Monthly water situation report

England

Summary – October 2013

It has been the wettest October since 2000 with England receiving 185% of the October long term average (LTA). Soil moisture deficits (SMDs) continued to decrease in the vast majority of areas response to October's rainfall. Monthly mean river flows for October were *normal* for the time of year in across most areas but *above normal* or higher in parts of Kent, central and south western parts of England. With the soils yet to be fully saturated, groundwater levels decreased at three quarters of our indicator sites and ranged from *notably low* to *notably high* across the principal aquifers of England. Overall reservoir stocks increased during October with storage supplying England as a whole at 82% of total capacity at the end of the month.

Rainfall

October rainfall totals were highest in our South West Region at 189mm. In our remaining regions, totals ranged from 172mm (North West Region) to 103mm (Anglian Region) (Figure 1.1). Locally, the highest rainfall totals (more than 230mm) fell in southern and western areas of Cumbria, the south east Cornish coast and south Devon, while the lowest rainfall totals (less than 90mm) fell in parts of Yorkshire and Cambridgeshire.

Rainfall totals for the whole of October were classed as *above normal* or higher for the time of year in all but three hydrological areas in England. Rainfall totals in parts of Lancashire and Cumbria were classed as *normal* whereas rainfall totals across central England and parts of south east Cornwall, south Devon, Wiltshire and Kent were classed as *exceptionally high* for the time of year. This is a notable departure from the rainfall pattern observed over the past three to six months, during which cumulative rainfall totals were classed as *normal* across much of England (Figure 1.2). October 2013 was the third wettest since records began in 1910 in our Midlands Region and the wettest October since 1998 It was the sixth wettest in our Anglian Region and the ninth wettest in England as a whole, both being the wettest October since 2000.

Monthly rainfall totals as a percentage of the October LTA were much greater than average in all of our six regions, ranging from 139% in our North West Region to 219% in our Midlands Region (Figure 1.3). England as a whole received 185% of the LTA rainfall (Figure 1.3).

Soil moisture deficit

Soil moisture deficits (SMDs) decreased in all of our regions during October 2013. At the end of October, SMDs ranged from less than 10mm across much of the northern England, southwest England, the Welsh borders and in parts of Essex and Kent, to between 71-100mm in parts of Norfolk and Lincolnshire around The Wash (Figure 2.1). The month end SMDs were 26-75mm less than the LTA in 21 MORECS squares covering much of the Midlands and parts of Suffolk, Essex, London and Kent. SMDs were 6-25mm less than the LTA in 65 MORECS squares covering the majority of the rest of England (Figure 2.1). SMDs were 6-25mm greater than the LTA in just one MORECS grid square covering The Wirral (Figure 2.1).

At the beginning of October, SMDs ranged from 35mm in our North West Region to 114mm in our Anglian Region. During the month SMDs decreased in all Regions in response to wet weather, particularly during the last week of the month. At the end of October, SMDs were between 4-26mm less than the LTA in all our regions (Figure 2.2).

River flows

Compared with September, monthly mean river flows for October increased at all but one of our reported indicator sites across England. More than three quarters of sites showed an increase in monthly mean flows for October expressed as a percentage of the LTA (Figure 3.1).

Monthly mean river flows for October were classed as *normal* or higher for the time of year at all of our indicator sites across England. Flows were classed as *above normal* or higher at just under half of indicator sites including all but one in our Midlands and one or two indicator sites in every other region (Figure 3.1).

River flows at the regional index sites in our Anglian, Yorkshire and North East, North West, and South East Regions were *normal* for the time of year. In our Midlands and South West Regions the regional index site was classed as *above normal* for the time of year (Figure 3.2).

Groundwater levels

During October groundwater levels continued to decline at three quarters of our indicator sites in England. Minor increases in levels were recorded at five indicator sites in sandstone, Jurassic limestone and chalk aquifers. At the end of October, groundwater levels were *normal* or higher for the time of year at all but three of the sites reported on. Groundwater levels were *below normal* for the time of year at Four Crosses (Staffordshire Trent Valley Sandstone) in our Midlands Region and Woodyates (Upper Dorset Stour Chalk) in our South West Region and *notably low* at Chilgrove (Chichester Chalk) in our South East Region (Figures 4.1 and 4.2). Four fifths of indicator sites have *normal* groundwater levels for the time of year.

Groundwater levels continued to be classed as *exceptionally high* in relation to historic values for this time of year at Priors Heyes (West Cheshire Sandstone) in our North West Region because the aquifer is recovering from the effects of historic abstraction.

Reservoir storage

During October, reservoir stocks increased at nearly two thirds of the reported reservoirs. Increases were greater than 10% of full capacity at a third of the reservoirs or reservoir groups reported on. Notable increases included the Derwent Valley reservoirs which rose 24%. Reservoir stocks are *normal* or higher for the time of year at 85% of the reported sites (Figure 5.1). At the end of October, reservoir stocks were classed as *below normal* at Chew Valley and Wimbleball in our South West Region and at Ardingly and Farmoor in our South East Region.

At a regional scale, reservoir stocks increased by between 1% and 12% across all our Regions. At the end of October regional reservoir stocks were lowest in our South West Region at 62% of total capacity, and highest in our North East Region at 88%. Overall reservoir storage for England increased during October to 82% of total capacity (Figure 5.2).

Forward look

November is likely to remain unsettled through the middle of the month, becoming colder with wintry showers possible, particularly over higher ground in the north. Later in the month unsettled conditions are likely to continue, with spells of rain or showers. Further ahead across the United Kingdom, above average temperatures are most probable for the November to January period, and there is a slightly higher probability of above average rainfall[1].

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

March 2014: With average (100% of the LTA) rainfall between November 2013 and the end of March 2014, river flows are likely to be *normal* or higher at all except three of our modelled sites. With 120% of the LTA rainfall, river flows are likely to be *above normal* or higher at three quarters of the modelled sites. With 80% of the LTA rainfall, river flows are likely to be *below normal* or lower at nearly four fifths of the modelled sites (see Figure 6.1).

September 2014: With average rainfall between November 2013 and the end of March 2014, river flows are likely to be *normal* at over three quarters of modelled sites. With above average rainfall (120% of the LTA), flows are likely to be *above normal* or higher at three quarters of our modelled sites. With below average rainfall (80% of the LTA), river flows are likely to be *below normal* or lower at all except three of the modelled sites (see Figure 6.2).

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

March 2014: Two thirds of modelled sites have a greater than expected chance of *normal* flows from November to March. A quarter of the sites have a greater than expected chance of *exceptionally high* flows, whilst half of the sites have a greater than expected chance of *notably low* flows (see Figure 6.3).

September 2014: Two thirds of all modelled sites have a greater than expected chance of *normal* flows from November 2013 to September 2014. Over two thirds of modelled sites have a greater than expected chance of *exceptionally high* flows, whilst one fifth of modelled sites have a greater than expected chance of *exceptionally low* flows between November 2013 and September 2014 (see Figure 6.4).

[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.

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

March 2014: With average rainfall (100% of the LTA) from November 2013 to March 2014, groundwater levels are likely to be *normal* or higher for the time of year at all modelled sites, and *above normal* or higher at half of the modelled sites. With above average rainfall (120% of the LTA) all sites will be *normal* or higher. With 80% of the LTA rainfall, just over two thirds of 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 November 2013 to September 2014, groundwater levels are likely to be *normal* or higher for the time of year at all but three 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 half of the modelled sites. With below average rainfall (80% of the LTA), groundwater levels are likely to be *below normal* or lower at half of our modelled sites (see Figure 6.6).

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

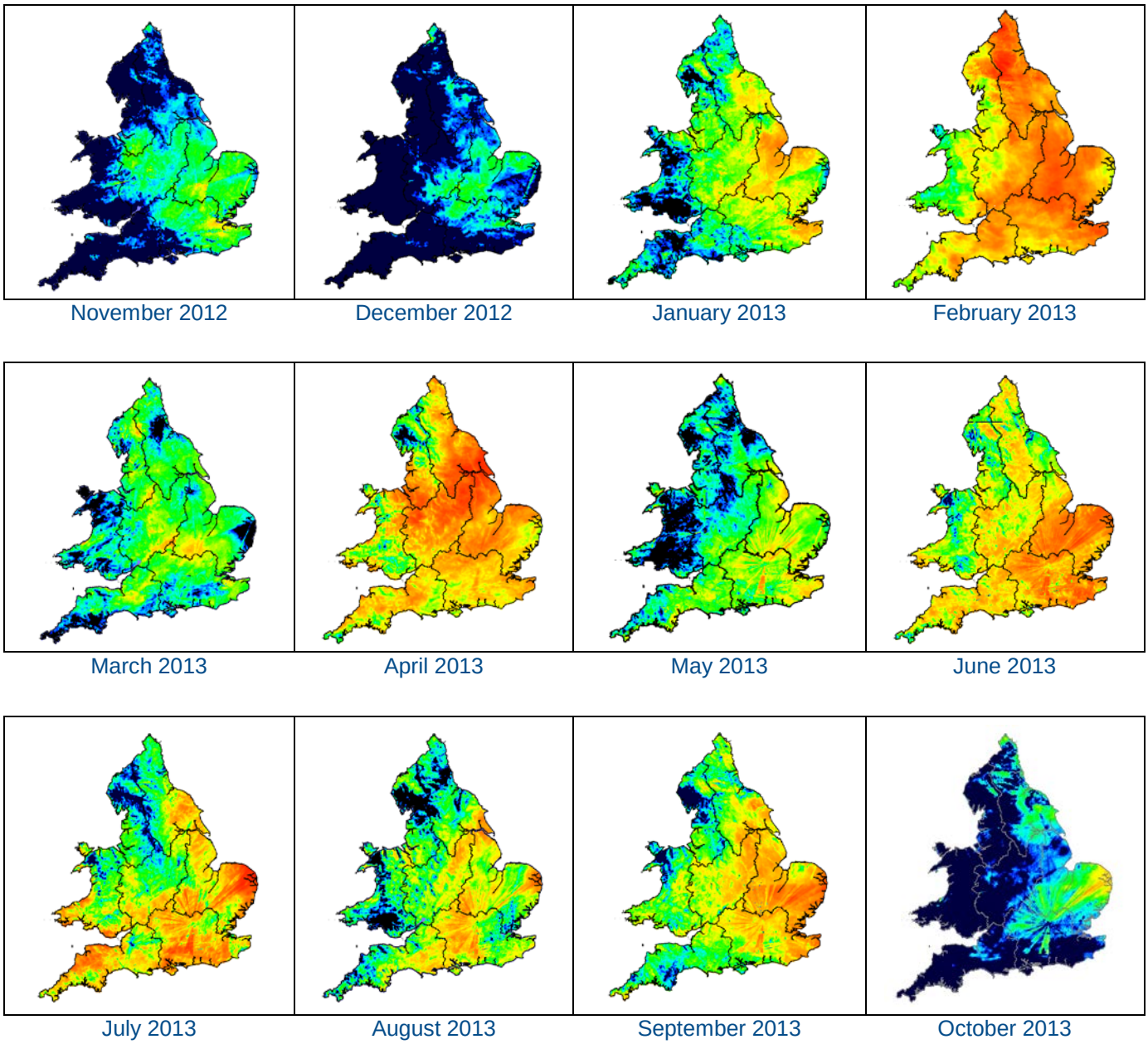
March 2014: Half of modelled sites have a greater than expected chance of *normal* groundwater levels for the time of year. Just over half of modelled sites have a greater than expected chance of *exceptionally high* levels. A quarter of modelled sites have a greater than expected chance of *notably low* groundwater levels for the time of year (see Figure 6.7).

September 2014: Two thirds of the modelled sites have a greater than expected chance of levels being *normal* for the time of year. A third of the modelled sites have a greater than expected chance of *notably high* groundwater levels. One fifth of modelled sites have a greater than expected chance of *notably low* groundwater levels by the end of September 2014 (see Figure 6.8).

Authors: Hydrology Team – 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



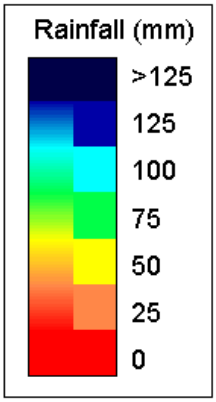


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2013). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.

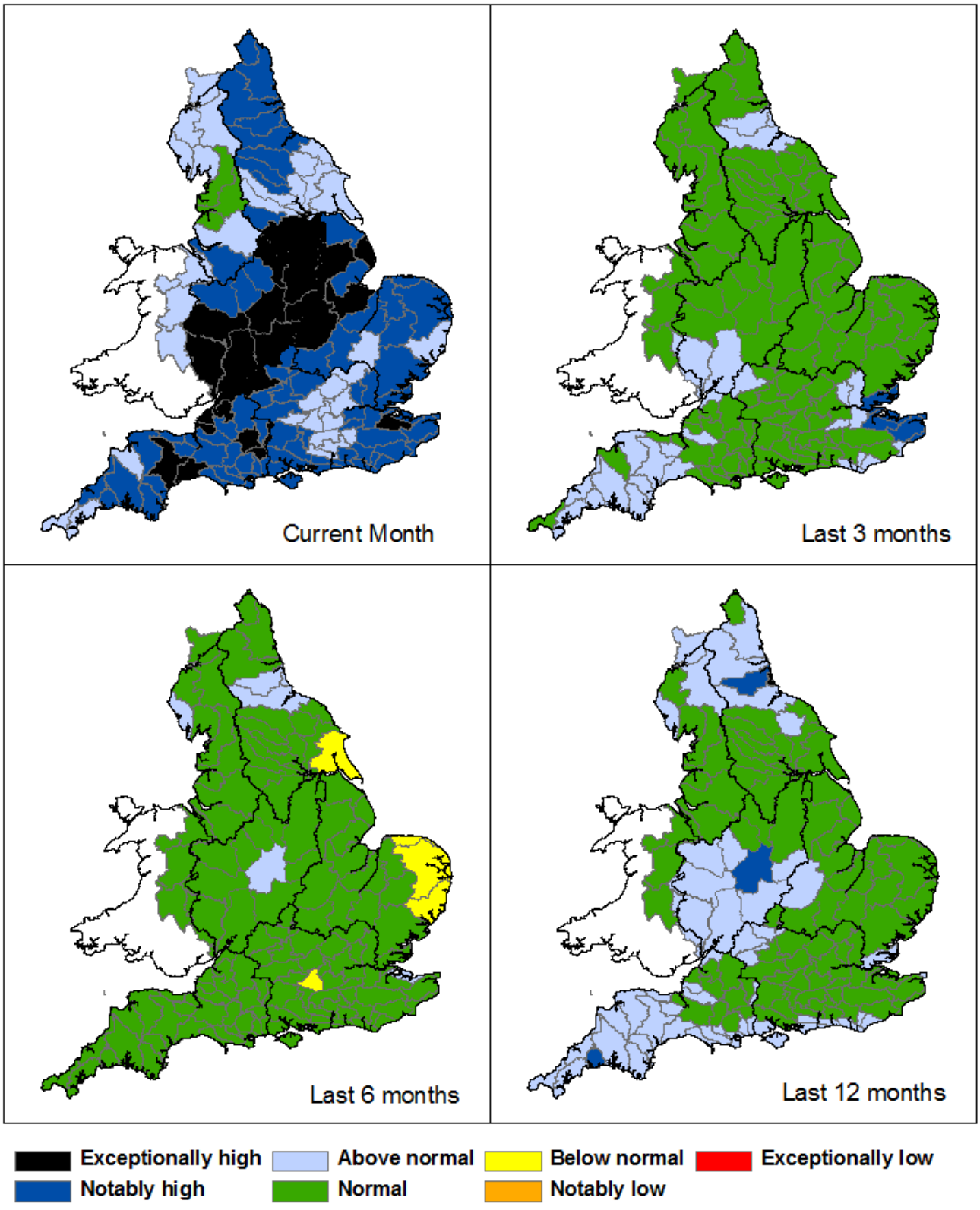


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31st August), the last three months, the last six months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2013).* Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.

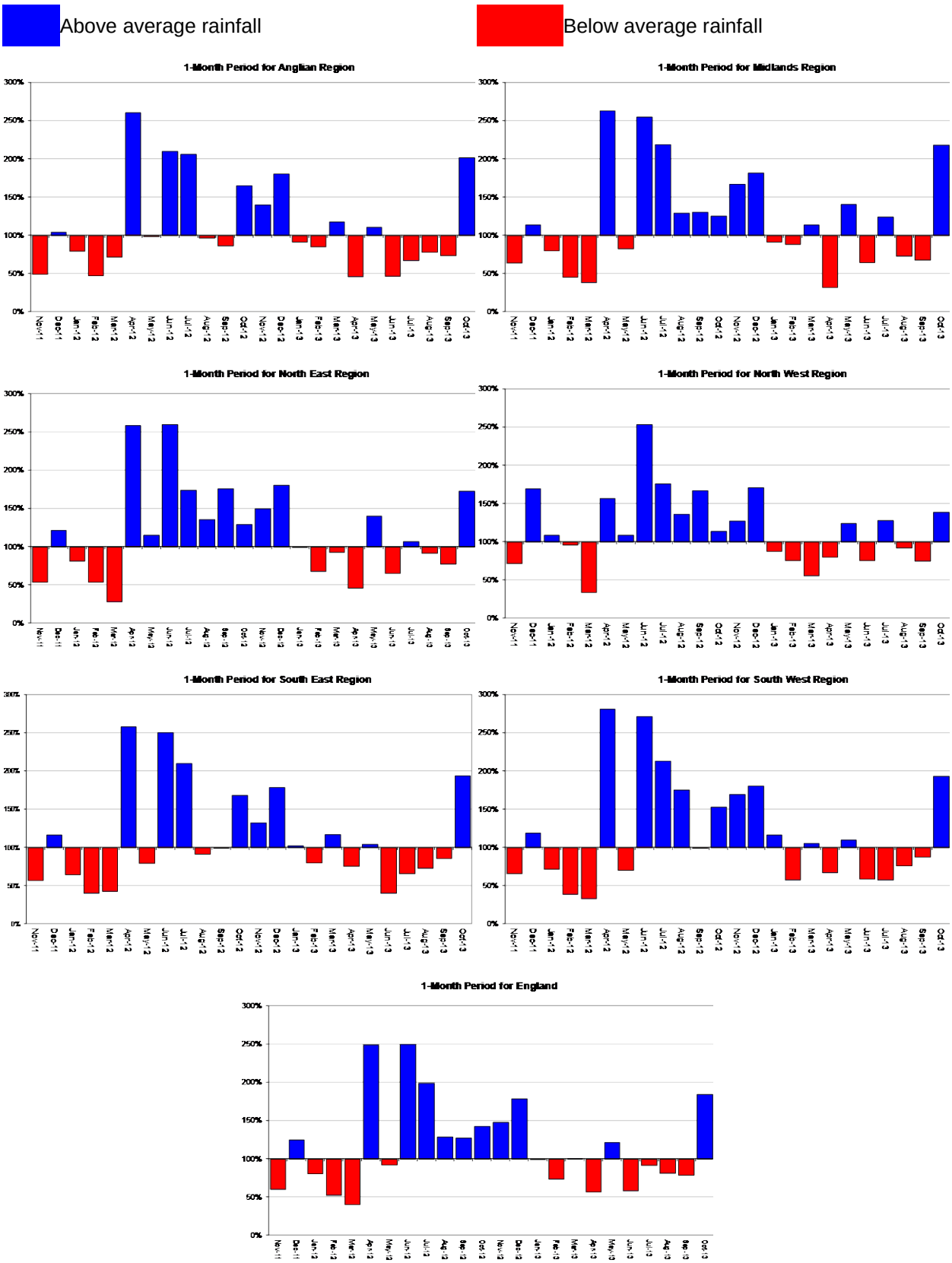


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each Environment Agency Region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2013).

Soil moisture deficit

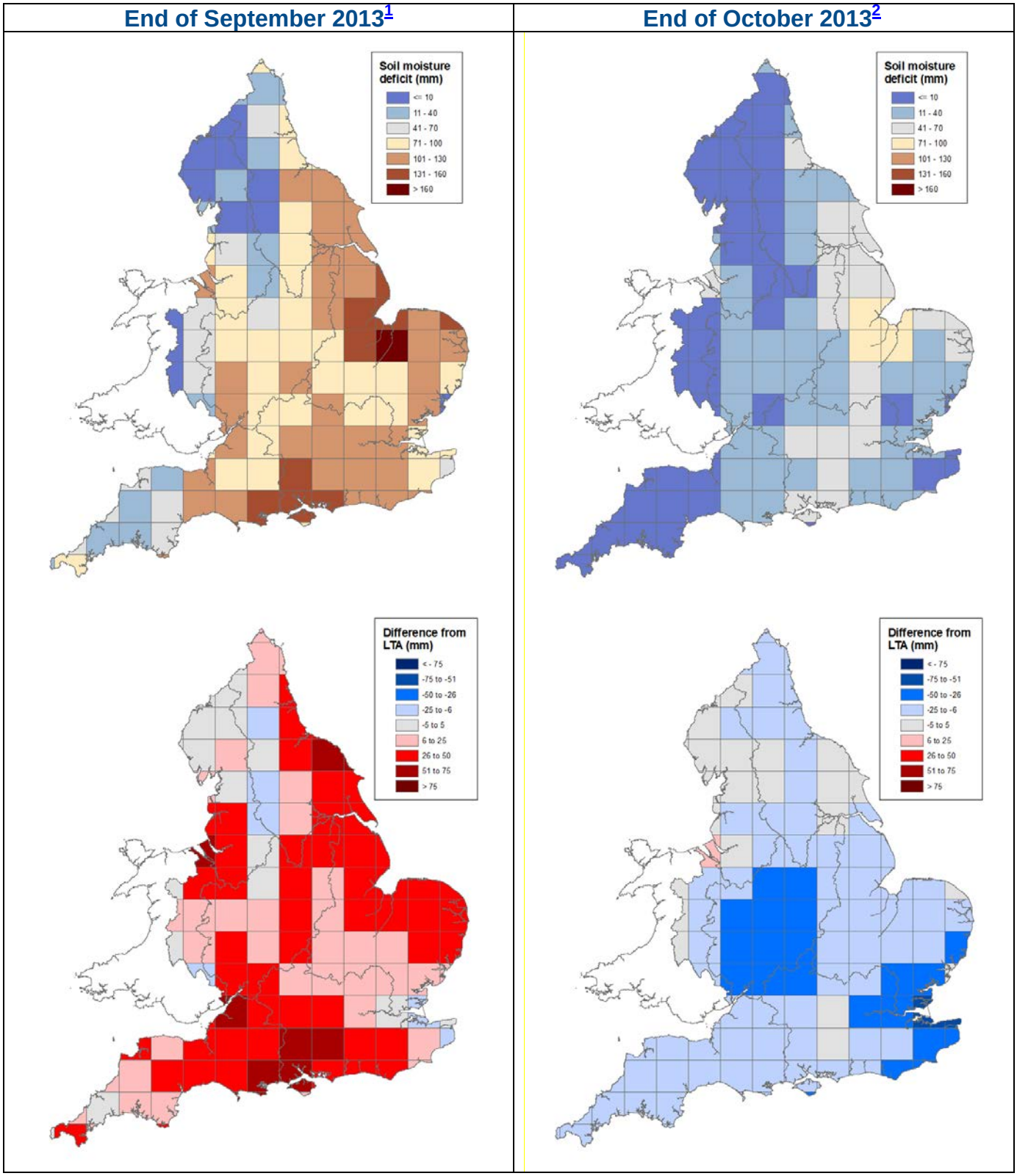


Figure 2.1: Soil moisture deficits for weeks ending 01 October 2013 [1] (left panel) and 30 October 2013 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2013). Crown copyright. All rights reserved. Environment Agency, 100026380, 2013

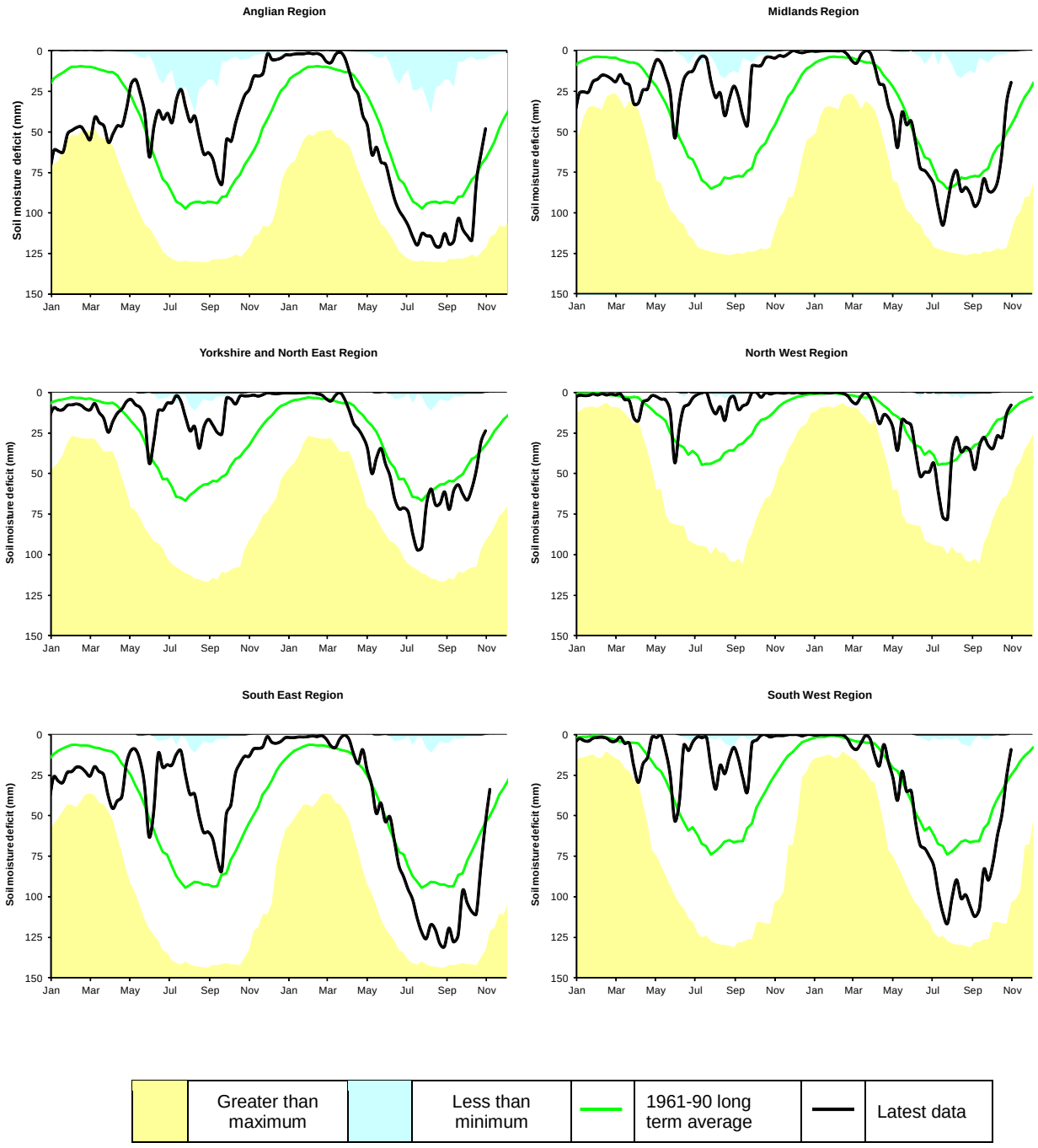
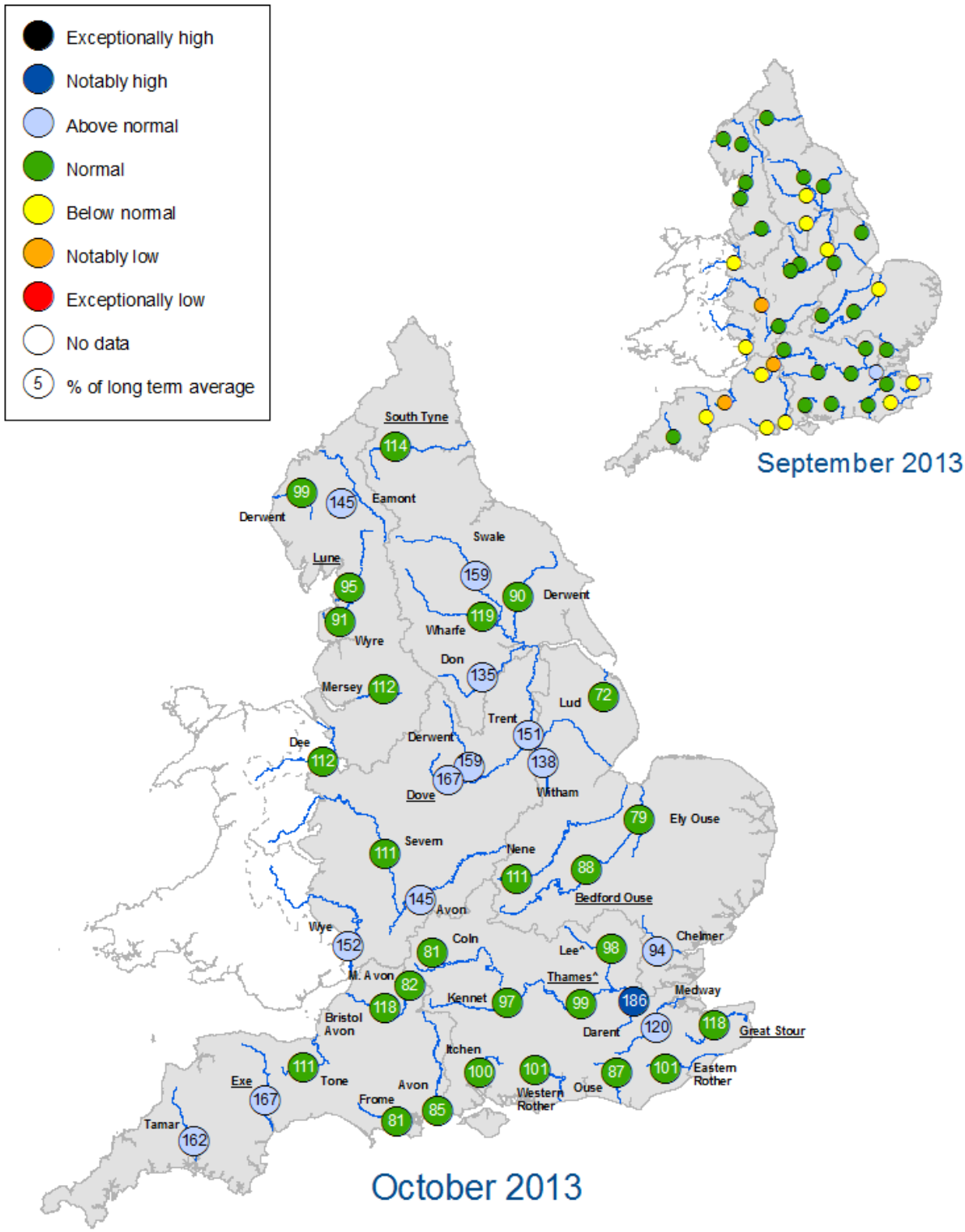


Figure 2.2: Latest soil moisture deficits for all Environment Agency Regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2013).

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 September 2013 and October 2013, expressed as a percentage of the respective long term average and classed relative to an analysis of historic September and October monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.

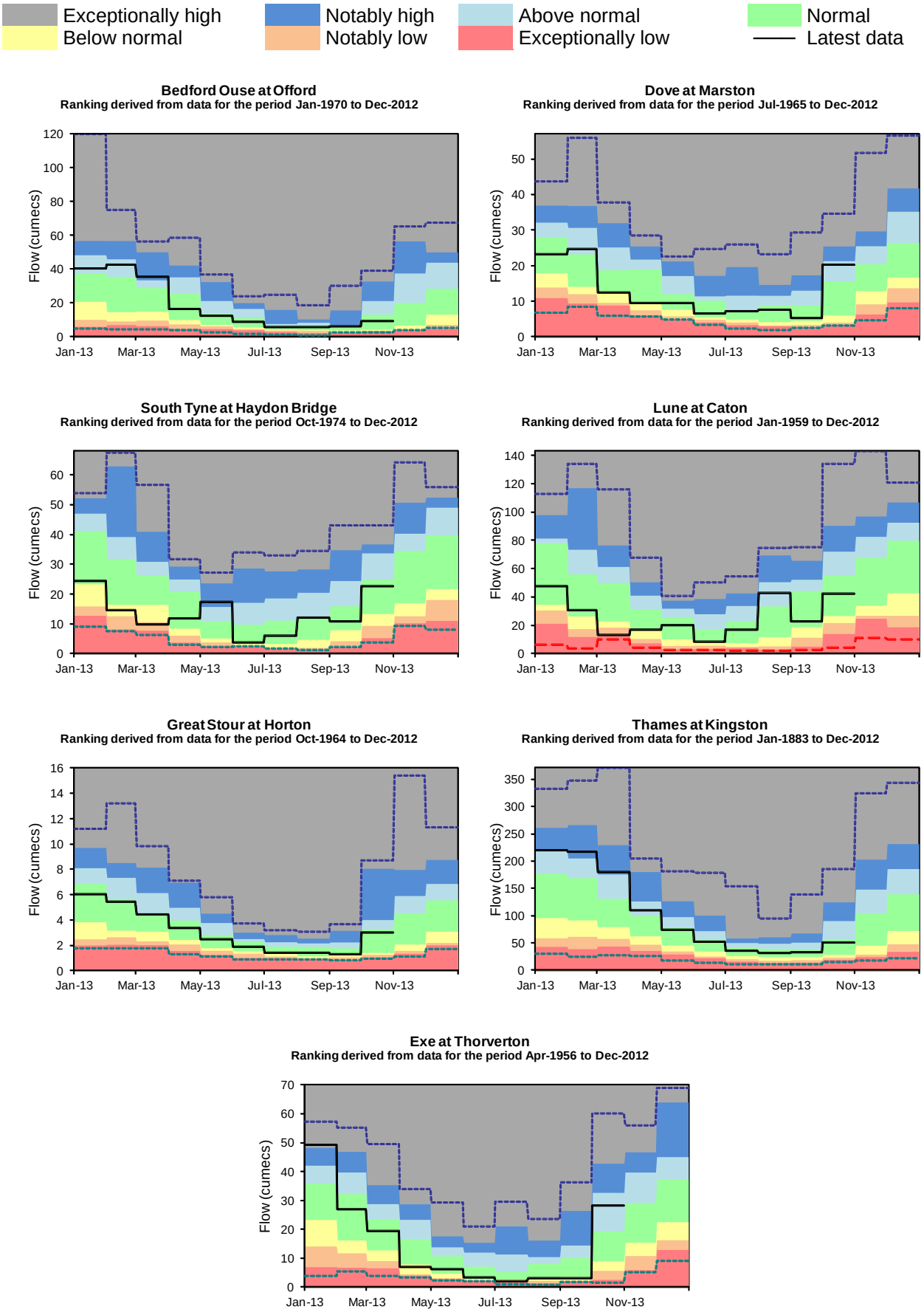
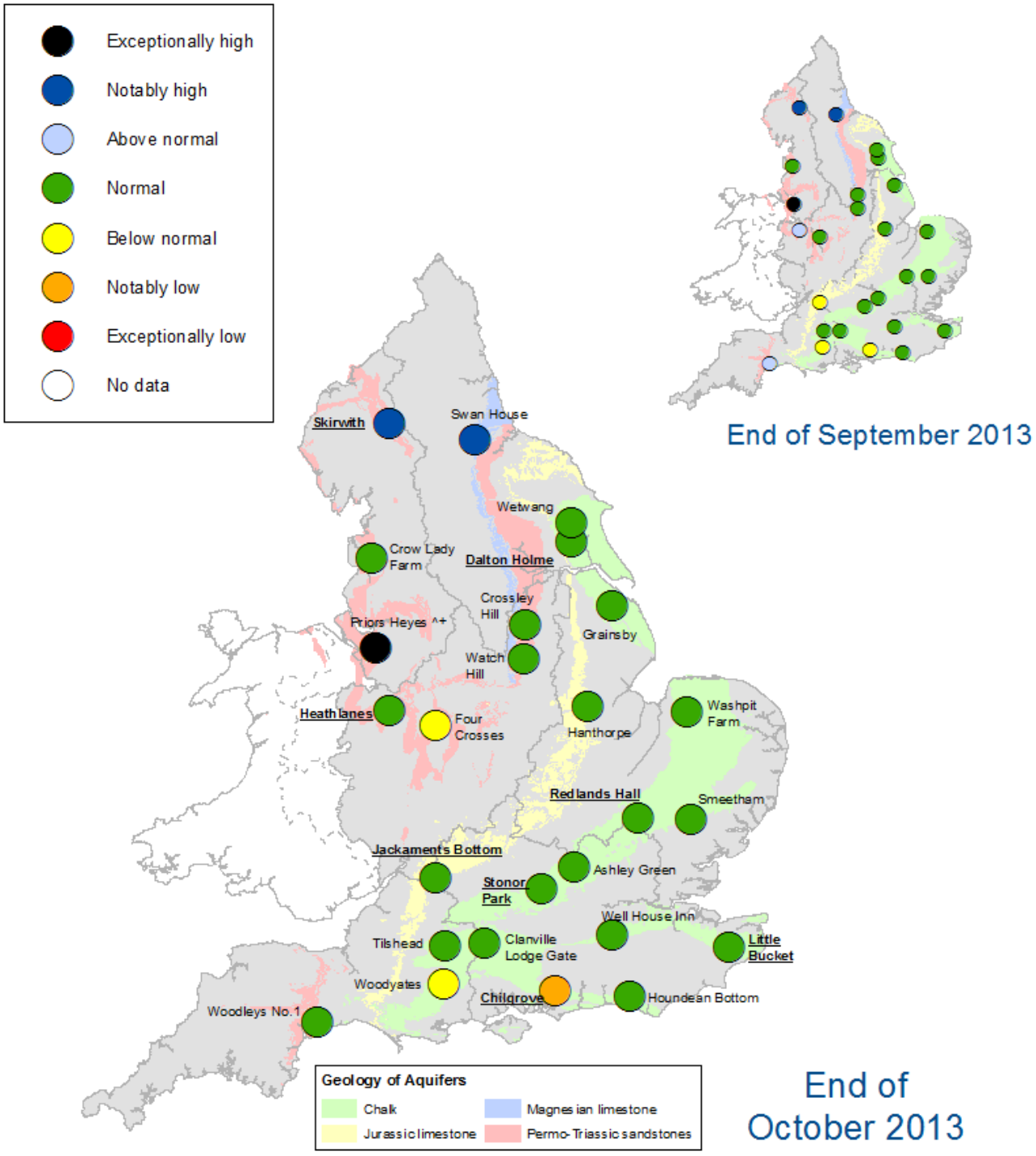


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

Groundwater levels



^ The level at Priors Heyes remains high compared to historic levels because the aquifer is recovering from the effects of historic abstraction.
End of month groundwater level is the highest (+) and lowest (-) on record (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 September 2013 and October 2013, classed relative to an analysis of respective historic September and October levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Note: groundwater levels are reported at different times during the month and therefore may not be fully representative of levels at the month end. Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.

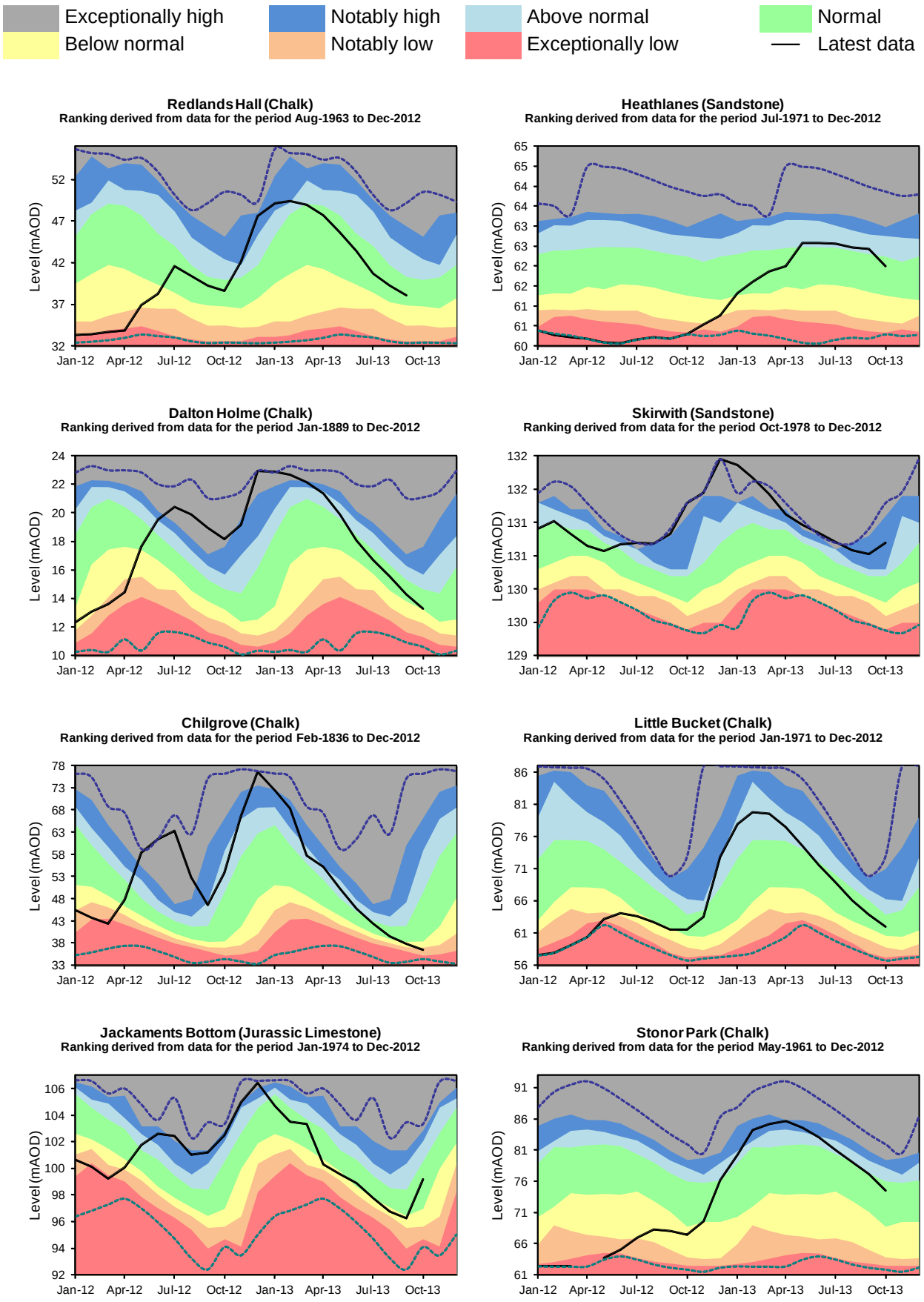
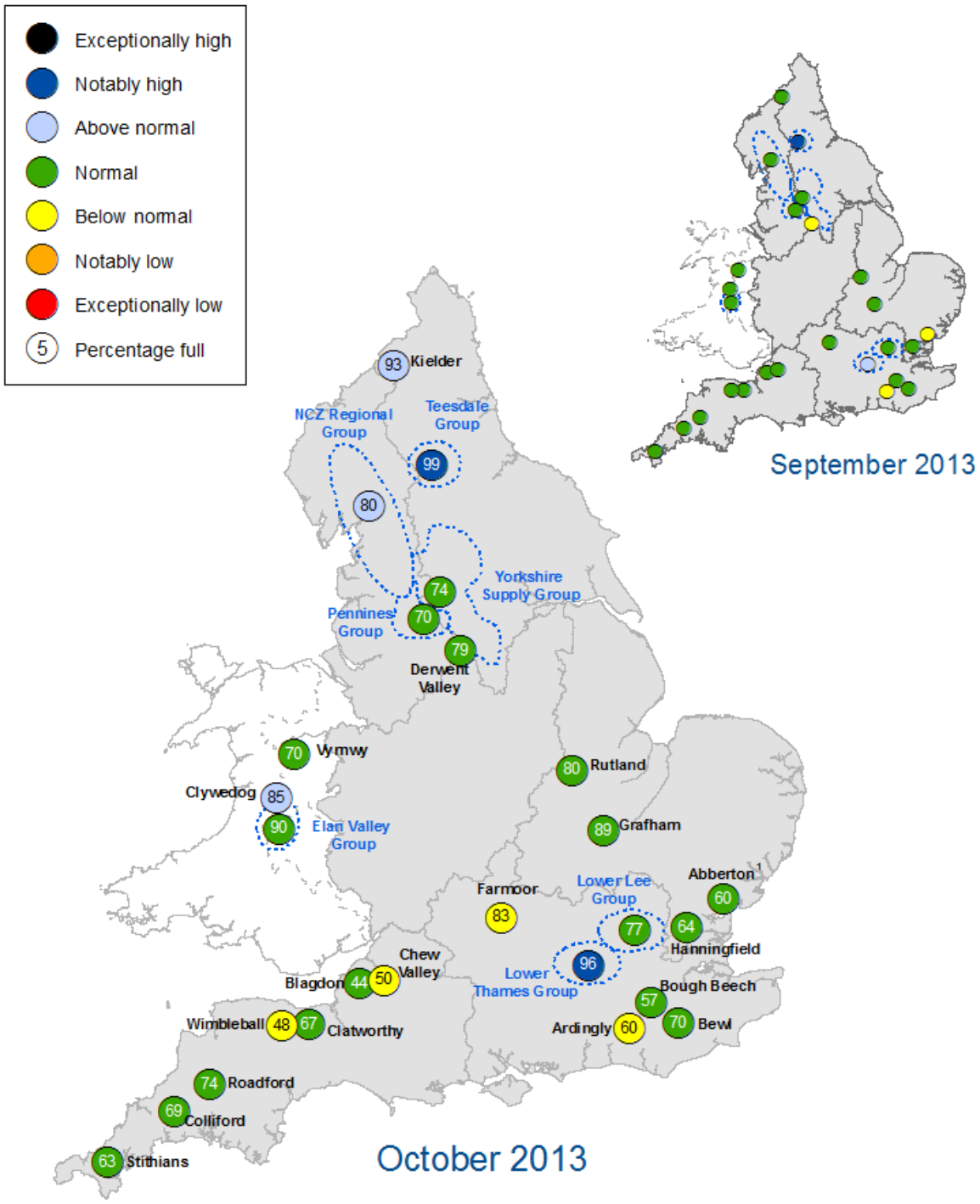


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2013).

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 September 2013 and October 2013 as a percentage of total capacity and classed relative to an analysis of historic September and October 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.

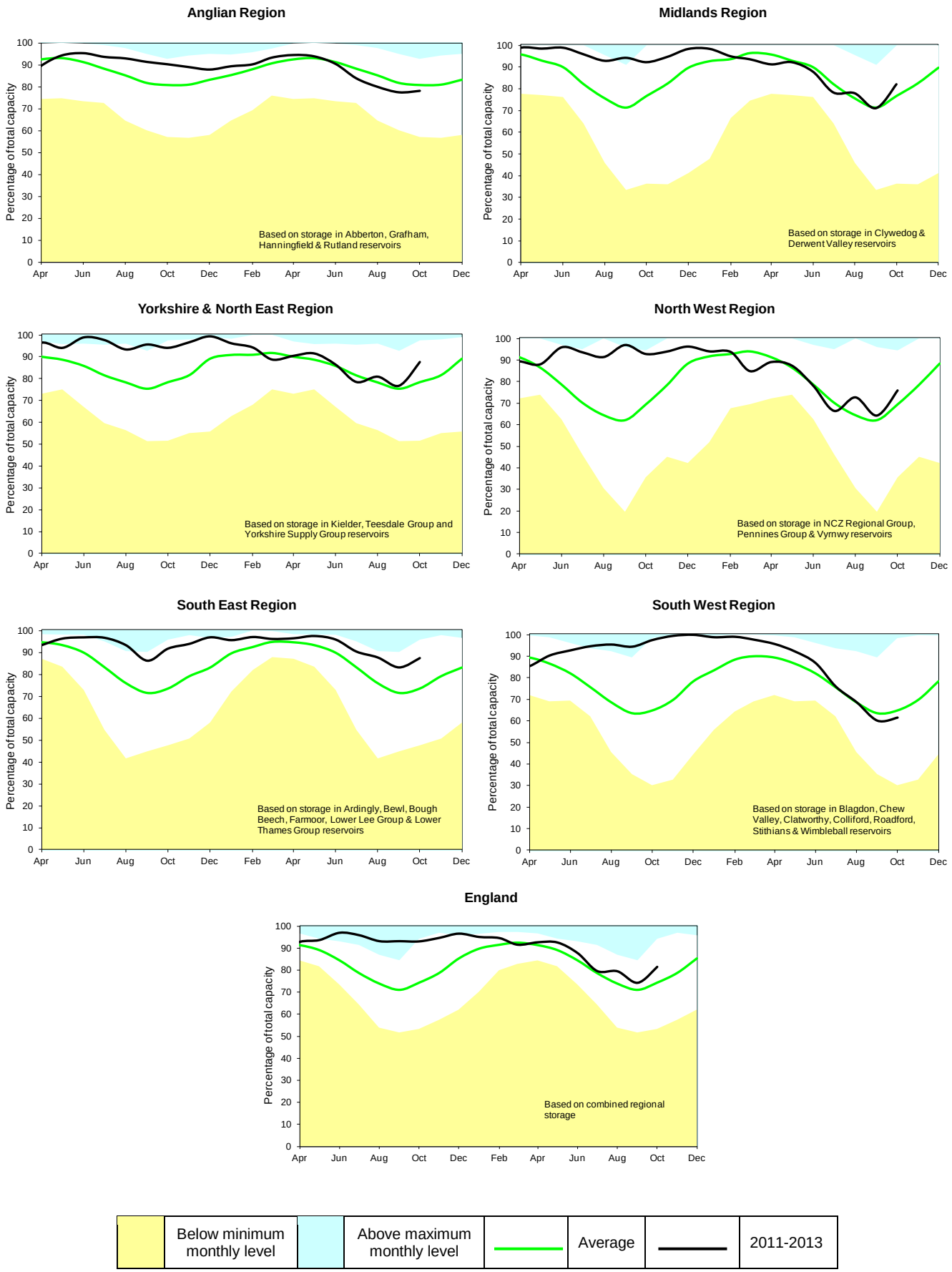


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

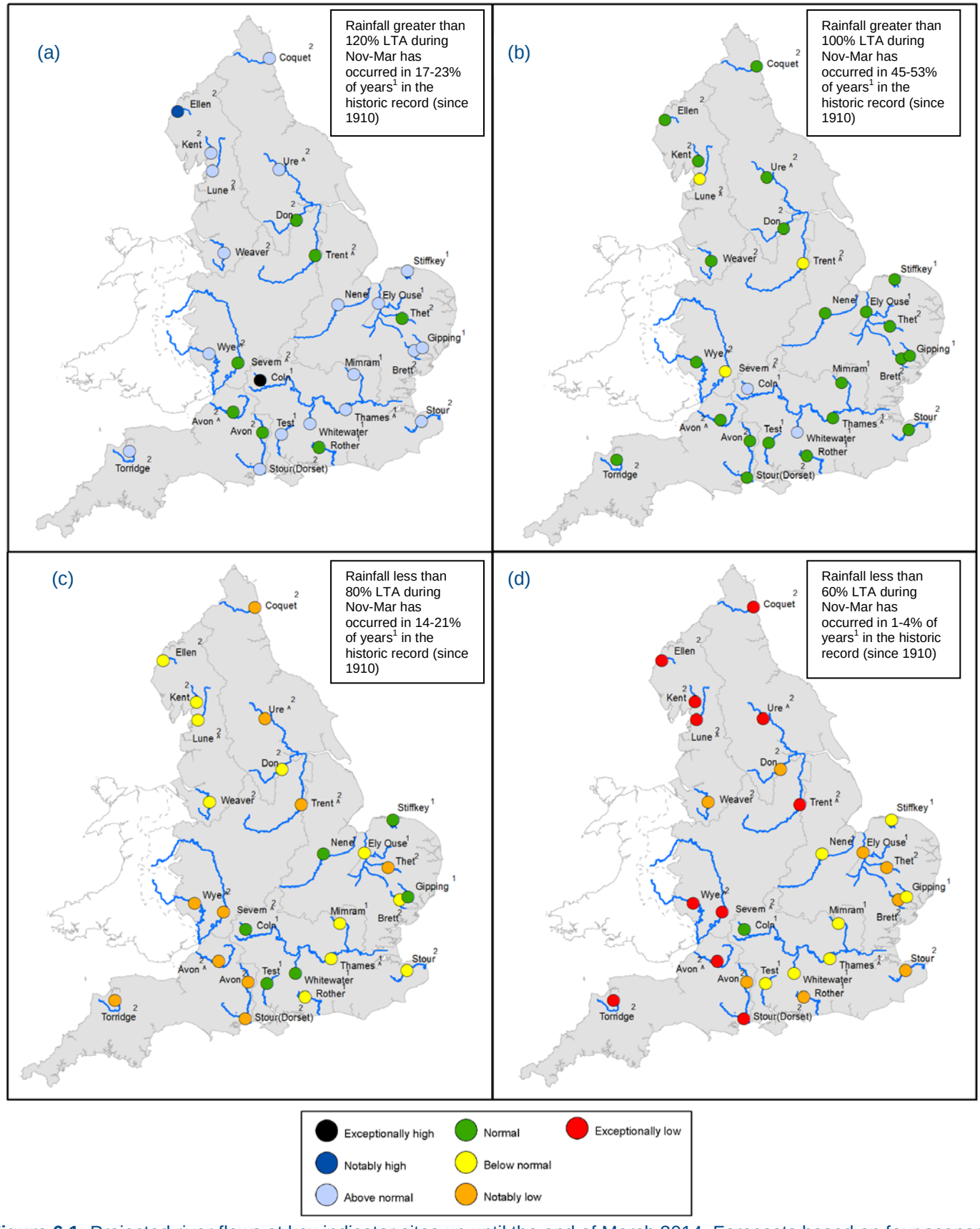
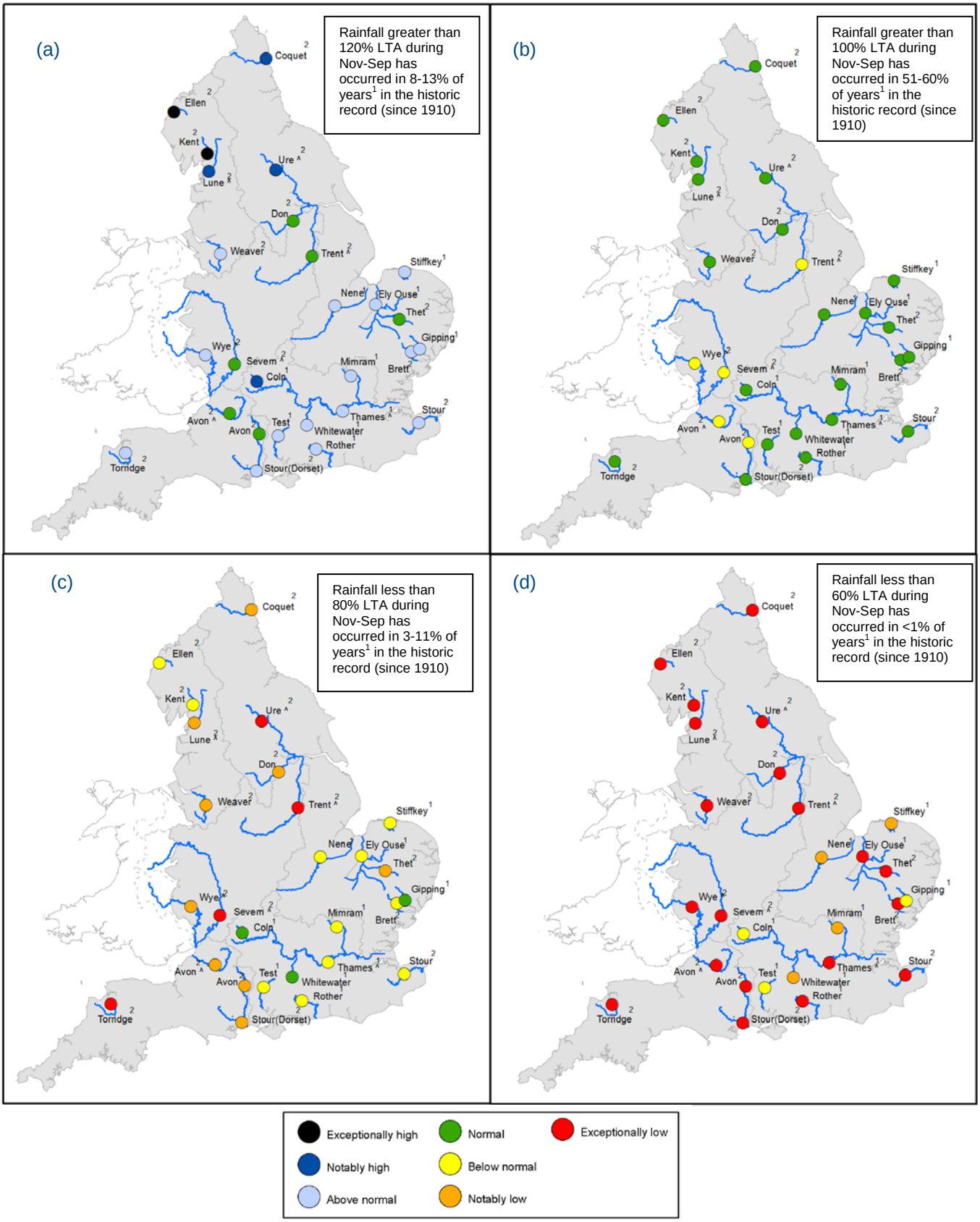


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2013 and March 2014 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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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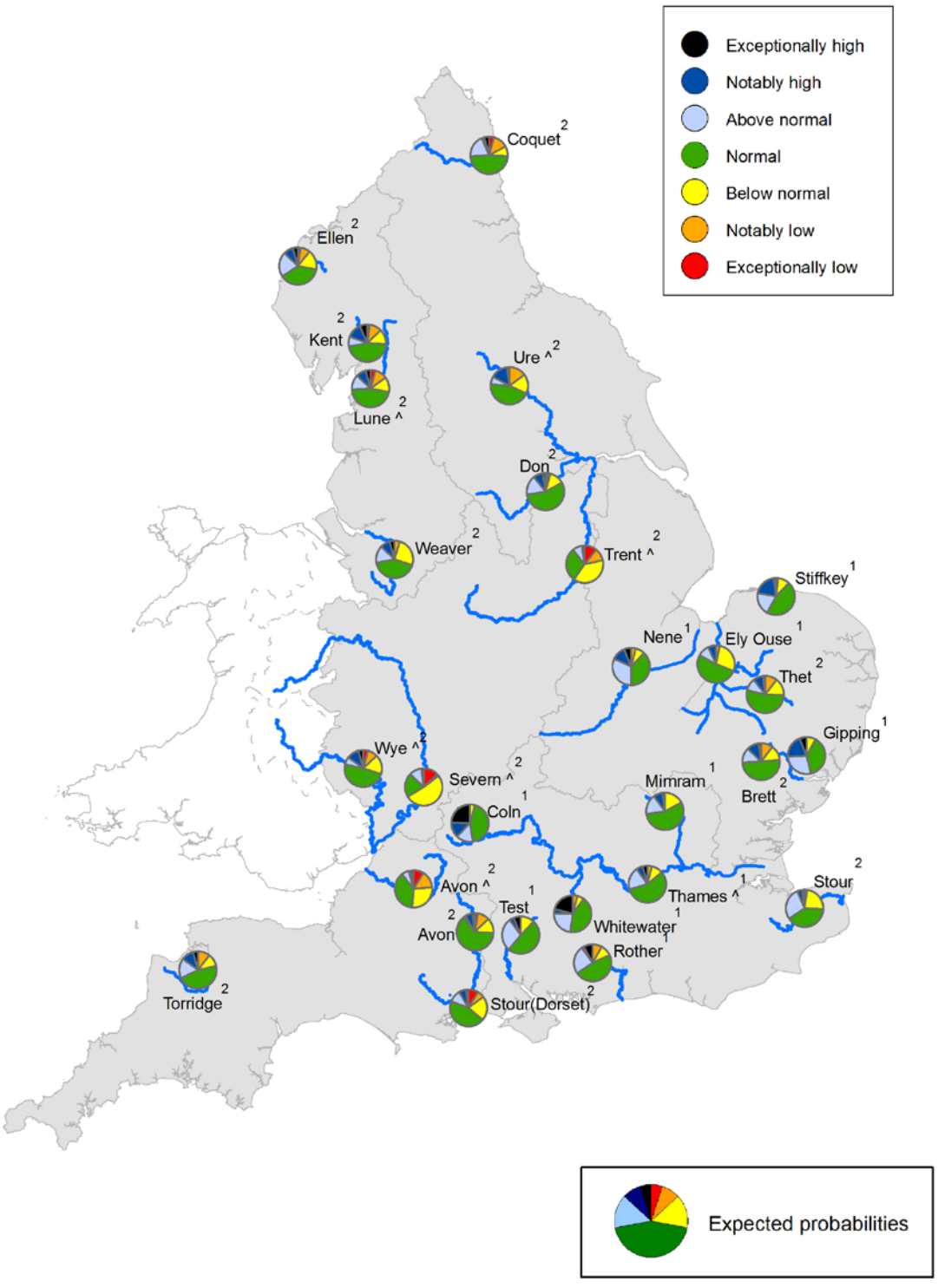

Figure 6.3: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2014. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology,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

[1]*Projections for these sites are produced by the Environment Agency,*[2] *Projections for these sites are produced by CEH*

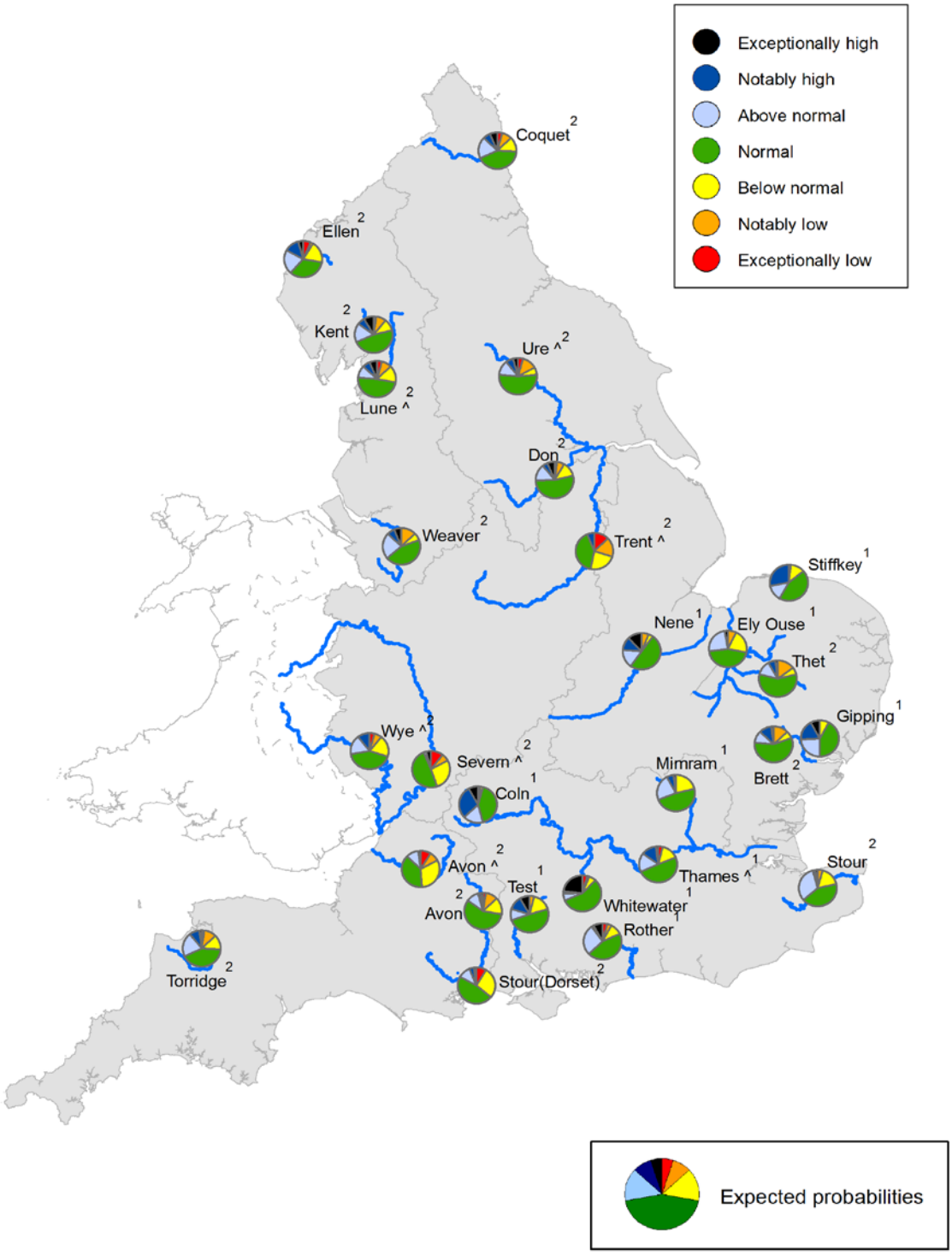

Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2014. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology,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

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.

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Forward look - groundwater

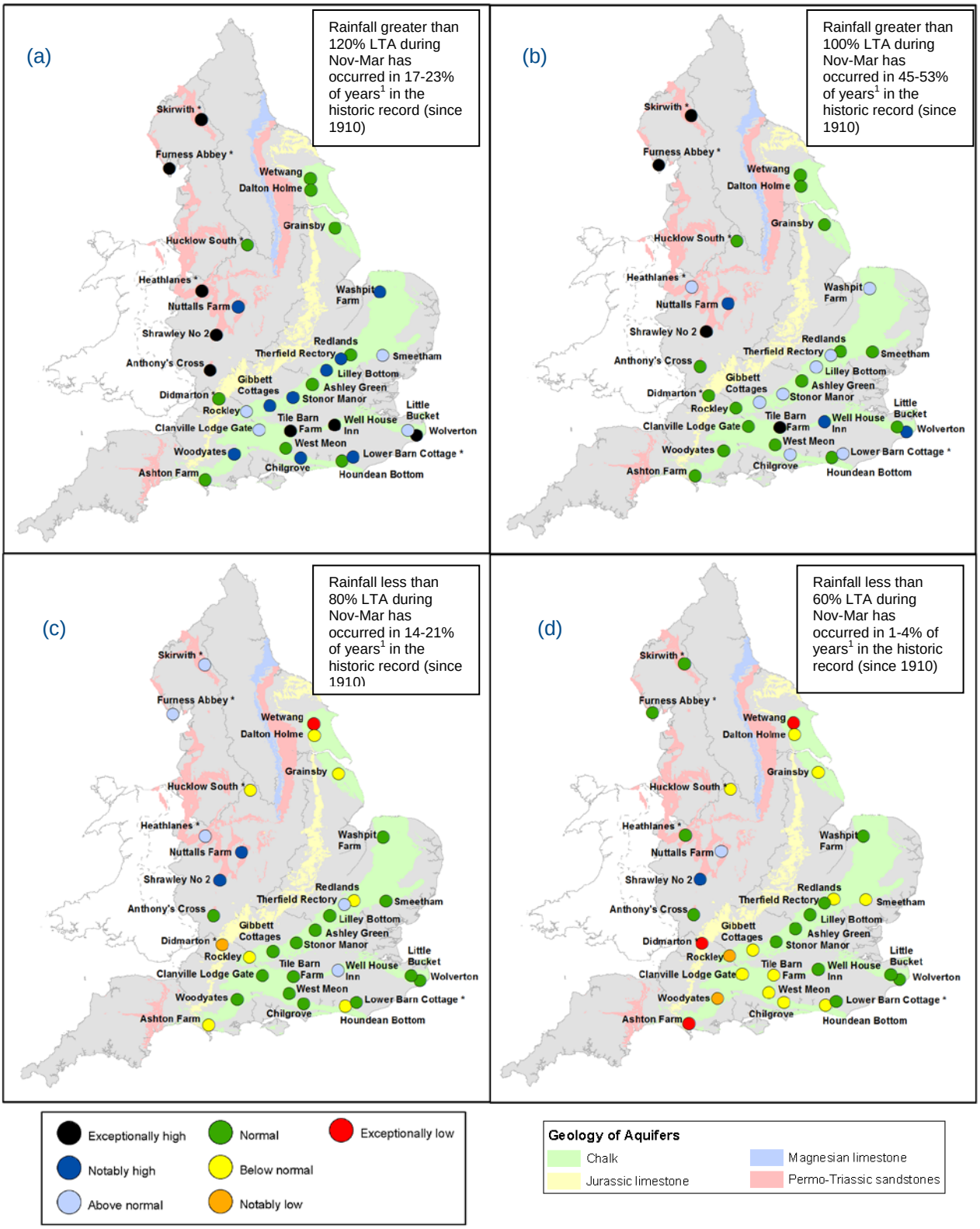

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2013 and March 2014 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2013.

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

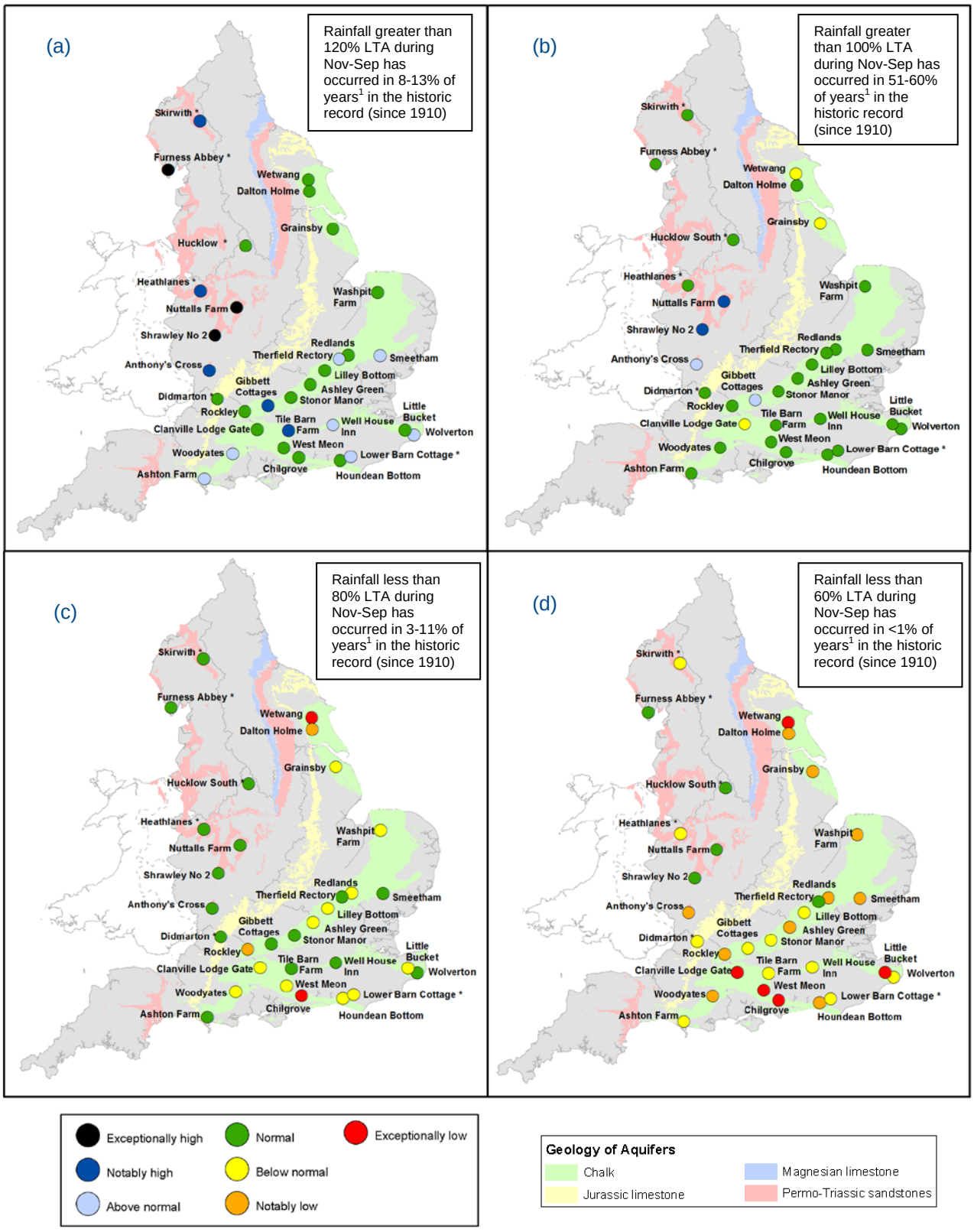

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2013 and September 2014 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2013.

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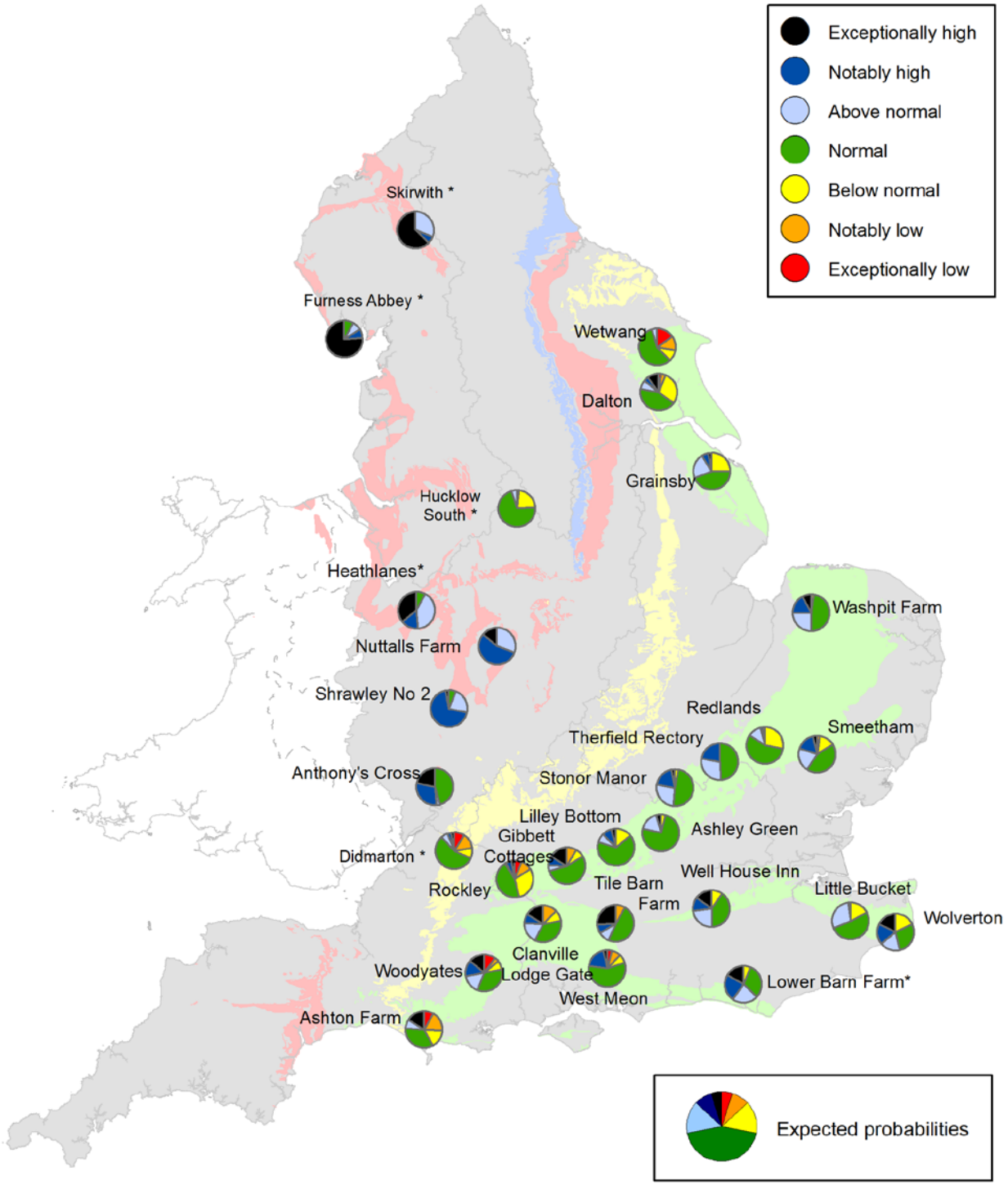
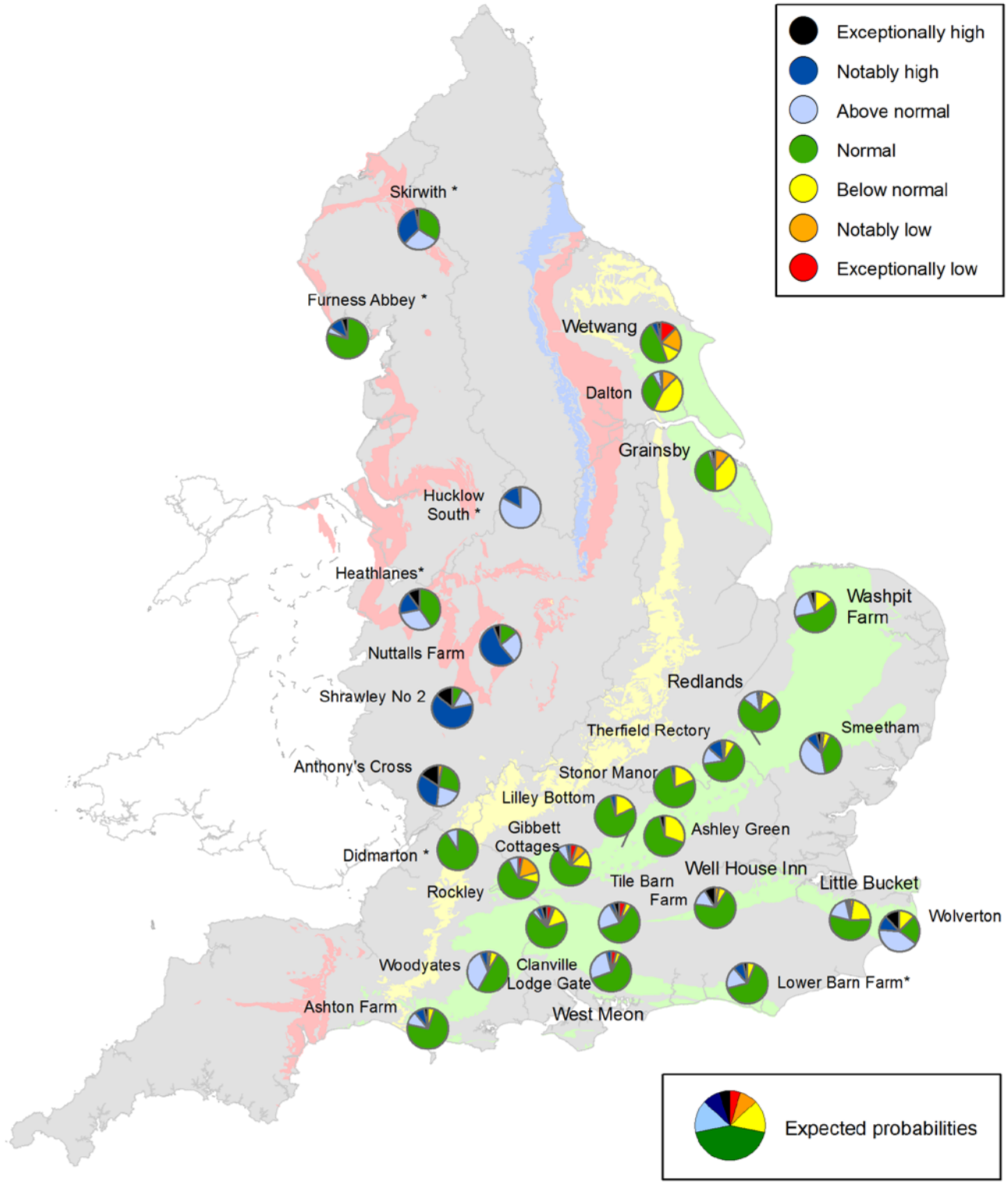


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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, 2013.

** 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, 2013.

* 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).