

Monthly water situation report

England

Summary – December 2014

December's rainfall was below average across England at 87% of the long term average, although regional totals ranged from 64% in the south-west to 125% in the north-west. Soil moisture deficits continued to decrease across most of England during the month and were generally close to or smaller than average by the end of the month. Monthly mean river flows increased at just over half of the indicator sites and were **normal** or higher for the time of year at the majority of sites. Groundwater levels increased at two-thirds of the updated indicator sites and were **normal** or higher for the time of year at all sites. Reservoir stocks increased at the majority of sites and stocks were **normal** or higher for the time of year at all but two sites. Overall reservoir stocks for England were 90% of total capacity at the end of December.

Rainfall

December rainfall totals were highest in parts of Lancashire and in the far north of Cumbria at more than 180 mm and lowest around the County Durham coast and across parts of Surrey and Yorkshire at less than 40 mm. Rainfall totals were below the December long term average (LTA) in most hydrological areas; however parts of north-west England received more than 120% of the LTA ([Figure 1.1](#)).

December rainfall totals were **normal** or higher for the time of year across just over half of the hydrological areas, covering much of central, east and north-west England. Most hydrological areas covering southern and north-east England were classed as **below normal** for the time of year. Rainfall totals in the areas covering West Dorset and the coast of County Durham were **notably low**. Over the 3 and 6 month periods ending in December, cumulative rainfall totals were generally **normal** to **above normal** across most of England. The exceptional winter rainfall of early 2014 remains evident in the 12 month cumulative rainfall totals, with the southern half of England and parts of the north classed as having received **notably high** to **exceptionally high** cumulative rainfall totals ([Figure 1.2](#)).

At a regional scale, December rainfall totals were **below normal** to **normal** for the time of year and ranged from 64% of the December LTA in south-west England to 125% in north-west England. Overall, England received 87% of the December LTA ([Figure 1.3](#)).

Soil moisture deficit

Soil moisture deficits (SMDs) continued to decrease during December across most of England. At the end of December SMDs were less than 25 mm across the whole of England and less than 10 mm in all but 6 MORECS grid squares. End of month SMDs were close to the LTA across much of south-west and north-west England and up to 40 mm smaller than the LTA across the rest of England ([Figure 2.1](#)).

At a regional scale, SMDs decreased during December and by the end of the month ranged from 1 mm in north-west England to 6 mm in east England. The largest decrease of 7 mm occurred in east England ([Figure 2.2](#)).

River flows

December monthly mean river flows increased compared to November at just over half of the indicator sites across England, including all those in north-west England and all but one in central England. Flows were **normal** for the time of year at three-quarters of the indicator sites and **above normal** at 8 sites. The River Derwent in north-east England and River Frome in the south-west were **below normal** for the time of year ([Figure 3.1](#)).

Monthly mean river flows were classed as **normal** at 6 of the 7 regional index sites; the Great Stour in south-east England was **above normal** for the time of year ([Figure 3.2](#)).

Groundwater levels

Groundwater levels rose at two-thirds of the updated indicator sites across England during December. At the end of the month levels were classed as **normal** or higher for the time of year at all sites.

End of month groundwater levels at the major aquifer index sites were **normal** for the time of year at 4 sites (located in the Carlisle Basin and Eden Valley sandstone, the Chichester chalk, the Burford Jurassic limestone and South West Chilterns chalk aquifers), **above normal** at 3 sites (located in the Shropshire Middle Severn sandstone, Cam and Ely Ouse chalk and Hull and East Riding chalk aquifers) and **notably high** at one site (located in the East Kent Stour chalk aquifer) ([Figures 4.1](#) and [4.2](#)).

Reservoir storage

During December reservoir stocks increased or remained static at all of the reported reservoirs and reservoir groups. Notable increases in stocks of between approximately 25 and 35% occurred at the Pennines Group and Vyrnwy reservoir supplying north-west England, Bough Beech reservoir in the south-east and Derwent Valley reservoir in central England. At the end of December, stocks were classed as **normal** or **above normal** for the time of year at all but two reported reservoirs ([Figure 5.1](#)).

At a regional scale reservoir stocks increased during December by between 3 and 20%. At the end of December regional stocks ranged from 79% of total capacity in east England to 96% in north-east England. Overall reservoir storage for England increased by 11% to 91% of total capacity ([Figure 5.2](#)).

Forward look

Weather for the remainder of January is likely to alternate between milder unsettled conditions (windy with heavy showers) and colder, more settled weather with brighter spells. Longer term, the 3 month forecast for the period from January to March slightly favours above average rainfall but with large uncertainty¹.

Projections for river flows at key sites ²

More than half of the sites have a greater than expected chance of **above normal** or higher cumulative flows from January to March 2015, and from January to September 2015. These sites are generally in the east and south of England.

For scenario based projections for river flows at key sites in March 2015 see [Figure 6.1](#)

For scenario based projections for river flows at key sites in September 2015 see [Figure 6.2](#)

For probabilistic ensemble projections for river flows at key sites in March 2015 see [Figure 6.3](#)

For probabilistic ensemble projections for river flows at key sites in September 2015 see [Figure 6.4](#)

Projections for groundwater levels in key aquifers ²

Even with below average rainfall (80% of the LTA), all except three of the projection sites are expected to have **normal** or higher levels for the time of year in March 2015. The probabilistic projections indicate that at more than three quarters of the sites there is a greater than expected chance of **above normal** or higher groundwater levels at the end of March 2015, and at nearly two thirds of the sites there is a greater than expected chance of **above normal** or higher groundwater levels at the end of September 2015.

For scenario based projections for groundwater levels in key aquifers in March 2015 see [Figure 6.5](#)

For scenario based projections for groundwater levels in key aquifers in September 2015 see [Figure 6.6](#)

For probabilistic ensemble projections for groundwater levels in key aquifers in March 2015 see [Figure 6.7](#)

For probabilistic ensemble projections for groundwater levels in key aquifers in September 2015 see [Figure 6.8](#)

Authors: [E & B Hydrology Team](#)

¹ Source: [Met Office](#)

² Information produced by the Water Situation Forward Look group led by Environment Agency in partnership with the Centre for Ecology and Hydrology, British Geological Survey, Met Office.

Rainfall

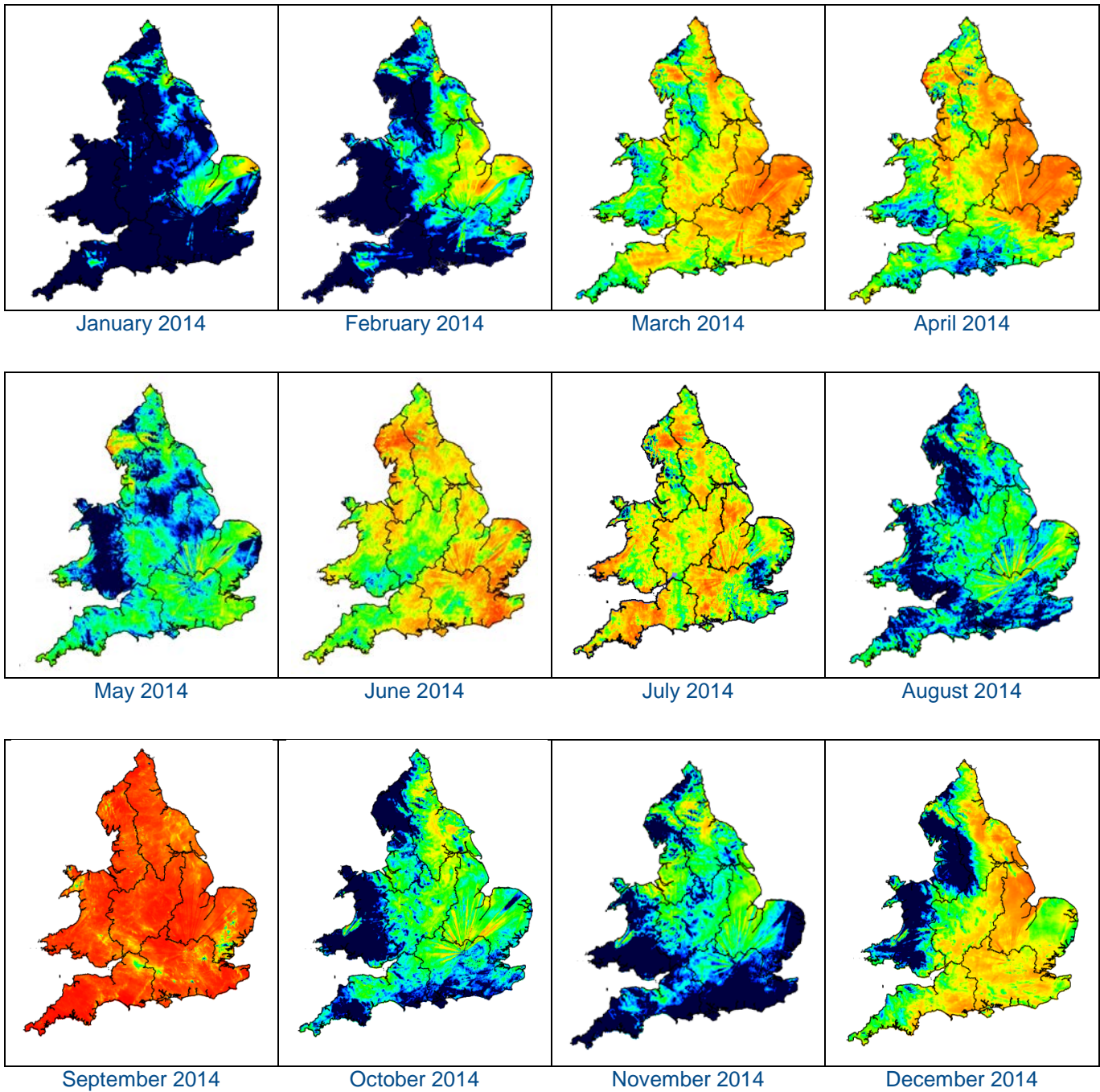
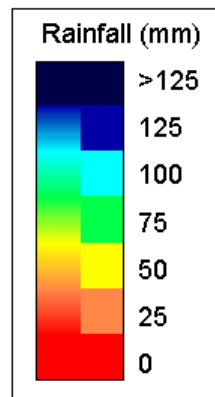


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2015). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.



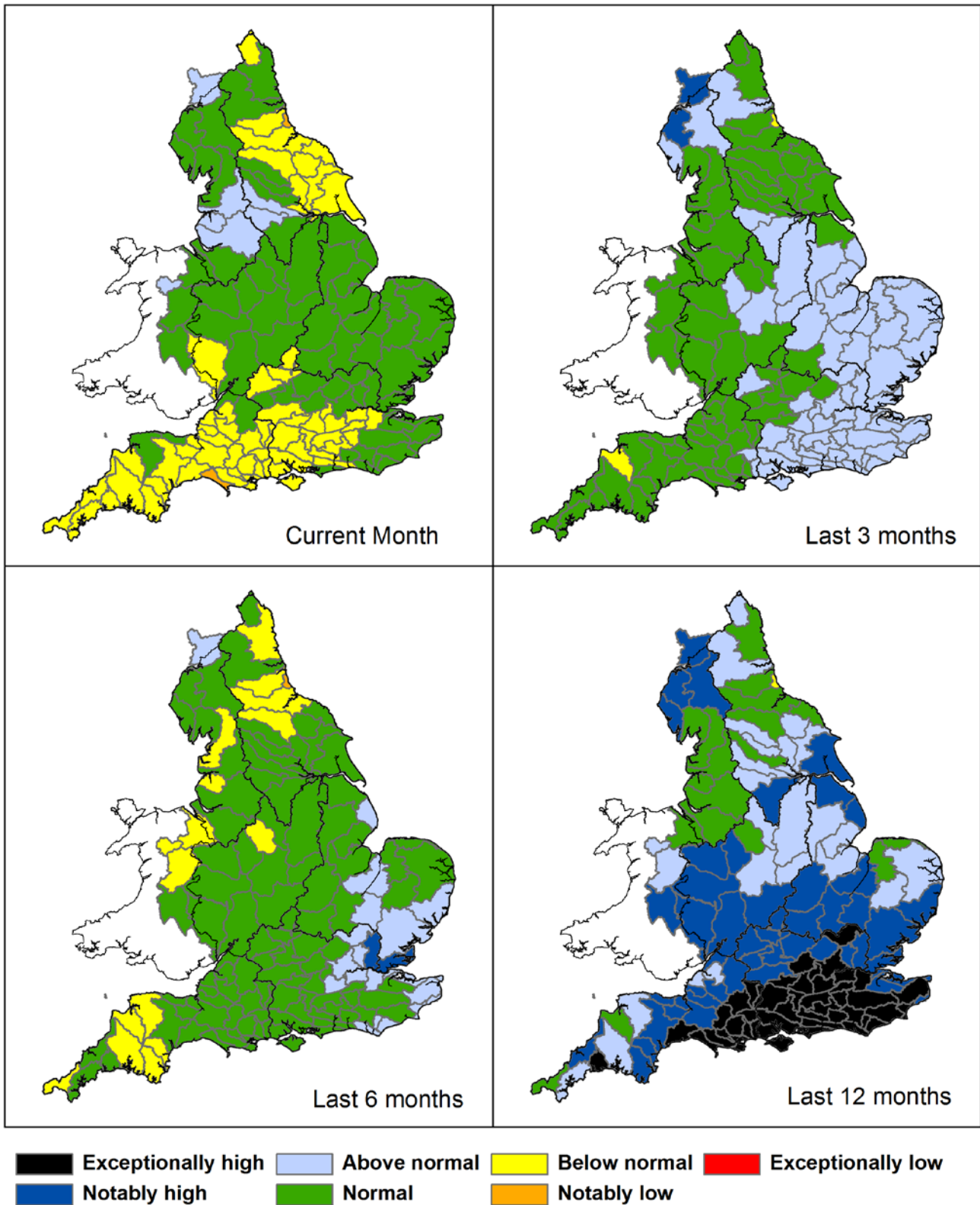


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 December), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges (Source: Met Office © Crown Copyright, 2015). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

■ Above average rainfall

■ Below average rainfall

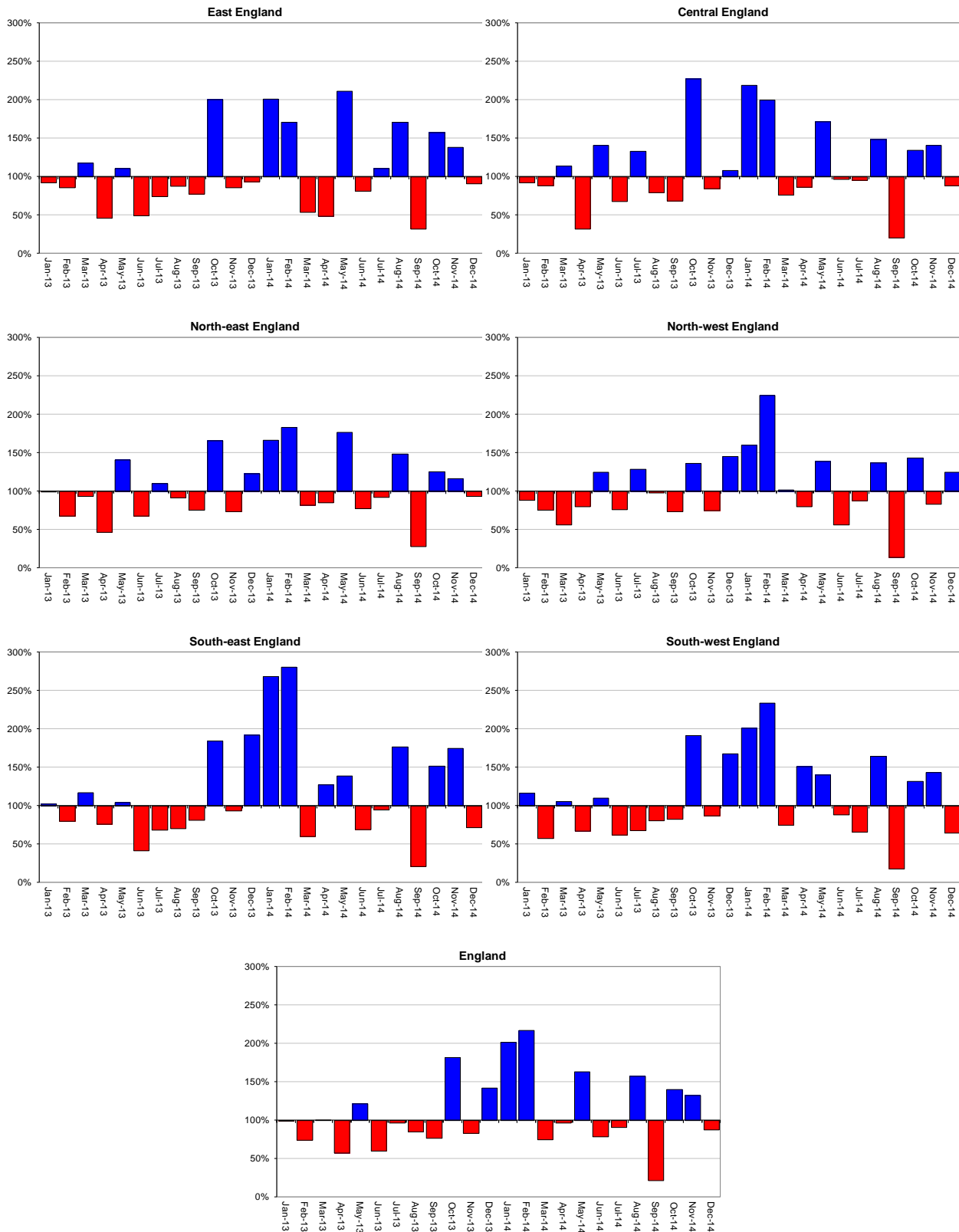


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2015).

Soil moisture deficit

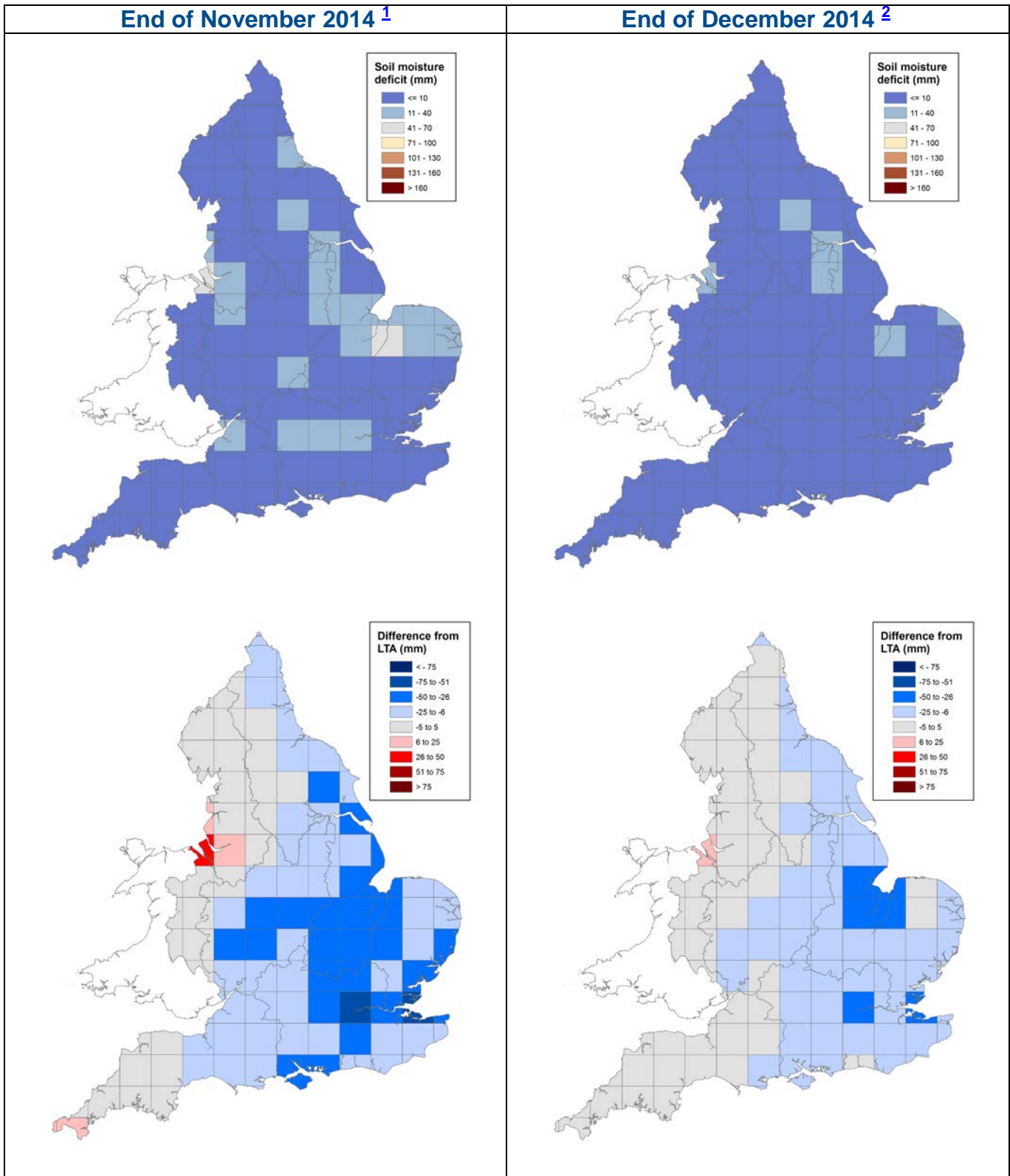


Figure 2.1: Soil moisture deficits for weeks ending 2 December 2014¹ (left panel) and 30 December 2014² (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2015). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015

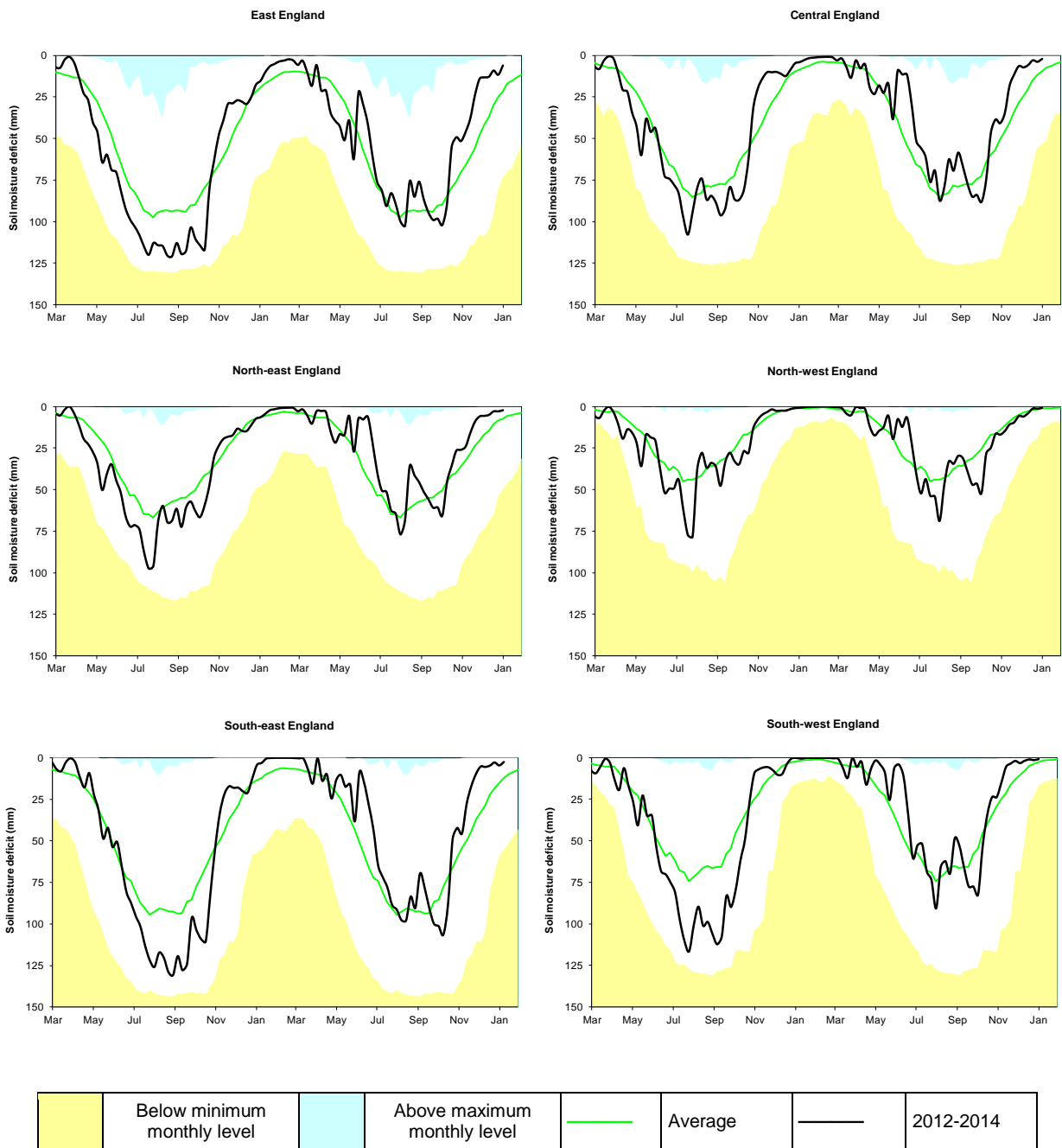
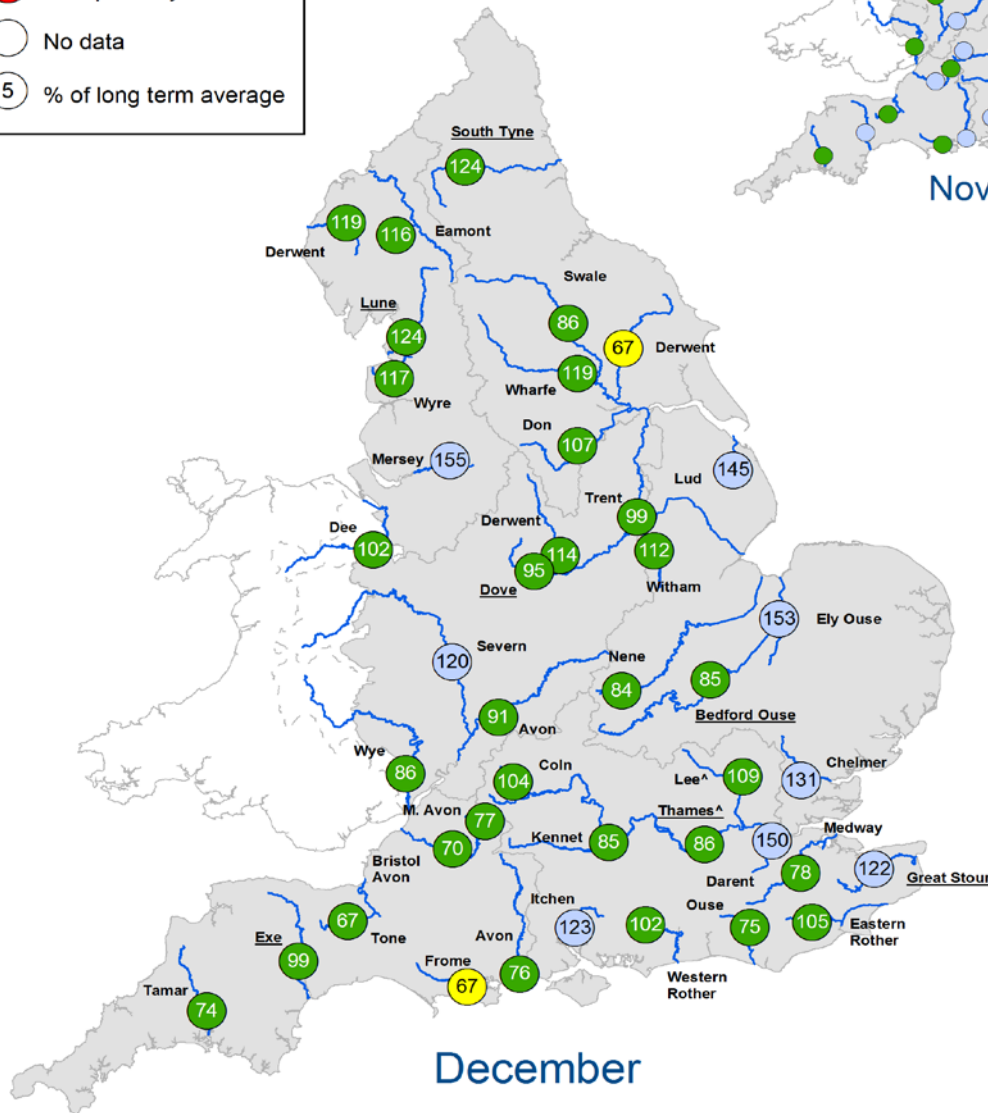
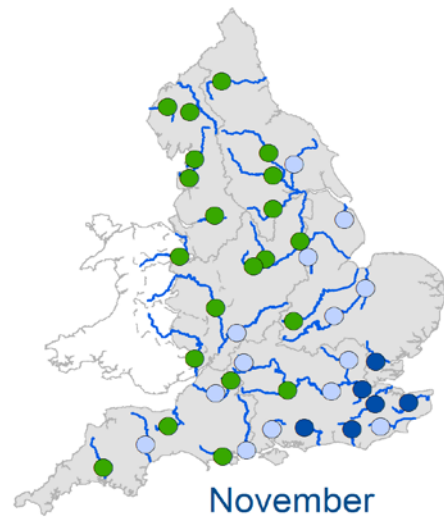
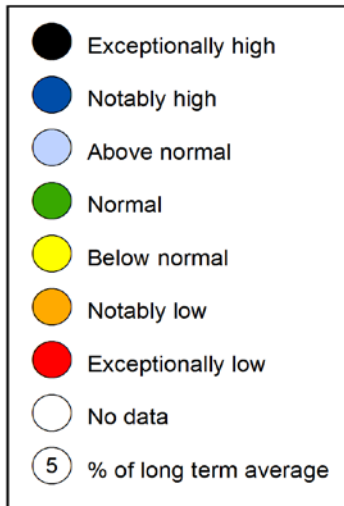


Figure 2.2: Latest soil moisture deficits for all regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2015).

River flows



^ "Naturalised" flows are provided for the 'Thames at Kingston' and the 'Lee at Feildes Weir'
 +/- Monthly mean flow is the highest/lowest on record for the current month (note that record length varies between sites)
 Underlined sites are regional index sites and are shown on the hydrographs in Figure 3.2

Figure 3.1: Monthly mean river flow for indicator sites for November 2014 and December 2014, expressed as a percentage of the respective long term average and classed relative to an analysis of historic November and December monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

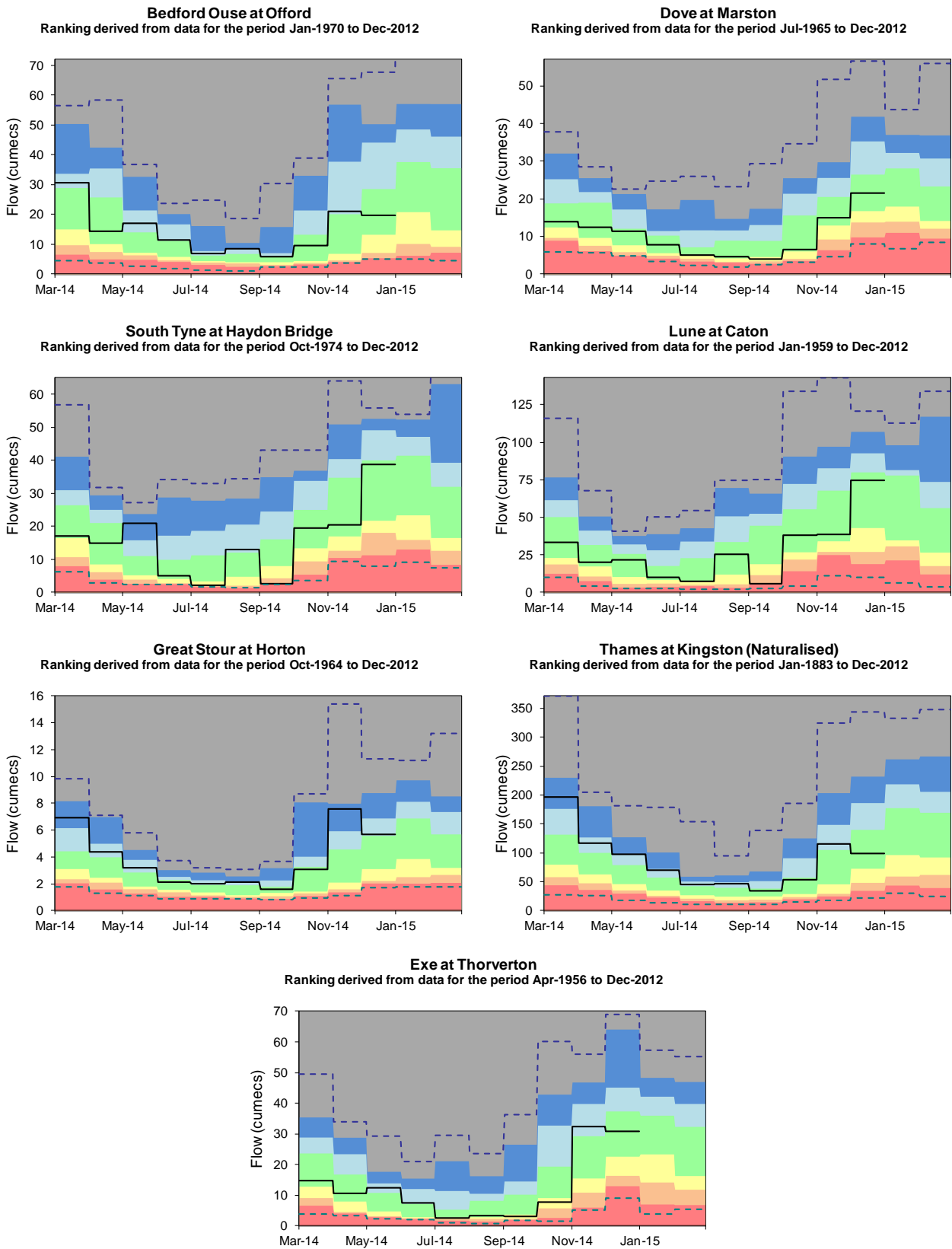
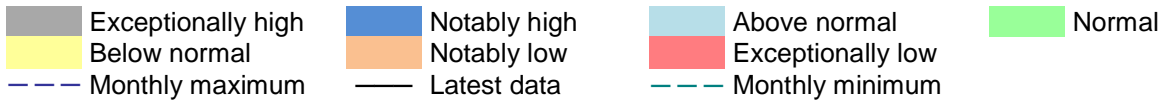
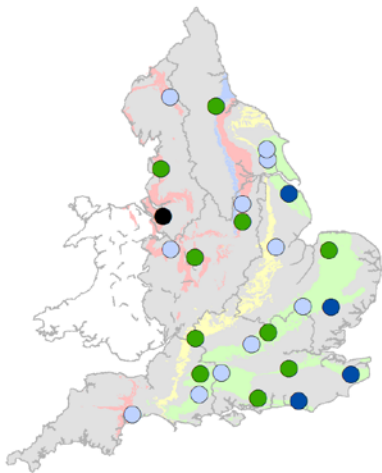
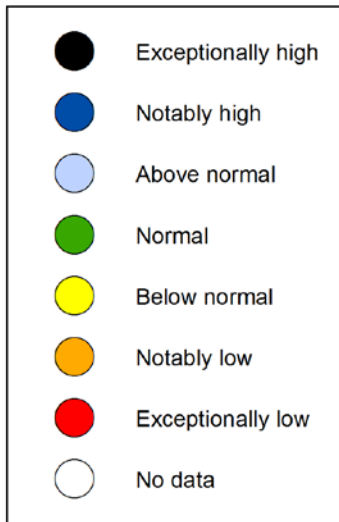
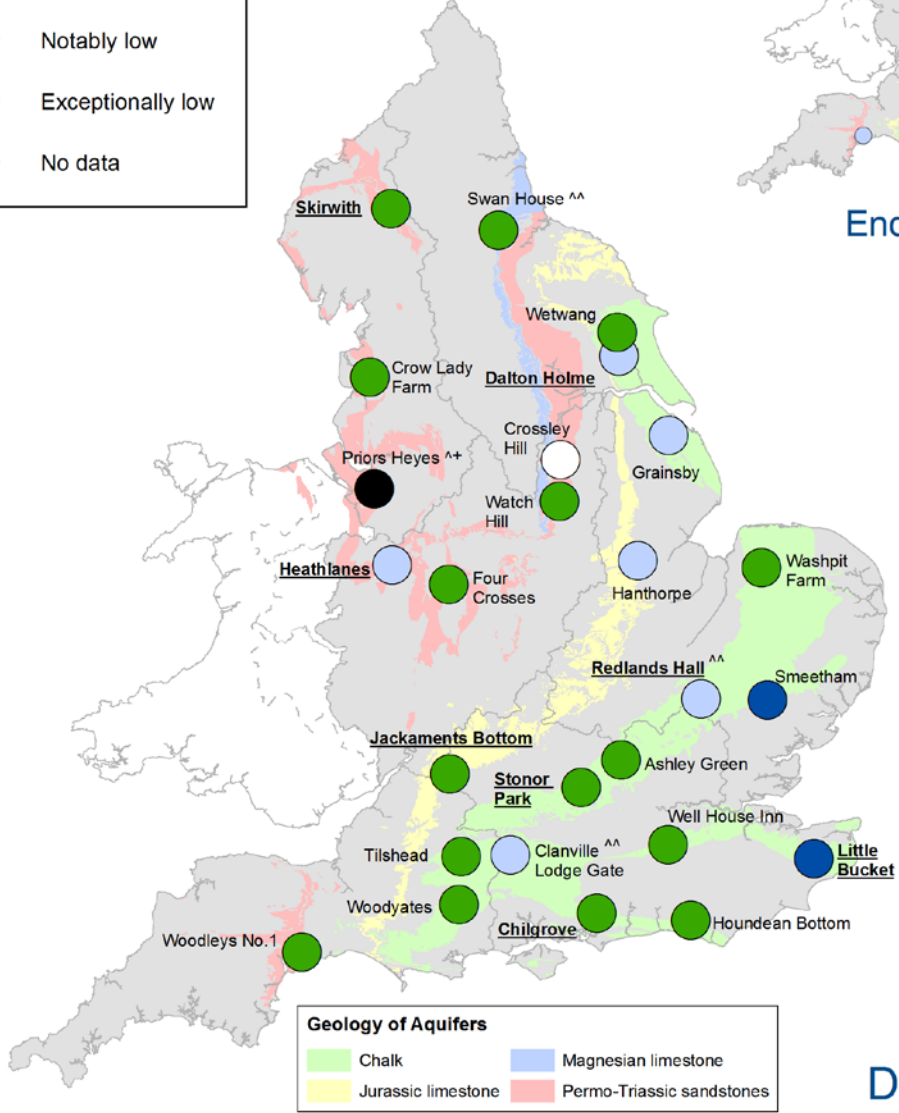


Figure 3.2: Index river flow sites for each region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

Groundwater levels



End of November



End of December

^ The level at Priors Heyes remains high compared to historic levels because the aquifer is recovering from the effects of historic abstraction.
 ^^ Sites are manually dipped at different times during the month. They may not be fully representative of levels at the month end
 +/- End of month groundwater level is the highest/lowest on record for the current month (note that record length varies between sites).
 Highlighted sites are major aquifer index sites and are shown in the groundwater level charts in Figure 4.2

Figure 4.1: Groundwater levels for indicator sites at the end of November and December 2014, classed relative to an analysis of respective historic November and December levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

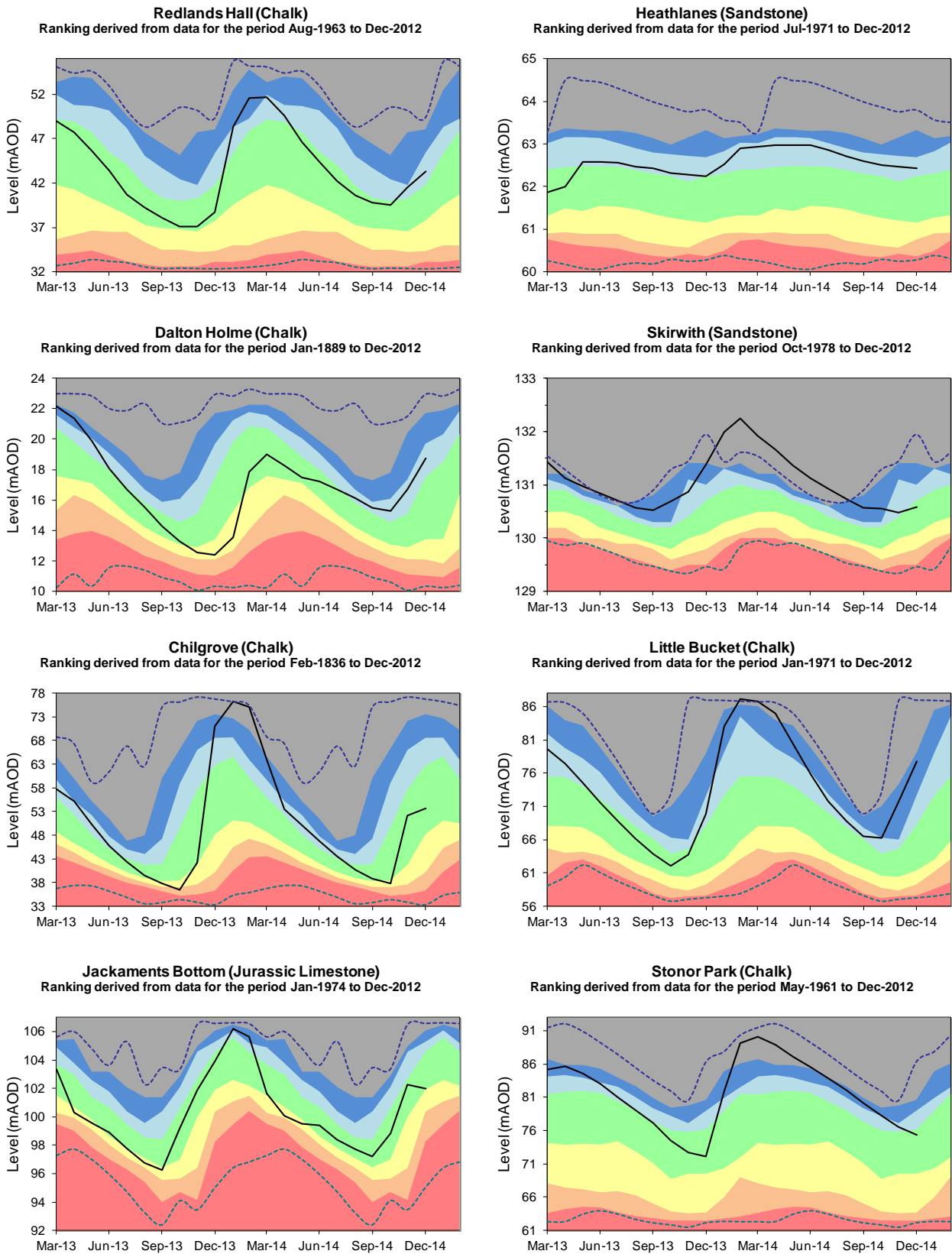
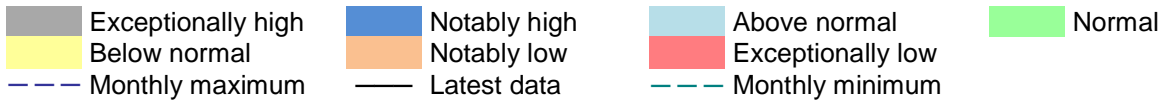
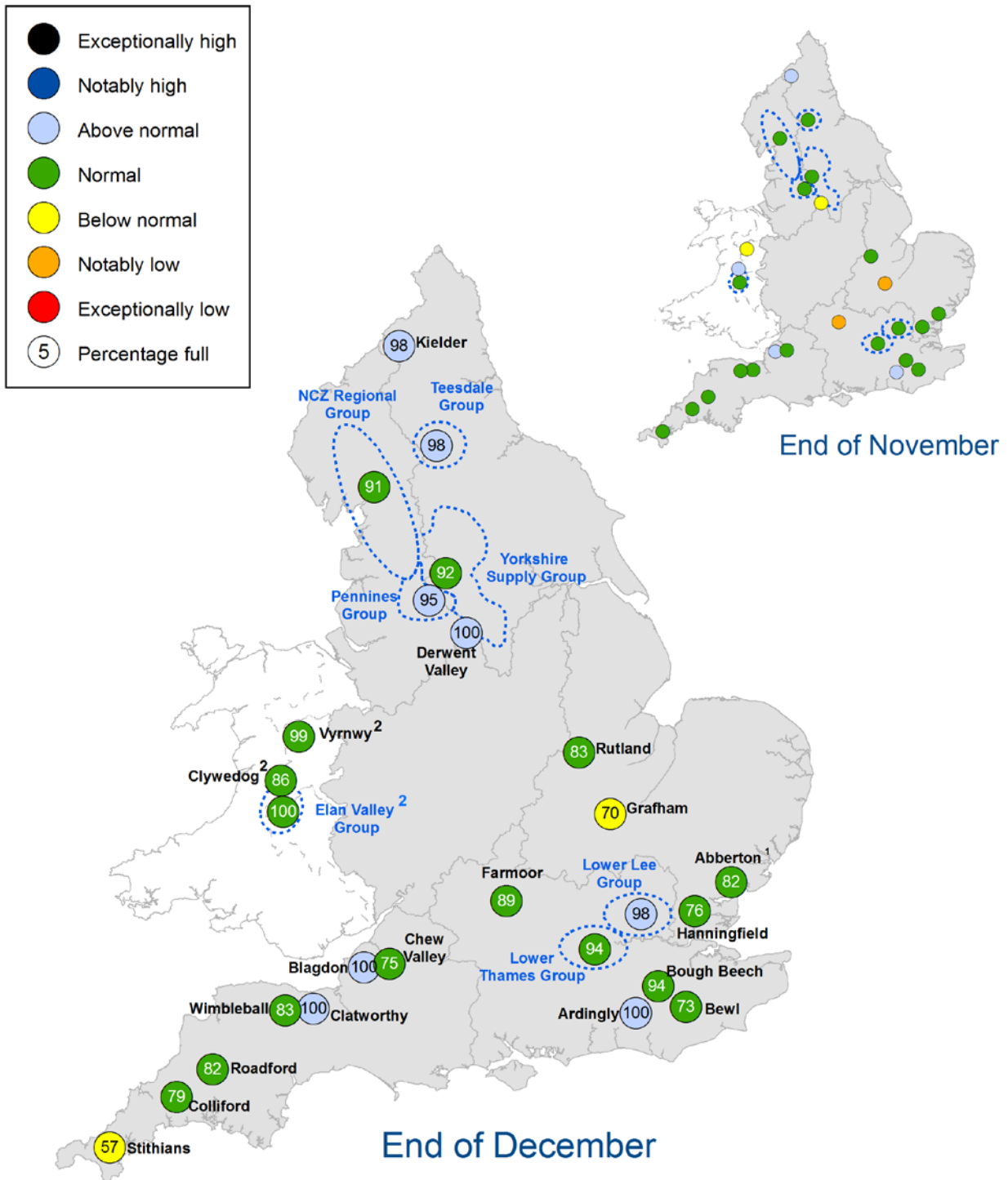


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2015).

Reservoir storage



1. Water levels have been affected by engineering work at Abberton Reservoir in Essex to increase capacity
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to central and north-west England

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of November and December 2014 as a percentage of total capacity and classed relative to an analysis of historic November and December values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate to control curves or triggers for drought actions. As well as for public water supply, some reservoirs are drawn down to provide flood storage, river compensation flows or for reservoir safety inspections. In some cases current reservoir operating rules may differ from historic ones. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

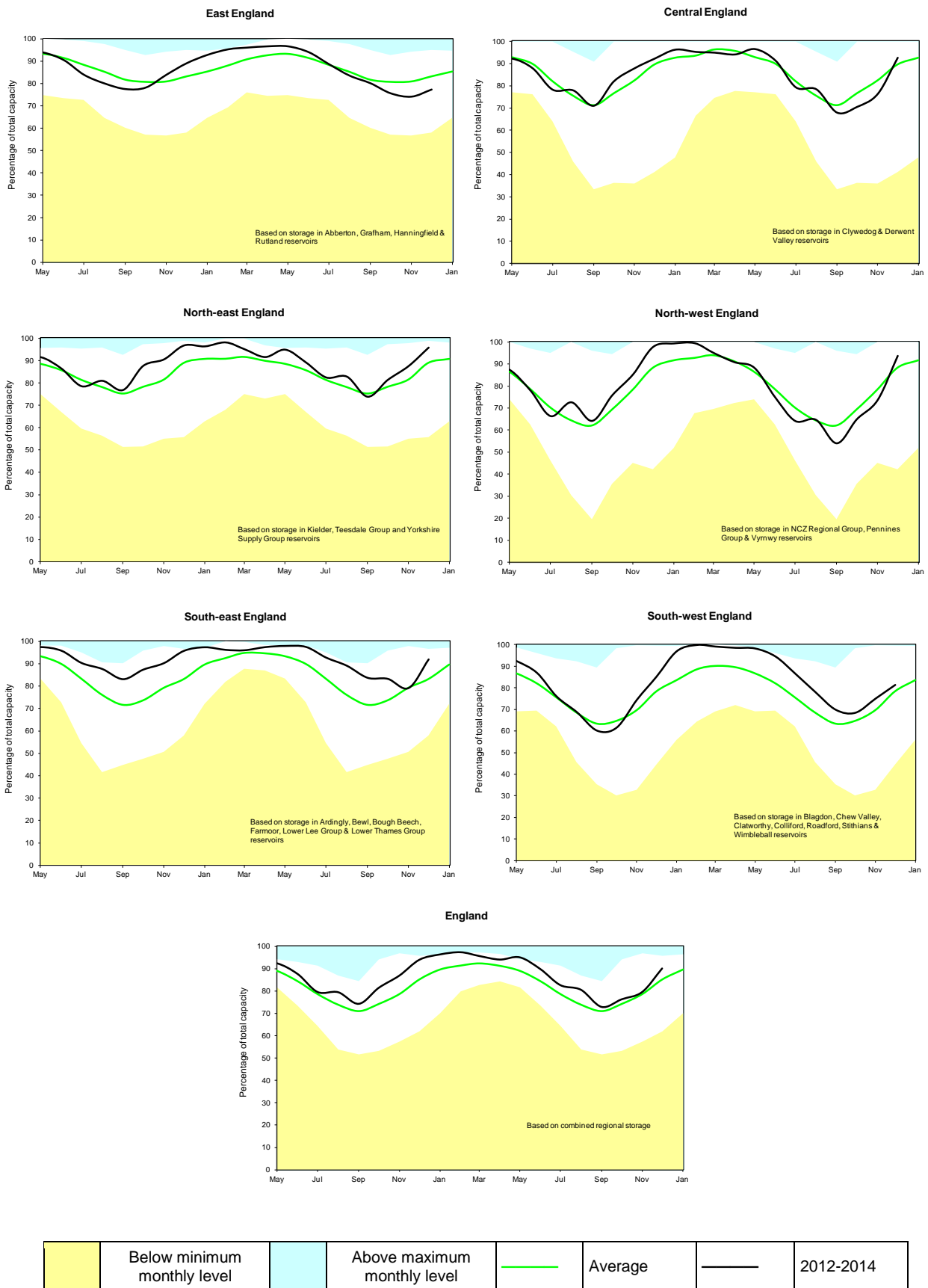


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

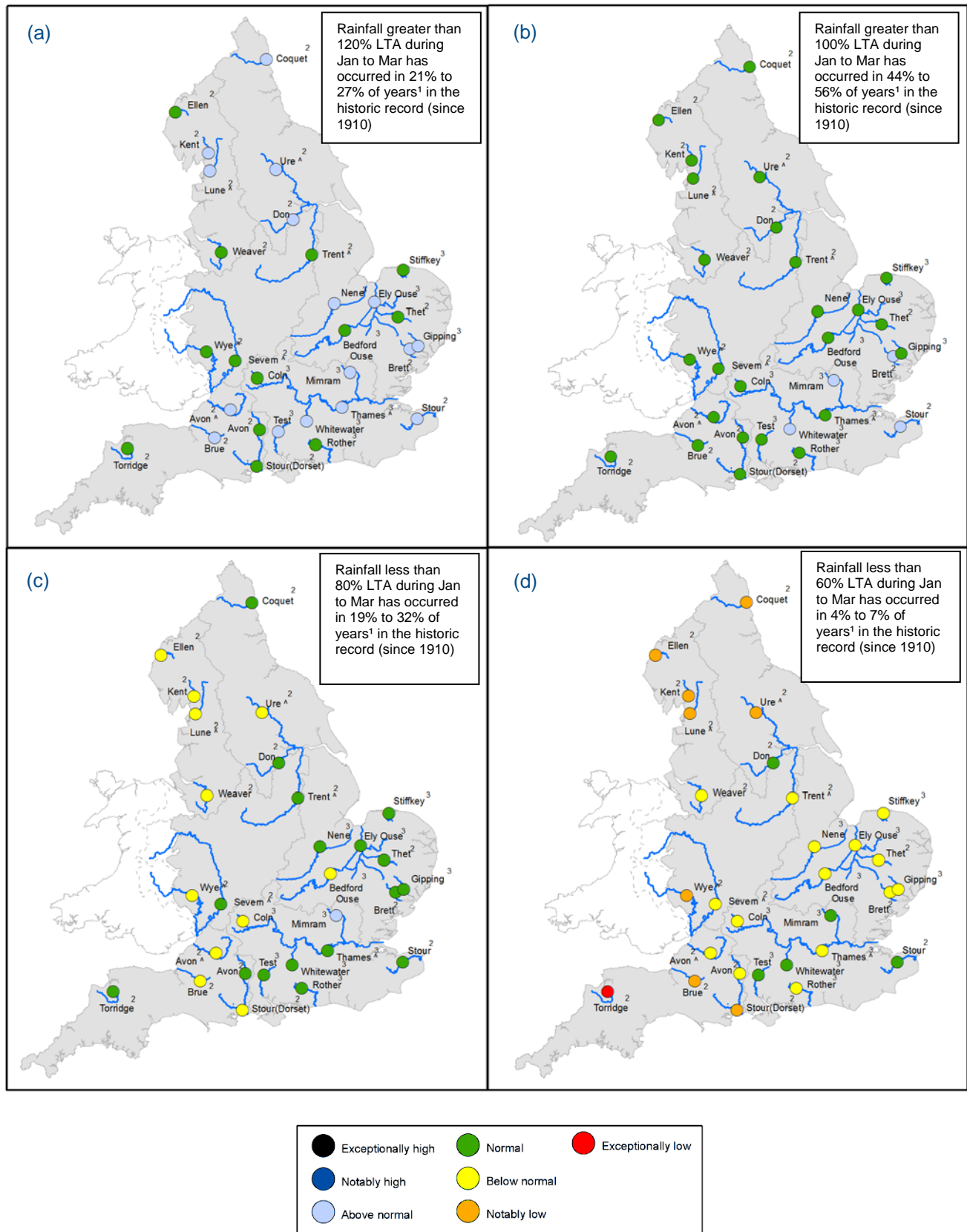


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between January and March 2015 (Source: Centre for Ecology and Hydrology, Environment Agency).

¹ This range of probabilities is a regional analysis
² Projections for these sites are produced by CEH,
³ Projections for these sites are produced by the Environment Agency
[^] "Naturalised" flows are projected for these sites

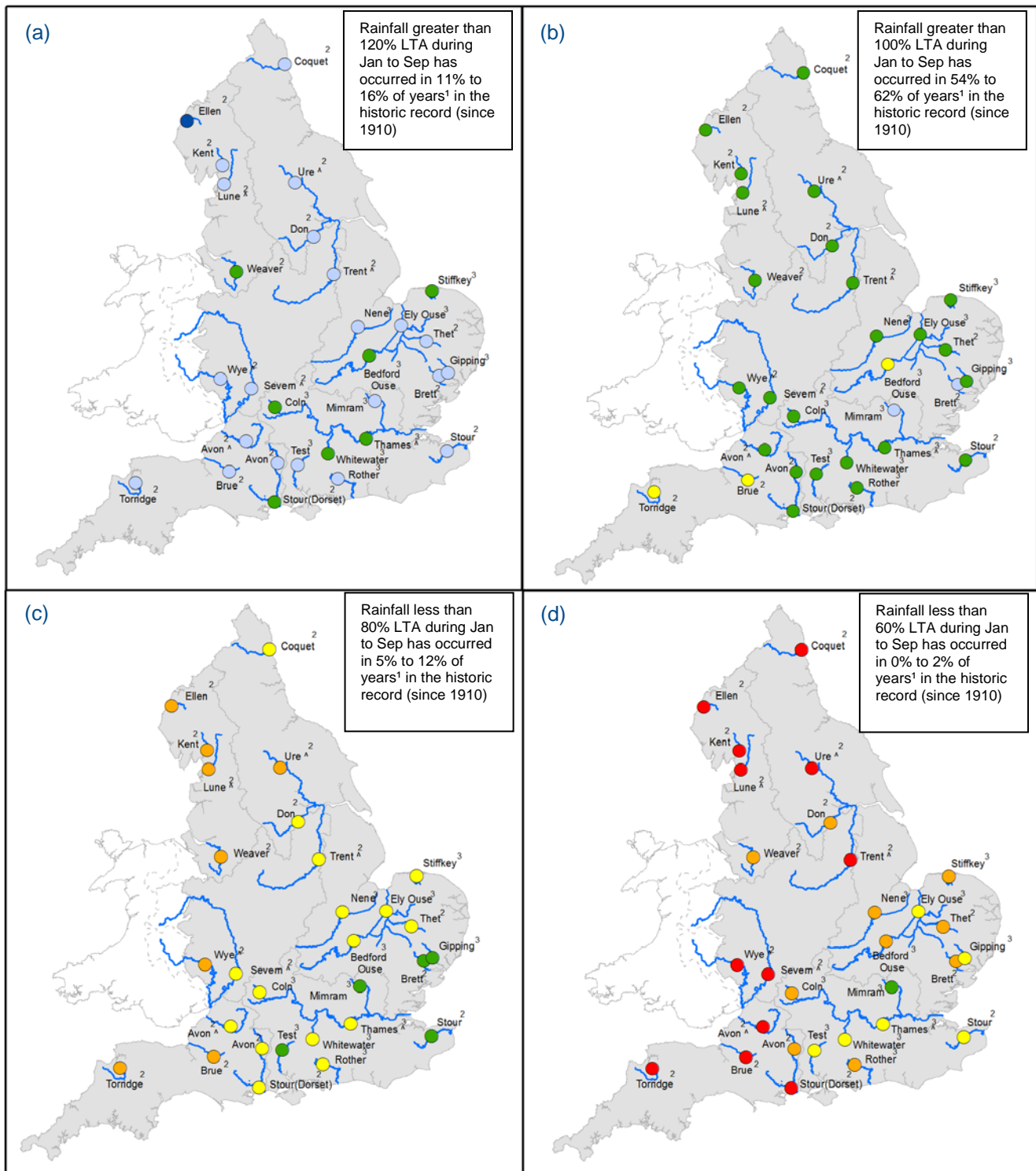
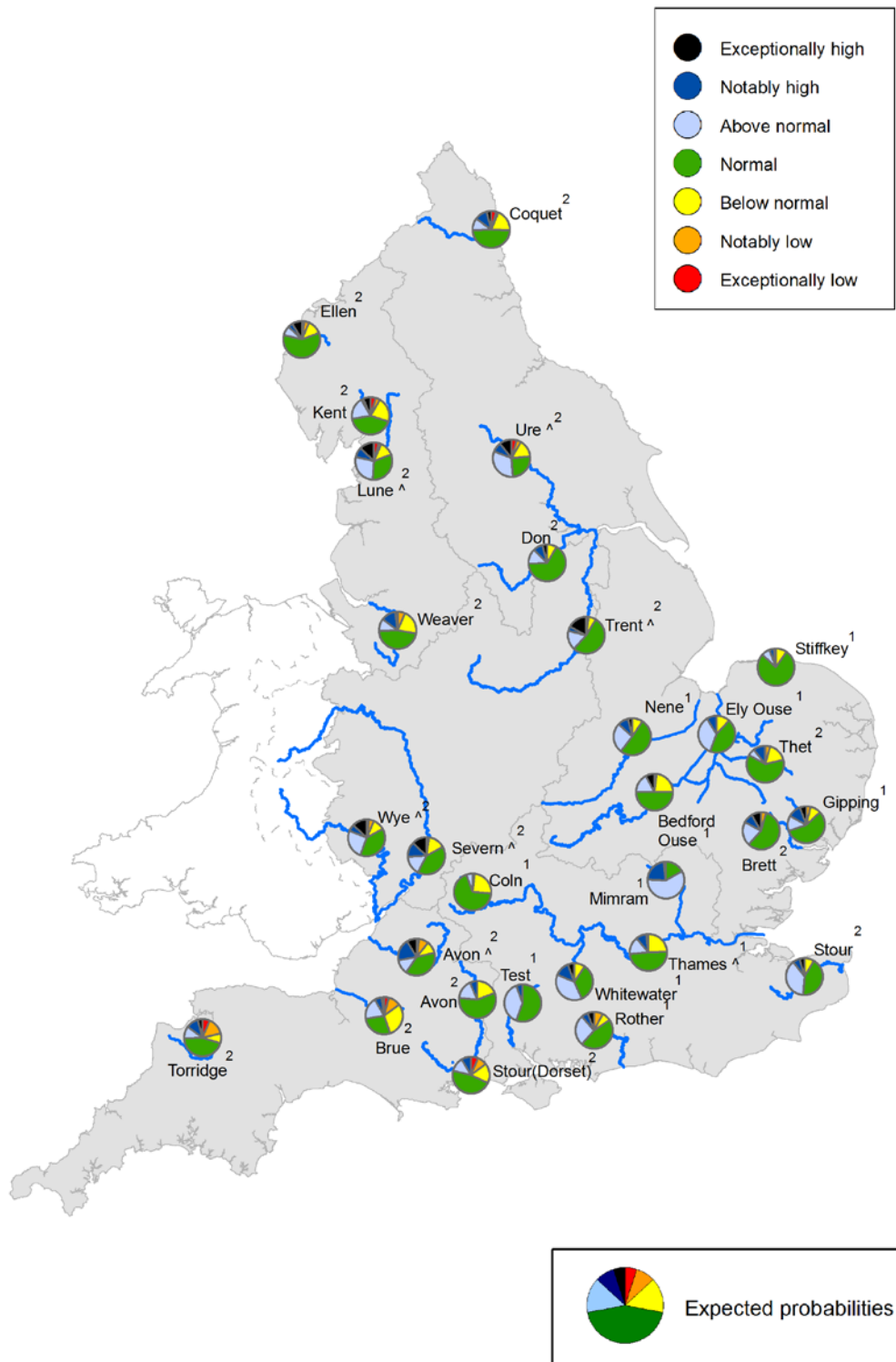


Figure 6.2: Projected river flows at key indicator sites up until the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between January and September 2015 (Source: Centre for Ecology and Hydrology, Environment Agency).

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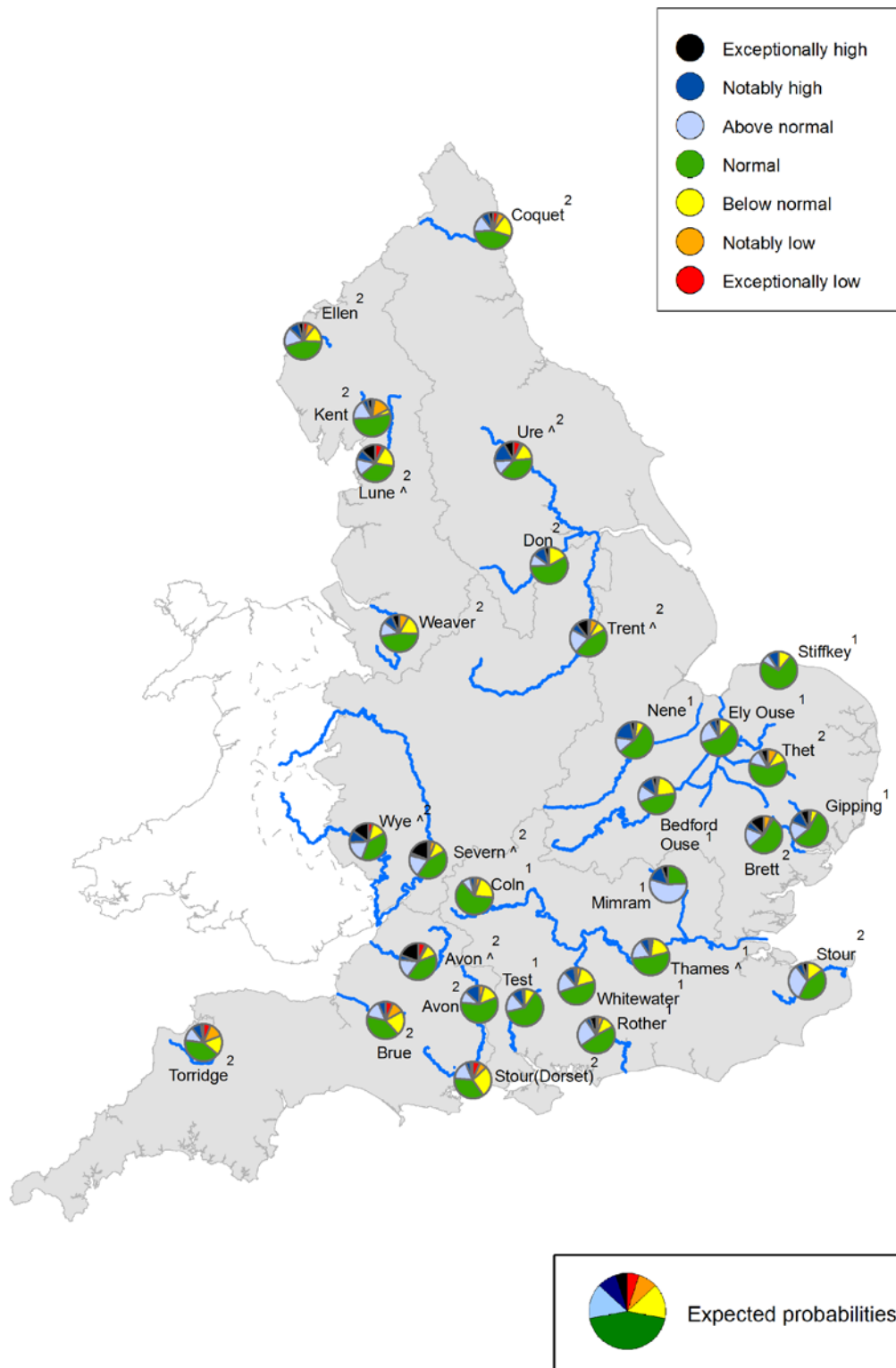
Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are those which would typically occur 44% of the time within the historic record.

Figure 6.3: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2015. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2015. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

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Forward look - groundwater

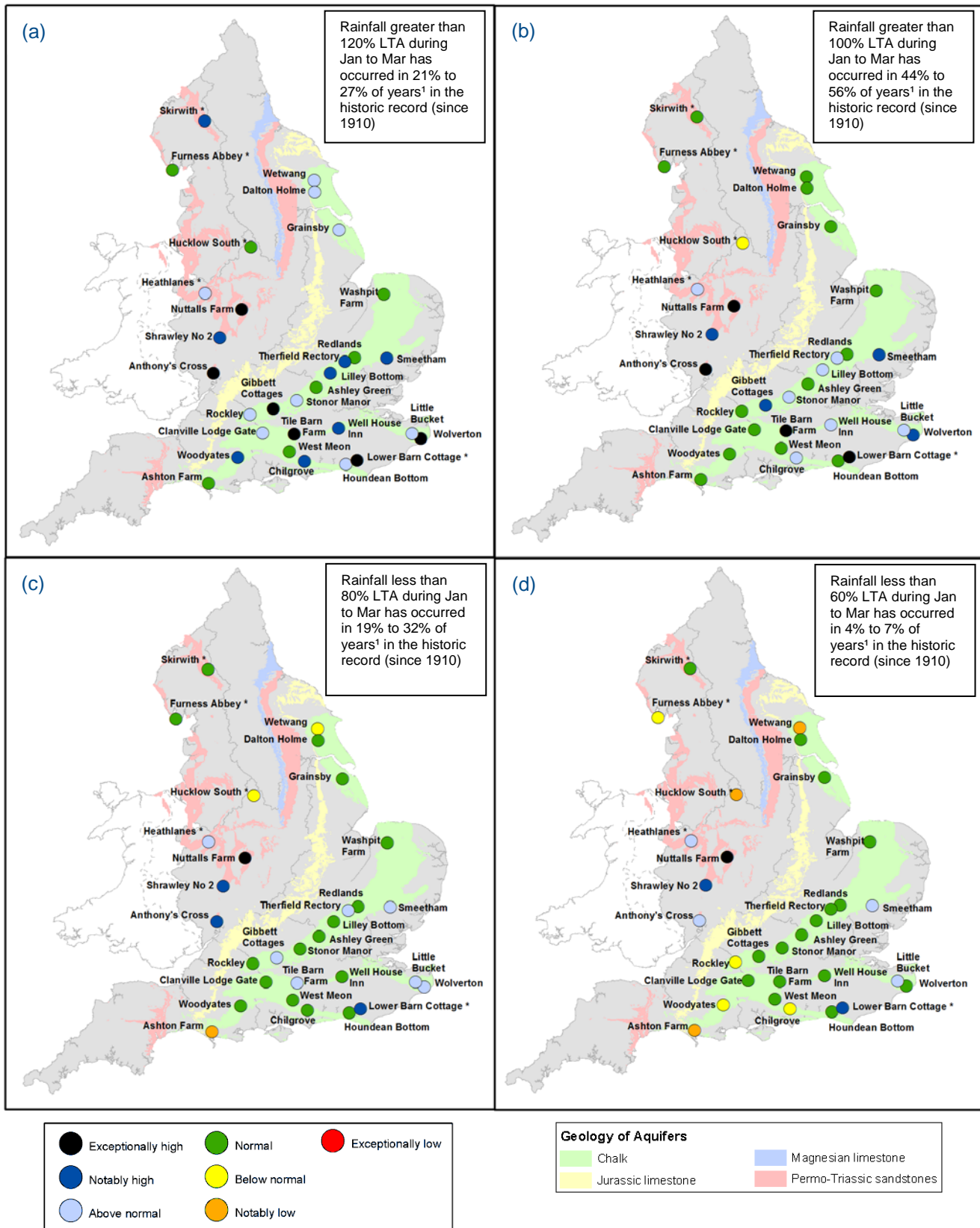


Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between January and March 2015 (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency, 100026380 2015.

¹ This range of probabilities is a regional analysis
 * Projections for these sites are produced by BGS

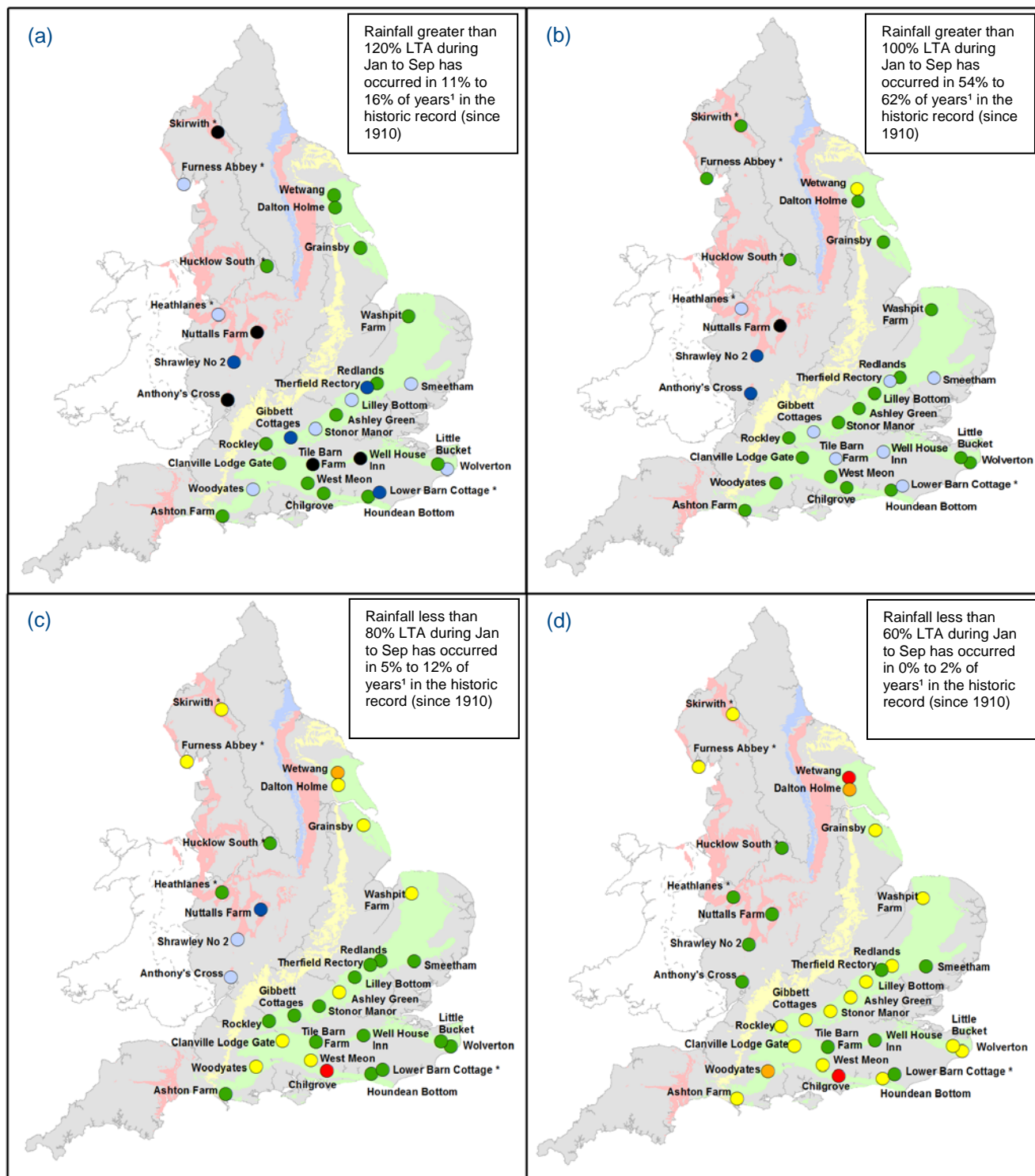
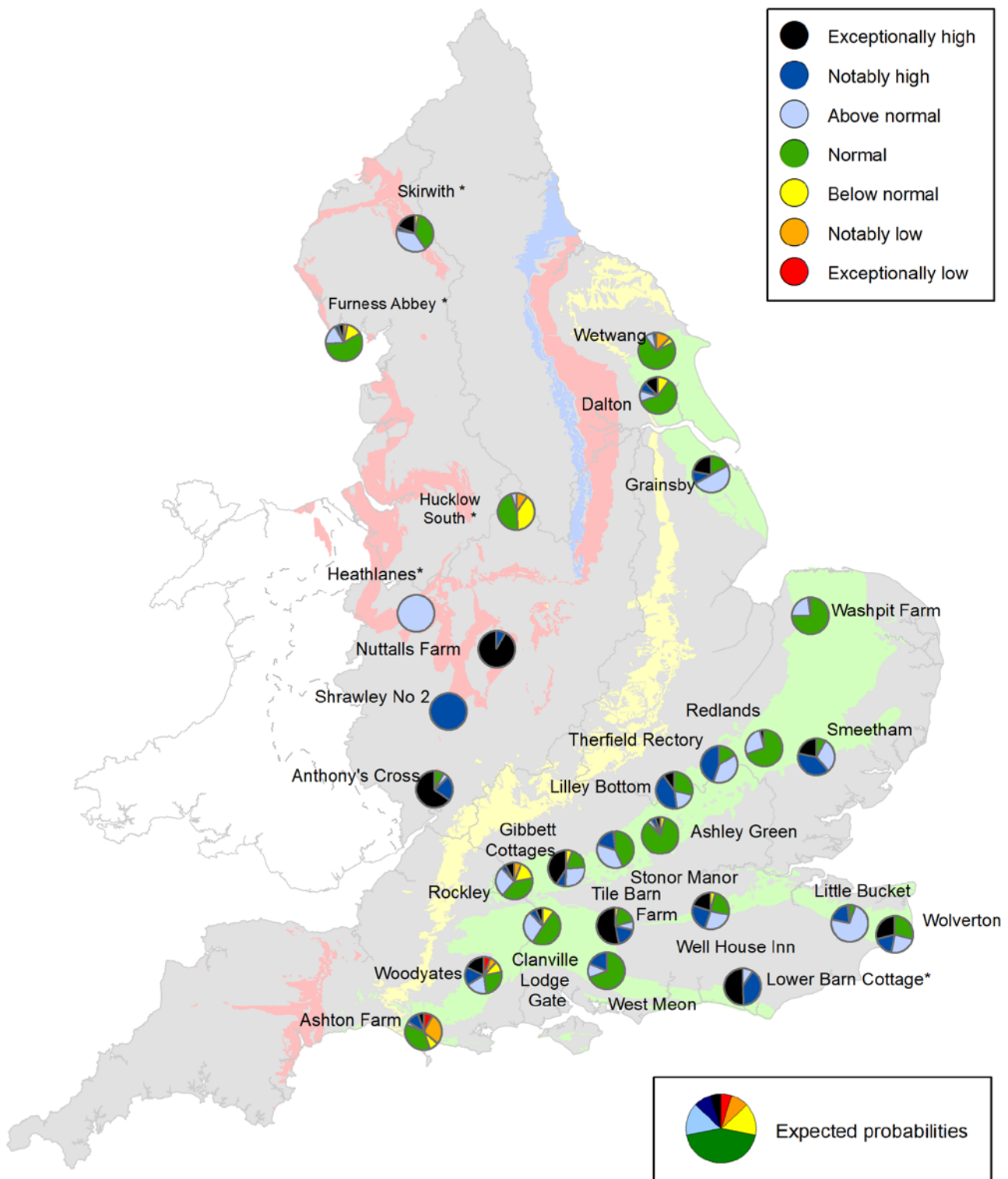


Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between January and September 2015 (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

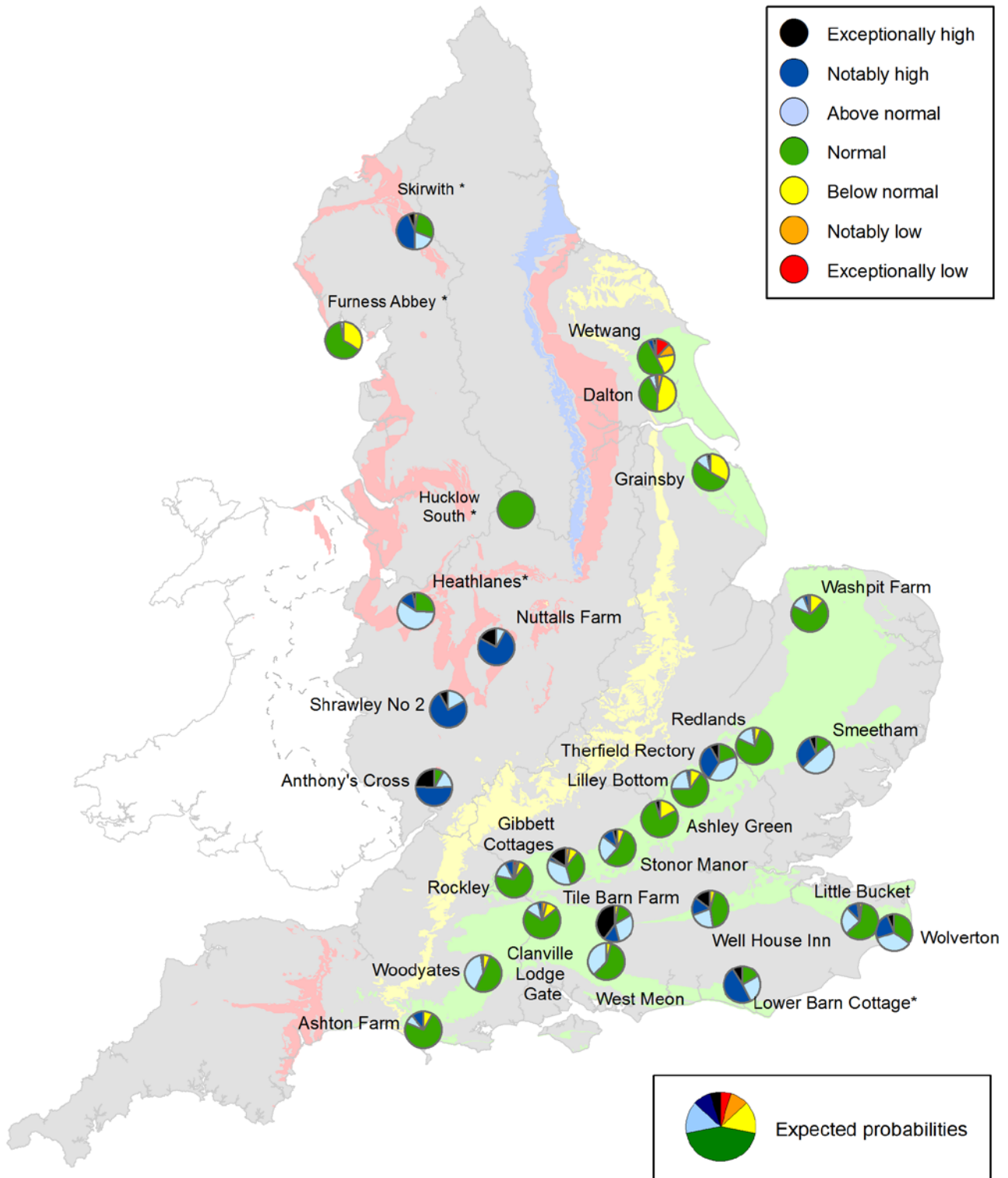
* Projections for these sites are produced by BGS
¹ This range of probabilities is a regional analysis



Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are those which would typically occur 44% of the time within the historic record.

Figure 6.7: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2015. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the time of year. (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

* Projections for these sites are produced by BGS



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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2015. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the time of year. (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

* Projections for these sites are produced by BGS



Figure 7.1: Geographic regions

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Glossary

Term

Definition

Aquifer	A geological formation able to store and transmit water.
Areal average rainfall	The estimated average depth of rainfall over a defined area. Expressed in depth of water (mm).
Artesian	The condition where the groundwater level is above ground surface but is prevented from rising to this level by an overlying continuous low permeability layer, such as clay.
Artesian borehole	Borehole where the level of groundwater is above the top of the borehole and groundwater flows out of the borehole when unsealed.
Cumecs	Cubic metres per second (m ³ s ⁻¹)
Effective rainfall	The rainfall available to percolate into the soil or produce river flow. Expressed in depth of water (mm).
Flood Alert/Flood Warning	Three levels of warnings may be issued by the Environment Agency. Flood Alerts indicate flooding is possible. Flood Warnings indicate flooding is expected. Severe Flood Warnings indicate severe flooding.
Groundwater	The water found in an aquifer.
Long term average (LTA)	The arithmetic mean calculated from the historic record, usually based on the period 1961-1990. However, the period used may vary by parameter being reported on (see figure captions for details).
mAOD	Metres Above Ordnance Datum (mean sea level at Newlyn Cornwall).
MORECS	Met Office Rainfall and Evaporation Calculation System. Met Office service providing real time calculation of evapotranspiration, soil moisture deficit and effective rainfall on a 40 x 40 km grid.
Naturalised flow	River flow with the impacts of artificial influences removed. Artificial influences may include abstractions, discharges, transfers, augmentation and impoundments.
NCIC	National Climate Information Centre. NCIC area monthly rainfall totals are derived using the Met Office 5 km gridded dataset, which uses rain gauge observations.
Recharge	The process of increasing the water stored in the saturated zone of an aquifer. Expressed in depth of water (mm).
Reservoir gross capacity	The total capacity of a reservoir.
Reservoir live capacity	The capacity of the reservoir that is normally usable for storage to meet established reservoir operating requirements. This excludes any capacity not available for use (e.g. storage held back for emergency services, operating agreements or physical restrictions). May also be referred to as 'net' or 'deployable' capacity.
Soil moisture deficit (SMD)	The difference between the amount of water actually in the soil and the amount of water the soil can hold. Expressed in depth of water (mm).

Categories

Exceptionally high	Value likely to fall within this band 5% of the time
Notably high	Value likely to fall within this band 8% of the time
Above normal	Value likely to fall within this band 15% of the time
Normal	Value likely to fall within this band 44% of the time
Below normal	Value likely to fall within this band 15% of the time
Notably low	Value likely to fall within this band 8% of the time
Exceptionally low	Value likely to fall within this band 5% of the time