Impact on Site Density of Lifetime Homes

This research was commissioned by the previous government and is not necessarily a reflection of the current government's policies and priorities.

DCLG is publishing this report in the interests of transparency.

Levitt, Bernstein [September 2009]

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Executive Summary

Strategic Overview – 6 Key Messages

1. Other related research, undertaken on behalf of CLG, indicates that LTH has spatial implications for the design of most current market sale house types.

2. These spatial implications inevitably have some impact on site density but this research suggests that these impacts can be mitigated, or even eliminated, by alternative design approaches albeit that these would need market testing.

3. Lifetime Homes has more impact on the density of 2/3 storey suburban developments (typically in the range of 30-60 dwellings per hectare) than on the density of schemes above or below this range.

4. Inclusion of Lifetime Homes Standards in the design of housing typologies is only one factor amongst a wide range of issues which tend to reduce actual site density well below the theoretical maximum possible for an equivalent mix of dwellings.

5. Other factors include choices made by the developer to maximise marketability (eg in relation to frontage and parking) as well as site and planning constraints over which there is often little control. These other factors are likely to have significantly more impact on site density than Lifetime Homes – in some cases, effectively capping potential density, even before house types and internal layouts are considered.

6. In general terms, the results of this initial investigation suggest that the likely impact of Lifetime Homes is equivalent to the loss of 1-1.5 dwellings per hectare for schemes with a typical mix of 2-4 bedroom, 2/3 storey house types, in the middle of the suburban density range (ie 40-50 dwellings per hectare).

Purpose and scope

This study has been commissioned by CLG to provide an initial assessment of the likely impact of Lifetime Homes on private sector housing. It focuses particularly on 2 and 3 storey house types in speculative, suburban developments of 30 - 60 dwellings per hectare (dph).

It draws on previous work undertaken by Levitt Bernstein (LB) and Hunt Thompson Associates (HTA) and relates the findings of a theoretical desk-top study based on typical, generic footprints to the evidence provided by a sample of current development sites. Feedback from a number of house-builders is also reflected throughout.

Initial findings

1. Lifetime Homes has modest spatial implications for certain parts of the home which, for most, but not all dwellings, will tend to result in increased floor area unless the habitable space elsewhere in the dwelling is reduced, or the circulation areas can be designed more efficiently.

2. For many dwelling types, alternative layouts which reduce, or in some cases eliminate, the need for extra space are possible, but need further testing to assess their marketability.

3. The amount of extra space needed varies for every dwelling type and layout configuration, and is also affected by the way in which the standard is interpreted. Generalisations are therefore difficult but we estimate the likely range of impact to be as follows;

– 1 and 2 bed flats	1-2m2 per dwelling
– 2 bed 2 storey houses	2-4m2 per dwelling
– 3 bed and larger 2 storey houses	3-5m2 per dwelling
– 3 bed and larger 3 storey houses	4-7m2 per dwelling

4. The overall impact on plot size and density is greater for smaller dwelling types and particularly for very narrow houses in centre terrace locations with on-street parking as a combination of these characteristics gives rise to the smallest plot sizes. This arrangement is typical for 2b 2storey houses at the lower end of the market and 3 storey properties with small footprints are often affected disproportionately too.

5. The density impact of upgrading to Lifetime Homes is greater where the standard has to be accommodated by extra width as this has ‘knock-on’ implications for gardens and other elements of the overall plot. For some very narrow dwelling types, increased width seems unavoidable unless the internal layout is radically altered.

6. The case studies examined indicate that schemes usually adopt a varied approach to frontage with wider properties used in many circumstances, especially at the top end of the market. A ‘length only’ increase will therefore usually be possible for a large proportion of houses and the impact of Lifetime Homes reduced accordingly compared with schemes which adopt narrow frontage.

7. Many lower density schemes, up to about 30 dph, are likely to be unaffected, in terms of density by applying LTH. Similarly, many higher density flatted developments will only be marginally affected.

8. Theoretical densities are rarely achieved in practice and actual densities will often be reduced to be 50-80% of the theoretical maximum for a number of reasons other than the design of the house. In other words, density will normally be determined by other over-arching conditions.

9. The additional factors which, in practice reduce density, include restrictions imposed by LA planners and constraints relating to the site and its surroundings - issues which are usually beyond the developer’s control. They also include the developer’s own choices about frontage, typology, parking ratios and provision, site layout and dwelling groupings.

10. Even where reasonable footprint increases are factored in to allow for meeting LTH, most of these other factors, even taken individually, have a much greater impact on site density than Lifetime Homes per se. Cumulatively, the effect is extremely significant.

Proposals for mitigating density loss in typical suburban developments

- fairly minor adjustments to the developer's chosen priorities, for example reducing some wide frontage dwellings to narrower frontages, reducing the number of end terrace conditions, replacing some garages with open parking, would counteract the density loss implied by the application of LTH.

- adopting alternative internal dwelling layouts can result in space-saving efficiencies, particularly where these seek to avoid width increase.

- extending the range of dwelling typologies by including small low/medium rise blocks of flats or efficient courtyard housing would significantly enhance suburban densities and increase housing choice – with potential benefit to certain market sectors, including older people, who's housing needs are currently poorly met.

Overall conclusions

These findings and conclusions are preliminary but suggest that the impact of Lifetime Homes standards on site density is less than might be expected and in most developments is significantly outweighed by a number of other factors; primarily conditions imposed by Local Planning Authorities or decisions based on local market conditions and demand.

Much, if not all of the impact of LTH on site density can be mitigated using a variety of approaches familiar to most developers in a number of ways. That said, further work is needed to allow robust conclusions to be drawn and effects to be fully measured and market tested.

In general, it appears that LTH will have little impact on either low density or flatted developments but a greater impact on schemes of around 30-60 dph comprising predominantly 2 and 3 bed houses. Even here, the design approach varies widely, and only those which have adopted a very narrow frontage approach will be significantly affected. This means that it is extremely difficult to establish a precise impact. Developers recognise this, and agree that it applies not just to LTH but to all the other variables and constraints discussed within this report.

At a broader level, this and the earlier research has highlighted the value of such dialogue with house-builders. Many are sympathetic to the aim of providing more inclusive housing but wish to see a clearer way forward. A combination of commercial and design skills, combined with sensible definition and interpretation of the Lifetime Homes standard should create opportunities to generate some very marketable solutions which could match or even exceed, the typical suburban densities currently being achieved for the mass housing market.

Contents

1.0 Introduction

1.1 Purpose

This study, commissioned in July 09, is an extension to an earlier piece of work carried out by Levitt Bernstein for CLG, details of which are outlined in section 2.1. It represents an initial exploration of the impact that the application of Lifetime Homes Standards is likely to have on the site density of private sector housing. It concentrates on low to medium density suburban developments, typically 30-60 dwellings per hectare (dph).

It comprises three main elements;

- a theoretical analysis - a desk-top exercise which considers the effect on plot size of generic increases to a range of typical plan footprints, as a theoretical indication of the effect on overall site density;
- considering the theory in relation to some live developments - a broad assessment of the likely impact on density across a small sample of typical site layouts, including a commentary about the other factors which typically affect site layout and approaches to mitigating the impact on density;
- other industry feedback – comments about site density and marketability provided by some of the major house-builders who are already incorporating Lifetime Homes into their standard private and affordable house plan ranges.

It also utilises the conclusions of two other pieces of work which consider the spatial, layout and specification implications arising from the Lifetime Homes standard and the additional construction cost implications. These conclusions are summarised in the next part of this report, section 2.0.

Section 3.0 describes the methodology and findings of the theoretical desk-top study, and section 4.0 contains observations in relation to the live developments and relates these to the findings of the desk-top study. The final section 5.0 considers other evidence and provides a broader overview which examines the contribution of good design.

2.0 Data from other recent studies used to inform this work

2.1 Analysis of distribution of housing typologies in public and private sector and typical compatibility with Lifetime Homes (LTH) criteria.

Study carried out by Levitt Bernstein (LB) for CLG, February - September 09.

This study considered the likely impact of the application of Lifetime Homes standards on a wide range of typical plan typologies, currently produced for speculative market sale. Over 100 non LTH flat and house plans were analysed and their potential compatibility for compliance assessed. A further '30-40 compliant' plans were also reviewed.

As expected, the study found that the non-compliant plans included very few LTH features over and above Part M. The 'compliant' plans were noticeably more accessible but most fell short of full compliance. The report concluded that meeting LTH standards will require some changes to the way in which mainstream, private sector, speculative house and flat types are currently designed and built.

We found implications for space, layout and specification; with the need for more space in certain parts of the dwelling, than developers are currently choosing to provide. The extent of the changes needed varies from very minor implications for the layout or size of the current plans, to a radical re-thinking of others, including the need for considerably more space. Cost implications were not within the remit of this study, but have been considered as part of another exercise considered under 2.2.

Of the typologies considered in the impact assessment, very narrow 2 or 3 bedroomed houses and 3 storey houses are likely to be the most affected by the imposition of LTH. The greater impact in these typologies reflects the fact that these are the homes which currently offer the lowest levels of accessibility and adaptability to those who occupy or live in them. Flats over garages (FOGs) are also inherently poor in terms of accessibility, as are all upper floor flats without lift access, though these typologies are not prohibited under LTH, as lift access is not a requirement under the current standard.

2.2 Detailed assessment of the impact of Lifetime Homes on a small number of typical flat and house plans.

Study carried out by Hunt Thompson Associates (HTA) February to August 09.

This study focused on three typical 2 storey house plans, with 2,3 and 4 bedrooms, and two typical flats or apartments with 1 and 2 beds. At or below average size examples of each type were selected and the plans modified to meet LTH using two different approaches. Firstly, the 'as found' layout was retained and simply modified to meet the requirements and the spatial impact measured. This revealed a fairly significant impact for houses (3-13m2), but very little impact for flats (0-2m2). The impact on the lift and stair core was also considered. For the houses only, a second approach was adopted whereby more radical design and layout changes were made to each plan in order to mitigate the extra space needed. In all cases, the floor area of the original 'as found' living, dining and kitchen spaces, and bedrooms was preserved, or matched, thus restricting the impact to the specific requirements of LTH.

The study concluded that the spatial implications of upgrading the 'as found plans' is minimal in the case of the flats considered and for the houses, could be mitigated to the point whereby minor changes to floor areas are required (1-3m2).

Construction cost implications arising from meeting the standard were also part of this study, but are not considered here as they have no impact on site density. The report notes that any sales value implications arising from the design changes have not been explored and that further work should be undertaken to test the marketability of the alternative solutions, particularly in comparison to the 'as found' solutions of the same type. It recommends too, that a much larger sample of dwelling types should be analysed to provide a more robust evidence base.

3.0 Desktop study to consider theoretical impact on density

For the purpose of this study, it was decided to consider only the spatial implications within the home. On level sites, external implications are limited to the requirement to be able to extend an in-curtilage parking space at a future date, and this is theoretically possible in all homes with an external frontage of 3.6m or more. No house types have been found to be narrower than this.

There are greater implications for sloping sites but it has not been possible to explore these so this is accepted as a limitation of this initial piece of work.

3.1 Methodology

Stage 1 - compiling a base set of typical non LTH dwelling footprints and plot sizes and establishing a theoretical site density for each type

The previous studies by HTA and LB involved collecting a range of sample house plans of different types from a range of house-builders. In each case, internal floor areas were recorded/ascertained and the average established for each type. Because the spatial impact of LTH on flats is demonstrably small, the desktop study focuses specifically on 2-4 bed, 2 and 3 storey houses. For each type, a floor area was selected which was at or just below average, based on the house-builder plans collected in the course of the previous studies.

For each type (using a mid terrace condition) a narrow and a wider footprint was established which correspond to the overall floor area targeted. For the narrow frontage, these were based on a reasonable minimum and for the wider frontage were based on an assumption about another frequently encountered configuration for each type.

Wall thicknesses, front and rear gardens, pavement and on-street parking zones were added, together with an allowance for half the width of a road, in order to provide a theoretical set of baseline, non LTH plot sizes. 1 car-parking space per dwelling was assumed although the varying frontages meant that there is space for more than one car in front of the wider house types.

A theoretical site density was then established in dwellings per hectare (dph) for the narrow and wider version each type.

The combination of centre terrace, narrow frontage with on-street parking was selected as the first baseline point of reference for each type because it represents the most efficient land-use, ie achieves the highest density, and therefore is subjected to the greatest impact when LTH is imposed.

The types and sizes are as follows:

Table 1

Dwelling Type	Total Dwelling Area	Dwellings per Hectare	
		Narrow	Wider
2 Bed 2 Storey	64m2	80.5	72.7
3 Bed 2 Storey	82m2	69.8	63.9
4 Bed 2 Storey	106m2	59.0	42.3
3 Bed 3 Storey	111m2	72.0	58.2
4 Bed 3 Storey	129m2	67.0	50.5

3.0 Desktop study to consider theoretical impact on density

Stage 2 - testing the possible impacts on plot size and theoretical site density arising from the incorporation of the LTH standard, using a range of footprint increases

Each footprint was increased by 1m2, 2m2 and 3m2. These figures were selected to represent a best and worst case scenario of the impact of LTH, based on the preliminary work carried out by HTA and LB, and reflecting feedback from house-builders. For 3 storey dwellings with equal-sized floor plans, this represents an overall floor area increase of 3m2, 6m2 and 9m2 respectively. Whilst the 9m2 figure is considered to be higher than necessary, it was felt that the footprint increase for 3 storey dwellings tends to be as significant as that for 2 storey dwellings, so the same figures should be used.

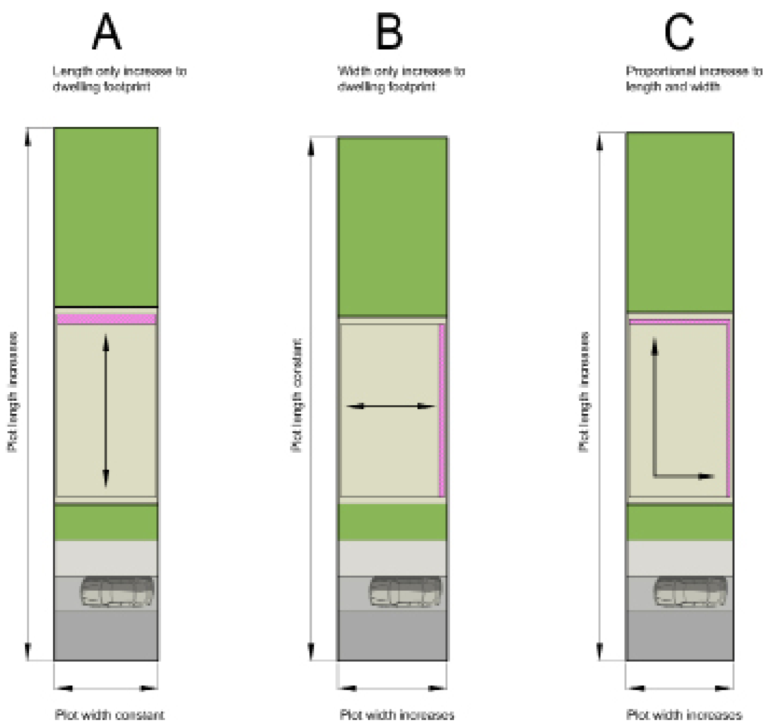
For each option, the increased area was allocated in three different ways, as follows;

A length only increase to dwelling footprint
B width only increase to dwelling footprint
C length and width increase in order to retain the proportion of the original dwelling

The impact on overall plot size and theoretical density was recorded in each case.

Parameters and results are shown in table 2. The option considered to represent the reasonable minimum increase likely to arise from up-grading each type to LTH is highlighted in the table and discussed in sub-section 3.3.

Diagrams showing the three options for increasing footprints to accommodate Lifetime Homes and their effect of plot sizes.



Range of baseline dwelling types and plot configurations with on-street parking

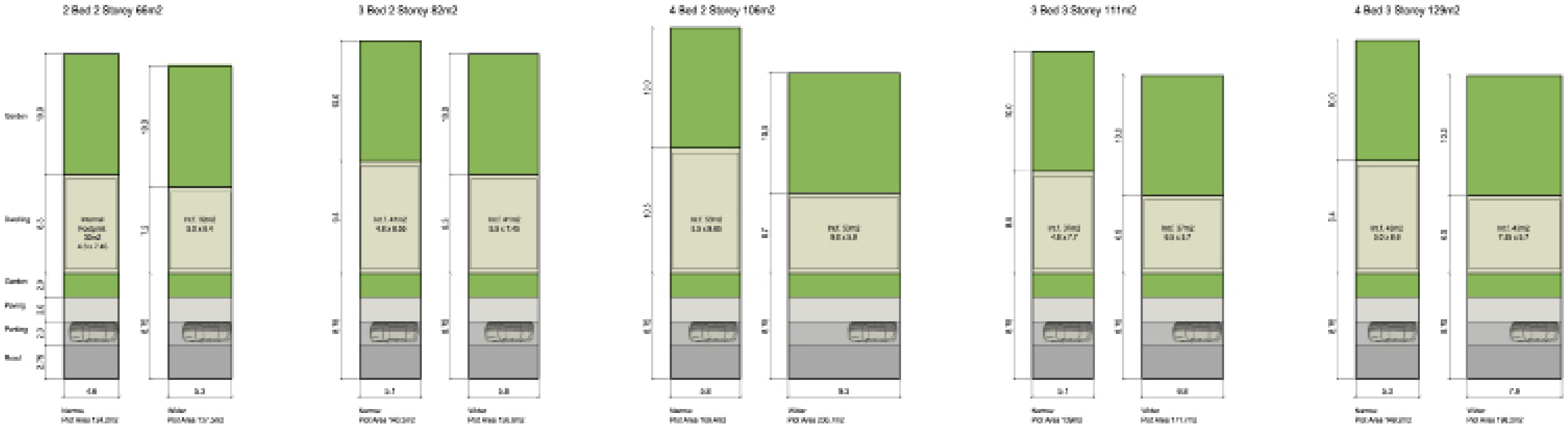


Table 2

Optional increases to Dwelling Footprints / Effect on Plot Areas / Theoretical Density

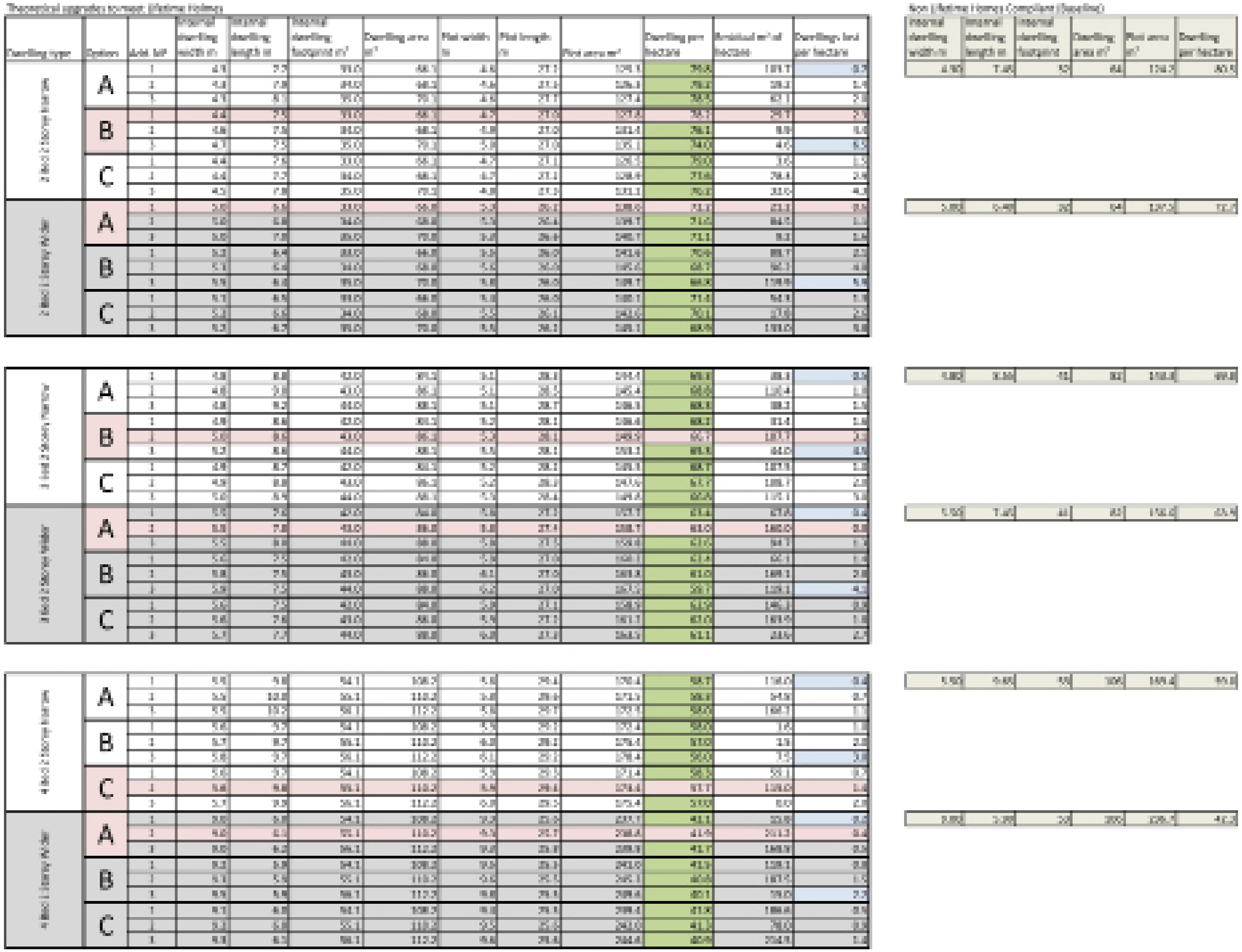
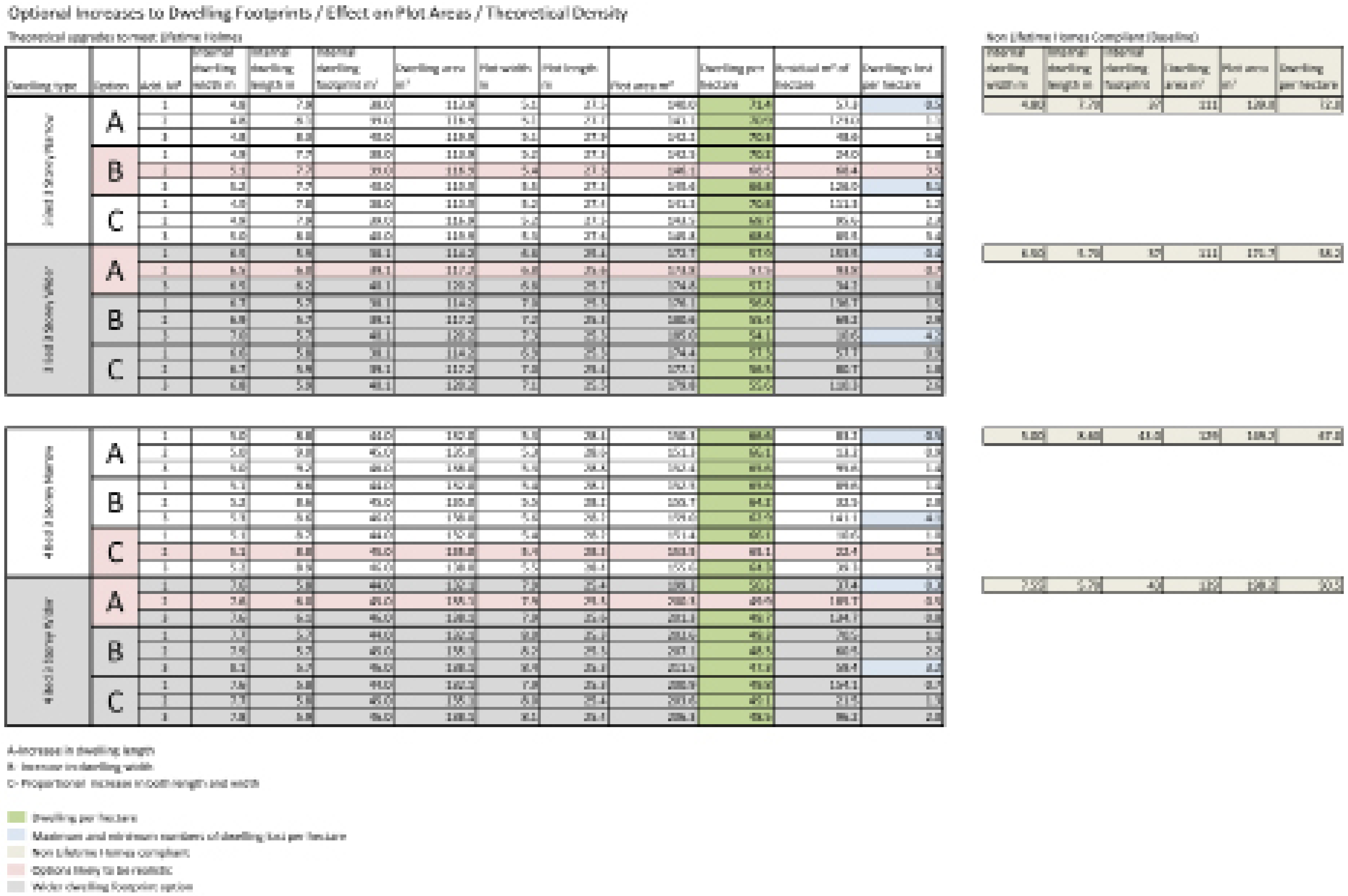


Table 2 Continued.



Optional Increases to Dwelling Footprints / Effect on Plot Areas / Theoretical Density

Theoretical upgrades to meet Lifetime Homes

Non Lifetime Homes Compliant (Baseline)

Stage 3 - assessing the implications of varying the balance of narrow and wider options with a view to mitigating the effects of increased footprints on plot size and theoretical density

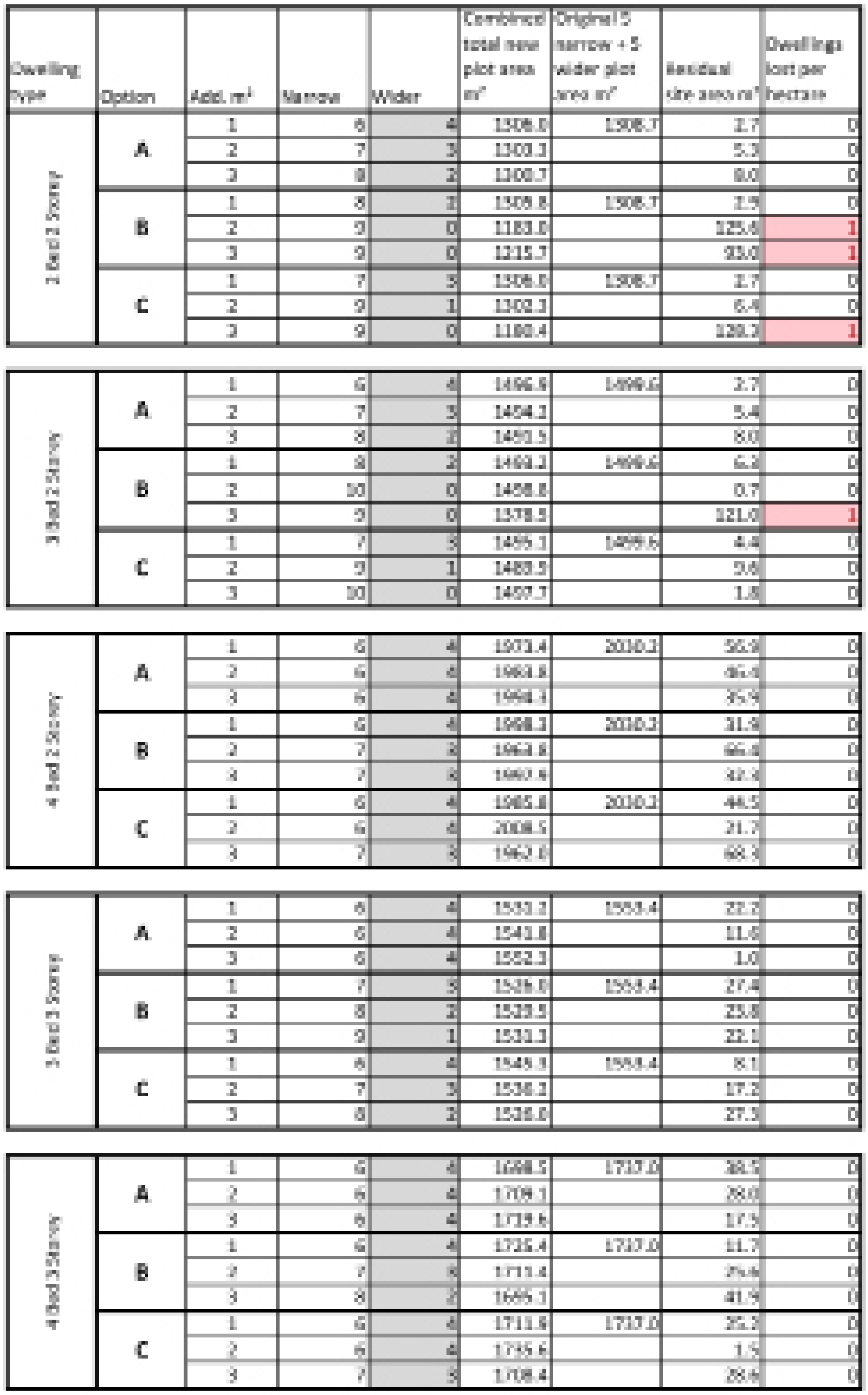
For each dwelling type (eg 2 bed 2 storey) the site area occupied by a notional terrace of 10 houses was established based on a mix of 5 narrow and 5 wider types.

Using each of the 1, 2, 3m2 footprint increases in each of the A, B and C configurations for each type, the balance of narrow to wider dwellings was adjusted to establish the impact on space and density of each scenario and establish, in principle, whether it would be possible to retain the same number of dwellings simply by adjusting the proportion of narrow and wider footprints and at what point that occurred.

Parameters and results are shown in table 3.

Table 3

Optimum combination of narrow and wider dwellings to mitigate dwelling loss.
(Originally 5 narrow 5 wider)



Dwelling type	Option	Addl. m²	Narrow	Wider	Combined total new plot area m²	Original 5 narrow + 5 wider plot area m²	Residual site area m²	Dwellings lost per hectare
2 Bed 2 Storey	A	1	6	4	1306.0	1308.7	2.7	0
		2	7	3	1303.3		5.3	0
		3	8	2	1300.7		8.0	0
	B	1	8	2	1305.8	1308.7	2.9	0
		2	9	0	1183.0		125.6	1
		3	9	0	1215.7		93.0	1
	C	1	7	3	1306.0	1308.7	2.7	0
		2	9	1	1302.3		6.4	0
		3	9	0	1180.4		128.3	1
3 Bed 2 Storey	A	1	6	4	1496.9	1499.6	2.7	0
		2	7	3	1494.2		5.4	0
		3	8	2	1491.5		8.0	0
	B	1	8	2	1493.3	1499.6	6.3	0
		2	10	0	1498.8		0.7	0
		3	9	0	1378.5		121.0	1
	C	1	7	3	1495.1	1499.6	4.4	0
		2	9	1	1489.9		9.6	0
		3	10	0	1497.7		1.8	0
4 Bed 2 Storey	A	1	6	4	1973.4	2030.2	56.9	0
		2	6	4	1983.8		46.4	0
		3	6	4	1994.3		35.9	0
	B	1	6	4	1998.3	2030.2	31.9	0
		2	7	3	1963.8		66.4	0
		3	7	3	1987.6		42.6	0
	C	1	6	4	1985.8	2030.2	44.5	0
		2	6	4	2008.5		21.7	0
		3	7	3	1962.0		68.3	0
3 Bed 3 Storey	A	1	6	4	1531.2	1553.4	22.2	0
		2	6	4	1541.8		11.6	0
		3	6	4	1552.3		1.0	0
	B	1	7	3	1526.0	1553.4	27.4	0
		2	8	2	1529.5		23.8	0
		3	9	1	1531.3		22.1	0
	C	1	6	4	1545.3	1553.4	8.1	0
		2	7	3	1536.2		17.2	0
		3	8	2	1526.0		27.3	0
4 Bed 3 Storey	A	1	6	4	1698.5	1737.0	38.5	0
		2	6	4	1709.1		28.0	0
		3	6	4	1719.6		17.5	0
	B	1	6	4	1725.4	1737.0	11.7	0
		2	7	3	1711.4		25.6	0
		3	8	2	1695.1		41.9	0
	C	1	6	4	1711.8	1737.0	25.2	0
		2	6	4	1735.6		1.5	0
		3	7	3	1708.4		28.6	0

A-Increase in dwelling length
B- Increase in dwelling width
C- Proportional increase in both length and width

▨ Wider dwelling footprint option
🟥 Situations where loss of dwelling

3.0 Desktop study to consider theoretical impact on density

Stage 4 - looking at the effect of end of terrace conditions and different parking options on plot size and density

Focussing on 3 bed 2 storey, as one of the most typical types, the difference between a centre and end of terrace condition was investigated in relation to a range of parking options.

Using just the original narrow and wider footprints of the 3 bed 2 storey type, the following additional conditions were assessed;

centre terrace

- ‘on driveway’ - increase o/a frontage depth by 1m (increase front garden from 2.0m to 5.0m, omit 2.0m on-street parking bay)

(on street parking already included in stage 1; garage option not feasible for centre terrace)

end terrace

- on street parking - adjust width by 1.2m (side passage + additional wall thickness) length unchanged
- ‘on-driveway’- adjust width by 1.2m (side passage +additional wall thickness) increase length by 1m (increase front garden from 2.0m to 5.0m, omit 2.0m on-street parking bay)
- garage - adjust width by 4.2m (1.2 side passage + additional wall thickness and 3.0m garage) length unchanged

3b 2st. baseline dwelling type showing end terrace and parking variations

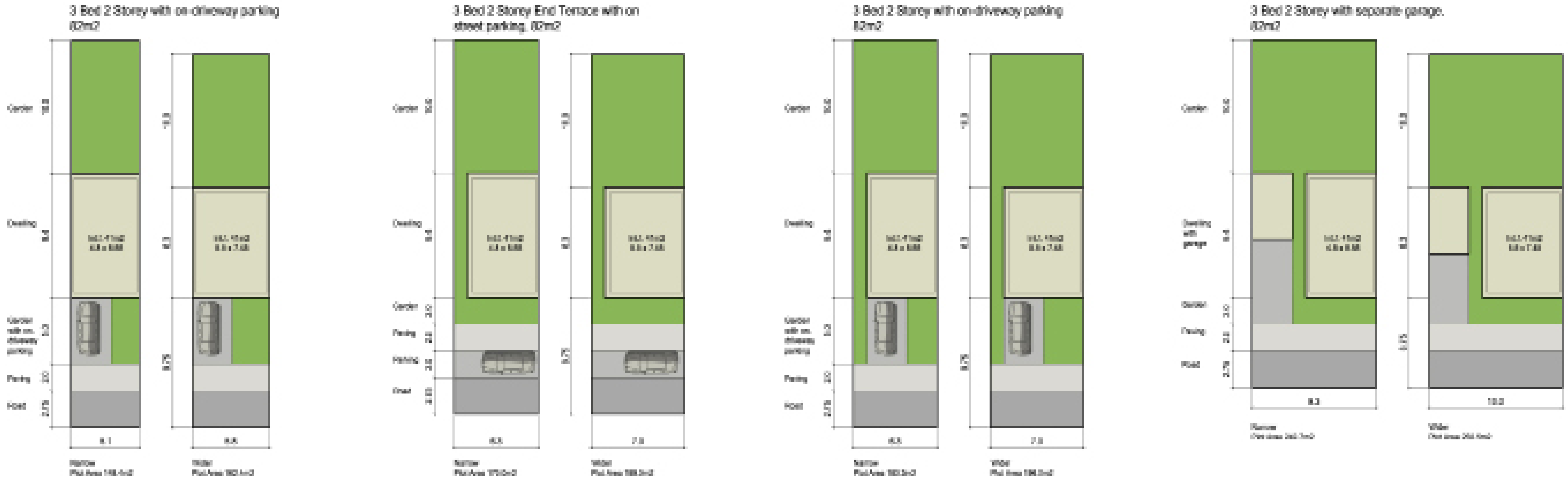
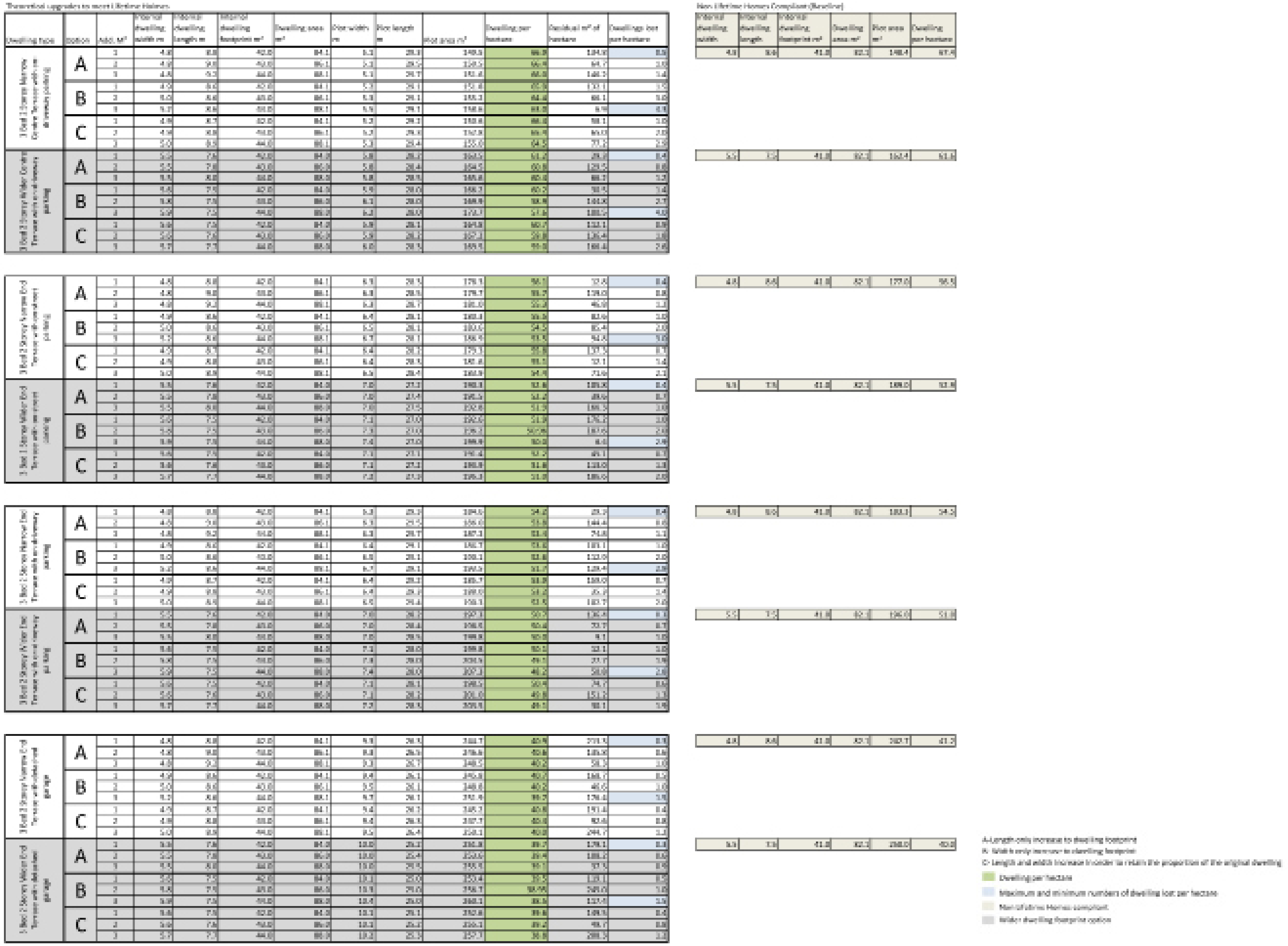


Table 4

Optional increases to dwelling footprints/ Considering effect of end terrace condition and alternative parking option for 3b 2storey house types.



3.2 Summary of findings

Effect on increasing dwelling footprints on plot areas and theoretical density; dwellings per hectare (dph)

- increasing dwellings in length (option A) has the least impact on overall plot area because there is no consequential increase to other components of the overall plot ie gardens, pavement, on street parking and road are all unaffected;
- increasing dwellings proportionately in both directions (option C) is midway between options A and B.
- the impact on dwellings per hectare is greatest for the smallest footprint dwellings, as the additional area represents a higher percentage increase on the initial footprint; (eg increasing the footprint of 2b2st narrow houses, using the options described, results in the loss of between 0.7 and 6.5 dph, compared with a loss of between 0.4 and 3.0 dwellings for a 4b2st narrow frontage; narrow 3 storey dwellings also indicate significant impact)
- the impact is less for wide frontage than for narrow frontage dwellings; (eg 2b2st narrow loses 0.7- 6.5 dph, compared with 2b2st wide, which loses only 0.6 - 5.9 dph and 4b2st narrow loses 0.4 - 3.0 dph, compared with 4b2st wide, which lose only 0.2 - 2.2 dph)
- the dwelling with the least potential impact is the wider 4b2st, increased by 1m², option A (length only) which results in the loss of 0.2 dph – reducing from 42.3 to 42.1 dph
- the dwelling with the highest potential impact is the 2b2st narrow, increased by 3m², option B (width only) which results in the loss of 6.5 dph – reducing from 80.5 to 74.0 dph

Effect of adjusting the balance of narrow and wider dwelling:

- in most theoretical blocks of 10, it is possible to retain all dwellings by altering the balance of narrow and wider frontage dwellings
- in four option scenarios, 1 dwelling is lost* even when all dwellings are converted to a narrow LTH frontage. These are 2b2st - option B +2m2, +3 m² and option C +3 m², and 3b2st - option B +3m². (A similar loss would have occurred in the 3 storey options, had the wider options been less generous)
- the greater the difference between the narrow and wider frontage options for each type, the less the mix has to be adjusted. eg. for 4b2st and 3 and 4b3st, little adjustment has to be made to the mix of 5 narrow, 5 wider because the wider dwellings provide large plots with more space to 'trade-off'

(*Note that where dwelling loss is reported, there is residual land, i.e. the loss is not one full dwelling.)

Effect of end terrace condition and various parking solutions:

(All examples relate to 3b2st base-line (non-LTH) scenarios for narrow and wider dwellings, unless noted otherwise).

- the extra plot width required for an end of terrace condition with side passage has a greater impact on plot size and density than the maximum width increase likely to be required as a result of compliance with LTH, e.g. without factoring in any spatial impact due to LTH, 3b2st narrow end terrace with on-street parking results in the loss of 13.3 dph compared with centre terrace with on-street parking; for 3b2st wider end terrace, the loss is 11.0 dph
- the increase to plot size required to accommodate 'on-driveway' parking is considerable; e.g. in a centre terrace condition, changing from on-street parking to on-driveway parking results in the loss of 2.4 dph where narrow dwellings are used and 2.3 dph for wider dwellings
- the increase to plot size required to accommodate a garage is particularly significant; e.g. in an end terrace condition, changing from on-street parking to garage parking results in the loss of 15.3 dph where narrow dwellings are used and 12.9 dph for wider dwellings
- the combined effect of an end terrace condition with garage parking has the most significant effect on density; e.g. in comparison with centre terrace on street parking, 3b 2st end terrace with garage parking loses 28.6 dph where narrow frontage dwellings are used, or 23.9 dph for wider dwellings
- in comparison, the density impact directly attributable to LTH where terrace and garage parking have been selected in preference to centre terrace with on-street parking is minimal (see table 4)
    - narrow centre terrace baseline (non LTH) with on street parking = 69.8 dph
    - narrow end terrace baseline (non LTH) with garage parking = 41.2 dph
    - narrow end terrace LTH (with B +2m2) with garage parking = 40.2 dph

3.3 Assessing the most likely footprint increase to each of the dwelling types

Other work, including that done by HTA and LB, suggests that, in the same way that the spatial impact of LTH is less for flats than houses, other general conclusions can be drawn. These are offered as 'likelihoods for discussion' rather than 'evidence based conclusions' and all need testing. In carrying out this work, the spatial amenity of the original dwelling was preserved by matching the 'found' space in all areas not affected by LTH.

- the footprint increase needed to meet the standard in 3 bed and larger houses is greater than that required for 2 bed houses (this is because, under criteria 10, the wc needs to be increased from a part M standard to a fully accessible LTH standard (typically achievable at 1.4m x 1.9m))
- it is unlikely that the narrowest 2 and 3 bed footprints could be increased in length alone to meet the standard without substantial re-planning possibly involving loss of value as a result of compromise
- it is likely that the wider footprints of each type could be increased by length alone without significant loss of value or undue compromise
- it is unlikely that the footprint of 4 bed houses needs to increase by any more than 3 bed houses because the most measurable areas of direct spatial impact (to bathrooms, wc's and hallways) remain similar. It could be argued that circulation is longer in a larger home, but it also tends to be wider initially
- where dwelling types need to be increased in size, and provided that some modification to layout is accepted, increases to overall dwelling area and footprint size are likely to be in the following ranges;

dwelling type	**o/a area increase**	**footprint increase**
1 and 2 bed flats	1-2 m2 per dwelling	1-2 m2
2 bed 2 storey houses	2-4 m2 per dwelling	1-2 m2
3 bed and larger 2 storey houses	3-5 m2 per dwelling	1.5 - 2.5 m2
3 bed and larger 3 storey houses	4-7 m2 per dwelling	1.5 - 2.5m2

Deciding which of the 9 possible increased footprint options are likely to be the most realistic for each dwelling type needs further work. In terms of the amount of extra space needed, ascertaining whether the likely increase is 1, 2 or 3m2 will depend on 4 main factors;

- the general arrangement of the original layout
- whether the spaces in the original layout are generous or tight
- the interpretation of the LTH standard (eg the extent to which the through-floor lift provision, stair-lift or temporary bedspace imply a need for additional space)
- the assumed occupancy of the dwelling

The 3m2 figure allows fairly generous extra space for features such as the through-floor lift, whereas the 1m2 increase reflects a greater level of compromise to the functionality of the space and assumes a degree of under-occupancy.

Similarly, deciding whether the extra space can reasonably be provided in length alone (A), a combination of length and width (C) or needs to be entirely reflected in width (B) depends largely on 3 things;

- the general arrangement of the original layout
- in particular where the wc is located in narrower houses
- whether the dwelling can be re-designed to mitigate the width increase needed whilst retaining the desirability and value of the property

These issues need further testing. Work carried out by HTA suggests that in order to provide an LTH compliant version of the 'as found' plans, the width of narrow 2 and 3 bed dwellings would need to be increased by more than the increase used in these theoretical scenarios, albeit that this could be offset by a reduction in length, which reduces the overall footprint increase. However, HTA also conclude that workable solutions are possible within the width increases tested here. This is broadly supported by separate work carried out by LB and some of the house-builders themselves, although market testing has not yet been carried out.

Based on a reasonable interpretation of the current standard and an overview of the many house plans reviewed in the previous studies, we suggest that these footprint increases, and consequential implications for theoretical density (compared with the base-line scenarios) are the minimum likely to be realistic;

2 bed 2 storey narrow	1m2, option B (width)	-2.3 dph
2 bed 2 storey wider	1m2, option A (length)	-0.6 dph
3 bed 2 storey narrow	2m2, option B (width)	-3.1 dph
3 bed 2 storey wider	2m2, option A (length)	-0.8 dph
4 bed 2 storey narrow	2m2, option C (width and length)	-1.4 dph
4 bed 2 storey wider	2m2, option A (length)	- 0.4 dph
3 bed 3 storey narrow	2m2, option B (width)	-3.5 dph
3 bed 3 storey wider	2m2, option A (length)	-0.7 dph
4 bed 3 storey narrow	2m2, option C (width and length)	-1.9 dph
4 bed 3 storey wider	2m2, option A (length)	-0.5 dph

These solutions are highlighted in the results tables for ease of reference.

4.0 Consideration of theoretical findings in relation to live schemes

4.1 General considerations

In practice, development density varies widely from site to site and is determined primarily by location, topography and local planning policy. In rural locations, densities tend to be below 30dph, suburban densities are typically 30-60 dph, urban, 60 -100 dph, and very urban, up to, or exceeding 300 dph. This study focuses on the suburban range of 30 – 60 dph as the predominant territory of the larger volume house-builders.

4.1.1 External constraints which make it difficult to realise theoretical density targets

For a wide range of reasons beyond the reasonable control of developers, sites are rarely developed in practice to their maximum theoretical density. Reasons include;

- public open space or play area provision
- higher levels of parking including visitor provision (eg as a result of planning requirements)
- site access roads and junctions (which are not directly serving dwellings)
- cycle, refuse and recycling storage
- other planning constraints (wheelchair units, Tree Preservation Orders, Section 106 requirements, buffer zones, rights of light to adjoining owners etc)
- existing infrastructure to be retained (roads, services etc)
- general inefficiencies in site use (arising from awkward shape or levels etc)

4.1.2 Choices about other priorities which over-ride density drivers

Again for a wide range of reasons, though generally ‘sales-driven’ responses to demand in the local areas, developers actively choose solutions which are below optimum efficiency in most cases. Reasons include;

- dwelling mix and the balance of flats to houses
- higher parking levels than required by the Local Authority
- different types of parking solution deemed to be more saleable (eg in-curtilage, private garages, parking courts etc)
- wide frontage dwellings (especially at the higher end of the market eg 4 beds and larger)
- short terraces of mixed dwelling types with relatively few centre terrace conditions, or semi-, or fully detached properties

The combined effect of various external constraints and development choices, is that, whilst the difference may be hard to quantify, for any given mix of dwellings, real densities tend to be substantially lower than theoretical maxima.

The general implication of this is that the overall impact on site density which can be directly attributed to Lifetime Homes, is substantially diminished in relation to that which might initially be expected.

4.2 Observations based on three specific sites supplied

We have looked briefly at three development site plans, supplied on request, by one of the large house-builders. All are fairly large, mixed tenure schemes, un-built but with planning approval. None has been designed to meet the Lifetime Homes standard. Density, mix and tenure breakdown are shown on the site plans which are referred to as sites 1-3 and are reproduced as figs 1, 2, 3.

4.2.1 General observations across all three developments

The following common characteristics can be identified;

- each includes a wide range of dwelling types (flats and 2/3 storey houses) which tend to be intermingled rather than grouped in single typologies
- all layouts are ‘street-based’ and each adopts a range of parking solutions rather than a single solution
- dwelling groups are fairly fragmented; none has long, unbroken terraces and each includes a number of detached dwellings
- each includes a significant number of wide frontage dwellings

These features support the suggestions in 4.11 and 4.12, that for a variety of reasons, both beyond and within their control, sites are developed considerably below their theoretical maximum efficiency.

4.0 Consideration of theoretical findings in relation to live schemes

4.2.2 Specific observations in relation to each development

Site 1 (30.6 dph) fig 1

This development provides 89 large 3, 4 and 5b houses for market sale. There are only 7 flats, none of which are for sale. None of the market sale dwellings are narrow frontage, most are very wide, and almost all are semi-detached or detached. Parking is generally on plot (in garages set back behind houses) or in small rear parking courts and exceeds 1:1 provision overall. These characteristics combine to have a very significant effect on density compared with a theoretical maximum based on a similar dwelling mix.

The plan shows a perimeter road accessing dwelling on one side only, and throughout the layout, adopts a wavy street pattern of varying width. These factors will have also had a negative impact on density.

3 bed dwellings

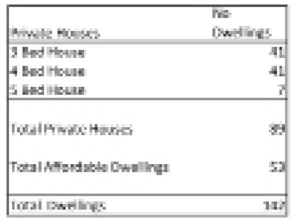
- 41 units (46% of the market sale dwellings) – of which, 9 (10.1%) are medium frontage centre terrace; the remainder are wide frontage semi-detached or detatched with a garage

4 bed dwellings

- 41 units (46%) – all detached, wide frontage with garages

5 bed dwellings

- 7 units (7.8%) – all detached, wide frontage with double garages



Private Houses	No Dwellings
3 Bed House	41
4 Bed House	41
5 Bed House	7
Total Private Houses	89
Total Affordable Dwellings	53
Total Dwellings	142

Private Units	Area m²	No. Dwellings
Flats		
1 Bed Flat	45.0	1
2 Bed Flat	70.3	2
2 Bed Flat	57.68	4
2 Bed Flat 3 Storey	65	8
2 Storey Houses		
2 Bed House 2 Storey	57.68	4
3 Bed House 2 Storey	85.44	16
3 Bed House 2 Storey	88.44	4
3 Bed House 2 Storey	80.6	7
4 Bed House 2 Storey	113.87	13
4 Bed House 2 Storey	119.73	14
4 Bed House 2 Storey	130.1	5
4 Bed House 2 Storey	134.2	2
4 Bed House 2 Storey	142.7	1
3 Storey Houses		
3 Bed House 3 Storey	101.17	7
3 Bed House 3 Storey	100.0	2
4 Bed House 3 Storey	113.87	5
4 Bed House 3 Storey	132.5	3
5 Bed House 3 Storey	163.19	8
Total Private Units		105
Total Affordable Units		35
Total Units		140

Site 2 (42.5 dph) fig. 2

This development consists predominantly of 2-4 bed units of 2 or 3 storeys. 105 (75%) of the total of 140 units are for market sale; 86% of these are houses rather than flats and most are detached or semi-detached. Over half of the private housing has 4 or 5 bedrooms and parking is a mixture of on-street and on-plot with single or garages for the larger houses.

1b dwellings

- only 1 of the 7 flats is for private sale.

2b dwellings

- 18 units (17% of the private units) – of which 14 are flats and 4 are narrow houses, including 3 end terrace units

3b dwellings

- 36 units (34% of the private units) – of which most are wider-frontage semi-detatched
- parking is provided at 1.5 spaces per dwelling; most have on-plot parking or detached garages, others have on-street or spaces in rear parking courts
- front garden depth ranges from 1-6m

4b dwellings

- 42 units (40%of the private units) – of which most are detached or semi-detached
- All have 2 dedicated parking spaces including one on-plot garage.
- front garden depth ranges from 1-5m.

5b dwellings

- 5 units (5% of the private units) - all are detaches houses
- each has 3 dedicated parking spaces including an on-plot garage

4.0 Consideration of theoretical findings in relation to live schemes

Site 3 (66.9 dph) fig. 3

Most of the site is developed as 2,3 storey, 2-4 bed units in short articulated runs of 2 -5 dwellings. Front 'gardens' are generally very small; rear garden depths vary considerably. Parking is generally on plot, or in small rear parking courts. Close to half of all units are flats, which has taken the density just above the typical suburban range. The layout is unusual in that a new road runs around the perimeter of the site and therefore only serves dwellings on one side. The reason for this is unknown but it has increased the road/dwelling ratio beyond what would normally be expected, with implications for density.

1b dwellings

- 10 units (3.7% of the market sale units and low cost units) - all are flats; likely to need only a very small increase to footprint with no knock-on effects to gardens

2b dwellings

- 150 units (55.5% of all market sale and low cost units) - of which, 8 units (2.9%) are narrow frontage 2st; the type likely to suffer the greatest impact due to LTH, but all are end terrace

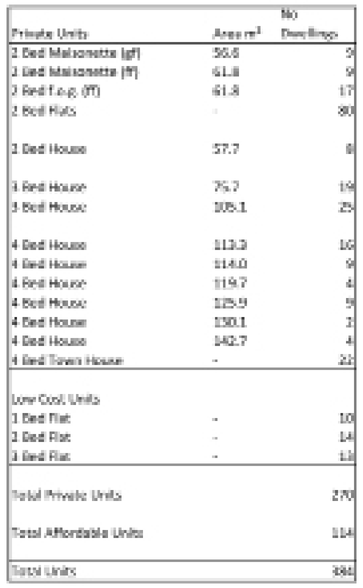
- of the remainder, 18 (6.6%) are wide frontage 'maisonettes' (ground floor flats with a single flat over served by private stair) with small gardens, and 124 (45.9%) are either wide frontage FOG's (flats over garages) or flats

3 bed dwellings

- 44 units (16.3%) – of which, 19 (7%) are narrow frontage; the type most likely to suffer the greatest impact due to LTH, though most are semi detached or detached, typically with a garage

4 bed dwellings

- 66 units (24.4%) – of which, 22 (8%) are narrow frontage; the type most likely to suffer the greatest impact due to LTH, though only 18 are centre terrace



Private Units	Area m^2	No Dwellings
2 Bed Maisonette (gf)	56.6	9
2 Bed Maisonette (ff)	61.8	9
2 Bed f.o.g. (ff)	61.8	17
2 Bed Flats	-	80
2 Bed House	57.7	8
3 Bed House	75.7	19
3 Bed House	105.1	25
4 Bed House	113.3	16
4 Bed House	114.0	9
4 Bed House	119.7	4
4 Bed House	125.9	5
4 Bed House	130.1	2
4 Bed House	142.7	4
4 Bed Town House	-	22
Low Cost Units		
1 Bed Flat	-	10
2 Bed Flat	-	14
3 Bed Flat	-	12
Total Private Units		270
Total Affordable Units		114
Total Units		384

Site 1 with area of private development shown yellow

Table 5 Comparison between site density as supplied and theoretical maximum site density for site 1

Analysis of site as supplied

Dwelling types	Parking per dwelling	Dwelling mix
P1 3 Bed house	1	32.0
P2 3 Bed house	1	5.0
P3 3 Bed house	1	4.0
P4 4 Bed house	1	16.0
P5 4 Bed house	1	5.0
P6 4 Bed house	1	10.0
P7 4 Bed house	1	10.0
P8 5 Bed house	2	7.0
Total dwellings		89.0
Total m²of private area of sample site		27410.2
Dwelling per hectare (private area only)		32.5

	New combined plot area using the same mix**
	5427.2
	809.3
	806.0
	3950.9
	825.7
	2776.0
	2218.0
	1828.3
Total m²	18641.4
Residual m²	8768.7

Theoretical maximum density*

Dwelling types	New theoretical dwelling mix	New combined plot area per house type**
P1 3 Bed house	50.0	8480.0
P2 3 Bed house	7.0	1140.0
P3 3 Bed house	6.0	1209.0
P4 4 Bed house	22.0	5428.6
P5 4 Bed house	6.0	977.2
P6 4 Bed house	15.0	4164.0
P7 4 Bed house	15.0	3327.0
P8 5 Bed house	10.0	2632.2
Total dwellings	131.0	
Total m²		27358.0
Residual m²		52.2
Dwellings per hectare		47.8

*Using the a combination of narrow and wider baseline footprints.

**Value includes 22 End of Terrace condition by retaining the original street layo

*** Parking is matched to original

4.2.3 Comparison between ‘actual site density’ (as supplied) and theoretical maximum site density (as calculated) for site 1.

A further exercise was carried out on site 1 to assess the extent to which the external constraints and development choices have together reduced the density of the private housing on the site from the theoretical maximum. This part of the site is shown yellow on the adjacent site plan.

The ‘as supplied’ breakdown of dwelling types, number of parking spaces and density achieved on this part of the site, are shown in the left hand section of table 5.

Using the same mix of dwellings with the same internal footprint area, and retaining the same number of parking spaces, the site was theoretically re-assessed using the more efficient dwelling configurations and the most efficient form of parking. These are based on the base-line assumptions of the desk-top study described in Section 3.0. Narrow frontage, terraced options were used except where this would have produced dwellings more than 10m long. In these cases, the wider base-line types were used. On-street parking was used throughout, with space for the additional 7 spaces included in the 5 bed plot areas to match the provision on the layout provided. The original street layout was retained in principal, by allowing for end of terrace plot areas at every ‘street corner’.

The central section of table 5 shows that the same number of dwellings and parking spaces, could, in theory, be accommodated on approximately two thirds of the site area.

In the final part of the exercise, we assessed the number of additional dwellings which could, again in theory, be accommodated on the site, retaining the original mix of dwelling types and increasing the level of parking provision to match the ‘as supplied’.

The right hand section of the table shows that an additional 42 dwellings and 52 cars (the number required to provide ‘like for like’ parking provision) could be accommodated. This produces a theoretical maximum density of 47.8 dph compared with 32.5 dph. For easy comparison, all footprints and figures are based on non Lifetime Homes footprints.

We emphasise that this is a theoretical exercise and not a recommendation for an alternative design approach. The assumptions used would produce a very different layout and character which would have a significant impact on marketability. The exercise serves to illustrate that the choices and constraints which affect site layout can be considerable and that their combined impact is likely to outweigh the impact which is directly attributable to Lifetime Homes.

4.3 Observations based on a section of other sites, from a range of developers

A number of other site layouts (viewed on the internet) have been briefly considered and four are reproduced here with a short commentary.

Site 4: Quenby Park, Leicestershire (fig. 4)

This is a very low density development of 16 executive style 3-5b detached homes with large gardens and private garages. There is unlikely to be any impact on site density arising from compliance with LTH.

Site 5: Witham St Hughs, Lincolnshire (fig. 5)

A low density development of 71 homes; comprising a large proportion of detached dwellings, as well as terraces of up to 4 houses. Most of the houses are wide frontage, suggesting that length only footprint increase would be possible. Front gardens are generous enough to allow for dwellings to expand to the front, rather than to the rear, thus maintaining density.

4.0 Consideration of theoretical findings in relation to live schemes

Site 6: Serpentine Walk, Cambridgeshire (fig. 6)

This is a much denser development with a large proportion of narrow frontage homes. A long ribbon of narrow frontage 3b homes, in terraces of 3 or 4, forms the western edge. Parking for these homes is already on-street and perpendicular to the road – the most efficient form of parking. Smaller groups of very narrow 2b houses are also provided. Upgrading these homes to meet LTH without losing density, would be very challenging and would rely on new, equally efficient internal layouts which may prove to be less marketable.

The 4 and 5 bedroom house types are all wider than they are long, and do therefore, offer considerable potential to be narrowed and release space to ease the narrower types.

Site 7: Eclipse Orchard Park, Cambridgeshire (fig. 7)

This site has the largest lengths of unbroken terrace (10-11 homes) but most are medium rather than narrow frontage so footprint increases could well be in length, not width. Most gardens are short already however so the best opportunity for off-setting the density implications of bigger dwellings might come from converting some of the 50 or so private garages or car-ports clustered in rear parking courts, to open parking. Implications for marketability are acknowledged.

4.4 Conclusions of site analysis in relation to desk-top study

Every site is unique and every development has particular constraints and priorities which drive the approach to the project. Many factors affect the site density which is ultimately achieved in practice and firm, generic conclusions about the direct impact of LTH are not possible.

Even for a specific site, robust testing of this theoretical outcome would require a detailed analysis of the impact of applying LTH to each dwelling type and to every plot configuration. It would require a thorough knowledge of the site and associated planning constraints and would involve adjustment to the site layout (possibly radical) and the detailed re-design of each dwelling type (which might also be considerable). A like for like comparison would mean accepting the existing design parameters that have been applied to a particular layout, as 'givens' (ie maintaining the same dwelling mix, parking levels, garden size and privacy distances). Inevitably, applying the larger footprints implied by LTH, would in most circumstances, result in some re-design and have some impact on site density.

Measuring the impact on actual sites would produce an infinite number of results, and the desk top study is an attempt to simplify a very complex situation whilst being mindful of reality. All except the smallest sites, comprise a mix of dwellings rather than a single typology and many include some non-rectangular plans and other dwelling types, including flats over garages, which have not been considered here. However, based on the parameters defined and the assumptions made, the various parts of this investigation can be pulled together to suggest a generic outcome which may be fairly typical for the main typologies used in suburban housing developments.

Evidence suggests that house-builders typically use narrow frontage plans for 2 bed houses and, on the whole, for 3 bed 2/3 storey houses too. 4 bed homes are often wider. The theoretical maximum density which could be achieved using on street parking (from table 1) and the suggested likely impact due to the incorporation of LTH (highlighted in table 2, and summarised in section 3.3) for five of the most typical typologies, are brought together here;

dwelling type	**theoretical max. density**	**likely impact due to LTH**
2b 2st narrow	80.5 dph	- 2.3 dph
3b 2st narrow	69.8 dph	- 3.1 dph
4b 2st wider	42.3 dph	- 0.4 dph
3b 3st narrow	72.0 dph	- 3.5 dph
4b 3st wider	50.5 dph	- 0.5 dph

In a hypothetical scheme comprising equal numbers of these house-types, averaging the figures in both columns suggests two things;

- that the theoretical maximum overall site density would be 63 dph and
- that the imposition of LTH, would result in the loss of 2 dph – equivalent to a density reduction of 3%

The overview of a sample of typical developments presented in section 4.2, supports the assumption that there are many other factors which tend to drive density down below theoretical maxima, and the exercise in 4.2.3 indicates that a reduction to two thirds may not be unusual. Applying this reduction to the hypothetical scenario above, would reduce the density from 63 dph to 42 dph, and the impact of LTH would reduce from 2 dph to 1.3 dph accordingly.

Because the impact of these other factors appears to be far greater effect than the impact that can be attributed directly to LTH, (33% compared with 3%) it seems likely that making fairly minor changes to a scheme, in line with one or more of the options explored in the desktop study, could lead to a solution in which the original density could be matched in a broadly similar layout by one or more of the following techniques;

- adjusting the balance of narrow and wider dwellings of the same basic type
- adjusting the balance of various types of parking provision
- adjusting the proportion of centre terrace, end terrace , semi-detached and detached dwellings

This ease with which this could be done depends on the nature of the layout and the original mix of dwelling typologies; in particular, how many of the most efficient (and therefore most affected) narrow frontage 2 or 3 storey centre terrace houses with on-street parking had been employed and whether new equally narrow frontage dwelling plans of the same types are possible. This too, points to a much larger piece of work, and as noted, the possible impact on cost and marketability cannot be ignored - but it seems a reasonable hypothesis.

In broad consideration of density, and the effect of mix and typology, it is important to mention that the biggest single impact (greater than frontage or parking) occurs when flats are provided instead of houses. By making this shift, density increases from a realistic maximum of about 60dph, for the most efficient small, narrow house types to about 100 dph (even at 3 storey) and 150+ for medium to high rise. This is well understood but has not been investigated here because it represents such a dramatic shift in typology and value, and would be inappropriate as the predominant approach for family housing in most suburban locations. Further comment is provided in section 5.0.

5.0 Other feedback, broad overview and the role of good design

5.1 Other feedback

As evidenced in our earlier work for CLG and our general housing experience across all sectors, volume house-builders have not been quick to embrace the Lifetime Homes standard for market sale housing. This has made evidence difficult to gather.

In the GLA, where LTH has been required by many London Boroughs as a condition of planning since the London Plan was launched in 2004, bespoke flatted developments are far more common than spec. housing so compliant house plans are scarce.

LTH is also required now across all tenures by a number of other LA's across the country and has been a requirement of former English Partnerships schemes (now amalgamated with the former Housing Corporation to form the Homes and Communities Agency HCA) since 2007, but this still presents a patchy picture with few reliable conclusions about the cost or spatial impact – or whether they have any positive or adverse affect on the desirability of the new homes which result.

A number of house-builders report that they are now 'gearing up' in the light of Government policy to require all new dwellings to comply with LTH by 2013. They confirm our initial findings that their approach to dwelling design differs across the market. At the top end, most 4-5b houses are already wide frontage and spaces tend to be generous throughout. The capacity of these house types to absorb Lifetime Homes is greater although it does still require a certain amount of spatial re-organisation and a slightly bigger footprint (almost always possible in length, not width) unless some rooms are reduced in order to increase halls and wc's etc.

The picture is quite different at the lower end of the market. The vast majority of 2 and 3b houses currently offer a narrow frontage comprising kitchen + front door + wc. The living room is at the rear, across the plan, winder stairs are the rule rather than the exception, halls and landings are very tight and in 2b houses, the bathroom is almost always internal. Internal frontages of 4.0 - 4.5m for 2b and 4.3 - 4.8m for 3b are typical. Interestingly, we found no wider 2b 2st. house types in the 3 sites supplied which suggests that we were wrong to include this as a baseline option.

The wider hallways, door nibs and wc's required by LTH put these layouts under pressure, and alternatives are being considered. One large developer is finalising a new range of house types which can accommodate LTH but they intend to implement the standard only when specifically required - until it becomes mandatory everywhere. Space ear-marked for a wider wc will remain in the living room until regulation demands otherwise.

They are managing to achieve compliance even in very small, narrow dwellings with almost no extra width or even overall floor area compared with their current range. Although floor areas are barely affected, many of their dwelling types have been substantially re-planned in order to achieve compliance within, or close to, the original footprint. They report a degree of compromise which will probably translate to slightly bigger homes, when implementation becomes mandatory and the playing field is levelled.

Others report more significant impact, as much as 10% or more. It is difficult to assess whether this is because their previous house types were extremely inaccessible and needed major overhaul or because they have taken a more conscientious approach when interpreting the standard. Both scenarios seem likely to occur within the industry and there are fairly widespread calls to clarify various aspects of the standard and ensure consistent assessment and approval mechanisms which must be taken seriously.

Given the other density-related variables which undoubtedly exist; uncertainty about additional space requirements means that the impact on density is harder still to pin down. Across the industry, some form of plotting efficiency tool (a more sophisticated version of the spreadsheet devised for this study) is widely used. These give an indication of the relative efficiency of different dwelling types and a rough guide to the impact of a range of decisions which affect plot size. As generic tools, they are unable to deal with the unique complexities of individual sites and therefore fail to provide a reliable assessment of eventual density.

5.2 Broad overview and the role of good design

Given that the underlying purpose of Lifetime Homes is to promote inclusive design, and that it represents a higher standard in terms of accessibility and adaptability than Part M, it would be surprising if it did not imply some form of change in the design or size of homes. In order to meet the full requirements, almost all mainstream housing, particularly in the private sector, would be subject to some change because current levels of accessibility rarely exceed the minimum requirements of the Building Regulations.

As a first step towards understanding the density implications of this change, this study suggests that the impact need not be significant and is outweighed by many other factors and choices. In many cases, relatively minor shifts in terms of parking, groupings and frontages could be made to mitigate any density loss.

Less conventional dwelling types may emerge which prove to be more accessible, but equally marketable and efficient. Finding such solutions is particularly relevant at the lower end of the market where narrow frontage 2 and 3b 2st types predominate. Some of the emerging solutions are far from ideal in other respects. The frontage of one new, narrow compliant 2b plan now has a boiler cupboard, front door and wc. The only habitable room at ground level is a deep open-plan living/kitchen/dining room which looks out to the rear garden. There are obvious drawbacks here in relation to other aspects of good design. The 'dead frontage' would affect the quality of the streetscape, passive surveillance and the extent to which the occupants engage with the neighbourhood. The kitchen would need artificial light and ventilation for much of the day, increasing energy demand beyond the previous typical dual aspect layouts.

Other plans relocate the wc to a central location between the kitchen and living/dining space thereby ruling out the possibility of a direct connection between the key spaces within the home. This is less of a problem but none-the-less reduces the flexibility of the dwelling over its lifetime. In embracing Lifetime Homes, it is important to ensure that increased accessibility does not impact negatively on other aspects of good design.

There are narrow alternatives which still involve functional compromise in comparison with wider frontage options, but avoid these particular drawbacks. It may be that more radical typology shifts are appropriate in some locations. Back-to-back courtyard housing or large lift-served 2b flats in small blocks achieve much higher densities than the tightest, conventional 2 storey houses and are much more suitable in principle for older people, or others, who have no wish for a garden.

It is also important that all standards and regulation find ways of permitting the sort of practical, affordable and attractive solutions that people feel happy to live with. It is impossible to control over time how people occupy their homes and what changes they make. Simple bathroom and wc solutions which provide good levels of accessibility and can be easily modified to give improved access to wheelchair users exist and should be widely adopted. This pragmatic approach which works with lifestyle choices, rather than against them, makes it more likely that key accessibility features will be retained for longer.

The mandatory application of LTH is being considered at a time when housing design is undergoing rapid change in response to parallel policies driven by climate change, energy efficiency and sustainability, and within the context of a difficult market place.

The challenge, therefore, is to ensure that we achieve well-designed solutions which maintain saleability, land viability and flexibility, whilst at the same time, becoming more accessible and adaptable. In many circumstances - but not all - this means that layouts will need to be re-considered, including the need to increase overall footprints. However, as demonstrated within this pilot research, there are many ways in which site density can be maintained when this proves necessary.

That said, there is much talk about the need to raise UK housing standards and go some way towards matching the norms. of many of our European counterparts. The very smallest of our mass market, private sector house designs (the group most affected by the application of LTH) are questionable in terms of functionality and amenity – even when under-occupied. They are of a size which is limiting in ways other than accessibility alone.

As a result, we would suggest that the modest area increases which are required to accommodate the principles of the LTH standard, may well be universally desirable in any case, and represent an overdue acknowledgment of the crucial role that housing plays in terms of enhancing quality of life and general well-being.

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