Masterplanning Checklist

for Sustainable Transport in New Developments

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Executive Summary

Between now and the year 2020 it is intended that as many houses will be built in England as were built in the whole of the Victorian era. This represents a once-in-a-lifetime opportunity to create truly sustainable communities, with low car use and high levels of walking, cycling and public transport travel, equivalent to the best examples in continental Europe. If this opportunity is grasped, we could significantly reduce our future carbon footprint.

Conversely, if we fail to design these new housing developments in a way which makes walking, cycling and public transport travel easy and attractive, and instead build new homes with 'designed in' car dependency, we will increase carbon emissions from transport, and at the same time risk building the slums of tomorrow. In a scenario of rising oil costs, places where jobs, education, shops and leisure facilities are inaccessible without a car are liable to become places people will not want to live.

The urgent need for large cuts in carbon emissions and the prospect of a continued rise in the price of fuel means that we should *only* be building homes in which people can enjoy living while making minimal use of a car. This is significantly different from the current approach, which is to build non-car-dependent housing in places where it is easy to do so, but to continue to build car-dependent dwellings elsewhere.

Part A of this report examines the evidence on the different factors which affect car use by residents of new developments, including: location, density, land-use mix, street layout and design, public transport provision, parking, car restraint, and the existence of smart travel behaviour change programmes. Based on this evidence, it sets out a Sustainable Transport Masterplanning Checklist (summarised in the table below) which can be used as a practical guide by local authority councillors, planners and developers to create new housing development which facilitates sustainable travel patterns. It is also of practical relevance to policy-making at regional, sub-regional and national levels.

Certain aspects of the Sustainable Transport Masterplanning Checklist may appear radical. It breaks away from the current consensus on what type of housing development is acceptable. The implication is that we must develop a totally different paradigm for twenty-first century housing, although it might also be viewed as a return to an earlier paradigm represented by the densely-built and highly sustainable urban form of housing in every century up until the last one.

The Sustainable Transport Masterplanning Checklist

Location of new developments

- Not close to motorways, or high-speed dual carriageway roads
- Within walking distance of major public transport links
- Adjacent to or within urban centres rather than smaller freestanding towns

Density of development

- New developments should be built to high density levels with a minimum net density of 100 dwellings per hectare
- Developments in locations close to excellent public transport should be built to net densities above 200 dwellings per hectare

Local facilities and jobs

- Residential developments should include or be closely associated with facilities that are used on an 'every day' basis – i.e. shop selling food and fresh groceries, newsagent, open space with children's play area, post office and cash point, creche/ nursery and primary school, eating and drinking places, supermarket, and secondary school
- Larger residential developments should also include or be close to facilities which can capture a large proportion of trips locally – i.e. medical centre, chemist, community centre
- Residential developments should include or be close to as wide a range of shops and facilities as possible
- The local centre with shops and facilities should be within walking distance of all residences - 800m
- Local centres should be pedestrian and cycle access only, so far as possible
- Employment planned in association with the development should be able to source the required staff from within a 30 minute travel time catchment on public transport, plus walking and cycling distance around the site
- Employment planned in association with the development should include many jobs that can easily be filled from a local pool of unskilled or semi-skilled labour
- Car access to planned employment sites and local shopping centres should be more expensive, less convenient, and less rapid in comparison to access by public transport, bike or walking

Street layout and design

- Filtered permeability should be fundamental to the plan
- Low speed limits (20mph maximum) throughout the estate area
- Home zone street design for all residential streets
- A network of safe cycling and pedestrian routes
- Pedestrianised local centres with cycle access
- People-centred attractive street design
- Cycle storage at local destinations

Public transport

- Public-transport centred development, based on high quality public transport providing rapid connections to the nearest major centre of employment and major urban facilities.
- Sites which currently have poor public transport should not be developed until public transport has been improved.
- Dedicated public transport routeways for large developments
- 800m maximum distance from residences to the main public transport hub
- Direct high quality pedestrian and cycle links to public transport
- Cycle storage at transport hubs
- Minimal car parking at transport hubs

Parking

- Set parking standards as maxima (definitely *not* minima) at less than 0.5 spaces per unit i.e. at least 50% of residential units should in effect be 'car-free'
- Segregate parking from homes in new residential developments
- A high proportion of housing should be car-free and have no dedicated parking space
- Residents should be charged the full cost of parking provision
- Limited parking at local facilities and shops, all with a parking fee

Restraint to car movement

- Design developments so that other modes are faster and more convenient than the car

Smart travel behaviour change programmes

- Residential travel plan, operative during first marketing of a development, then ongoing
- Ongoing finance to employ a travel plan coordinator
- Travel plans for local schools and local employers
- Car club, up and running before residents move in
- Restricted parking

Part B of this report assesses the likelihood that current national policy will lead to the development of housing that encourages sustainable travel. The policy review shows that, viewed from the standpoint of sustainable transport, official policy documents are contradictory: some promote activities that will tend to increase car use, whilst others promote activities that will tend to decrease car use.

To gain an understanding which of these conflicting presentations of policy is actually being given priority 'on the ground', an analysis is undertaken of the split of public funding allocated to transport projects within one of the Housing Growth Areas – the Thames Gateway. A striking difference is apparent between the split in London where 79% of expenditure is on public transport, and the split in Kent and Essex where, respectively, 76% and 68% of expenditure is on road projects. In London, the spending priorities appear broadly commensurate with expressed policy priorities to achieve lower car use. Outside London there appears to be an assumption that travel patterns will inevitably be dominated by the car in future, and that this should be catered for in terms of increased road capacity.

Recommendations for national policy

In addition to proposing the Sustainable Transport Masterplanning Checklist the report makes the following broader policy recommendations.

Targets for modal shift

There should be a high-level aim for new housing to be, on average, significantly *less* car dependent than current housing stock.

- A target should be adopted for new developments to achieve '20% less car use' than the average in the wider local area (e.g. borough). Analysis in the report shows this target to be realistic.
- A threshold target of less than 50% car driver mode share is also required, so that no developments that would fail this test receive approval.

Rule out unsuitable sites proposed for Eco-towns

Several sites are located too close to motorways or high speed roads and should not go ahead because they are unlikely to deliver the Government's aim of at least 50% of trips being made by sustainable modes.

Set a higher national indicative minimum housing density

- The evidence presented in this report demonstrates that new housing net densities should be at least 100 dwellings per hectare.

This density should be applied to all sites of significant size even in non-urban settings, in order to enable the provision of sustainable transport options and to encourage the development of a range of local facilities. Until

the last century even small towns and villages were built to high densities that supported local facilities and journeys on foot and by bike.

Re-balance funding between public transport and road schemes

- At least 50% of funding for transport measures should be allocated to public transport, walking and cycling.

This principle accords with the Government's suggested target for 50% of trips in Eco-towns to be by foot, bicycle or public transport, but it should be adopted for the Housing Growth Areas and New Growth Points as well as Eco-towns. In some areas, the historic over-emphasis of investment on road-building means that it would be appropriate to spend a much higher proportion of total investment on sustainable modes.

Recommendations for Thames Gateway policy

Prioritise the most sustainable locations for development

Housing development in London should be prioritised over development in Kent and Essex, since there is greater potential to link into a high quality public transport network. The London Housing Capacity Study identified capacity for 146,000 homes within East London, which is more than 90% of the target for housing development in the *whole* of the Thames Gateway.

Within London, housing development should be focussed initially in those areas with the best public transport and then in areas where substantial improvements to public transport are planned or possible. Sites which currently have poor public transport should not be developed until public transport has been improved.

Focus development where high densities are appropriate

Areas with poor public transport which are considered unsuitable for development at densities below 100 dwellings per hectare should remain undeveloped unless and until public transport can be improved. No significant sites should be developed at net densities of less than 100dph.

In areas with excellent public transport links, net densities of new housing developments should be at least 200dph in order to maximise the number of households able to enjoy excellent public transport connections. This figure is in line with densities recommended in the London Plan for central and urban locations with very strong public transport access.

Tighten parking provision in new developments

Even the strictest parking standards for residential developments in The London Plan are notably high and liable to lead to high levels of car use, despite the ambitions for sustainable transport expressed elsewhere in the plan. The evidence presented in this report shows that new developments in continental Europe achieve much lower standards, and, moreover, that the

level of parking expressed in the London Plan would represent a significant deterioration even from the existing car ownership levels in wards of London boroughs well served by public transport – exactly the sorts of wards which new development should be concentrated in. Parking provision has a fundamental influence on travel habits and standards should be set at 0.5 parking spaces per household or less, with substantial proportions of new developments designed as car-free.

Re-balance funding between public transport and road schemes

There should be a review of public transport and road schemes in the Kent and Essex parts of the Thames Gateway to identify a series of ambitious new public transport schemes which would unlock the potential for sites to be developed to high densities. The overall aim should be a re-balancing of transport expenditure so that at least 50% (and in the short term, 75%) is for public transport, walking and cycling.

Where new public transport is planned to serve housing developments, it should have sufficient capacity to meet the desired public transport modal split.

In planning for new development in the Thames Gateway, a high priority and a high proportion of overall public transport funding should be given to the local transport links – cycle paths, walking links, bus rapid transit, conventional bus, DLR and other light rail.

Current plans for the Thames Gateway involve a number of proposals for major road schemes, at various stages of development, that are liable to increase overall road capacity and create the conditions for development of car-dependent sites. These include the Thames Gateway Bridge, the Silvertown link, plans for a Lower Thames Crossing, and possible plans for Junction 30 of the M25. These and other road schemes should be cancelled or reconsidered.

Introduction

This report examines the evidence from a wide range of empirical research on the design and location of new housing and how it influences people's travel patterns. It also attempts a high level assessment of how well current policy is succeeding in creating the conditions for less car-dependent housing development. It is intended to encourage politicians, planners and developers to provide housing developments which make it easy and attractive for new residents to travel by sustainable means of transport.

We believe the evidence assembled here deserves close attention, because the housing development planned over the next decade is on a massive scale and, as such, represents a major opportunity. The Government's 2007 housing green paper (*Homes for the Future: More Affordable, More Sustainable*) committed to a target of three million new homes in England by 2020. This is roughly comparable to the increase in housing stock in the whole of the Victorian period. The current rate of new housing construction is 185,000 homes per year, and the housing green paper aims for this to rise to 240,000 additional homes per year by 2016, which is approaching three times the *peak* rate of housing construction by the Victorians[1].

Another way to look at the intended scale of housing construction is by comparison with existing housing stock. If the Government's ambition to build three million new homes is realised, these as yet un-built homes will represent an increase in the housing stock of over a fifth (21%) in the six regions in which the development is to be focussed (London, South East, East, South West, East Midlands, West Midlands) in 2020.

It is commonly said that the biggest challenge in terms of sustainable travel is to encourage less car-dependent travel patterns within the existing fabric of our towns and cities. However, the planned large increase in new housing described above offers a once-in-a-lifetime opportunity to create truly sustainable communities, with low car use and high levels of walking, cycling and public transport travel, equivalent to the best examples in continental Europe. If this opportunity is grasped, we could significantly reduce our future carbon footprint.

Conversely, if we fail to design these new housing developments in a way which makes walking, cycling and public transport travel easy and attractive,

[1] National census data shows that the total housing stock in England *and* Wales during the Victorian era increased from 3.2 million in 1841 to 6.7 million in 1901 – that is, an additional 3.5 million houses over sixty years. The annual rate of housing construction for England and Wales in the years between national censuses during the Victorian period ranged from a low of 30,000 per year (decade to 1851) to a peak of 89,000 per year (decade to 1901).

and instead build new homes with 'designed in' car dependency, we will increase carbon emissions from transport, and at the same time risk building the slums of tomorrow. In a scenario of rising oil costs, places where jobs, education, shops and leisure facilities are inaccessible without a car are liable to become places people will not want to live. In this scenario, such homes will be difficult to sell and difficult to let.

Some of the recommendations in this report may make for uncomfortable reading, as they break away from the current consensus on what type of housing development is acceptable. We believe that the urgent need for large cuts in carbon emissions and the prospect of a continued rise in the price of fuel means that we should *only* be building homes in which people can enjoy living while making minimal use of a car. This is significantly different from the current approach, which is to build non-car-dependent housing in places where it is easy to do so, but to continue to build the old car-dependent dwellings elsewhere.

This approach of building homes in which people can enjoy living while making minimal use of a car is to some extent reflected in the Government's idea of Eco-towns (although in fact there are serious doubts about whether the reality will match the aspiration, given the proposed locations of some of these towns), but we believe that it should apply to *all* new housing development, including in the Housing Growth Areas, New Growth Points and elsewhere. There should be no further housing development in sites which are poorly located with respect to public transport; and no more road-building to unlock the (car-dependent) 'potential' of development sites. New building should be at densities and in a form which supports a wide range of local facilities and makes it easy to reach them on foot or by bike. There should be a large shift in funding away from road-building and towards schemes to improve public transport, walking and cycling.

In a sense, what we are suggesting is that we must develop a totally new paradigm for twenty-first century housing, akin to the densely-built and highly sustainable urban form of housing in every century up until the last one. Our new housing should be like the best of the housing built by the Georgians and Victorians, in providing generous space for people to live, while at the same time providing excellent transport connections and a range of services and amenities within walking distance. The model for this is many of the inner suburbs of London and other cities which remain successful urban communities more than a hundred years after they were built. We must make a firm break from the deeply unsustainable low density suburban development of the last eighty years which is so difficult to live in without relying on a car.

This report was commissioned by Campaign for Better Transport specifically to support their work in London, and as such it has a particular emphasis on

housing development there, and especially in the Thames Gateway. However, it also has wider relevance, to the other Housing Growth Areas in the South of England, to the proposed Eco-towns, and to housing in the New Growth Points across England.

Part A of the report examines the evidence on the different factors which affect car use by residents of new developments, including location, density, land-use mix, street layout and design, public transport provision, parking, car restraint, and the existence of smart travel behaviour change programmes. Based on this evidence, it sets out a Sustainable Transport Masterplanning Checklist which can be used as a practical guide by local authority councillors, planners and developers to create new housing development which facilitates sustainable travel patterns, and also as a guide to policy-making at regional, sub-regional and national levels.

Part B of the report begins with an overview of the Government's plans for new housing in the Growth Areas, Growth Points and Eco-towns, including the Thames Gateway as a specific example. It then examines national policy in relation to new housing and sustainable transport, and assesses the extent to which current policy seems likely to deliver the Government's aim of 'sustainable communities'. It looks at funding for transport schemes related to new housing. Finally, it makes recommendations for policy change at national level and for the Thames Gateway, based on the evidence presented in the Sustainable Transport Masterplanning Checklist.

Part A

The Sustainable Transport Masterplanning Checklist: Evidence Base

In this first part, we examine the empirical evidence for the effects of a range of factors on residents' travel patterns. The factors examined are:

- Location;
- Density of development;
- Local facilities and jobs;
- Street layout and design;
- Public transport quality and proximity;
- Car parking;
- Restraint to car movements;
- 'Smart' travel behaviour change programmes.

For each factor, we identify a small number of key questions and then review the evidence in relation to these, drawn from the academic and policy literature. Based on these research findings, we make recommendations as to the appropriate actions and policies to minimise car-dependent travel patterns. Taken together, these recommendations form a Sustainable Transport Masterplanning Checklist which is presented in summary form at the end of Part A.

The search of the academic literature covered 27 journals in the fields of transport, planning and applied geography. For the sixteen most relevant journals, all available online issues were manually checked for titles and abstracts of pertinent articles. The remainder were electronically searched using approximately twenty key-words and key-word combinations. Some 130 articles emerged which were categorised according to topic and relevance. Further academic articles were acquired from pre-electronic issues via personal and institutional collections and through direct requests to the authors. Additional material was also sourced via references in articles studied. The data sources named within the following section are listed in full in the References section at the end of the report.

1 Location

This section concerns the overall question of where a development is, particularly in relation to transport routes – for example, whether it is adjacent to a motorway or trunk road or whether its links to nearby urban centres are fastest by railways or other public transport.

1.1 The key questions

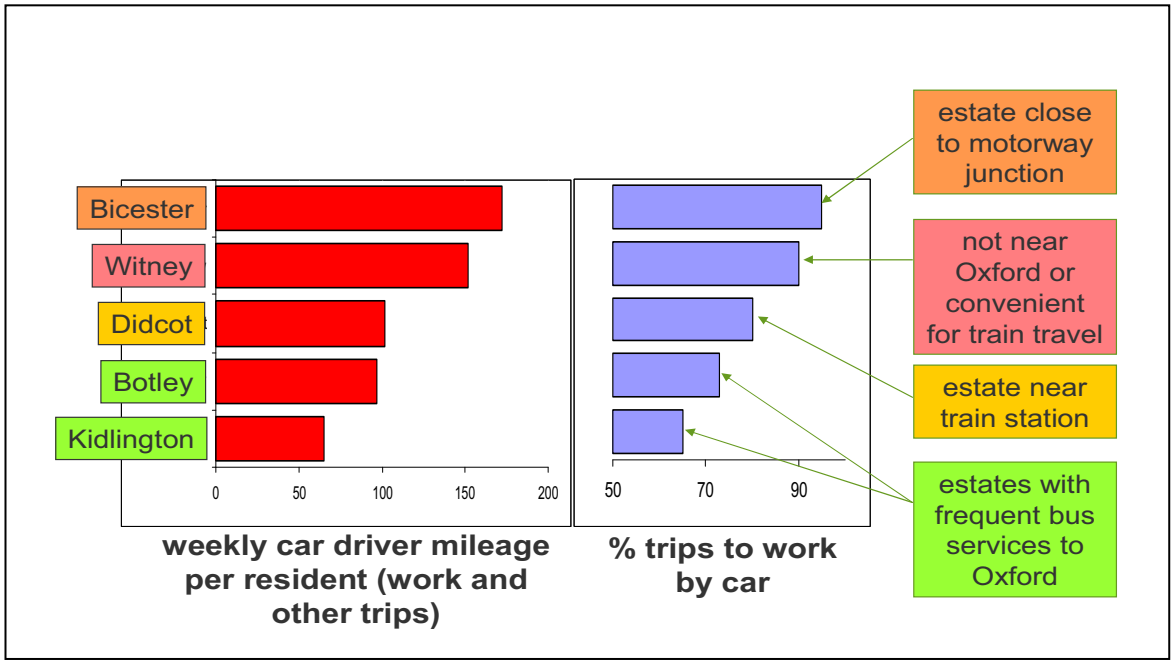
- Is travel behaviour of residents influenced by a development's location in relation to transport corridors and urban centres?

1.2 The evidence

- **Is travel behaviour of residents influenced by a development's location in relation to transport corridors and urban centres?**

Curtis (1996) selected five estates in Oxfordshire to study how the travel habits of residents varied with proximity to major transport routes and distance to a 'functional centre'. All the estates are of similar size and socio-economic profile and, although close to existing local town centres, lack shops on the estates themselves. The distance to Oxford, the nearest large urban centre for shopping, employment and leisure varies from 3 to 15 miles. Access, including access to the workplace, dominated the reasons that residents gave for choosing their present residential area, and differences in the overall weekly distance travelled resulted almost entirely from differences in commuting distance. Lowest levels of car use were in the two estates closest to Oxford, Botley and Kidlington, which both have frequent bus services to the city centre. However, of these two estates, Botley which is the nearer estate (3 miles away compared with Kidlington at 7 miles) recorded higher car mode share for commuting, 49% more overall car miles per adult per week (measured as driver miles for all types of trip), and under a quarter the proportion of the bus journeys to work (4% vs 17% of trips). The authors attribute this difference to Botley's proximity to the intersection of two major roads, the A34 and the A420. The development at Bicester, characterised by proximity to the M40 motorway and rather poor public transport, stood out as having the highest car mode share at 96% (measured as car driver and car passenger journeys for all types of trip), with weekly car driver mileage 59% above the average for the five settlements studied. Only in the case of Didcot, served by rapid and frequent trains, was rail a significant proportion of journeys to work (11% compared with zero to 2% elsewhere).

Figure 1: Effect of housing location on car use



Source: Curtis 1996

These developments were later compared with a new development on a former industrial site in Oxford itself (Brown 2004). This estate (Waterways) differs from the other developments in being contiguous with the built up areas of Oxford and being inside the Oxford ring road, although its distance from the city centre (slightly under two miles) is not much less than Botley, the closest estate included in the earlier study. In other respects it is similar to the other estates, including the number of houses, the lack of shops on the estate itself, and the presence of shops nearby in the local centre of Summertown. The study included analysis of changes to residents' car use when they moved to the estate. It found a small decrease in the proportion of trips by car (56% to 53%). However, the author highlighted the difference with the marked rise in car trips (68% to 82%) that had been recorded by the earlier research of the five sites outside the city. In conclusion he supports the findings of the earlier research that new developments should be located within, or close to, the periphery of main urban areas that act as 'employment magnets' (in preference to the smaller freestanding towns).

Although the scale of distances considered is smaller, it is relevant to note the correlation found in Dutch survey data (Meurs and Haaijer 2001) between the number and proportion of household car trips and whether a main road could be reached from home in less than one minute's driving. This study is discussed further in the section on street layout and design and the section on restraint to car movements.

1.3 The masterplanning criteria for location of new developments

- **Not close to motorways, or high-speed dual carriageway roads:** road links to both regional and local centres for employment, shopping and recreation should be markedly slower and less convenient than links by public transport.

- **Within walking distance of major public transport links:** particularly links to the nearest urban centre. Given the general unacceptability of commute times greater than 30 minutes (see discussion in section on Local facilities and jobs), the journey time to the nearest major employment centre should not considerably exceed half an hour.

- **Adjacent to or within urban centres rather than associated with smaller freestanding towns:** urban edge development, suburban 'densification', brownfield development; *not* development at towns or villages in the surrounding rural areas (nor in entirely rural locations).

2 Density of development

Density is the most fundamental of three measures of 'land-use', sometimes termed the 3 D's (after Cervero and Kockelman 1997). These are:

Density of development;
Diversity (land-use mix, including provision of local facilities and jobs);
Design (layout of roads, buildings, car parks, pavements and other street features that influence the ease and comfort of walking and cycling relative to driving).

2.1 The key questions

- How important is development density as a determinant of travel behaviour?
- Are there density thresholds for travel behaviour changes?

2.2 The evidence

- **How important is development density as a determinant of travel behavour?**

Much academic effort, described further below, strives to disaggregate the travel effect of variation in density *itself* from the variations in land-use mix

and street design that tend to go with it. But from a practical standpoint it is more relevant that without high density, public transport services, shops, schools and other facilities cannot viably be spaced within walking distance of people's homes, and the street environment tends towards a purely residential expanse where people rely on cars to reach even the nearest facilities. There is also evidence (e.g. Meurs and Haaijer 2001, Cervero 2004) that whilst different land-use variables may have quite limited effects on their own, when combined together the overall effect is considerable.

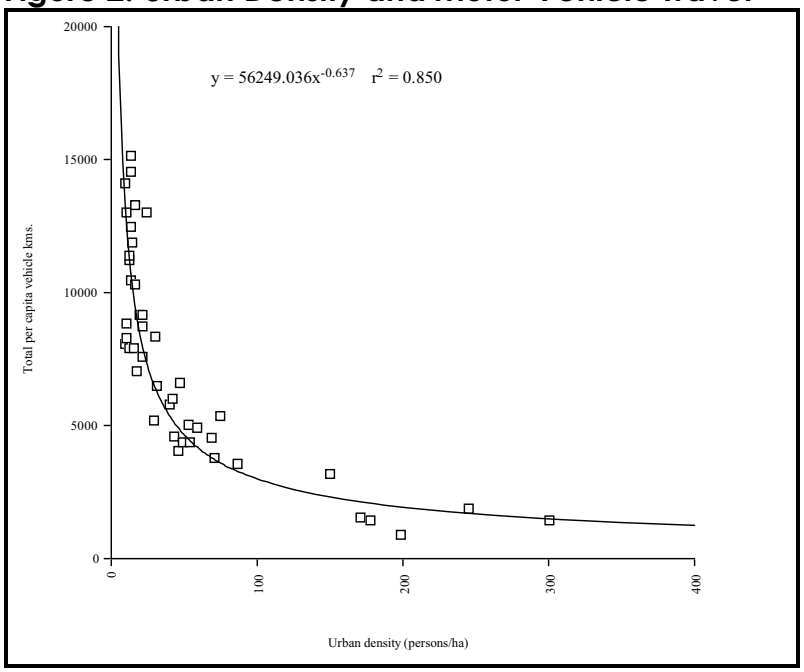
Development density is measured in several different ways. Approximate conversion factors between these different measures are provided in Table 1 below. The term gross density includes large open spaces and schools and major roads, and tends to be used at an area-wide or city-wide level. Net density is a measure of land actually allocated to development, and is restricted to the space occupied by a residential development and its associated uses, including gardens and local access roads.

Table 1: Density measurements and the relationship between them

Density measurements	**Conversion factors**	
people per net hectare/ bedspaces per net hectare	1	taken as equivalent
people per net hectare/ habitable rooms per net hectare	1	not fixed, but close to a ratio of 1 e.g. both equal 3 for a 2-bedroom house with 1 double + 1 single bedroom if 1 living room & kitchen is not a kitchen-diner
people per net hectare/ dwelling units per net hectare	not fixed: see below	depends on the type and mix of dwellings
	4	CABE (2005) table uses 4 but notes this is higher than UK average household size
	3	for the two bedroom house above
gross density/ net density	not fixed: see below	depends on scale under consideration
very small sites < 0.4 ha	1	source: ODPM (2005) land assessment guidance
small sites 0.4-2 ha	0.75-0.9	
larger sites > 2ha	0.5-0.75	
across larger area including schools and parks	0.45	given as a minimum level within an overall urban context (calculations across areas of open countryside could result in lower factors but would carry limited meaning)
acres in a hectare	2.471	

At an overall level, international comparison of cities with different densities shows a very strong inverse relation to annual car miles per capita (Kenworthy and Laube 1999), as shown in Figure 2.

Figure 2: Urban Density and Motor Vehicle Travel



Each square represents a major city.
Source: Kenworthy and Laube, 1999, as presented in Litman 2008

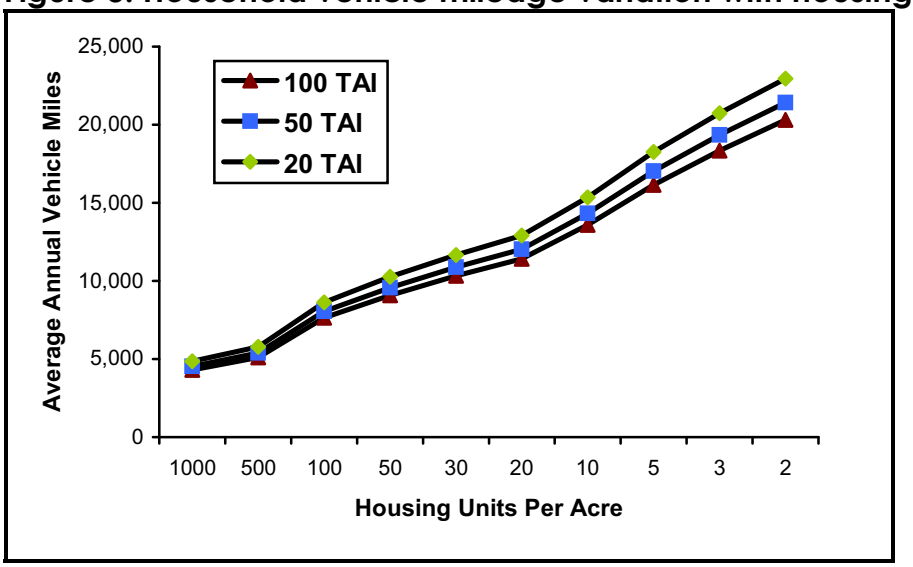
Taking just the twenty largest American cities, Manville and Shoup (2005) similarly found a strong correlation between increase in population density and reduction in per capita vehicle miles (a coefficient of correlation of minus 0.58).

On the scale of different neighbourhoods within a single city, Cervero and Radisch (1996) compared two areas in the San Francisco Bay Area that have different residential densities and land uses but similar public transport service and freeway access. They found that the neighbourhood with more compact development, more mixed land uses, and grid-like street layout showed higher levels of walking, cycling and public transport use than the neighbourhood with low densities and curvilinear streets. The difference was most marked for non-work trips. In the higher density neighbourhood (still comparatively low density by non-American standards) residents made about 15% of their non-work trips by sustainable modes. In the lower density neighbourhood, residents made just 4% of their non-work trips by sustainable modes, and 96% by car. The densities of the two neighbourhoods were 8.5 units per hectare and 2.5 units per hectare (conversions from densities quoted per square mile, so therefore most likely to represent gross density, although this is not specified in the study).

Travel surveys of different types of neighbourhood in San Francisco resulted in the finding that doubling suburban housing densities to roughly the density of urban neighbourhoods would result in a 20-30% drop in per capita

vehicle mileage, presuming public transport services improved to match those seen at similar housing densities elsewhere (Holtzclaw 1990 and 1994, as reported in Kuzmyak et al. 2003a; see Figure 3 below).

Figure 3: Household vehicle mileage variation with housing density



TAI is 'transit accessibility index', a measure of daily public transport services
Source: Holzclaw (1994), as presented in Litman (2008)

- **Are there density thresholds for travel behaviour changes?**

One question is how densely a residential development should be built around a public transport hub in order to ensure that most commuter trips are made by public transport. A study of areas within 1 mile radius of each of the 129 rail stations in the San Francisco Bay area (Cervero 2004) found strong relationships between rail transit use and density (and with other associated physical characteristics of the areas). The likelihood that a resident commuted by rail (transit commute modal share) rose from 24% at densities of 10 units per gross acre to 43% at 20 units/gross acre to 67% at 40 units/gross acre. The strength of this correlation reflects the fact that higher density areas also tend to have other features that encourage use of public transport, such as greater mix of land use and smaller block sizes that make walking routes more direct. Statistically stripping out all other factors that tend to vary (be co-linear) with density, the study found that an increase from 10 to 20 dwelling units per gross acre, on its own, would account for a 4% increase in public transport's mode share (measured as an absolute rise, i.e. 100% = all types of commuter trip). However, this effect rose to 8% increase if the density rise were combined with a reduction in the average residential block size from 6 acres to 4 acres. For practical purposes, density has to be considered as a planning variable that tends to bring other sorts of variation with it – i.e. it acts to some degree as a proxy for other built environment variables in addition to density itself. Viewed in this way, the

key message from this study appears to be that, to achieve a situation where a substantial majority of inhabitants, say two thirds, commute by rail, it is necessary to aim for 1-mile radius catchments around stations to be built to densities of at least 40 units per gross acre (nearly 100 units per gross hectare). This conclusion, however, presumes American urban design conditions, which have many features that encourage car use instead of public transport.

Analysis of the UK national travel survey (DoE/DoT 1993) showed a strong overall relationship between public transport use and population density but did not break down the highest density category that other studies show to be of most relevance. Weekly rail trips per person were approximately the same for density categories between one and 29 people per gross hectare (not stated as gross density, but this can be assumed considering the nature of the data source). In the next category of 30-49 people per gross hectare rail use was more than 50% higher. The highest density category considered was defined only as 50 people per gross hectare or more, and for this category weekly rail trips were 70% above the 30-49 people per gross hectare category. Bus use showed a steadier rise but the category above 50 people per gross hectare showed usage 25% above the 30-49 people per gross hectare group. Fifty people per gross hectare approximately translates to only 12 dwellings per gross hectare for dwellings with four bedspaces (5 dwellings per gross acre) so there is no data to compare with the higher density levels studied by Cervero in San Francisco.

A linked question is what threshold density is required to make provision of public transport services feasible. The Commission for Architecture and the Built Environment (CABE 2005) listed thresholds of 25 residential units per (net) hectare to sustain a bus service and 60 units/ha to sustain a tram service (apparently after Rudlin and Falk 1999). To a first order of magnitude, the threshold of the highest gross density DoE/DoT category appears comparable to CABE's threshold for a sustainable bus service (assuming the gross/net density ratio of 0.45 given in land assessment guidance from Office of the Deputy Prime Minister 2005). The development of Vauban, described in more detail in later sections, which was sufficient to justify extension of a tram service, is built to net densities of 90-100 dwellings per hectare.

Threshold housing density levels above which various types and level of public transport services are practicable are also listed in the American *Traveler Response to Transportation System Changes Handbook* (Kuzmyak et al 2003a), citing earlier research findings. These service levels are calculated for journeys to an urban centre and are caveated with notes on how the distance to the centre and its size influence the threshold levels. 7-8 dwelling units 'per residential acre' (presumably net, therefore) are considered sufficient to

support a bus service every 30 minutes (40 buses per day). A density of 12 units/acre is considered sufficient to support 'metro/rapid rail'. The density to support buses is comparable density to that cited by CABE (although no service frequency is specified by CABE) but CABE's cited threshold for a tram service is much higher than the threshold for 'metro/rapid rail'. This might be because, as the handbook points out, what is regarded as practicable is dependent on what assumptions are made about the feasible level of subsidy. In the UK context, the CABE figures seem more credible.

The various studies summarised above are difficult to compare because of the range of different units (acres / hectares and gross or net densities) that they use. Table 2 presents the key findings in a consolidated form, normalised to net densities per hectare, to aid comparison.

Table 2: Summary of relationships between public transport and housing density

Study	Approximate net density* (dwellings per hectare**)	Trip type	Proportion by sustainable modes
Cervero & Radisch 1996	5 17	non-work non-work	4% (walking, cycling, public transport) 15% (walking, cycling, public transport)
Cervero 2004	50 100 200	commute commute commute	24% (rail) 43% (rail) 67% (rail)
CABE 2005	25 60	will sustain bus service (quality not specified) will sustain a tram service	
Kuzmyak 2003a	20 30	will support half-hourly bus service will support 'metro/rapid rail'	
Melia 2006, Scheurer 2001 (studies of Vauban)	90-100	sufficient density to justify extension of a tram service	

* Where original study gives only gross density, it is assumed to relate to net density with a ratio of 0.5
** To facilitate comparison original numbers quoted per acre have been recalculated per hectare

2.3 The masterplanning criteria for density of development

- **New developments should be built to high density levels with a minimum net density of 100 dwellings per hectare:** this density is sufficient to sustain high quality public transport services within walking distance from the new homes. Provided the development is located reasonably close to strategic public transport corridors this density also makes it feasible to physically construct new connections to the existing public transport network, where the development is of sufficient scale. At such densities the number of residents within the walking catchment

of the public transport hub can also support associated development of a local centre with shops and amenities (see later sections on mixed land use and public transport). This density is in the mid-range of what CABE (2005) list as 'urban villages' or town infill and about triple the densities that they list as normal for 'garden cities' or 'suburban semis'. It is in the middle of the range of guideline densities in *The London Plan* (2008, Table 3A.2) for developments in suburban zones of dwellings with 3 habitable rooms per unit and in an area of good public transport. This density level should be considered as a minimum for all development locations, not just urban settings.

- **Developments in locations close to excellent public transport should be built to net densities above 200 dwellings per hectare:** strong transport hubs with high frequency 'turn-up-and-go' rail, light rail or tube can support housing densities at 200 dwellings per hectare and above, and in turn these densities make such public transport services feasible. At these high densities a high quality and density of other facilities and services can be viable in the locality. This density level is approximately the level at which the San Francisco data of Cervero (2004) shows that a majority of commuter trips are undertaken by public transport. It falls within the range of guideline densities in *The London Plan* (2008, Table 3A.2) for 'central' and 'urban' locations with excellent public transport access but is above that recommended for 'suburban' areas with equally good transport. Where transport hubs provide this level of service, development should not be less than 200 dwellings per hectare, even in suburban areas where existing densities are lower.

3 Local facilities and jobs

3.1 The key questions

- How much does provision of local facilities and jobs impact on travel habits?
- What sort of local facilities make a difference to travel behaviour?
- How close do facilities need to be to cut car use?

3.2 The evidence

- **How much does provision of local facilities and jobs impact on travel habits?**

Terms such as land-use mix or simply diversity (after Cervero and Kockelman 1997) are other ways of describing the presence or absence of local facilities and jobs.

A large study in Adelaide of influences on walking for transport purposes (i.e. not for leisure) found that people living in areas that had higher proportions of shops and businesses on average spent 40 minutes more each week walking (Cerin et al 2007). The study showed a statistical correlation between the amount of walking and the number of different types of destination reported to be within a 5 minute walk of home, with food shops showing a particularly strong correlation. Cafes and restaurants emerged as the type of destination most likely to be visited more often on foot when close-by. Parents of children living within a 5 minute walk from school reported 60 minutes more transport-related walking per week than parents of children living more than 30 minutes walk away from a school[2]. The biggest contributor to the total amount of transport-related walking was proximity to the workplace, for women in particular.

In another study, 430 households that moved house in Seattle were studied to see if their travel habits changed when they moved from one type of area to another (Krizek 2003). The research used a land-use measure that combines density, street connectivity and land-use mix, the latter comprising the number of food stores, eating/drinking places and general retailers. Findings were that vehicle miles per household fell by some 5 miles per day when a household moved from a suburban area where these factors were low to a 'traditional' area where these factors were high.

A study of American Housing Survey data (Cervero 1996) found a relationship between shops and mixed land use in a person's area of residence and their mode of travel to work, even where the distance of travel required public transport. The study's measure of land-use mix included a yes/no score for shops or other non-residential buildings within 300 feet of the residence and a yes/no scoring for presence/absence of a grocery or drug store between 300 feet and a mile. Where shops were within 300 feet, which the study considers 'convenient walking distance', there was more commuting by public transport, walking and cycling. This was not the case where facilities were further away. The study concludes that having commercial and other activities within 300 feet lowers the probability of driving to work (car driver mode share) by 2 - 5%. The study attributes this influence to whether or not commuters travelling without a car are easily able to do other tasks on their way to and from work. For people living just one mile from work, the study finds that the influence of mixed land use is more

[2] This effect however, was correlated with parents who also indicated that they had a preference for living close to a school, i.e. they may have chosen to live there in order to be able to walk to school, so the statistical correlation with walking does not necessarily indicate straightforward cause-and-effect.

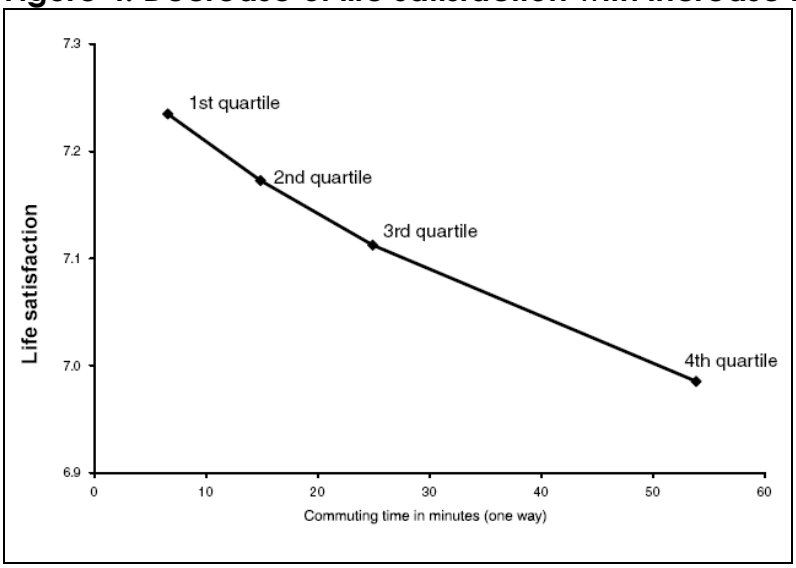
marked, causing a rise in the walking or cycling share of trips to work from 38% to 55% (calculated for households all of whom have one vehicle and live in areas of the same 'high' density).

Whether more sustainable travel patterns are generated by placing employment sites amongst residential areas appears to depend on factors such as the type of employment in question and where those residential/employment areas are, relative to access from the public transport network. The reviews by Litman (2008) and Kuzmyak et al. (2003a) both discuss the failure of research to grapple with the multiple factors that can operate in different directions. So, for example, in an area that provides both homes and jobs, people who both live and work there will have short commute distances and more options to walk and cycle. However, if employment is dispersed to suburbs that are hard to access without a vehicle then their workers who do not live locally will tend to access employment at those sites by car. A study of travel in Minneapolis showed that where employment is concentrated in central areas of the city the proportion of commuter trips by public transport is ten times higher than to employers in other parts of the city (Barnes and Davies 2001). This is attributed to the comparatively good public transport to the central area combined with the inconvenience of driving and the cost of parking. Another complicating factor is that employers who require a high proportion of higher-skill-higher-wage workers will tend to need to draw on a larger catchment area. Analysis of data from the Scottish Household Survey (Barker and Connolly 2006) showed strong correlation between commute distance and skill/wage level: people working in professional occupations travel, on average, twice as far to work as those who work in unskilled occupations (and the average commute of those in partly-skilled occupations falls in between).

Definitions of employment catchments also need to take into account the body of evidence that journey-to-work trips are subject to a psychological travel time budget of approximately one hour per day, representing how much time, in practice, the average person is prepared to spend travelling. Metz (2008) points out that the UK average travel time per person, presently 385 hours per year, has remained essentially the same over the 30 years that data is available, despite that period covering a doubling in car ownership and a 60% increase in the average distance travelled (see also, for example, Kenworthy and Laube, 1999; Curtis 1996). A similar travel time budget, according to Metz, appears to be broadly valid for other countries, although differences are apparent *within* populations. A personal travel time budget of one hour translates to a commute time radius of 30 minutes. A slightly different perspective on the same issue is provided by Stutzer and Frey (2004) from analysis of the long-running German Socio-Economic Panel Study which recorded subjective well-being with the question: 'How satisfied are you with your life, all things considered?' Their results plot what the

authors term 'a sizeable negative correlation between commuting time and individuals' well-being' (see Figure 4).

Figure 4: Decrease of life satisfaction with increase in commuting time



Source: Stutzer and Frey (2008), based on German Socio-Economic panel data 1985-2003

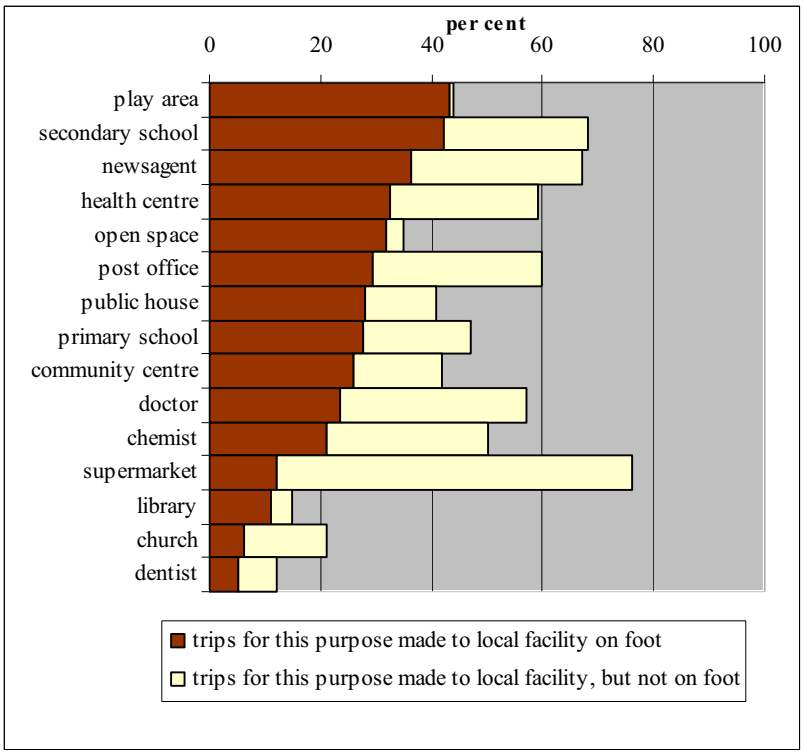
The considerations outlined above, although potentially contradictory, nevertheless seem to point to a logical combination of options for employment location that will tend to reduce car dependency. Employers who need to draw on large catchments to fill specialist high-skill jobs or to source large numbers of employees, should be concentrated at the centres of public transport networks (which should themselves be a focus of residential developments if space is available). Residential developments further from the centre of the public transport network (that should still be strongly connected to it) should include medium-sized or small employers that can draw lower skilled employees from a local catchment, and that local catchment should be planned so that it is primarily accessible by walking, cycling and public transport. For both situations the catchment size should be defined in terms of thirty minutes travel time using sustainable modes.

- **What sort of local facilities make a difference to travel behaviour?**

An examination of travel patterns in five large housing developments in SW England (Winter et al. 1995) considered 16 types of facility. The general finding was that local provision of services leads to local use. The study identified eight important 'day-to-day facilities' which merit inclusion in all large housing developments because of their potential to reduce everyday car travel. These are: food-shop, newsagent, open space, post office, primary school, pub, supermarket, and secondary school. The findings showed that if there was, for example, a newsagent within the housing development, it absorbed two-thirds of all newsagent trips, of which slightly over half were

on foot. The study shows that further facilities which are not such everyday destinations, will also absorb a majority of the relevant type of trip if they are situated within the development. This applies to health centres and chemists. If the criterion of importance is the proportion of a relevant type of trip that changes from walking to driving if the facility is not within the development, then the list expands further and shows, in order of descending priority: library, community centre, secondary school, health centre, doctor, dentist, play area, supermarket, pub, open space. For all of these, when they are not local, there is a decline of over 50% in the proportion of relevant trips made by walking. For a secondary school within the development a large majority (67%) of trips are on foot, but if it is situated outside the development only a small minority of trips to it from the development will be made on foot.

Figure 5: Shares of trips captured by local facilities within housing developments, and proportion of these on foot



Source: *Less Traffic where People Live* (Sloman 2003) adapted from Winter et al. (1995)

A study of travel habits in Holland (Meurs and Haaijer, 2001) found that where schools were close to home, fewer trips were made by car, and the nearer the school the fewer the car trips. Where the place of work was close to home there were also fewer car trips. The study drew a distinction between daily and weekly shopping, finding that for daily shopping more trips were made on foot and by bike when the shop was nearby, but that for weekly shopping the proportion done by vehicle was similar whether the location was close or further afield. This finding tallies with the study of

Winter et al. (1995), described above, who found that, even when a supermarket is locally situated, the great majority of visits to it are by car, in which respect it is unlike nearly every other facility that they studied.

- **How close do facilities need to be to cut car use?**

Neighbourhood surveys in the UK (DoE/DoT 1993) looked at travel mode split for journeys to 'local centres'. Up to one kilometre, walking was the dominant mode of access (63% of trips), followed by cycling (19%). Between one kilometre and 1.6 km cycling became the largest mode share (27%) followed by walking (20%). Above this distance (1.6 - 5 km) cycling and walking were supplanted by public transport and car, in roughly equal proportions. The facilities at these local centres that were most utilised were food shops, followed by newsagents then banks, post offices and medical services.

3.3 The masterplanning criteria for local facilities and jobs

- **Residential developments should include or be closely associated with facilities that are used on an 'every day' basis – i.e. shop selling food and fresh groceries, newsagent, open space with childrens' play area, post office and cash point, creche/ nursery and primary school, eating and drinking places, supermarket, and secondary school:** the results of the studies cited probably should be updated to include an internet/web access point, which is now a busy feature of some libraries.

- **Larger residential developments should also include or be close to facilities which can capture a large proportion of trips locally – i.e. medical centre, chemist, community centre:** other facilities such as dentist and library also come into this category.

- **Residential developments should include or be close to as wide a range of shops and facilities as possible:** including leisure facilities.

- **The local centre with shops and facilities should be within walking distance of all residences - 800m:** 800m approximately corresponds to a 10 minute walk (see 'ped-shed' definition in section on public transport)

- **Local centres should be pedestrian and cycle access only, so far as possible:** with attractive pedestrian-friendly and cyclist-friendly design to both the shopping area itself and its access routes (see section on street layout and design).

- **Employment planned in association with the development should be able to source the required staff from within a 30 minute travel time catchment on public transport, plus walking and cycling distance around the site:** This means that very large employers or employers requiring a high proportion of specialist staff can only be part of housing developments where these are built at major public transport hubs. To facilitate work access for residents seeking more specialist jobs that are unlikely to be available locally the planned development should have public transport connections to a major urban centre within 30 minutes travel time.

- **Employment planned in association with the development should include many jobs that can easily be filled from a local pool of unskilled or semi-skilled labour:** this is to some degree a by-product of an area that is rich in local shops and facilities.

- **Car access to planned employment sites and local shopping centres should be more expensive, less convenient, and less rapid in comparison to access by public transport, bike or walking:** This may require constraints on parking provision or parking charges (see also sections on car parking and restraint to car movements).

4 Street layout and design

4.1 The key questions

- How does local street layout and design alter residents' travel behaviour?

4.2 The evidence

- **How does local street layout and design alter residents' travel behaviour?**

In a comparison of four neighbourhoods in San Francisco Bay area, Handy et al (2005) looked at people who moved from one type of area to another to see if a change in their local environment caused a change in their travel behaviour. The study found that people walked more when they moved to a neighbourhood that scored more highly on measures constructed to reflect accessibility, attractiveness and safety. The safety measure included perceptions of low levels of car traffic, good street lighting and safety for walking. The attractiveness measure included general visual appeal, variety of housing styles, good upkeep and presence of big street trees. The accessibility measure included proximity of shops and amenities. In common

with most studies of American environments, this study uses a measure of accessibility that is flawed because it can mean that destinations tend to become more accessible by car as well as by non-motorised modes. More informative measures of accessibility distinguish walking or cycling access from car access. Nevertheless, people moving to neighbourhoods characterised as 'more accessible' did tend to drive less. Considering the whole population (i.e. not just those who had moved house) this study also found a general correlation that residents in 'suburban' areas drive 18% further than residents of 'traditional areas'.

In their study of Dutch travel habits, Meurs and Haaijer (2001) were also able to look at travel behaviour changes when people moved house, using 189 members of a survey panel that moved between surveys in 1990 and 1999. They found that moving to a pedestrian priority area (i.e. woonerf or home zone) or moving to a 30 km/hr zone reduced the number of car trips. In addition, they analysed changes of travel behaviour for households who had not moved, but where the local street environment had significantly changed. They found that most behaviour change occurred after: '*construction of a pedestrian priority area (fewer trips by all means of transport); planting in the neighbourhood (more trips on foot); [increasing] accessibility of the main road by car (more car trips at the expense of the bike).'* They noted that the reverse was also true in each case, e.g. reduced vehicle accessibility to the main road led to fewer car trips and more cycle trips. The measure of access to the main road was whether or not it could be reached by car in less than a minute.

Moudon et al (1997) undertook pedestrian counts in areas of Puget Sound, Washington State, that had different street patterns and pedestrian provision, but that were similar in density, land-mix, car ownership and income. Each count site was on the edge of a 'neighbourhood commercial centre' containing 'all of the retail facilities necessary for daily living', with an average of 6000 people living within a radius of ½ mile. The study found three times the number of pedestrians in areas with small block sizes (300-400ft) and with continuous pavements compared with areas with large blocks (1000-1300ft) and incomplete pavements. Pavement is probably the most basic provision for pedestrians, but the study notes in passing that 'more than half of the residential areas of Seattle do not have sidewalks'. Although the study areas were standardised in many respects, the differing nature of the shopping centres themselves seems likely to have also been a factor in the differences in pedestrian traffic. In the areas with more pedestrians, the centres were formed of a single main street lined with shops, some in mixed-use buildings, whereas in the areas where pedestrians were scarcer, the retail facilities were 'spread through large blocks of private land dominated by parking.' The study includes recommendations that recognise that accessibility on foot requires different routes to those provided for cars, and recommends a 'walkway network' around the local centres on a 200-foot grid, through the open land and car park areas surrounding apartment

buildings and stores. The study also records that the more pedestrian-friendly areas had more cyclists.

A large study of King County, Washington, (which includes Seattle), also concluded that street 'connectivity' had a positive influence on walking (Frank et al. 2005). This was measured by how closely the street pattern approximated to a grid pattern, using density of junctions as a proxy. It found that for each quartile increase in the number of intersections per square kilometre there was a 14% increase in the likelihood of walking for non-work travel. As noted before, a rise in this measure also creates shorter more direct routes for cars. They also found a correlation between the amount of walking and the amount of pavement in an area.

Melia (2008) has advanced the idea of 'filtered permeability' to counter the idea that a move to grid-pattern streets is, of itself, sufficient to achieve high levels of mode shift. He particularly points out the inadequacy of the UK's re-drafted *Manual for Streets*, which he criticises for adopting American-style grid patterns which do not discriminate between car accessibility and pedestrian or cyclist accessibility. Melia instead recommends that the UK follow European examples of filtered permeability, where direct access is deliberately restricted for private motor vehicles, but maximised for walking, cycling and public transport:

'In cities such as Freiburg, Groningen and Zwolle the principle of filtered permeability is acknowledged as a key element in their success in restraining car use and promoting alternatives. Through traffic is channelled onto a limited network of main roads. Suburban developments are often designed as giant culs de sac for cars, while short cuts provide a far more permeable network for the sustainable modes. People use these modes – particularly cycling – because of the time and convenience advantage compared to travelling by car.'

For Groningen, a city of 180,000 where cycle journeys account for 60% of non-pedestrian trips (Melia 2007), he describes the guiding principles as:

'compact city planning with large employment areas within the city boundaries, a comprehensive network of separate cycle routes with priority over other vehicles, and a policy of channelling through-traffic. Transport official Cor van der Klaauw describes this as a 'coarse grain' for cars and a 'fine grain' for bikes. Vehicular access points to residential areas are limited, while bridges, tunnels, bus gates and a panoply of short cuts assist the more sustainable modes.'

A main road cutting through the middle of a deprived estate in Glasgow has been studied for changes in levels of walking before and after a fairly basic application of traffic calming: just five speed cushions, two zebra crossings (but with adjacent railings), and creation of parking bays (Morrison et al. 2004). Somewhat surprisingly, the survey of residents found that 20%

reported walking more in the area as a result of the scheme. This finding was corroborated by before-and-after pedestrian counts at three different sites on the main road itself, which found substantial increases in pedestrians. Adult pedestrian traffic increased by between 11% and 55% at the three sites, the latter corresponding to over 700 extra pedestrians on the survey day. All three sites saw increases in children walking, 18% more at one site and over 40% at the other two, close to 400 extra children per day at each. This shows some correspondence with the questionnaire of residents, where more than 10% of respondents gave positive answers to two questions that asked if they allowed their children to play out more or to walk more. The research also asked questions enabling the researchers to score respondents' health (in fact the primary purpose of the research), and found a statistically significant improvement in physical health scores after the traffic calming scheme was installed. These results are greater than might be expected for an apparently minor traffic calming scheme, but perhaps indicate that one busy hostile-feeling road through a residential area can have a major effect on whether people choose to walk.

4.3 The masterplanning criteria for street layout and design

- **Filtered permeability:** giving direct access for pedestrians and cyclists from home to local facilities, shops and public transport, combined with limited points for vehicle access that are indirectly routed and have low speed limits.

- **Low speed limits:** throughout the estate area. Even on a large estate's main distributory road the highest speed limit should be set at 20mph, and road design should be such as to make this limit largely self-enforcing.

- **Home zone residential street design:** most of an estate should be designed according to home zone principles, i.e. to physically restrict vehicles to approximately walking speed and to emphasise that pedestrians should be given priority over vehicles. This generally entails opening the whole street area to pedestrian activity with large proportions of non-tarmac surface, with trees, seats, planters, play equipment and other items making the street pleasant for pedestrians whilst obstructing driver sight lines and obliging drivers to move slowly.

- **A network of safe cycling and pedestrian routes:** new developments should be permeated with safe cycling and pedestrian routes to reach all different types of local destination. Separate cycle and pedestrian paths should be used in preference to shared use paths.

- **Pedestrianised local centres with cycle access:** local centres (with shops and other facilities, generally grouped around a public transport hub) should be largely pedestrianised.

- **People-centred attractive street design:** this can include many features specific to the locality in question but general principles include provision of plants and trees, seats and play equipment, a safe feeling with clear sight lines and good lighting, varied building design, interesting interactions between the street and shops, cafes and gardens, generous width pavements, 'legible' design so that pedestrians can easily work out the route they need to take and follow an unobstructed 'desire line', avoidance of large tarmac areas that have unrestricted access to vehicles.

- **Cycle storage at local destinations:** local shops, facilities and public transport access points should be equipped with cycle parking that is free, high profile, convenient, plentiful, dry, well lit and secure.

5 Public transport quality and proximity

5.1 The key questions

- How much can public transport impact on travel habits?
- How close does public transport have to be to affect travel habits?
- How good does public transport have to be to affect travel habits?
- Does the type of public transport influence travel behaviour?
- Does the environment around a station or bus stop affect its level of use?

5.2 The evidence

- **How much can public transport affect travel habits?**

At a city-wide scale, some cities have bucked the prevalent growth in car use through, in combination with other measures, provision of good public transport. Newman and Kenworthy (1996) have described how Zurich achieved a 10% reduction in car mode share for work commuting trips between 1980 and 1990. The city invested in trams to achieve a maximum service interval of 6 minutes and integrated the trams with an S-Bahn (rail) system. They also highlighted Freiburg, where total trips grew 30% between 1976 and 1991 with hardly any increase in car trips (1% increase). The increased travel was accommodated by a 53% increase in public transport trips - and a doubling of cycling trips. This equates to a 13% decrease in car mode share over this period, from 60% to 47% of total trips.

Havlick and Newman (1998) examine the effects of 'transit-led' development (i.e. development centred on public-transport) in Stockholm. These policies led to increased population density in the central city, the inner city and the outer suburbs. The new housing was built as 'urban villages' around the high quality rail system, both in the inner city and in new outer suburbs. They comment:

'*These new developments are all dense, mixed use areas with a careful eye for the kind of design characteristics found in the old inner city of Stockholm. They have been popular as places to live and work'*.

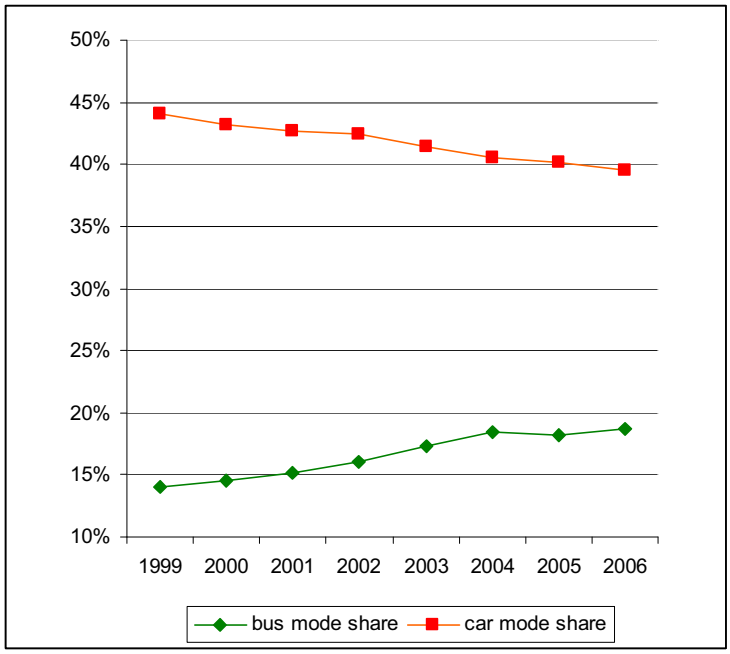
Over the decade studied, car use in Stockholm fell 5% (4867 to 4638 miles per year per person) whilst public transport use increased 14% (from 304 to 348 trips per year per person).

Rabinovitch (1996) described development of the city-wide bus-based public transport system in Curitiba, Brazil, based on road space allocation to dedicated high-speed high-frequency arterial bus routes. This system now carries 75% of all commuters, a quarter of whom used to commute by car.

A sustained programme of investment in buses has also been a feature of transport policy in London, another city where car mode share has been reduced. As the graph in Figure 6 illustrates, the drop in car mode share is accounted for by an increase in bus mode share. From 1999 to 2006 bus mode share rose 5% (from 14% to 19%) whilst car mode share fell 5% (from 44% to 39%) (data from *London Travel Report 2007*). The measures responsible for the increased ridership included more frequent services on many routes, introduction of a competitively priced simple flat fare system, and new vehicles that, in conjunction with pre-paid ticketing using a proximity card system, enabled faster boarding times. Combined with bus priority measures to bypass congestion at key locations, these improvements resulted in quicker and more reliable bus services. In central London, the congestion charge also played an important role in encouraging bus use.

At the level of individual developments or neighbourhoods, threefold differences in levels of car use have been attributed to differences in transit (public transport) provision and building density between different neighbourhoods of American cities (a study of Chicago, Los Angeles and San Francisco by Holtzclaw et al 2002). The study concludes that: '*differences in density and transit can [between them] explain over 3:1 variations in vehicle miles driven per household*'.

Figure 6: Changes in trip mode share in London



Source: plotted from data derived from *London Travel Report 2007*

Analysis of data from all of the rail services in California's major cities (Lund et al. 2004) concludes that residents of areas within ½ mile (walking distance) of rail stations are five times more likely to commute by train than the same city's average resident. All stations considered had service frequencies of 15 minutes or better.

On the scale of large new developments of thousands of new homes, examples from Freiburg are again relevant. Good public transport provision has been central to achieving low car use at two large developments on the edge of Freiburg – Rieselfeld (10,000 residents) and Vauban (5000 residents). Extensions to the tram network form spines to both developments. In the case of Rieselfeld, the tram was put in before the site was developed; in the case of Vauban, although always part of the plan, it arrived a few years after the site was developed, with an interim service being provided by frequent buses (Urbed 2008). During the morning peak hour, trams to the town centre depart from Vauban every 5 minutes (Freiburg timetable). Car mode share at Vauban is only 16% of all trips, significantly below the average for Freiburg as a whole, despite the location of Vauban on the edge of the city (Scheurer 2001, also discussed in Melia 2006). Many features of Vauban, as discussed elsewhere in this document, combine to encourage non-car travel, and walking and cycling mode share at 64% of trips exceeds that of public transport at 19%. However, 32% of residents have some sort of public transport season ticket (Scheurer 2001).

The Oxfordshire study by Curtis (1996), mentioned earlier in section 1.2 on Location, looked at new housing developments ranging between 350 to 700 houses. This study found a relationship between availability of public transport and car mode share. A development on the outskirts of Bicester with poor public transport had the highest car mode share for commuting (95%, measured as driver plus passenger trips) and only 1% of commuter trips by bus or train. In comparison, a housing development close to Didcot Parkway rail station had 11% of commuter trips by train (and 80% by car); Kidlington, a housing development with a frequent bus service into Oxford had 17% of commuter trips by bus (and 65% by car).

- **How close does public transport have to be to affect travel habits?**

The distance that people tend to walk to railway stations has been studied for three rail systems in San Francisco and Chicago (Kuzmyak et al. 2003a). Walking was found to be the dominant mode of station access for home-to-station distances up to 0.5 miles, 0.625 miles and 0.75 miles, for the three different railways. Above these distances those travelling to the station had come by car or by public transport. The data is interpreted as confirming previous assumptions that the maximum acceptable walking distance to rail stations is half to three quarters of a mile.

The 'liveable neighbourhoods' policy of Western Australian Government considers that 'a major transport stop, such as a station' has a 'walkable catchment' or 'ped-shed' (terms derived by analogy with river catchments and watersheds) defined by a 10-minute walking distance (Jones 2001 in WTPP). They equate this to a radius of 800m (i.e. equivalent to the ½ mile radius in the American study above).

This ped-shed concept is used as basis for recommendations for suburban infill and intensification in London by Urbed (2002), who suggest a 'city of villages' around 'local centres'. They recommend 800m ped-shed areas around urban centres that:

- *'Provide a range of local facilities and services so that the population of the Ped Shed can meet most of their daily needs on foot without having to travel to other centres';*
- *'Provide access to high-quality, frequent public transport so that local people can get access to the rest of London and particularly to employment without needing to use a car.'*

They recommend that new housing in ped-shed areas should be built at minimum densities of 50 dwellings per hectare. They list the local facilities required of a local centre as:

'a good range of food and convenience shopping along with services such as a post office, local council housing office, health centres and chemists. It should also include leisure facilities, such as pubs and cafes.'

The term 'transit zone' is used by Reconnecting America (2004) to describe a circle of ½ mile radius about a 'fixed-guideway transit' stop, on the basis that this zone is 'the geographic area within which transit is most likely to have an impact on travel behaviour of its residents'. Their research, covering all of America's fixed-guideway transit stops (over 3000), finds that households within transit zones own significantly fewer cars than households living outside them (0.9 cars/household c.f. 1.6 cars/household) and that many fewer residents of transit zones commute by car (54% c.f. 83%).

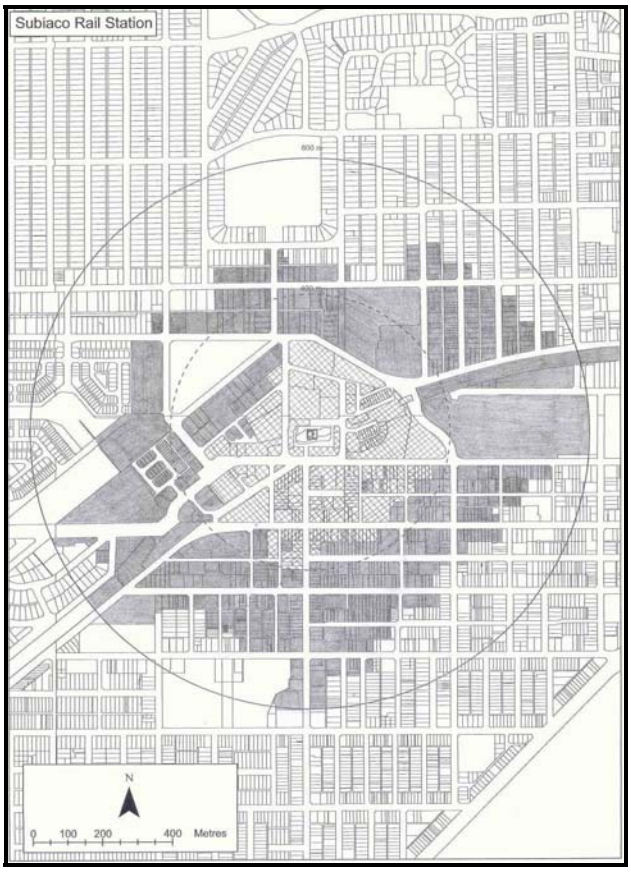
Public transport hubs can, of course, be designed to facilitate car use rather than pedestrian and cycle access. Curtis (2005) describes how some new railway stations in Perth have been designed to facilitate car use rather than access via walking or cycling and how this type of design also militates against development of a mixed-use local town centre:

'The railway planners have created mostly transit interchanges, placing stations within a freeway reserve [i.e. in the centre of a dual carriageway] with spacing predicated on larger, car-based patronage catchments. Land use transport integration is poor with isolated transport hubs and residential densities that are too low and beyond walking distance of railway stations. Railway stations are virtually impossible to adapt to an integrated centre concept. Thomsons Lake station for example, on the South West Metropolitan Railway, is portrayed as an integrated transit-oriented development. But integration will be a difficult task to achieve with a 100-metre freeway reserve running through the centre of the station precinct [used to mean the station's 800m walking catchment]. Designed to draw on motorised catchments, 1200 car parking spaces and 50 peak hour bus movements are to be provided in front of the station. This further limits the opportunity for active complementary land uses in close proximity and good pedestrian access to the station.'

Curtis (2005) plotted pedestrian access to another station with similar access problems (Warwick Rail Station), which may be contrasted with the much better access at Subiaco Station (see Figure 7).

The point here is that in order to avoid car-dependency in new developments they should not be planned in conjunction with what in the UK would be termed 'parkway' or 'park-and-ride' stations.

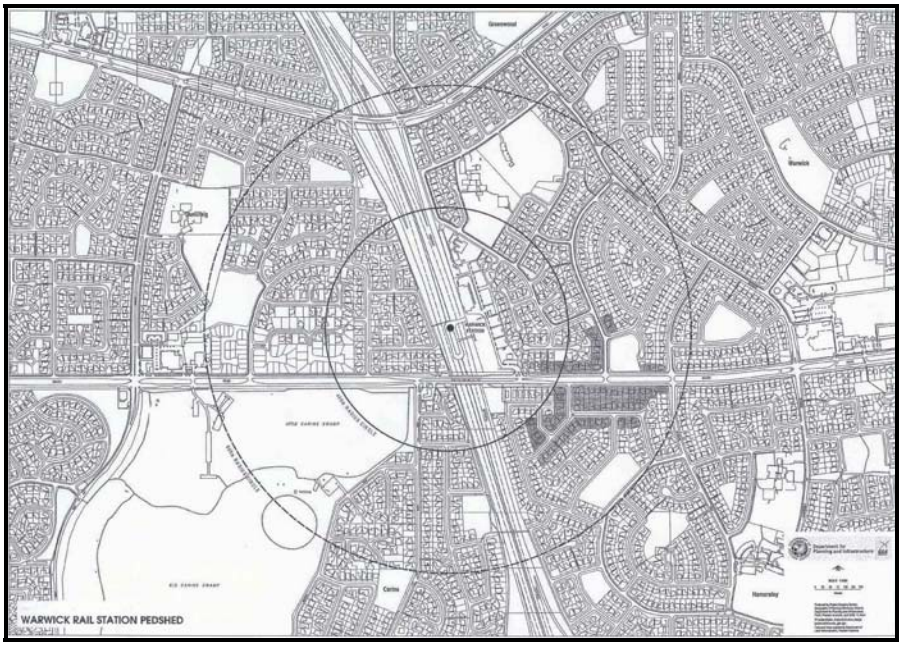
Figure 7: Comparison of pedestrian-friendly and pedestrian-unfriendly catchments for two stations in Perth



Outer circles mark 800m from the stations as the crow flies. The shaded areas show the houses that are actually within 800m of the station measured along the route that must be walked - the real pedestrian catchment ('pedshed'). Because the road route pedestrians must follow to get to Warwick railway station (below) is so tortuous, strikingly few houses are within walking distance.

Warwick station does, in fact, have a pedestrian bridge to the western side of the freeway, but the study assessed that its design made it unusable for security reasons under the prevailing local circumstances, including during key times for commuters (personal communication from author, 2008).

Source: Curtis 2006



For less significant public transport links than train or metro stations, a smaller catchment area applies, because potential passengers will, in general, not be prepared to walk so far. For bus stops in urban settings, 300-400m, about a 5 minute maximum walking time, is often taken as a practical standard to determine spacing of bus stops (e.g. Northamptonshire County Council 2007 *Transport Strategy for Growth, Appendix 3, Guidance on creating lasting modal shift*).

- **How good does public transport have to be to impact on travel habits?**

The relation between rail use and several decades of development has been studied near seven Washington metro-rail stations in Arlington County, Virginia (Cervero 2004). Service levels have risen as development near the stations has taken place. The study shows a correlation that where service levels at a station have increased by 100 passenger spaces per day and 100 extra residential units have been built in the area surrounding the station, then rail trips starting or ending at the station have risen by 50 per day. When the study statistically isolates just the service levels (i.e. no extra development or other changes) it calculates that 1000 extra passenger spaces through a station per day would attract 210 additional passengers.

For rail, some UK service operators refer to a 'turn-up-and-go' level of service, implying a behavioural switching point at a level of service frequency above which passengers tend to switch from aiming for a timetabled service and instead just show up and wait. Whilst this must be dependent on the average trip time in question, 15 minutes between trains has been used by Transport for London as a minimum 'high frequency turn-up-and-go' standard for cross-London rail routes (TfL response to Network Rail, 2006).

For buses (not running on segregated busways), which can suffer delays in traffic that tend to result in irregular service intervals and 'bunching', there is some evidence that perhaps a more frequent service interval of 10 minutes or less is required to achieve a passenger perception of a 'turn-up-and-go' service. Analysis of bus services in Northamptonshire (Northamptonshire County Council 2007, *Transport Strategy for Growth, Appendix 3, Guidance on creating lasting modal shift*) showed that the services which attract enough passengers to be commercially successful tend to have service intervals of no longer than 10 minutes.

For new developments in Vienna, the city has a policy of providing 6 minute trams even when the estates are still building sites with relatively few residents. Roger Levett (2003) quotes a city official:

"It does look a bit wasteful. But the city council has a policy that when new housing is built there should never be a time when anybody has to be dependent on a car, because once they get into the habit it is hard to change. So before anybody can move in, the public transport has to be in place, working to the same standard we expect everywhere else in the city."

- **Does the type of public transport influence travel behaviour?**

In a world-wide comparison of many cities, Kenworthy and Laube (1999) conclude: *'cities with a higher level of rail service within their transit systems generally have better utilised transit and lower automobile dependence'*. Considering only the American cities in their study, they point out that those with rail systems average 117 public transport trips per capita per year, compared with just 30 for cities with only buses. It does not seem that this disparity can be explained away by variations between different cities' expenditure on public transport, because elsewhere the study presents the counterintuitive finding that cities with higher public transport passenger miles spend a *lower* proportion of their gross regional product on their public transport. This outcome is partly explained by the study's finding that high public transport use is most strongly correlated to urban density, which enables efficient public transport operation. The authors point out that only in cities where rail plays the largest role is the overall operating speed of public transport faster than general road traffic. Their view is that the permanence, reliability and visibility of rail systems are important to achieving services that can compete with cars. Although the authors do not say it, light rail, segregated tramways and segregated busways can also have these salient features.

These findings are borne out by Litman (2006) who finds that in American cities where rail is a major component of the public transport system there is 400% higher per capita ridership than in cities with only bus transport. The rail-dominated systems' operating costs are 33% less per passenger mile and achieve a higher proportion of cost recovery from fares.

- **Does the environment around a station or bus stop affect its level of use?**

Bogota has developed a bus rapid transit system based on corridors with high frequency rapid services. A study (Estupinan and Rodriguez 2008) of the differences in the street environment within a 250m radius of stops with equivalent services showed that where the environment for walking is better there is higher use of the buses. This was measured by giving a positive weighting to variables such as width of the pavement, buffering of the path from the road, lack of obstructions, feeling of friendliness, how well buildings physically related to the road, benches, crossings, lighting.

5.3 The masterplanning criteria for public transport

- **Public-transport centred development:** all new developments should centre on high quality public transport that provides rapid connection to the nearest major centre of employment and major urban facilities. Sites which currently have poor public transport should not be developed until public transport has been improved. Housing developments that are too small to justify new high quality public transport connections should only be built where the existing public transport infrastructure is already strong.

- **Dedicated public transport routeways for large developments:** for a scale of development where thousands of new homes are intended, the development should be served by segregated public transport routeways that guarantee reliable services unaffected by traffic congestion, that can therefore be competitive on journey time with private motor vehicles, and that are highly visible to potential users (and to potential investors in housing or businesses). This means segregated busways, tramways or railways.

- **800m maximum distance from residences to the main public transport hub:** this distance defines a 10-minute walk 'ped shed' around a major public transport hub that is appropriate for development. Services for local links, such as buses, should be closer - 400m maximum.

- **Direct high quality pedestrian and cycle links to public transport:** (see also the section on street layout and design) walkers and cyclists should be able to access public transport by routes that are as close to a straight line as possible and offer access that is faster and more convenient than by car. The routes should be designed to offer an attractive and safe environment i.e. with trees and other planting, good lighting, passing local shops, cafes and other facilities.

- **Cycle storage at transport hubs:** cycle storage facilities should be large, under cover and prominently sited close to station entrances (as per good European practice.

- **Minimal car parking at transport hubs:** new developments should *not* centre on, or be planned in association with, park-and-ride style transport hubs.

6 Car Parking

6.1 The key questions

- How does the amount of parking provision impact on travel habits?
- What parking should be provided in a new development?
- How does the cost of parking impact on travel habits?

6.2 The evidence

- **How does the amount of parking provision impact on travel habits?**

At a city-wide level, availability of parking in central areas has been shown to have a marked inverse correlation to commuting by public transport. A review by Kuzmyak et al. (2003b) notes the strength of the relationship emerging from a study of eight Canadian cities. For example, in comparison with Montreal, Saskatoon has more than triple the parking provision per square foot of office space, and has less than a third the peak hour transit share (15% c.f. 49%). The review notes that this study does not disaggregate the tendency for reduced parking supply to also raise the market price of parking. Other factors such as transit quality and urban form also influence the comparison.

Copenhagen adopted a long-term policy for its city centre to remove 3% of parking capacity every year and to avoid building any extra roads. Havlick and Newman (1998) consider these policies to be vital contributors to a range of measures that have led to zero traffic growth in the old city over a fifteen year period.

Three mixed-use town centres in the suburbs of Toronto have been compared by Filion (2001), including assessment of the apparent effects of different parking provision. A survey of the trips made within the centres by people working in offices in the locality showed that where no free parking was available, two thirds of intracentre trips were on foot and the car mode share was half that of the other two centres where there was 'plentiful free parking'. Data for modal split of all journeys to and from these centres also showed that public transport had the highest share in the centre without free parking, but the extent of this effect could not be disaggregated from the fact that this centre was also served by a better public transport service.

The highest level of control on residential parking is a contractual obligation upon householders not to own vehicles. A model settlement of 244 households in Vienna has taken this approach. A survey of the householders (Ornetzeder et al. 2008) compared this settlement with another project

nearby with similar characteristics but without the car-free obligation upon residents. They found that 55% of the households in the car-free project did not use a car at all in the survey year, compared with 30% in the comparison project. Households in the reference project recorded nearly 11,000km annual car mileage. This compared with 700km average car mileage in the car-free project. The average would have been less than half this figure without the substantial mileage covered by one household who owned a car in breach of the contract – although perhaps the all-in average is a more likely representation of real-life enforcement conditions. Excluding this one car owner, the great majority of the car mileage of the car-free households was through the use of car-club vehicles. Car-free residents used bicycles four times as much and were twice as likely to own an annual public transport season ticket (48% vs 24%).

- **What parking should be provided in a new development?**

A lesser restriction on car parking is described as a case study of the European Transland project looking at integration of transport and land use planning (Paulley and Pedler 2000). The suburban development of Messestadt Riem was built on the old Munich airport site, covering 556 hectares on the edge of the city, some 10km from the city centre (Munich Metro Map). It was planned as a mixed use development with housing, industry, leisure facilities and large green spaces. It was designed to have its own identity 'as opposed to the so-called dormitory towns', with deliberate sustainable travel objectives, including reducing travel distances and use of the private car whilst boosting non-motorised modes and public transport. To this end the Metro system was extended to the site to provide two stations, and bus services were upgraded. Despite being on the edge of the city, the development only has an average of 0.75 parking spaces per residential unit. This compares with an average of one for Munich as a whole.

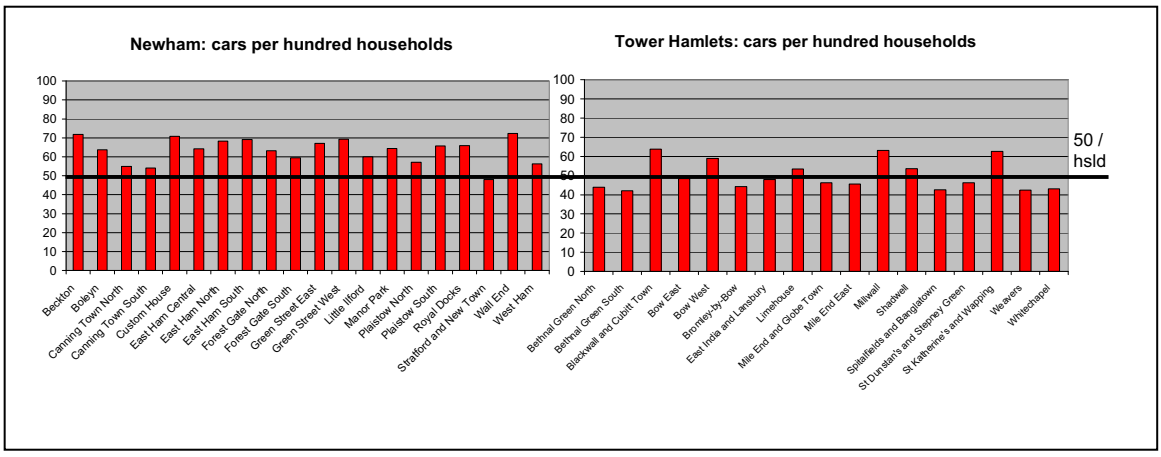
Another case study in the Transland report (Paulley and Pedler 2000 described segregation of parking spaces from residential units without accompanying rules on car ownership. Sudstadt is a high-density mixed-use redevelopment of a former military area to the South of Tubingen planned to eventually house 7000 residents and to offer 2500 jobs. A proportion of the buildings are mixed use. The new district is designed to reduce motorised modes of travel and to reduce distances of travel. It includes pedestrian zones, cycle paths, traffic calming and areas with controlled car access. Buses run within 300m of all residences. Parking is 300m from housing units in multi-storey car parks at the edge of the residential areas, whilst in the centre of the district the only parking provided is for retailers and people with disabilities (i.e. *no* parking provision for people living there).

The Commission for Architecture and the Built Environment (CABE 2005) considers that 100 dwellings per hectare is the density above which multi-storey or underground parking becomes viable. This conclusion is apparently drawn from a review of the literature, but it is not specified whether the threshold is on the basis of building costs, or maximum reasonable walking distance to car-owners' surrounding dwellings.

GWL Terrein, an estate of 600 residential units in Amsterdam, also adopts the approach of placing parking at the periphery of the site (Young 2008, CABE 2008). The site is two miles from the city centre, close to two tram lines and buses. It includes social housing and private housing as well as shops, cafes and small businesses. The gross residential density of the site is 100 residential units per hectare. Parking provision, which is controlled by an official allocation process, is limited to less than 0.25 parking spaces per residential unit, including parking reserved for visitors.

The UK 2001 census data enables a ward-by-ward view of the present number of cars per household in areas earmarked for future housing development. A ward, averaging some 4000 to 5000 households, provides data on a scale comparable to that of the larger housing developments planned for the Thames Gateway and other housing growth areas. Figure 8 (2001 Census data, original analysis for this report) shows car ownership levels for Newham and Tower Hamlets, the two London boroughs due for most new housing development (see Appendix for a full listing of anticipated housing allocations).

Figure 8: Car ownership levels in two London boroughs



Source: data from 2001 UK Census, original analysis for this report

In Tower Hamlets there are less than 50 cars per hundred households in a large majority of the wards. In Newham the dominant category is 60-70 cars per hundred households, although other data shows that households without any vehicle comprise over 50% of households in seven wards and more than

40% of households in all wards. It is notable that the ward where car ownership is less than 50 per hundred households includes Stratford, the most important public transport hub in the borough. The borough of Islington (not graphed) is, perhaps surprisingly, in view of its wealthier demographic, broadly similar to Tower Hamlets, with most wards showing 50 or fewer cars per hundred households. The implication for parking levels in new developments would appear to be that a parking target of about 50 spaces per hundred households should be considered achievable. This would represent a moderately progressive approach in an area like Newham where it approximates to the levels in the best wards in the borough. In more centrally situated areas such a target would just ensure that new developments were no worse than the present status quo.

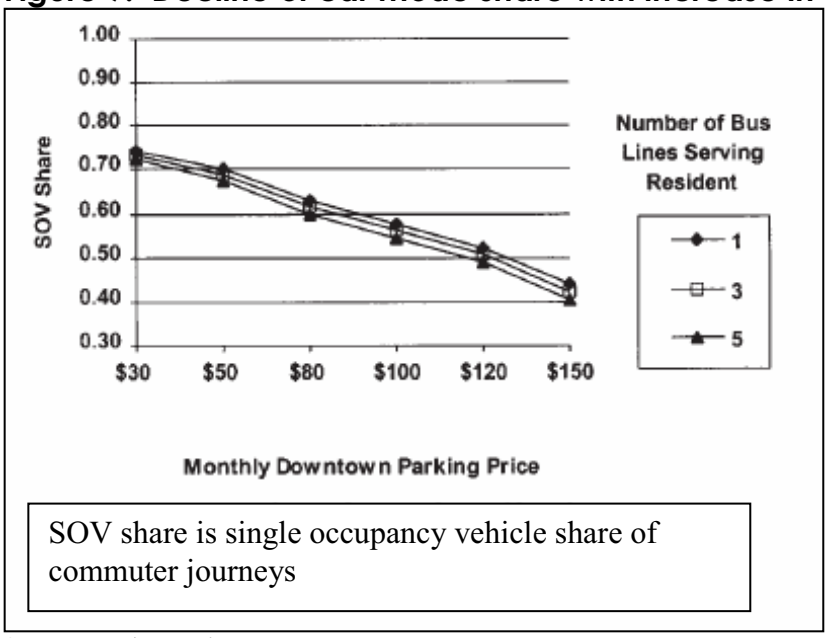
- **How does the cost of parking impact on travel habits?**

Case studies of seven employment sites in North America show a 25% difference in car mode share of journeys to work between employers who allow their staff free parking and those who charge their staff the cost of providing parking (Shoup 1994, as reviewed in Vaca and Kuzmyak, 2005). At sites without parking charges, 67% of staff arrived as solo drivers, compared with 42% where a parking charge applied. This study considered employees who experienced different parking policies at the same location and also included two before-and-after comparisons for firms that altered their charging policy. (Evidence of the effect of parking controls on the efficacy of corporate travel plans is discussed in section 8 on Smart travel behaviour change programmes.)

Dueker et al. (1998) considered the effect of parking price on commuters in areas of Portland, Oregon, served by equivalent public transport. For commuters to the city centre from suburban areas with comparable bus services, 10% increase in the monthly cost of parking from $80 to $88 caused single occupancy vehicle commuting to drop 5% (an elasticity of minus 0.46).

The bulk of the academic evidence about the impact of parking price stems from studies of commuter parking, but a city-wide San Francisco parking tax in the 1970s provided the basis for a wider analysis (case study in Vaca and Kuzmyak 2005). Overall elasticity to price was about minus 0.3 (i.e. 10% increase in price would cause 3% reduction in parking demand) but this overall figure apparently disguised different responses amongst shoppers and commuters. Shoppers to some degree accommodated the higher charges by parking for shorter periods, an option not available to commuters. Non-work trips to the centre of Sydney have also been studied, and show elasticities to price increase in the range of minus 0.48 to minus 1.02 (Hensher 2001).

Figure 9: Decline of car mode share with increase in cost of parking



Source: Dueker et al 1998

When parking charges apply in a residential area, the influence on car use is partly through an effect on levels of car ownership. Nobis (2003) has looked in detail at the influence of radical parking policies for the new development Vauban, on the edge of Freiburg (also featured in the section on public transport). Nobis describes Vauban as 'car-reduced', not 'car-free'. Residents can choose to own cars and can drop off and pick up at their homes, but they must park their cars in communal multi-storey car parks at the edge of the development, for which they pay a one-off purchase charge based on the construction costs and a monthly charge to cover ongoing maintenance (Melia 2006). Households without cars have access to a local car club when they require a car. So, all vehicle use in Vauban is subject to an inconvenience effect as well as a price effect. Nobis compares car ownership levels with Riesfeld, another development which is similar in terms of age, design, public transport provision and relation to the city centre, but which does not have the same car management policy. She finds that car ownership levels in Vauban are 44% lower (150 cars per thousand residents vs 270 per thousand). Nobis compares the travel habits of the car-owning and non-car householders for shopping and leisure trips, and finds that 73% of the car-owning householders' 'bulk' shopping trips are by car, compared with 6% for the non-car households. For 'daily' shopping, the proportions are 10% and zero percent. The split for leisure trips is 28% vs 2%. Commuter trips to work or education constitute most remaining travel and are dominated by cycling for both types of household. A complete modal breakdown is not given for commuter trips, but 91% of non-car householders cycle to work, compared with 61% of car-owning households, and non-car householders are 50% more likely to own public transport travel

card, so a difference in car use is implied. Overall, 16% of all trips by all types of Vauban residents are by car (according to Scheurer 2001).

The influence of parking controls on residents is also discussed in section 8 on 'smart' travel behaviour change programmes, because they provide essential underpinning for smart measures such as residential travel plans to be successful.

6.3 The masterplanning criteria for parking

- **Set parking standards as maxima (definitely *not* minima) at less than 0.5 spaces per unit:** overall levels of provision for new residential developments should be less than 0.5 parking spaces per housing unit, *including on-street parking spaces*. If access to public transport and to local facilities is not deemed sufficient to support this standard then either these services must be improved, or the development should be refused at the site in question. The implication of this standard is that developments should be designed so that at least 50% of residential units are car-free. This level of parking provision approximates to the car ownership levels in Vauban and is also comparable to car ownership levels in wards of London boroughs well served by public transport. By comparison, the guideline level of parking provision in *The London Plan* (2008, Annex 4 notes to Table A4.2) is that *'all developments in areas of good public transport accessibility and/or town centres should aim for less than 1 space per unit.'*

- **Segregate parking from homes in new residential developments:** as a general principle, only drop-off and unloading should be permissible at the residence entrance, with car parking at a suitable distance to allow provision of (a) pleasant home-zone design of street space outside residences and (b) a sufficient access distance to personal cars that there is some level of disincentive to casual use for short trips.

- **A substantial proportion of legally-binding car-free housing in all new residential developments:** some residences should be sold or rented with legally-binding conditions that the owners do not own a vehicle. This requires a link with provision of a car club, generally through one of the commercial operators of car clubs (see section 8 on Smart travel behaviour change programmes for evidence of reduced car usage amongst car club members).

- **Residents should be charged the full cost of parking provision:** a parking space should have to be purchased separately to the residence, at a price reflective of its construction cost, with an ongoing charge that is at least the cost of its maintenance.

- **Limited parking at local facilities and shops, all with a parking fee:** layout of the development should ensure that most trips to these shops and facilities can be easily done on foot or by bike. Parking charge exclusions should apply for disability permit holders. Local centres with shops and other amenities should be largely pedestrianised.

7 Restraint to car movements

7.1 The key questions

- Are restrictions on car use necessary in order to create sustainable travel patterns?
- What restraints to car movement are required to cause travel behaviour change?

7.2 The evidence

- **Are restrictions on car use necessary in order to create sustainable travel patterns?**

Considering travel times at a macro level, throughout the Netherlands, Schwanen et al (2002) concluded that people choose their mode of travel according to what is most time-efficient:

'The time that people are willing to spend on traveling to work, shops, and leisure facilities by any of the travel modes in the various residential environments seems to be an important determinant of the mode used. In cities, walking, cycling, and local public transport seem to be substituted for the car, because getting anywhere by car takes so much time.'

The European Transland project (Paulley and Pedler 2000), established to recommend best practice in integration of transport and land use planning, undertook an extensive review, of which the first two conclusions emphasise the need to make car use less attractive:

'*Land-use and transport policies are only successful with respect to criteria essential for sustainable urban transport (reduction of travel distances and travel time and reduction of share of car travel) if they make car travel less attractive (i.e. more expensive or slower).'*

'Land-use policies to increase urban density or mixed land-use without accompanying measures to make car travel more expensive or slower have only little effect as people will continue to make long trips to maximise opportunities within their travel cost and travel time budgets. However, these [land-use] policies are important in the long run as they provide the preconditions for a less car-dependent urban way of life in the future.'

- **What restraints to car movement are required to cause travel behaviour change?**

The analysis of data from the nation-wide Dutch Time Use Study by Meurs and Haaijer (2001) allowed comparison of travel behaviour in areas characterised by high and low accessibility to cars. The factors defining low car accessibility included: at least one minute's drive to reach the nearest main road; presence of a 30 km/hr zone; traffic calming measures; pedestrian priority area (woonerf i.e. home zone). The number of car trips was over 40% lower for the area with restricted car access, in comparison to an area of high car access but with the same level of density and land use mix (calculations on the basis of their Table 6). The authors' prime conclusion is:

'reduced car mobility will be achieved when facilities for daily and other shopping and schools are located close to the home, the road network in the neighbourhood is laid out for slow traffic (by bike and on foot), and therefore is unsuitable for the car, and the accessibility of locations outside the neighbourhood (including the main road and places for shopping) discourage car use. The reduction in car use is greatest when this occurs in a densely built up area.'

The density levels in this study are not particularly intense: 30 units/ha are termed 'high density' areas; 10 units/ha are low density areas. So it is striking, particularly in comparison with the American studies cited elsewhere, that car mode share is less than 50% in a majority of the scenarios considered. Car mode share is a minority wherever car accessibility is restricted and even in the high density scenario of unrestricted car access. Car mode share only becomes a majority (approaching 70%) in the scenario with both low density and unrestricted car use.

The concept of 'filtered permeability' has been mentioned in the street layout and design section as a guiding principle to achieve relatively higher accessibility for non-car modes.

7.3 The masterplanning criteria for restraint to car movement

- **Design developments so that other modes are faster and more convenient than the car:** for local trips to reach shops, facilities, and public transport, access should be easier and faster on foot and by bike than by car. Car routes should be 'the long way round' through 'home zone' environments that necessitate very low-speed driving and giving way to pedestrians. Parking unavailability and cost should also be significant deterrents to gratuitous driving for local trips.

8 'Smart' travel behaviour change programmes

8.1 The key questions

- How much travel behaviour change is achievable through information and encouragement?
- What are the necessary conditions for residential behaviour change programmes to operate successfully?

8.2 The evidence

- **How much travel behaviour change is achievable through information and encouragement?**

Research for the Department for Transport (Cairns et al. 2004) undertook original case studies and reviewed existing data in order to compile the evidence for change in travel behaviour resulting from 'personalised travel planning'. These programmes engage with individual households to provide information, advice and targetted incentives (e.g. free tickets as an encouragement to try out public transport services). The study concluded that:

'*results so far available suggest that personalised travel planning may lead to reductions in car driver trips of 7-15% amongst targeted populations in urban areas (according to trials in Germany, Australia, USA and the UK), with rather lower reductions in car driver trips (2 – 6%) reported from a smaller number of more rural trials.'*

It is notable that these percentage changes are of comparable size to many of the travel behaviour differences ascribed to differences in urban form and transport infrastructure in the preceding sections.

Other strands of this large research project looked at school and workplace travel plans. These are programmes designed to shift car trips to sustainable modes, comprising largely information and promotion with secondary small scale infrastructure improvements. School travel plans were assessed to have reduced car trips to and from school by 8-15% on average, with a large proportion achieving over 20% reduction. Workplace travel plans were found to have achieved 15-20% reduction in car commuting trips on average. Programmes to market public transport on a route-specific and area-wide level were also analysed and found to have a significant influence on ridership levels. In general, for the case study bus services, the promotional activity appeared to deliver at least as much ridership increase as an improvement to the service did on its own. In combination, marketing coupled with service improvements delivered ridership increases of 40-60% within three years or less.

- **What are the necessary conditions for residential behaviour change programmes to operate successfully?**

The importance of moving house as a key moment for possible travel behaviour change was studied by Standbridge et al (2004) through interviews with people who had moved within the last year. They concluded that:

'Important prerequisites for breaking habits are a change to the situational context and behaviour becoming more conscious and deliberate. Residential relocation meets both of these and the qualitative research reported in this paper confirms that in many instances people are consciously considering the travel mode implications during the course of moving home.'

The implication of this is that it is important to have travel behaviour programmes in place before an estate begins to be occupied. The study also shows that significant travel decisions are made early in the process of deciding where to move. This finding means that there is a strong case for designing residential travel plans so that they interact with *potential* residents who are considering moving to the estate, implying a link with the processes of property marketing and sales (or the process of allocation of social housing). The conclusions of this qualitative research are supported by a quantitative analysis of the British Household Panel Survey (Dargay and Hanly, 2003, as cited in Barker and Connolly, 2006) that found that 45% of individuals who both moved house and changed employer also changed their mode of commuting in the same two consecutive years, compared to only 14% who neither moved house nor changed job.

Experience of workplace travel plans (*The Essential Guide to Travel Planning*, DfT 2008) has shown the importance of strategies to help people use cars less, rather than alienating people who really do require a car for certain purposes. In the workplace context this may translate to provision of a car pool to obviate the need for employees to bring their own vehicles to the workplace. The equivalent provision for residential travel plans is a car club, giving residents (or local business users) ready access to a vehicle on the basis of pay-per-hour and mileage fees. As described earlier for various European examples, car clubs are characteristic of developments that aim to achieve low car mode share. Several rapidly expanding commercial car club companies now operate in major UK cities, with 24 hour booking services and satellite-tracked cars activated upon presentation of the booked user's proximity card to the car's reader. A survey of members of UK commercial car clubs showed a 21% net reduction in car ownership amongst member households over the previous year (Carplus 2008). A survey of new joiners estimated that they had reduced their car trips by over one third (36%) and reduced their car miles by over a half (54%).

The Department for Transport guidance *Making Residential Travel Plans Work* (2005) contains parking restriction as one of its 'guiding principles' for travel plan success. This conclusion is supported by an evaluation of workplace travel plans, for which monitoring data is available (Cairns et al. 2002). This study showed that organisations that had parking restrictions, parking charges or financial incentives *not* to park, achieved 24 % average reduction in car driver mode share of trips to work, more than double the average reduction (10%) achieved by firms with no controls on parking.

Personalised travel planning and other aspects of a residential travel plan require personnel and therefore ongoing revenue funding. *Making Residential Travel Plans Work* drew upon case studies to identify a lengthy list of measures that may form part of a residential travel plan. Many of these imply personnel time. Practical experience from local authorities dealing with company travel plans seems to show that allocation of staff responsibility for a company travel plan is an important factor for success (*The Essential Guide to Travel Planning*, DfT 2008 p.10). Cairns et al. (2002) found that successful company travel plans showed a wide range of levels of expenditure and varied models for allocation of staff time, but noted that senior management support was vital. For residential travel plans this probably translates as local and regional policies that state emphatically that low car mode share is a priority.

8.3 The masterplanning criteria for smart travel behaviour change programmes

- **Residential travel plan, operative from the earliest stages of marketing a development, then ongoing:** to include both smart promotional measures and small scale infrastructural measures to back them up. Personal travel advice should be offered to all individuals moving to, *or considering moving to*, the development, with information and encouragement to use sustainable travel options, including promotional campaigns and financial incentives.

- **Ongoing finance to employ a travel plan coordinator:** for the scale of new developments envisaged in housing growth areas, full-time travel planning staff will be justified. The role may span different types of travel plan in addition to the residential travel plan (as below). Revenue funding should be sufficient to provide an operating budget for ongoing small-scale infrastructure improvements and upkeep as well as the coordinator's salary.

- **Travel plans for local schools and local employers:** all local schools and larger employers should have their own travel plan. Smaller employers should be engaged with travel planning as part of an area-wide

travel planning approach, linked to the travel plans of larger employers and to residential travel planning.

- **Car club, up and running before residents move in:** to give households the ready use of a vehicle when required without the requirement of owning one (or its cost). New developments should have allocated spaces for car club cars. These should be more prominent and more convenient than private parking spaces.

- **Restricted parking:** parking restrictions are an important determinant of the success of travel plan measures (also see section 6 on Car parking).

The Sustainable Transport Masterplanning Checklist

Location of new developments

- Not close to motorways, or high-speed dual carriageway roads
- Within walking distance of major public transport links
- Adjacent to or within urban centres rather than smaller freestanding towns

Density of development

- New developments should be built to high density levels with a minimum net density of 100 dwellings per hectare
- Developments in locations close to excellent public transport should be built to net densities above 200 dwellings per hectare

Local facilities and jobs

- Residential developments should include or be closely associated with facilities that are used on an 'every day' basis – i.e. shop selling food and fresh groceries, newsagent, open space with childrens' play area, post office and cash point, creche/ nursery and primary school, eating and drinking places, supermarket, and secondary school
- Larger residential developments should also include or be close to facilities which can capture a large proportion of trips locally – i.e. medical centre, chemist, community centre
- Residential developments should include or be close to as wide a range of shops and facilities as possible
- The local centre with shops and facilities should be within walking distance of all residences - 800m
- Local centres should be pedestrian and cycle access only, so far as possible
- Employment planned in association with the development should be able to source the required staff from within a 30 minute travel time catchment on public transport, plus walking and cycling distance around the site
- Employment planned in association with the development should include many jobs that can easily be filled from a local pool of unskilled or semi-skilled labour
- Car access to planned employment sites and local shopping centres should be more expensive, less convenient, and less rapid in comparison to access by public transport, bike or walking

Street layout and design

- Filtered permeability should be fundamental to the plan
- Low speed limits (20mph maximum) throughout the estate area
- Home zone street design for all residential streets
- A network of safe cycling and pedestrian routes
- Pedestrianised local centres with cycle access
- People-centred attractive street design
- Cycle storage at local destinations

Public transport

- Public-transport centred development, based on high quality public transport providing rapid connections to the nearest major centre of employment and major urban facilities.
- Sites which currently have poor public transport should not be developed until public transport has been improved.
- Dedicated public transport routeways for large developments
- 800m maximum distance from residences to the main public transport hub
- Direct high quality pedestrian and cycle links to public transport
- Cycle storage at transport hubs
- Minimal car parking at transport hubs

Parking

- Set parking standards as maxima (definitely *not* minima) at less than 0.5 spaces per unit i.e. at least 50% of residential units should in effect be 'car-free'
- Segregate parking from homes in new residential developments
- A high proportion of housing should be car-free and have no dedicated parking space
- Residents should be charged the full cost of parking provision
- Limited parking at local facilities and shops, all with a parking fee

Restraint to car movement

- Design developments so that other modes are faster and more convenient than the car

Smart travel behaviour change programmes

- Residential travel plan, operative during first marketing of a development, then ongoing
- Ongoing finance to employ a travel plan coordinator
- Travel plans for local schools and local employers
- Car club, up and running before residents move in
- Restricted parking

Part B

National and regional policy on new housing and sustainable transport

In the previous section we looked at the evidence base on the extent to which 'good' housing location and design can reduce car use and encourage sustainable modes.

Now, we look at the likelihood that current policy will lead to the development of housing in a form which encourages sustainable travel. We begin with an overview of the main locations at which there are plans for large numbers of new homes. This is followed by a review of policy documents which are supportive of a sustainable approach to new development, at national level and specifically in relation to the Thames Gateway. We then look at the contradictory pressures, reviewing documents from Government and regional bodies which encourage a 'business as usual' approach to new development, assuming and planning for high levels of car dependency. We examine the views of commentators from outside government on how well the current approach is likely to succeed at fostering sustainable travel patterns in new housing.

Policy documents can tell us something about the extent to which new houses will form genuinely sustainable communities, but it is sometimes difficult to distinguish a real commitment to sustainable development from 'business as usual' but with a skim of greenwash. An acid test of the commitment to sustainable development is provided by funding allocations, and so we examine these for the Thames Gateway.

The section concludes with recommendations for policy makers on reforms which would encourage the development of truly sustainable communities, with low car use and high levels of walking, cycling and public transport travel.

9 Locations for new housing

The main locations identified for housing growth are in the south of England. In theory, they fall into broadly three categories:

- Housing Growth Areas;
- New Growth Points;
- Eco-towns.

The following review summarises the scale of new housing development planned in these main locations, and also considers the scale of development envisaged for the whole of Greater London. Tables giving further detail on the number of dwellings planned in each of these areas are in an Appendix.

It is important to keep in mind that these are not the only locations where there will be substantial housing development. For example, in the Eastern Region, approximately a third of housing development proposed in the East of England Plan lies outside these targeted areas. Similarly, approximately half of the housing development proposed by the London Plan lies outside either the Thames Gateway or the London-Stansted-Cambridge-Peterborough Growth Area.

9.1 Housing Growth Areas

The origin for the concept of Housing Growth Areas lies in the 2001 *Regional Planning Guidance for the South East* (RPG9). This set out a series of principles governing new development in the region, key of which was the conclusion that it was preferable for development to be concentrated in urban areas, rather than being widely dispersed across the region. But RPG9 recognised that in addition to development focussed around existing urban areas it would probably be necessary to create new 'urban growth areas'. The Thames Gateway had already been recognised as an important location for regeneration and the provision of new housing and employment. RPG9 additionally identified Ashford, Milton Keynes (subsequently described as Milton Keynes / South Midlands) and the London-Stansted-Cambridge area (subsequently London-Stansted-Cambridge-Peterborough) as areas in which housing growth should be concentrated.

In 2003, the Government's 'Sustainable Communities Plan' (*Sustainable Communities: Building for the Future*, ODPM 2003) confirmed that there should be major housing development in these four Growth Areas, and promised a range of actions to stimulate a step change in the supply of new housing in London and the South East.

The headline figures for each of the Housing Growth Areas are as follows:

- Thames Gateway: 160,000 new dwellings by 2016;
- Milton Keynes / South Midlands: 208,500 new dwellings by 2021;
- London-Stansted-Cambridge-Peterborough: 173,300 new dwellings by 2021 in the parts of the Growth Area within Hertfordshire, Essex and Cambridgeshire, and 37,300 new dwellings by 2016 in the part of the Growth Area within London;
- Ashford: 10,400 new dwellings by 2016.

9.2 New Growth Points

The New Growth Points initiative was announced in December 2005. It involves substantial housing development in 45 towns and cities at 29 locations across the South East, East, South West, East Midlands and West Midlands. Taken together, the plans for the existing 29 New Growth Points will lead to 426,000 new homes being built by 2016.

The Government has also announced a further round of funding for an expanded New Growth Points programme which will include towns in the North of England.

9.3 Eco-towns

The proposed Eco-towns will be new settlements, separate and distinct from existing towns but well linked to them. They are intended to demonstrate the highest environmental standards, including best practice in sustainable transport. From an original 'long-list' of proposals, fifteen possible sites for Eco-towns are now being considered by the Government. However, concerns have been raised by a 'Challenge Panel' of experts appointed by the Government about whether a number of these proposed developments are likely to demonstrate best practice in terms of the future travel patterns of their residents. If all these were to go ahead (which is unlikely) they would provide 112,000 new homes.

9.4 London

In London, the recent document issued by the Mayor, *Planning for a Better London* (July 2008) sets out his intention to review the numbers and spatial allocation of housing in the London Plan, in particular in the context of work by Transport for London which suggests that there may be scope to deliver more housing in areas of East London that will be served by Crossrail and other new transport infrastructure. This document also states that in other locations 'there is a need for new transport infrastructure to support the new homes being built' and comments that 'we must not create new communities that have to be dependant upon the car.'

The current housing allocations (now subject to review) are based on the *2004 London Housing Capacity Study* (published in 2005). This reviewed the capacity of over 4,000 sites of more than 0.5 hectares across the capital, and identified 1,450 sites with some housing potential. It also examined the potential for new housing to be provided from small sites, non-self-contained units and reductions in vacant housing stock. The study concluded that there was a total capacity to provide 315,327 new dwellings during the period to 2016/17. Of these, approximately 60% would be developments on large sites of more than 0.5 hectares.

In calculating the potential housing capacity of each site, the study made an assumption about likely development density, based on the location of the site (central, urban or suburban) and its public transport accessibility level, or PTAL. For example, urban sites with good public transport (PTAL = 6 to 4) were assumed to have a viable development density of 115 dwellings per hectare, while urban sites with poor public transport (PTAL = 1 or 0) were assumed to have a development density of 40dph. The study also included a range of scenarios, some of which assumed higher or lower development densities.

Table 3 summarises the total capacity within each London sub-region. Nearly half of the capacity identified by the study was in east London. The London boroughs making the greatest overall contribution to housing capacity were Newham (35,109 dwellings), Tower Hamlets (31,160) and Greenwich (20,101), reflecting the significance of development in the Thames Gateway to overall provision of new housing in London. Other major contributions were from Barnet (19,637), Redbridge (16,237) and Southwark (16,279).

Table 3: Housing capacity in London

Sub-region	Total capacity*	Share of total
Central	62,095	20%
East	145,899	46%
North	37,184	12%
South	31,120	10%
West	39,029	12%
London total	**315,327**	**100%**

Source: *London Housing Capacity Study* (2005)

Modelling carried out by Transport for London suggests that public transport schemes for which funding is already committed will have the capacity to meet transport demand from *more* housing in the western part of the London Thames Gateway than is currently planned (Murray-Clark 2007).

10 Policy documents in support of a sustainable approach to new development

The high level ambition for a sustainable approach to the development of new housing was laid out in the Sustainable Communities Plan (*Sustainable Communities: Building for the Future*, ODPM, 2003). This was described as a *'long term programme of action for delivering sustainable communities in both urban and rural areas'* and drew a contrast between the experience of the past and a new *'wider vision of strong and sustainable communities…flowing from the Government's strong commitment to sustainable development'*. It promised that potential impacts on the environment would be addressed alongside social and economic goals.

Beyond this high level vision, more specific policies in support of a sustainable approach to new development are most commonly associated with the Government's plans for Eco-towns.

For example, the *Eco-towns Prospectus* (CLG, July 2007) describes the key features of Eco-towns, including:

- Places with a separate and distinct identity but good links to surrounding towns and cities in terms of jobs, transport and services;
- The development as a whole to achieve zero carbon (but its transport emissions will be excluded from the calculation);
- A good range of facilities within the town including a secondary school, shopping, business space and leisure.

The Prospectus states that each Eco-town should have an area-wide travel plan, high quality public transport, street design in line with the *Manual for Streets*, and traffic control measures which give priority to public transport and high occupancy vehicles. It also says that consideration should be given to the impact on roads and congestion when siting the Eco-town.

Guidance on the detail of site design in Growth Points and Eco-towns (*Building Sustainable Transport into New Developments: a menu of options for Growth Points and Eco-towns,* Department for Transport, April 2008) states that:

- Employment opportunities and other community facilities (such as schools and health centres) should where possible be provided on site;
- Plans for new roads to developments should only be considered where they are essential for improved access or the town's economic sustainability;
- Streets should be primarily designed to accommodate the needs of pedestrians, cyclists and public transport, in line with the *Manual for Streets*;
- Car dependency may be reduced through limited car parking, charging for parking, a car-free site or by limiting car access to the periphery of the development;
- Restrictions on car use should be accompanied by car clubs, on-demand public transport or a car-sharing scheme;
- Sites should have frequent, reliable, accessible public transport links to urban centres, major employment and leisure sites; and good cycle tracks, footpaths and bus services to the nearest train station;
- Developers should become engaged in initiatives to support take-up of sustainable travel options, such as marketing bus services, providing high quality information, offering personal travel planning and supporting cycling and walking initiatives such as bike/walk clubs;

- Developers should agree targets for modal share and monitor travel patterns to ensure that these are achieved.

This approach is further supported by the *Eco-towns transport worksheet* prepared by the Town and Country Planning Association for Communities and Local Government and published in March 2008. This recommends that:

- Transport measures across an Eco-town should achieve modal share for sustainable modes which is equal to or better than European best practice, with no more than 25-40% of journeys being made by private car;
- A full range of 'hard' and 'soft' measures should be used to manage mobility, using a travel planning approach applied to the whole town;
- Spending should be apportioned according to the desired modal split.

The Government's update, *Eco-towns: Living a greener future: progress report* (2008) sets out its thinking on standards for Eco-towns. These include:

- More than 50 per cent of trips originating in Eco-towns should be by foot, bicycle or public transport;
- Homes should be within 10 minutes walk of frequent public transport and neighbourhood services;
- Access to and through the development should give priority to walking, cycling and public transport.

Looking specifically at the Thames Gateway, a sustainable vision for new development is best exemplified by the *Sub-Regional Development Framework for East London,* published under The London Plan in May 2006. This states that:

'New residential communities will be centred around new and existing public transport, in many cases building out from existing well served locations. At a local level the emphasis will be on 'walk to' facilities…'

It goes on to say that:

'East London will shift from an over reliance on the car to more sustainable modes including public transport, cycling and walking. Most of the trip growth necessary due to increased population and economic activity will be made by public transport in the longer term and there will be efficient transport for freight and business. Massive investment in public transport quality and capacity, combined with appropriate measures to manage the demand for private vehicles, can help create this virtuous outcome.'

The *Sub-Regional Development Framework for East London* highlights the importance of high development densities in order to support high quality

public transport services, and the need for new public transport services to be in place in advance of development rather than afterwards. It also recognises the need for car travel demand to be managed through behavioural change measures and car parking restraint.

11 Policy documents in support of a 'business as usual' approach to new development

In parallel with the emphasis on design for sustainable transport, there is also a recurring theme in policy documents that existing transport networks will not be able to accommodate the increase in trips resulting from large new housing developments, and that large scale investment in new transport infrastructure will therefore be required. Generally, the emphasis is on multi-million pound 'grands projets' – rail, light rail and road – with limited reference to bus services (with the exception of some bus rapid transit schemes) or cycling and walking. Policy documents tend to imply that investment in public transport and roads infrastructure will be equally necessary, although, as we shall see in section 13, this is not necessarily reflected in actual funding allocations which are strongly biased towards road schemes.

This theme appears in a wide range of documents in relation to all the Housing Growth Areas and also in documents dealing with the New Growth Points. Here, we look specifically at the Thames Gateway as an example.

In *Creating Sustainable Communities: Delivering the Thames Gateway* (ODPM March 2005), the Government comments that the existing transport network in the Thames Gateway is already under strain with heavily used road and rail commuter routes and local networks that are at capacity. Although it suggests that new development will be focussed initially on areas with good existing or planned transport links, it also comments that the transport network must be improved to cope with the additional demands of new communities, and says that in some areas, such as Kent Thameside, transport constraints currently limit the capacity for growth. It says that the Community Infrastructure Fund will help tackle these constraints, providing funding for transport schemes that unlock housing growth across all four Housing Growth Areas.

An inter-regional planning statement by the Thames Gateway Regional Planning Bodies (*Growth and regeneration in the Thames Gateway*, East of England Regional Assembly, Mayor of London and South East England Regional Assembly, 2004) reflects on the same theme, stating that:

- Many movements, especially in the outer Gateway, are by car and some road improvements will be needed, but generally new road capacity would be very quickly absorbed, so that public transport and a multi-

modal approach offer the most effective means of increasing accessibility;

- Some major enhancement of strategic public transport infrastructure will be needed to release the full potential of sites and manage the movement of growing numbers of passengers;
- Sustainable development will only occur if local public transport is also enhanced so that homes and jobs can be effectively linked, more intensive development can be achieved in locations with good accessibility and fullest benefit can be gained from strategic public transport investment;
- Transport improvements are critical to regeneration and are important in reducing risk for developers;
- Investment is needed to address existing infrastructure deficits and connectivity.

The statement identifies a list of public transport improvements and road schemes which it considers are necessary. The public transport schemes include Channel Tunnel Rail Link domestic services; East London Transit; Greenwich Waterfront Transit; Kent Fastrack; Docklands Light Railway extensions; East London Line extensions; Crossrail; C2c line improvements; Thameslink 2000; and public transport improvements in the Medway area. The road projects listed include schemes to increase capacity of the M25, A2, A13 and A127; the A249 Swale Crossing; the Thames Gateway Bridge; road capacity expansion in south Essex and north Kent; the Silvertown Crossing; and a Lower Thames Crossing.

The *Thames Gateway Delivery Plan* (CLG 2007) includes a spending programme for 2008-2011 and some priorities for resources beyond 2011. It identifies a series of major transport schemes which are an investment priority because they will provide links to four 'spatial transformers', or locations which are expected to be responsible for the biggest growth in jobs in the Thames Gateway area. These include widening of the A2 in North Kent (already complete) and changes to the M25 / A2 junction (opening 2008). The Delivery Plan comments that 'Junction 30 of the M25 (the junction with the A13) is recognised as the biggest remaining constraint to development in the Thames Gateway' and commits to announcing a 'recommended approach' in autumn 2008, with major construction work probably beginning in 2013/2014. The Delivery Plan also commits to a study into options for building a further lower Thames crossing. It states that the Government will support plans for the growth of Southend Airport and an associated business park, and that it is supporting the A127 Employment Corridor in Basildon (through a £14.5 million scheme to increase road capacity). In terms of public transport, the Delivery Plan points to the expected impact of Crossrail in improving access to town centres at Abbey Wood, Custom House and

Woolwich, and to the impact of planned Docklands Light Railway extensions.

The Delivery Plan also identifies 13 smaller transport schemes (typically costing £2 million - £20 million) which will be funded via £100 million from the forthcoming round of the Community Infrastructure Fund. Of these, eight are public transport or walking/cycling schemes and five are road schemes. Cross-referencing against other data published by the Department for Transport, which is reviewed more fully in section 13, it appears that the public transport and walking/ cycling schemes tend to be of a smaller scale than the road schemes.

The Delivery Plan sets out proposals for making the Thames Gateway an 'eco-region' that will 'act as an international exemplar of sustainability'. It proposes a series of actions to achieve this, including eco-assessments of the top ten housing programmes; investment to improve energy efficiency of existing building stock; development of a regional 'Green Homes Service'; and development of a district heating system using waste heat from Barking Power Station. The proposals for an eco-region do not mention any low carbon travel behaviour change programme, which might perhaps have been expected in a list of measures focussed on behaviour change and energy efficiency.

12 How sustainable is the current approach? – views from outside government

Next, we look at the views of commentators from outside Government on the extent to which the approach to new housing development is sustainable in terms of its effect on transport and travel patterns. We begin with reports which take a national perspective, and then look at views on developments in the Thames Gateway.

The Sustainable Development Commission made the Government's Sustainable Communities programme the topic of its first thematic review. Its report *Building houses or creating communities?* (2007) concluded that there was insufficient emphasis on sustainable transport solutions. It comments that:

'there is a tendency for road-only solutions (new link roads, roundabouts or traffic lights) to be presented as part of the developer's Section 106 planning agreement….The primary focus of the Department for Transport (DfT) and the Highways Agency (HA) appears to have been to combat congestion, with developers having to consider the impacts of proposed housing growth on the road networks. Developers therefore tend to default to offering improvements for road transport flow, and are not especially encouraged to develop low

carbon transport options such as public transport, which would actually reduce car dependency.'

The Commission welcomes a recent shift in emphasis within the Highways Agency, which intends to become engaged with strategic planning 'to direct development to locations where least transport harm will be caused.'

It also welcomes the fact that a significant proportion of the Community Infrastructure Fund has been spent on public transport, but comments that the schemes being funded are in some cases too short term and unambitious in their scope.

The report raises concerns about the densities of planned developments. It argues that a 'sustainability minimum' of 50 dwellings per hectare should be achieved in order to support local services and public transport, and points out that the national average is still only 40dph, despite high densities of new build in London (112dph in 2005).

The Commission's recommendations include:

- Government to raise the minimum density in planning guidance to an expectation of 50dph wherever possible;
- Guidance for developers and local authorities to be robust about the need for more up-front partnership working and planning time to ensure sustainable transport solutions work effectively;
- The Communities Infrastructure Fund to be completely remodelled in the 2007 Comprehensive Spending Review to become a defined feasibility and facilitation fund for sustainable transport solutions, with capital funding available for low carbon transport infrastructure projects;
- All Housing Market Renewal and Growth Areas to include plans to promote more sustainable travel and to reduce car use – e.g. prioritising active travel (cycling and walking) and infrastructure in travel plans and development design, public transport provision, limiting car parking, greater density.

The House of Commons Select Committee with responsibility for housing and planning investigated the Government's Sustainable Communities plan in 2003. Its report, *Planning for sustainable housing and communities: sustainable communities in the south east,* raised several concerns about the extent to which housing and transport were likely to be integrated. The key issues it raises include:

- Concerns about the low density at which some development may take place. The report points out that the Government has issued a planning

direction requiring notification of any housing proposals below 30 dwellings per hectare, and suggests that this is a low figure to choose;
- The importance of putting new public transport in place before residents move in;
- The need for local shopping, recreation, health and community facilities to be within easy walking distance;
- The risk that certain forms of development will encourage long-distance commuting (for example amongst new communities in the London-Stansted-Cambridge-Peterborough Growth Area, who may make heavy use of the M11 for commuting), and the need for fiscal measures to discourage this;
- The need for services which facilitate local travel within towns and cities rather than encouraging long distance travel.

The House of Commons Environmental Audit Committee has also looked at the Government's housing plans. Its report *Housing: Building a Sustainable Future* (2005) comments again on housing density, pointing out that between 1997 and 2001 average housing density for new development in the South East of England was 23 dwelling per hectare. While this figure has since risen to 41dph, the Committee's view that this is a low figure remains valid.

For the Eco-towns, the Government has appointed an expert panel to scrutinise proposals. Their comments about each of the schemes are set out in *Notes and recommendations from session 1 of Eco-town challenge* (2008). Many of these are critical of the lack of innovation of the schemes, their failure to provide detail on issues such as travel behaviour change, the lack of ambition of public transport, excessive levels of car parking, and too great a reliance on road schemes.

CPRE's submission to the Government's consultation paper on Eco-towns (June 2008) raises the concern that the location of the proposed Eco-towns outside existing settlements is likely to make them car-dependent commuter towns. It comments on the 'significant credibility gap in the light of the number of schemes which are predicated on substantial increases in highway capacity'.

Llewelyn Davies and Steer Davies Gleave were commissioned by the Government to examine transport provision in the Thames Gateway. Their report, *Relationship between transport and development in the Thames Gateway* (2003), provides an interesting analysis of the importance of local transport in determining whether the travel patterns of future residents will be highly car-dependent or more sustainable. They comment that:

'securing high density sustainable developments in the Thames Gateway will require a step change in the level of commitment to and resources for the building and procurement of

local *transport systems. Without this there is no reasonable prospect of being able to achieve the quantity or quality of development to which the Thames Gateway project aspires.'*

They go on to contrast the role of local transport infrastructure and strategic transport links:

'Transport must serve a range of access requirements, but in terms of ***volume*** *of movement, the most important are local in character. So although the strategic transport links are vital in attracting and shaping the economic potential, it is the local transport provision for the Thames Gateway that will be the main determinant of how people actually travel, and the degree of sustainability that is achieved.'*

The report points to the Fastrack proposals for North Kent Thameside, where there is an explicit target for 40% of all motorised trips to be made by public transport by 2025. It goes on to suggest a series of criteria for local transport services:

- Will the capacity of the public transport system be sufficient to accommodate the expected and desired demand, consistent with the target mode split?
- Will the public transport system be of a quality that will attract users who have a car at their disposal?
- Will this quality be sufficiently self-evident to persuade property investors and developers to adopt development formats with low levels of parking and car use?
- Will other aspects of local transport provision, especially parking supply and price at employment, retail and other facilities, be consistent with the desired mode share and levels of demand?

It suggests that housing development in the Thames Gateway should be focussed on those areas with greater potential for travel demand to be met by public transport.

CPRE's review of progress in the Thames Gateway (*Focus on the Thames Gateway 2* 2007) assesses the performance of local authorities in the Thames Gateway against a range of factors, including the amount of new development with easy access to local amenities and services, and the density of new housing developments.

On access to essential services, the indicator used is the amount of new residential development within 30 minutes public transport travel of a GP, a hospital, a primary school, a secondary school, areas of employment and a major retail centre. The figures are taken from local authority annual monitoring reports for 2004/5 and 2005/6. Data reporting on this indicator

is poor, but appears to indicate that new development in the Thames Gateway outside London may have rather low levels of public transport accessibility with, for example, only 46% of new development in Rochford, Essex and 9% of new development in Castle Point, Essex achieving this minimal standard.

On residential densities, the indicator used is the proportion of new housing completed at above 50 dwellings per hectare, based on the same local authority annual monitoring reports. Here, CPRE notes an improvement compared to earlier years. Nevertheless, it remains the case that in some local authorities a significant proportion of new housing falls below this threshold: 27% in Castle Point, 39% in Gravesham, 57% in Swale, and 28% in Medway.

In its *Submission to the Greater London Authority Planning and Spatial Development Committee* (2006), Transport 2000 (now the Campaign for Better Transport) set out its key concerns about plans for housing development in the Thames Gateway. These were:

- That there are numerous road schemes in the Thames Gateway which will encourage car travel, including in London the Thames Gateway Bridge which will attract 17 million car trips per year;
- That the level of expenditure on road schemes is excessive, even in London where it might be expected that spending would be predominantly on public transport;
- That there is massive over-provision of car parking in new developments in the Thames Gateway;
- That the principle of reducing the need to travel is not being applied, with no policy to promote proximity between new housing and new jobs.

The submission argues for intensification of development around public transport hubs; policies to locate jobs and homes near to one another; action to improve access to local facilities; reduced maximum car parking standards in London and complementary standards in local authorities beyond the London boundary; and guidance to local authorities on the enforcement of parking standards when determining planning applications.

13 Assessment of allocation of transport funding

The policy review in the previous section indicates that, viewed from the standpoint of sustainable transport, official policy documents are contradictory: some promote activities that will tend to increase car use whilst others promote activities that will tend to decrease car use. So the question arises as to which of these conflicting presentations of policy is

actually being given priority 'on the ground', as indicated by allocation of funds to transport projects.

To gain an indication of the real-life situation, this section considers the split of public funding allocated to transport projects within one of the Housing Growth Areas – the Thames Gateway.

The source used in the analysis below is *Thames Gateway 2007 Transport Summary* (DfT 2007), which provides a comparatively complete overview of transport funding, covering completed projects, projects in progress and planned projects. This was cross-checked against the *Thames Gateway Delivery Plan* (CLG 2007).

The Department for Transport summary includes Highways Agency schemes, the Transport for London investment programme, schemes funded through the Local Transport Plan settlement, and £100 million of schemes which will be funded through the second round of the Community Infrastructure Fund. It is possible that there are some additional Local Transport Plan-funded projects in Kent and Essex which are not specifically identified in the DfT summary, but these are likely to be so small that they will not affect the overall analysis. Costs met by the private sector (e.g. entirely developer-funded schemes, or developer contributions) are sometimes (although not always) indicated in the DfT summary, but we have excluded them from our calculation. For schemes funded via the Private Finance Initiative, we have used the figure described by DfT as 'total investment'.

The analysis excludes two major public transport projects. Crossrail has been excluded because the only figure available is the anticipated total project cost of £16 billion and this spans many areas in addition to the Thames Gateway. The Channel Tunnel Rail Link is almost entirely excluded because, again, the £6 billion total project cost covers much more than the Thames Gateway. However, the £135 million cost of the new Ebbsfleet station on the high-speed line is disaggregated and included in the analysis. These two mega-projects dwarf the other transport expenditure in the Thames Gateway, which approaches £4 billion in total. Although it is fair to say that these mega-projects will obviate many car journeys within the Thames Gateway region, particularly some longer-distance commuter journeys, the degree to which the Thames Gateway developments achieve a mode split that is not car-dominated will depend much more on 'finer grain' transport projects which make provision for local journeys. The critique of transport provision in the Thames Gateway by Llewelyn Davies and Steer Davies Gleave (described in section 12 above) makes the point that the *local* transport context will be key in determining whether new developments lead to car-dependent travel behaviour. It is therefore informative to analyse the balance within the transport project list independently of the mega-projects,

which if included without disaggregation would dominate to such a degree that patterns at the relevant local scale would be obscured.

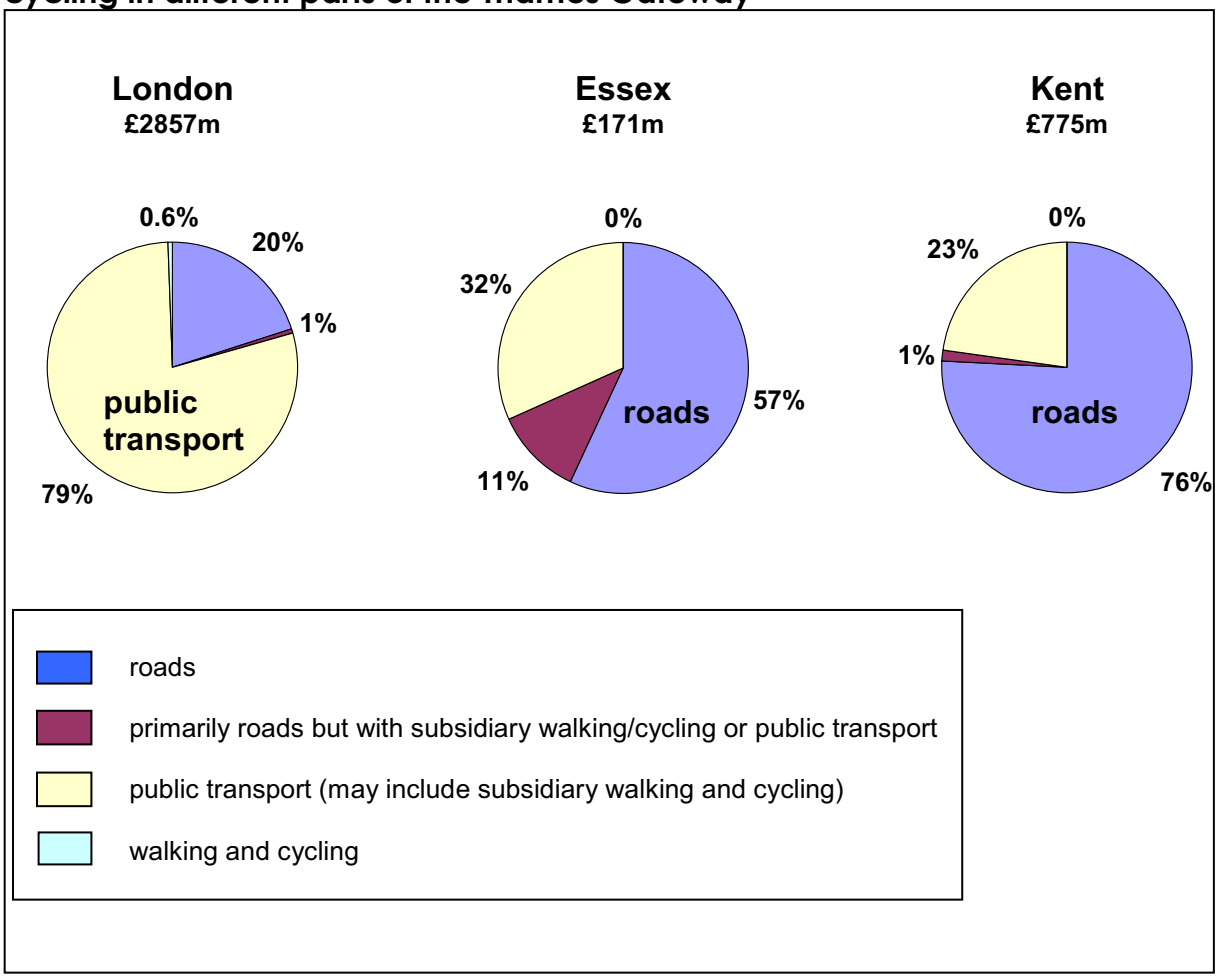
The split of transport funding across the Thames Gateway is shown graphically in Figure 10. A striking difference is apparent between the split in London where 79% of expenditure is on public transport, and the split in Kent and Essex where 76% and 57% respectively of expenditure is on road projects. The proportion of expenditure on road projects in Essex is actually closer to 68% including projects that are mainly roads but contain some elements to facilitate public transport or walking and cycling.

Where spending priorities are directing two-thirds to three-quarters of transport spending towards roads, as in Kent and Essex, quite clearly they will not deliver low levels of car mode share. It appears that in these areas the high level policy aim of creating sustainable communities is being ignored, at least as far as sustainable transport is concerned. There appears to be an assumption in Kent and Essex that travel patterns will inevitably be dominated by the car in future, and that this should be catered for in terms of increased road capacity. In London, however, the spending priorities do appear broadly commensurate with expressed policy priorities to achieve lower car use, although even here there are plans to provide for increases in road capacity and therefore in car travel.

Assessing the cost breakdown for the other Housing Growth Areas is complex because there is no published compendium of data of the form that is available for the Thames Gateway. However, so far as we are able to tell, the pattern in the Kent and Essex parts of the Thames Gateway appears to be typical of that seen elsewhere. To take just one example, the recent third round Growth Area Fund allocation (GAFIII) for Luton and South Bedfordshire (in the Milton Keynes South Midlands Housing Growth Area) has been split so that 67% of the transport expenditure will be for roads, 21% for public transport and 11% for walking and cycling.

In this particular case, it is also interesting to note that the funding is very poorly targeted to the areas where the housing growth will be concentrated. Within Luton and South Bedfordshire, the £18.85 million GAFIII funding allocated to transport will be split in the ratio 49% Luton; 45% Dunstable and Houghton Regis; 3% Leighton Linslade; and 3% Wing village. Yet in the period for which the GAFIII funding is allocated (to 2011), almost all the housing growth in this area (70%) will be in Leighton Linslade. Luton's population is actually forecast to decline. This suggests that – in this particular instance at least – a local authority is using government monies to fund its general (roads-oriented) transport priorities, and not using that money for the purpose for which it was intended.

Figure 10: Funding split between roads, public transport, walking and cycling in different parts of the Thames Gateway



14 Recommendations for policy change

In this concluding section, we examine how the current approach to developing 'sustainable communities' could be improved at national level and within the Thames Gateway.

We begin with recommendations for a new approach which would involve targets to reduce the car dependency of new developments, based on a model developed in Northamptonshire. We then identify three key areas in which we recommend that there should be changes to national policy, and to plans for the Thames Gateway: in relation to location of development; minimum densities; and the balance of funding between road schemes and public transport.

14.1 Targets for modal shift

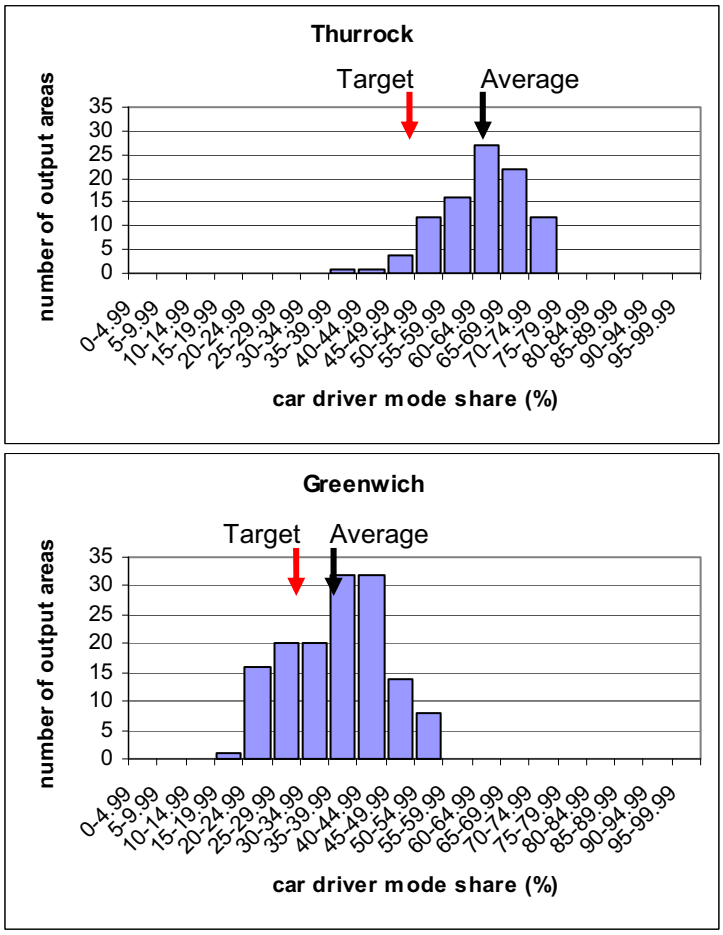
We recommend that there should be a high-level aim for new housing to be, on average, significantly *less* car dependent than current housing stock. This aim should apply both nationally and at the level of regions, sub-regions and counties.

One way of putting such an aim into practice is to set mode shift targets for new developments. This approach is being pioneered by Northamptonshire County Council. Their *Transport Strategy for Growth* (2007) includes a modal shift strategy which requires new developments to achieve a level of car use for the journey to work which is 20% less than in the surrounding area (adjoining wards). The target will be measured relative to a baseline of car driver mode share for the journey to work from the national census. The intention is that all new developments will be required to achieve the target within a defined period from first occupation, and that progress will be monitored and enforced by the council. In order to achieve the target, it will be necessary for sustainable travel initiatives to be designed in from the beginning.

A review of the proposed '20% less car use' target by Transport for Quality of Life for Northamptonshire County Council (2007) concluded that it was challenging but achievable, and that it would typically result in new housing developments which had car driver mode shares equal to the current 'best in ward'. Achievement of the target would require new housing to be designed in a way which is distinctively different from current suburban / urban-edge developments, with new development sited in suitable locations; with low car parking standards and street designs which encourage walking and cycling; with frequent, high quality public transport services into the nearest town centre; and with an intensive programme of 'smart' measures such as personalised travel information to new residents.

This target might most logically be applied at the level of district or unitary councils. Figure 11 illustrates how it might be applied in two unitary authorities in the Thames Gateway, Thurrock and Greenwich.

Figure 11: Car driver mode share for travel to work in two Thames Gateway authorities



The graphs show variation in car driver mode share for the journey to work for 'output areas' within each local authority. An output area is a group of about 125 geographically adjacent households, with a population which tends to be fairly homogeneous. Within each output area there will typically be about 100-200 residents who are in work.

In Thurrock there is a range in car driver mode share for the journey to work, from a low of 35-40% in one output area to a high of 70-75% in 12 output areas. The average (mean) is 62%, shown by the black arrow. A '20% less car use' target would be equivalent to 49% car driver mode share, shown by the red arrow.

In Greenwich, car driver mode share ranges from 15-20% in one output area to 50-55% in eight output areas. The average is 36% (black arrow) and a '20% less car use' target would be 29% (red arrow).

Within each local authority area, there is a significant variation in car driver mode share, such that a target of '20% less car use' lies at the lower end but well within the range of existing car mode share figures. For example, in Thurrock there are five output areas which already have a car mode share of less than the proposed target; and in Greenwich there are 31 output areas with a car mode share less than the proposed target. Thus, the effect of the target – if achieved – would be to ensure that any new development was equivalent to the existing 'best in borough'. This seems a reasonable demand to make of a developer.

It is worth noting that the '20% less car use' target is less challenging in areas with lower existing car use, which is perhaps counterintuitive. So, in

Greenwich, one in five output areas already have a car driver mode share which is lower (better) than the target, whereas in Thurrock only about one in twenty output areas are better than the target. This suggests that it would be relatively easier for a development to achieve the target in an area which already had low car use. In practice, this would result in inner urban areas with low car mode shares being more attractive development sites than urban edge or rural locations – in itself a desirable result.

In addition to a '20% less car use' target, it might also be necessary to adopt a threshold, such that no development would receive planning permission unless it could demonstrate that expected car driver mode share would be under 50%. This would act as further discouragement to housing development in highly unsuitable locations where existing car mode share was very high.

One weakness of the approach outlined above is that it focuses on commuter trips, rather than looking at all journey purposes. The reason for this is pragmatic, in that baseline data on commute modal split is available for all areas from the National Census, whereas baseline data on modal split for all journey purposes may not be available in all local authorities. There is a risk that a target framed in terms of commuter trips would be reached through measures which reduced car use for commuting while having little effect on car use for other trips (e.g. by building parkway stations and improving peak hour public transport rather than investing in better bus services throughout the day). In areas where full travel survey data were available, it would be possible to set a target with reference to this rather than with reference to national census data on trips to work.

It is also worth noting that the Government has already proposed a target for the Eco-towns that more than 50% of trips should be by sustainable modes (foot, bicycle or public transport). The approach adopted in Northamptonshire represents an extension of the Eco-towns approach to other areas, but with some flexibility to allow for local circumstances.

14.2 Other priorities for national policy change

14.2.1 Only permit Eco-towns in sustainable locations

The evidence presented in Part A shows that new housing must be located within walking distance of major public transport links, and at some distance from motorways and high-speed dual carriageways, in order to avoid creating the conditions for high car dependency.

Nationally, this suggests that a number of the proposed sites for Eco-towns are unsuitable and unlikely to deliver the Government's aim of at least 50%

of trips being made by sustainable modes, because they are located too close to motorways or high speed roads. The most obvious examples are:

- Weston Otmoor, Oxfordshire (site adjoins the M40);
- Hanley Grange, Cambridgeshire (adjacent to the A11);
- Elsenham, Essex (near M11);
- Marston Vale, Bedfordshire (adjacent to A421 which is intended to be dualled);
- Rossington, Yorkshire and Humberside (near A1(M) and M18, and with an associated proposal to build a new road, the Finningley and Rossington Route Regeneration Scheme, FARRS).

These Eco-town proposals – and possibly others which suffer from similar locational disadvantages – should not be taken forward.

14.2.2 Set a higher national indicative minimum density

Planning Policy Statement 3, Housing sets a national indicative minimum density of 30 dwellings per hectare (net) as a guide to local policy development and decision-making. It encourages local planning authorities to set out a range of densities across their area rather than one broad density range. This guidance (and the density direction which preceded it) has had a positive effect in increasing average densities of new-build housing. Average densities of new dwellings in England have increased from 25dph in 2001 to 41dph in 2006 (*Land Use Change in England to 2006,* CLG 2007). However, after a fairly rapid rise, the increase in average densities of new dwellings now appears to have levelled off at about 40dph.

As both the Sustainable Development Commission and the House of Commons Select Committee on Housing, Planning, Local Government and the Regions have pointed out, 30dph is a very low figure to choose for a minimum indicative density. New housing built at this density will be difficult to serve by public transport and will have rather poor access to local everyday facilities, and is hence likely to be heavily car-dependent. The Sustainable Development Commission recommended the introduction of a 'sustainability minimum' of 50dph. However, from a sustainable transport perspective, the evidence presented in this report demonstrates that we should be building new housing at densities of at least 100dph.

This would represent a significant shift, implying that new housing should generally be of a built form similar to Victorian or Georgian terraces or urban villages, with an end to building in the style of suburban semis or 'executive homes' (see, for example, *Better Neighbourhoods, Making Higher Densities Work* CABE 2005 for typical densities of different types of residential built form). If a national indicative minimum of 100dph were

introduced, as we recommend, it should be accompanied by guidance on the quality of street design, public transport provision and parking standards to avoid new housing being built at high densities but without the design and service provision to make it successful.

It is fairly standard planning practice to allow lower development densities in areas of existing low density. This is a misguided approach which perpetuates existing problems of car-dependency. We recommend that a national indicative minimum density of 100dph should be applied to significant sites even in completely non-urban settings, in order to enable the provision of sustainable transport options and to encourage the development of a range of local facilities. It is often forgotten that the history of small towns and villages is that until the last century they were built to high densities and consequently supported local facilities and journeys on foot and by bike.

14.2.3 Re-balance funding between public transport and road schemes

The Government's progress report on the Eco-towns (*Eco-towns: Living a greener future: progress report* 2008) suggests a target that more than 50% of trips originating in eco-towns should be by foot, bicycle or public transport. The *Eco-towns Transport Worksheet* (CLG / TCPA 2008) suggests that spending should be apportioned according to the desired modal split.

Taking these two statements together, it logically follows that at least 50% of funding for transport measures in the Eco-towns should be allocated to public transport, walking and cycling.

We suggest that this principle should be adopted for the Housing Growth Areas and New Growth Points as well as the Eco-towns. In some areas, the historic over-emphasis of investment on road-building means that it would be appropriate to spend a much higher proportion of total investment on sustainable modes.

We also believe that the allocations of GAFIII and Community Infrastructure Fund monies should be reviewed to assess how well they are being targeted at the areas where housing is planned. Evidence from the Milton Keynes South Midlands Growth Area (outlined in section 13) suggests that these funds may be being used to fund roads schemes which have no direct relevance to the areas where there will be housing growth, rather than transport schemes which would facilitate sustainable travel in the specific locations where there will be new housing.

14.3 Policy change within the Thames Gateway

14.3.1 Prioritise most sustainable locations for development

The London Plan and its *Supplementary Planning Guidance: Housing* (2005) directly link development density to the proximity and frequency of public transport, with high recommended densities in areas with a public transport accessibility level (PTAL) of 4-6, and lower densities in areas with a lower PTAL.

This approach should be strengthened so that development in the Thames Gateway *only* takes place in locations which already have a PTAL of 4-6, or locations where new investment in public transport services and infrastructure will bring the PTAL up to 4-6 before housing is occupied. This will require public transport accessibility mapping for the whole of the Thames Gateway outside London.

This new approach is likely to mean much smaller numbers of new homes in the Kent and Essex parts of the Thames Gateway, most probably confined to town centre sites and a few sites where it is possible to provide very high quality public transport services.

It is likely to mean *more* housing development in the London part of the Thames Gateway, focussed in areas with the best public transport (i.e. the highest public transport accessibility level, PTAL), and areas where substantial improvements to public transport are planned or possible. Based on evidence assembled by Transport for London (Murray-Clark 2007), there should be more development in the western part of the London Thames Gateway, where intended public transport improvements have the capacity to cater for more housing than currently planned.

Sites which currently have poor public transport should not be developed until public transport has been improved.

14.3.2 Build to high densities in sustainable locations

In the areas with good public transport where development is to be focussed, densities should be at least 100 dwellings per hectare. Areas with poor public transport which are considered unsuitable for development at this density should remain undeveloped unless and until public transport can be improved.

It is worth noting that average net densities for new development in inner London boroughs almost all exceed 100dph (with figures for each borough in the range 92-300dph in the period 2003-2006). Average densities of new

housing in outer London boroughs are currently in the range 42-107dph (2003-2006 data), up substantially from 29-56dph in 1999-2002. By contrast, density of new development in districts in the Kent and Essex parts of the Thames Gateway are still woefully low, typically lying in the range of 28-44dph (with the exception of Thurrock and Southend-on-Sea which have slightly higher densities) (*Land Use Change in England*, CLG 2007).

In areas with excellent public transport links (e.g. within one mile of light rail or tube station, or within one mile of a rail station with frequent services to central London), net densities of new housing developments should be at least 200dph in order to maximise the number of households able to enjoy excellent public transport connections. This figure is in line with densities recommended in the London Plan for central and urban locations with a high PTAL.

14.3.3 Tighten parking provision in new developments

The strictest parking standard for residential developments in *The London Plan* (2008, Annex 4 notes to Table A4.2) is that *'all developments in areas of good public transport accessibility and/or town centres should aim for less than 1 space per unit.'* For other locations the standard is set even lower. This is a notably lax standard that seems to reveal an underlying belief that all new developments will have high levels of car use, despite the ambitions for sustainable transport expressed elsewhere in the plan. The evidence presented in this report shows that new developments in continental Europe achieve much lower standards, and, moreover, that the level of parking expressed in the London Plan would represent a significant deterioration even from the existing car ownership levels in wards of London boroughs well served by public transport – i.e. the sorts of wards which new development should be concentrated in. Parking provision has a fundamental influence on travel habits and standards should be set at 0.5 parking spaces per household or less, with substantial proportions of new developments designed as car-free. As already noted, development design and location relative to public transport and local facilities and should anyway be such that non-car travel is the *most* convenient mode.

14.3.4 Re-balance funding between public transport and road schemes

London is currently the only part of the Thames Gateway where public transport accounts for more than half of all transport investment. In other parts of the Thames Gateway, spending is heavily biased towards road schemes. We recommend that there should be a review of public transport and road schemes in the Kent and Essex parts of the Thames Gateway to identify a series of ambitious new public transport schemes which would unlock the potential for sites to be developed to high densities. The overall aim should be a re-balancing of transport expenditure so that at least 50% (and in the short term, 75%) is for public transport, walking and cycling.

Where new public transport is planned to serve housing developments, it should have sufficient capacity to meet the desired public transport modal split.

The research by Llewelyn Davies and Steer Davies Gleave (*Relationship between transport and development in the Thames Gateway,* 2003) highlights the importance of the local transport system, as opposed to 'strategic' (i.e. long-distance) transport links. In planning for new development in the Thames Gateway, a high priority and a high proportion of overall public transport funding should be given to the local transport links – cycle paths, walking links, bus rapid transit, conventional bus and DLR.

Part A of this report suggested that where access to local facilities by car is easy, with plentiful parking at the destination, levels of car use are higher. It also showed that car use is higher in locations where there is easy access to high speed motorways or dual carriageways. Current plans for the Thames Gateway involve a number of proposals for major road schemes, at various stages of development. Amongst these, the most problematic are the Thames Gateway Bridge, plans for a Lower Thames Crossing, and possible plans for Junction 30 of the M25. To avoid increasing overall road capacity and creating the conditions for development of car-dependent sites, these and other road schemes should be cancelled or reconsidered.

15 Conclusion

There is an understandable desire to build large numbers of new homes in the next decade in order to reduce the severe pressure for housing in the south of England. However, at policy level this has led to a tendency to emphasise volume of construction, at the expense of environmental quality.

If the new homes in the Growth Areas, Growth Points and Eco-towns are to be part of truly 'sustainable communities', they must be designed to facilitate low car use. This requires that major new developments be in locations which are easy to serve by good public transport, rather than in locations where a car is the quickest way to travel. Housing densities, street design and land use mix must be such as to make it easy and attractive to walk and cycle to a wide range of every day local facilities, and such as to support frequent, high quality public transport to town centres and other key destinations. There should be less emphasis on building 'strategic' transport links (which are often not at all strategic, but simply facilitate more short car trips), and more emphasis on providing high quality local transport links for everyday travel by sustainable means. There should be greater emphasis on car-free neighbourhoods and more developments with shared car parking at a

distance from houses, so that residents must walk to reach it. These developments should be coupled with car clubs so that residents do not need to own a car in order to have the occasional use of one.

There should also be a reversal of the current funding pattern, in which – outside London – around three-quarters of transport investment is for new road construction and only a quarter is for sustainable modes.

We need a completely new paradigm for housing in the age of climate change, and this must address the crucial issue of how we can reduce the amounted of fossil fuel used in our travel as well as measures to increase efficiency and reduce household energy use for heating, cooking and lighting. Rather than encouraging a built form which is more *car-dependent* than our average housing stock, we should be developing a new, high-quality form of housing which is more *sustainable* in the travel patterns of its residents.

Appendix: Number of dwellings planned in each area

Thames Gateway

In the Thames Gateway**,** the Government is aiming for 160,000 new homes to be built by 2016. Most of these (nearly 110,000) will be concentrated in what the Thames Gateway Delivery Plan identifies as the 'ten locations where new homes are most urgently needed'. Funding allocations will give priority to these areas. The 'top ten' locations, and the amount of housing planned for each, are summarised in Table 4.

Table 4: Housing units to be developed in ten main locations in Thames Gateway in period to 2016

LONDON THAMES GATEWAY	**72,100**
Lower Lea Valley and Stratford	23,400
Royal Docks including Canning Town	18,900
Greenwich Peninsula	13,200
Barking (Riverside and Town Centre)	10,500
Woolwich	6,100
KENT THAMES GATEWAY	**17,500**
Medway	8,100
Kent Thameside Waterfront	5,700
Ebbsfleet Valley	3,700
ESSEX THAMES GATEWAY	**18,900**
Thurrock	12,200
Basildon	6,700

Source: Thames Gateway Delivery Plan, HM Government (2007). Note that these figures do not necessarily tally with borough-based figures for the London part of the Thames Gateway as set out in the London Plan, and only include 'top ten' locations where the Government intends investment to be targeted.

Milton Keynes / South Midlands

In Milton Keynes / South Midlands, the Sub-Regional Strategy published in 2005 identifies locations for just over 200,000 new homes in the period to 2021, and just over 300,000 in the period to 2031. The biggest increases in housing are planned for Milton Keynes itself and Northampton. Table 5 summarises the main locations and the amount of new housing envisaged in each. Some of these figures are firmer than others. For example, in Aylesbury housing locations to the north of the town (at Berryfields and Weedon Hill) are already identified. In other cases the sub-regional strategy indicates a range of possible 'search areas' within which new housing might be located: for example 'to the east, west and south of Kettering'.

Table 5: Housing units to be developed in Milton Keynes / South Midlands

Location	Additional dwellings in period 2001-2021	Possible further dwellings in period 2021-2031 (subject to revision)
Milton Keynes	44,900	23,700
Northampton	30,000	17,500
Luton / Dunstable / Houghton Regis	26,300	15,400
Bedford	19,500	10,000
Aylesbury	15,000	
Aylesbury Vale	3,300*	
Corby	16,800	28,000
Kettering	13,100	
Wellingborough	12,800	
Daventry	10,800	
East Northants	9,400	
South Northants	6,600	
TOTAL	**208,500**	**94,600**

* in period 2001-2016
Source: Milton Keynes and South Midlands Sub-Regional Strategy (2005)
Note: The Draft South East Plan (2006) re-bases the housing figures for those parts of MKSM in the South East region to 2006-2016, 2016-2021 and 2021-2026. These figures have not been amended here for the sake of consistency with data from other regions within MKSM.

London-Stansted-Cambridge-Peterborough

The London-Stansted-Cambridge-Peterborough Housing Growth Area includes parts of Cambridgeshire, Hertfordshire, Essex and north-east London boroughs. In the three counties, the latest figures for number of housing units are set out in the East of England Plan (the regional spatial strategy for the East of England), published in 2008. For London, the latest figures are set out in an update to the London Plan, published in 2006. The number of units in each location is set out in Table 6.

Ashford

Ashford is the smallest of the Growth Areas. It was designated as a Growth Area because of the expectation that the introduction of high speed domestic rail services in 2009 would stimulate economic activity and housing demand. Table 7 sets out the proposed scale of housing development in Ashford, based on figures from the Draft South East Plan (2006).

Table 6: Housing units to be developed in London-Stansted-Cambridge-Peterborough

Location	Additional dwellings in period 2001-2021	Targets for additional homes 2007/08 – 2016/17
CAMBRIDGESHIRE	**98,300**	
Cambridge	19,000	
East Cambridgeshire	8,600	
Fenland	11,000	
Huntingdonshire	11,200	
South Cambridgeshire	23,500	
Peterborough	25,000	
ESSEX	**35,200**	
Braintree	7,700	
Epping Forest	3,500	
Harlow	16,000	
Uttlesford	8,000	
HERTFORDSHIRE	**39,800**	
Broxbourne	5,600	
East Hertfordshire	12,000	
North Hertfordshire	6,200	
Stevenage	16,000	
LONDON BOROUGHS		**37,300**
Enfield		3,950
Haringey		6,800
Hackney		10,850
Redbridge		9,050
Waltham Forest		6,650
TOTAL	**173,300**	**37,300**

Note: London-Stansted-Cambridge-Peterborough is defined by the Government as including: the London Boroughs of Enfield, Haringey, Hackney, Redbridge and Waltham Forest; Hertfordshire districts: Broxbourne, East Hertfordshire, North Hertfordshire, Stevenage; Essex districts: Braintree, Epping Forest, Harlow and Uttlesford; all Cambridgeshire districts: Cambridge, East Cambridgeshire, Fenland, Huntingdonshire, South Cambridgeshire; and Peterborough.
http://www.communities.gov.uk/housing/housingsupply/growthareas/growthareasby/londonstanstedcambridge/whatishappening/, accessed 21 July 2008

Table 7: Housing units to be developed in Ashford

	2006-2016	2016-2026
Ashford	10,400	12,000

New Growth Points

Table 8 summarises the locations identified under the New Growth Points initiative, and the scale of proposed development at each location.

Table 8: Housing units to be developed at the New Growth Points

Growth point	Total new housing units 2006-2016
EAST MIDLANDS	**110,300**
3 Cities and 3 Counties	81,500 (including 9,800 in Derby; 18,400 in Nottingham and 17,800 in Leicester)
Lincoln (incl North Kesteven and West Lindsey)	16,500 (of which 9,500 will be in Lincoln)
Grantham (incl South Kesteven)	6,300 (of which 2,750 will be in Grantham)
Newark on Trent (incl Sherwood)	6,000 (of which 5,000 will be in Newark)
EAST OF ENGLAND	**46,400**
Norwich	15,950
Haven Gateway (area of 1200 sq. km of northeast Essex and southeast Suffolk)	22,850
Thetford (Breckland District Council)	7,600 (of which 3,000 will be in Thetford)
SOUTH EAST	**77,800**
Reading	7,000
Oxford	5,692
Didcot	5,000
Basingstoke and Deane	9,650
Maidstone	5,040
Reigate and Banstead	5,000 (of which 2,600 will be in two new neighbourhoods in Horley)
Partnership for Urban South Hampshire	40,425
SOUTH WEST	**109,050**
West of England Partnership (including Bath and North East Somerset, Bristol, North Somerset and South Gloucestershire)	46,250
Swindon	17,700
Exeter and East Devon	9,250 (of which 3,500 will be in new community at Cranbrook)
Plymouth	12,250 (of which 1,000 at new neighbourhood of Millbay; 4,000 at new community of Sherford; 1,500 at new neighbourhood of Plymstock Quarry)
Truro	5,000
Poole	7,000 (of which 4,000 in central area)
Torbay	5,000
Taunton	6,600
WEST MIDLANDS	**82,800**

Birmingham and Solihull	40,000
Coventry	9,000
Telford	13,000
East Staffordshire – Burton-upon-Trent	5,000
Hereford	8,500 (in Herefordshire)
Shrewsbury and Atcham	3,500
Worcester	3,800 (in Worcestershire)
TOTAL	**426,350**

Source: www.communities.gov.uk/housing/housingsupply/growthareas/newgrowthpoints/newgrowthpoints/ accessed 31 July 2008-08

Eco-towns

Table 9 summarises the locations for the proposed Eco-towns, and the number of new homes at each location.

Table 9: Housing units in the possible Eco-towns

Eco-towns	Location	Number of units
Pennbury, Leicestershire	4 miles southeast of Leicester	12-15,000
Manby and Strubby, Lincolnshire	2 sites with large element of brownfield land including former RAF base	5,000
Curborough, Staffordshire	Site of Fradley airfield, 10 miles from Burton	5,000
Middle Quinton, Warwickshire	Site of Royal Engineers depot, 6 miles south west of Stratford upon Avon	6,000
Bordon Whitehill, Hampshire	MoD site	5-8,000
Weston Otmoor, Oxfordshire	Site adjoining M40 and Oxford-Bicester railway, 3 miles south west of Bicester	10-15,000
Ford, West Sussex	Site including brownfield land and former airfield	5,000
Imerys China Clay Community, Cornwall	Former china clay workings / industrial land	5,000
Rossington, South Yorkshire	Former colliery village three miles south of Doncaster	Up to 15,000
Coltishall, Norfolk	Former airfield, 8 miles north of Norwich	5,000
Hanley Grange, Cambridgeshire	Land adjacent to A11	8,000
Marston Vale and New Marston, Bedfordshire	Several sites along rail line to Stewartby and Millbrook	Up to 15,400
Elsenham, Essex	Northeast of Elsenham village, near M11 and London-Cambridge rail line	5,000
Rushcliffe, Nottinghamshire	Site not yet identified	
Leeds city region	Site not yet identified	

Source: CLG website, accessed 30 July 2008

London

Updated borough-by-borough housing targets based on the figures in the *London Housing Capacity Survey* were published in 2006, as a revision to the *London Plan*, and carried forward to the 2008 version of the *London Plan*. These targets are reproduced in Table 10.

Table 10: Targets for additional homes in London 2007/08 to 2016/17

North sub-region	**66,500**	**South West sub-region**	**43,150**
Barnet	20,550	Croydon	11,000
Camden	5,950	Kingston upon Thames	3,850
Enfield	3,950	Lambeth	11,000
Hackney	10,850	Merton	3,700
Haringey	6,800	Richmond upon Thames	2,700
Islington	11,600	Sutton	3,450
City of Westminster	6,800	Wandsworth	7,450
North East sub-region	**100,450**	**West sub-region**	**40,450**
Barking and Dagenham	11,900	Brent	11,200
Corporation of London	900	Ealing	9,150
Havering	5,350	Hammersmith and Fulham	4,500
Newham	35,100	Harrow	4,000
Redbridge	9,050	Hillingdon	3,650
Tower Hamlets	31,500	Hounslow	4,450
Waltham Forest	6,650	Kensington and Chelsea	3,500
South East sub-region	**54,450**	**London total**	**305,000**
Bexley	3,450		
Bromley	4,850		
Greenwich	20,100		
Lewisham	9,750		
Southwark	16,300		

Source: The London Plan 2008

Looking specifically at the Thames Gateway, the London Development Agency has assembled a detailed database of housing sites (www.lda.gov.uk/tghousingsites). This covers 150 sites in five categories of scheme 'on site' (that is, under construction); 'planning consent granted'; 'in planning' (i.e. planning application lodged); 'pre-planning stage'; and 'site identified'. Across all 150 sites, a total of just under 120,000 units would be provided. Individual sites range in size from under 50 homes to 5000 homes, with two sites which would accommodate more than 10,000 homes. While not completely up to date, the database does provide a useful overview of the main development sites. The fourteen largest sites, which together account for almost half of the total number of homes, are summarised in Table 11.

Table 11: Largest sites for housing development in London Thames Gateway

Site name	Number of units	Location	Scheme status	Key issues / features
Barking Riverside	10,700	*London Riverside*, LB Barking & Dagenham	4	On site of old power station between the Royal Docks and Ford's old Dagenham plant. LB Barking & Dagenham is working with English Partnerships and Bellway to draw up a master plan for the whole of the site. The master plan should take into account the need to extend DLR line from Beckton to Dagenham Dock. Planning permission granted in November 2006 and first homes could be delivered in 2008
MDL Site	10,010	*Greenwich Peninsula*, LB Greenwich	4	Planning consent and s106 negotiations complete. MDL, working in partnership with English Partnerships, is leading the regeneration of the Greenwich Peninsula. On completion it will provide a riverside community of 10,000 homes, offices, shops, schools, community facilities and a park. Bellway Homes has been signed to deliver the first housing development at the 80ha scheme, comprising 229 riverside apartments on the southern part of the site. A mix of private for sale and affordable apartments is planned, including two-storey duplexes targeting families. Bellway anticipates starting on site in 2007 with residents moving in during 2009. The rest of the homes are scheduled to be delivered by 2025
Silvertown Quay	4,930	*Royals,* LB Newham	4	Silvertown Quays is a large strategic development owned by The London Development Agency, which is working with development partner Silvertown Quays Limited. The scheme will provide 5,000 homes - including social rent and affordable housing - plus 180,000 sq ft of leisure facilities; 130,000 sq ft of restaurants and shops; 165,000 sq ft of offices and flexible workspace; 85,000 sq ft of community facilities and an 85,000 sq ft hotel. The 155,000 sq ft aquatic visitor centre – Biota! - will be Europe's largest aquarium and forms the centrepiece of the scheme's plans, creating a town centre for the Royal Docks. Planning permission was granted in November 2005.
South Dagenham (West 8 Site)	4,100	*London Riverside,* LB Barking & Dagenham	2	This is primarily a residential led development of around 7,350 homes (3,250 on the Western Site and 4,100 on the Eastern). The Western site has been sold to Axa to take forward for development and they have proposed a residential scheme with some mixed use development. The eastern side is planned to be more residential. This area suffers from low transport accessibility and there are a number of proposed transport infrastructure projects that are key to unlocking this area for development. Construction is expected to start in 2009.
South Dagenham (Axa Site)	3,250			
Stratford City Zones 2-5	4,077	*Lower Lea Valley,* LB Newham	3	Westfield has lodged its masterplan and environmental strategies for the site with government body the Olympic Delivery Authority. The masterplan comprises 13.5m sq ft of retail, leisure and entertainment facilities, offices and hotels. There will also be 5,312 new homes, of which 3,000 will be used initially for the Olympic Village community facilities, and public spaces. In the first phase of the development, Westfield plans to develop a 1.5m sq ft shopping centre anchored by a 240,000 sq ft John Lewis department store, a

				32,000 sq ft Waitrose and 1,040 homes. Westfield and LCR are in the process of choosing either a Lend Lease-led consortium or Barratt Homes and Bouygues as developer of the remaining six zones, which will include 4,500 homes, up to 5m sq ft of offices and almost 400,000 sq ft of leisure. Its plans for the "Town Centre District" or zone one will link two major rail interchanges: the new International Station on High Speed 1 and Stratford Regional Station.
Convoys Wharf	3,600	*Deptford and Lewisham,* LB Lewisham	4	Convoy's Wharf is a 16.6 ha site just to the north of Deptford. The revised application for the comprehensive redevelopment of Convoys Wharf to provide a mixed-use scheme of up to 447,045 m sq comprises: 3,514 units residential, up to 72,730 sq m employment space including waste recycling and processing facility, boat repair yard, river bus facility, wharf with associated vessel moorings, up to 6,945 sq m retail, up to 3,370 sq m restaurants/bars/cultural/community, up to 2,700 sq m leisure. Application approved by LB Lewisham in May 2005. Sent to Mayor and ODPM.
Gascoigne Estate	3,500	*London Riverside,* LB Barking & Dagenham	2	Site excluded from LBBD development framework as would require special funding and delivery arrangement. Large, social housing estate, key site for area as link between town centre & riverside.
Greenwich Millenium Village	2,950	*Greenwich Peninsula,* LB Greenwich	5	Greenwich Millennium Village is located at the southern end of English Partnerships' 121 ha (300 acre) Greenwich Peninsula site.1a,1b,2a & 2b all completed. The Village is being developed by Greenwich Millennium Village Ltd (GMVL), a joint venture between Countryside Properties and Taylor Woodrow. Currently over 800 homes in the Village are occupied and the overall project is due for completion in 2012. Stages 3,4,5 granted permission by LB Greenwich subject to referral to Mayor.
West Ham Masterplan	2,766	*Lower Lea Valley,* LB Newham	2	West Ham is identified in the Lower Lea Valley OAPF as having the capacity to support relatively high density residential mixed use development, building on its excellent transport links. The Parcelforce site was acquired by the LDA in November 2004. The Agency is keen to progress the development of this site and is currently working with other key stakeholders with a view to preparing a masterplan for the site by spring 2007. The LLV OAPF identifies the potential for 2,766 homes on this site. An alternative use for part of the site would be the relocation of businesses activities from the Olympic zone, however in this instance it is likely that two-thirds would still be retained for residential and district centre use.
Minoco Wharf	2,572	*Lower Lea Valley,* LB Newham	3	The site occupies an area of 15.96 hectares and is bounded by North Woolwich Road and the DLR extension to the north, the residential development of Barrier Point to the east, existing employment premises to the west and the River Thames to the south. The scheme will provide a total development floorspace of 288,000 gross sq m (gross external area) including between 2,572 and 3,360 residential units at densities of between 251 and 328 dwellings per hectare (over 10.23 hectares) and B1 office, retail A1- A5, and D1 community uses. Application submitted July 2006.

The Warren	2,500	*Woolwich, Thamesmead, Belvedere and Erith,* LB Greenwich	4	This is Phase 2 of the Royal Arsenal development and will see the site connect with Woolwich, doubling the size of the town centre. It will see an additional 2047 homes, a ten-screen cinema and hotel, retail spaces, offices, bars and restaurants. Planning permission granted Jan 2006.
Delivery Zone 6 and 10 Clays Lane Village	2,197	*Lower Lea Valley,* LB Newham	2	The Olympic Development Authority (ODA) has submitted one of the biggest planning applications in European history. The 15-volume 10,000-page application, which sets out plans for creating new venues, roads and parks in east London, also includes details of how the facilities will be changed for use after the games. The document, received by Newham Council, contains plans for the 'Big 4' - the Olympic Stadium, Aquatics Centre, the Village and the International Broadcast Centre and Main Press Centre. Westfield lodged its masterplan and environmental strategies for Stratford City, the 180-acre Olympic Village site in east London, with the ODA in January. The master plan for the site, owned by London & Continental Railways, comprises 13.5m sq ft of retail, leisure and entertainment facilities, offices and hotels. There will also be 5,312 new homes, of which 3,000 will be used initially for the Olympic Village community facilities, and public spaces.
Tripcock	2,000	*Woolwich, Thamesmead, Belvedere and Erith,* LB Greenwich	4	This is a 28 ha brownfield site located within Thamesmead. It has a 1.25 km frontage to the River Thames. The Twin Tumps and Thamesmead Lake for the eastern boundary separating Tripcock Point from Thamesmead Town Centre . Tripcock Park borders the site to the west. To the south of Tripcock Point is a safeguarded area for the proposed Thames Gateway Bridge which will separate the neighbouring Gallions Reach development and Gallions Hill. This development received outline planning in June 2006, however in March 2007 Tilfien Land announced that it is to be put on hold for the foreseeable future.

Source: London Thames Gateway Housing Sites Schedule, London Development Agency, www.lda.gov.uk

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