Monthly water situation report

England

Summary – January 2014

January has been exceptionally wet across many parts of England, with rainfall, flows and groundwater levels in some areas setting new records. England received 200% of the January long term average (LTA) rainfall. Significant rainfall over the month has exacerbated flooding across many parts of England, particularly in parts of the south east and south west where monthly rainfall totals have been classed as *exceptionally high*. Soil moisture deficits decreased in all areas during January. Monthly mean river flows for January were *above normal* or higher for the time of year in all areas and *exceptionally high* at almost two thirds of our indicator sites. Flows at fifteen indicator sites recorded their highest monthly mean for January. Groundwater levels are *exceptionally high* at one third of our indicator boreholes, with three sites having levels that are the highest on record for the end of January. Half of our reported reservoir groups are full. In the other reservoir groups, stocks increased at all but one reported site during January. Storage in England as a whole is 97% of total capacity at the end of the month.

Rainfall

January has been extremely wet across all parts of the country. Rainfall totals for January were highest in our South West Region where the cumulative total was 220 mm. In our other regions, totals ranged from 99 mm (Anglian Region) to 196 mm (South East Region) (Figure 1.1). Locally, the highest rainfall totals (more than 250 mm) fell across Cumbria and many parts of central, south eastern and south western England. The lowest rainfall totals (less than 90 mm) fell across parts of Norfolk, Suffolk and Cambridgeshire.

January rainfall totals were *above normal* or higher for the time of year across the whole of England and *exceptionally high* across extensive areas of central, southern south eastern and south western England. Cumulative rainfall totals across these areas were also *exceptionally high* for the time of year for the past two and six months. (Figure 1.2).

All of our regions have received more than 160% of the January LTA. Our South East Region received almost 275% of the average monthly rainfall, Midlands Region received 215% and our other regions received between 160% and 194%. Overall England received 200% of the January LTA (Figure 1.3). Over half of catchments across England received more than 200% of the LTA rainfall for January and catchments across Hampshire, West Sussex, Surrey and Oxfordshire received more than 300%.

January 2014 has been the wettest January since records began in 1910 in almost 50% of catchments, with almost 90% of catchments in our South East Region and almost 60% in our South West Region recording new maxima. Our Midlands, South East and South West Regions and England as a whole have seen the wettest January on record. The two month period ending January 2014 was also wettest in our South East Region (since 1910) and second wettest since 1930 in our South West Region.

Soil moisture deficit

Soil moisture deficits (SMDs) continued to decrease in all six of our regions during January. At the end of the month, SMDs were less than 10 mm across almost all of the country (Figure 2.1). Month end SMDs were within 5 mm of the LTA across most of England, but were 6-25 mm less than the LTA in around one quarter of the MORECS squares reported on, mainly covering parts of Lincolnshire and Nottinghamshire (Figure 2.1).

At the beginning of January, SMDs ranged from zero in our North West Region to 15 mm in our Anglian Region. SMDs have decreased steadily throughout the month and by the end of January, ranged from zero in our North West, South East and South West Regions to less than 5 mm in our Anglian Region. SMDs in all our regions were less than the LTA (Figure 2.2).

River flows

Monthly mean river flows for January increased compared to December at all but one of our reported indicator sites across England. Figure 3.1).

Monthly mean river flows for January were *above normal* or higher for the time of year at more than 90% of our indicator sites across England. Flows at almost two thirds of sites were *exceptionally high* for the time of year, notably in the lower River Severn and all of South East and South West Region. Flows for fifteen rivers had the highest monthly mean on record for January. Flows at a further six sites were *notably high*. (Figure 3.1).

The monthly mean river flows at four of the seven regional index sites were *exceptionally high* for the time of year. Monthly mean river flows at Kingston on the River Thames were the highest of any month in the naturalised flow records which starts in 1883, and the second highest gauged monthly mean flow on record (the highest being March 1947) (Figure 3.2).

Groundwater levels

During December, groundwater levels increased at all of our indicator sites. At the end of January, groundwater levels were *normal* or higher for the time of year at all sites reported on. Levels at eight sites (a third of the total number) were *exceptionally high*, with six of these sites located in chalk aquifers in southern England (Figures 4.1 and 4.2).

Priors Heyes (West Cheshire Sandstone) and Skirwith (Carlisle Basin and Eden Valley Sandstone) in our North West Region, Well House Inn (Epsom North Downs Chalk) in our South East Region and Tilshead (Upper Hampshire Avon Chalk) in our South West Region had the highest January month end levels on record. Levels at Tilshead are artesian meaning that groundwater levels are above the ground level. Please note, however, that Priors Heyes remains high compared to historic levels on account of the aquifer recovering from the effects of historic abstraction.

Reservoir storage

During January, reservoir stocks increased or remained unchanged at all but one of the reported reservoirs and reservoir groups. Increases were greater than 10% of full capacity at four of the reservoirs or reservoir groups. In our South West Region Blagdon, Chew Valley and Wimbleball increased by up to 20% and Farmoor in our South East Region increased by 16% of full capacity. Eleven reservoirs or reservoir groups (a little under half) are full. Reservoir stocks are *normal* or higher for the time of year at all of the reported sites (Figure 5.1).

At a regional scale, reservoir stocks increased in all our regions by between 2% and 4% of full capacity. At the end of January, regional reservoir stocks remained lowest in our Anglian Region at 93% of total capacity and were highest in our North West Region at 99%. Overall reservoir storage for England increased during January to 97% of total capacity (Figure 5.2).

Forward look

February is likely to remain unsettled and changeable throughout. Mid-month, temperatures may decrease, with the chance of snow in the north of England. The predominance of wet and windy weather is likely to continue through to the beginning of March, when drier spells may be interspersed with Atlantic weather systems[1].

Scenario based projections for river flows at key sites [2]

March 2014: With average (100% of the LTA) rainfall between February 2014 and the end of March 2014, river flows are likely to be *normal* at a third of our modelled sites, and *above normal* or higher at two thirds. With 120% of the LTA rainfall, river flows are likely to be *notably high* or higher at more than two thirds of the modelled sites. With 80% of the LTA rainfall river flows are likely to be *normal* or higher at all of the modelled sites (see Figure 6.1).

September 2014: With average rainfall between February 2014 and the end of September 2014, river flows are likely to be *normal* or higher at all of our modelled sites. With above average rainfall (120% of the LTA), flows are likely to be *exceptionally high* at more than a third of our modelled sites. With below average rainfall (80% of the LTA), river flows are likely to be *normal* or *below normal* at two thirds of the modelled sites (see Figure 6.2).

Probabilistic ensemble projections for river flows at key sites [2]

March 2014: At more than four fifths of the modelled sites, there is a greater than expected chance of *exceptionally high* flows from February 2014 to the end of March 2014. There is also a greater than expected chance of *above normal* flows at nearly two thirds of the modelled sites (see Figure 6.3).

[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.

September 2014: There is a greater than expected chance of *notably high* flows at the end of September 2014 at three quarters of the modelled sites. There is also a greater than expected chance of *above normal* flows at half of the modelled sites (see Figure 6.4).

Scenario based projections for groundwater levels in key aquifers[3]

March 2014: With average rainfall (100% of the LTA) from February 2014 to March 2014, groundwater levels are likely to be *normal* or higher for the time of year at all of the modelled sites, and *above normal* or higher at more than two thirds of modelled sites. With above average rainfall (120% of the LTA) groundwater levels are likely to be *exceptionally high* at nearly half of the modelled sites. With 80% of the LTA rainfall, all except one of the modelled sites are likely to have *normal* or higher groundwater levels for the time of year (see Figure 6.5).

September 2014: With average rainfall (100% of the LTA) from February 2014 to September 2014, groundwater levels are likely to be *normal* or higher for the time of year at all but two of the modelled sites. With above average rainfall (120% of the LTA), levels are likely to be *above normal* or higher for the time of year at nearly two thirds of the modelled sites. With below average rainfall (80% of the LTA), groundwater levels are likely to be *normal* or higher at four fifths of our modelled sites (see Figure 6.6).

Probabilistic ensemble projections for groundwater levels in key aquifers [3]

March 2014: More than a half of all modelled sites have a greater than expected chance of *exceptionally high* groundwater levels for the time of year (see Figure 6.7).

September 2014: More than half of the modelled sites have a greater than expected chance of levels being *above normal* for the time of year. A third of the modelled sites have a greater than expected chance of *normal* groundwater levels for the time of year (see Figure 6.8).

Authors: Karen Croker and Tom Schnetler (Hydrology – Water Resources Technical Services)

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

Rainfall

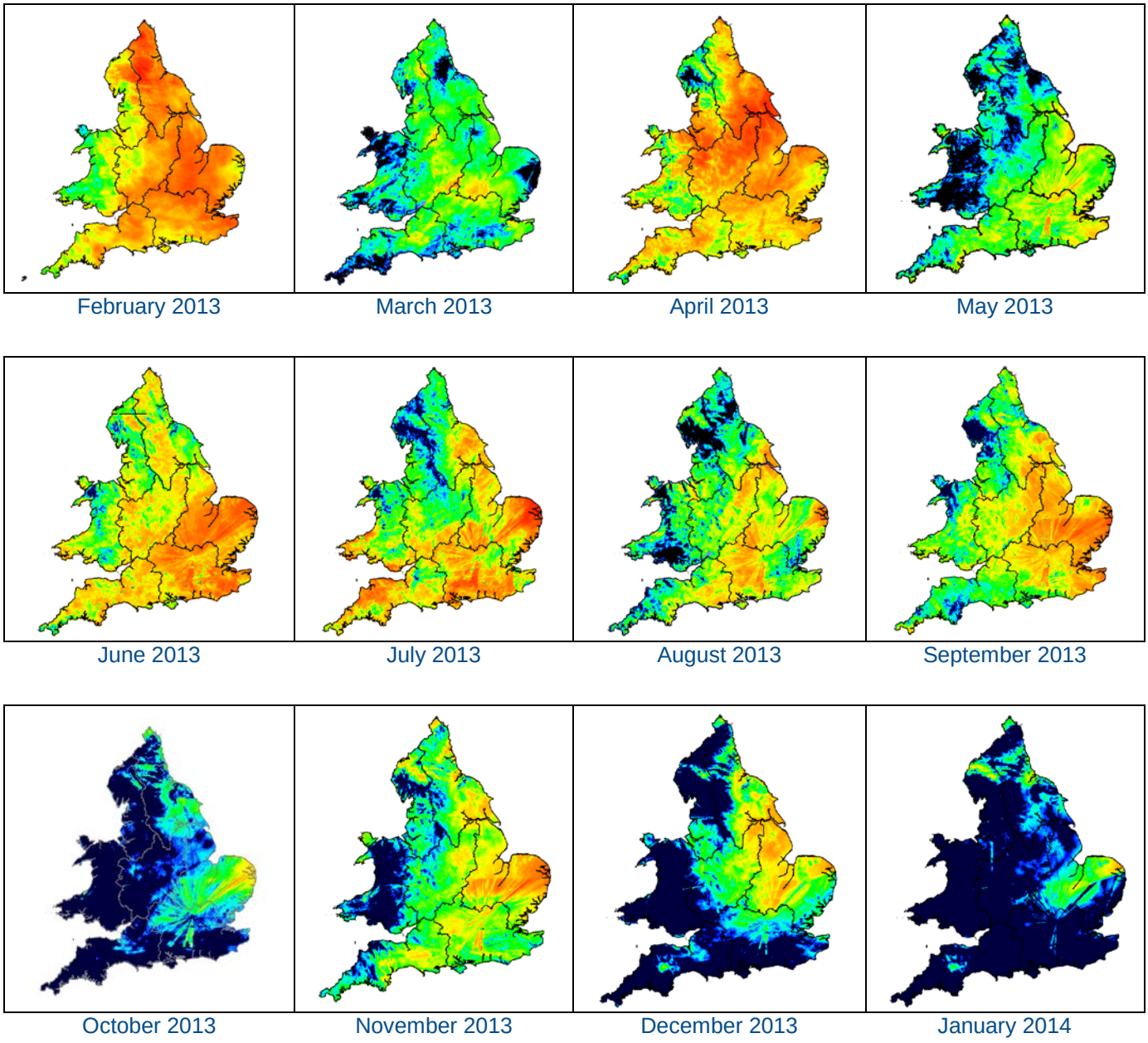


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2014). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

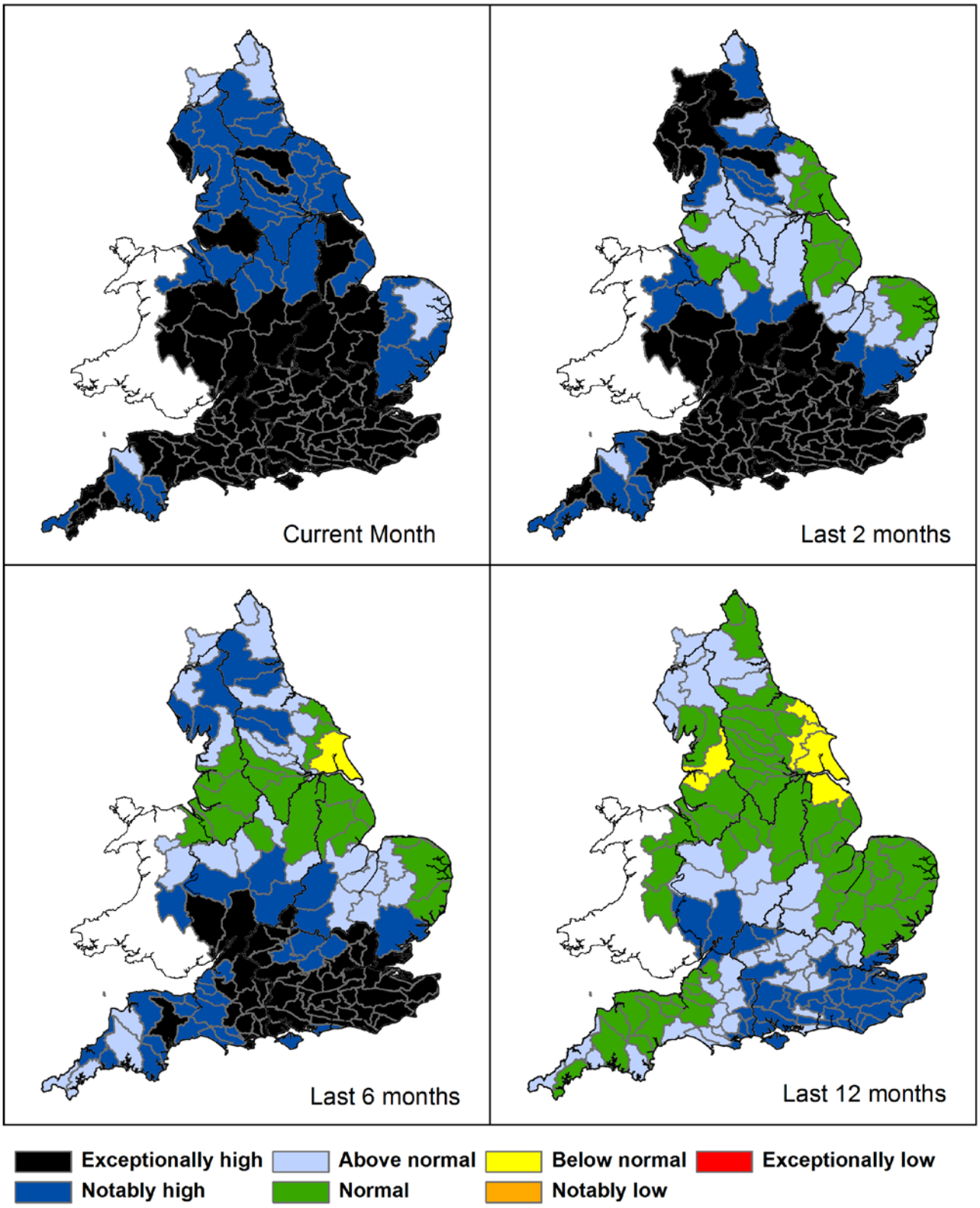


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31st January), the last two months, the last six months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2014).* Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

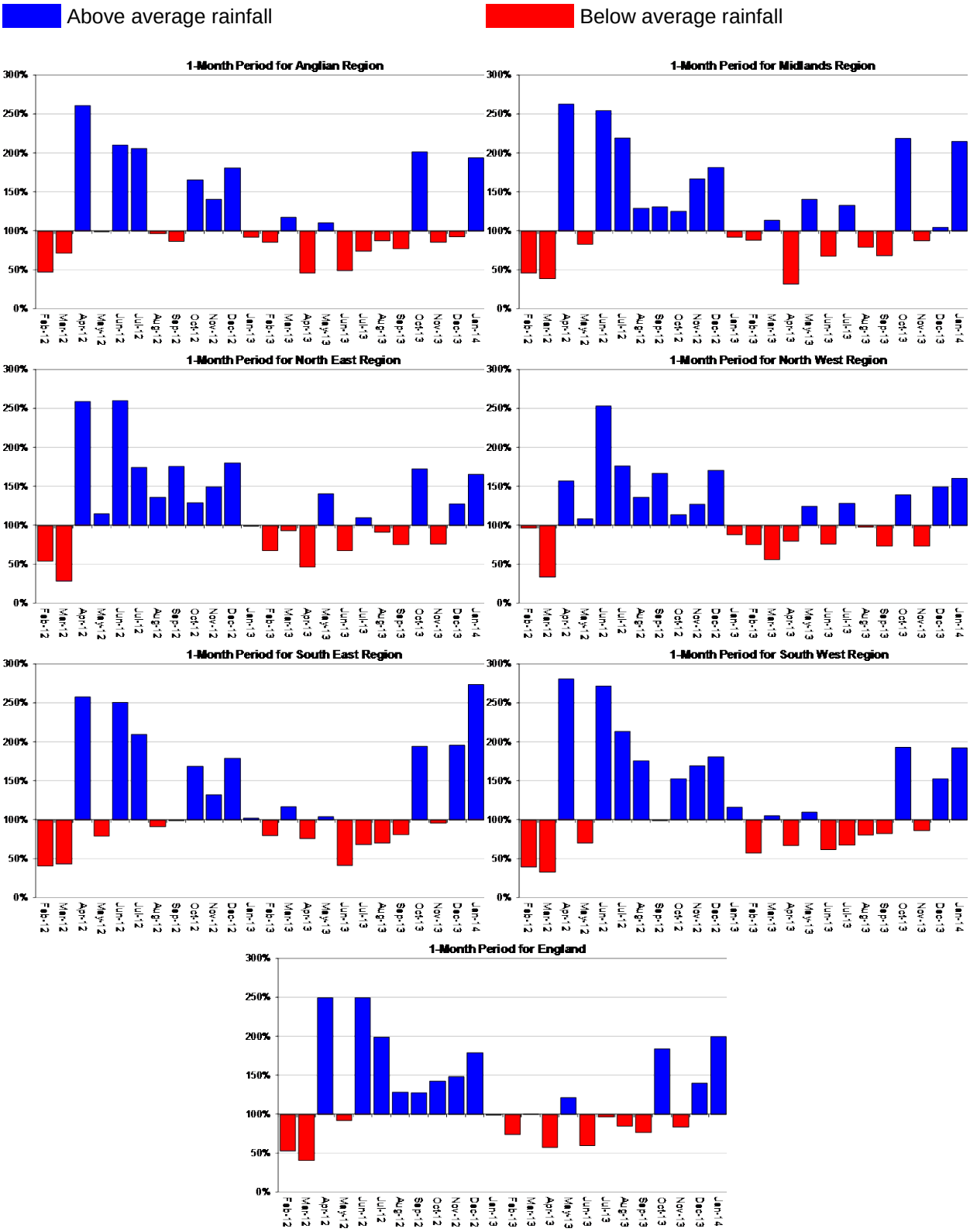


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each Environment Agency Region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2014).

Soil moisture deficit

End of December 2013[1]	End of January 2014[2]

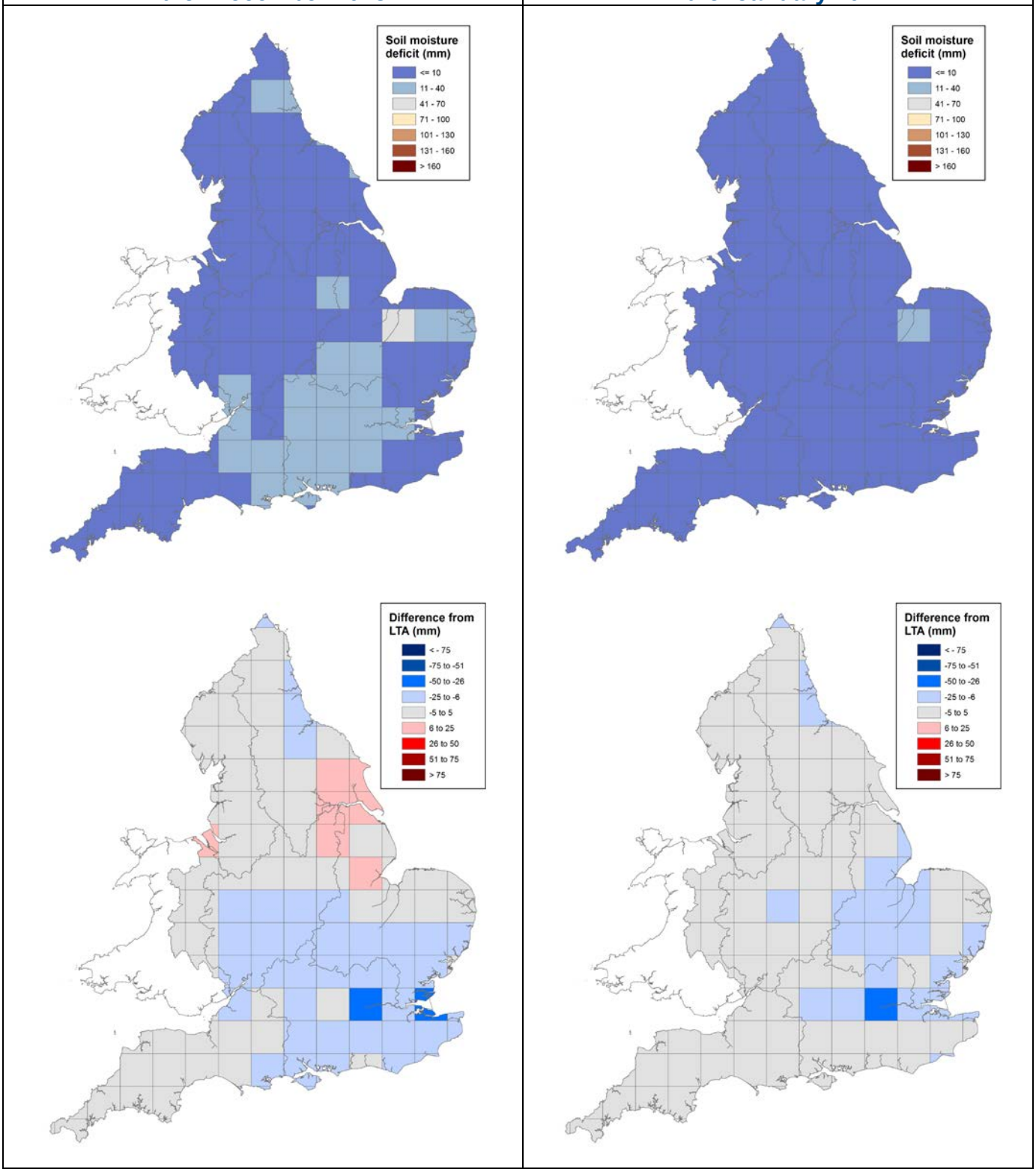


Figure 2.1: Soil moisture deficits for weeks ending 24 December 2013 [1] (left panel) and 28 January 2014 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2014). Crown copyright. All rights reserved. Environment Agency, 100026380, 2014

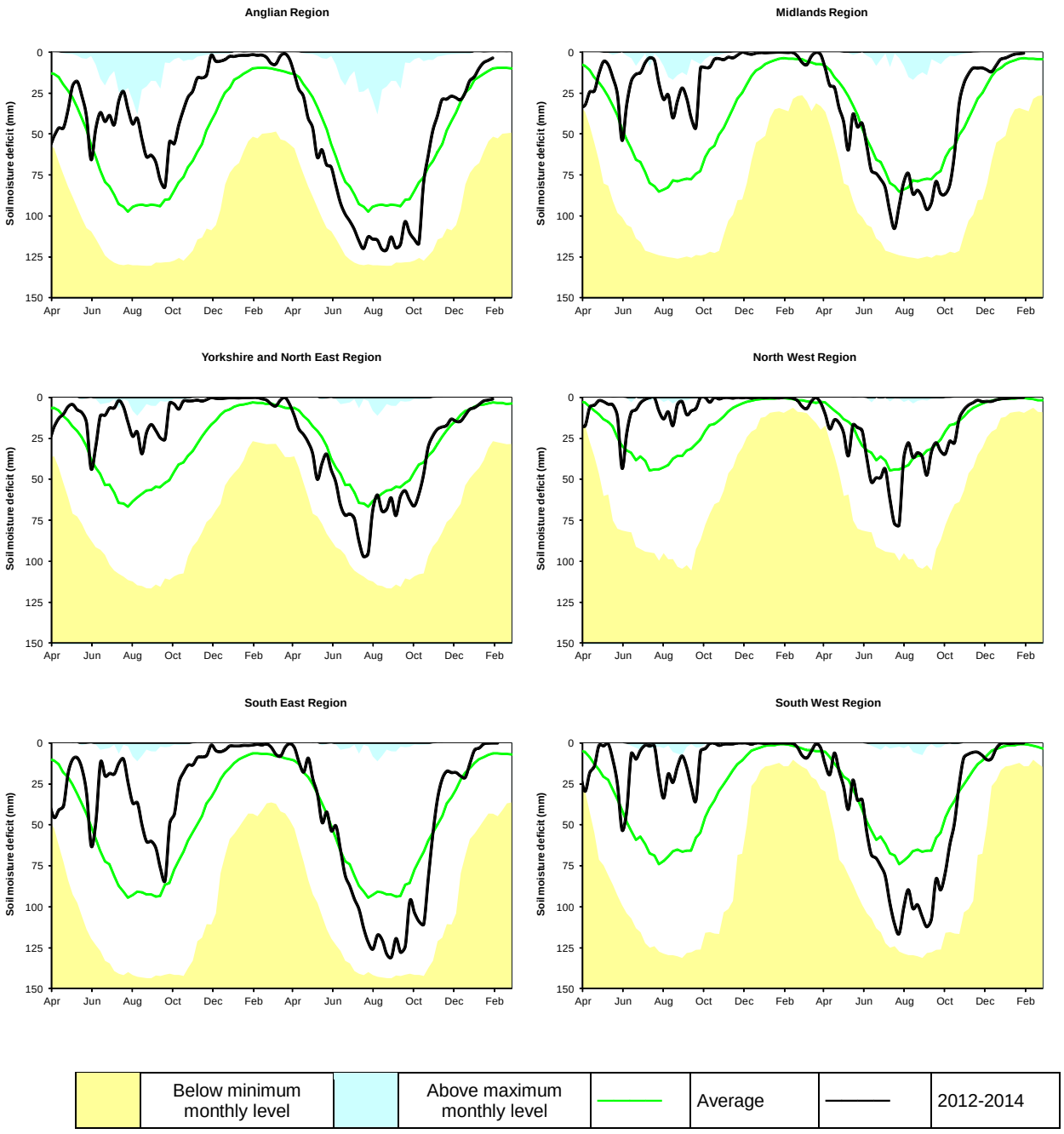
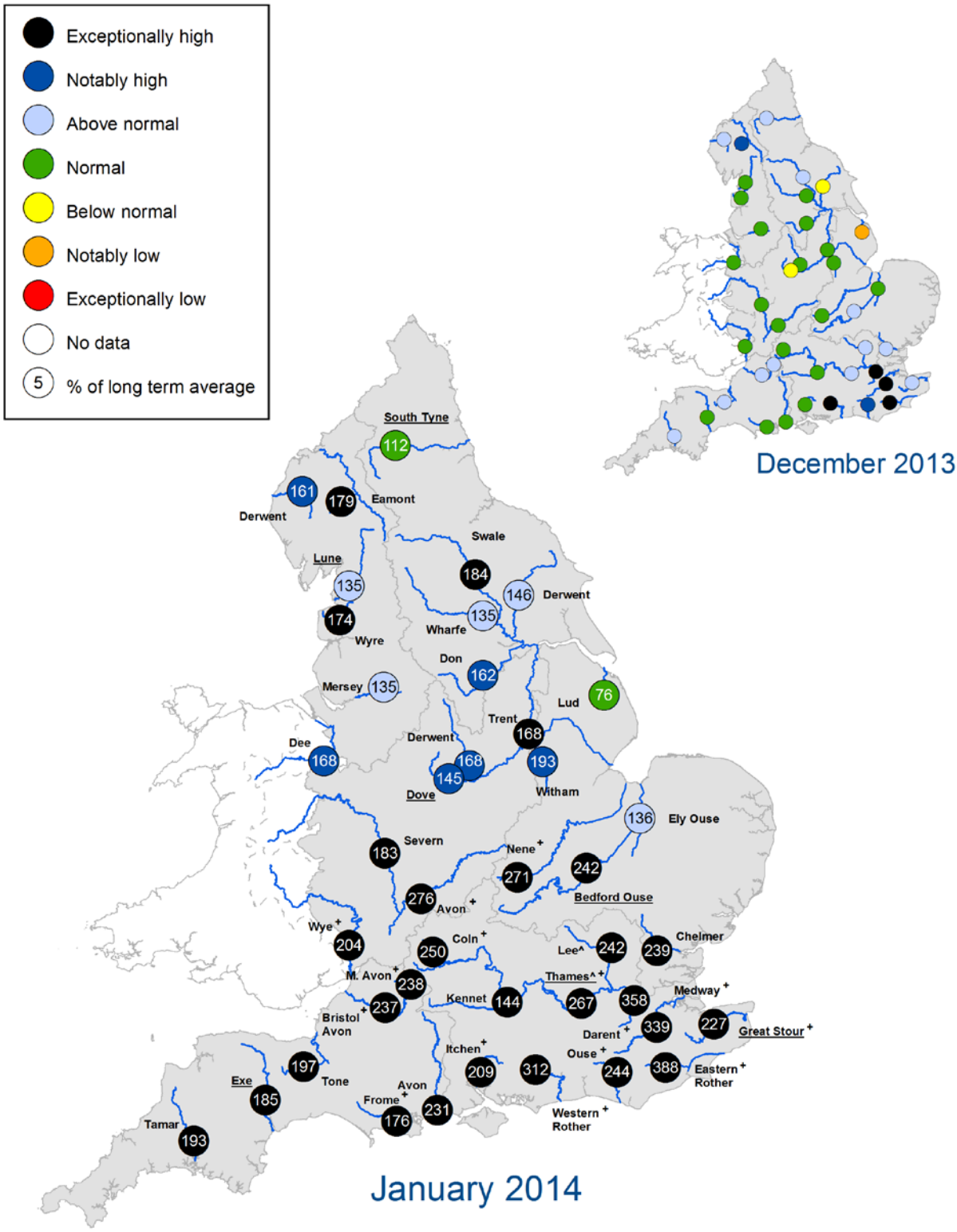


Figure 2.2: Latest soil moisture deficits for all Environment Agency Regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2014).

River flows



^ "Naturalised" flows are provided for the 'Thames at Kingston' and the 'Lee at Feildes Weir'

\+ Monthly mean flow is the highest 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 December 2013 and January 2014, expressed as a percentage of the respective long term average and classed relative to an analysis of historic December and January monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

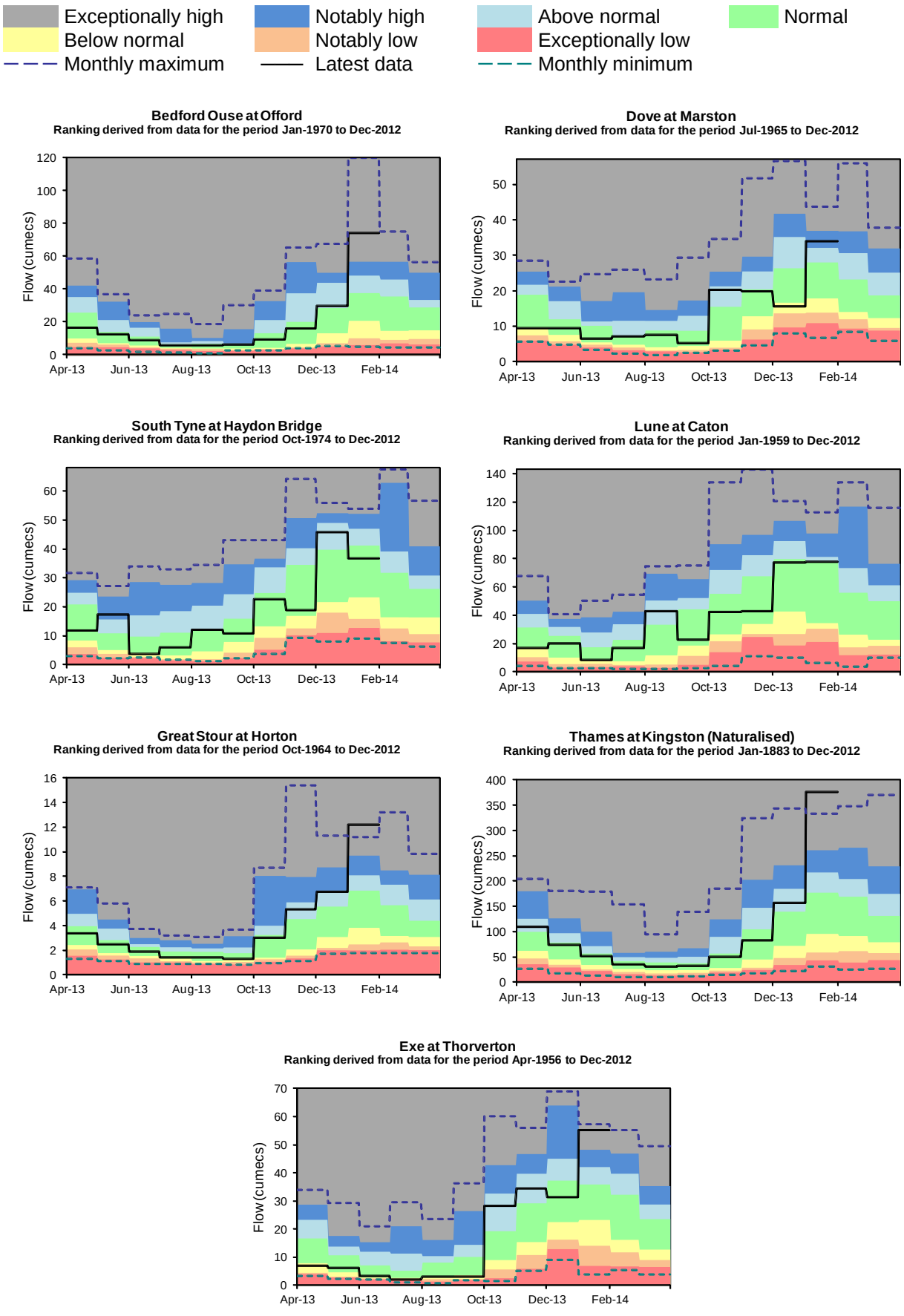
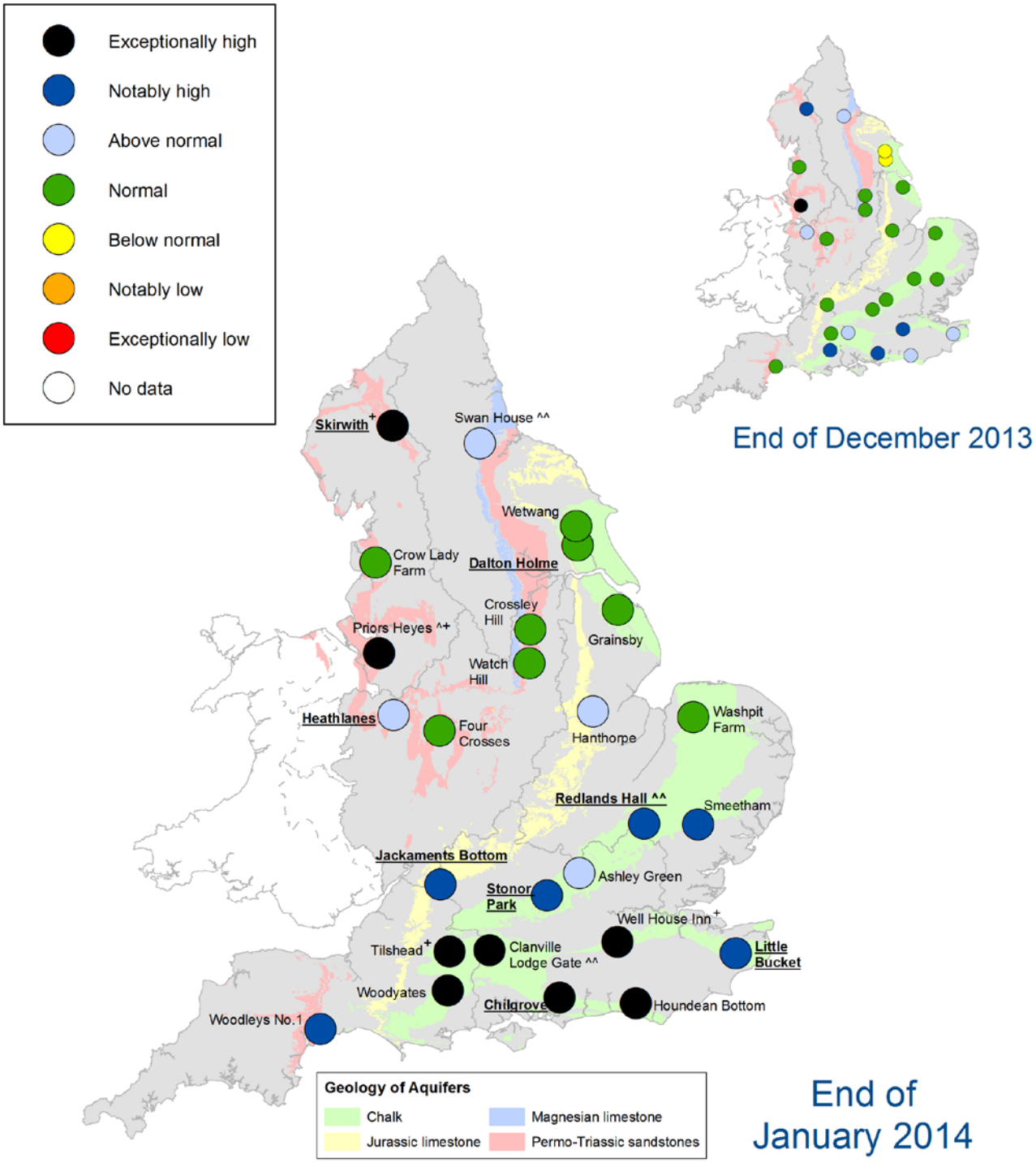


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

Groundwater levels



^ 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 on record (note that record length varies between sites).
Underlined 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 December 2013 and end of January 2014, classed relative to an analysis of respective historic December and January levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Note: All groundwater levels are from telemetry except those marked. Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

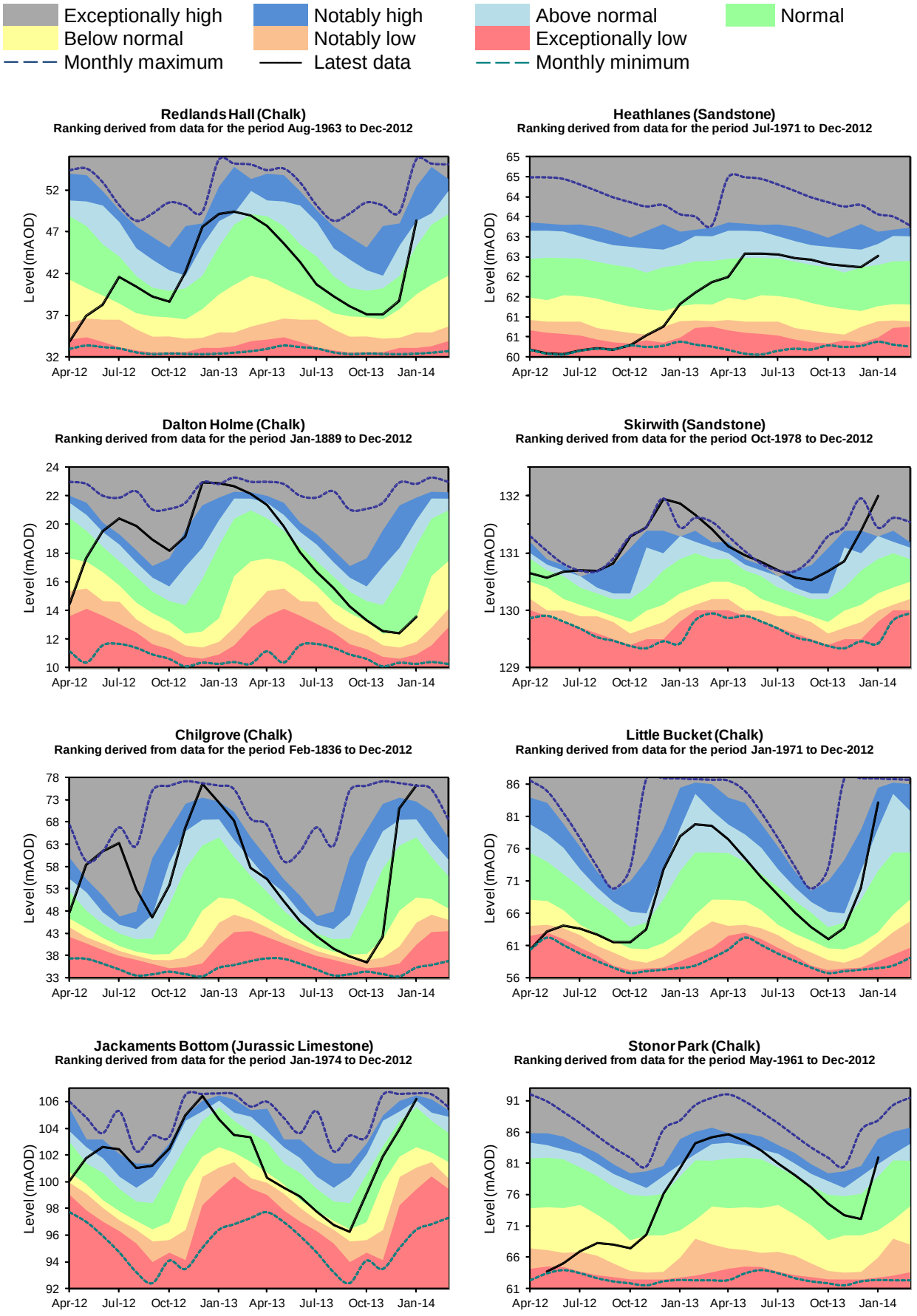
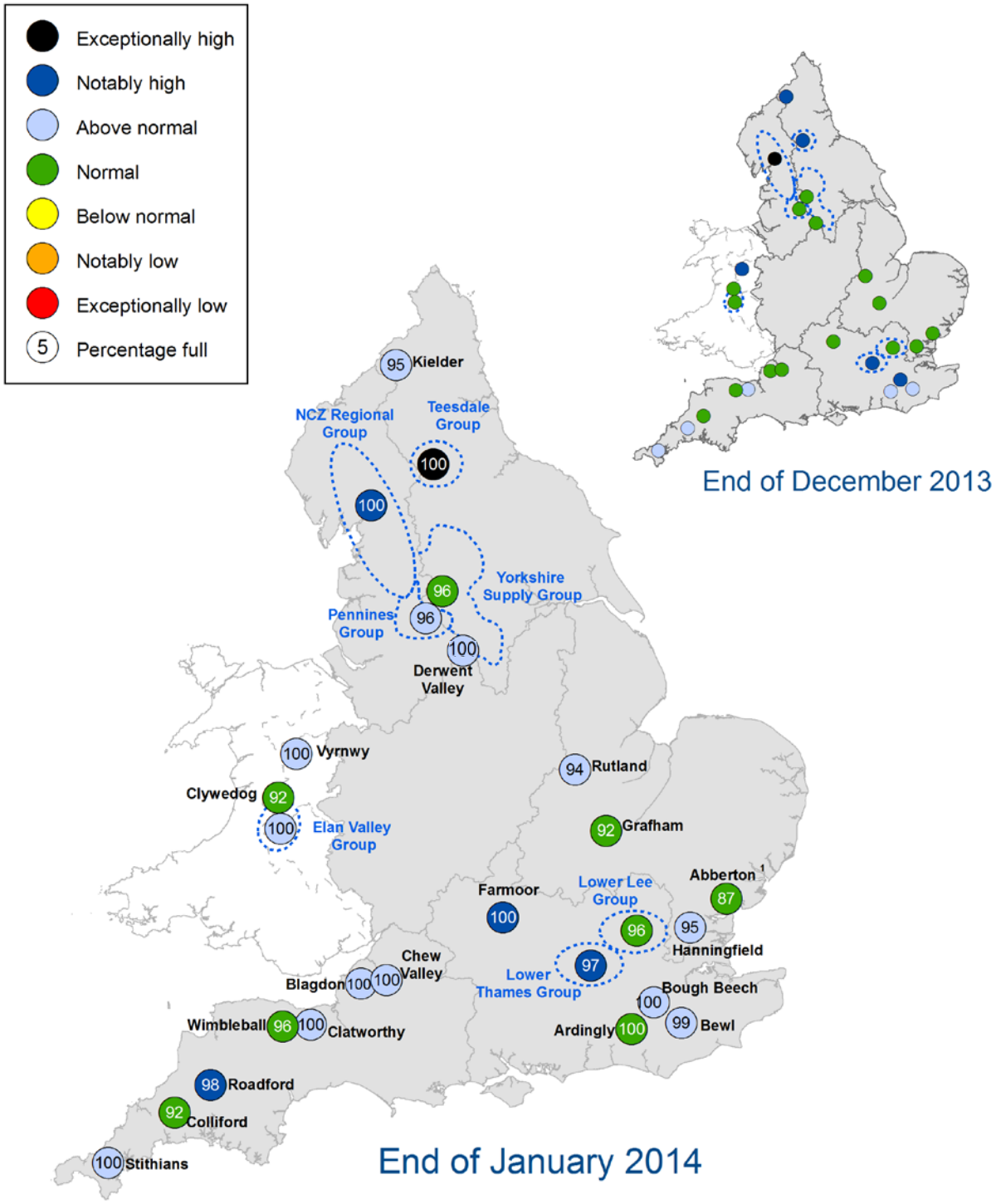


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2014).

Reservoir storage



1. The level at Abberton Reservoir in Anglian Region is affected by ongoing engineering works to increase capacity by 60%
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to our Midlands and North West regions

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of December 2013 and end of January 2014 as a percentage of total capacity and classed relative to an analysis of historic December and January 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, 2014.

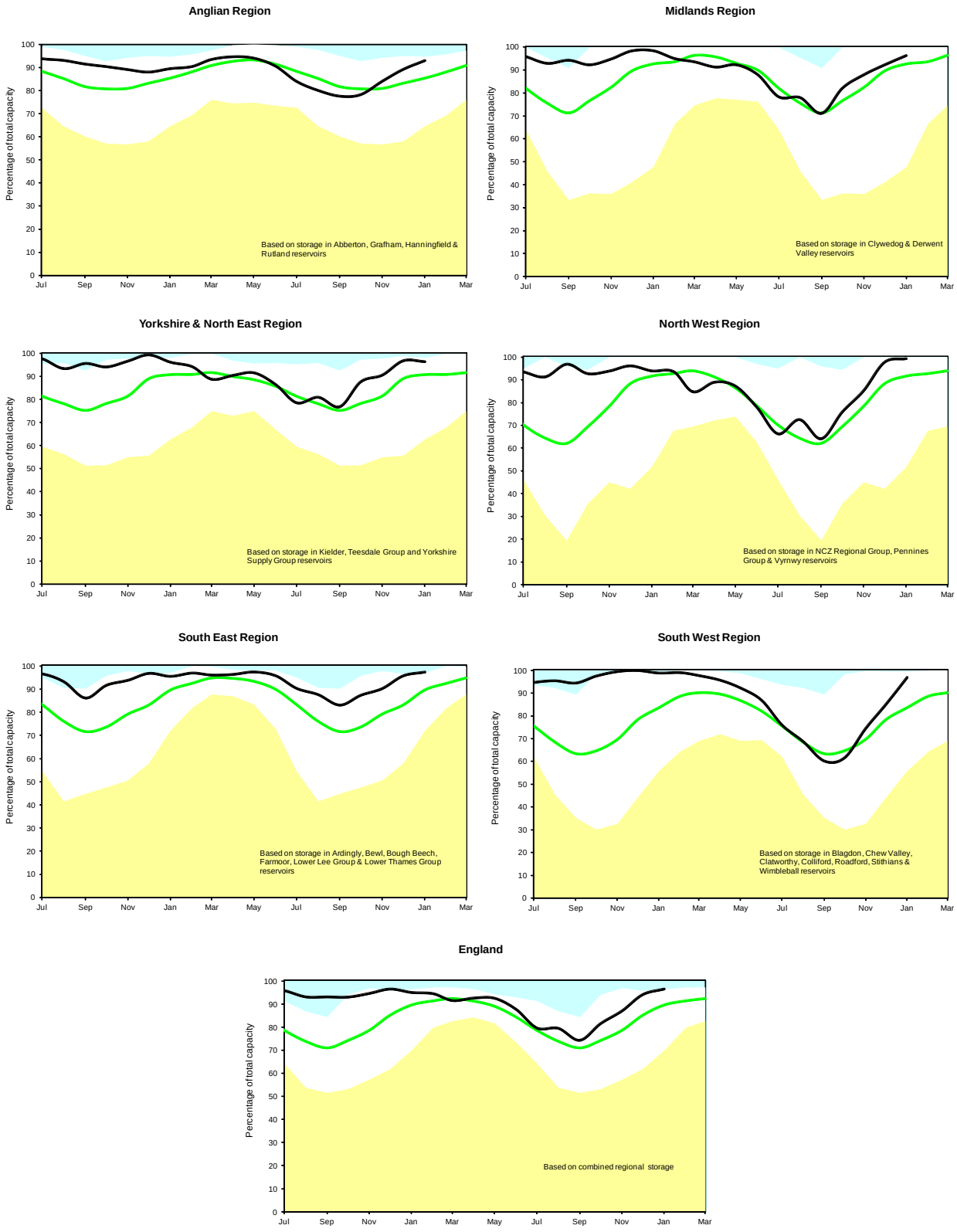


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

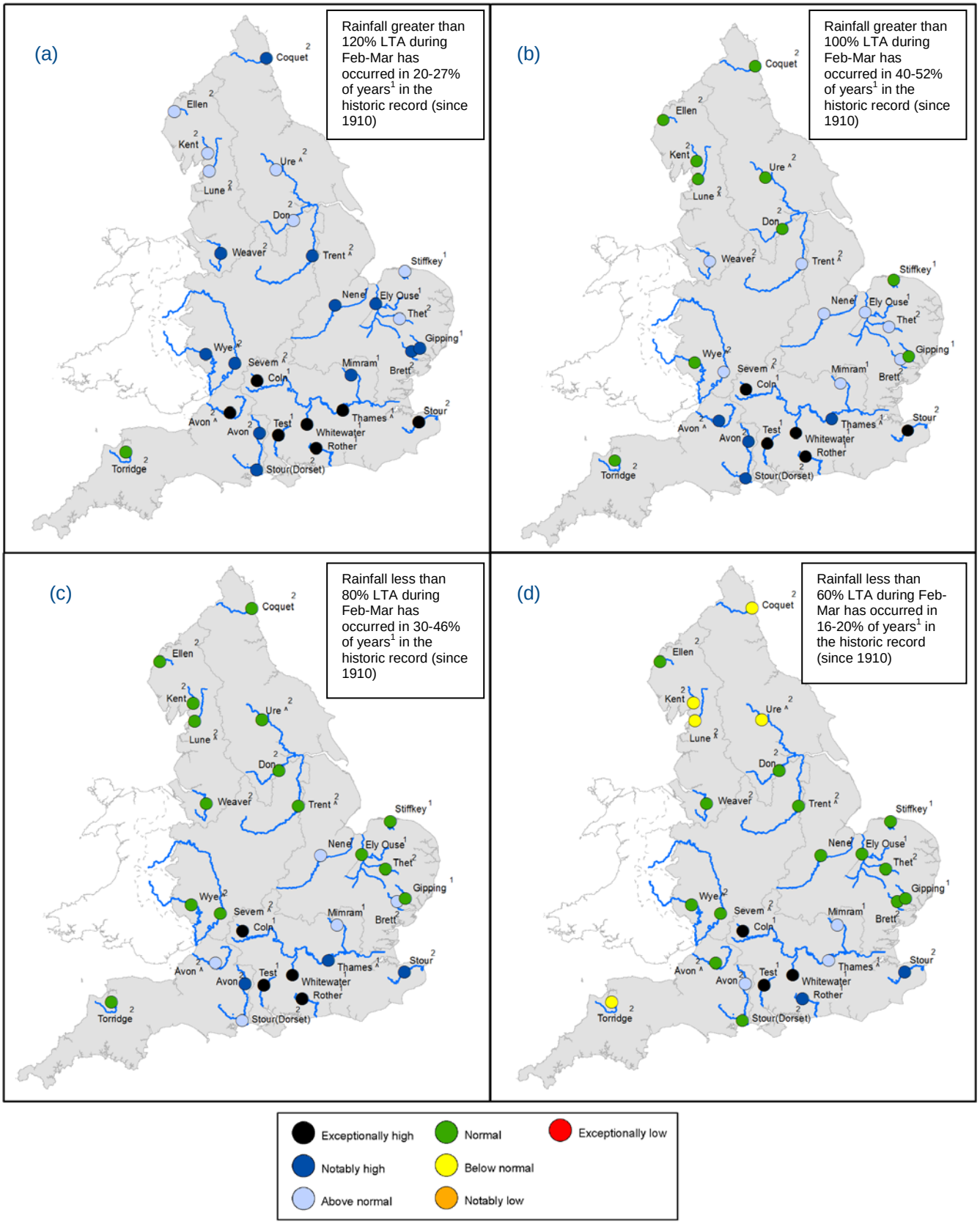
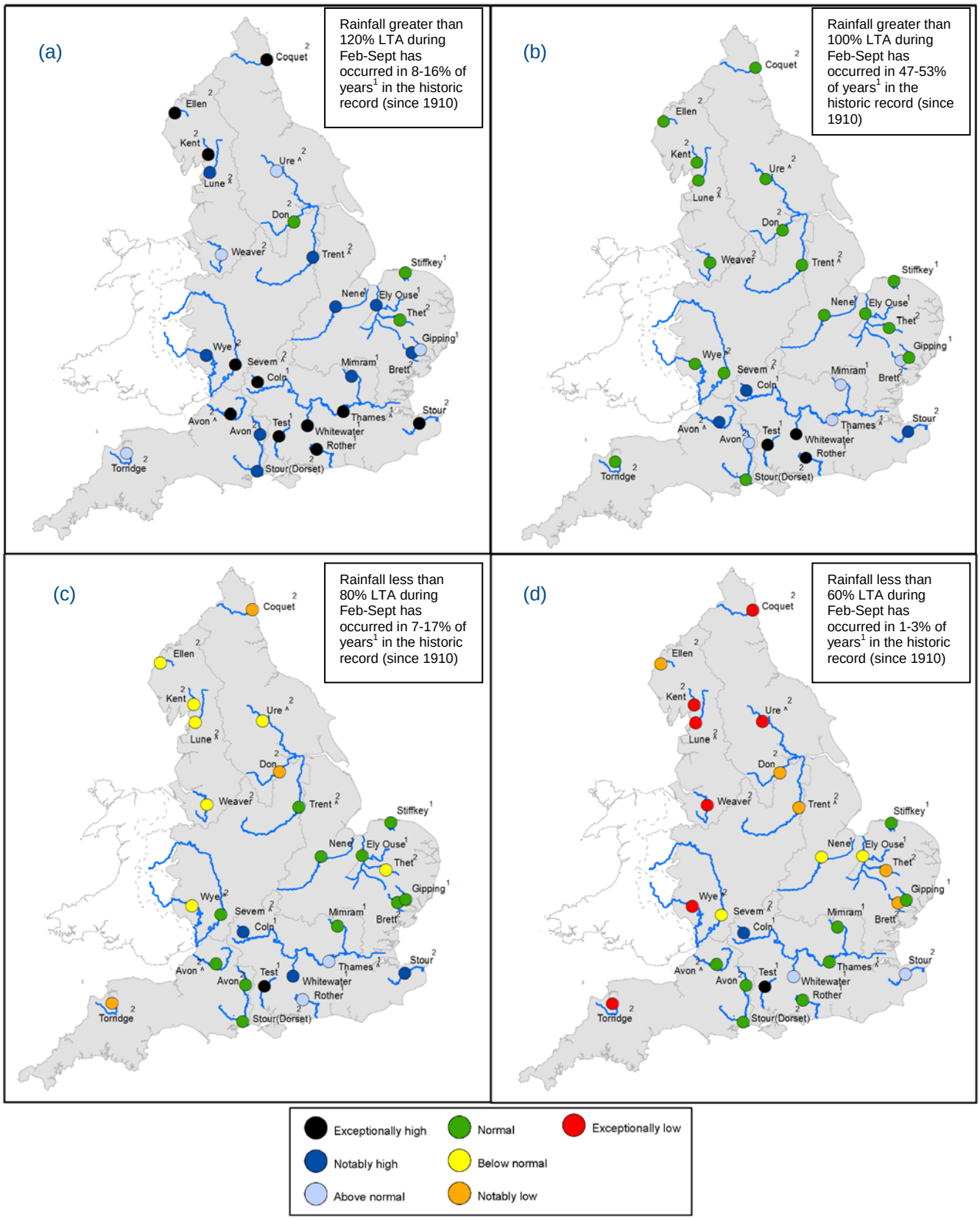


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between February 2014 and March 2014 (Source: Centre for Ecology and Hydrology, Environment Agency)

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



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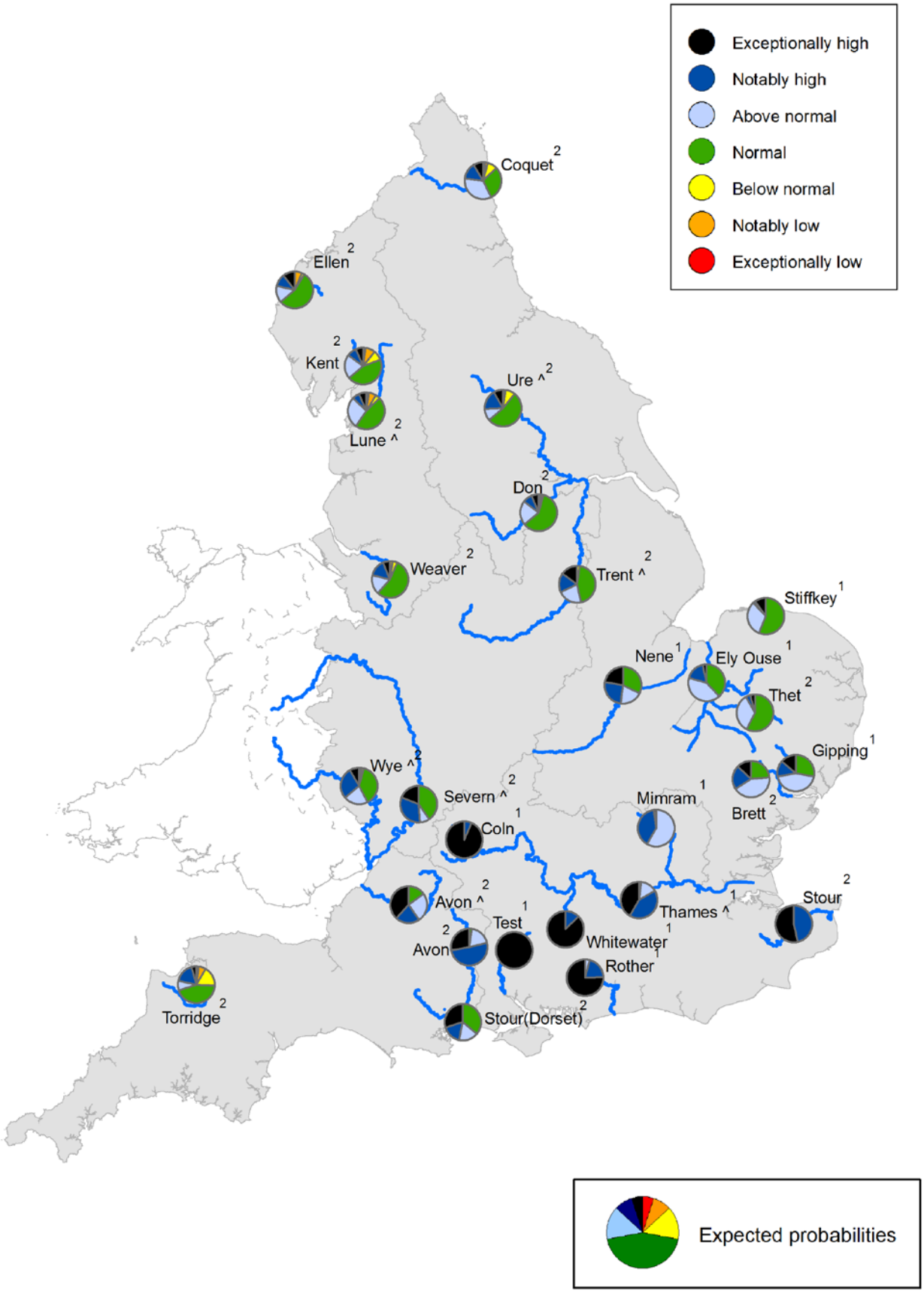

Figure 6.3: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2014. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

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.

^ *"Naturalised" flows are projected for these sites'*

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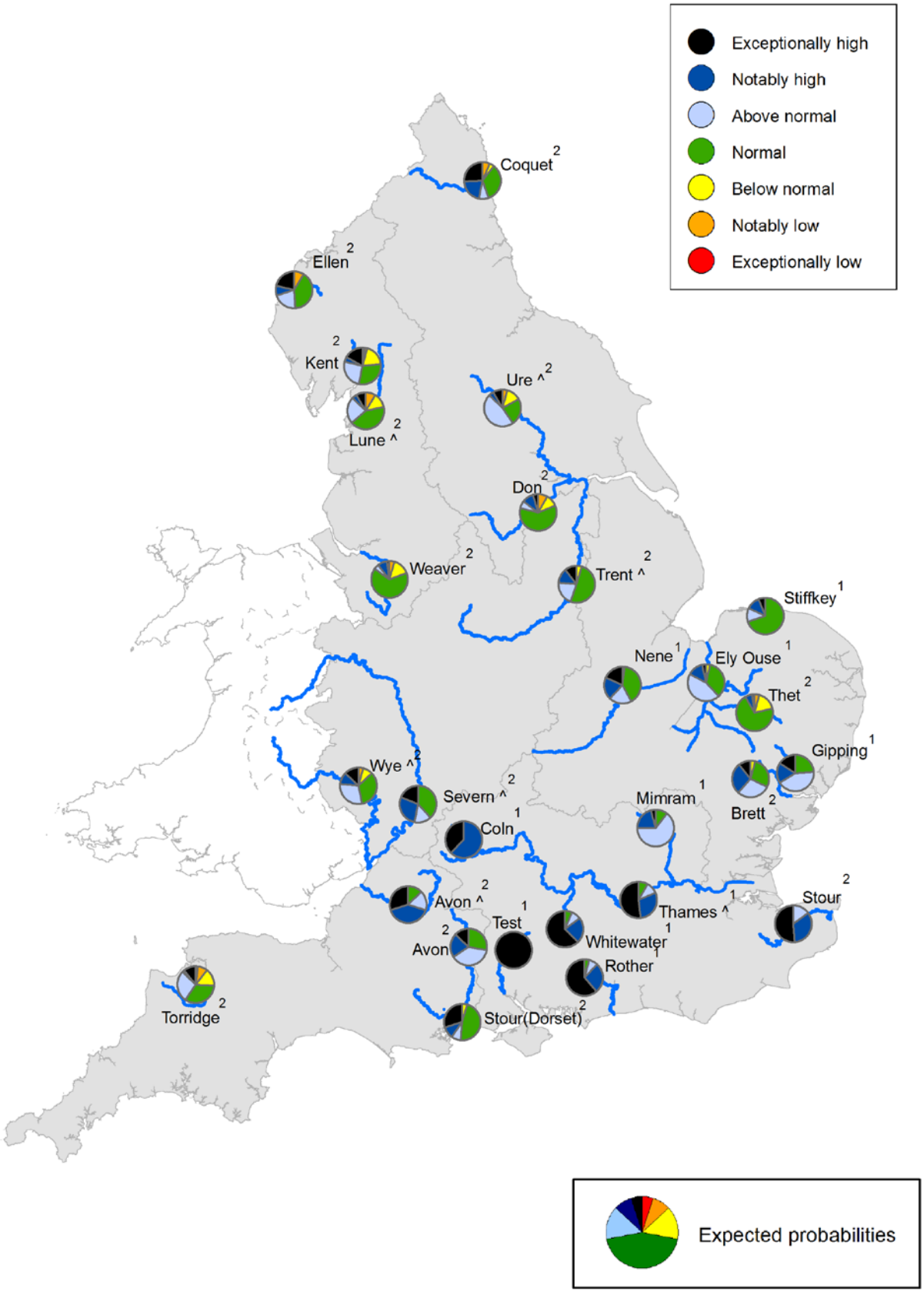

Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2014. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

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Forward look - groundwater

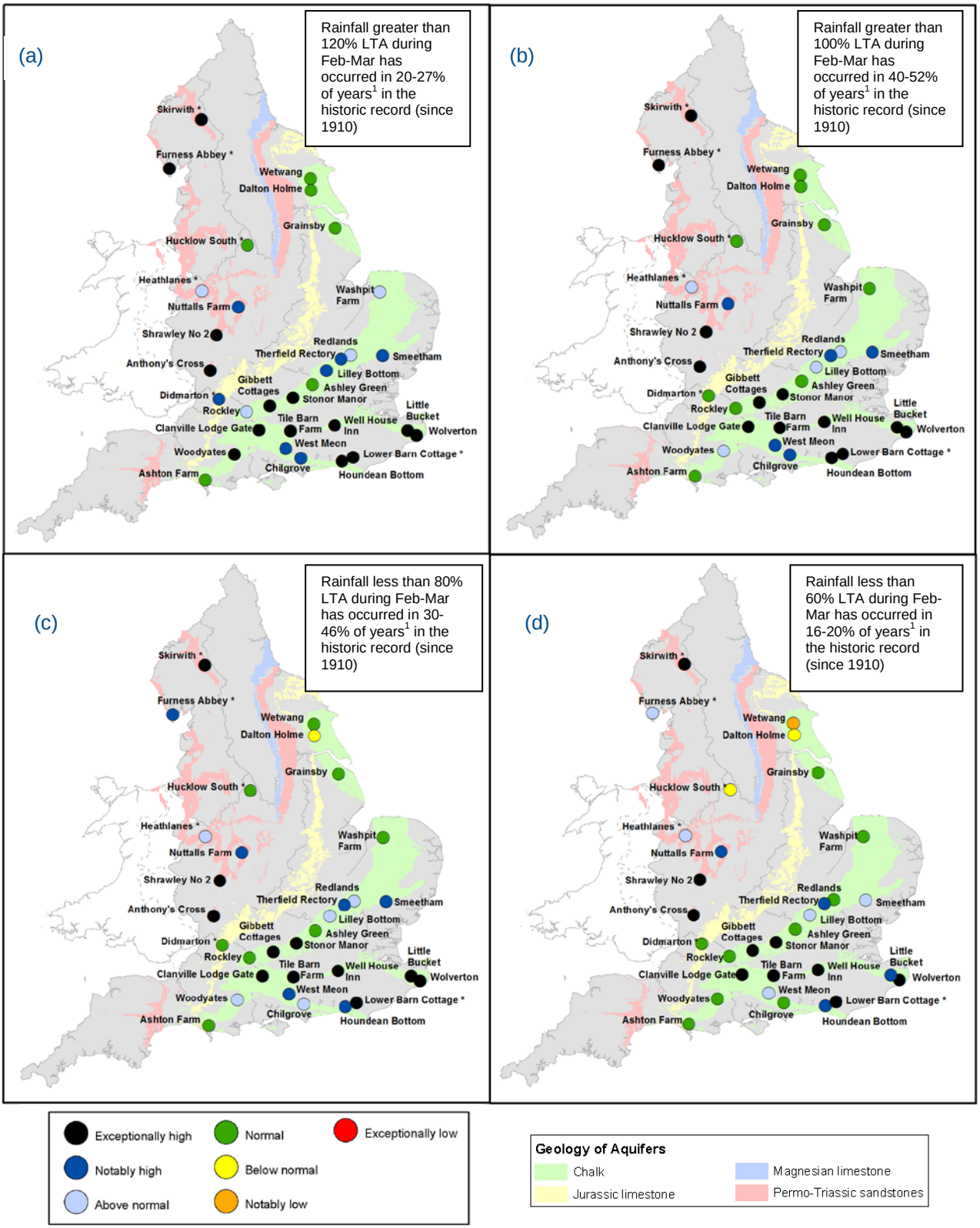

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between February 2014 and March 2014 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2014.

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

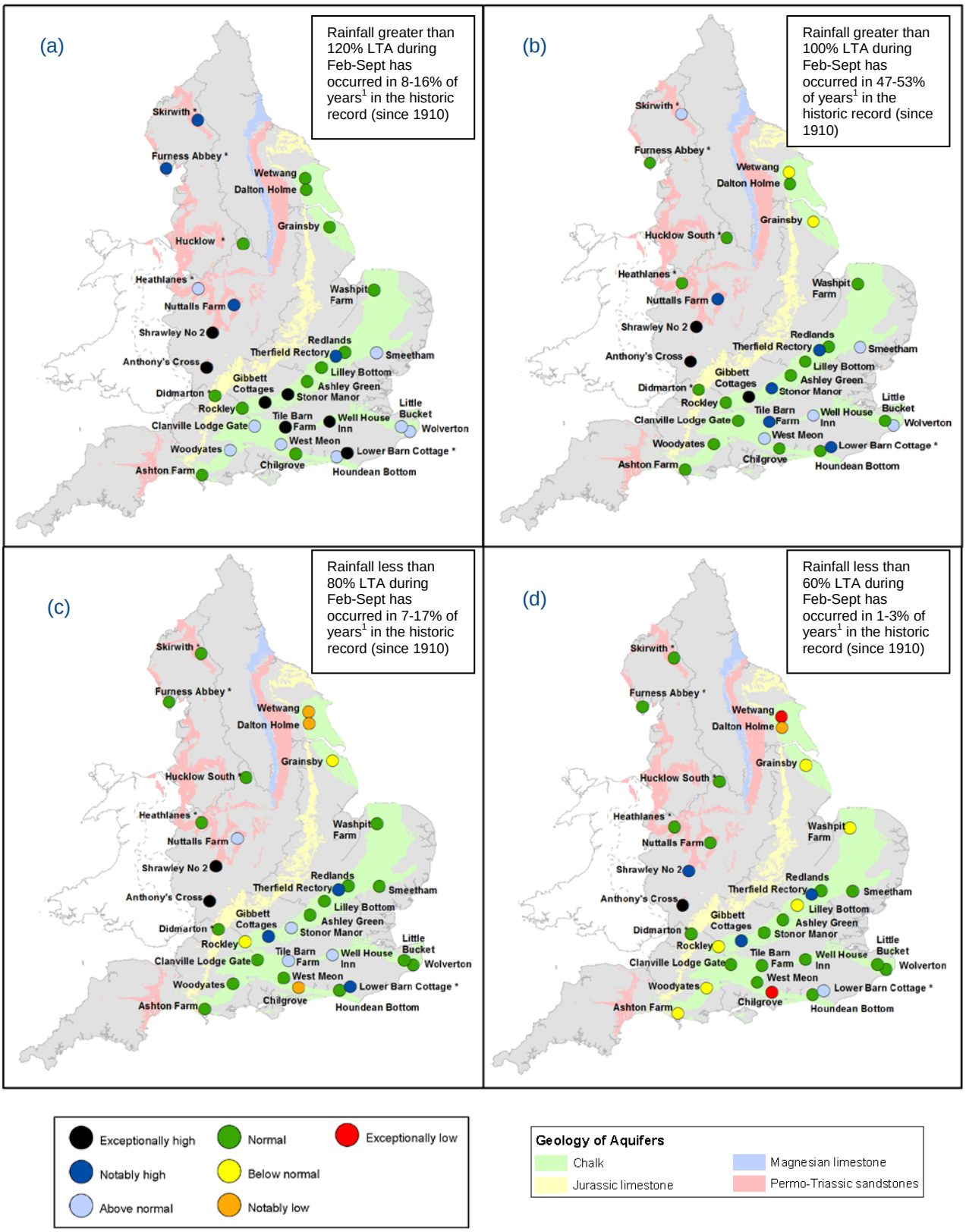

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between February 2014 and September 2014 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2014.

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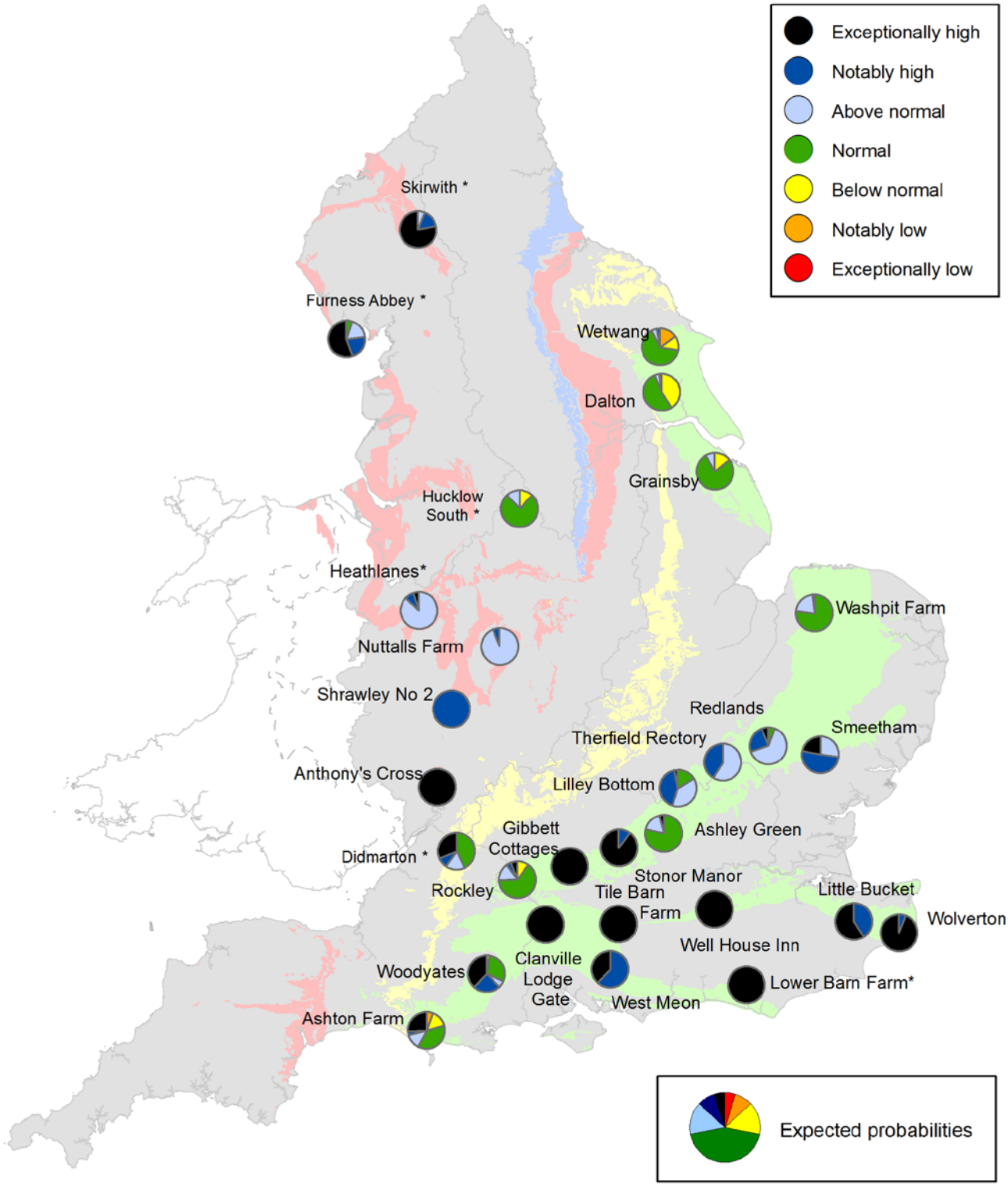
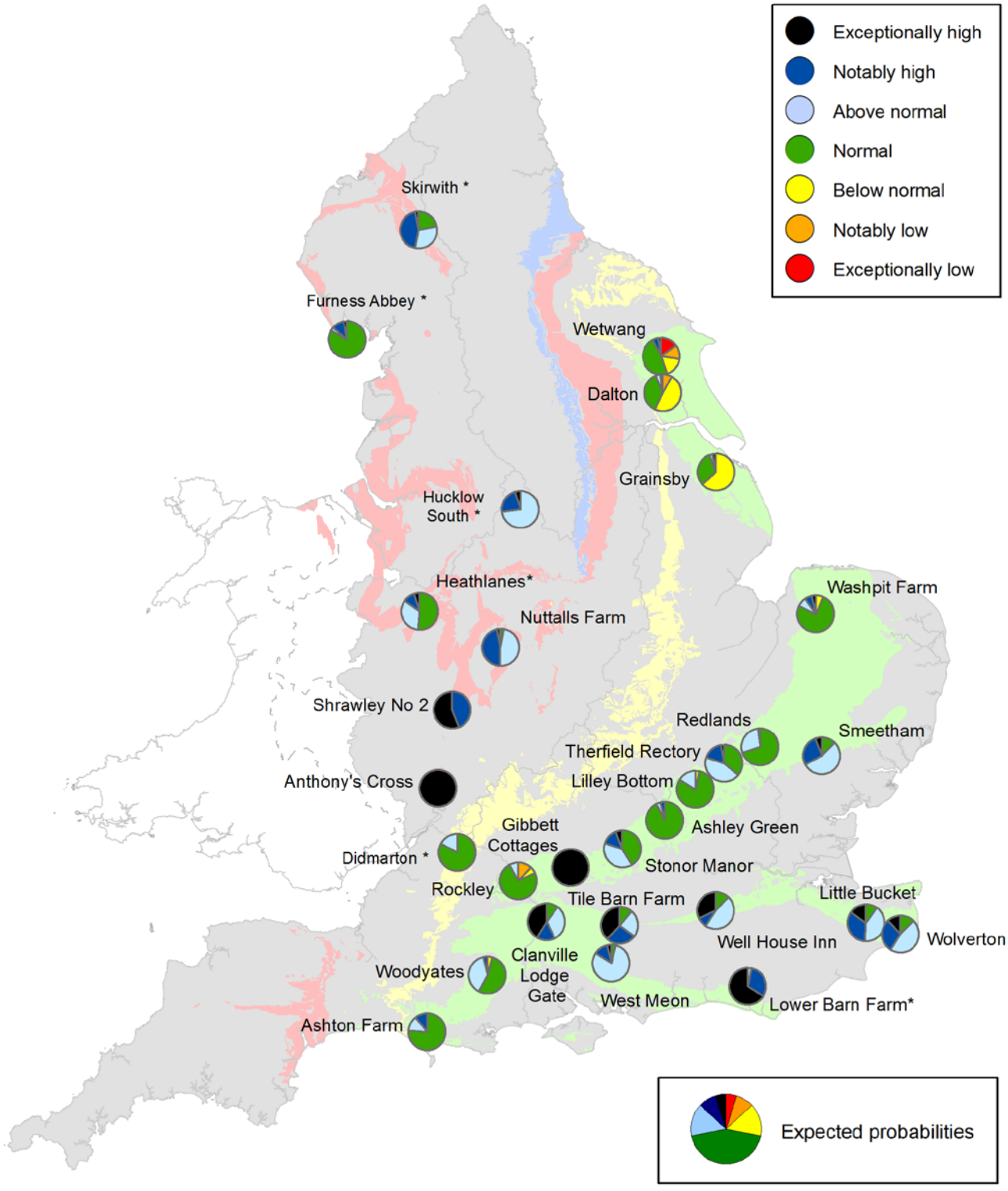


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

Figure 6.7: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2014. 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, 2014.

** Projections for these sites are produced by BGS*



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 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2014. 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, 2014.

* Projections for these sites are produced by BGS

Figure 7.1: Environment Agency Region Location Map

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).
Effective rainfall	The rainfall available to percolate into the soil or produce river flow. Expressed in depth of water (mm).
Groundwater	The water found in an aquifer
Recharge	The process of increasing the water stored in the saturated zone of an aquifer. Expressed in depth of water (mm).
Reservoir live capacity	The reservoir capacity normally usable for storage to meet established reservoir operating requirements. It is the total capacity less that not available because of operating agreements or physical restrictions. Only under abnormal conditions, such as a severe water shortage might this additional water be extracted.
Soil moisture deficit (SMD)	The difference between the amount of water actually in the soil and the amount of water that 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

Units

cumecs	Cubic metres per second ($m^3 s^{-1}$)
mAOD	Metres Above Ordnance Datum (mean sea level at Newlyn Cornwall).