



# 2011 Built-up Areas - Methodology and Guidance

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## 1. Introduction

2011 Census data for built-up areas (BUA) in England and Wales provide information on the villages, towns and cities where people live, and allows comparisons between people living in built-up areas and those living elsewhere. The data will also be used to underpin a revised version of the rural-urban classification in England and Wales. Census information released for built-up areas and the rural-urban classification has a variety of uses, including statistical analysis and reporting, policy development, monitoring and evaluation, and planning.

Census data for built-up areas (previously called urban areas) have been produced every 10 years since 1981. For 2011 Census outputs the areas have been renamed built-up areas. This will help to avoid previous inconsistency in terminology with the rural-urban classification, and provide a name that more accurately describes the geography.

A new methodology to capture the areas has been used in the 2011 version of the dataset, but it follows the rules used previously so that results are broadly comparable. As before, the definition follows a 'bricks and mortar' approach, with areas defined as built-up land with a minimum area of 20 hectares (200,000 m<sup>2</sup>), while settlements within 200 metres of each other are linked. Built-up area sub-divisions (BUASD) are also identified to provide greater detail in the data, especially in the larger conurbations.

This document has three parts: an explanation of the methodology used to capture the areas and assign Census data to them; guidance to help users of the data; and advice for users interested in comparability over time.

## 2. Methodology

### 2.1 Identifying built-up areas for the 2011 Census

Technological advances since 2001, both in the underlying data and processing techniques, have meant that it has been possible to move away from the manual process used to identify the areas in the past to an automated method. This has enabled a more consistent, transparent and repeatable dataset to be produced.

Ordnance Survey, the national mapping agency of Great Britain, were commissioned by a cross government working group<sup>1</sup> to create the digital boundaries for the 2011 built-up areas using an automated approach based on grid squares. The dataset was built in four stages.

#### *(i) Creating the grid*

A 50m grid, based on the British National Grid System, was created over England and Wales. Then, using OS MasterMap® Topography Layer<sup>2</sup>, the features within each grid cell were identified. The land cover information for each of the features was categorised into one of four nominal National Land Use Database (NLUD) classes. Finally, each grid cell was then attributed with the percentage coverage of each of the four classes.

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<sup>1</sup> Office for National Statistics; Department for Communities and Local Government; Department for Environment, Food and Rural Affairs and Welsh Government

<sup>2</sup> Extract taken in March 2011 to reflect the 2011 Census date



**Figure 1:** Creating the grid

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Certain land-use types (large industrial sites, airports and areas of mobile homes) that had been included in previous versions of the urban area boundaries were not picked up by the automated process described above. This is due to the amount of open space alongside the man-made structures in these sites. In order to ensure consistency with previous versions these areas were identified and manually digitised from aerial imagery. Once captured, the digitised boundaries were then 'gridded' so that they appeared consistent with the rest of the dataset.

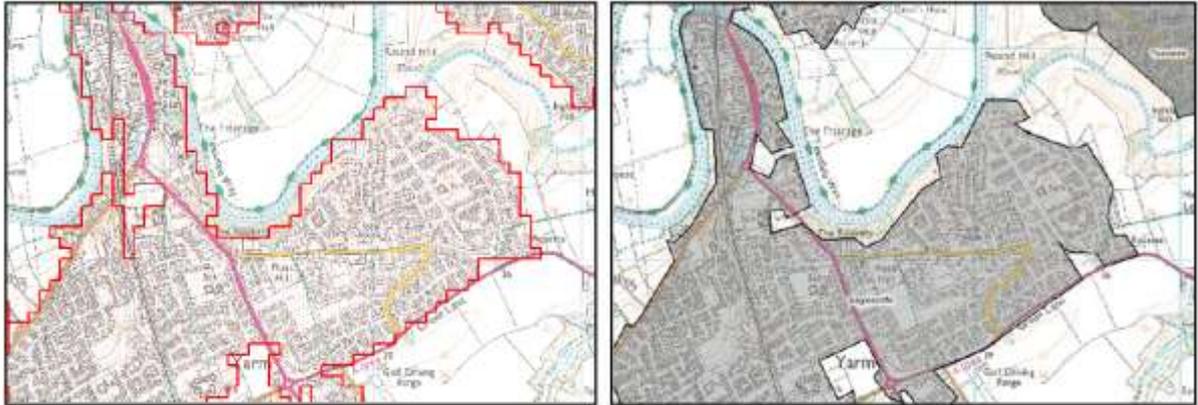
*(ii) Creating the polygons*

The data from the grid cells were selected and transformed into a set of urban area polygons. Three of the four classes (Buildings and Glasshouses, Areas of tarmac, concrete, etc. and Primarily gardens) were given Priority A status, while the fourth (The metalled surface of roads) was labelled Priority B.

All grid cells meeting the agreed minimum NLUD percentages were identified. Those cells whose only criteria for selection were their Priority B attribution were further analysed. If they were not adjacent to cells selected for their Priority A attribution, they were discarded. This prevented the automated process from selecting unwanted areas, for example tracts of motorway. Cells adjacent to each other which meet the above selection criteria were merged together to form initial urban polygons, and attributed as 'built-up areas'.

Two further steps were then taken to make the built-up areas consistent with previous versions of the dataset. Open spaces within the areas (for example, parks that are wholly surrounded by housing) were identified and merged back into the initial built-up area polygons. Secondly, built-up areas smaller than the desired minimum size (200,000 m<sup>2</sup>) were discarded. At the end of stage 2 an unnamed set of built-up area polygons had been created.

The resulting data was very consistent with the 2001 dataset:



**Figure 2a:** 2011 grid-based built-up area boundaries, **Figure 2b:** 2001 manually digitised urban area boundaries  
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(iii) *Naming the built-up areas*

The naming of urban areas in previous versions of the dataset had evolved over time. However, by 2001 there was some inconsistency in the names. For the 2011 version the names, like the areas themselves, were created via an automated process. This would improve the consistency of naming both in the 2011 product and future versions.

The un-named polygons were analysed against a cartographic data source for named extents of settlements, which is used to apply names to settlements in Ordnance Survey's national mapping products. There are three classes of settlement: *City*, *Town*, and *Other* (which includes villages, rural localities and urban development).

A series of rules were applied so that each of the un-named polygons was assigned a single name. Where a single polygon picks up two or more names from the *Other* category, then it takes the name of the part with the largest area. In some cases, a larger, single built-up area polygon may pick up more than one name from the *City* and *Town* categories. Here, these names are retained so that the area can be sub-divided, but the main urban area will take the name of the highest classification of settlement or, in cases where the area has the same classification of settlement, the name of the part with the largest area.

As a post-production process, some manual adjustments were made to a small number of the automatically generated names. This was necessary for re-naming the major conurbations (for example, Greater London), and in these cases the revised names were based on those used in 2001 wherever possible. Renaming also occurred to allow more detail in the names of built-up areas where the population was evenly spread between two (or more) of its sub-divisions (for example, Amersham/Chesham). In these cases, it was felt that this would provide a more recognisable name to users than simply the name of the area with the largest area. The automated naming process was unable to assign names to some areas, and therefore manual naming was required in these instances.

Duplicate place names were made unique with the addition of the local authority name in brackets after the name (for example, Easton (South Norfolk) and Easton (Suffolk Coastal)). Where duplicate names involved a large city and a small settlement, the local authority name was only added to the smaller, less well-known place (for example, Cambridge and Cambridge (Stroud)).

Finally, to avoid confusion with other geographical entities with the same name, the suffix 'BUA' or 'BUASD' was added to the name of all built-up areas or sub-divisions for which Census data were released.

(iv) *Linking and sub-dividing urban areas*

To retain consistency with previous versions, settlements which were within 200m of each other were linked and sub-divisions identified.

Where separate built-up area polygons with individual names were linked through the 200m rule, the combined area was defined as the built-up area, but with the separate parts identified as sub-divisions. Where the separate polygons were given the same name through the automated naming process, they were kept together as a multi-part polygon. Sub-divisions were also identified in the larger built-up areas based on information from the naming process described above.

The naming process led to two anomalies in large settlements, Milton Keynes and Redditch. In both cases the OS database assigned the same place name to two large polygons that were separated by more than 200m (but less than 300m). An exception was made here so that both parts were assigned data to the same place.

## **2.2 Allocating 2011 Census data to the built-up areas**

2011 Census data for built-up areas and their sub-divisions are produced by aggregating the statistics of one or more whole Output Areas (OA) to form the total estimate. OAs are the lowest level of statistical unit in England and Wales, with an average population of approximately 300 people.

OAs are allocated to higher level geographies on a best-fit basis using a population weighted centroid (PWC) method. Each OA has a PWC, a summary single point on the ground that represents how the population at Census time was spatially distributed and grouped within that OA. An OA is best-fitted to a built-up area if its PWC falls within the boundary of a built-up area.

Best-fitting OAs to built-up areas complies with the GSS Geography Policy<sup>3</sup> by using whole statistical building blocks to build aggregated statistics for a higher geography. This approach to building estimates for any geography prevents the risk of disclosure of details about very small populations exposed in slivers caused by overlapping different geographical areas.

The PWC methodology successfully allocated OAs to the built-up areas in the majority of cases. However, in some instances where an OA that might reasonably have been expected to be allocated to a built-up area, it was found that the PWC of the OA fell outside of the built-up area. This happened, for example, where built-up areas were an unusual shape (Figure 3a) or where a small number of houses elsewhere in an OA had the effect of pulling the PWC outside of the recognised BUA (Figure 3b).

This problem was countered by applying a 100m buffer to the built-up areas and re-running the OA best-fit allocation. As a final stage, a manual review was performed on the allocations to resolve any further anomalies.

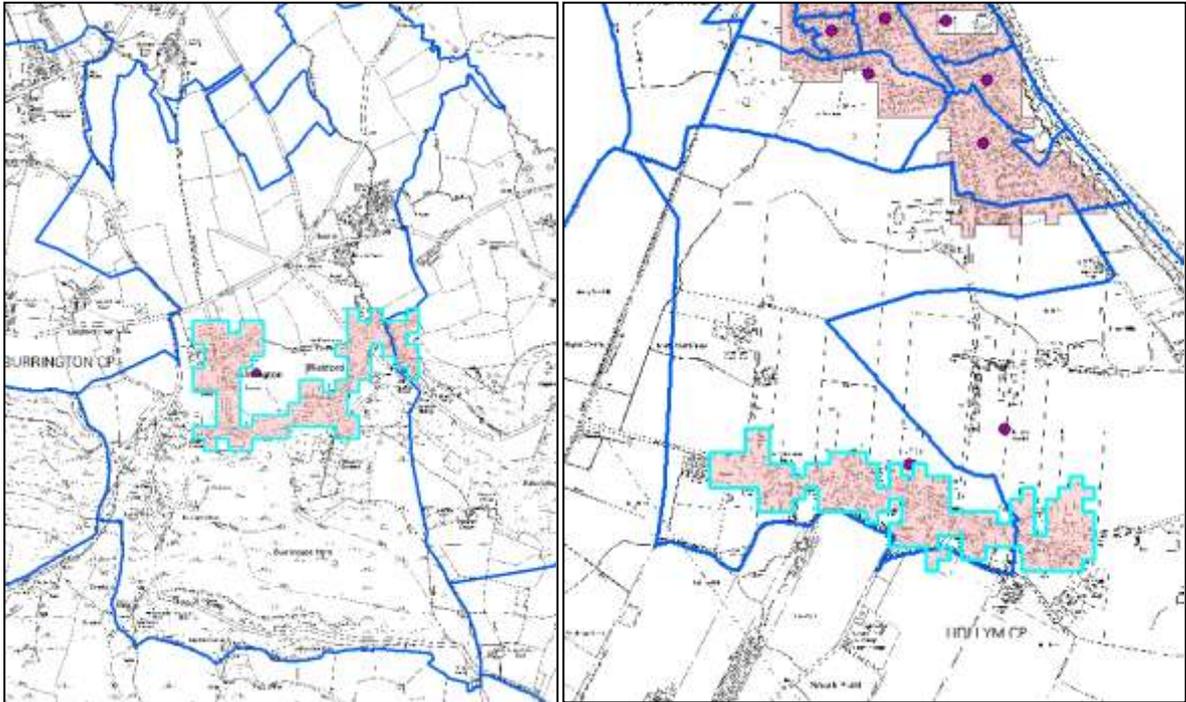
This methodology was also applied to allocate Workplace Zones (WZ), Lower Layer Super Output Areas (LSOA) and Middle Layer Super Output Areas (MSOA) to Built-Up Areas and Built-Up Area Sub Divisions. A manual review was undertaken on the WZ allocations to identify where a population weighted centroid should reasonably have been associated with a built-up area. This manual review process was not undertaken for the LSOA and MSOA allocations, instead only a 100m buffer was applied to each built-up area or sub-division to capture population weighted centroids.

WZs were created following the 2011 Census; they were designed to contain consistent numbers of workers, based on where people work. Workplace zones are based on maintained 2011 OA which are then merged or split using thresholds of number of workers or workplace postcodes. Where an OA contained less than 100 workers or three workplace postcodes, it was merged with an adjacent OA

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<sup>3</sup> <http://www.ons.gov.uk/ons/guide-method/geography/geographic-policy/index.html>

until the minimum worker/workplace threshold is reached, to form a WZ. Where an OA contained more than 625 workers, it was split it down using building blocks composed of workplace postcodes, to form two or more WZ. WZs are constrained to MSOAs to provide consistency between the OA and WZ geographies, and to allow comparison of the 2001 and 2011 Census workplace outputs at the MSOA level.



**Figures 3a and 3b:** Examples where the OA population weighted centroid fell outside of a built-up area (2011 Output Area (blue line), 2011 built-up area (pink area), OA population weighted centroid (pink dot))

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Not all built-up areas and sub-divisions were allocated a population. In most cases, these areas are functional sites, such as industrial estates, where there is no residential property. This is explained in more detail in section 3.3.

### 3. User guidance

#### 3.1 Presentation of Census data

The built-up area represents the wider area around a place, for example a city and any linked towns and villages. Sub-divisions provide greater detail in the data, by identifying the neighbouring settlements and localities within the larger conurbations.

Data are provided for two area types: *built-up areas* (covering the built-up areas only); and *built-up areas including sub-divisions* (covering all built-up areas, but broken down by subdivision for those areas with sub-divisions). The sum of all the sub-divisions presented for a built-up area will always equal the total for that built-up area.

Users viewing/selecting areas in the *built-up areas* area type will see an information icon *[i]* against those areas where more detail is available in the *built-up areas including subdivisions* data. In these instances, users wanting a population figure for the town itself, rather than the wider area, should look at the tables in *built-up areas including sub-divisions* area type. For example, the *built-up area* area type will show:

E34004855 Coventry BUA *[i]*

In the *built-up area including sub-divisions* data it will appear as:

E35000258 Coventry - Bedworth BUASD  
 E35000903 Coventry - Binley Woods BUASD  
 E35001376 Coventry - Coventry BUASD

### 3.2 Number of areas in the Census data

Built-up areas:

	Number	<i>Of which additional data is provided for sub-divisions*</i>
Total	5,493	501
England	5,055	451
Cross-border	11	4
Wales	427	46

\*There are an additional 64 built-up areas that contain sub-divisions but where only one has been allocated a population (in most cases, the other sub-division is a functional site, for example an industrial estate, where there is no residential population). In these instances, the data for the built-up area sub-division is identical to the data for the built-up area.

Built-up area sub-divisions:

	Number
Total	1693
England	1539
Cross-border	4
Wales	150

### 3.3 Areas with no population allocated

Census data are not provided for all the built-up areas and sub-divisions that were identified (and appear in the digital boundary dataset). In most cases, this is because the areas in question do not have people living in them – for example, industrial estates, airports and theme parks. In a small number of cases, areas do contain housing but they are not included in the data as the OA had already been allocated to another built-up area.

Total number of unallocated Built-Up Areas and Sub-Divisions by geographic level:

Geographic level	Built-up area			Built-up area sub-division		
	<b>Total</b>	England	Wales	<b>Total</b>	England	Wales
OA	<b>337</b>	305	32	<b>133</b>	123	10
LSOA	<b>2630</b>	2457	173	<b>515</b>	481	34
MSOA	<b>4599</b>	4241	358	<b>944</b>	859	85
WZ	<b>2245</b>	2059	186	<b>435</b>	401	34

### **3.4 Areas with a population of less than 1,500 people**

As explained in the methodology section, Census data for built-up areas and sub-divisions are provided on an OA best-fit basis. This means that figures are aggregated up from whole OAs that have been best-fitted to the areas, rather than the actual figure for the area itself. OA best-fit estimates for areas with a population of greater than 1,500 people are likely to be more robust than the estimates for smaller areas. Therefore, caution is needed when using statistics for built-up areas and sub-divisions with a population of less than 1,500 people.

### **3.5 Comparisons with local authorities**

Many built-up areas share the same name as local authority areas. However, the areas are not the same. The boundaries of the built-up areas represent the built environment and do not respect administrative boundaries. Therefore, data provided for the areas will differ. Users wanting local authority level data should use previously published Census data for local authorities. A lookup file has been created to help users understand which local authority a given built-up area is situated in (or all the built-up areas located in a given local authority). It is available for download from the ONS [Open Geography portal](#).

### **3.6 Areas measurements / density figures**

Area measurements (and therefore density figures) are based on the extent of the actual built-up areas and sub-divisions rather than the extent of the OA best-fit on which the data are based. This provides a more sensible area measurement than the OA best-fit area figure which, in the vast majority of cases, is higher. The differences can be significant in smaller settlements in rural areas (with large OAs).

All area measurements appear as multiples of 0.25 hectares (2,500m<sup>2</sup>) because the boundaries of the areas are based on 50m grid squares.

Section 2.1 described how built-up areas include areas of open spaces that are completely surrounded by land identified as built-up. This rule occasionally creates a 'bridging' effect where settlements link to enclose a large area of non-built-up land. Where this has occurred between 2001 and 2011, for example the area to the south of Pudsey, between Leeds and Bradford, in West Yorkshire BUA, it explains significant increases in area measurement figures and decreases in population density.

### **3.7 Digital boundaries**

Digital boundaries for built-up areas and built-up area sub-divisions can be downloaded free of charge under the terms of the OS OpenData Licence from the [Open Geography portal](#).

Details of the OS OpenData Licence terms of use are available [here](#).

As explained in the methodology section, the automated process used to identify the areas is based on a 50m grid. As a result, the boundaries of the areas do not reflect real world features and are therefore not appropriate for detailed planning use.

## **4. Comparability over time**

An important benefit of the change from a manual to automated process for capturing the areas is that it will be possible to create areas entirely consistently in future versions of the dataset. This will allow for comparison over time in a way that has never been possible since the first version of the dataset was created in 1981.

The rules used in the automated process are based on those used previously, and therefore the 2011 built-up areas are broadly comparable with the 2001 urban areas. However, comparisons between

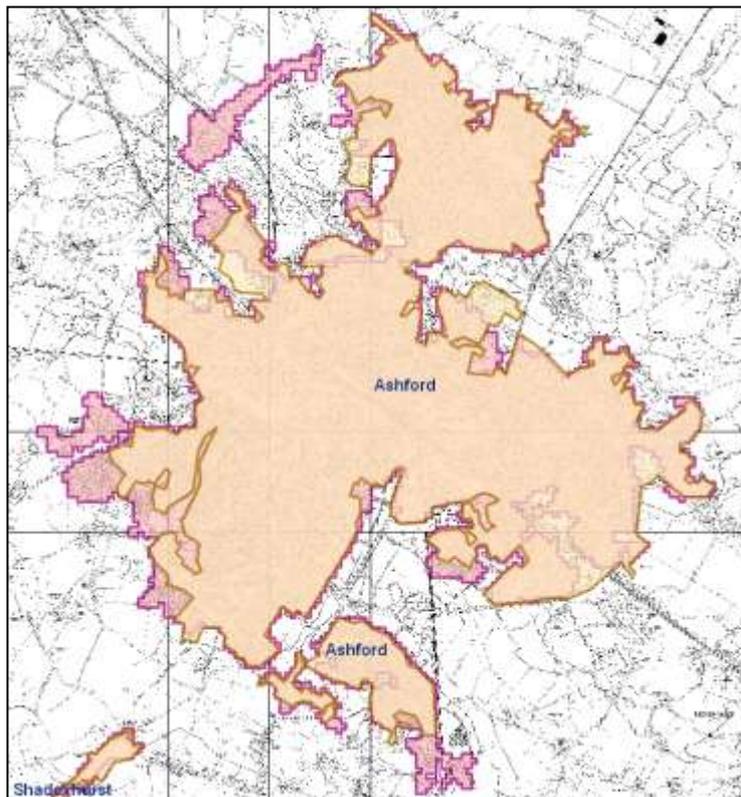
2011 and 2001 should be made with caution as the automated creation and naming processes have led to some differences. As a general rule, settlements that are free-standing tend to offer better direct comparison. In areas with more complex structures (for example, larger conurbations where many settlements have been linked together), this becomes more difficult.

Where numerous areas that were identified as separate urban areas in 2001 have merged together in the 2011 dataset (for reasons discussed below), it can significantly increase the population size of an area. Examples include Cardiff BUA, which now includes Caerphilly and Pontypridd, and South Hampshire BUA, which comprises three distinct areas from 2001, Southampton, Portsmouth and Locks Heath/Bursledon/Whiteley. In most cases areas that have linked together can be identified in the 2011 data as built-up area sub-divisions.

The data for built-up areas can change for a variety of reasons, the main ones being actual change, the change in process used to capture the areas, and the change in method for allocating names.

(i) *Actual change*

There has been significant urban development over the past decade and where this is residential it can lead to a significant increase in population. Figure 4 shows Ashford BUA in Kent, where the extent of the residential development is clear when comparing the extent of the 2011 built-up area (pink) with the 2001 urban area (beige).

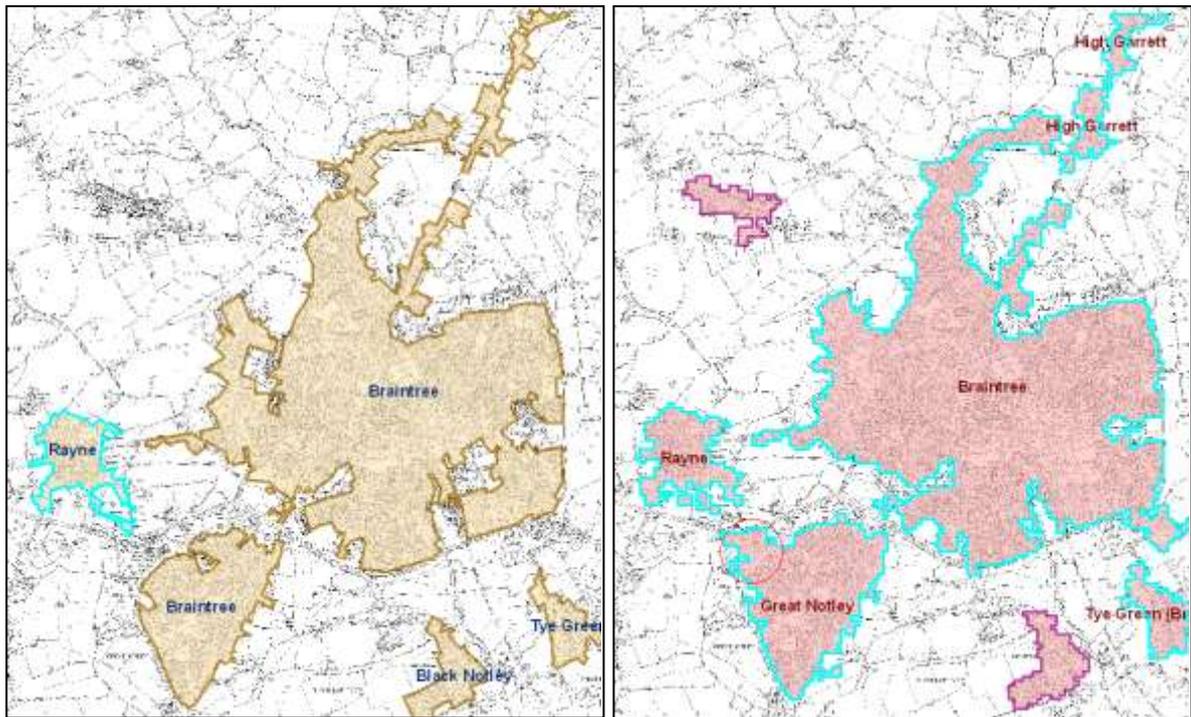


**Figure 4:** Example of residential development since 2001 (2001 urban area (beige), 2011 built-up area (pink))

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Sometimes, actual development can link areas that were previously separated. Figures 5a and b show how the village of Rayne in Essex is now linked to the town of Braintree. The development of a business park (red circle – Figure 5b) between Rayne and Great Notley means that the areas are now

within 200m of each other. The village of Rayne can still be identified in the 2011 data as a sub-division of Braintree BUA.



**Figure 5a:** 2001 – Braintree and Rayne urban areas, **Figure 5b:** 2011 – Braintree BUA (highlighted in light blue) and its BUASDs (labelled), including Rayne

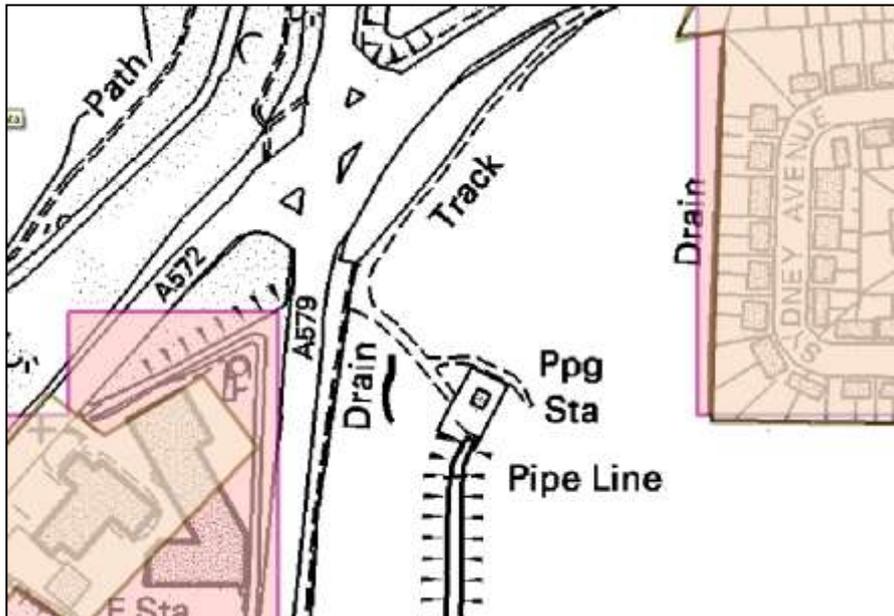
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While the example provided shows a significant development, the same effect can occur with only a small amount of development (for example, the building of a single house).

*(ii) Process for capturing the areas*

The automated process for capturing the built-up areas and sub-divisions was based on 50m grid squares. As such, the boundaries of the areas always follow the grid and do not reflect real world features. Sometimes, at a very local level, this can have the effect of increasing the extent of an area captured in 2001 by a few metres even where there has been no development since. In some cases this can be enough to link areas (because they are within 200m) that were separate in 2001 as the gap was marginally greater than 200m.

Figure 6 gives an example from Greater Manchester BUA. The area to the west, Golborne, was separated from Greater Manchester urban area (to the east) in 2001 as the gap between the two areas was approximately 215m. In 2011, because of the 'grid effect', the gap is 200m and so the areas are linked. Therefore, in the 2011 dataset Golborne is part of Greater Manchester BUA, but can still be identified in the data as a sub-division.



**Figure 6:** Example of the 'grid effect' (2001 urban areas (beige), 2011 built-up areas (pink))

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In a small number of cases the automated methodology has separated areas that were linked in 2001. This is due to differences in how the areas were captured or because of increased accuracy in the 2011 data. The separated areas can be identified in the 2011 data as built-up areas in their own right or, occasionally, as sub-divisions of another built-up area.

For example, Great Yarmouth BUA no longer includes Caister-on-Sea, but the latter area is now identified as a separate built-up area. Another example is Tyneside BUA which no longer includes a number of settlements, including Washington and Chester-le-Street, which were assigned to the Tyneside urban area in 2001. In this case, the separated areas are included as sub-divisions of Sunderland BUA in the 2011 data. In the second example, the changes have made significant differences to the population of both Tyneside BUA and Sunderland BUA when compared to the 2001 urban areas of the same name.

*(iii) Process for capturing names*

As described in section 2, names in the 2011 dataset were generated using an automated process. The built-up area names are generally very consistent with those used in 2001. The automated process has, however, led to some changes in the way the sub-divisions are named, especially in the large conurbations and cities. Sometimes different names to those used in 2001 have been assigned, in other cases the same name has been used but for a slightly different area than in 2001. Therefore, caution is needed when comparing statistics for built-up areas sub-divisions over time. It will be possible to apply the automated naming rules consistently in future versions, which will improve the ability to compare over time.

