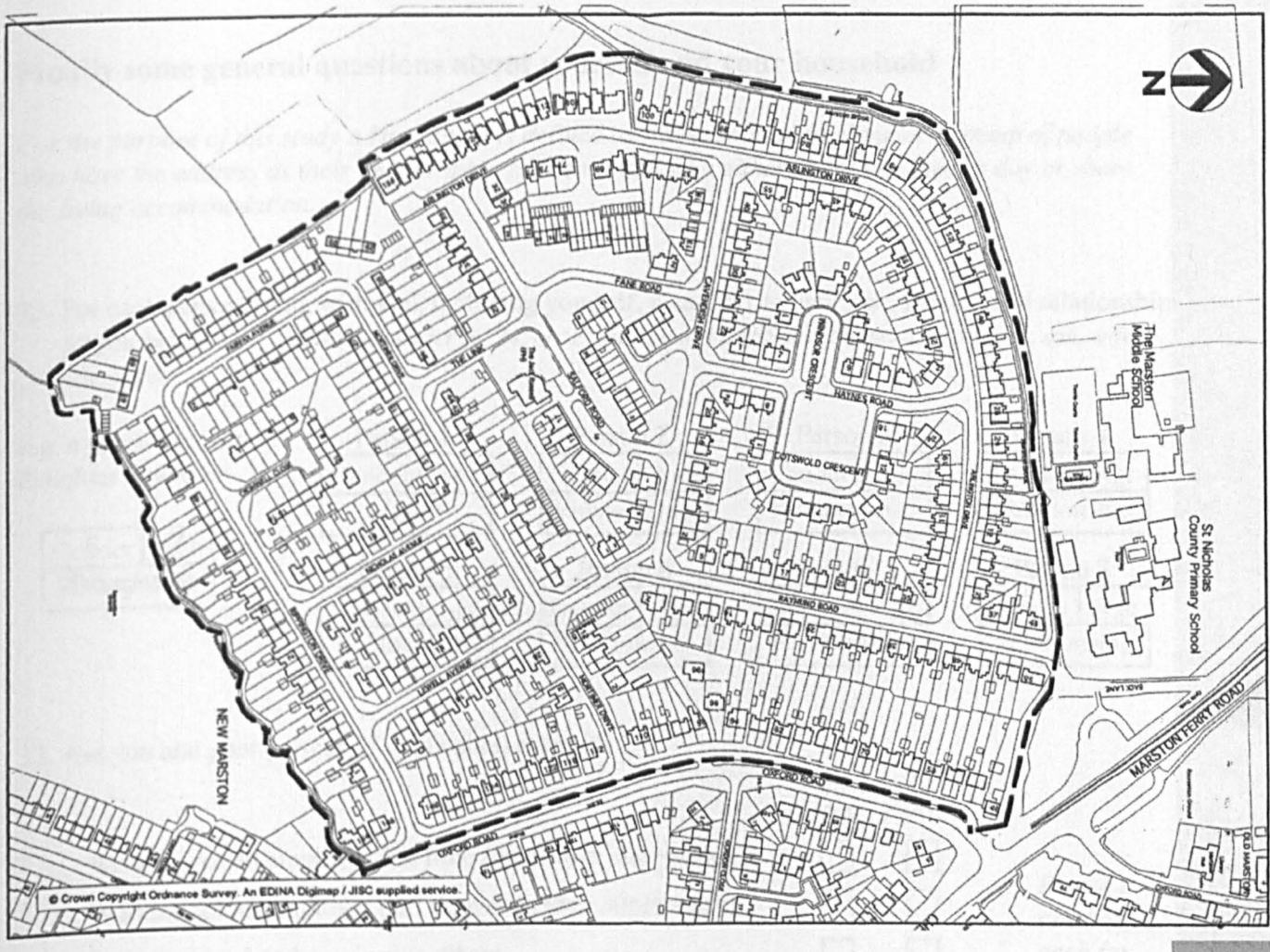
31. Now can you mark on the same map the route you most often take while going out of your neighbourhood on foot or by car as well as spaces within your neighbourhood where you are most likely to meet your friends or people you know. (Again use the symbols below)

	(Dotted line)	Usual route
	(Shaded area)	Spaces where you are most likely to meet your friends or people you know.

(Please refer to the completed example map in page 10)

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in the final questionnaire this map was on larger on an A3 sized paper

for office use

Finally some general questions about yourself and your household

For the purpose of this study a Household is defined as "a person living alone or a group of people who have the address as their only or main residence and who either share one meal a day or share the living accommodation.

32. For each person living with you, including yourself, please write their age, gender, and relationship to you below... *Write the gender as 'M' or 'F' the age in YEARS and the relationship e.g. son, wife, friend, etc.*

e.g. a seven year old daughter would be

Gender	Age
F	7
Daughter	

Person 1		Person 2		Person 3		Person 4	
Gender	Age	Gender	Age	Gender	Age	Gender	Age
Myself		Relationship		Relationship		Relationship	

Person 5		Person 6		Person 7		Person 8	
Gender	Age	Gender	Age	Gender	Age	Gender	Age
Relationship		Relationship		Relationship		Relationship	

33. Are you and your partner (if applicable) currently...

	You	Partner
Working for an employer full time (more than 30hrs/week)	☐	☐
Working for an employer part time (less than 30hrs/week)	☐	☐
Self employed and employing others	☐	☐
Self employed, not employing others	☐	☐
Unemployed (looking for job)	☐	☐
Looking after home or family	☐	☐
In full time education	☐	☐
Unable to work because of long-term illness or disability	☐	☐
Retired	☐	☐
Other_____ (Please specify)	☐	☐

Please tick one box each for you and your partner

34. Please give the full title of your job_____

35. Please specify the industry you are employed in_____

36. Number of cars/vans in the household ☐☐

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37. Please specify your household income

Please tick one box

- Below £14,999 per year ☐ 1
- £15,000-£24, 999 per year ☐ 2
- £25,000-£34, 999 per year ☐ 3
- £35,000-£44, 999 per year ☐ 4
- £45,000 and over per year ☐ 5

38. How long have you lived in this flat/house?

Please tick one box

- Less than 6 months ☐ 1
- 6 months, less than a year ☐ 2
- 1 year, less than 2 years ☐ 3
- 2 years, less than 5 years ☐ 4
- 5 years, less than 10 years ☐ 5
- 10 years, less than 20 years ☐ 6
- 20 years, less than 30 years ☐ 7
- 30 years or more ☐ 8

39. How long have you lived in this neighbourhood?

Please tick one box

- Less than 6 months ☐ 1
- 6 months, less than a year ☐ 2
- 1 year, less than 2 years ☐ 3
- 2 years, less than 5 years ☐ 4
- 5 years, less than 10 years ☐ 5
- 10 years, less than 20 years ☐ 6
- 20 years, less than 30 years ☐ 7
- 30 years or more ☐ 8

40. Do you own or rent your present flat/house?

Please tick one box

- Own outright ☐ 1
- Own with a mortgage or loan ☐ 2
- Own part rent and part mortgage ☐ 3
- Rent ☐ 4
- Lodging ☐ 5
- Other_____(please specify) ☐ 6

Comments:

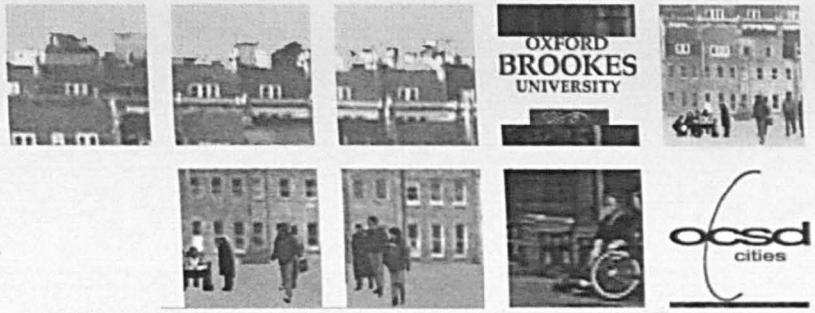
Thank you very much for your help and time

Further information

If you would like more information about the research please visit the survey website:

http://wwwusers.brookes.ac.uk/p0072955/survey/

Alternatively you may contact:
Shibu Raman School of Architecture Oxford Brookes University Gipsy Lane Campus
Oxford OX3 0BP Tel: 01865 484296 Email: **skraman@brookes.ac.uk**



Your local neighbourhood: is it a friendly place to live?

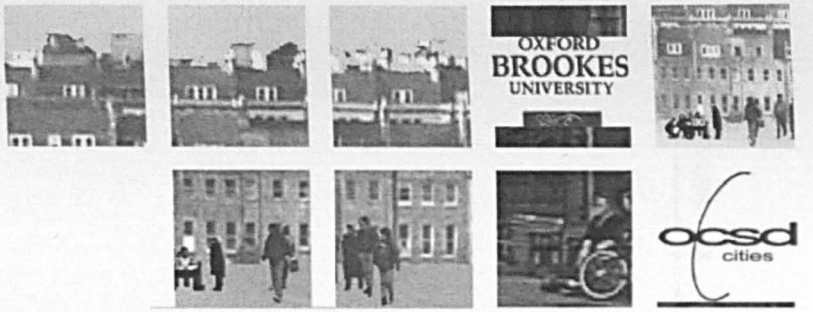
Dear Occupier
I called last week with a questionnaire, requesting your help in a research project. Unfortunately I didnot meet you at that time and hence I dropped the questionnaire at your door/post box. If you have no objection in filling out the questionnaire please use the attached self-addressed post-paid envelope to return it to me.

Thank you very much for your help in advance.

Shibu Raman
School of Architecture
Oxford Brookes University
Gipsy Lane Campus
Oxford OX3 0BP
Tel: 01865 484296 Email: skraman@brookes.ac.uk

Confidentiality and Anonymity
We can assure you that the information you provide will be treated confidentially, anonymously and that your name will not be associated with the completed questionnaire.
Further information
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http://wwwusers.brookes.ac.uk/p0072955/survey/



Your local neighbourhood: is it a friendly place to live?

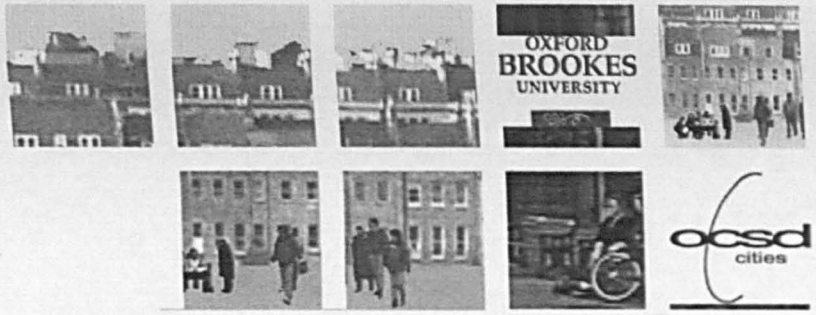
Dear Occupier
I called last week with a questionnaire, requesting your help in a research project. Unfortunately I didnot meet you at that time and hence I dropped the questionnaire at your door/post box. If you have no objection in filling out the questionnaire please use the attached self-addressed post-paid envelope to return it to me.

Thank you very much for your help in advance.

Shibu Raman
School of Architecture
Oxford Brookes University
Gipsy Lane Campus
Oxford OX3 0BP
Tel: 01865 484296 Email: skraman@brookes.ac.uk

Confidentiality and Anonymity
We can assure you that the information you provide will be treated confidentially, anonymously and that your name will not be associated with the completed questionnaire.
Further information
If you would like more information about the research please visit the survey website:

http://wwwusers.brookes.ac.uk/p0072955/survey/



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Appendix B

Observation Survey Notations

Observation Schedule

(Observation day checklist and instructions)

Tools

1. Large-scale map of the study area (scale 1:1250 or 1:2500)
2. Colour pens
3. Clipboard
4. ID card

Preparation before the observation day

1. Print out 11 copies of map of study area
2. Draw convex spaces within the study area into zones.
3. Pre-plan a continuous route, which covers all the convex space zones in a most effective way.
4. Print out a smaller scale map with pre-planed route marked on it.

Method

An observer on foot will walk through the pre-planned route marking on the map all the activities in the neighbourhood. Areas covered will include all the public areas such as streets, public squares, parks, car parks as well as observable semi-private spaces like front gardens, balcony, terraces which are visible from the public spaces.
Activities of children and adults are to be marked separately using codes as below.

Time and period of observation
Observation will be done on a working day (Friday) as well as a weekend (Saturday). The observation will start at 8.00am and will end at 7.00pm.

Codes for marking the activity
Use a red colour pen for adults and green for children for all the symbols

▷	Moving pedestrian in the direction of arrow
○	Sitting person/ child
P	Playing person/ child
S	Standing person/ child
⬭	Group in conversation
☁	Group playing

Appendix C

Survey Checklist

Questionnaire survey

(Survey day checklist and instructions)

Tools

1. Questionnaires
2. Leaflets
3. Envelopes
4. ID card
5. Map with address codes for marking the coverage and avoid cross posting

Preparation before the survey

1. Prepare a clear map for a detailed observation area (see selection criteria) and a larger area map with readable street names, general directions etc.
2. Code the address on the first page of questionnaire
3. Enclose the envelopes with one questionnaire and information leaflets
4. Brief the survey team before setting out.

Method

Questionnaires will be posted to all the addresses in the study area on the day of observation survey. It will be collected on a week after posting it. Survey team should be able to help the householder if require assistance to fill the questionnaire on that day. A further attempt will be made to collect as many questionnaires as possible on the second week after initial posting of the questionnaires.
An average of 100 responses is expected from each area.

Appendix D

Introduction to Case Study

New Marston: Headington, Oxford -Low-density low rise

Case 1















Brief description:

New Marston development is located in the north-eastern side of Oxford and mainly consists mainly of two storey semi-detached and terraced houses. It has a few three-storey flats in the middle of the development along with a pub and a few shops. On the north side of the development adjoining the meadows there are two schools, a primary and a secondary. Two bus stops on the eastern boundary of this development provide public transport connecting it to the city centre. Management is by a resident's association and city council. Initially developed by city council as council housing today about 46% of housing is owner occupied

1. Aerial photo
2. Terraced houses
3. Communal space and bungalows
4. Flats
5. Semidetached
6. Semidetached and parking

Period of development	Between 1940-60
No of Dwellings	521
Flats	3
Terraced	196
Semi- Detached	276
Detached	46
Site area	20.88 hectares
Communal space	1.53%
Private garden	62.10%
Roads and footpath	23.00%
Parking	0.50%
Av. Density	25.00 hh/ha
Av. Coverage	14.77%

Thames Street, Oxford-Medium density low rise

Case 2















Brief description:

Built on a triangular site with a busy street (Thames Street) on its north side, the river Thames on its south and a large stretch of recreational green land on its west.- Thames Street housing has two distinct areas one with terraced houses of G+1 to2 on the western side developed in the1980s and the other with 86 flats in four storey blocks. The flats in 1960s development are of the duplex type and are accessed either from the ground floor or from a second floor walkway whereas the 80s development has a variety of house sizes ranging from two to five bedrooms. There is a national bicycle path running thought the centre of the estate and it has a pedestrian bridge connecting the estate to the south bank of the river. The estate has some green spaces adjoining the river on the south side that consist of a small play space for children and a quieter green space.

1. Aerial photo
2. Mix of type/ form
3. Spatial separation from busy road
4. Blocks of flats
5. New terraced
6. New flats

Period of development	1960-80
No of Dwellings	264
Flats	108
Terraced	156
Semi- Detached	0
Detached	0
Site area	5.46 hectares
Communal space	18.2%
Private garden	37.6%
Roads and footpath	11.5%
Parking	1.2%
Av. Density	48.38 hh/ha
Av. Coverage	17.22



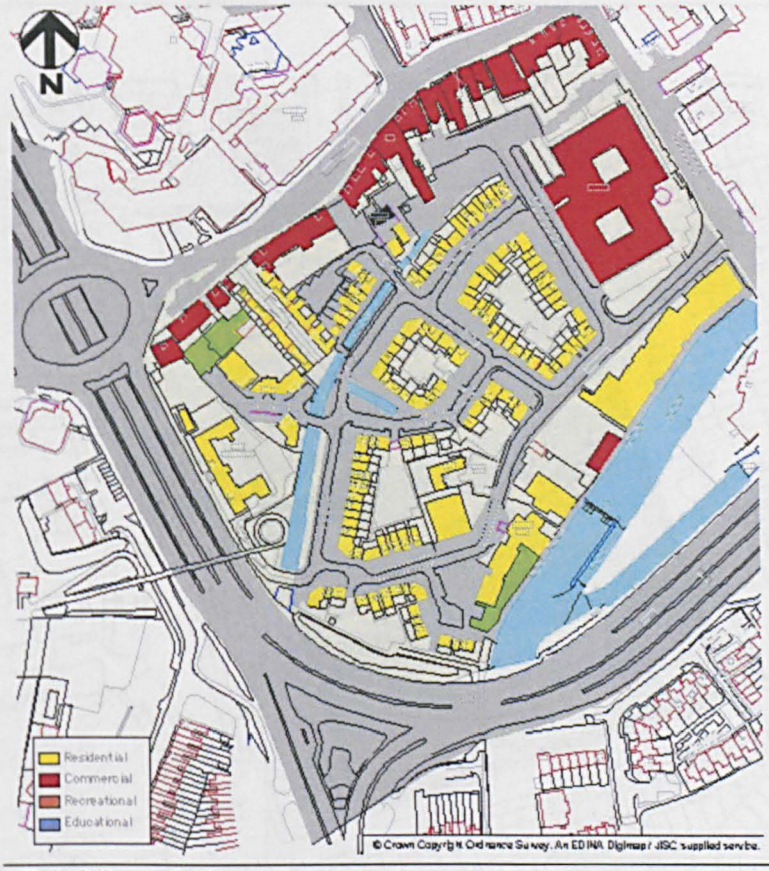












Brief description:

Holybrooks is an inner city housing development in Reading. The older housing section, behind Fobney Street, was developed between 1980-85 and has about 264 dwellings. The new development consists of about 140 dwellings along the Kennet River, some of which were still under construction during the period of this study (60 under construction, 50 sheltered homes). They were not included in this research. Bounded by Kennet river and main roads the Holybrooks area consists manly of flats in 4-5 storied buildings at the corners of most blocks and have terraced houses between blocks of flats. The block of flats and terraced houses together form perimeter blocks with back entrances through the courtyards and front entrances from the streets. The car parking for residents is mainly in these courtyards. The housing mix in this neighbourhood ranges from single-bedded flats to five-bedded terraced houses. The estate is managed by private company and about 47% is rented from private individuals

1. Aerial photo
2. Streets
3. Streets
4. Mixed building form
5. Mixed building form
6. Mixed building form

Architect/ Planners	
Developer	
Period of development	mid 80's, ongoing
No of Dwellings	404
Flats	380
Terraced	24
Semi- Detached	0
Detached	0
Site area	3.75 hectares
Communal space	..%
Private garden	..%
Roads and footpath	.%
Parking	..%
Av. Density	107.88 hh/ha
Av. Coverage	25.51%



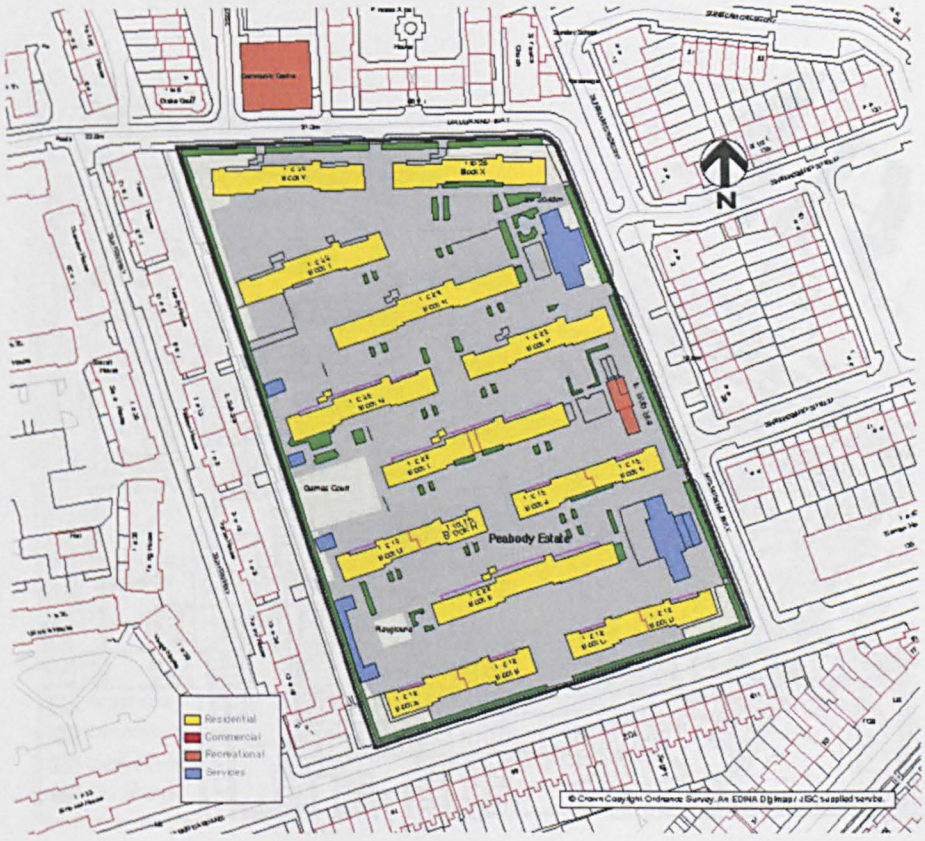












Brief description:

Dalgarno Gardens is a pre war development in North Kensington, London. The estate is developed and managed by the Peabody Estate Trust and underwent a major renovation between 1960 and 1967. Twelve blocks in Dalgarno Gardens contain 361 flats on a small site of 2.2 hectares. This includes 29 sheltered dwellings in block 'T'. The four to five storey blocks accommodate between 25-38 small to medium size flats (one to two bedrooms). There are mainly two types of blocks; the shorter blocks have 25-35 flats, accessed by two disconnected walkways at each level, while the three longer blocks have 38 flats accessed by a continuous walkway. Each block has two staircases and in some cases a lift (lifts were added in 1980's during a renovation). The blocks are arranged in a staggered pattern with no continuous vehicular street running through the estate. About 95% of occupant s during the survey were living in the estate for more than 20years

1. Aerial photo
2. Space between the blocks
3. Childrens play area
4. Typical block and walkways
5. Estate general view
6. Estate general view

Period of development	1940's(major redevelopment in 60s)
No of Dwellings	361
Flats	361
Terraced	0
Semi- Detached	0
Detached	0
Site area	2.23 hectares
Communal space	3.8%
Private garden	0.0%
Roads and footpath	59.2%
Parking	5.5%
Av. Density	161.76 hh/ha
Av. Coverage	24.84%



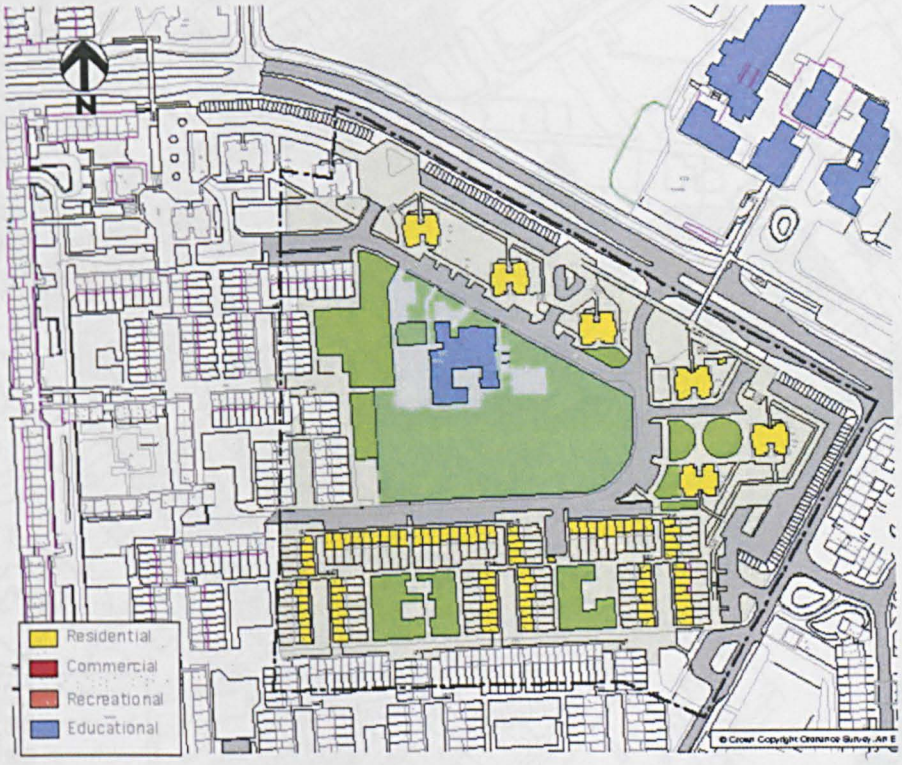










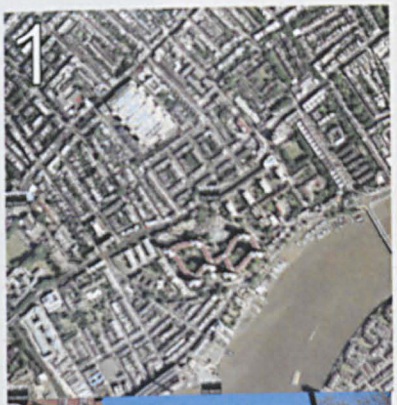


Brief description:

Parkview is part of the Thamesmead development of the 1960s in the Southeastern suburbs of London and is often described as a city within city. Thamesmead was designed and build to address the growing housing problem of London after the second world war. In general, development consists of both high and low-rise blocks with interconnecting walkways that covers 130 acres of former marshland in the north of the London Borough of Bexley near the River Thames. Parkview, the part of development included for this study comprises of six towers as well as a few three storey terraced houses, totalling about 378 dwelling units. Parkview is owned and managed by Gallion Housing Association. Most of the present tenants have lived in the estate for long period

1. Aerial photo
2. Block of flats
3. Block of flats
4. Terrance housing pedestrian bridge
5. Terrance housing common courtyard
6. Terrance housing general view

Period of development	1960-70
No of Dwellings	378
Flats	288
Terraced	90
Semi- Detached	
Detached	
Site area	3.98 hectares
Communal space	28.4 %
Private garden	19.7.%
Roads and footpath	25.3%
Parking	4.3 %
Av. Density	94.93 hh/ha
Av. Coverage	10.06%















Brief description:

Worlds End Estate comprises of seven tower blocks with 16-19 storeys, situated at the lower end of the Kings Road facing the Thames Embankment. Low-level walkways link these tower blocks. The Royal Borough of Kensington and Chelsea Tenant Management Organisation (TMO) manages properties and communal grounds on behalf of the borough.

1. Aerial photo
2. Estate general view
3. Estate general view
4. Communal garden first floor
5. Upper level walkways
6. Upper level walkways

Period of development	1960-70
No of Dwellings	744
Flats	744
Terraced	0
Semi- Detached	0
Detached	0
Site area	2.75 hectares
Communal space	38.1%
Private garden	0.0%
Roads and footpath	9.7%
Parking	22.9%
Av. Density	270.83 hh/ha
Av. Coverage	56.43%

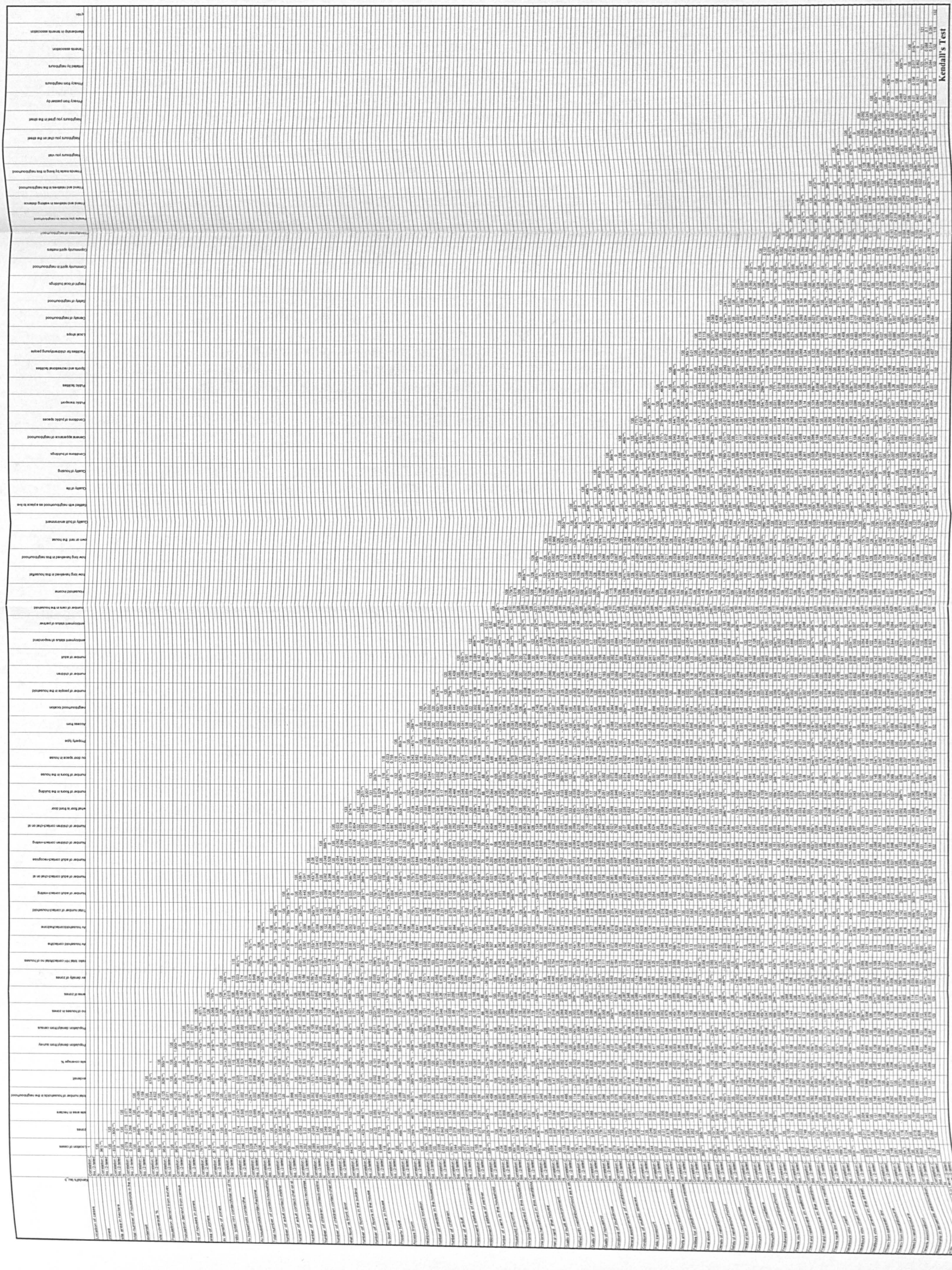
Appendix E

Correlation Metrics

Variable Information	
Variable	**Label**
casestud	Location of cases
zones	<none>
avdensit	<none>
referenc	reference for respondent
q8	what floor is front door
q9	number of floors in the building
q10	number of floors in the house
q11	out door space in house
s	Number of adult contact-visiting
t	Number of adult contact-chat on street
k	Number of adult contact-recognise
c	Number of children contact-visiting
p	Number of children contact-chat on street
totalcon	Total number of contact-household
proptype	Property type
accessfr	Access from
neighloc	neighbourhood location
q32	number of people in the household
q32a	number of children
q32b	number of adult
q33	employment status of respondent
q33a	employment status of partner
q34	Job title
q35	industry
q36	number of cars in the household
q37	Household income
q38	how long have lived in this house/flat
q39	how long have lived in this neighbourhood
q40	own or rent the house
q1n	Quality of built environment
q2n	Satisfied with neighbourhood as a place to live
q4n	Quality of life
q5an	Quality of housing
q5bn	Conditions of buildings
q5cn	General appearance of neighbourhood
q5dn	Conditions of public spaces
q5en	Public transport
q5fn	Public facilities
q5gn	Sports and recreational facilities
q5hn	Facilities for children/young people
q5in	Local shops
q6n	Density of neighbourhood
q3n	Safety of neighbourhood
q7a	Height of local buildings
q13a	Community spirit in neighbourhood
q14n	Community spirit matters
q15n	Friendliness of neighbourhood
q17n	People you know in neighbourhood
q18n	Friend and relatives in walking distance
q19n	Friend and relatives in the neighbourhood
q20n	Friends made by living in this neighbourhood
q21n	Neighbours you visit
q22n	Neighbours you chat on the street
q23n	Neighbours you greet in the street
q25n	Privacy from passer-by
q24n	Privacy from neighbours
q27n	Irritated by neighbours
q28n	Tenants association
q29n	Membership in tenants association
q16n	<none>
filter_$	totalcon >= 1 (FILTER)
Variables in the working file	

Variable Information	
Variable	**Label**
ConnectivityDegree	Connectivity (Degree)
IsovistMaximumRadial	Isovist Maximum Radial
IsovistMomentofInertia	Isovist Moment of Inertia
VisualClusteringCoefficient	Visual Clustering Coefficient
VisualControl	Visual Control
VisualControllability	Visual Controllability
VisualEntropy	Visual Entropy
VisualIntegrationHH	Visual Integration [HH]
VisualIntegrationPvalue	Visual Integration [P-value]
VisualIntegrationTekl	Visual Integration [Tekl]
VisualMeanDepth	Visual Mean Depth
VisualRelativisedEntropy	Visual Relativised Entropy
Density	Density (Building)
avsocialcontact	Average social contact
avRn	Average Global integration
Avpedestrianmovement	Average pedestrian movement (Weekend)
Svis	Number of adult contact-visiting (within visual field)
Tvis	Number of adult contact-chat on street (within visual field)
Kvis	Number of adult contact-recognise (within visual field)
Cvis	Number of children contact-visiting (within visual field)
Pvis	Number of children contact-chat on street (within visual field)
TOTCOvis	Total number of contact-household (within visual field)
S1min	Number of adult contact-visiting (within one min walk)
T1min	Number of adult contact-chat on street (within one min walk)
K1min	Number of adult contact-recognise (within one min walk)
C1min	Number of children contact-visiting (within one min walk)
P1min	Number of children contact-chat on street (within one min walk)
TOTCO1min	Total number of contact-household (within one min walk)
S2min	Number of adult contact-visiting (within two min walk)
T2min	Number of adult contact-chat on street (within two min walk)
K2min	Number of adult contact-recognise (within two min walk)
C2min	Number of children contact-visiting (within two min walk)
P2min	Number of children contact-chat on street (within two min walk)
TOTCO2min	Total number of contact-household (within two min walk)
S5min	Number of adult contact-visiting (within five min walk)
T5min	Number of adult contact-chat on street (within five min walk)
K5min	Number of adult contact-recognise (within five min walk)
C5min	Number of children contact-visiting (within five min walk)
P5min	Number of children contact-chat on street (within five min walk)
TOTCO5min	Total number of contact-household (within five min walk)
viscon	Connectivity (Degree)
isorad	Isovist Maximum Radial
isoiner	Isovist Moment of Inertia
visclucoef	Visual Clustering Coefficient
viscontr	Visual Control
contabili	Visual Controllability
Entropy	Visual Entropy
VisInte1	Visual Integration [HH]
visinte2	Visual Integration [P-value]
visinte3	Visual Integration [Tekl]
medepth	Visual Mean Depth
RelaEntry	Visual Relativised Entropy
neigarea	site area in hectare
noofhous	total number of households in the neighbourhood
sitecoverage	site coverage in %
popdensity1	Population density from survey
popdensity2	Population density from census
noofzoho	no of houses in zones
zonearea	area of zones
avzoden	av density of zones
plotarea	areas of each plots
totbuilt	total built up area of each house
far	floor area ratio (FAR)
ratcon	household contact (normalised by no. of dwellings)
avcont	household contact (normalised by site area)
avzocont	Av household contact / ha / zone

Pearson's Test


Kendall's Test

Correlations

		S	T	K	TOTALCON	S vis	T vis	K vis	S1min	T1min	K1min	S2min	T2min	K2min	TOTCOvis	TOTCO1min	TOTCO2min	visclucoef	viscontr	contabili	VisInte1	visinte2	visinte3	medepth
S	Pearson Correlation	1	0.421712791	0.076923816	0.611103582	0.842649355	0.285005577	0.078940546	0.918567355	0.312062739	0.068101939	0.972510036	0.405710246	0.095137123	0.477876818	0.553399373	0.635317966	-0.265376157	-0.056886148	-0.166597834	0.169938491	0.167871302	0.182193469	-0.189501693
	Sig. (2-tailed)		5.25714E-05	0.48145298	4.13524E-10	2.67851E-24	0.007819583	0.469998951	1.2973E-35	0.003444305	0.533262283	6.11572E-55	0.00010645	0.383571919	3.27182E-06	3.27482E-08	5.01234E-11	0.013532676	0.602894567	0.125253016	0.117750581	0.12235105	0.093161234	0.080546735
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
T	Pearson Correlation	0.421712791	1	0.188682707	0.899583267	0.456864389	0.715700422	0.213666508	0.350812078	0.863189968	0.184961743	0.374684822	0.974282856	0.17505899	0.716596448	0.764431522	0.859944734	-0.195758852	0.09018657	-0.277387513	0.477119681	0.498426924	0.446379962	-0.385508528
	Sig. (2-tailed)	5.25714E-05		0.081888674	5.79148E-32	9.79597E-06	9.64347E-15	0.048229321	0.000927624	1.17069E-26	0.088211351	0.000379069	3.85569E-56	0.106929248	8.62299E-15	1.09137E-17	2.92317E-26	0.070863958	0.408916358	0.009718224	3.40802E-06	1.0411E-06	1.64885E-05	0.000246857
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
K	Pearson Correlation	0.076923816	0.188682707	1	0.486331259	0.095918431	-0.024280145	0.586853656	0.137538426	0.176647737	0.782610442	0.103620181	0.19471826	0.93802198	0.135246097	0.425660381	0.462861376	-0.071100528	-0.046645595	-0.079516484	-0.014167776	0.00023169	-0.002512342	-0.020859793
	Sig. (2-tailed)	0.48145298	0.081888674		2.0611E-06	0.379660151	0.824389665	2.88236E-09	0.206651741	0.103733948	5.62623E-19	0.342401161	0.072405883	2.03543E-40	0.214391098	4.39301E-05	7.2163E-06	0.515346829	0.669761137	0.466755262	0.896985409	0.998310746	0.981684091	0.848810956
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
TOTALCON	Pearson Correlation	0.611103582	0.899583267	0.486331259	1	0.59255589	0.60729387	0.36946795	0.551816104	0.78752534	0.404724478	0.57175839	0.884350261	0.462213238	0.721686721	0.873451743	0.968534703	-0.234475171	0.011810421	-0.292782569	0.415200087	0.435184447	0.399889091	-0.36420026
	Sig. (2-tailed)	4.13524E-10	5.79148E-32	2.0611E-06		1.85236E-09	5.67146E-10	0.000463683	3.65004E-08	2.40268E-19	0.00011105	8.92441E-09	1.58253E-29	7.46072E-06	4.5303E-15	5.51389E-28	1.64061E-52	0.029779922	0.914054079	0.00622581	7.03581E-05	2.82211E-05	0.000136401	0.000566371
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
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	Sig. (2-tailed)	2.67851E-24	9.79597E-06	0.379660151	1.85236E-09		1.10628E-05	0.209069352	1.79098E-36	8.91456E-05	0.209392422	3.70329E-24	0.000175071	0.202265841	1.72021E-12	1.15549E-11	1.17212E-09	0.006905971	0.919392186	0.011911242	0.002709596	0.002709596	0.002723626	0.004540097
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
T vis	Pearson Correlation	0.285005577	0.715700422	-0.024280145	0.60729387	0.45444632	1	0.16592048	0.267027355	0.845728976	0.05294855	0.177855685	0.65289081	-0.011896688	0.926524489	0.692660053	0.523355086	-0.056459134	0.040996786	-0.247636352	0.518958934	0.545556965	0.484369069	-0.420093086
	Sig. (2-tailed)	0.007819583	9.64347E-15	0.824389665	5.67146E-10	1.10628E-05		0.126817877	0.012941289	1.2482E-24	0.6282586	0.101354763	9.61487E-12	0.913428718	2.03865E-37	1.48799E-13	2.33907E-07	0.605623216	0.707821956	0.021515696	3.07029E-07	5.57399E-08	2.29697E-06	5.65548E-05
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
K vis	Pearson Correlation	0.078940546	0.213666508	0.586853656	0.36946795	0.136815892	0.16592048	1	0.148523106	0.253913611	0.807474972	0.098945631	0.250355835	0.705564311	0.383588188	0.487341448	0.425361289	-0.115236795	-0.105282214	-0.066584656	0.089921691	0.108575915	0.109858425	-0.143100053
	Sig. (2-tailed)	0.469998951	0.048229321	2.88236E-09	0.000463683	0.209069352	0.126817877		0.172323919	0.018322104	5.94596E-21	0.364732736	0.02007803	3.31951E-14	0.000266664	1.94876E-06	4.45353E-05	0.290717516	0.334672692	0.542443819	0.410299422	0.319685998	0.313968933	0.188707402
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
S1min	Pearson Correlation	0.918567355	0.350812078	0.137538426	0.551816104	0.922467427	0.267027355	0.148523106	1	0.304422502	0.163542897	0.949087434	0.311182742	0.182605035	0.499748805	0.611333705	0.589446369	-0.35780135	-0.05597825	-0.242325433	0.207137103	0.202410394	0.215952926	-0.215028166
	Sig. (2-tailed)	1.2973E-35	0.000927624	0.206651741	3.65004E-08	1.79098E-36	0.012941289	0.172323919		0.004375258	0.132429148	6.61016E-44	0.003541654	0.092411771	9.64676E-07	4.05654E-10	2.35994E-09	0.000718905	0.608702577	0.024578262	0.055669852	0.061622044	0.045826196	0.046785952
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
T1min	Pearson Correlation	0.312062739	0.863189968	0.176647737	0.78752534	0.409810833	0.845728976	0.253913611	0.304422502	1	0.218147691	0.244155083	0.841335796	0.183584146	0.815879397	0.8605528	0.740669013	-0.193708638	0.023457218	-0.34269152	0.571847761	0.598321936	0.530234103	-0.454066196
	Sig. (2-tailed)	0.003444305	1.17069E-26	0.103733948	2.40268E-19	8.91456E-05	1.2482E-24	0.018322104	0.004375258		0.043613432	0.023483769	3.69131E-24	0.090647918	1.09732E-21	2.46691E-26	3.60402E-16	0.073927586	0.830251051	0.001238419	8.86637E-09	1.17413E-09	1.51637E-07	1.12754E-05
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
K1min	Pearson Correlation	0.068101939	0.184961743	0.782610442	0.404724478	0.136719789	0.05294855	0.807474972	0.163542897	0.218147691	1	0.100182884	0.213099628	0.923868229	0.248830436	0.53400518	0.465851171	-0.142086176	-0.03446379	-0.03031517	0.094293838	0.113964569	0.105987003	-0.117669094
	Sig. (2-tailed)	0.533262283	0.088211351	5.62623E-19	0.00011105	0.209392422	0.6282586	5.94596E-21	0.132429148	0.043613432		0.358736868	0.048840953	8.5737E-37	0.020873949	1.19077E-07	6.18303E-06	0.191891562	0.974876527	0.781717756	0.387821065	0.296111996	0.331429018	0.280585886
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
S2min	Pearson Correlation	0.972510036	0.374684822	0.103620181	0.57175839	0.841322458	0.177855685	0.098945631	0.949087434	0.244155083	0.100182884	1	0.363153057	0.130873971	0.398064795	0.527645958	0.624096893	-0.329619148	-0.053359245	-0.196609668	0.142052208	0.131209475	0.15832352	-0.172428268
	Sig. (2-tailed)	6.11572E-55	0.000379069	0.342401161	8.92441E-09	3.70329E-24	0.101354763	0.364732736	6.61016E-44	0.023483769	0.358736868		0.000589111	0.229716516	0.000147283	1.78697E-07	1.36318E-10	0.001940883	0.625592186	0.069622981	0.19199891	0.228514073	0.145407127	0.112387941
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
T2min	Pearson Correlation	0.405710246	0.974282856	0.19471826	0.884350261	0.393918268	0.65289081	0.250355835	0.311182742	0.841335796	0.213099628	0.363153057	1	0.199873699	0.662685518	0.746523553	0.885701372	-0.221189962	0.093110349	-0.282482033	0.457394966	0.472982358	0.435493718	-0.389311165
	Sig. (2-tailed)	0.00010645	3.85569E-56	0.072405883	1.58253E-29	0.000175071	9.61487E-12	0.02007803	0.003541654	3.69131E-24	0.048840953	0.000589111		0.065023778	3.65143E-12	1.5785E-16	9.94098E-30	0.040693415	0.393831718	0.008408802	9.53684E-06	4.2516E-06	2.78122E-05	0.000211573
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
K2min	Pearson Correlation	0.095137123	0.17505899	0.93802198	0.462213238	0.138864752	-0.011896688	0.705564311	0.182605035	0.183584146	0.923868229	0.130873971	0.199873699	1	0.185259398	0.49613318	0.496378819	-0.108907802	-0.008520044	-0.048646375	0.024259433	0.038979863	0.038987399	-0.060498276
	Sig. (2-tailed)	0.383571919	0.106929248	2.03543E-40	7.46072E-06	0.202265841	0.913428718	3.31951E-14	0.092411771	0.090647918	8.5737E-37	0.229716516	0.065023778		0.087691761	1.18744E-06	1.17089E-06	0.318200166	0.937941923	0.656471491	0.824537072	0.721593267	0.721541643	0.580033711
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
TOTCOvis	Pearson Correlation	0.477876818	0.716596448	0.135246097	0.721686721	0.670056259	0.926524489	0.383588188	0.499748805	0.815879397	0.248830436	0.398064795	0.662685518	0.185259398	1	0.834066666	0.675106625	-0.148631545	0.00065186	-0.29287599	0.525039098	0.552648256	0.501350993	-0.451174434
	Sig. (2-tailed)	3.27182E-06	8.62299E-15	0.214391098	4.5303E-15	1.72021E-12	2.03865E-37	0.000266664	9.64676E-07	1.09732E-21	0.020873949	0.000147283	3.65143E-12	0.087691761		2.06906E-23	1.01437E-12	0.172007328	0.995247317	0.006208555	2.10546E-07	3.448E-08	8.79154E-07	1.30225E-05
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
TOTCO1min	Pearson Correlation	0.553399373	0.764431522	0.425660381	0.873451743	0.650990075	0.692660053	0.487341448	0.611333705	0.8605528	0.53400518	0.527645958	0.746523553	0.49613318	0.834066666	1	0.878138742	-0.298792538	-0.014041797	-0.346359959	0.517637684	0.540124965	0.49452941	-0.441450681
	Sig. (2-tailed)	3.27482E-08	1.09137E-17	4.39301E-05	5.51389E-28	1.15549E-11	1.48799E-13	1.94876E-06	4.05654E-10	2.46691E-26	1.19077E-07	1.78697E-07	1.5785E-16	1.18744E-06	2.06906E-23		1.24847E-28	0.005198294	0.897896461	0.001087896	3.32936E-07	7.99326E-08	1.30109E-06	2.09388E-05
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
TOTCO2min	Pearson Correlation	0.635317966	0.859944734	0.462861376	0.968534703	0.59834343	0.523355086	0.425361289	0.589446369	0.740669013	0.465851171	0.624096893	0.885701372	0.496378819	0.675106625	0.878138742	1	-0.291635535	0.012736995	-0.295024412	0.398100555	0.409350673	0.39113288	-0.36668141
	Sig. (2-tailed)	5.01234E-11	2.92317E-26	7.2163E-06	1.64061E-52	1.17212E-09	2.33907E-07	4.45353E-05	2.35994E-09	3.60402E-16	6.18303E-06	1.36318E-10	9.94098E-30	1.17089E-06	1.01437E-12	1.24847E-28		0.006441151	0.764765962	0.005823232	0.000147063	9.09485E-05	0.000196374	0.000515659
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
visclucoef	Pearson Correlation	-0.265376157	-0.195758852	-0.071100528	-0.234475171	-0.289270792	-0.056459134	-0.115236795	-0.35780135	-0.193708638	-0.142086176	-0.329619148	-0.221189962	-0.108907802	-0.148631545	-0.298792538	-0.291635535	1	0.005713408	0.610959993	-0.274458851	-0.261657384	-0.257751209	0.21513199
	Sig. (2-tailed)	0.013532676	0.070863958	0.515346829	0.029779922	0.006905971	0.605623216	0.290717516	0.000718905	0.073927586	0.191891562	0.001940883	0.040693415	0.318200166	0.172007328	0.005198294	0.006441151		0.958362107	4.18509E-10	0.010549049	0.014951065	0.016577671	0.046677377
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
viscontr	Pearson Correlation	-0.056886148	0.09018657	-0.046645595	0.011810421	-0.011074329	0.040996786	-0.105282214	-0.05597825	0.023457218	-0.03446379	-0.053359245	0.093110349	-0.008520044	0.00065186	-0.014041797	0.032736995	0.005713408	1	0.476861632	-0.006634879	-0.001130193	-0.007226125	0.011310143
	Sig. (2-tailed)	0.602894567	0.408916358	0.669761137	0.914054079	0.919392186	0.707821956	0.334672692	0.608702577	0.830251051	0.974876527	0.625592186	0.393831718	0.937941923	0.995247317	0.897896461	0.764765962	0.958362107		3.45565E-06	0.951654175	0.991759904	0.947351886	0.917681671
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
contabili	Pearson Correlation	-0.166597834	-0.277387513	-0.079516484	-0.292782569	-0.270066704	-0.247636352	-0.066584656	-0.242325433	-0.34269152	-0.03031517	-0.196609668	-0.282482033	-0.048646375	-0.29287599	-0.346359959	-0.295024412	0.610959993	0.476861632	1	-0.584336732	-0.566304896	-0.567089834	0.520158916
	Sig. (2-tailed)	0.125253016	0.009718224	0.466755262	0.00622581	0.011911242	0.021515696	0.542443819	0.024578262	0.001238419	0.781717756	0.069622981	0.008408802	0.656471491	0.006208555	0.001087896	0.005823232	4.18509E-10	3.45565E-06		3.49407E-09	1.32401E-08	1.25149E-08	2.85166E-07
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
VisInte1	Pearson Correlation	0.169938491	0.477119681	-0.014167776	0.415200087	0.319532086	0.518958934	0.089921691	0.207137103	0.571847761	0.094293838	0.142052208	0.457394966	0.024259433	0.525039098	0.517637684	0.398100555	-0.274458851	-0.006634879	-0.584336732	1	0.992394997	0.989565002	-0.928805821
	Sig. (2-tailed)	0.117750581	3.40802E-06	0.896985409	7.03581E-05	0.002709596	3.07029E-07	0.410299422	0.055669852	8.86637E-09	0.387821065	0.19199891	9.53684E-06	0.824537072	2.10546E-07	3.32936E-07	0.000147063	0.010549049	0.951654175	3.49407E-09		3.32421E-78	1.8513E-72	5.68288E-38
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
visinte2	Pearson Correlation	0.167871302	0.498426924	0.00023169	0.435184447	0.330136421	0.545556965	0.108575915	0.202410394	0.598321936	0.113964569	0.131209475	0.472982358	0.038979863	0.552648256	0.540124965	0.409350673	-0.261657384	-0.001130193	-0.566304896	0.992394997	1	0.977038251	-0.912178037
	Sig. (2-tailed)	0.12235105	1.0411E-06	0.998310746	2.82211E-05	0.001907378	5.57399E-08	0.319685998	0.061622044	1.17413E-09	0.296111996	0.228514073	4.2516E-06	0.721593267	3.448E-08	7.99326E-08	9.09485E-05	0.014951065	0.991759904	1.32401E-08	3.32421E-78		3.493E-58	2.70979E-34
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
visinte3	Pearson Correlation	0.182193469	0.446379962	-0.002512342	0.399889091	0.319373249	0.484369069	0.109858425	0.215952926	0.530234103	0.105987003	0.15832352	0.435493718	0.038987399	0.501350993	0.49452941	0.39113288	-0.257751209	-0.007226125	-0.567089834	0.989565002	0.977038251	1	-0.971259436
	Sig. (2-tailed)	0.093161234	1.64885E-05	0.981684091	0.000136401	0.002723626	2.29697E-06	0.313968933	0.045826196	1.51637E-07	0.331429018	0.145407127	2.78122E-05	0.721541643	8.79154E-07	1.30109E-06	0.000196374	0.016577671	0.947351886	1.25149E-08	1.8513E-72	3.493E-58		3.86288E-54
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86
medepth	Pearson Correlation	-0.189501693	-0.385508528	-0.020859793	-0.36420026	-0.303223592	-0.420093086	-0.143100053	-0.215028166	-0.454066196	-0.117669094	-0.172428268	-0.389311165	-0.060498276	-0.451174434	-0.441450681	-0.36668141	0.21513199	0.011310143	0.520158916	-0.928805821	-0.912178037	-0.971259436	1
	Sig. (2-tailed)	0.080546735	0.000246857	0.848810956	0.000566371	0.004540097	5.65548E-05	0.188707402	0.046785952	1.12754E-05	0.280585886	0.112387941	0.000211573	0.580033711	1.30225E-05	2.09388E-05	0.000515659	0.046677377	0.917681671	2.85166E-07	5.68288E-38	2.70979E-34	3.86288E-54	
	N	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86	86

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Pearson Correlation Test

Appendix F

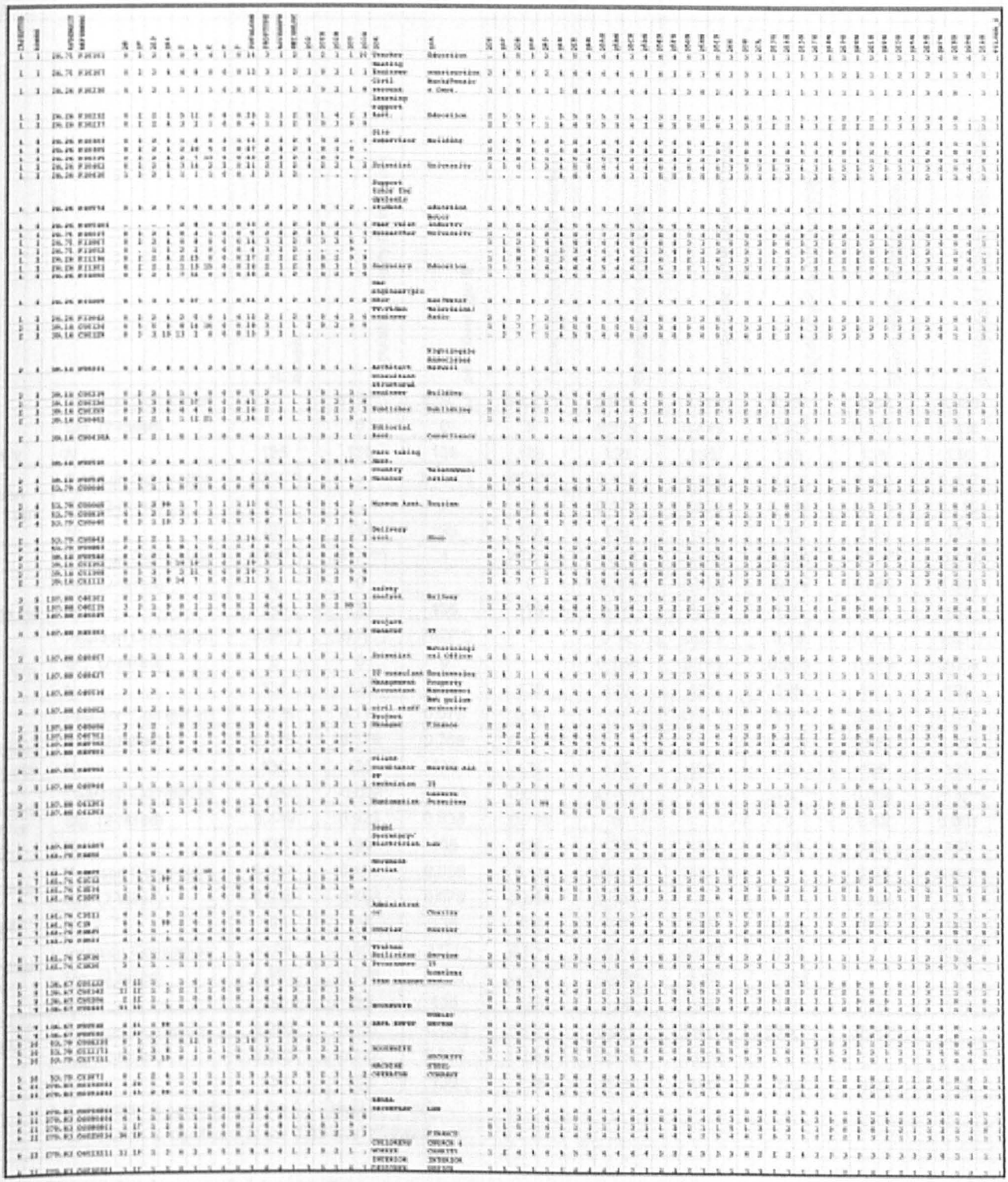
Correlation of Key Variables

Variable Values		
Value		Label
casestud	1	Marston
	2	Thames street
	3	Holybrook
	4	Dalgarno
	5	Thamesmead
	6	Worlds end
zones	1	C1-A
	2	C1-B
	3	C2- A
	4	C2-B
	5	C3-A
	6	C3-B
	7	C4-A
	8	C4-B
	9	C5-A
	10	C5-B
	11	C6-A
	12	C6-B
q11	0	none
	1	a garden
	2	a patio or yard
	3	roof terrace or large balcony
	4	Garden & Patio or Yard
	5	Patio & Yard and Roof
	6	Garden, Patio or yard & roof terrace
	7	garden, patio or yard and other
	8	garden and other
	9	Patio or yard and other
	10	Garden & roof terrace or large balcony
	99	Others
proptype	1	detached
	2	semi detached
	3	terraced
	4	flats
	5	others
accessfr	1	street corner
	2	straight street
	3	curved street
	4	cu de sac
	5	upper level walkway
	6	flat cluster of 4
	7	flat in blocks
	8	others
neighloc	1	inner city
	2	inner suburbs
	3	outer suburbs
	4	village
	5	others
	6	street type at upper level
	7	cul de sac
q33	1	working full time
	2	working part-time
	3	self employed employing others
	4	self employed with out employing others
	5	unemployed
	6	looking after family and home
	7	full time education
	8	unable to work (illness)
	9	retired
	10	No reply
	13	Working full time & working part time also
	99	Others

Value		Label
q33a	1	working full time
	2	working part-time
	3	self employed employing others
	4	self employed with out employing others
	5	unemployed
	6	looking after family and home
	7	full time education
	8	unable to work (illness)
	9	retired
	10	No reply
	99	Others
q37	1	> 14999
	2	15000-24999
	3	25000-34999
	4	35000-44999
	5	> 45000
	7	Didn't answer
q38	1	< 6 months
	2	6 months- 1 yr
	3	1-2 yr
	4	2-5yr
	5	5-10 yr
	6	10-20yr
	7	20-30yr
	8	>30 yr
q39	1	< 6 months
	2	6 months- 1 yr
	3	1-2 yr
	4	2-5yr
	5	5-10 yr
	6	10-20yr
	7	20-30yr
	8	>30 yr
q40	1	own outright
	2	own with mortgage or loan
	3	own part rent and mortgage
	4	rent
	5	lodging
	99	Others
q1n	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad
	4	fairly good
	5	very good
q2n	0	can't say, no answer, others
	1	very dissatisfied
	2	fairly dissatisfied
	3	Neither satisfied nor dissatisfied
	4	fairly satisfied
	5	very satisfied
q4n	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad
	4	fairly good
	5	very good
q5an	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad

Value		Label
	4	fairly good
	5	very good
q5bn	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad
	4	fairly good
	5	very good
q5cn	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad
	4	fairly good
	5	very good
q5dn	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad
	4	fairly good
	5	very good
q5en	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad
	4	fairly good
	5	very good
q5fn	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad
	4	fairly good
	5	very good
q5gn	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad
	4	fairly good
	5	very good
q5hn	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad
	4	fairly good
	5	very good
q5in	0	can't say, no answer, others
	1	very bad
	2	fairly bad
	3	Neither good not bad
	4	fairly good
	5	very good
q6n	0	can't say, no answer, others
	1	very low
	2	low
	3	medium
	4	high
	5	very high
q3n	0	can't say, no answer, others
	1	not at all safe
	2	not very safe
	3	fairly safe
	4	very safe

Value		Label
q7a	0	others/cant say etc
	1	mainly low rise
	2	mainly med rise
	3	mainly high rise
q13a	0	none, can't say etc
	1	a little
	2	a lot
q14n	0	none, can't say etc
	1	a little
	2	a lot
q15n	0	can't say, no answer, others
	1	very unfriendly
	2	fairly unfriendly
	3	fairly friendly
	4	very friendly
q17n	0	none, can't say, no answer, others
	1	hardly any
	2	a few
	3	fairly friendly
q18n	0	none, can't say, no answer, others
	1	hardly any
	2	a few
	3	fairly friendly
q19n	0	none, can't say, no answer, others
	1	hardly any
	2	a few
	3	fairly friendly
q20n	0	none, can't say, no answer, others
	1	hardly any
	2	a few
	3	fairly friendly
q21n	0	none, can't say, no answer, others
	1	hardly any
	2	a few
	3	fairly friendly
q22n	0	none, can't say, no answer, others
	1	hardly any
	2	a few
	3	fairly friendly
q23n	0	none, can't say, no answer, others
	1	hardly any
	2	a few
	3	fairly friendly
q25n	0	none, can't say, no answer, others
	1	little privacy
	2	some privacy
	3	plenty of privacy
q24n	0	none, can't say, no answer, others
	1	little privacy
	2	some privacy
	3	plenty of privacy
q27n	0	never, can't say, no answer, others
	1	some time
	2	often
	3	always
q28n	0	no/ don't know
	1	yes
q29n	0	no/ don't know
	1	yes
q16n	0	no
	1	yes
filter_$	0	Not Selected
	1	Selected



Cases selected for details analysis: summery of questionnaire response

Correlations										
		Av density	Population density from survey	site coverage %	Population density from census	Standardised adult visits	Standardised adult chat on street	Standardised adult recognise	Standardised children visits	Standardised children chat on street
Av density	Pearson Correlation	1	.975(**)	.836(**)	.932(**)	0.076	-0.066	0.087	-0.08	0.083
	Sig. (2-tailed)		0	0	0	0.379	0.449	0.315	0.357	0.336
	N	135	135	135	135	135	135	135	135	135
Population density from survey	Pearson Correlation	.975(**)	1	.817(**)	.977(**)	0.116	-0.008	0.128	0.003	0.137
	Sig. (2-tailed)	0		0	0	0.179	0.925	0.138	0.975	0.112
	N	135	135	135	135	135	135	135	135	135
Site coverage %	Pearson Correlation	.836(**)	.817(**)	1	.767(**)	0.078	-0.053	0.036	-.172(*)	-0.035
	Sig. (2-tailed)	0	0		0	0.369	0.538	0.679	0.046	0.686
	N	135	135	135	135	135	135	135	135	135
Population density from census	Pearson Correlation	.932(**)	.977(**)	.767(**)	1	0.14	0.027	0.15	0.013	.182(*)
	Sig. (2-tailed)	0	0	0		0.104	0.755	0.083	0.879	0.035
	N	135	135	135	135	135	135	135	135	135
Standardised adult visits	Pearson Correlation	0.076	0.116	0.078	0.14	1	.477(**)	.295(**)	0.013	0.072
	Sig. (2-tailed)	0.379	0.179	0.369	0.104		0	0.001	0.884	0.404
	N	135	135	135	135	135	135	135	135	135
Standardised adult chat on street	Pearson Correlation	-0.066	-0.008	-0.053	0.027	.477(**)	1	.343(**)	0.056	.294(**)
	Sig. (2-tailed)	0.449	0.925	0.538	0.755	0		0	0.52	0.001
	N	135	135	135	135	135	135	135	135	135
Standardised adult recognise	Pearson Correlation	0.087	0.128	0.036	0.15	.295(**)	.343(**)	1	0.08	.336(**)
	Sig. (2-tailed)	0.315	0.138	0.679	0.083	0.001	0		0.358	0
	N	135	135	135	135	135	135	135	135	135
Standardised children visits	Pearson Correlation	-0.08	0.003	-.172(*)	0.013	0.013	0.056	0.08	1	.322(**)
	Sig. (2-tailed)	0.357	0.975	0.046	0.879	0.884	0.52	0.358		0
	N	135	135	135	135	135	135	135	135	135
Standardised children chat on street	Pearson Correlation	0.083	0.137	-0.035	.182(*)	0.072	.294(**)	.336(**)	.322(**)	1
	Sig. (2-tailed)	0.336	0.112	0.686	0.035	0.404	0.001	0	0	
	N	135	135	135	135	135	135	135	135	135
**	Correlation is significant at the 0.01 level (2-tailed).									
*	Correlation is significant at the 0.05 level (2-tailed).									

Density variable v social contacts

Appendix G

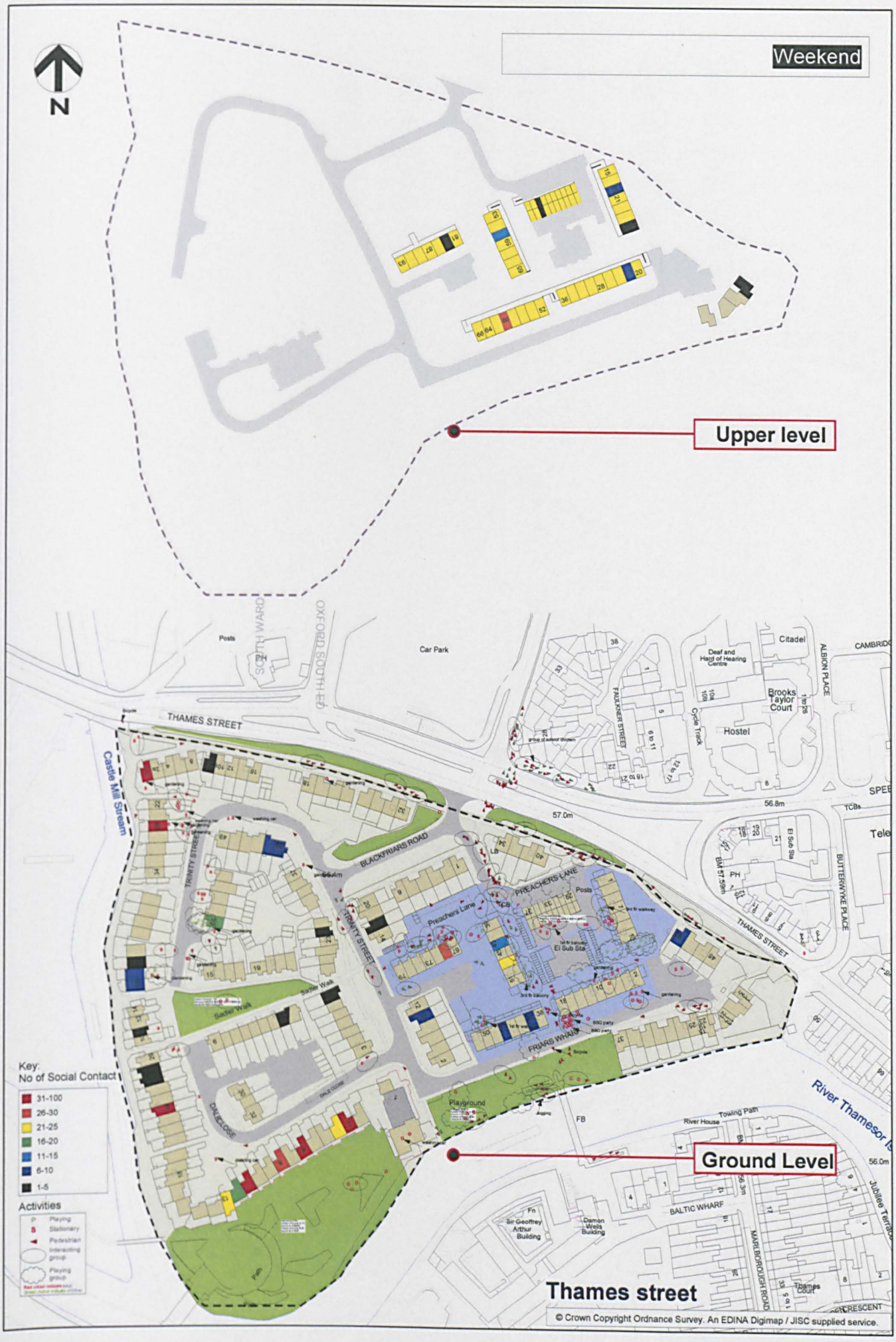
Weekend Observation Social Activities

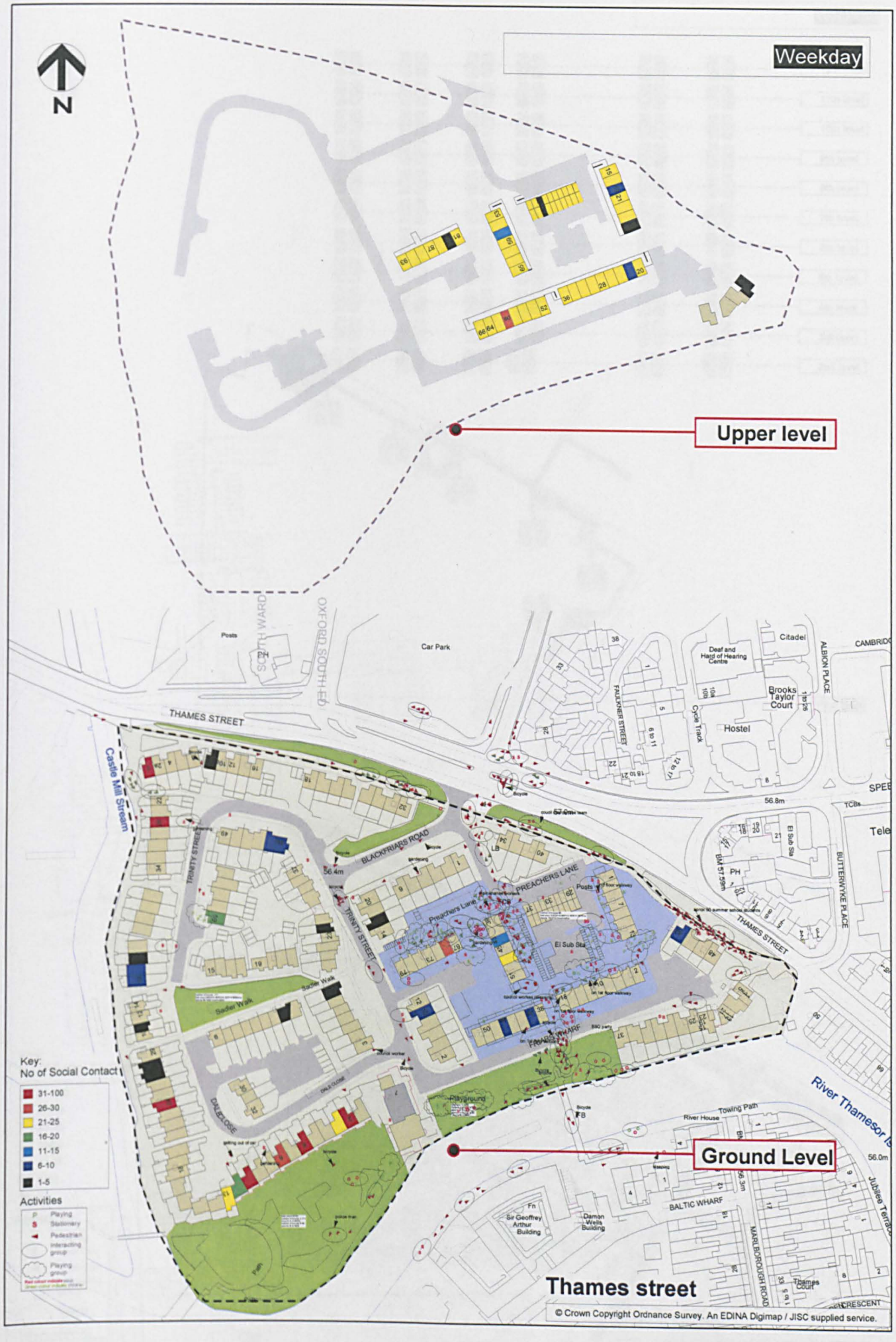
Weekday Observation Social Activities


Weekend
N
Repairing car
Gardening
Repairing
Gardening
Gardening
Gardening
Gardening
Car reparing
loading car
Gardening
Car cleaning
Gardening packing into car
getting into car
Gardening
Gardening
Gardening
Washing Car
Getting out of loading car
Gardening
Repair
Gardening
Gardening
Gardening
Gardening
Gardening
Getting out of car
Cleaning
car washing
Gardening
Gardening
Cleaning
Gardening
Gardening
Car Repair
contractors
getting out of car
Cleaning car
Car Washing
Gardening
washing car
Car repairing
Car washing
Gardening
getting into car
washing car
Gardening
cleaning
Gardening
Gardening
Key:
No of Social Contact car
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian
Interacting group
Playing group
New Marston
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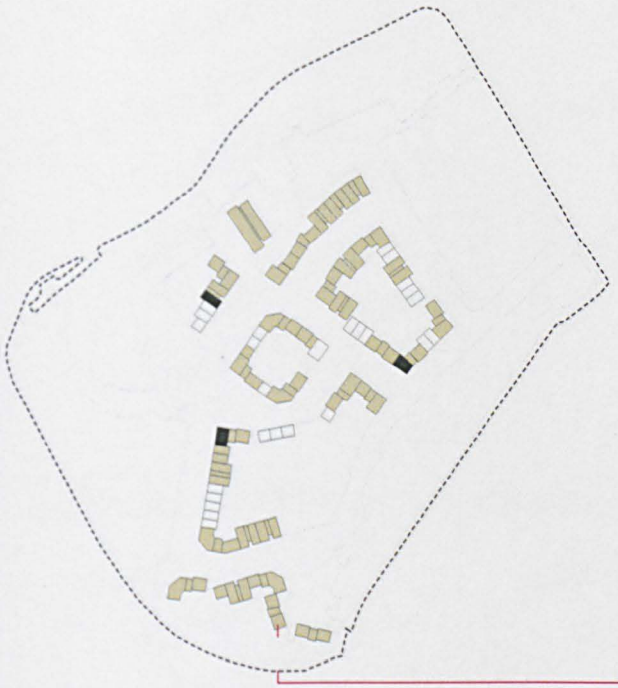

Weekend
N
Upper level
Ground Level
Thames street
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
Playing
Stationary
Pedestrian
Interacting group
Playing group
THAMES STREET
BLACKFRIARS ROAD
PREACHERS LANE
FRIARS WHARF
TRINITY STREET
Castle Mill Stream
Sadler Walk
DALE CLOSE
DALEHOUSE
Playground
Car Park
Posts
Citadel
Deaf and Hard of Hearing Centre
Brooks Taylor Court
Hostel
Cycle Track
FAULKNER STREET
ALBION PLACE
BUTTERWYKE PLACE
El Sub Sta
PH
TCBs
Towing Path
River House
River Thames
BALTIC WHARF
MARLBOROUGH ROAD
Sir Geoffrey Arthur Building
Damon Wells Building
Thames Court
56.8m
57.0m
56.0m
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Weekday
N
Upper level
Ground Level
Thames street
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
Playing
Stationary
Pedestrian interacting group
Playing group
THAMES STREET
BLACKFRIARS ROAD
PREACHERS LANE
TRINITY STREET
Sadler Walk
Castle Mill Stream
Car Park
Hostel
Cycle Track
Deaf and Hard of Hearing Centre
Brooks Taylor Court
Citadel
ALBION PLACE
FAULKNER STREET
BUTTERWYKE PLACE
El Sub Sta
Playground
River House
Towing Path
BALTIC WHARF
MARLBOROUGH ROAD
Sir Geoffrey Arthur Building
Daman Wells Building
Thames Court
River Thames
56.8m
56.4m
56.0m
BM 57.59m
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Weekend
N
12th level
11th level
10th level
9th level
8th level
7th level
6th level
5th level
4th level
3rd level
2nd level
First level
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian
Interacting group
Playing group
Red colour indicate adult
Green colour indicate children
Parkview
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Weekday
N
12th level
11th level
10th level
9th level
8th level
7th level
6th level
5th level
4th level
3rd level
2nd level
First level
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian interacting group
Playing group
Red colour indicate adult
Green colour indicate children
Parkview
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Weekend





3rd level

2nd level





1st level

Ground level

Key:

No of Social Contact

- 31-100
- 26-30
- 21-25
- 16-20
- 11-15
- 6-10
- 1-5

Activities

- P Playing
- S Stationary
- Pedestrian
- Interacting group
- Playing group

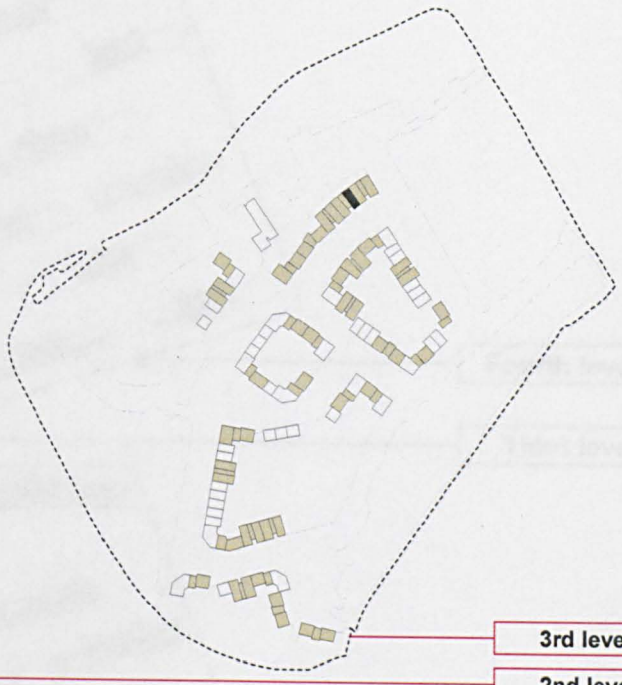
Red colour indicate adult
Green colour indicate children

Holybrooks

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Weekday





3rd level

2nd level





1st level

Ground level

Key:
No of Social Contact

- 31-100
- 26-30
- 21-25
- 16-20
- 11-15
- 6-10
- 1-5

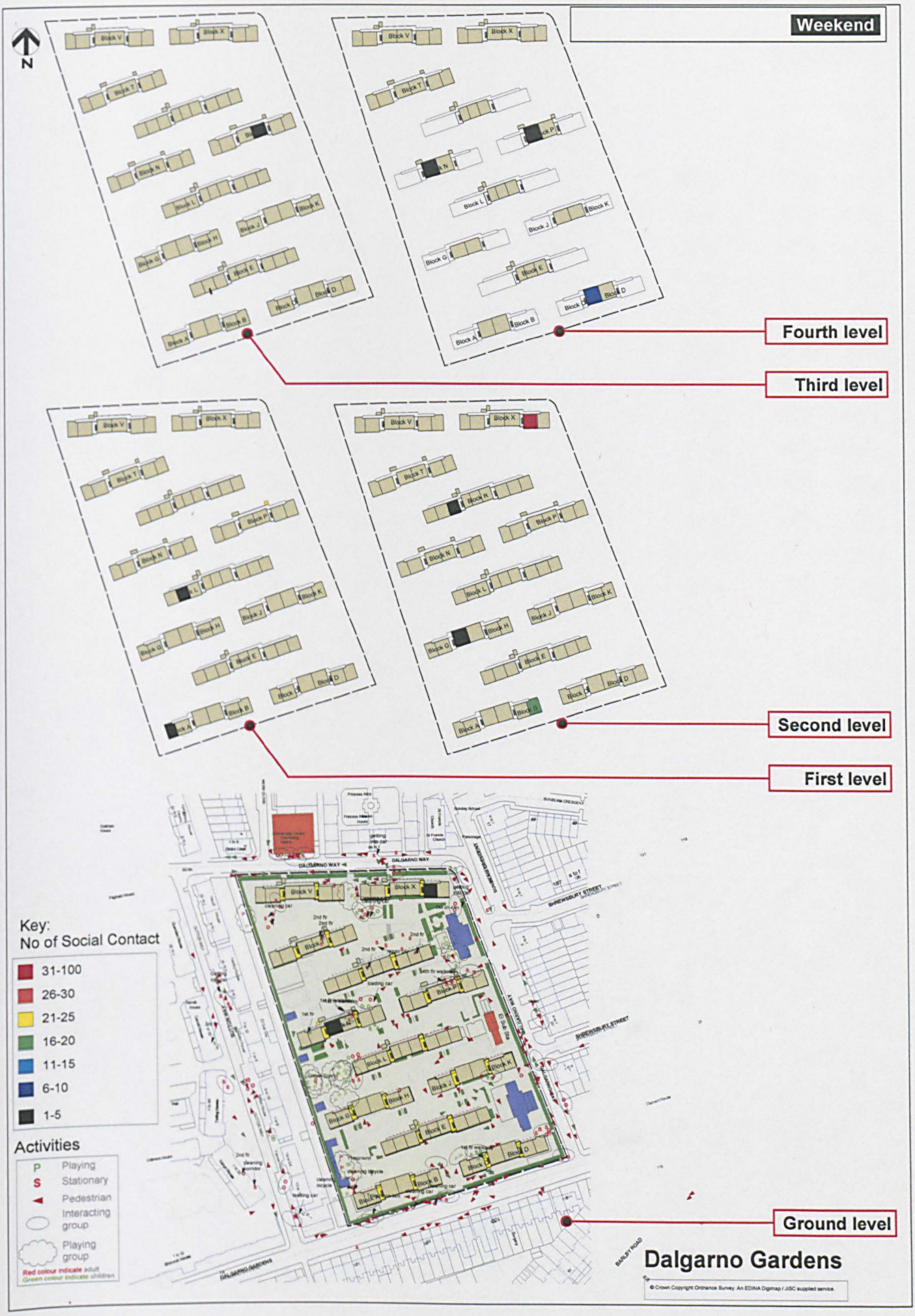
Activities

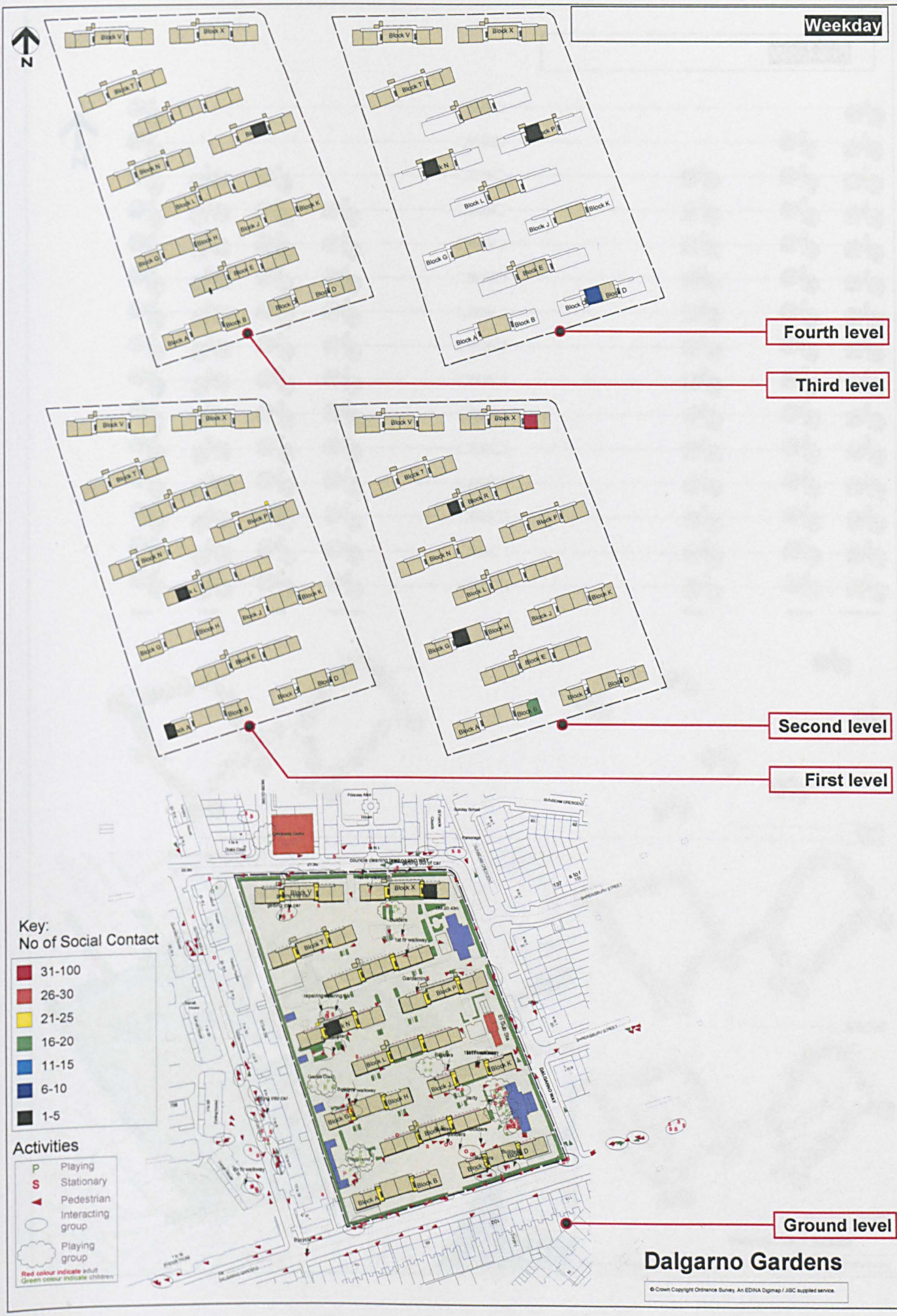
- P Playing
- S Stationary
- Pedestrian
- Interacting group
- Playing group

Red colour indicate adult
Green colour indicate children

Holybrooks

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Weekend
N
Fourth level
Third level
Second level
First level
Ground level
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian
Interacting group
Playing group
Red colour indicate adult
Green colour indicate children
Dalgarno Gardens
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Weekday
N
Fourth level
Third level
Second level
First level
Ground level
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian
Interacting group
Playing group
Red colour indicate adult
Green colour indicate children
Dalgarno Gardens
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Weekend



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Weekday
N
19th level
18th level
17th level
16th level
15th level
14th level
13th level
12th level
11th level
10th level
9th level
8th level
7th level
6th level
5th level
Greves
Wistler
Datrey
Ashburnham
Berenger
Byantyre
Chelsea reach
3rd level
4th level
Second level
First level
Ground level
Weekday
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian interacting group
Playing group
Red colour indicate adult
Green colour indicate children
Worlds End Estate
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Appendix H

Example of Isovist Field and Walking

Distance Calculation Using Depthmap

Isovist from entrance space

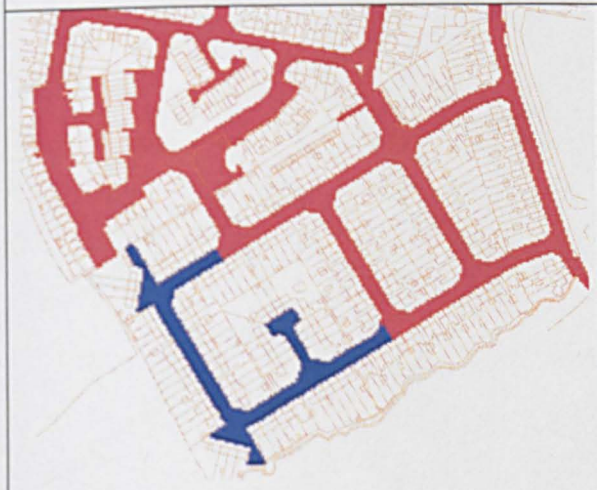


Walking distance



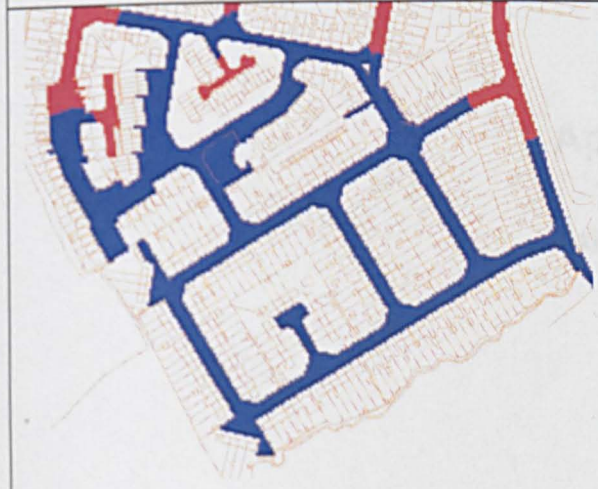
1 min walking distance

Approximately 80 meters



2 min walking distance

Approximately 160 meters



5 min walking distance

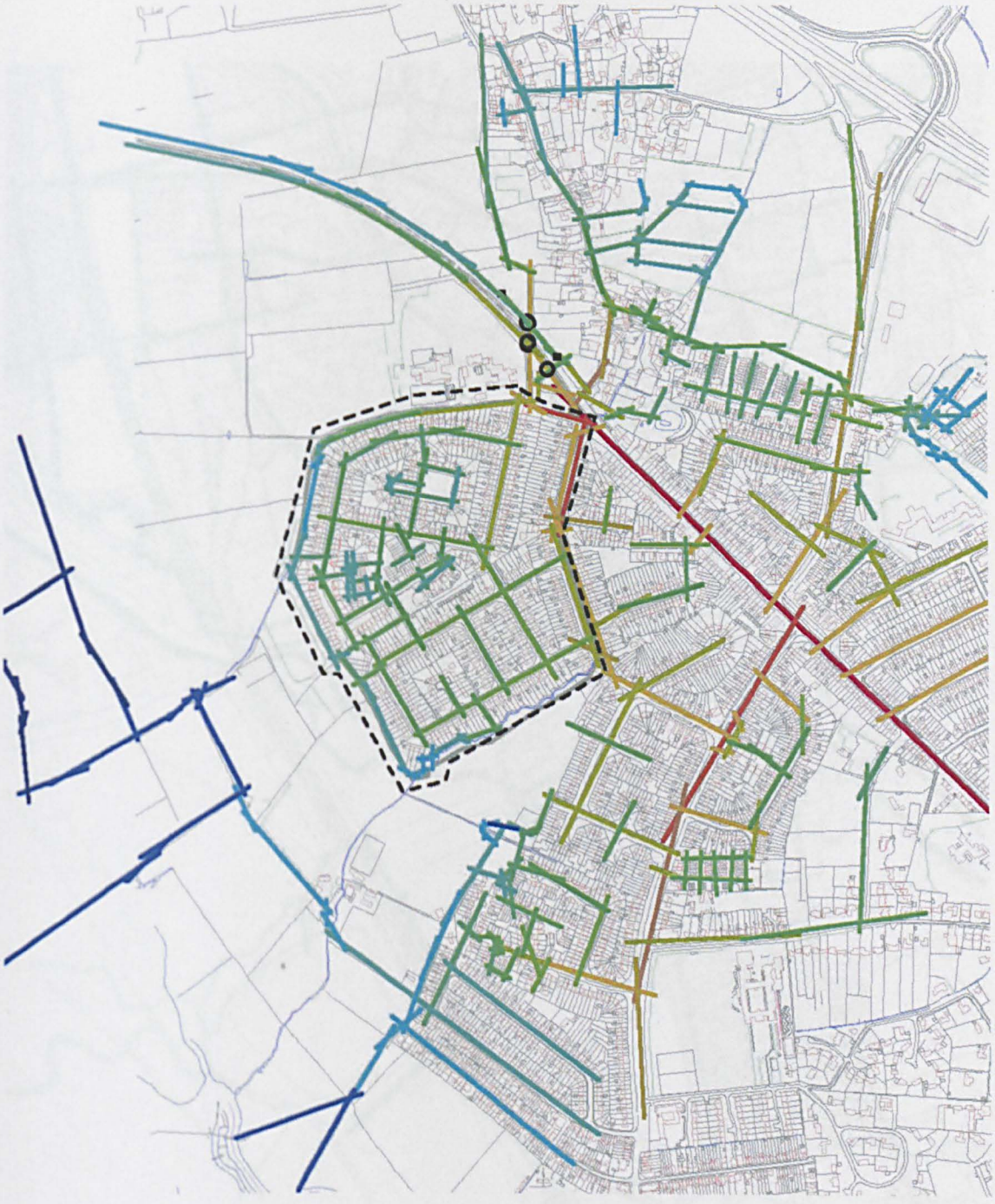
Approximately 400 meters

Appendix I

Axial Maps

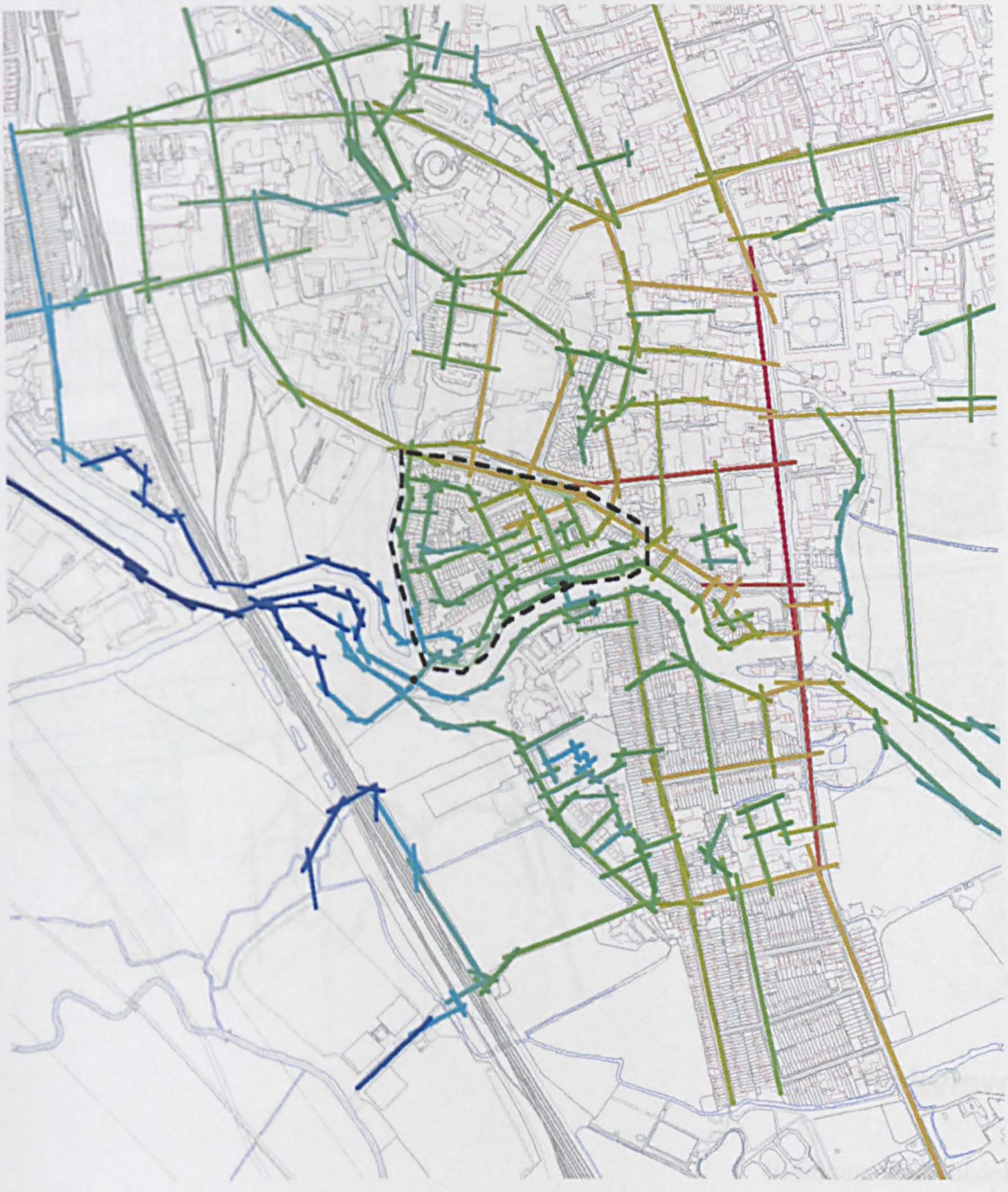
10 minute walk model (context)

Model of all spaces (local)



New Marston

10 minute walk model



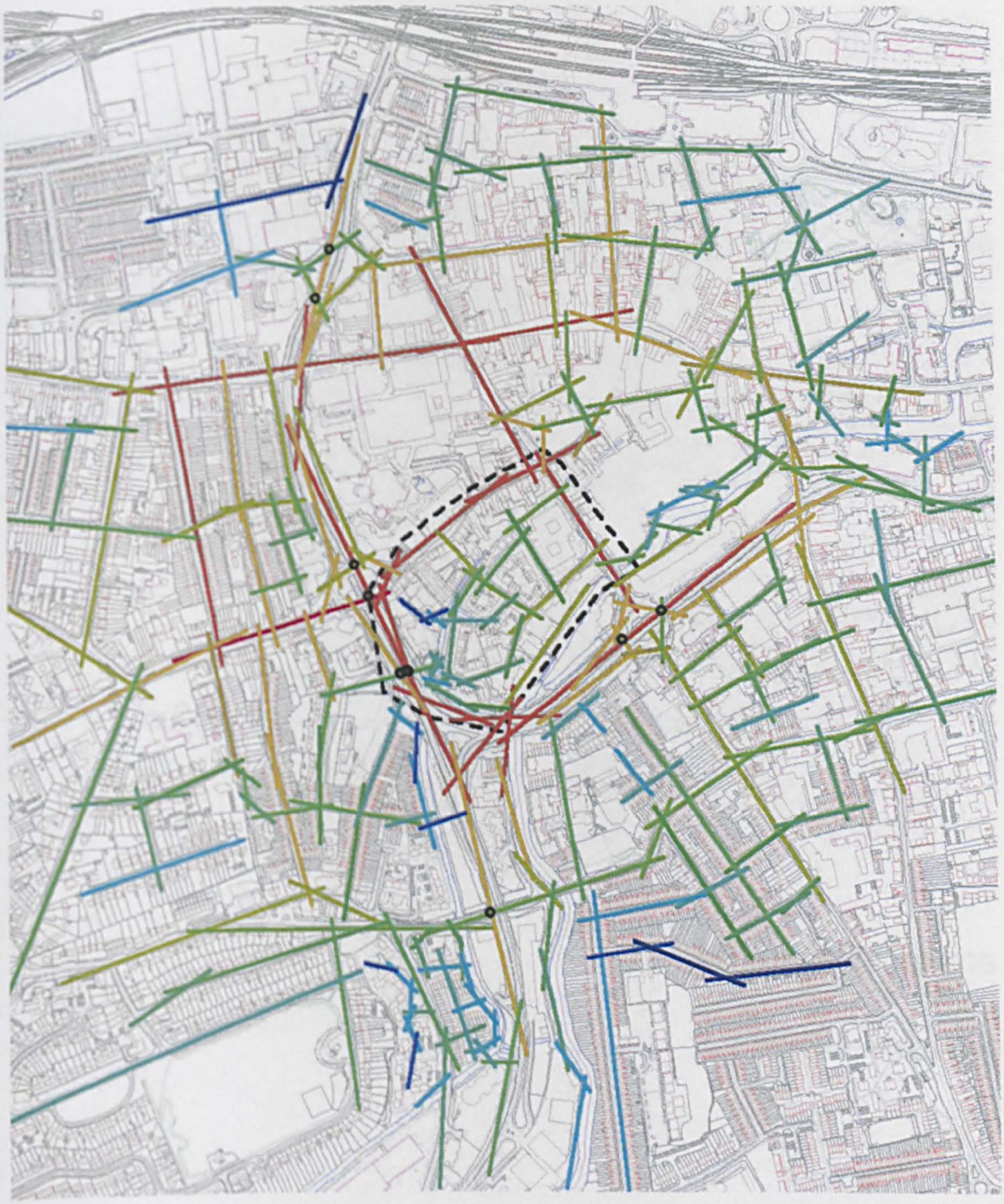
Thames Street

10 minute walk model



Parkview

10 minute walk model



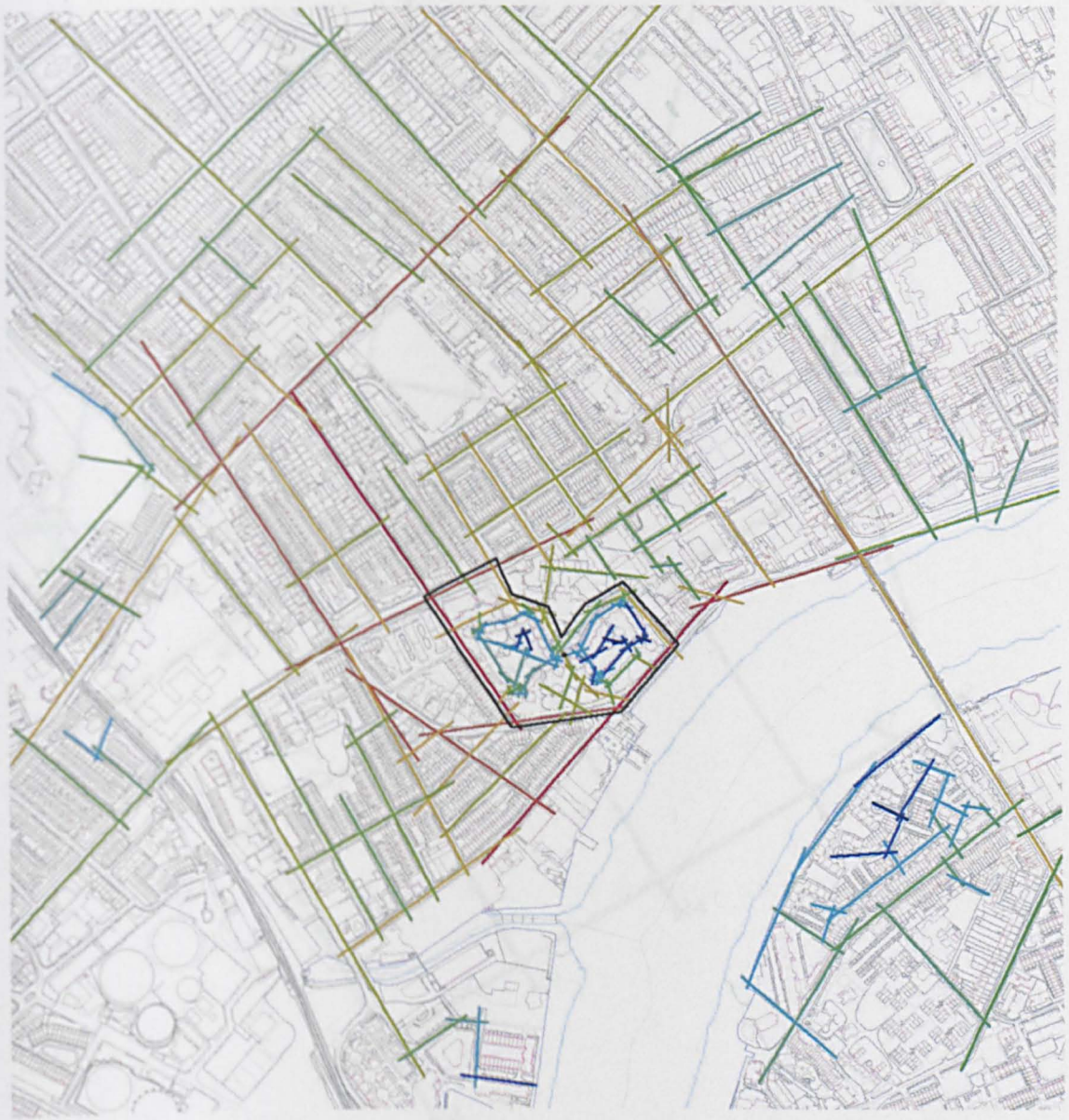
Holybrooks

10 minute walk model



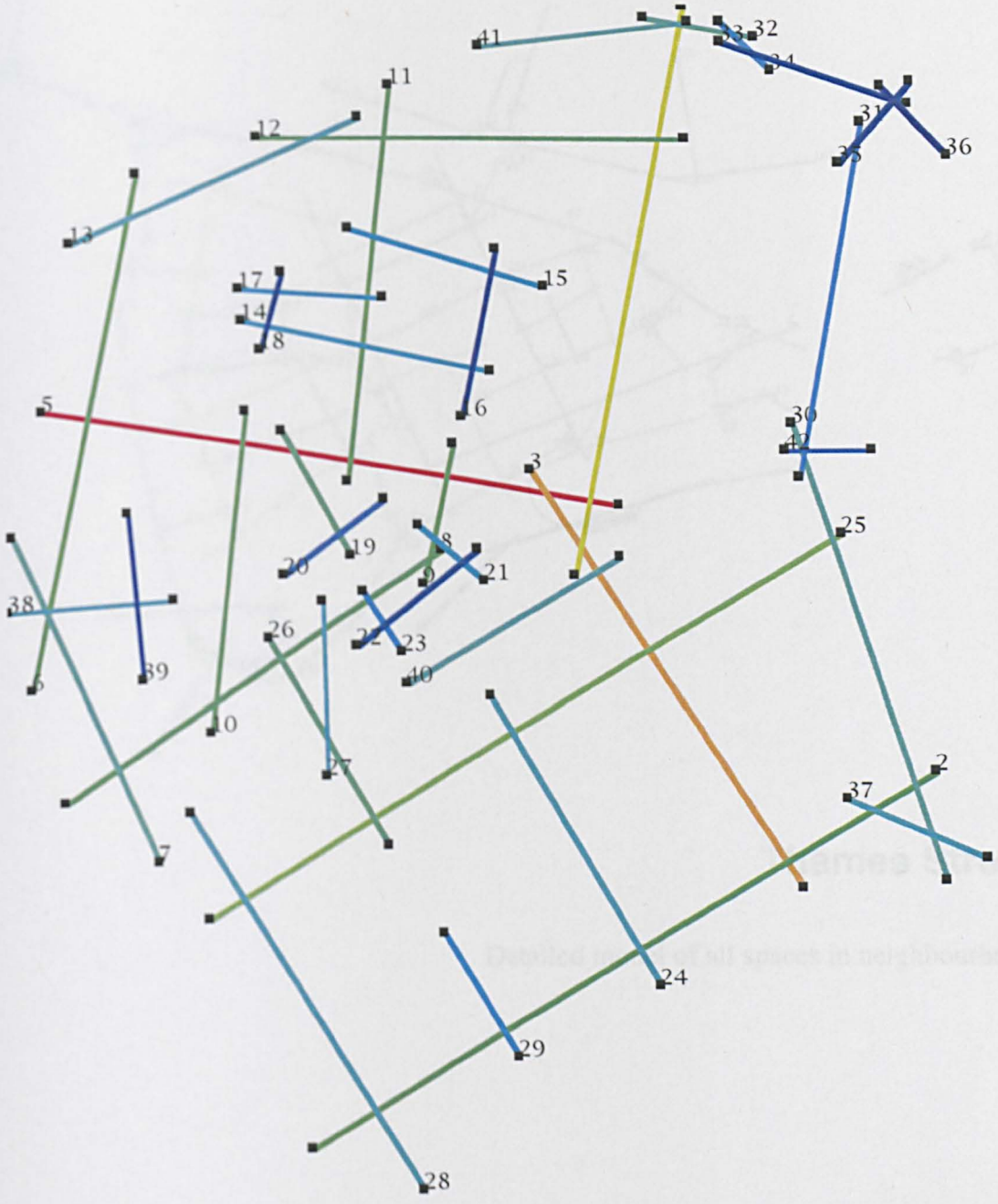
Dalgarno Gardens

10 minute walk model



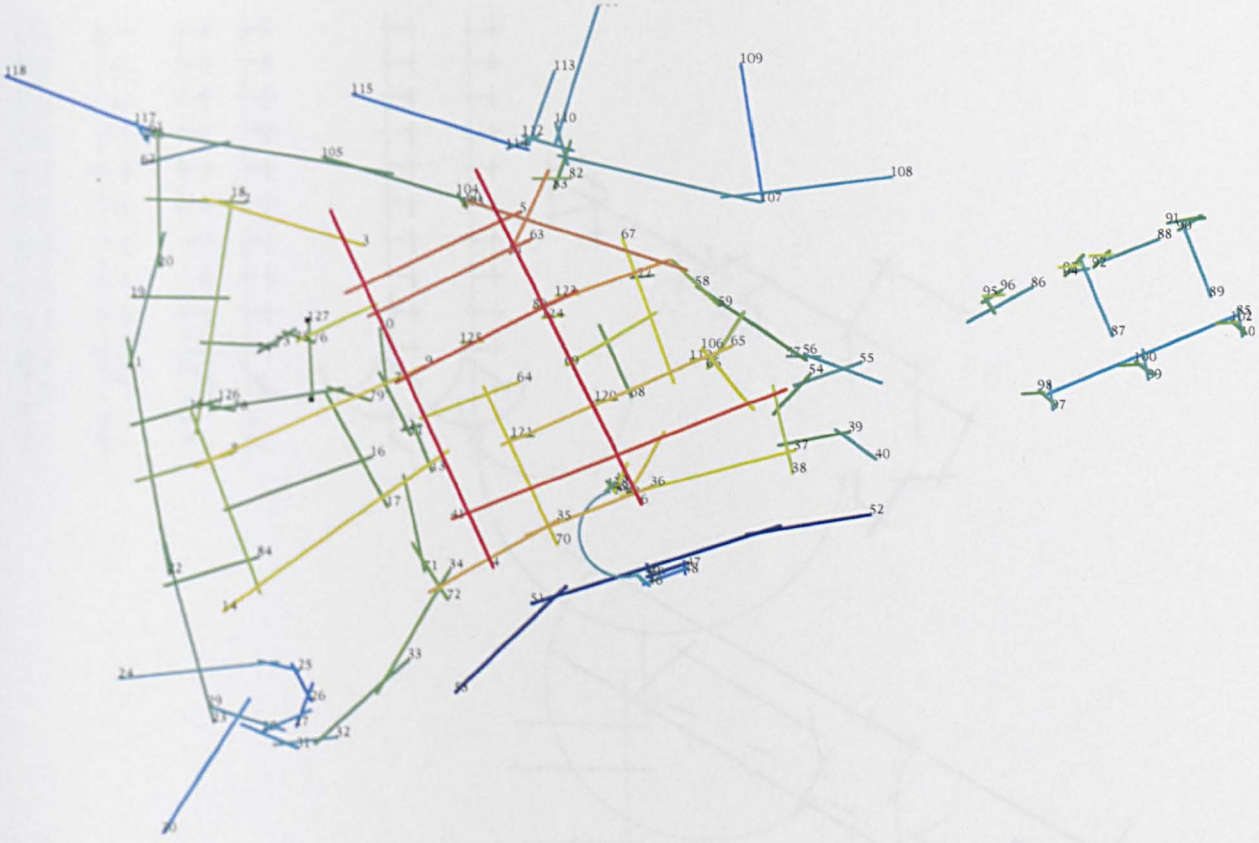
Worlds End Estate

10 minute walk model



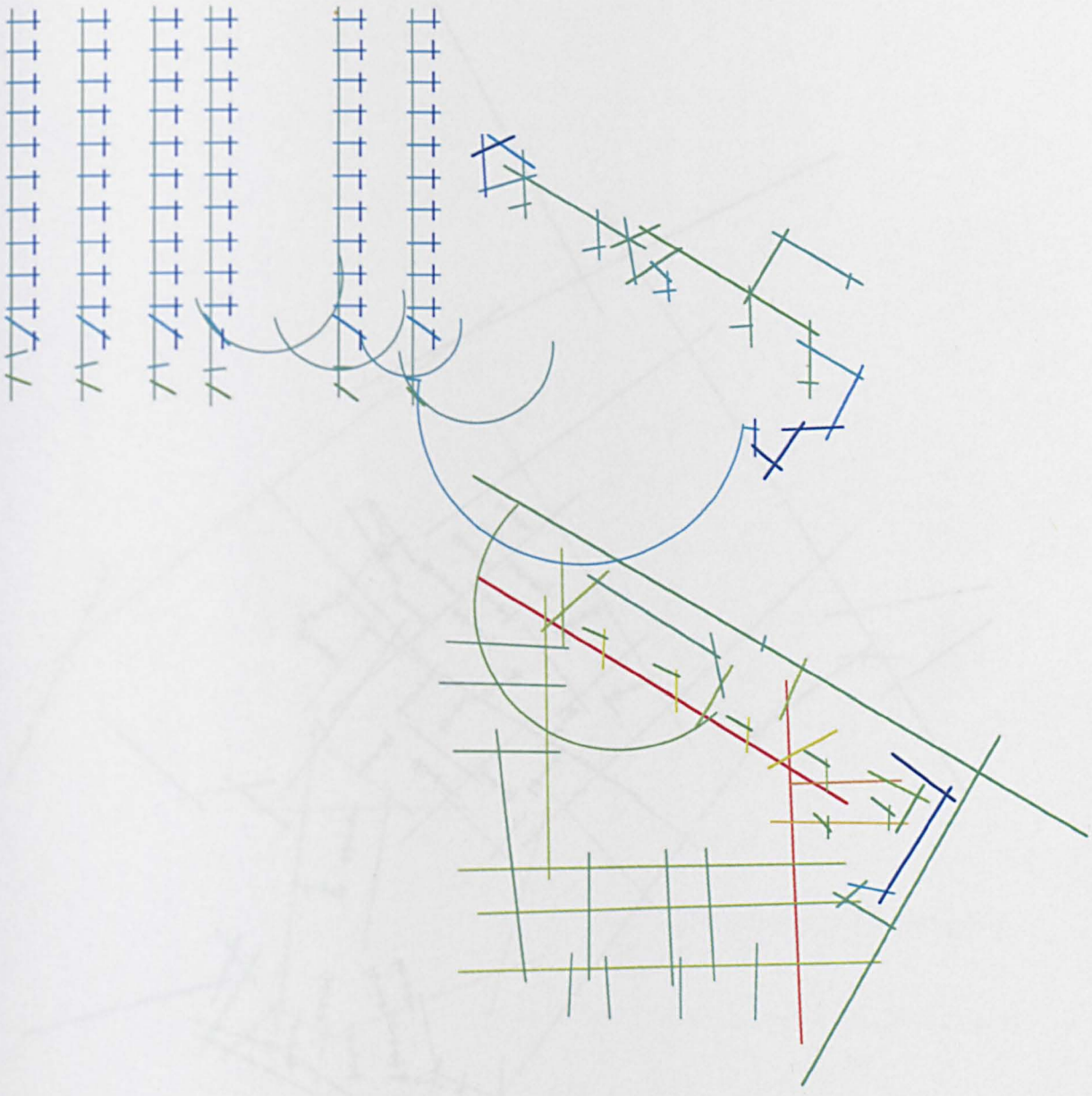
New Marston

Detailed model of all spaces in neighbourhood



Thames Street

Detailed model of all spaces in neighbourhood



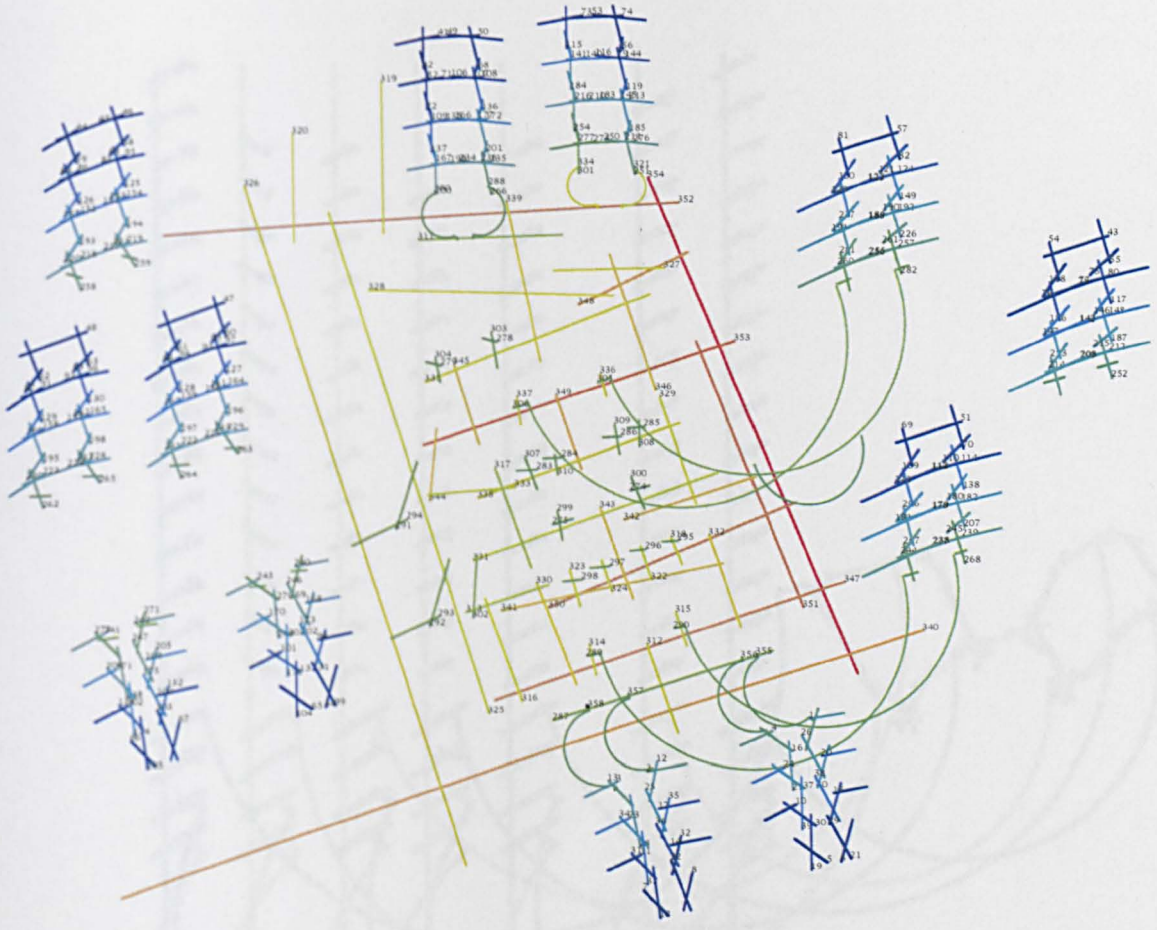
Parkview

Detailed model of all spaces in neighbourhood



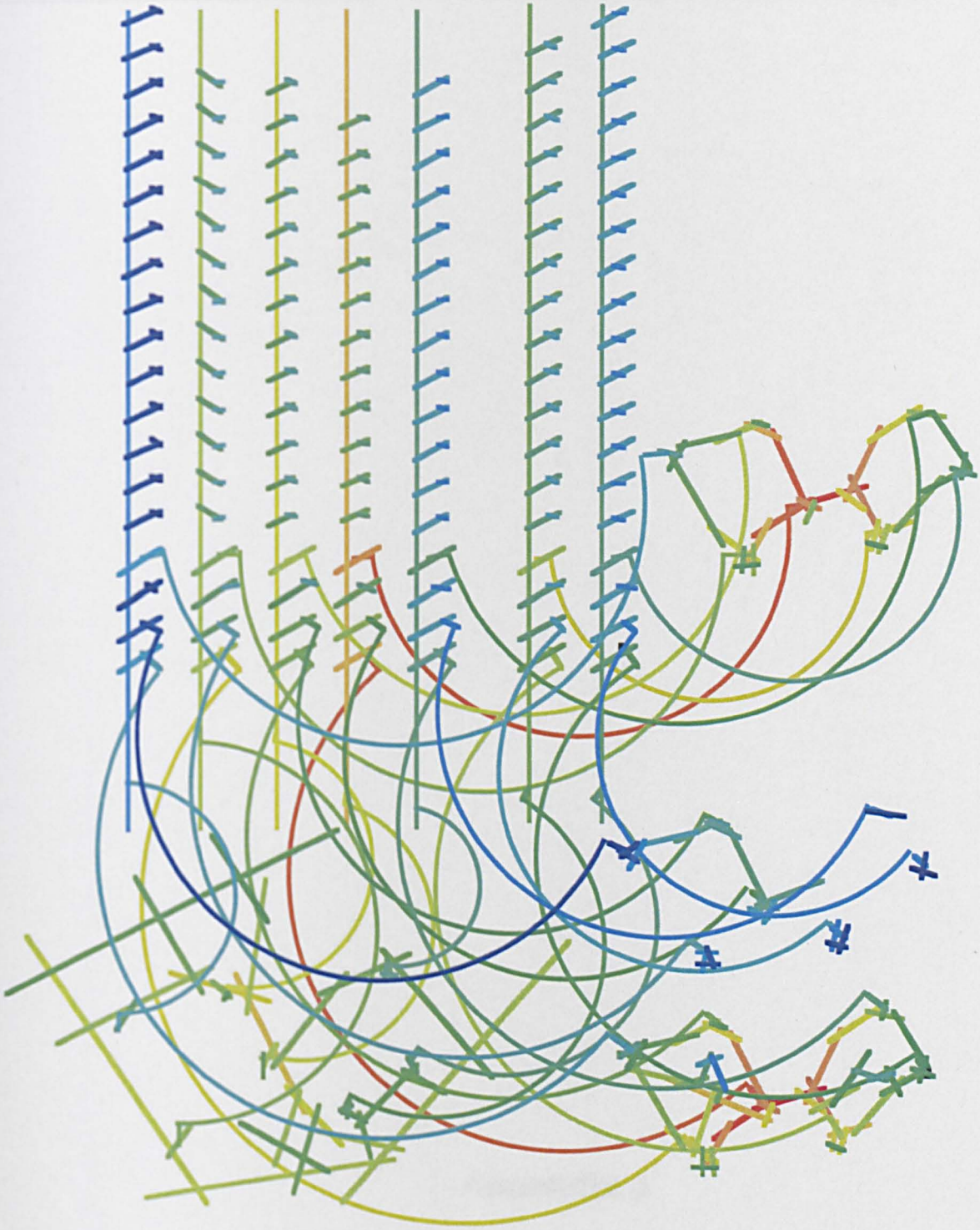
Holybrooks

Detailed model of all spaces in neighbourhood



Dalgarno Gardens

Detailed model of all spaces in neighbourhood



Worlds End Estate

Detailed model of all spaces in neighbourhood

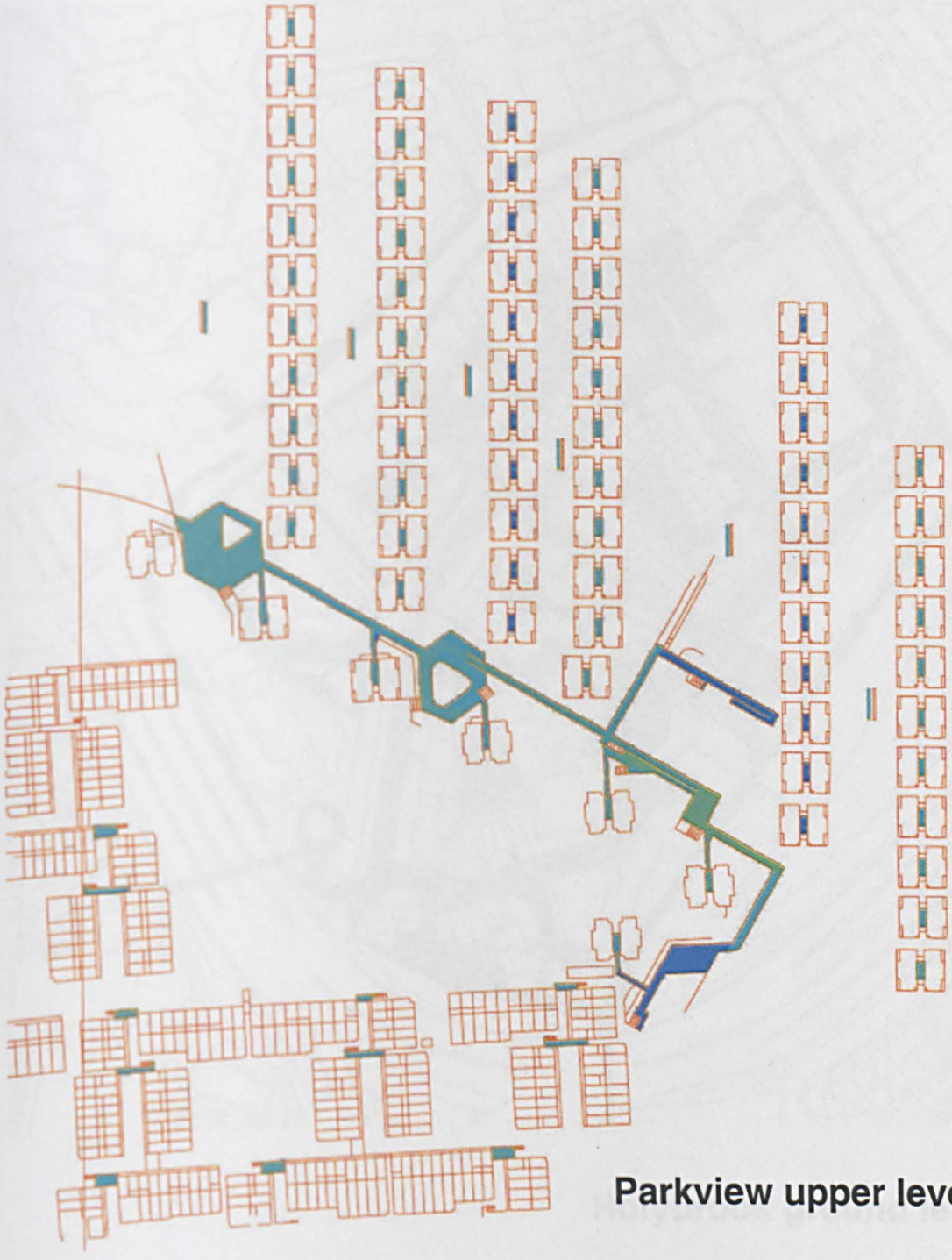


New Marston


Thames Street



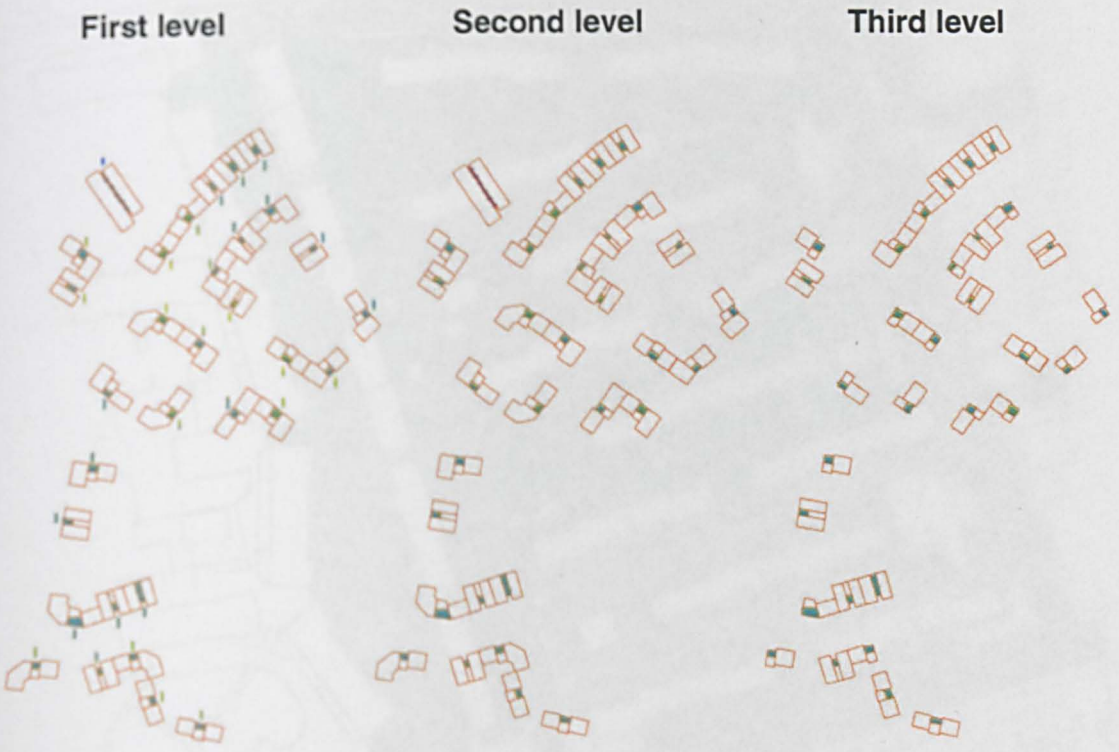
Parkview ground level



Parkview upper levels



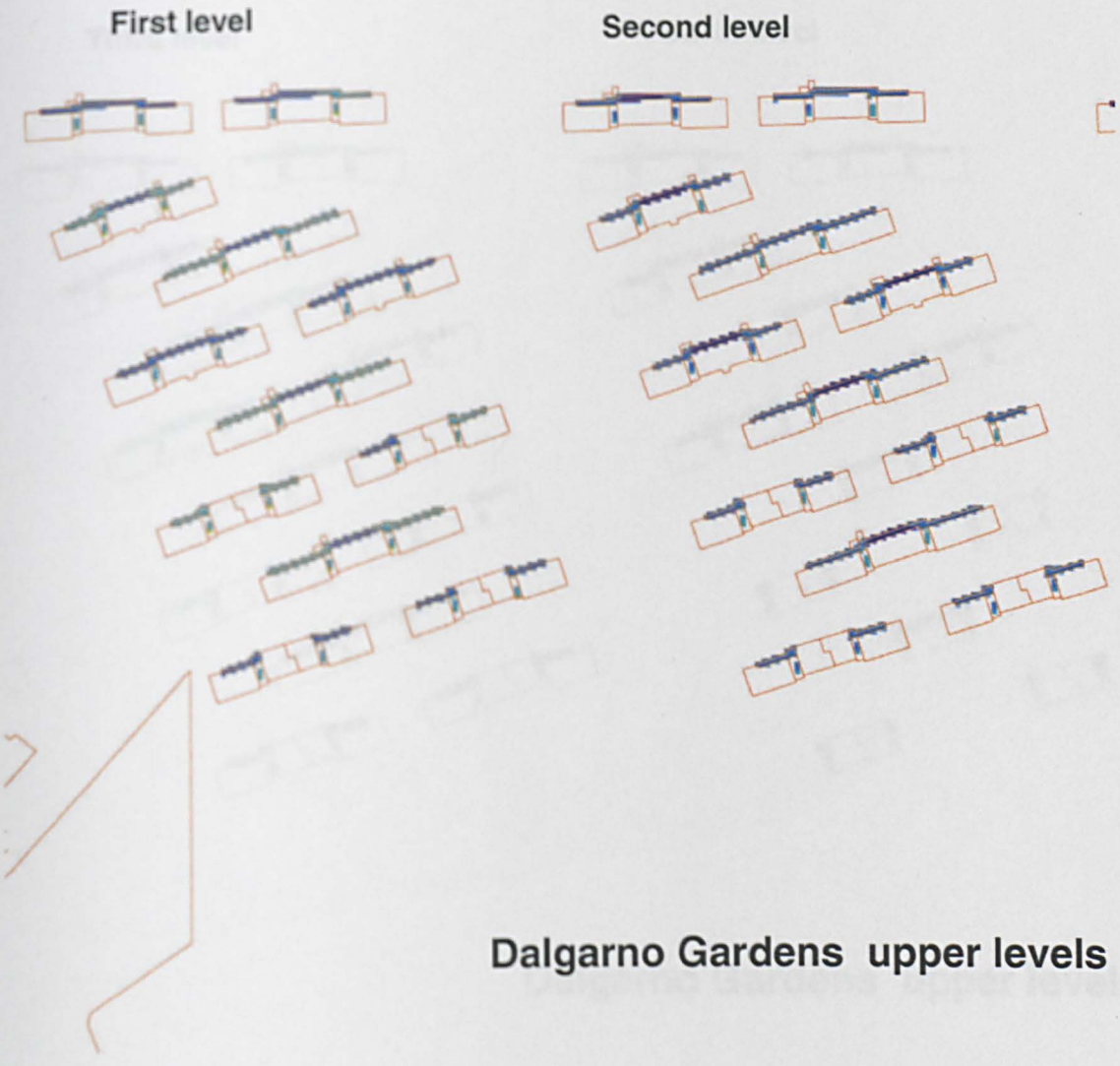
Holybrook ground level



Holybrook upper levels



Dalgarno Gardens ground level



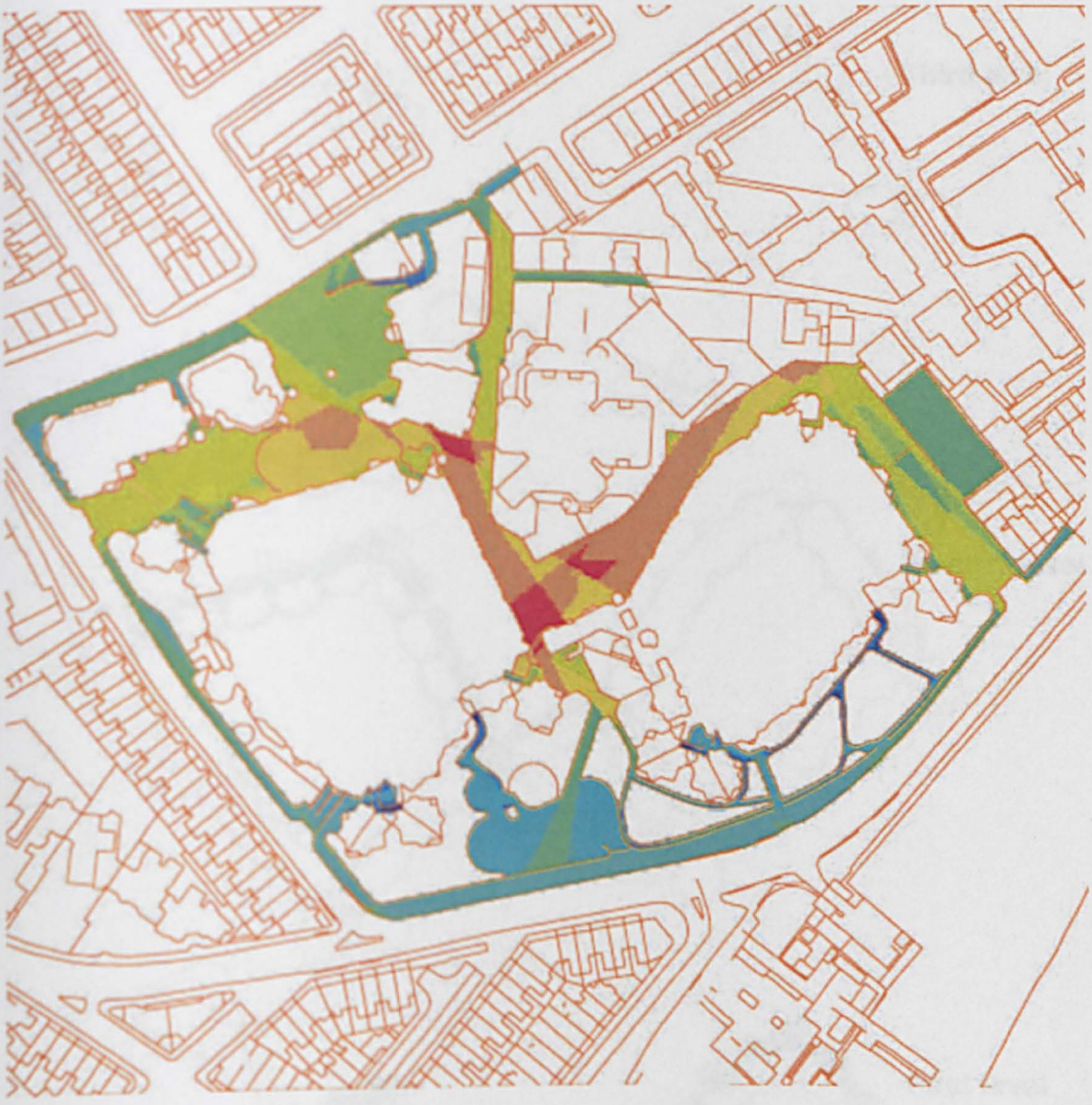
Dalgarno Gardens upper levels

Third level

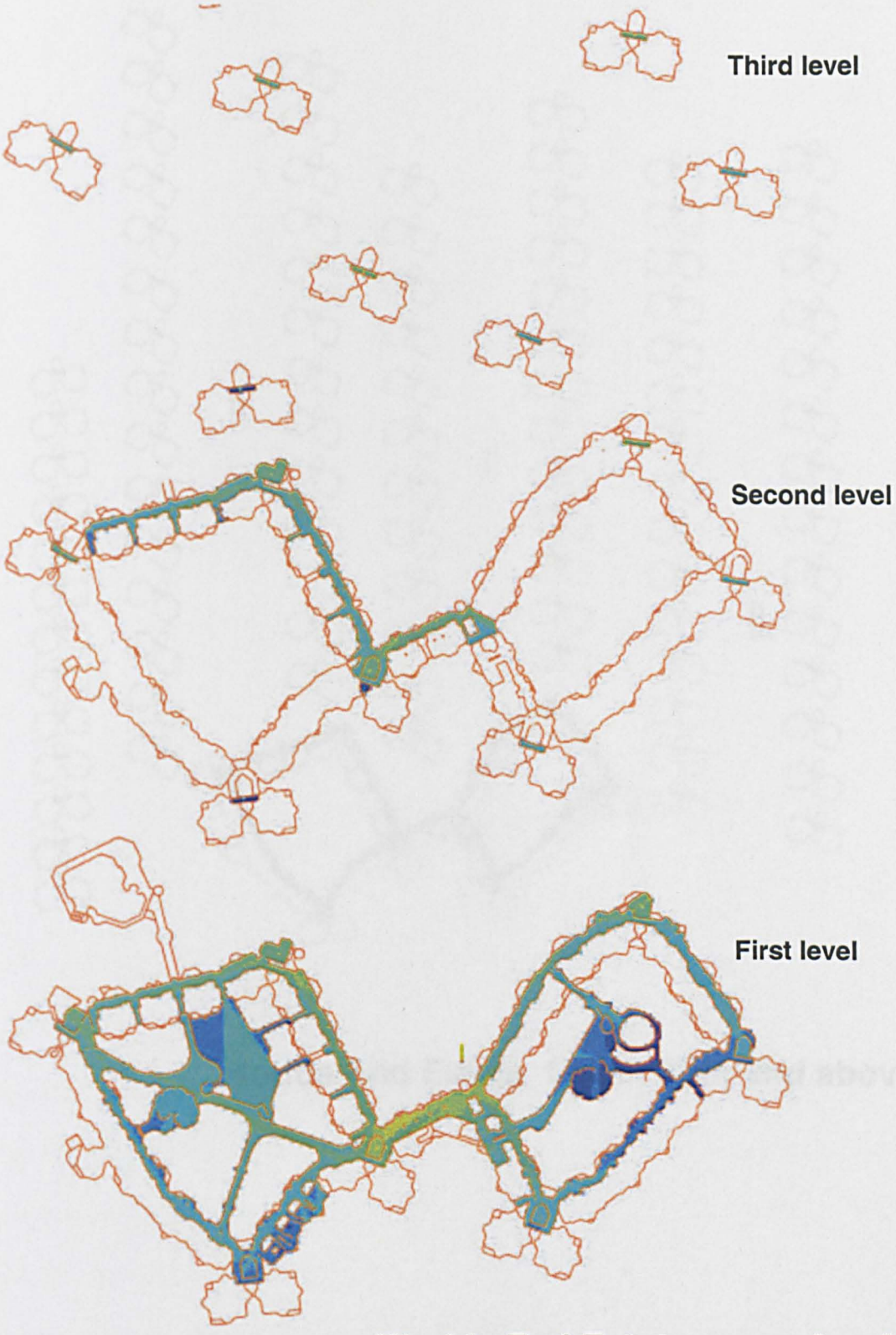
Fourth level



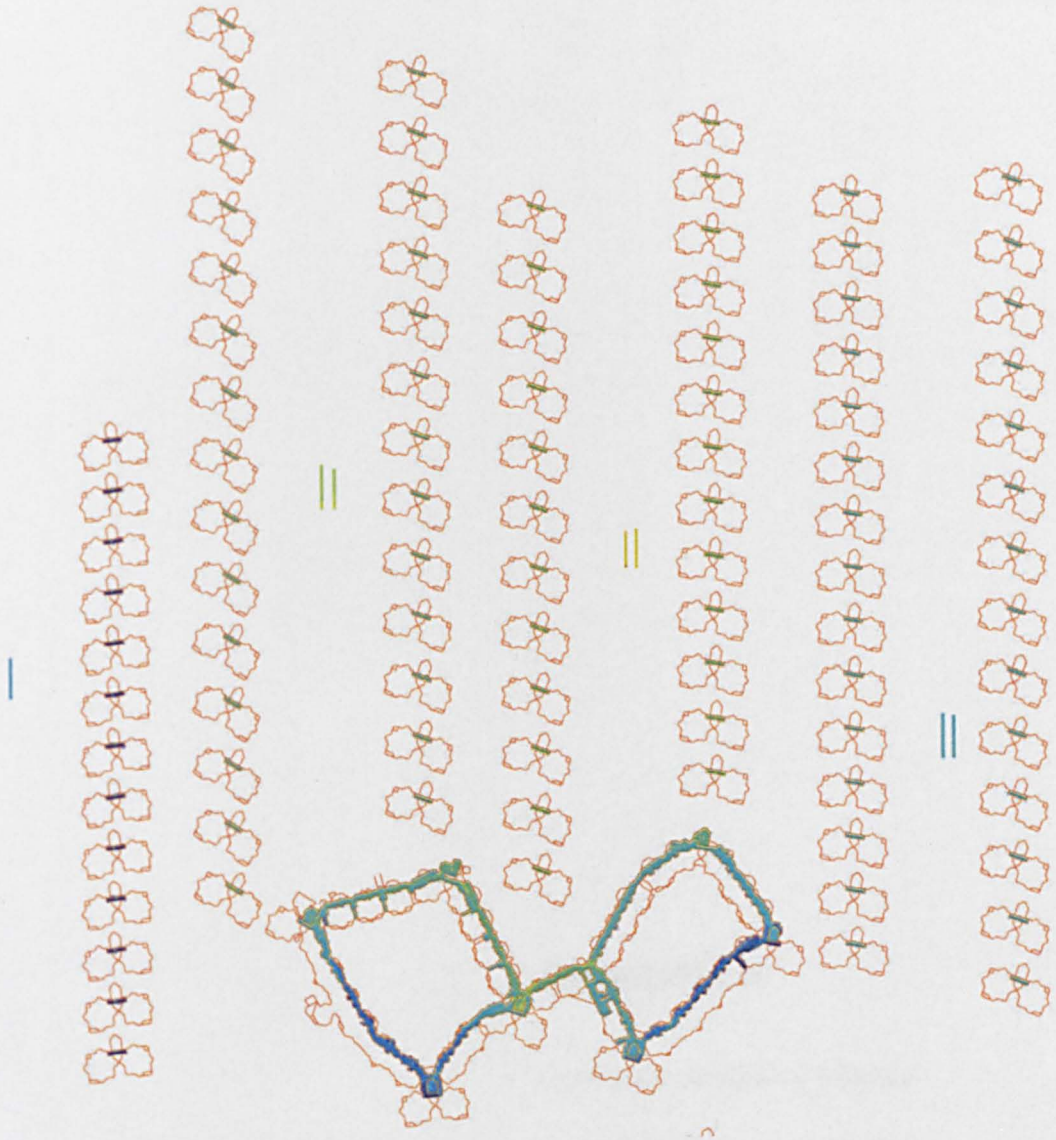
Dalgarno Gardens upper levels



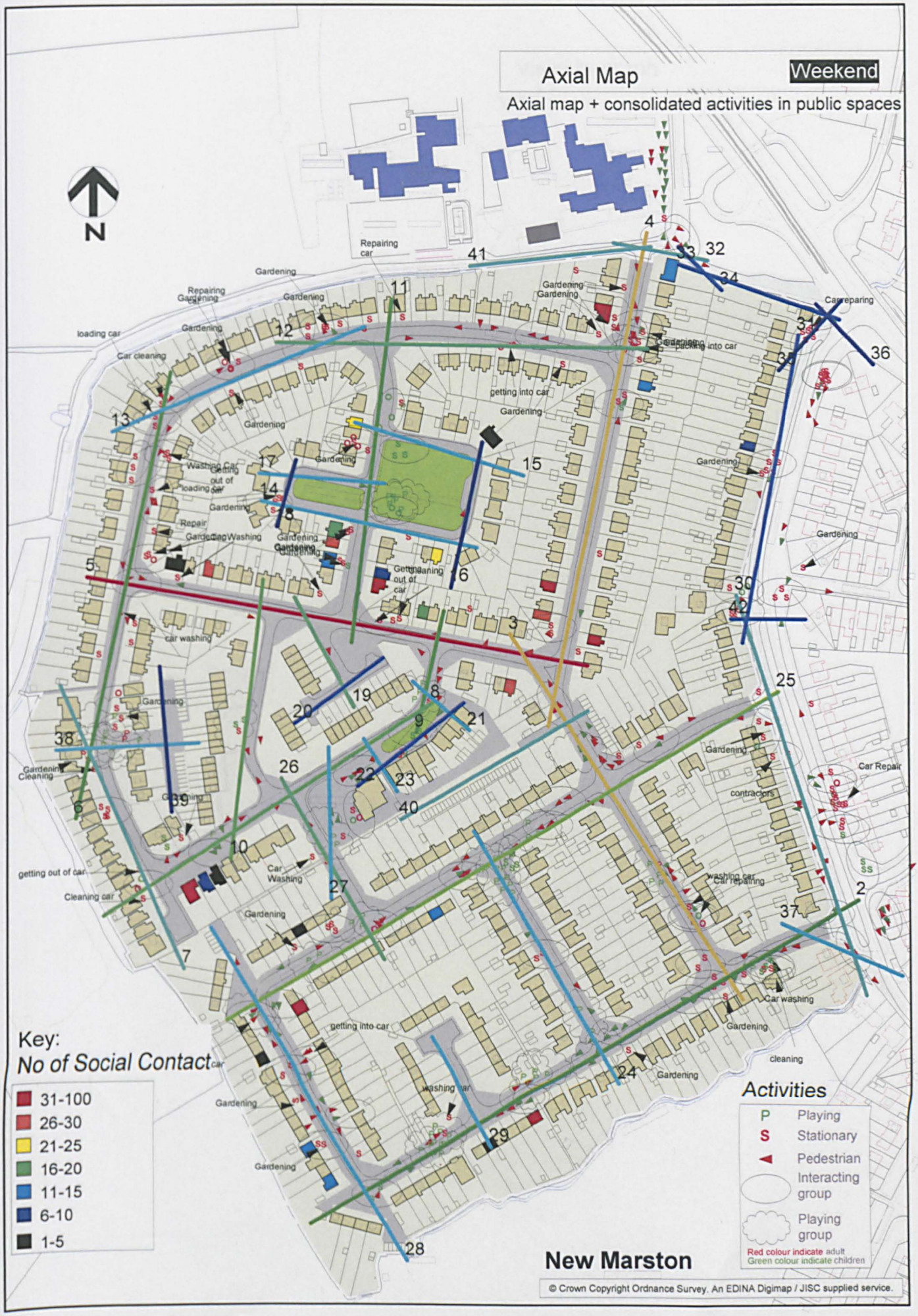
Worlds End Estate ground level



Worlds End Estate upper levels



Worlds End Estate fourth floor and above


Axial Map
Weekend
Axial map + consolidated activities in public spaces
N
Repairing car
Gardening
Repairing
Gardening
Gardening
Gardening
Gardening
Carreparing
loading car
Gardening
Car cleaning
Gardening
packing into car
getting into car
Gardening
Gardening
Gardening
Washing Car
Getting out of loading car
Gardening
Repair
Gardening
Washing
Gardening
Gardening
Gardening
Gardening
Getting out of car
Gardening
car washing
Gardening
Gardening
Cleaning
Gardening
Car Repair
contractors
getting out of car
Cleaning car
Car Washing
Gardening
washing car
Car repairing
Car washing
Gardening
getting into car
cleaning
Gardening
Gardening
Gardening
Gardening
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian
Interacting group
Playing group
Red colour indicate adult
Green colour indicate children
New Marston
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Appendix K

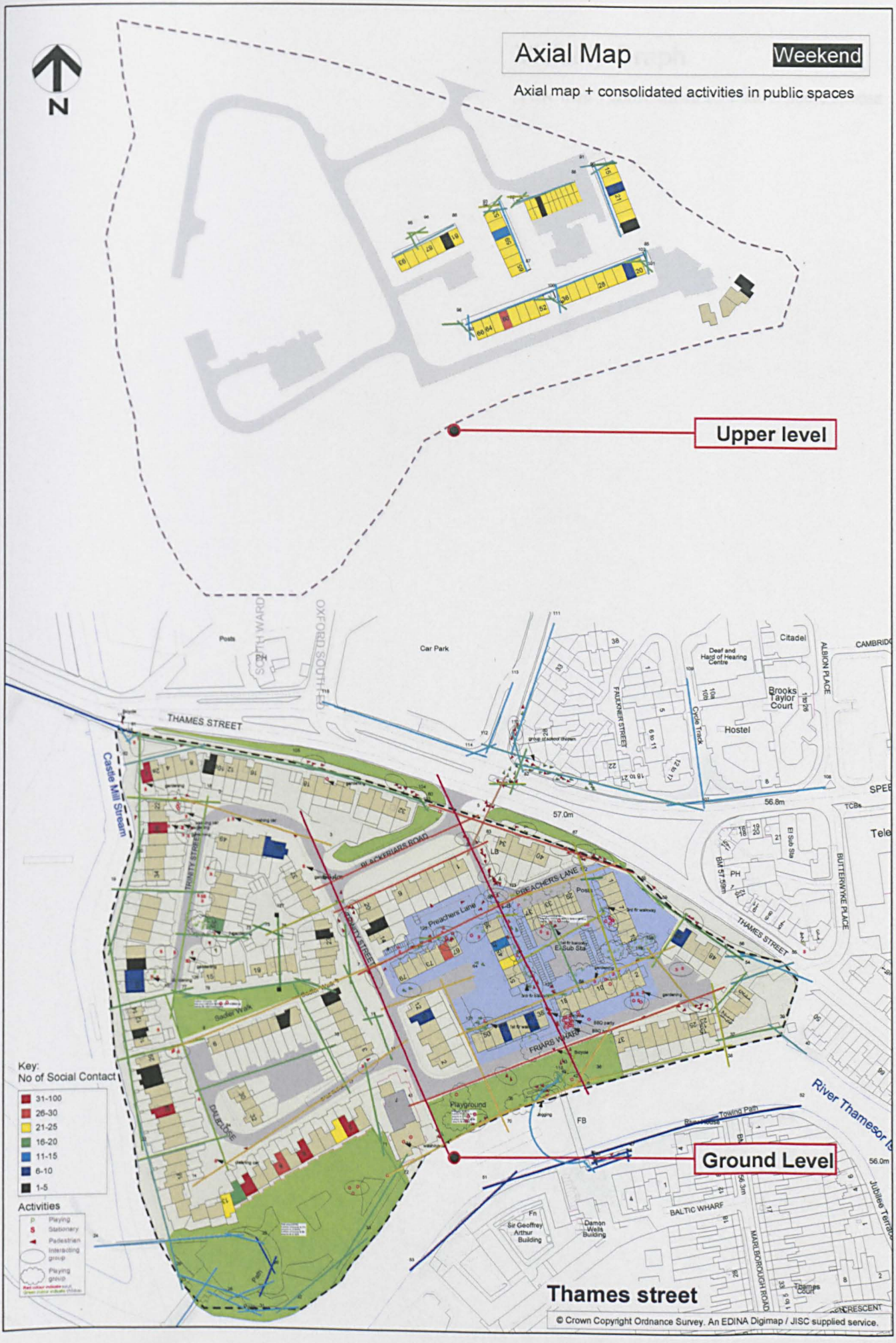
Combined Analytical Models

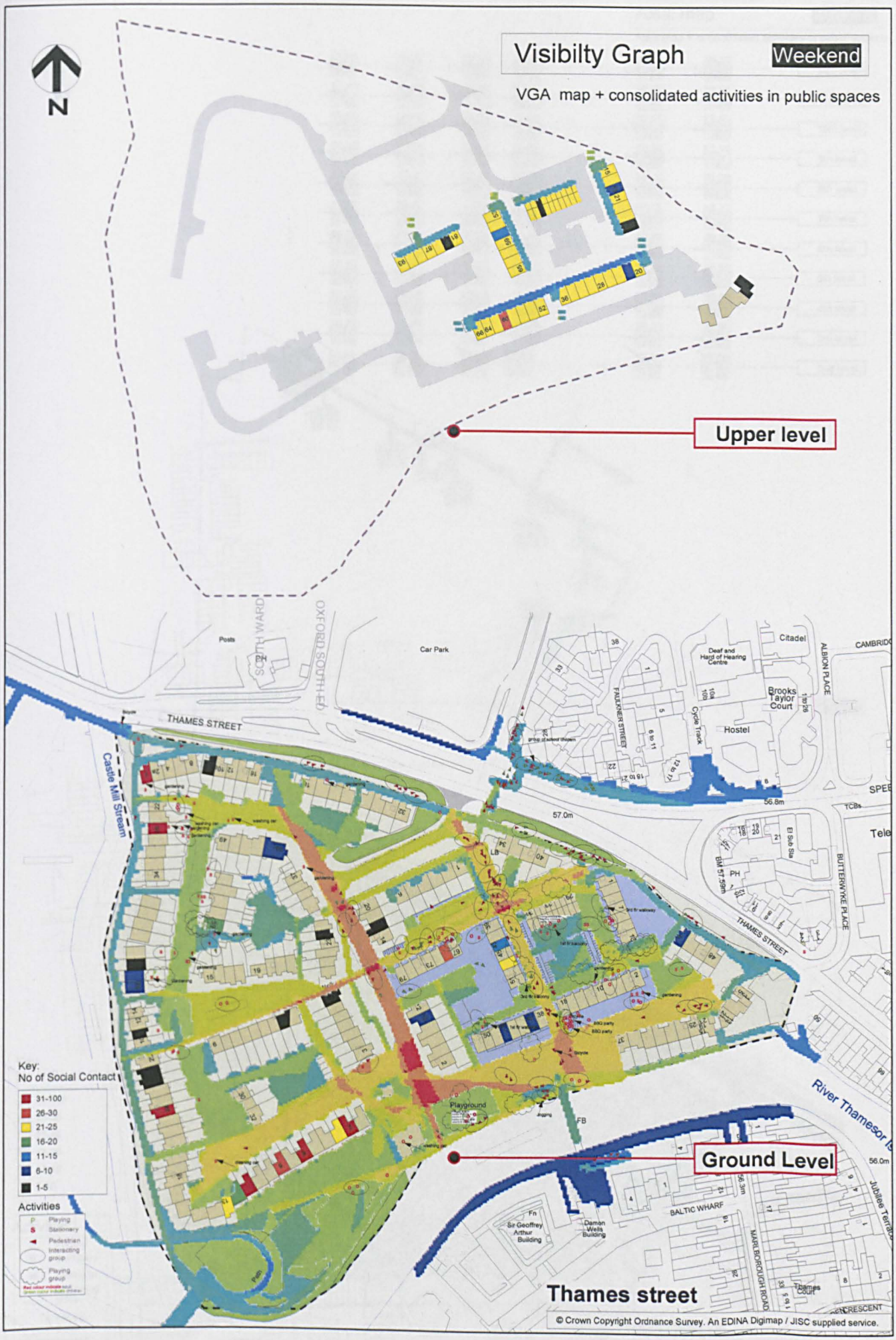
Axial + social activity

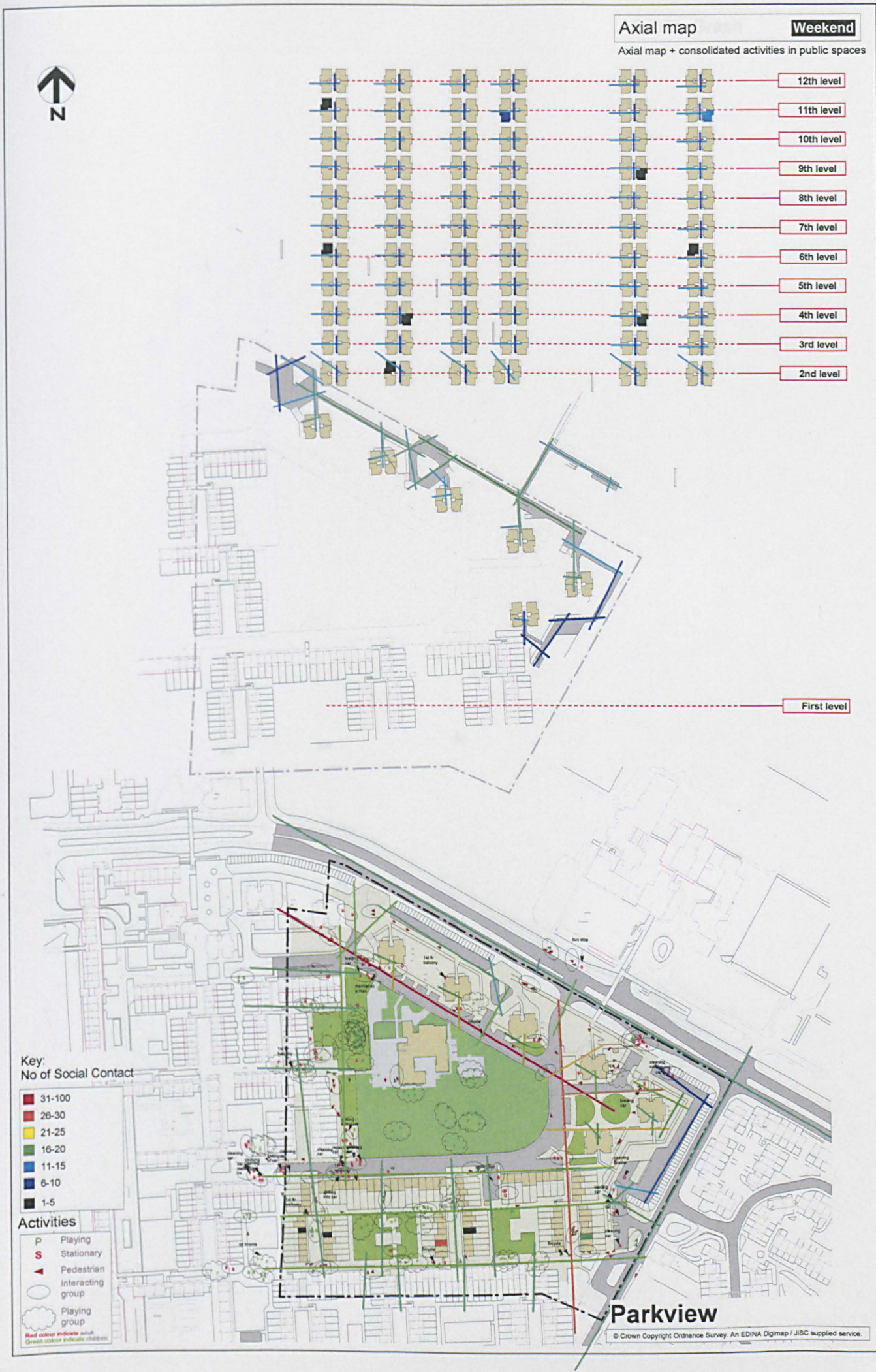
VGA+ social activity

The figures in appendix K are produced by superimposing observation data (social activities in public space) on the spatial analysis models. There are two sets of figures for each neighbourhood. The first of the two figure is made-up of an axial model of all public spaces within the neighbourhood, superimposed on observation data. The second figure includes Visibility Graph Analysis output (visual integration), superimposed on observation data.


Visibility graph
Weekend
VGA map + consolidated activities in public spaces
N
Repairing car
Gardening
Repairing
Gardening
Gardening
Gardening
Gardening
Car reparing
loading car
Gardening
Car cleaning
Gardening
Packing into car
getting into car
Gardening
Gardening
Gardening
Washing Car
Getting out of loading car
Gardening
Repair
Gardening
Washing
Gardening
Gardening
Gardening
Gardening
Getting out of car
Cleaning
car washing
Gardening
Gardening
Cleaning
Gardening
Gardening
Car Repair
contractors
getting out of car
Car Washing
Cleaning car
Gardening
Car repairing
washing car
Car washing
Gardening
getting into car
Gardening
cleaning
Gardening
washing car
Gardening
Gardening
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian
Interacting group
Playing group
Red colour indicate adult
Green colour indicate children
New Marston
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Axial Map
Weekend
Axial map + consolidated activities in public spaces
N
Upper level
Ground Level
Thames street
THAMES STREET
Car Park
Posts
PH
OXFORD SOUTH ED
Citadel
Deaf and Hard of Hearing Centre
Brooks Taylor Court
Hostel
ALBION PLACE
FALKNER STREET
Cycle Track
Castle Mill Stream
BLACKFRIARS ROAD
PREACHERS LANE
Preachers Lane
FRIARS WHARF
Playground
Sadler Walk
DALEDENE
TRINITY STREET
COLLEGE STREET
BUTTERWYKE PLACE
El Sub Sta
LB
FB
Towing Path
River Thames
BALTIC WHARF
MARLBOROUGH ROAD
Sir Geoffrey Arthur Building
Damon Wells Building
Thames Court
57.0m
56.8m
56.3m
56.0m
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
Playing
Stationary
Pedestrian
Intersecting group
Playing group
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Visibilty Graph
Weekend
VGA map + consolidated activities in public spaces
N
Upper level
Ground Level
Thames street
THAMES STREET
Castle Mill Stream
River Thames
Car Park
Posts
SOUTH WARD
OXFORD SOUTH ED
Citadel
Deaf and Hard of Hearing Centre
Brooks Taylor Court
Hostel
Cycle Track
FALKNER STREET
ALBION PLACE
BUTTERWYKE PLACE
Playground
BALTIC WHARF
MARLBOROUGH ROAD
Sir Geoffrey Arthur Building
Damon Wells Building
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
Playing
Stationary
Pedestrian
Intersecting group
Playing group
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Axial map
Weekend
Axial map + consolidated activities in public spaces
N
12th level
11th level
10th level
9th level
8th level
7th level
6th level
5th level
4th level
3rd level
2nd level
First level
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian
Interacting group
Playing group
Red colour indicate adult
Green colour indicate children
Parkview
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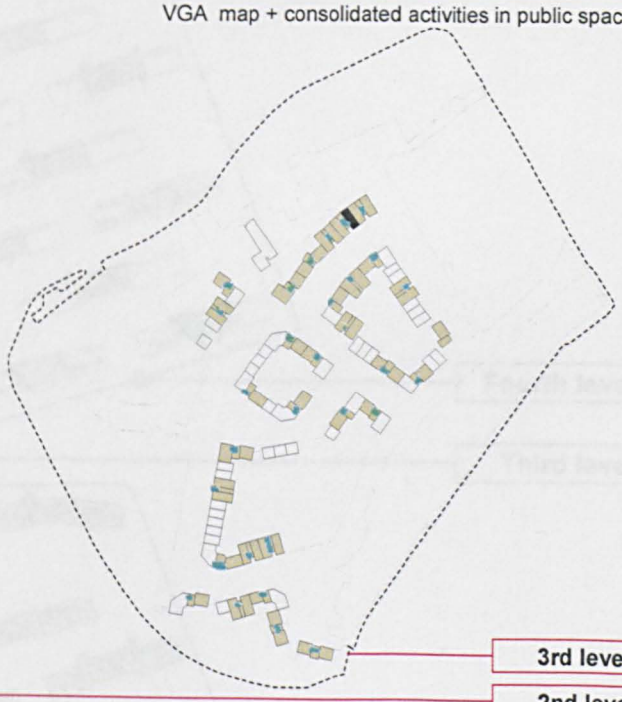

Visibility Graph
Weekend
VGA map + consolidated activities in public spaces
N
12th level
11th level
10th level
9th level
8th level
7th level
6th level
5th level
4th level
3rd level
2nd level
First level
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian
Interacting group
Playing group
Red colour indicate adult
Green colour indicate children
Parkview
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Axial map
Weekend
Axial map + consolidated activities in public spaces
3rd level
2nd level
1st level
Ground level
Key.
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian
Interacting group
Playing group
Red colour indicate adult
Green colour indicate children
Holybrooks
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Visibility graph Weekend

VGA map + consolidated activities in public spaces





3rd level

2nd level





1st level

Ground level

Key.

No of Social Contact

- 31-100
- 26-30
- 21-25
- 16-20
- 11-15
- 6-10
- 1-5

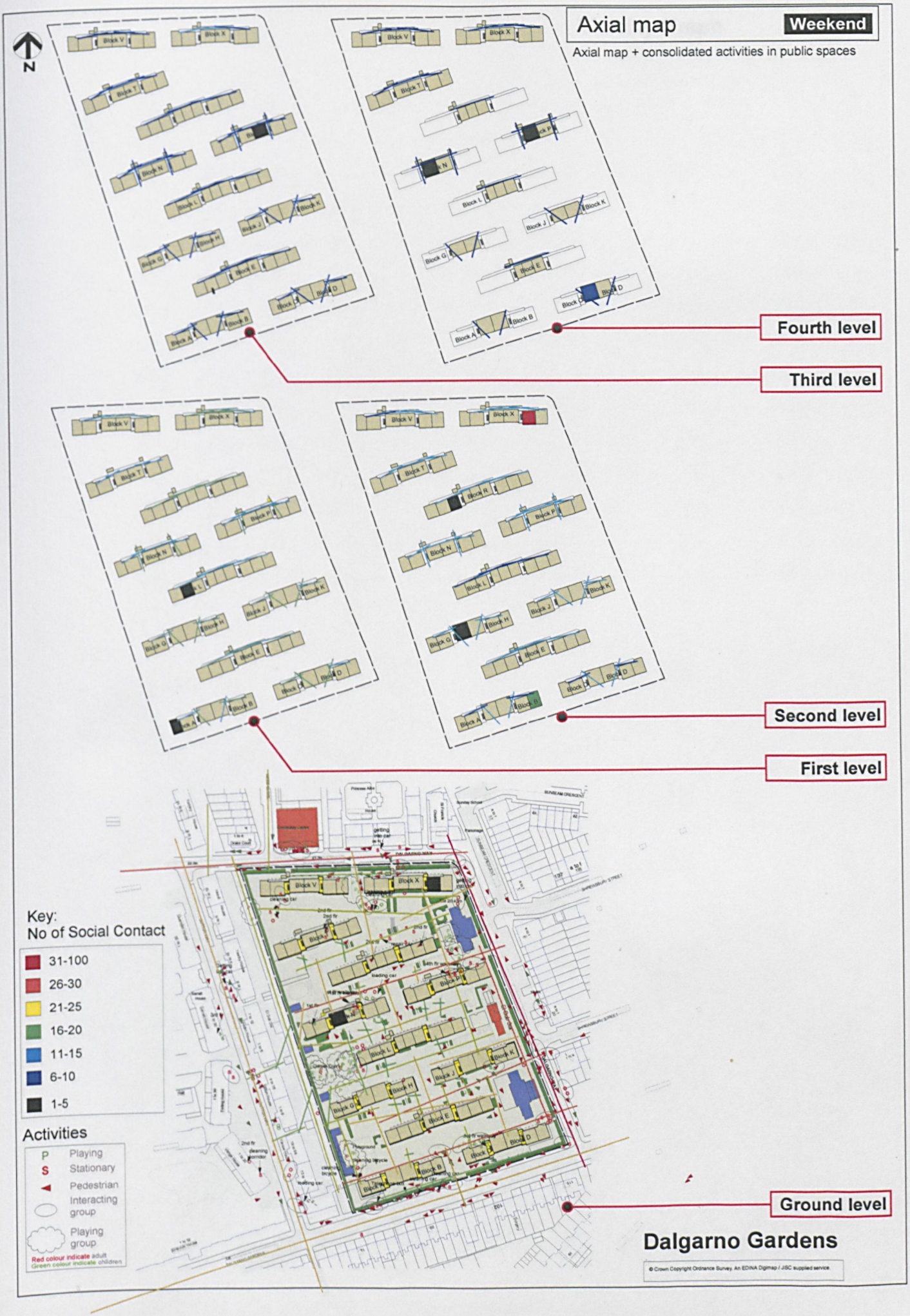
Activities

- P Playing
- S Stationary
- Pedestrian
- Interacting group
- Playing group

Red colour indicate adult
Green colour indicate children

Holybrooks

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Axial map
Weekend
Axial map + consolidated activities in public spaces
N
Fourth level
Third level
Second level
First level
Ground level
Key:
No of Social Contact
31-100
26-30
21-25
16-20
11-15
6-10
1-5
Activities
P Playing
S Stationary
Pedestrian
Interacting group
Playing group
Red colour indicate adult
Green colour indicate children
Dalgarno Gardens
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Visibilty Graph

VGA map + consolidated activities in public spaces



Axial map

Weekend

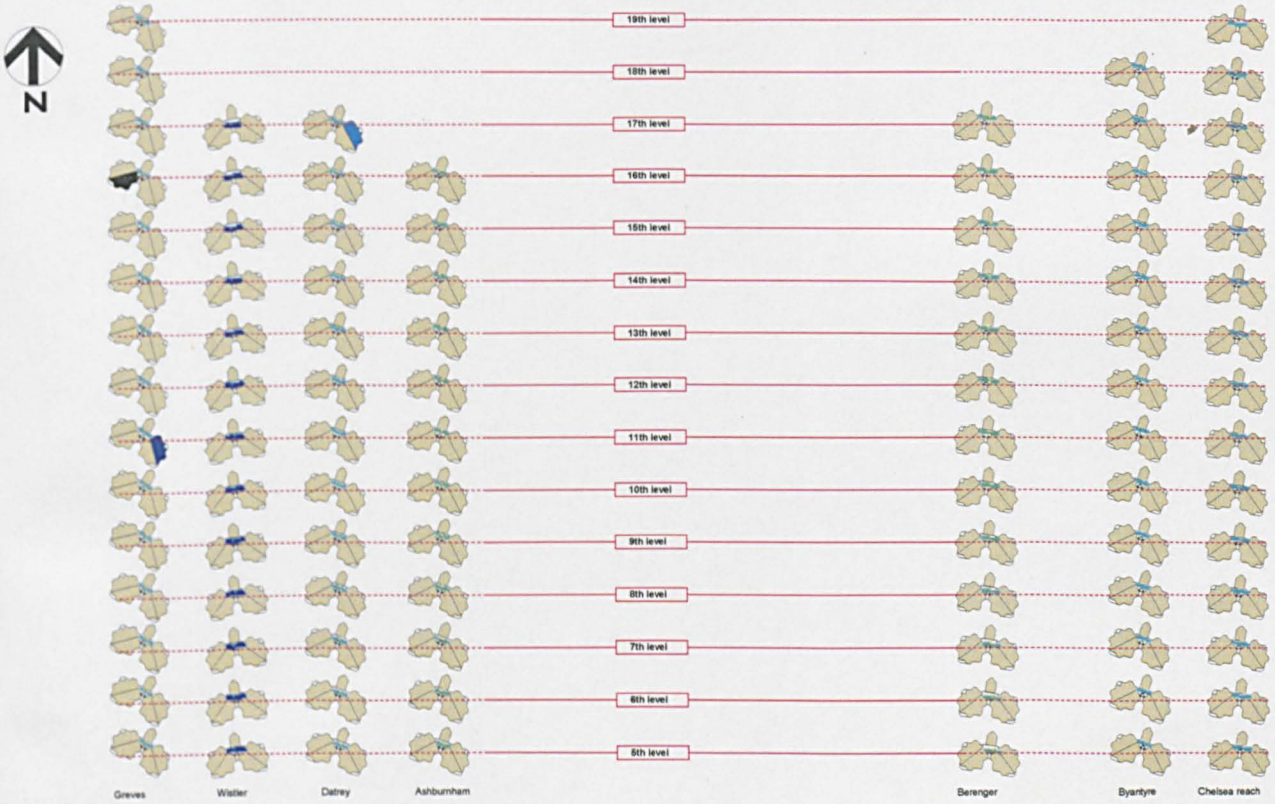
Axial map + consolidated activities in public spaces

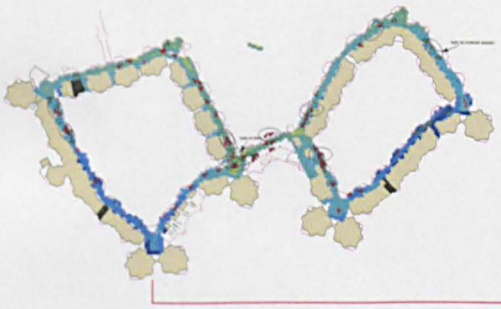


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Visibility Graph **Weekend**

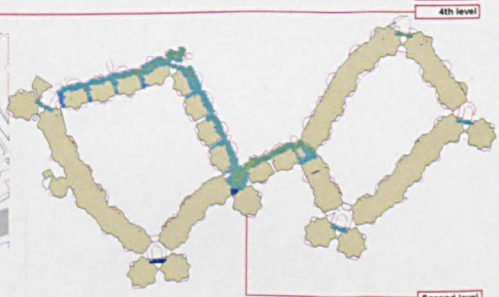
VGA map + consolidated activities in public spaces

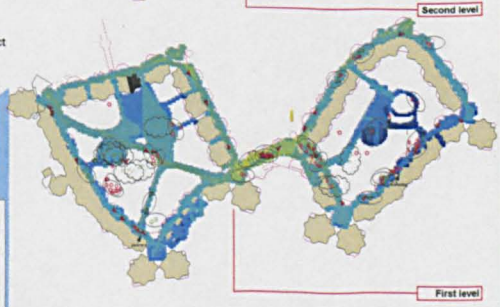












Worlds End Estate

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OXFORD BROOKES
UNIVERSITY
LIBRARY