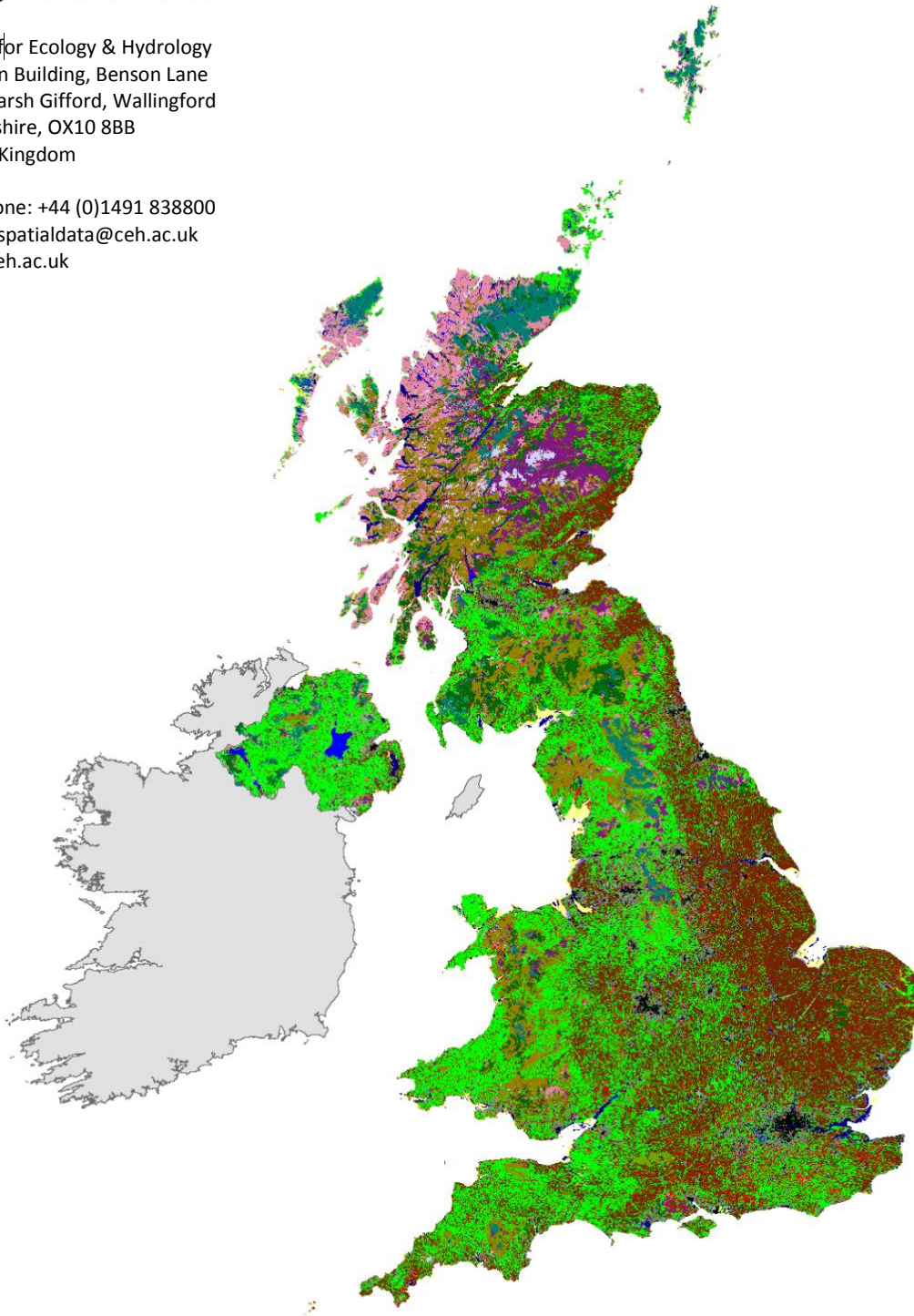




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# Land Cover Map 2015

## Dataset documentation

Version 1.2, 22<sup>nd</sup> May 2017

<b>Version</b>	<b>Date</b>	<b>Updates</b>
1.0	6 <sup>th</sup> April 2017	Original release
1.1	4 <sup>th</sup> May 2017	Data set publication year corrected in Tables 4 and 5
1.2	22 <sup>nd</sup> May 2017	Updated vector attribute “composite” in Table 2

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*Please note: LCM2015 is a complex data set.*

To help get the most from this data and to guard against inappropriate use it is important that you familiarise yourself with the information in this document.

**Land cover change** – users are advised not to use the LCM series for change mapping in their current state.

Differences between land cover maps are a combination of real change and classification error, which is compounded by the thematic and spatial differences between the LCM products over time.

## Introduction

Land Cover Map 2015 (LCM2015) is provided as a range of data products to support the diverse requirements of the LCM user community. This report provides a brief introduction to key aspects of the LCM2015 data sets for users and potential users.

This document only covers LCM2015 data products, for details about previous Land Cover Maps please consult the appropriate dataset documents.

## Background

Land Cover Map 2015 (LCM2015) is a parcel-based land cover map for the UK, created by classifying satellite data into 21 land cover classes. The classes are based on the UK Biodiversity Action Plan Broad Habitat definitions (Jackson, 2000). LCM2015 was created by classifying two-date composite images and is based mainly on data from Landsat-8 (30m resolution) supplemented with AWIFS data (60m resolution) as required. LCM2015 updates the 2007 Land Cover Map and uses an updated version of the LCM2007 spatial framework. LCM2015, like LCM2007 before it, is therefore constructed from polygons that reflect real-world boundaries. This increases both its ease of interpretation for users and also its compatibility with other geospatial data sets.

The LCM2015 spatial framework was derived from generalised digital cartography (Ordnance Survey MasterMap topographic layer (OSMM) for GB and Land & Property Services Large-scale Vector for Northern Ireland), refined with rural payment boundary data (see Morton *et al.*, 2011 for details).

## Differences from LCM2007

**Users should be aware that some changes in data format have taken place between LCM2007 and LCM2015. Consequently, users should check all aspects of the data product they intend to use, prior to applying scripts written for LCM2007 data.**

To date each Land Cover Map has adopted a slightly different method, reflecting the range of influences and the key requirements at the time of production. These influences include evolving user needs, methodological developments, increased availability and accessibility of other spatial data sets and increases in computing power. LCM2015 continues this trend, by reflecting a need to increase the speed of production and decrease the amount of manual input in the production process. This is driven by both a need to release the data in a more timely manner and to create a repeatable method that can be used for mapping change. Consequently a number of modifications to the method have been made and these are described below under two headings, first, the changes that affect the output data and secondly, methodological differences that do not affect the output data.

### Differences in output data

1. **'Montane' class removed** – The montane class was removed, because in LCM2007 it was mapped purely as a function of a variable altitude threshold (Morton *et al.*, 2011), rather than from the spectral data. LCM2015 would have adopted the same approach and the same set of altitude thresholds, consequently, the 'Montane' distribution would be constant over time. Therefore to enable the move to both a method and a set of classes that are appropriate for change mapping this class was removed. Areas mapped as 'Montane' in LCM2007 are therefore mapped based on the spectral data in LCM2015 and are mapped as 'Inland Rock' or one of the other upland habitats. This improves the suitability of the LCM-

series for mapping change in the future. Anyone requiring the distribution of 'Montane' for the UK should use the LCM2007 distribution. ***This change affects all products.***

2. **Rough grassland class removed** – The rough grassland class was first added in LCM2007. For LCM2007 grassland was mapped by classifying images into 'Improved Grassland' and **Rough grassland**, after which knowledge-based enhancement (KBE) rules were applied. The KBEs, taking account the ancillary data, such as soil type, aspect and elevation suggested whether **Rough grassland** should be assigned to 'Neutral Grassland', 'Calcareous Grassland' or 'Acid Grassland', or whether it should remain as **Rough grassland** (Morton *et al.*, 2011). This caused problems for a number of reasons, including:
  - a. Lack of consistent soil data across the UK (and across GB)
  - b. Link between soil type, as recorded in spatial data sets, and grassland type is often complicated
  - c. Analysis of **Rough grassland** mapped by LCM2007 against Countryside Survey data showed that it was predominantly a mix of 'Improved grassland' and 'Neutral grassland'.
  - d. The LCM2015 method requires stable training areas, defined as areas that have remained constant across LCM2000 and LCM2007, because Rough grassland was not used in LCM2000.

For all of these reasons, the Rough grassland class was removed, so in LCM2015 grassland types again match the JNCC Broad Habitat types. No soil data was used in the LCM2015 classification. ***This change affects all the target class products (vector, 25m and 1km).***

3. **25m raster** – the 25m raster is a two band image, rather than a single band image, as in previous LCMs. The first layer contains the classification layer and the second band contains the mean per-polygon probability value produced by the classification algorithm. ***This change affects the 25m raster data only.***
4. **Differences in the way probability data is recorded** – probability information for LCM2007 was given in the ProbList attribute, with the top 5 spectral sub-classes and their respective probabilities listed. Probability information for LCM2015 is simplified and streamlined, with the mean probability of the majority class recorded in the vector data and this value (the mean per polygon probability) given in band 2 of the 25m raster. Probability information is not given for the 1km products, as it is not appropriate at that scale. ***This change affects the vector and 25m raster only.***
5. **No spectral sub-classes** – LCM2007 used a maximum likelihood classification algorithm, which required training samples for each class to be grouped into spectrally similar sub-classes. This, in conjunction with the extensive field data, led to the development of spectral sub-classes. LCM2015 uses a Random Forest classifier that handles multi-modal classes, so the grouping of spectrally similar sub-classes is not required. This simplifies the process of preparing training data for classification and means that spectral sub-classes are redundant. LCM was never validated at the spectral sub-class level and users were always urged to use caution if using the sub-class data, so this is unlikely to impact many users. ***This change affects the vector data only.***

6. **Spatial framework** - For LCM2007 the spatial framework derived from the generalised digital cartography was further refined with image segments, however for LCM2015 polygons created by these segments have been removed. The segmentation used in LCM2007 was used to 'break-up' large polygons, for example those found in upland areas, into smaller polygons. There were problems with the segmentation in many cases, as it can vary significantly with image and with segmentation parameters. For LCM2007, often the image segmented and incorporated into the spatial framework for an area was not the image that produced the best classification for the area. Consequently, the segmentation polygons did not always match the final classifications well and they did not always capture real-world objects well. Applying different segmentation for different LCMs will also complicate change mapping, so for these reasons no segmentation has been incorporated in the LCM2015 spatial framework. Identifying the perfect spatial framework for LCM and related products like CEH LCM Plus: Crops will require balancing competing requirements, as the underlying LCM2015 product is the per-pixel classification it will be possible to summarise it against different frameworks in the future if required. The removal of segmentation in LCM2015 will mainly affect upland areas and will not affect Northern Ireland, as no segmentation was added to the Northern Ireland LCM2007 data set. In addition some errors in the spatial framework have been fixed. *These changes will affect users of the GB vector data and the GB 25m raster.*
  
7. **Mixed woodland** – according to the JNCC Broad Habitat definitions a woodland with > 20% Deciduous woodland is classified as mixed woodland and as such recorded under the 'Broadleaf, Mixed and Yew Woodland' class (see also Appendices 1 & 2). For LCM2007 object-based classification methods were applied and mixed woodland stands were selected and used for training. In LCM2015 pure stands of Coniferous or Broadleaf woodland were chosen for training, with individual pixels being classified. The pixels are then summarised at the polygon level, with the modal\_class (Table 2) being assigned as the polygon label. This means that some mixed woodland with > 20% Broadleaf cover is likely to be assigned to the 'Coniferous Woodland' class, rather than the Broadleaved woodland class, users interested in investigating this can explore the pix\_dist attribute in the vector product. *This change will affect all products.*

## Differences in methodology

1. **New classification algorithm** – LCM2015 uses a Random Forest classifier, whilst LCM2007 used a Maximum Likelihood Classifier. The key advantage of changing to Random Forest is that it handles multi-model training data, so training samples do not need grouping into spectral sub-classes. In addition, Random Forest has been found to match or out-perform Maximum Likelihood.
  
2. **Stable training areas** – for previous LCMs all the training areas used to train the classification algorithm have been manually defined. This time, building upon the LCM legacy, an initial set of training areas, defined as areas that were classified the same in both 2000 and 2007, was used for classification. This initial set was then manually supplemented with additional training areas for coastal areas (inter-tidal areas were removed from the stable data set, due to issues with tidal state in the images; sea water was also removed) and classes that LCM

has traditionally mapped poorly, such as *'Fen, Marsh and Swamp'* and the semi-natural grassland types.

- 3. Ancillary data and Knowledge-based enhancements** – for LCM2007 ancillary data, such as altitude and soil type data, were applied post-classification to minimise classification errors. For example, to remove coastal classes from mountainsides that should have been classified as *'Inland Rock'* using an altitude-based rule. This process was difficult and time-consuming as it required the identification of a systematic error and then the definition of a rule that would correct the error; when classifications cover large areas this is difficult to judge and it becomes a very subjective process. For LCM2015 the ancillary data sets are part of the input data along with the satellite data, so the classification algorithm uses the ancillary data as required making the knowledge-based enhancements objective and an integral part of the process.

## LCM2015 product specification

### LCM2015 maps land cover (not land use)

LCM2015 maps **land cover** and whilst this may be synonymous with **land use** it will not be in all cases. For example, an arable crop cover denotes arable land use, but often land use cannot be inferred, as, for example, grass used for recreation looks very similar to that which is grazed.

### LCM2015 is a stable, archived data set and as such each data set has a Digital Object Identifier (DOI)

The DOI's should be cited when referring to the data set in publications (see Citing LCM2015 (DOI's)).

### LCM2015 sets a minimum mappable area of >0.5 ha

Parcels less than 0.5ha and linear features less than 20m were dissolved into the surrounding landscape during the production process.

### LCM2015 classes

LCM2015 maps 21 classes (Table 1), which are based on the UKs terrestrial Broad Habitats (Jackson *et al.*, 2000). In some cases, the Broad Habitats can be reliably divided further, based on their spectral signatures, so:

- The *'Built-up Areas and Gardens'* Broad habitat is divided into 'Suburban' and 'Urban' classes.
- The *'Dwarf Shrub Heath'* is divided into 'Heather' and 'Heather grassland' classes.
- The *'Littoral Sediment'* Broad Habitat is divided into 'Littoral sediment' and 'Saltmarsh' (a Priority Habitat).

### LCM2015 has unique object labelling

During the production process each parcel is given a unique label which is stored in the Geometry Id (gid) attribute. All users of the LCM2015 vector products will receive data containing this attribute. It is recommended that the gid attribute is retained within the LCM2015 data set and any developments of it. This will allow unambiguous communication between LCM2015 users.

### LCM2015 has rich metadata

During the production of LCM2015, like LCM2007 and LCM2000 before it, information about processing has been retained where possible. The LCM2015 vector data set therefore has a rich set of metadata for each polygon. The polygon attributes provide details about the dominant class for the polygon, but also a breakdown of the number of pixels classified as each land cover class in the polygon and the mean probability for the polygon from the classification algorithm.

### LCM2015 has uncertainty information

The Random Forest classifier produces an estimate of per-pixel probability. This is included as a mean per-polygon value in the vector and in the 25m raster.

### LCM2015 has a range of data products

The Land Cover Maps cater to a wide range of users requiring the data in a range of formats. LCM2015 has the 'core' vector data set, a 25m classification product, as well as percentage and dominant cover products at 1km. The 1km products are available in either the 21 target classes or grouped into 10 aggregate classes.

## LCM2015 product overview

LCM2015 is distributed in a range of data formats and at a range of thematic and spatial resolutions to supports the diverse range of LCM applications. The 'core' product is the LCM2015 vector from which the 25m raster is derived. The 25m raster is then used to produce the 1km percentage cover products for both the 21 target classes and the 10 aggregate classes (Table 1), which in turn are used to create the dominant cover products. Notes on each of the LCM classes are included in Appendix 1.

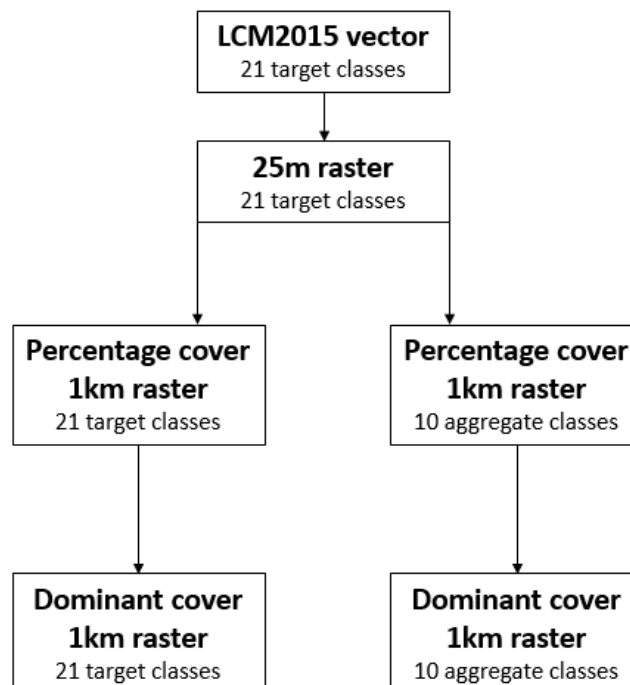


Figure 1. LCM2015 data products.



**Table 1. Relationship between Aggregate classes, Broad Habitat and LCM2015 classes.** Green shading highlights Broad Habitats as documented by JNCC ([Jackson, 2000](#)) and summarised in Appendix 2. <sup>1,2</sup> Aggregate class number and LCM2015 class number used for raster data sets.

Aggregate class	Aggregate class number <sup>1</sup>	Broad Habitat	LCM2015 target class	LCM2015 target class number <sup>2</sup>
Broadleaf woodland	1	<i>'Broadleaved, Mixed and Yew Woodland'</i>	<b>Broadleaved woodland</b>	1
Coniferous woodland	2	<i>'Coniferous Woodland'</i>	<i>'Coniferous Woodland'</i>	2
Arable	3	<i>'Arable and Horticulture'</i>	<i>'Arable and Horticulture'</i>	3
Improved grassland	4	<i>'Improved Grassland'</i>	<i>'Improved Grassland'</i>	4
Semi-natural grassland	5	<i>'Neutral Grassland'</i>	<i>'Neutral Grassland'</i>	5
		<i>'Calcareous Grassland'</i>	<i>'Calcareous Grassland'</i>	6
		<i>'Acid Grassland'</i>	<b>Acid grassland</b>	7
		<i>'Fen, Marsh and Swamp'</i>	<i>'Fen, Marsh and Swamp'</i>	8
Mountain, heath, bog	6	<i>'Dwarf Shrub Heath'</i>	<b>Heather</b>	9
			<b>Heather grassland</b>	10
		<i>'Bog'</i>	<i>'Bog'</i>	11
		<i>'Inland Rock'</i>	<i>'Inland Rock'</i>	12
Saltwater	7	<b>Saltwater</b>	<b>Saltwater</b>	13
Freshwater	8	<b>Freshwater</b>	<b>Freshwater</b>	14
Coastal	9	<i>'Supra-littoral Rock'</i>	<i>'Supra-littoral Rock'</i>	15
		<i>'Supra-littoral Sediment'</i>	<i>'Supra-littoral Sediment'</i>	16
		<i>'Littoral Rock'</i>	<i>'Littoral Rock'</i>	17
		<i>'Littoral Sediment'</i>	<b>Littoral sediment</b>	18
			<b>Saltmarsh</b>	19
Built-up areas and gardens	10	<i>'Built-up Areas and Gardens'</i>	<b>Urban</b>	20
			<b>Suburban</b>	21

## Example datasets

Figure 2 provides illustrations of the data sets available for Land Cover Map 2015 and the level of detail associated with each product. Spatially the vector data set and the 25m raster data set are quite similar, however, the advantage of the vector data set is that each polygon has a set of metadata attached. The disadvantage of the vector is that this increases the file size and may make processing unwieldy for many applications/users. The 25m raster data set maybe useful in such circumstances, as it provides the same land cover detail, but without all of the metadata information and the polygon boundaries; this is more appropriate for many applications. The 1km data sets are typically used for modelling the whole of the UK in conjunction with other data, such as meteorological data or species distribution data. They are created by calculating the percentage of the 1km square covered by each class (e.g. urban) based on the distribution of the class (e.g. urban) in the 25m raster data set. Figure 3 shows the 1km aggregate percentage cover for *'Built-up areas and gardens'* across the UK.

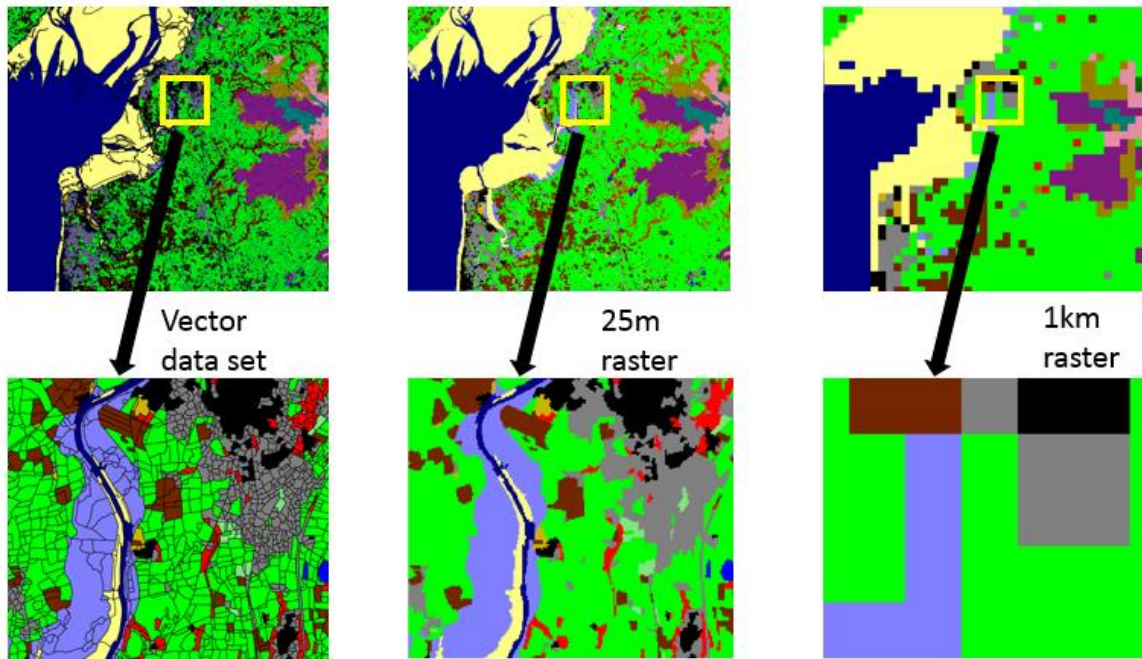


Figure 2. Comparison of the level of spatial detail in the vector data set, 25m raster data set and 1km dominant cover raster data set for an area  $\sim 35\text{km} \times 3\text{km}$  (top images) and  $\sim 6\text{km} \times 6\text{km}$  (lower images). © NERC (CEH) 2017. © Crown Copyright 2007. Ordnance Survey Licence number 100017572.

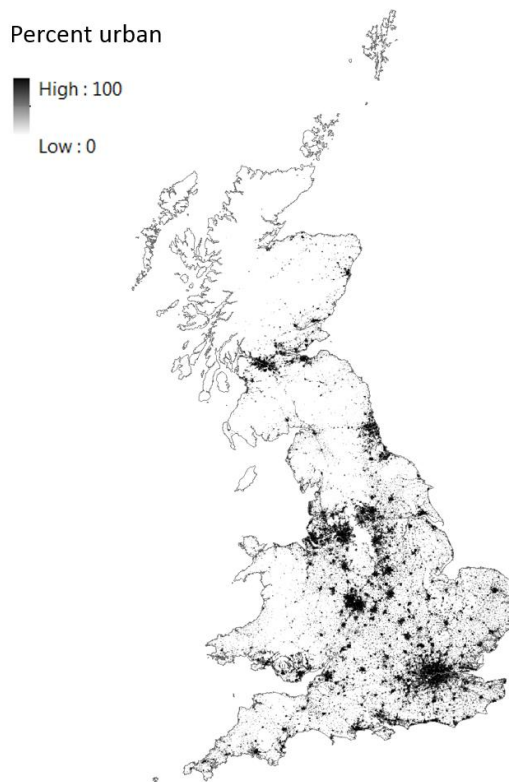


Figure 3. Map showing the 1km percentage cover aggregate product for LCM2015 Built-up areas and gardens. © NERC (CEH) 2017.

## Vector data set

The vector data product is provided as polygons with each one having a list of attributes attached to it. The nine attributes include land cover class (as text and integer), source image, uncertainty information, the number of pixels recorded for each class and the proportion of the polygon classified as the dominant class (Table 2). The vector data set contains 6.7 million polygons for Great Britain and 0.9 million for Northern Ireland.

**Table 2. Description of the attributes of the LCM2015 vector data set.**

Attribute	Description
gid	Unique parcel identifier (geometry identifier) for each parcel.
BHAB	Dominant land cover at Broad Habitat level e.g. <i>Improved grassland</i>
Pix_dist	List of 23 numbers giving the number of pixels of each class within the polygon (numbers 1-21), followed by the number of pixels in the polygon and the majority class (note – these final two are given as the npix and modal_class attributes in their own right).
unc	Uncertainty – mean per polygon probability from Random Forest, scaled between 0-255
Unc_stdev	Standard deviation of the uncertainty.
npix	Number of pixels in polygon
Modal_class	<b>RECOMMENDED FOR DISPLAY.</b> This attribute gives the LCM2015 class as an integer code from 1-21 (see Table 2). Note this is often referred to as the LCM2015 target class (see Appendix 3 for standard LCM colour mapping).
Modal_prop	Proportion of polygon classified as dominant class
Composite	The number of the composite image that the classification is derived from; 99 signifies infill from LCM2007 (see Appendix 4 for details of composite images).

## Raster data sets

The raster data were derived from the vector dataset to produce a 25m raster and a series of 1km products. Great Britain and Northern Ireland are provided in separate data sets to allow for their different projections. Not all applications need the thematic resolution of the complete set of LCM2015 classes, so LCM2015 has a defined set of Aggregate classes, based on merging LCM2015 classes (Table 1). The Aggregate classes are used for the 1km raster products.

### 25m raster

This is supplied as a 2-band raster, where band 1 is the LCM2015 classification (dominant) class per-polygon and band 2 is the mean per-polygon probability from the Random Forest classifier. The relationship between the band 1 pixel value and corresponding LCM2015 class is shown in Table 1, with detail on the extent of the data set and other metadata in Table 3.

## 1km raster

The 1km products for LCM2015 were created by summarising the LCM2015 25m raster data set to produce percentage cover for each class and to identify the dominant (most widespread) class in each 1km pixel (Table 3). The products at 1km are:

- Dominant cover at 1km for LCM2015 classes (1-band)
- Dominant cover at 1km for LCM2015 Aggregate classes (1-band)
- Percentage cover at 1km for LCM2015 classes (21 bands)
- Percentage cover at 1km for LCM2015 Aggregate classes (10 bands)

For the percentage cover products, integer values are reported, so the rounding of each value means that in some cases the sum of all the layers may be slightly above or below 100. Around the coast the values will be sum to less than 100 reflecting the proportion of mapped area in the 1km square. One 1km x 1km pixel covers the area of 1600 25m pixels, consequently, a land cover type has to cover more than sixteen 25m-pixels to exceed 1% of the 1km pixel area and hence have a percentage cover value in the 1km percentage cover data sets.

**Table 3. Metadata information for the LCM2015 25m and 1km raster data sets.**

	Great Britain		Northern Ireland	
Pixel size	25m	1km	25m	1km
Columns / Width (pixels)	28000	700	7600	190
Rows / Height (pixels)	52000	1300	6400	160
Lower left easting (m)	0	0	180000	180000
Lower left northing (m)	0	0	300000	300000
Pixel size (m)	25	1000	25	1000
Data type	Unsigned 8-bit			
Coordinate system	British National Grid		TM75 Irish Grid	
EPSG	27700 ( <a href="https://epsg.io/27700">https://epsg.io/27700</a> )		29903 ( <a href="https://epsg.io/29903">https://epsg.io/29903</a> )	

Note: Different software packages define coordinates from different parts of the pixel. The values in Table 3 refer to the south-west corner of the lower left pixel.

## Citing LCM2015 (DOI's)

All LCM2015 products have individual DOI's, so you can cite the data in the same way that you cite other sources of information, such as journal articles. Citing the DOI's enables methods to be clear and repeatability, as well as enabling better understanding of the levels of usage of different LCM2015 products, DOI's are also increasingly required by scientific journals. The DOI's are given for Great Britain (Table 4) and for Northern Ireland (Table 5).

When using the DOI in publications please include the author(s) and date within the text and the full DOI citation in the references section. For example, '(name of first author et al., date)' in the text and '(for example) Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (vector, GB). NERC Environmental Information Data Centre. <https://doi.org/10.5285/6c6c9203-7333-4d96-88ab-78925e7a4e73>' in the references.

For more information about data citation and DOIs, see <http://eidc.ceh.ac.uk/citing-data>

**Table 4. Digital Object Identifier (doi) for LCM2015 products for Great Britain.**

<b>Product</b>	<b>DOI</b>
<b>GB vector</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (vector, GB). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/6c6c9203-7333-4d96-88ab-78925e7a4e73">https://doi.org/10.5285/6c6c9203-7333-4d96-88ab-78925e7a4e73</a>
<b>GB 25m raster</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (25m raster, GB). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/bb15e200-9349-403c-bda9-b430093807c7">https://doi.org/10.5285/bb15e200-9349-403c-bda9-b430093807c7</a>
<b>GB 1km percentage cover target classes</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (1km percentage target class, GB). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/505d1e0c-ab60-4a60-b448-68c5bbae403e">https://doi.org/10.5285/505d1e0c-ab60-4a60-b448-68c5bbae403e</a>
<b>GB 1km dominant cover target classes</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land cover map 2015 (1km dominant target class, GB). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/c4035f3d-d93e-4d63-a8f3-b00096f597f5">https://doi.org/10.5285/c4035f3d-d93e-4d63-a8f3-b00096f597f5</a>
<b>GB 1km percentage cover aggregate classes</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (1km percentage aggregate class, GB). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/7115bc48-3ab0-475d-84ae-fd3126c20984">https://doi.org/10.5285/7115bc48-3ab0-475d-84ae-fd3126c20984</a>
<b>GB 1km percentage cover aggregate classes</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (1km dominant aggregate class, GB). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/711c8dc1-0f4e-42ad-a703-8b5d19c92247">https://doi.org/10.5285/711c8dc1-0f4e-42ad-a703-8b5d19c92247</a>

**Table 5. Digital Object Identifier (doi) for LCM2015 products for Northern Ireland.**

<b>Product</b>	<b>DOI</b>
<b>NI vector</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (vector, N. Ireland). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/60764028-adeb-4316-987a-14b3b21a8f9a">https://doi.org/10.5285/60764028-adeb-4316-987a-14b3b21a8f9a</a>
<b>NI 25m raster</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (25m raster, N. Ireland). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/47f053a0-e34f-4534-a843-76f0a0998a2f">https://doi.org/10.5285/47f053a0-e34f-4534-a843-76f0a0998a2f</a>
<b>NI 1km % cover target classes</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (1km percentage target class, N. Ireland). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/9e08e1c3-d2c6-41d0-8919-d9015b38ead2">https://doi.org/10.5285/9e08e1c3-d2c6-41d0-8919-d9015b38ead2</a>
<b>NI 1km dominant cover target classes</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (1km dominant target class, N. Ireland). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/4278d500-a165-452d-ae5f-b503323df9cb">https://doi.org/10.5285/4278d500-a165-452d-ae5f-b503323df9cb</a>
<b>NI 1km % cover aggregate classes</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (1km percentage aggregate class, N. Ireland). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/362feaea-0ccf-4a45-b11f-980c6b89a858">https://doi.org/10.5285/362feaea-0ccf-4a45-b11f-980c6b89a858</a>
<b>NI 1km dominant aggregate classes</b>	Rowland, C.S.; Morton, R.D.; Carrasco, L.; McShane, G.; O'Neil, A.W.; Wood, C.M. (2017) Land Cover Map 2015 (1km dominant aggregate class, N. Ireland). NERC Environmental Information Data Centre. <a href="https://doi.org/10.5285/c38b3986-b67e-40e9-9026-85ddbe3830d3">https://doi.org/10.5285/c38b3986-b67e-40e9-9026-85ddbe3830d3</a>

## Map projection

The LCM2015 vector and raster data sets for Great Britain and Northern Ireland data sets are in the British National Grid and Irish National Grid projections respectively (see Table 3 for details).

## Data access

The LCM2015 1km raster data sets are available via the CEH Environmental Information Platform <https://eip.ceh.ac.uk/>

The full vector product and 25m product are available under licence on request from CEH. Please complete the online application on the CEH web site [<http://www.ceh.ac.uk/services/information-products>] or contact [spatialdata@ceh.ac.uk](mailto:spatialdata@ceh.ac.uk) for further details. Please note that licence fees may apply for some users and some applications.

## Further Information

Further information about LCM2015 is available at:

<https://www.ceh.ac.uk/services/land-cover-map-2015>

<https://eip.ceh.ac.uk/lcm>

Queries should be addressed to: [spatialdata@ceh.ac.uk](mailto:spatialdata@ceh.ac.uk)

The LCM2015 data paper is currently in preparation and will contain additional information.

## References

Jackson D.L., (2000), *Guidance on the interpretation of the Biodiversity Broad Habitat Classification (terrestrial and freshwater types): Definitions and the relationship with other classifications*, JNCC Report 307, 73 pages, ISSN 0963 8091 (available online at: <http://www.jncc.gov.uk/page-2433> ).

Morton, D., Rowland, C., Wood, C. Meek, L., Marston, C., Smith, G., Wadsworth, R., Simpson, I.C. 2011. *Final Report for LCM2007 - the new UK land cover map*. Countryside Survey Technical Report No 11/07 NERC/Centre for Ecology & Hydrology 112pp. (CEH Project Number: C03259).

## Appendix 1. Comment on classes as mapped in LCM2015

(see also Appendix 2 for a summary of JNCC Broad Habitat definitions)

LCM2015 class	Brief Review
Broadleaved woodland	<p>Broadleaved woodlands are characterised by stands &gt;5 m high with tree cover &gt;20%; scrub (&lt;5 m) requires cover &gt;30% for inclusion in this BH. Such fine distinctions cannot be made through remote sensing. Open-canopy woodland (stands with trees &lt;50%) is a particular problem, albeit occurring relatively rarely, and may not often be mapped consistently, due to the dominance of the non-woodland plants. Stands with near-closed canopies can be interpreted easily in the field and pure examples can normally be found for training the classifier. Broadleaved evergreen trees (part of this BH) rarely occur in stands &gt;1ha (an area large enough to create suitable training areas appropriate for classification).</p> <p>Mixed woodland (see differences from LCM2007 section). Where individual stands of broad-leaved or evergreen trees exceeded the minimum mappable unit, they were treated as separate blocks within the woodland; in many parts of the UK, truly 'mixed woodlands' as opposed to those with mosaic-blocks of broadleaved and coniferous trees, are unusual.</p>
'Coniferous Woodland'	<p>'Coniferous Woodland' includes semi-natural stands and plantations, with cover &gt;20%. The recognition of coniferous woodland is generally straightforward. Rare examples of open canopy semi-natural pinewoods may have been classified according to the dominant understorey class. The BH includes new plantation and recently felled areas (this is a class where the BH definition is based on land use, i.e. forestry, rather than cover). New plantations, predominantly heather and/or grass, for example, are recorded as such by the spectral classification of image data. New plantations are only consistently recorded as conifers when tree cover is sufficient to strongly influence the reflectance. LCM2015 includes newly felled areas. Once they are fully recolonised by rough grass, heath or scrub, they are recorded according to that cover. Deciduous larch is discernible from other deciduous trees and is generally correctly included with other conifers.</p>
'Arable and Horticulture'	<p>This Broad Habitat includes annual crops, perennial crops such as berries and orchards and freshly ploughed land. Orchards with a ground flora are hard to distinguish.</p>
'Improved Grassland'	<p>Improved grassland is distinguished from semi-natural grasslands based on its higher productivity, lack of winter senescence and location and/or context. In some cases heavy grazing can cause mis-classification with, arable land or semi-natural grassland.</p> <p>Some confusion occurs between 'Improved Grassland' and 'Calcareous Grassland' and 'Neutral Grassland', as 'Calcareous Grassland' and 'Neutral Grassland' are often very productive grassland and so spectrally very similar to 'Improved Grassland'.</p>

'Neutral Grassland'	For LCM2015 ' <i>Neutral Grassland</i> ' is mapped spectrally, however, the inclusion of ancillary layers for slope and distance to rivers is expected to improve the classification of ' <i>Neutral Grassland</i> ' on flood plains. Areas identified as ' <i>Neutral Grassland</i> ' by LCM should probably be treated as having the potential to be ' <i>Neutral grassland</i> ' as for a conclusive classification field survey is required to make a determination based on botanical composition. ' <i>Neutral Grassland</i> ' also includes semi-improved grasslands managed for silage, hay or pasture (Jackson, 2000), which in LCM2015 will often be classified as ' <i>Improved Grassland</i> '.
'Calcareous Grassland'	For LCM2015 ' <i>Calcareous Grassland</i> ' is mapped spectrally, however, the inclusion of ancillary layers for slope is expected to improve the classification of ' <i>Calcareous Grassland</i> ' in some cases. Areas identified as ' <i>Calcareous Grassland</i> ' by LCM should probably be treated as having the potential to be ' <i>Calcareous Grassland</i> ' as for a conclusive classification field survey is required to make a determination based on botanical composition.
'Acid Grassland'	For LCM2015, ' <i>Acid Grassland</i> ' is mapped spectrally.  Bracken can be mapped using LCM2015 methods, but it depends on image timing and suitable training areas (bracken often fails to offer stands sufficiently extensive for classification and training), so for consistency it is assigned to ' <i>Acid Grassland</i> '. However, some stands of bracken can be identified at the subclass level.
Note about grassland classes	The comparisons between previous LCM data and other data sets (for example the ground reference polygons and Countryside Survey in 2007 Broad Habitat maps) (Morton <i>et al.</i> , 2011), have shown that ' <i>Neutral Grassland</i> ' and ' <i>Calcareous Grassland</i> ' were often mis-classified as ' <i>Improved Grassland</i> '. Some users may wish to aggregate the grassland classes together, if this is appropriate for their needs.
'Heather' and 'Heather grassland' (together form the 'Dwarf Shrub Heath' Broad Habitat)	' <i>Dwarf Shrub Heath</i> ' is divided into two classes, depending on the density of Heather, producing ' <i>Heather</i> ' and ' <i>Heather grassland</i> ' classes respectively. This is similar to LCM1990's and LCM2000s Open and Dense Shrub Heath classes.  Note: the Land Cover Maps typically show confusion over the separation of ' <i>Bog</i> ' and ' <i>Dwarf Shrub Heath</i> ', however, this only affects the separation of these two BHs and they are often difficult to separate in the field.  Note, the Broad Habitat classification treats ericaceous vegetation on peat > 0.5 m depth as ' <i>Bog</i> '.
'Fen, Marsh and Swamp'	' <i>Fen, Marsh and Swamp</i> ' includes fen, fen meadows, rush pasture, swamp, flushes and springs. From a remote sensing perspective ' <i>Fen, Marsh and Swamp</i> ' is problematic as it can be comprised of a wide range of land cover types and many patches of Fen are below the LCM2015 MMU. The small size of ' <i>Fen, Marsh and Swamp</i> ' patches, plus their typically mosaic nature make it difficult to find representative areas of sufficient size to conduct a spectral classification. Consequently, ' <i>Fen, Marsh and Swamp</i> ' will be underestimated by LCM2015.
'Bog'	' <i>Bog</i> ' includes ericaceous, herbaceous and mossy swards in areas with a



	peat depth > 0.5 m. <i>'Bog'</i> forms part of an ecological continuum covering <i>'Acid Grassland'</i> , <i>'Dwarf Shrub Heath'</i> and some types of <i>'Fen, Marsh and Swamp'</i> and the separation of these habitats can be difficult, as the surface vegetation (i.e. land cover) maybe very similar and the division rests on the depth of peat. The division in the field can account for species presence, plus peat depth, but for LCM2015 the division is based on the spectral data and presumably also the slope data.
Saltwater	Saltwater is mapped to a limited extent around the coastline of the UK. The extent is constrained by the extent of the digital cartography, which covers land and tidal areas, but not sea.
Freshwater	This is based on merging two freshwater BHs ( <i>'Standing Open Water and Canals'</i> and <i>'Rivers and Streams'</i> ), as they cannot be reliably separated from each other using the methods and data used for LCM2015. In many cases small and/or narrow water bodies fall below the MMU. Water bodies > 0.5 ha are readily mapped, as are very wide rivers (>50 m). The main exceptions are temporary water bodies, especially in quarries where the water body extent differs between the two images and differs from the associated polygon shape. Water in some quarries is strongly affected by the minerals in the rock and can result in strange water colours that maybe misclassified.
<i>'Inland Rock'</i>	This Broad Habitat type covers both natural and artificial exposed rock surfaces which are >0.25ha, such as inland cliffs, caves, screes and limestone pavements, as well as various forms of excavations and waste tips such as quarries and quarry waste. To be classified as <i>'Inland Rock'</i> the rock has to be the dominant spectral signature.
<i>'Urban'</i> and <i>'Suburban'</i>  (together form the <i>'Built-up Areas and Gardens'</i> Broad Habitat)	Within the <i>'Built-up Areas and Gardens'</i> Broad Habitat LCM2015 recognises two categories that can be determined reliably: <i>'Urban'</i> and <i>'Suburban'</i> . <i>'Urban'</i> includes dense urban, such as town and city centres, where there is typically little vegetation. <i>'Urban'</i> also includes areas such as dock sides, car parks and industrial estates. <i>'Suburban'</i> includes suburban areas where the spectral signature is a mix of urban and vegetation signatures.
<i>'Supra-littoral Rock'</i>	Features that may be present in this coastal class include vertical rock, boulders, gullies, ledges and pools. Very limited areas are mappable using satellite remote sensing.
<i>'Supra-littoral Sediment'</i>	This class includes sand-dunes, which are reliably mapped in this class. Areas of coastal sand may be confused between this class and the <i>'Littoral sediment'</i> class.
<i>'Littoral Rock'</i>	These classes are those in the maritime zone on a rocky coastline. They are generally more extensive than supra-littoral rock and thus more readily mappable from satellite images.

<p>'Littoral sediment' and 'Saltmarsh' (together form the '<i>Littoral Sediment</i>' Broad Habitat)</p>	<p>Littoral sediment is mapped as two classes: 'Saltmarsh' and 'Littoral sediment'. Saltmarsh is a Priority Habitat and of sufficient extent and spectral distinction to be mapped consistently. The remaining 'Littoral Sediment' is mapped spectrally, although there maybe some confusion with the 'Supra-littoral sediment' class.</p>
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## Appendix 2: Biodiversity Action Plan (BAP) Broad Habitats (reproduced from Morton *et al.*, 2011)

This section provides a brief summary of the JNCC definitions of the Broad Habitats and is based on Jackson (2000).

There is some duplication of material for some classes between Appendix 2 and Appendix 1, however the intention is to provide users with the key information they require to understand the LCM2015 classes and the Broad Habitat definitions they are based on.

**Note: class numbers here are JNCC's Broad Habitat class numbers, not LCM2015 numbers.**

### 1. Broadleaved, Mixed and Yew Woodland

This Broad Habitat is characterised by vegetation dominated by trees >5m high when mature, with tree cover >20%. Scrub (<5 m) requires cover >30% for inclusion in this Broad Habitat. It includes stands of both native and non-native broadleaved trees and yew. Woodlands dominated by coniferous species but with >20% cover by deciduous species are included in this category. Areas of fen woodland dominated by species such as willow (*Salix* spp.), alder (*Alnus glutinosa*) or birch (*Betula* spp.) are also included.

### 2. Coniferous Woodland

This Broad Habitat is characterised by vegetation dominated by trees >5m high when mature, which forms a canopy having a cover of >20%. 'Coniferous Woodland' includes semi-natural stands and plantations and includes both native and non-native coniferous trees.

### 3. Boundaries and Linear Features

This Broad Habitat type covers a range of linearly arranged landscape features such as hedgerows, lines of trees, walls, stone and earth banks, grass strips and dry ditches. These features are not mapped by LCM2007 as they are generally too narrow to be reliably captured from the satellite images. It is included here as its inclusion in Countryside Survey is relevant for the Comparison between LCM2007 and Countryside Survey in Chapter 4.

### 4. Arable and Horticulture

This Broad Habitat includes annual crops, perennial crops, woody crops, intensively managed commercial orchards, commercial horticultural land (such as nurseries, commercial vegetable plots and commercial flower growing areas), freshly-ploughed land, annual leys, rotational set-aside and fallow.

### 5. Improved Grassland

'Improved Grassland' is characterised by vegetation dominated by a few fast-growing grasses such as *Lolium* spp., and also white clover (*Trifolium repens*), on fertile, neutral soils. Improved Grasslands are typically either managed as pasture or mown regularly for silage production or in non-agricultural contexts for recreation and amenity purposes.

## **6. Neutral Grassland**

This Broad Habitat type is characterised by vegetation dominated by grasses and herbs on a range of neutral soils usually with a pH of between 4.5 and 6.5. It includes enclosed dry hay meadows and pastures, together with a range of grasslands which are periodically inundated with water or permanently moist.

## **7. Calcareous Grassland**

'*Calcareous Grassland*' is characterised by vegetation dominated by grasses and herbs on shallow, well-drained soils which are rich in bases (principally calcium carbonate) formed by the weathering of chalk and other types of limestone or base-rich rock. Soil pH tends to be high (>6) although it may be as low as 5.

## **8. Acid Grassland**

'*Acid Grassland*' is characterised by vegetation dominated by grasses and herbs on a range of lime-deficient soils which have been derived from acidic bedrock or from superficial deposits such as sands and gravels. Such soils usually have a low base status, with a pH of <5.5.

## **9. Bracken**

This Broad Habitat type covers areas dominated by a continuous canopy cover of bracken (*Pteridium aquilinum*) at the height of the growing season. It does not include areas with scattered patches of bracken or areas of bracken which are >0.25 ha which are included in the Broad Habitat type with which they are associated.

## **10. Dwarf Shrub Heath**

'*Dwarf Shrub Heath*' is characterised by vegetation that has >25% cover of plant species from the heath family (ericoids) or dwarf gorse *Ulex minor*. It generally occurs on well-drained, nutrient-poor, acid soils. This habitat type does not include dwarf shrub dominated vegetation in which species characteristic of peat-forming vegetation such as cotton-grass *Eriophorum* spp. and peat-building sphagna are abundant, or that occurs on deep peat (> 0.5 m) as these are included in the '*Bog*' Broad Habitat type.

## **11. Fen, Marsh and Swamp**

This habitat includes fen, flushes, springs, fen meadows, rush pasture and swamp. Fens are peatlands which receive water and nutrients from groundwater and surface run-off, as well as from rainfall. Flushes are associated with lateral water movement, and springs with localised upwelling of water. Marsh is a general term usually used to imply waterlogged soil; it is used more specifically here to refer to fen meadows and rush-pasture communities on mineral soils and shallow peats. Swamps are characterised by tall emergent vegetation. Reedbeds (i.e. swamps dominated by stands of common reed *Phragmites australis*) are also included in this type. Apart from rush pasture, examples of this Broad Habitat are relatively rare.

## **12. Bog**

This Broad Habitat type covers wetlands that support vegetation that is usually peat-forming and which receive mineral nutrients principally from precipitation rather than ground water.

This is referred to as ombrotrophic (rain-fed) mire. The Bog Broad Habitat includes ericaceous, herbaceous and mossy swards in areas with a peat depth >0.5m.

### **13. Standing Open Water and Canals**

This Broad Habitat type includes natural systems such as lakes, meres and pools, as well as man-made waters such as reservoirs, canals, ponds and gravel pits.

### **14. Rivers and Streams**

The '*Rivers and Streams*' Broad Habitat type covers rivers and streams from bank top to bank top, or where there are no distinctive banks or banks are never overtopped, it includes the extent of the mean annual flood.

### **15. Montane**

The '*Montane Habitats*' category includes a range of vegetation types that occur exclusively in the montane zone such as prostrate dwarf shrub heath, snow-bed communities, sedge and rush heaths, and moss heaths. The distinction between the sub-montane and montane zone is often blurred and the two usually merge through a band of transitional vegetation.

### **16. Inland Rock**

This Broad Habitat type covers both natural and artificial exposed rock surfaces which are >0.25ha, such as inland cliffs, caves, screes and limestone pavements, as well as various forms of excavations and waste tips such as quarries and quarry waste.

### **17. Built-Up Areas and Gardens**

This Broad Habitat type covers urban and rural settlements, farm buildings, caravan parks and other man-made built structures such as industrial estates, retail parks, waste and derelict ground, urban parkland and urban transport infrastructure. It also includes domestic gardens and allotments. This type does not include amenity grassland which should be included in the '*Improved Grassland*' category.

### **18. Supralittoral Rock**

'*Supralittoral Rock*' occurs above the high water mark, in areas influenced by wave splash and sea-spray. Features that may be present include vertical rock, boulders, gullies, ledges and pools, depending on the wave exposure of the site and its geology.

### **19. Supralittoral Sediment**

'*Supralittoral Sediment*' occurs above the high water mark, but in areas influenced by wave splash and sea-spray. Includes shingle beaches, sand dunes and machair.

### **20. Littoral Rock**

The geology and wave exposure of the shore influence the form of Littoral Rock habitats, which can be as varied as vertical rock, shore platforms, boulder shores, or rocky reefs surrounded by areas of sediment. In general, '*Littoral Rock*' tends to be colonised by algae in wave-sheltered conditions, and by limpets, barnacles and mussels as wave-exposure increases.

## **21. Littoral Sediment**

Areas of '*Littoral Sediment*' are widespread around the UK forming features such as beaches, sand banks, and intertidal mudflats. A large proportion of this habitat occurs in estuaries and inlets where it can cover extensive areas. Saltmarsh is included within this Broad Habitat.

## **22. Inshore Sublittoral Sediment**

All areas of sea and estuary class are assumed to be '*Inshore Sublittoral Sediment*'. It is defined as within six nautical miles of the shoreline by JNCC.

### Appendix 3: Recipe for standard LCM2015 colour mapping.

LCM2015 class	LCM2015class number	Red	Green	Blue
<b>Broadleaved woodland</b>	<b>1</b>	255	0	0
<i>'Coniferous Woodland'</i>	2	0	102	0
<i>'Arable and Horticulture'</i>	3	115	38	0
<i>'Improved Grassland'</i>	4	0	255	0
<i>'Neutral Grassland'</i>	5	127	229	127
<i>'Calcareous Grassland'</i>	6	112	168	0
<b>Acid grassland</b>	7	153	129	0
<i>'Fen, Marsh and Swamp'</i>	8	255	255	0
<b>Heather</b>	9	128	26	128
<b>Heather grassland</b>	10	230	140	166
<i>'Bog'</i>	11	0	128	115
<i>'Inland Rock'</i>	12	210	210	255
<b>Saltwater</b>	13	0	0	128
<b>Freshwater</b>	14	0	0	255
<i>'Supra-littoral Rock'</i>	15	204	179	0
<i>'Supra-littoral Sediment'</i>	16	204	179	0
<i>'Littoral Rock'</i>	17	255	255	128
<b>Littoral sediment</b>	18	255	255	128
<b>Saltmarsh</b>	19	128	128	255
<b>Urban</b>	20	0	0	0
<b>Suburban</b>	21	128	128	128

## Appendix 4: Composite images used in LCM2015

Composite number	Path	Row	Image date	Image date	sensor
c2	200	23	30/06/2015	23/12/2015	L8,L8
c3	200	24	30/06/2015	23/12/2015	L8,L8
c4	200	25	30/06/2015	23/12/2015	L8,L8
c5	202	22-23	09/04/2015	02/10/2015	L8,L8
c6	202	22-23	09/04/2015	12/06/2015	L8,L8
c7	202	24-25	09/04/2015	02/10/2015	L8,L8
c8	204	20	20/04/2014	30/09/2015	L8,L8
c9	204	21-22	23/04/2015	30/09/2015	L8,L8
c10	204	21	25/07/2014	30/09/2015	L8,L8
c11	204	22-23	23/04/2015	10/06/2015	L8,L8
c12	204	24-25	07/04/2015	30/09/2015	L8,L8
c13	204	24	07/04/2015	10/06/2015	L8,L8
c14	205	18	26/03/2014	27/04/2014	L8,L8
c15	206	19	18/04/2014	20/05/2014	L8,L8
c16	206	20	18/04/2014	23/07/2014	L8,L8
c17	206	21	18/04/2014	23/07/2014	L8,L8
c18	206	19	05/04/2014	20/05/2014	L8,L8
c19	206	20	18/04/2014	20/05/2014	L8,L8
c20	207	19	24/03/2014	14/05/2015	L8,L8
c21	207	21	14/05/2015	18/08/2015	L8,L8
c22	206	22	21/04/2015	18/06/2014	L8,AWIFS
c23	202	24-25	19/01/2015	09/04/2015	L8,L8
c24	201	23	26/02/2014	17/05/2014	L8,L8
c25	201	23	08/08/2015	12/11/2015	L8,L8
c26	201	24	26/02/2014	04/07/2014	L8,L8
c27	201	25	18/04/2015	08/08/2015	L8,L8
c28	201	25	18/04/2015	04/07/2014	L8,L8
c29	203	22	12/03/2014	09/10/2015	L8,L8
c30	203-204	22-23	12/03/2014	10/06/2015	L8,L8
c31	203-202	22-23	12/06/2015	09/10/2015	L8,L8
c32	201	24	14/03/2014	04/07/2014	L8,L8
c33	202-203	22-23	09/04/2015	09/10/2015	L8,L8
c34	204	22	10/06/2015	30/09/2015	L8,L8
c35	204	23	10/06/2015	01/11/2015	L8,L8
c36	204	23	10/06/2015	30/09/2015	L8,L8
c37	204	23	22/03/2015	10/06/2015	L8,L8
c38	5,207	23,19-20	20/04/2014	14/05/2015	AWIFS, L8
c39	206	22	21/04/2015	23/07/2014	L8,L8
c40	206-205	21-22	21/04/2015	05/11/2014	L8,L8
c41	207-206	22	06/01/2015	21/04/2015	L8,L8
c42	5,7	23	20/04/2014	11/07/2014	AWIFS, AWIFS
c43	205	18	27/04/2014	21/11/2014	L8,L8



c45	203	25	16/04/2014	02/07/2014	AWIFS, L8
c46	204	25	16/04/2014	25/07/2014	AWIFS, L8
c47	9,14	30,34	16/04/2014	08/09/2014	AWIFS, AWIFS
c48	9,7	30,28	16/04/2014	17/06/2014	AWIFS, AWIFS
c49	11,14	29,30	09/03/2014	08/09/2014	AWIFS, AWIFS
c50	5	23	20/04/2014	-	AWIFS
c51	205	18	27/04/2014	-	L8
c52	2	23	27/08/2014	-	AWIFS
c53	11	30	09/03/2014	08/09/2014	AWIFS, AWIFS
c54	11,20	30	09/03/2014	17/05/2014	AWIFS, AWIFS
c55	204,14	22,30	23/04/2015	02/10/2014	AWIFS, TM
c56	11,203	30,22-23	09/03/2014	09/10/2015	AWIFS, TM
c57	203	22-23	09/10/2015	-	L8
c58	202,9	23, 30	01/02/2014	16/06/2014	L8, AWIFS
c59	11,9	30	09/03/2014	16/04/2014	AWIFS, AWIFS
c60	203	22-23	12/03/2014	-	L8
c61	14,204	30,22-23	01/01/2014	10/06/2015	AWIFS, L8
c62	9, 204	30, 24	16/04/2014	10/06/2015	AWIFS, L8
c63	11,9	30,30	09/03/2014	16/04/2014	AWIFS, AWIFS
c64	203	25	15/05/2014	-	L8
c65	11	30	09/03/2014	-	AWIFS
c66	204, 14	23, 30	07/04/2015	02/10/2014	AWIFS, L8
c67	204	24	07/04/2015	10/06/2015	L8, L8
c68	204	24	23/04/2015	-	L8
c69	9,14	30	16/04/2014	02/10/2014	AWIFS, AWIFS
c70	204	22	30/09/2015	-	L8
c71	14	30	02/10/2014	-	AWIFS
c72	206	21-22	18/04/2014	-	L8
c73	205	22	05/11/2014	-	L8
c74	11	30	09/03/2014	-	AWIFS
c75	205	21	10/12/2015	-	L8
c76	206	22	21/04/2015	23/07/2014	L8,L8
c77	205	25	16/04/2014	14/06/2014	AWIFS, L8
c78	208	22	18/02/2015	18/06/2014	L8, AWIFS
c79	208	22	18/02/2015	20/04/2014	L8, AWIFS
c80	20	12	20/04/2014	18/06/2014	AWIFS, AWIFS
c81	207	22	17/08/2015	-	L8
c82	208	22	18/03/2015	-	L8
c83	206	22	18/04/2014	-	L8
c84	20	12	18/06/2014	-	AWIFS
c85	20	05	20/04/2014	-	AWIFS