Monthly water situation report

England

Summary – September 2013

September has been the fourth consecutive month with below average rainfall across England, receiving 79% of the September long term average (LTA). With the transition from summer to autumn, soil moisture deficits (SMDs) decreased in most areas. Monthly mean river flows for September were normal for the time of year in northern, central and southern England but below normal or lower elsewhere, and in particular in the west Midlands and west of England. Groundwater levels decreased at the majority of our indicator sites but ranged from below normal to notably high across the principal aquifers of England. Overall reservoir stocks remained stable during September with storage supplying England as a whole at 80% of total capacity at the end of the month. Generally, prospective river flows in spring 2014 are similar to the typically expected range. Groundwater levels in sandstone aquifers are likely to be towards the higher end of the typical range while levels in the chalk cover the full range of typical outcomes.

Rainfall

September rainfall totals were highest in our North West Region at 84mm. In our remaining regions totals ranged from 36mm (Anglian Region) to 72mm (South West Region) (Figure 1.1). Locally, the highest rainfall totals (more than 100mm) fell in Cumbria and on the southern coast of Cornwall, while the lowest rainfall totals (less than 25mm) fell in Lincolnshire.

Rainfall totals for the whole of September were classed as *normal* or lower for the time of year in all hydrological areas across England. Rainfall totals in north Lincolnshire and south Denbighshire (Upper Dee catchment) were classed as *notably low* in September (Figure 1.2). Cumulative rainfall totals over the past three and six months were *below normal* or lower across much of the central and southern England. Cumulative rainfall totals over the past six months have been classed as *exceptionally low* across north Norfolk, Suffolk, Somerset and west Devon. The six month period ending September 2013 was the seventh driest since records began in 1910 in our South West Region and the eighth driest in our Anglian Region.

Monthly rainfall totals as a percentage of the September LTA were well below average in all of our regions, ranging from 68% in our Midlands Region to 88% in our South West Region (Figure 1.3). England as a whole received 79% of the LTA rainfall (Figure 1.3).

Soil moisture deficit

Soil moisture deficits (SMDs) decreased in all six of our regions during September 2013. At the end of September, SMDs ranged from <10mm in parts of Cumbria and North Yorkshire, to more than 130mm in parts of south Lincolnshire, west Norfolk, east Dorset and the Hampshire coast (Figure 2.1). The month end SMDs were 6-75mm greater than the LTA in 86 MORECS squares covering much of eastern, central and south western parts of England. SMDs were between 6-25mm less than the LTA in 6 MORECS grid squares covering parts of North Yorkshire, Gloucestershire, Thames estuary and east Kent (Figure 2.1).

At the beginning of September, SMDs ranged from 48mm in our North West Region to 128mm in our South East Region. SMDs decreased in all Regions during the middle of the month in response to rainfall but increased again by the end of the month following a period of dry weather. At the end of September, SMDs were between 5-33mm greater than the LTA in all our Regions (Figure 2.2).

River flows

Compared with August, monthly mean river flows for September decreased at four fifths of our reported indicator sites across England. The same proportion of sites showed a decrease in monthly mean flows for September expressed as a percentage of the LTA (Figure 3.1).

Monthly mean river flows for September were classed as *normal* or lower for the time of year at all but one of our indicator sites across England. Monthly mean flows were *below normal* or lower for the time of year at over a third of our indicator sites, particularly those in west and south western England (Figure 3.1). River flows on the River Severn, Bristol Avon and River Tone were all classed as *notably low* for the time of year.

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

Groundwater levels

Groundwater levels continued their seasonal decline at the vast majority of indicator sites in England during September. Levels only rose slightly in three sandstone aquifers. At the end of September, groundwater levels were *normal* or higher for the time of year, at all but three of the sites reported on. Groundwater levels at Jackaments Bottom (Burford Jurassic limestone) and Chilgrove (Chichester chalk) in our South East Region and Woodyates (Upper Dorset Stour chalk) in our South West Region were *below normal* for the time of year (Figures 4.1 and 4.2).

Reservoir storage

During September, reservoir stocks decreased at all but three of our reported reservoirs. Decreases were less than 10% of full capacity at the majority of these reservoirs. Reservoir stocks remain *normal* or higher for the time of year at 90% of the reported sites (Figure 5.1). At the end of September, reservoir stocks were classed as *below normal* for Abberton in our Anglian Region which is subject to ongoing engineering works, Derwent Valley in our Midlands Region, and Ardingly in our South East Region.

At a regional scale, reservoir stocks decreased by less than 5% in our Anglian, North East and South East Regions, and by 5-9% in our Midlands, North West and South West Regions. At the end of September, regional reservoir stocks were lowest in our South West Region at 60% of total capacity, and highest in our South East Region at 83%. Overall reservoir storage for England remained stable during September at 80% of total capacity (Figure 5.2).

Forward look

Mid to late October is likely to bring unsettled weather to much of England, with temperatures as expected for the time of year in the north, and slightly warmer than expected in the south. There is low confidence in the forecast for the period of October to December, which indicates a slightly elevated probability of above average rainfall[1].

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

March 2014: With average rainfall between October 2013 and the end of March 2014, river flows are likely to be *normal* at two thirds of modelled sites and *below normal* at a third of modelled sites. With above average rainfall (120% of the LTA), flows are likely to be *normal* at two thirds of modelled sites and *above normal* at a third of our modelled sites. With below average rainfall (80% of the LTA), river flows are likely to be *notably low* or lower at four fifths of the modelled sites (see Figure 6.1).

September 2014: With average (100% of the LTA) rainfall between October 2013 and the end of September 2014, river flows are likely to be *normal* at half of our modelled sites. With 120% of the LTA rainfall, river flows are likely to be *above normal* or higher at half of the modelled sites. With 80% of the LTA rainfall river flows are likely to be *notably low* or lower at over four fifths of the modelled sites (see Figure 6.2).

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

March 2014: A quarter of modelled sites have a greater than expected chance of *normal* flows from October 2013 to March 2014. Three quarters of modelled sites have a greater than expected chance of *below normal* flows, whilst nearly a third of modelled sites have a greater than expected chance of *above normal* flows between October 2013 and March 2014 (see Figure 6.3).

September 2014: More than half of the modelled sites have a greater than expected chance of *normal flows* from October 2013 to September 2014. More than half of the sites have a greater than expected chance of *notably low* flows, whilst nearly a quarter of the sites have a greater than expected chance of *notably high* flows (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 October 2013 to March 2014, groundwater levels are likely to be *normal* or higher for the time of year at four fifths of 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 all of the modelled sites. With below average rainfall (80% of the LTA), groundwater levels are likely to be *below normal* or lower at more than half of our modelled sites (see Figure 6.5).

September 2014: With average rainfall (100% of the LTA) from October 2013 to September 2014, groundwater levels are likely to be *normal* or higher for the time of year at four fifths 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, more than two thirds of the modelled sites are likely to have *below normal* or lower groundwater levels for the time of year (see Figure 6.6).

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

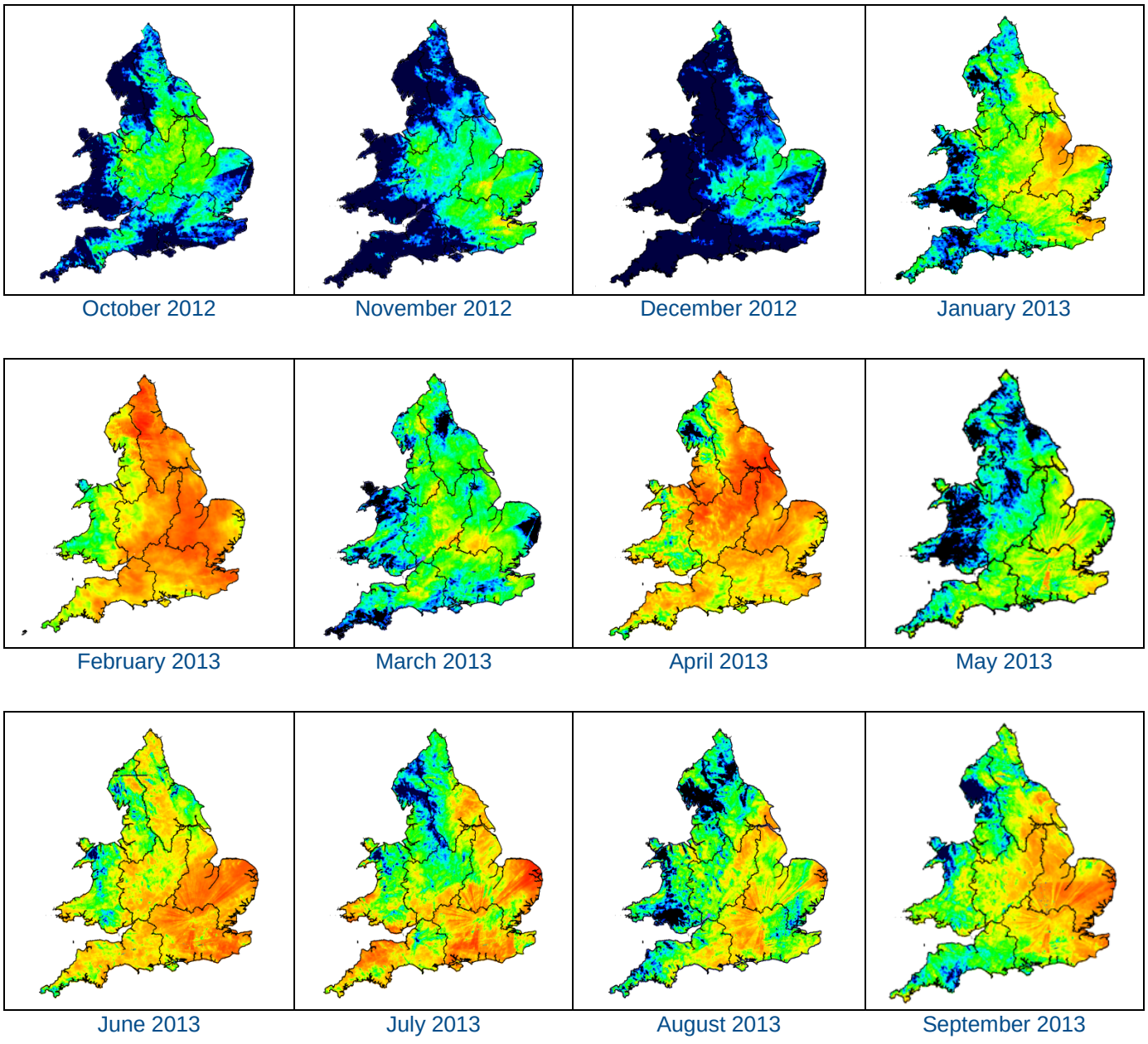
March 2014: More than a third of the modelled sites have a greater than expected chance of levels being *normal* for the time of year. Half of the modelled sites have a greater than expected chance of *exceptionally high* groundwater levels for the time of year. Nearly half of all modelled sites have a greater than expected chance of *exceptionally low* groundwater levels by the end of March 2014 (see Figure 6.7).

September 2014: Nearly two thirds of modelled sites have a greater than expected chance of *normal* groundwater levels for the time of year. A third of the sites have a greater than expected chance of *above normal* levels, and a third of the sites have a greater than expected chance of *notably low* levels for the time of year (see Figure 6.8).

Authors: Caroline Wallis 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



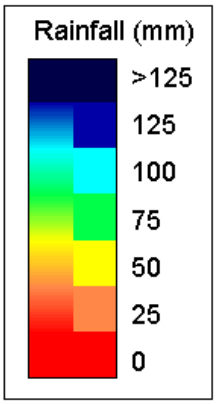


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2013). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.

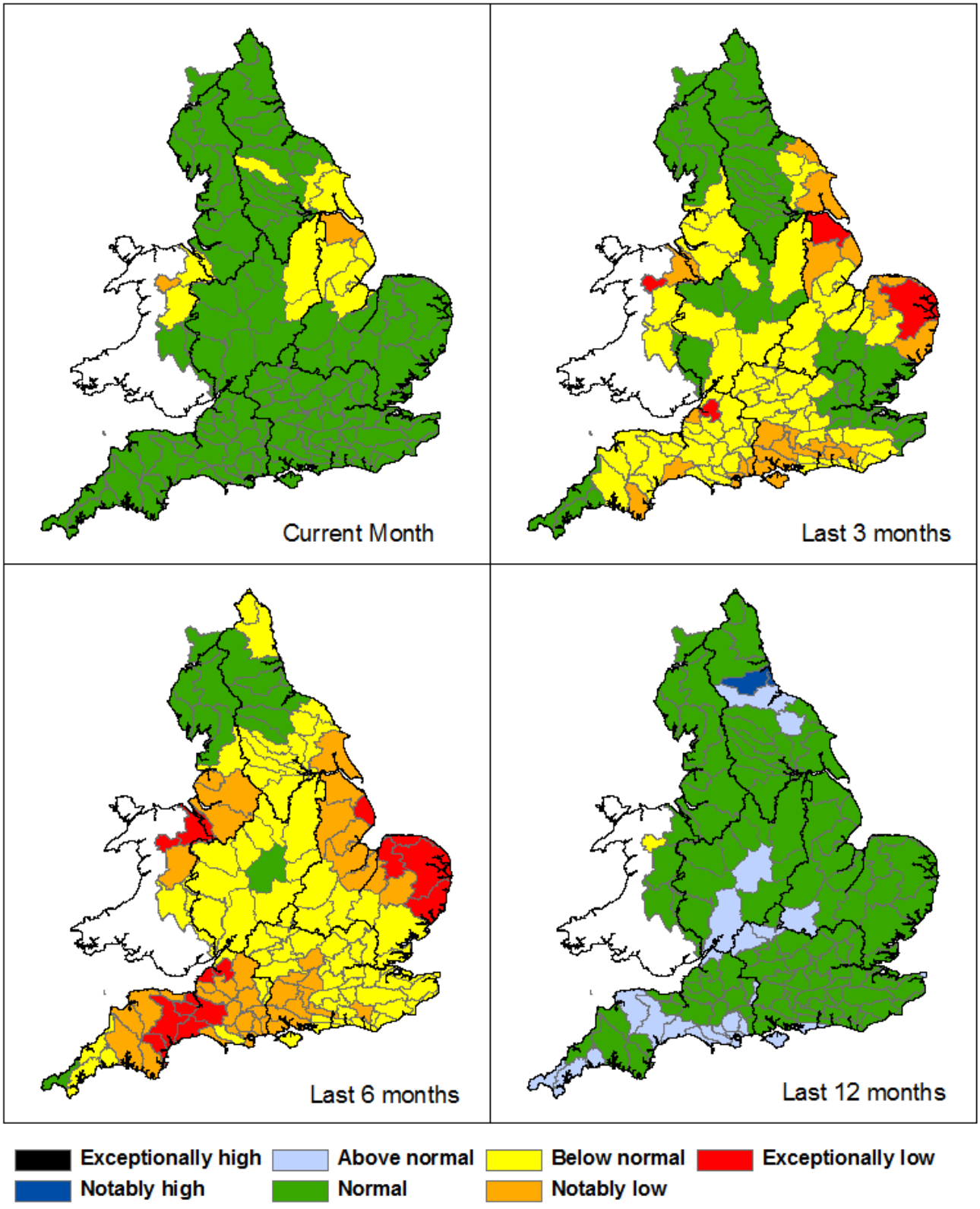


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30th September), the last three months, the last six months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) 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.

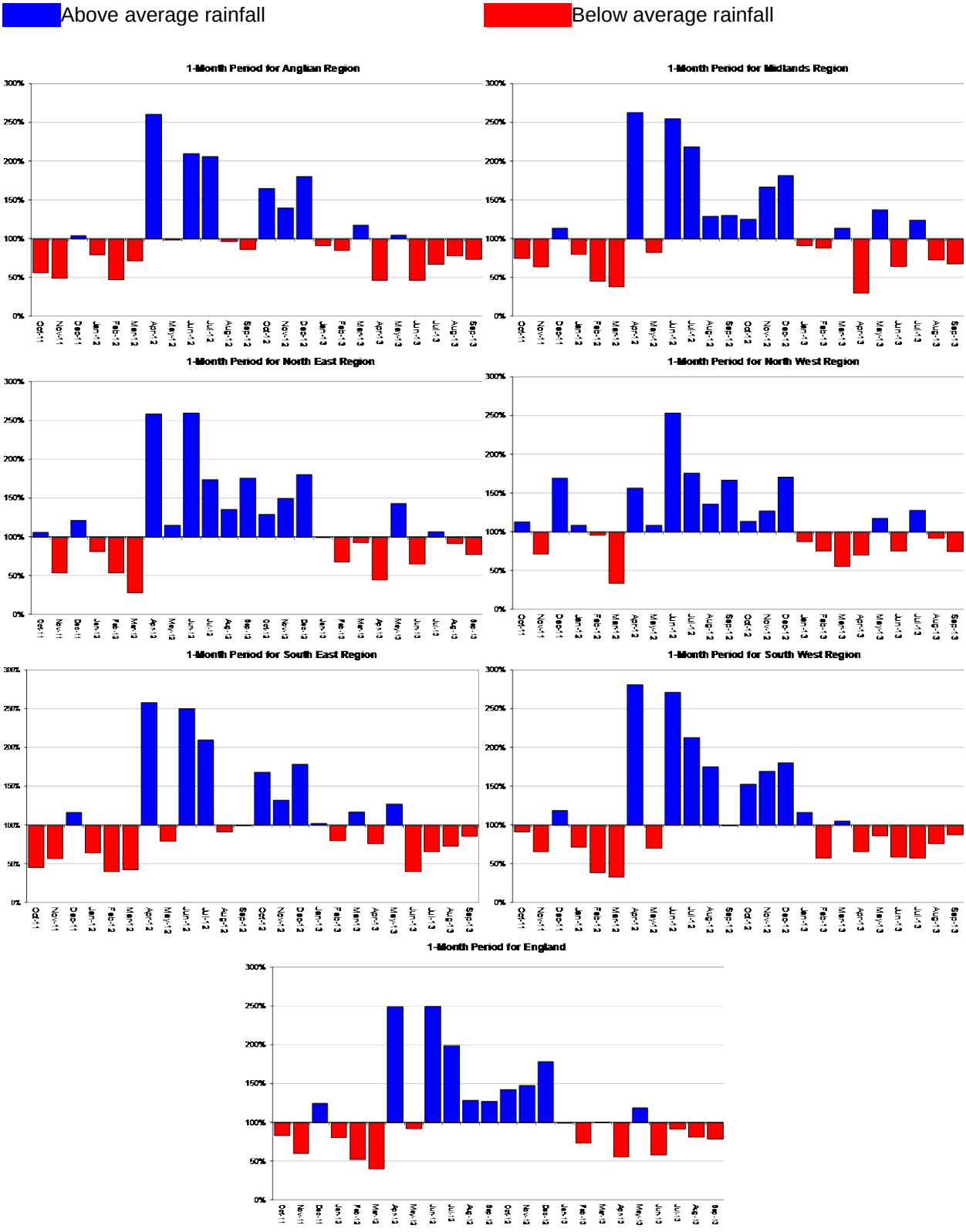


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each Environment Agency Region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2013).

Soil moisture deficit

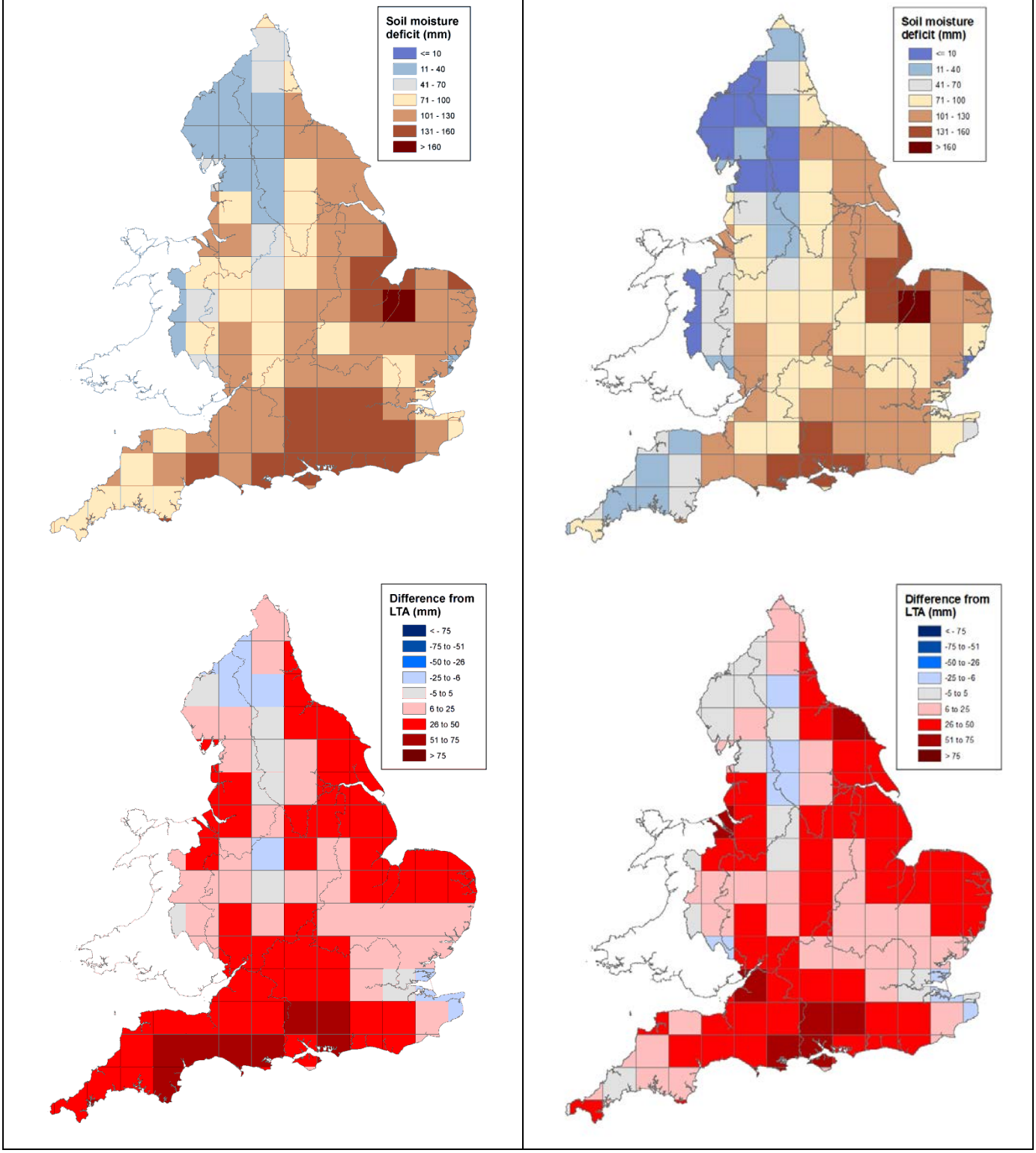
End of August 2013[1]	End of September 2013[2]
	

Figure 2.1: Soil moisture deficits for weeks ending 03 September 2013 [1] (left panel) and 01 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

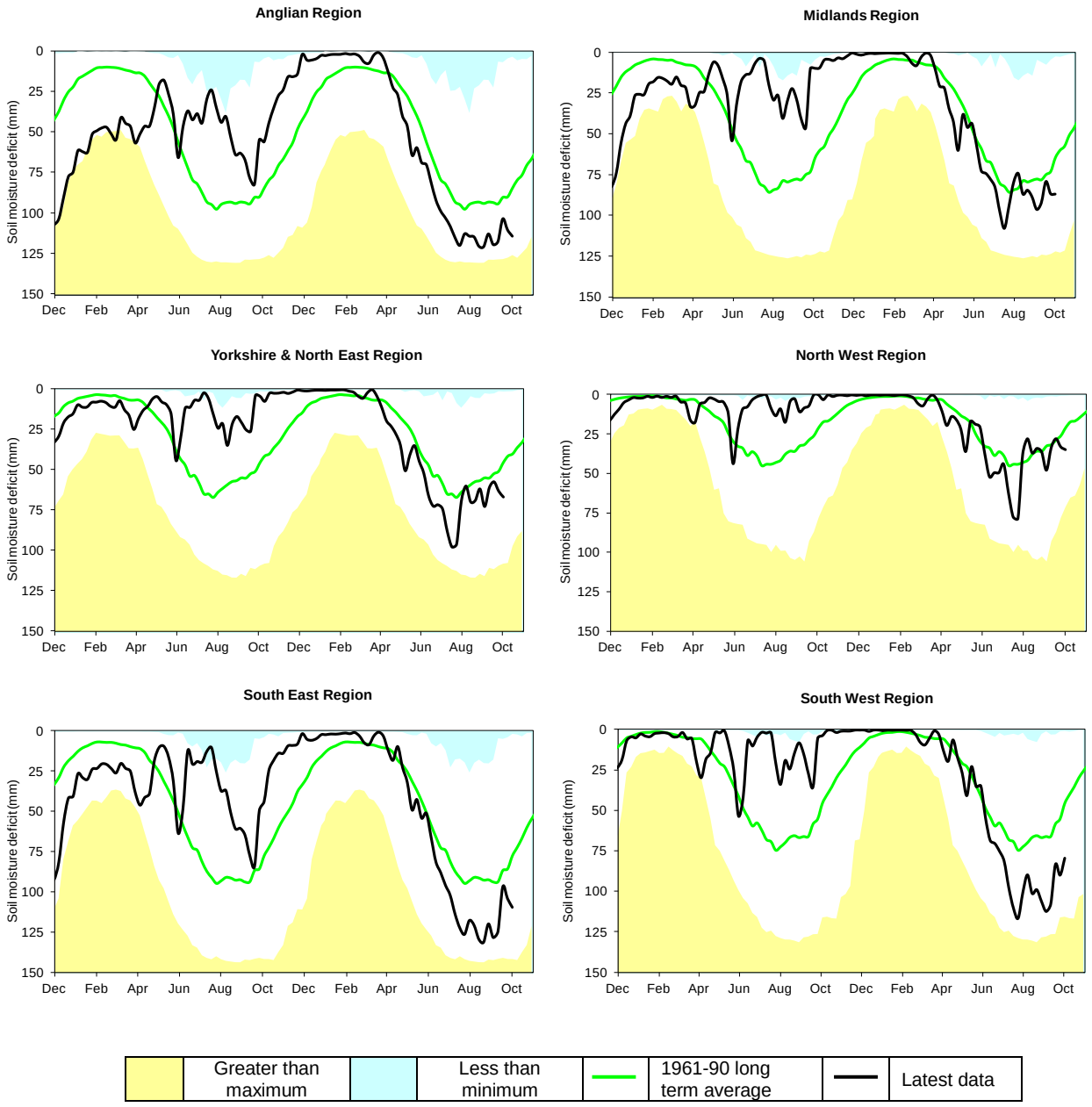
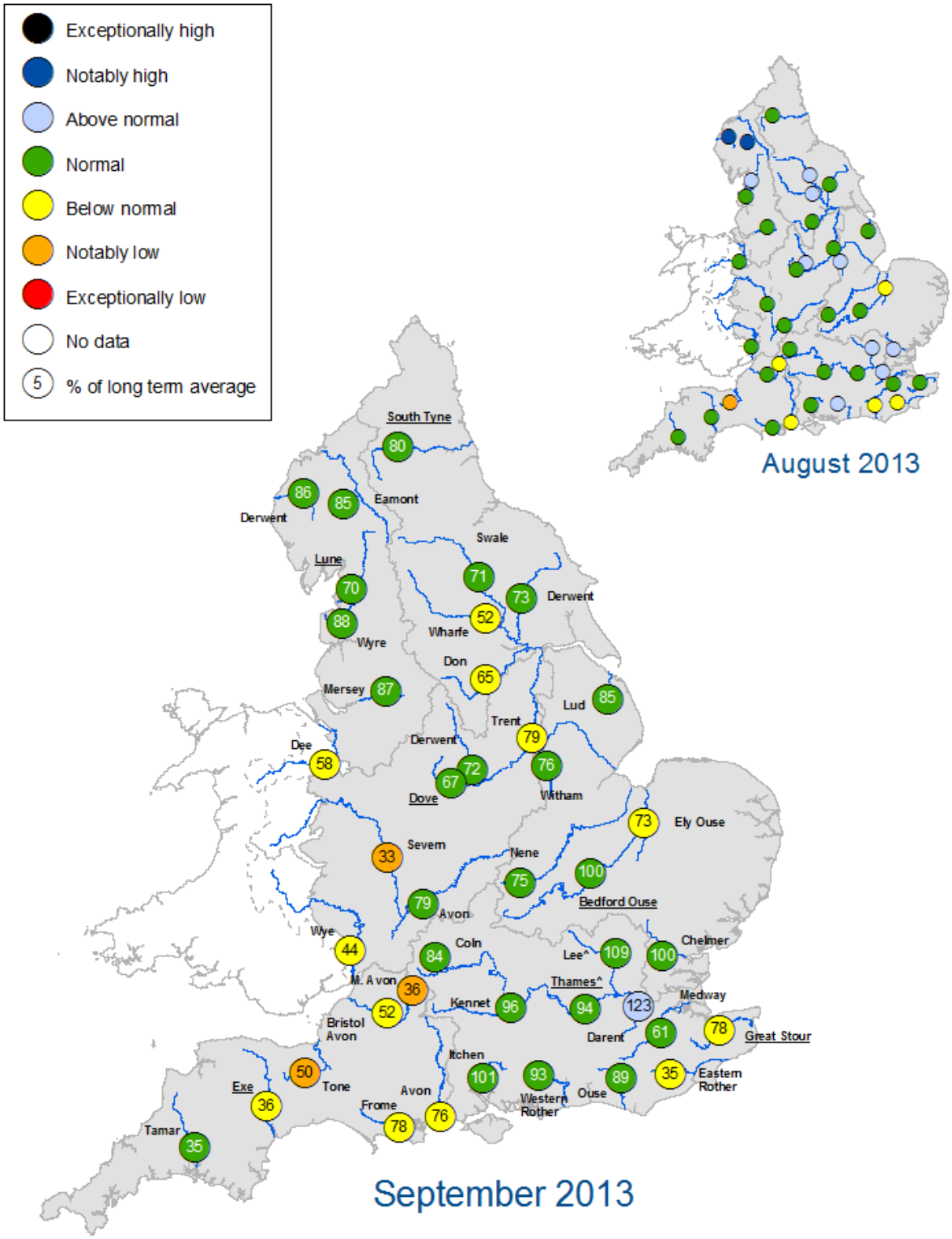


Figure 2.2: Latest soil moisture deficits for all Environment Agency Regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2013).

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

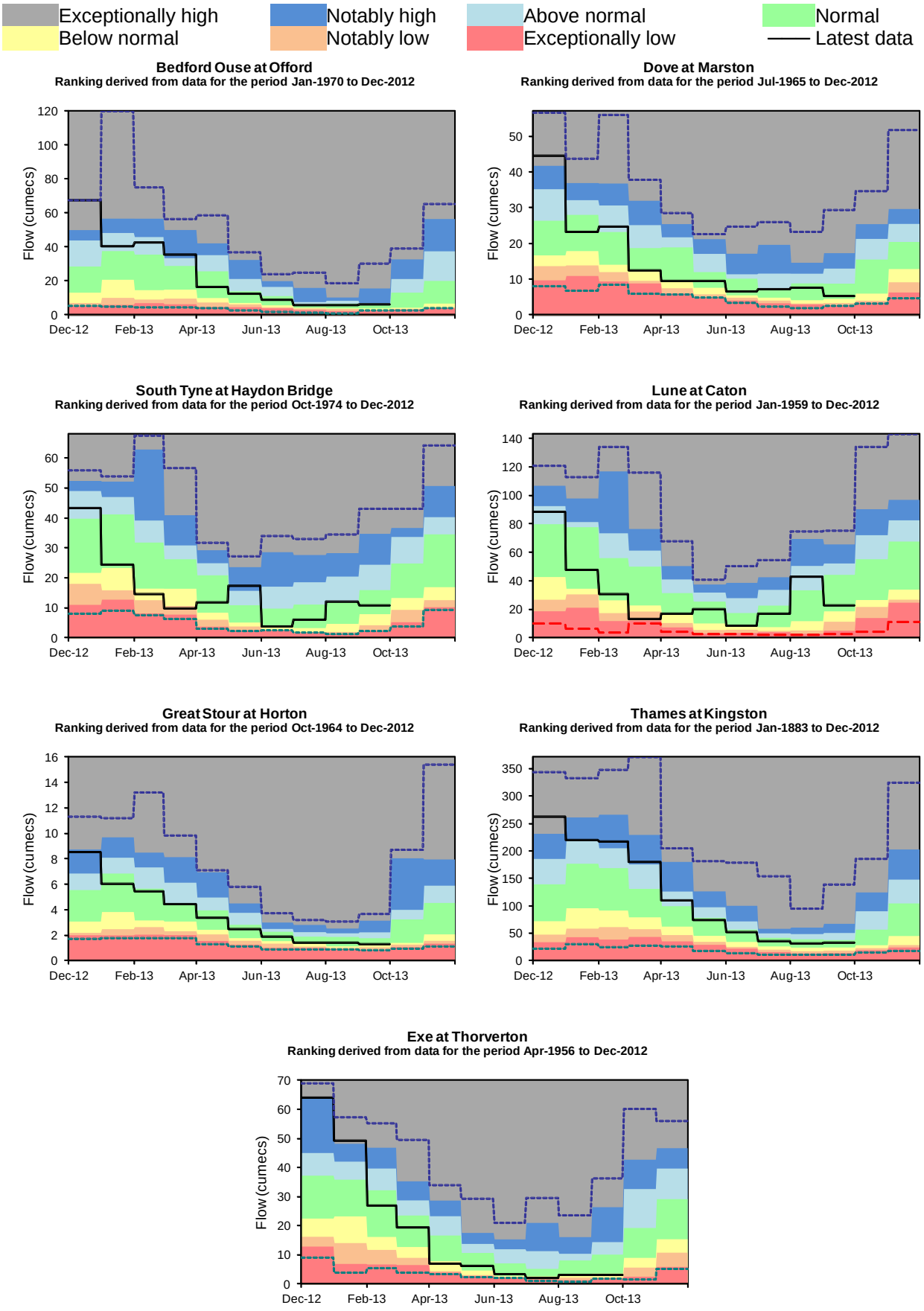
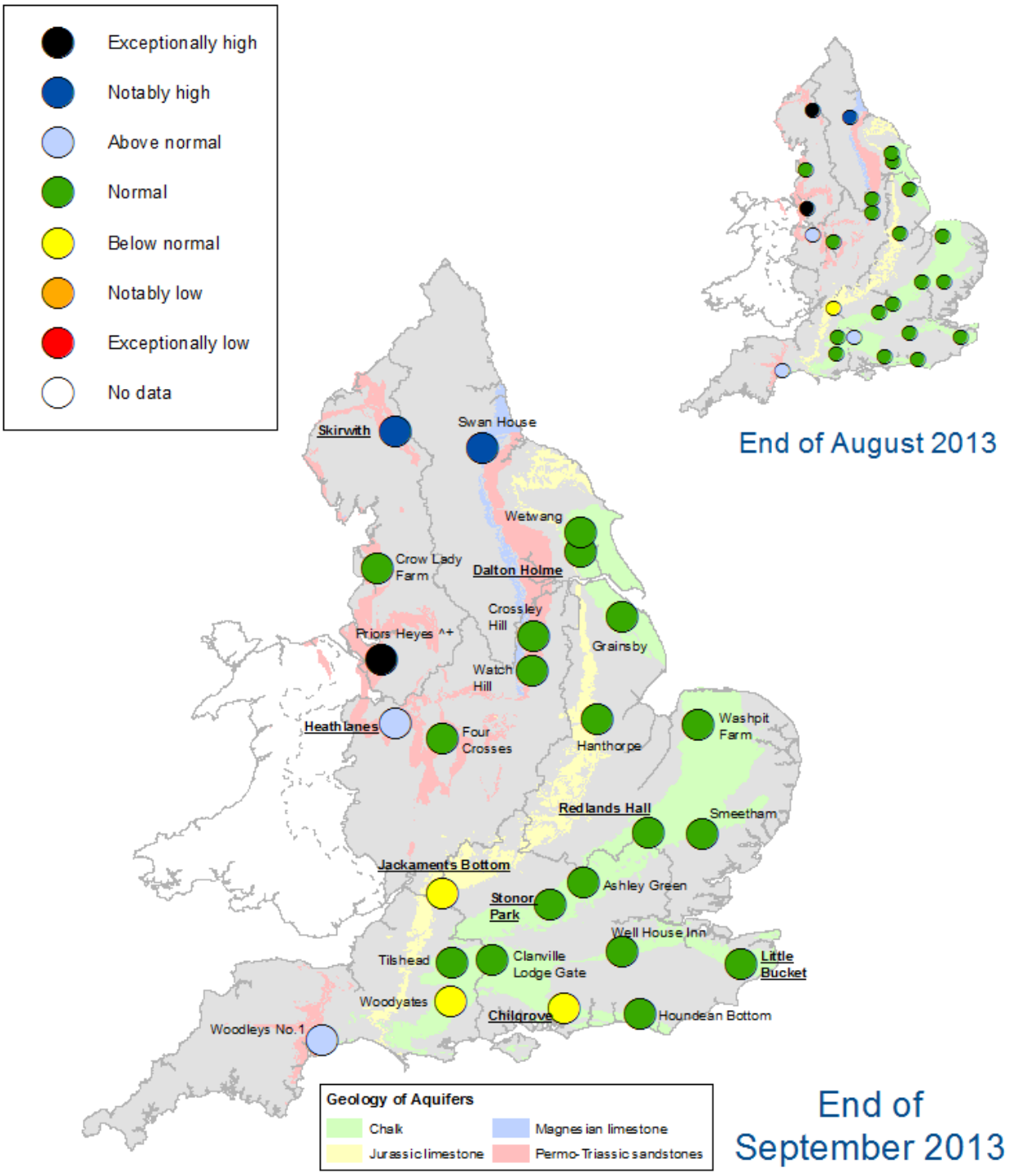


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 August 2013 and September 2013, classed relative to an analysis of respective historic August and September 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.

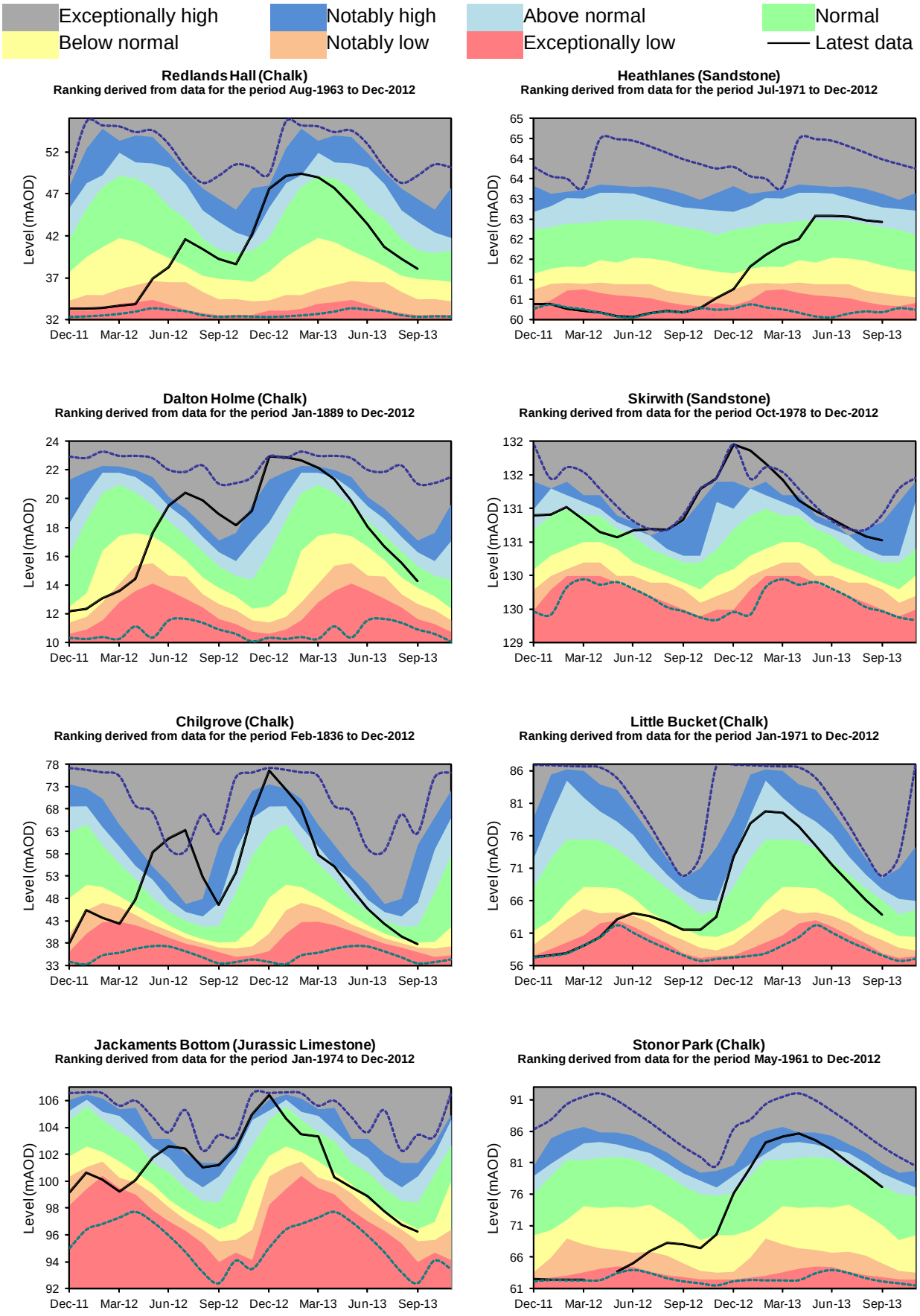
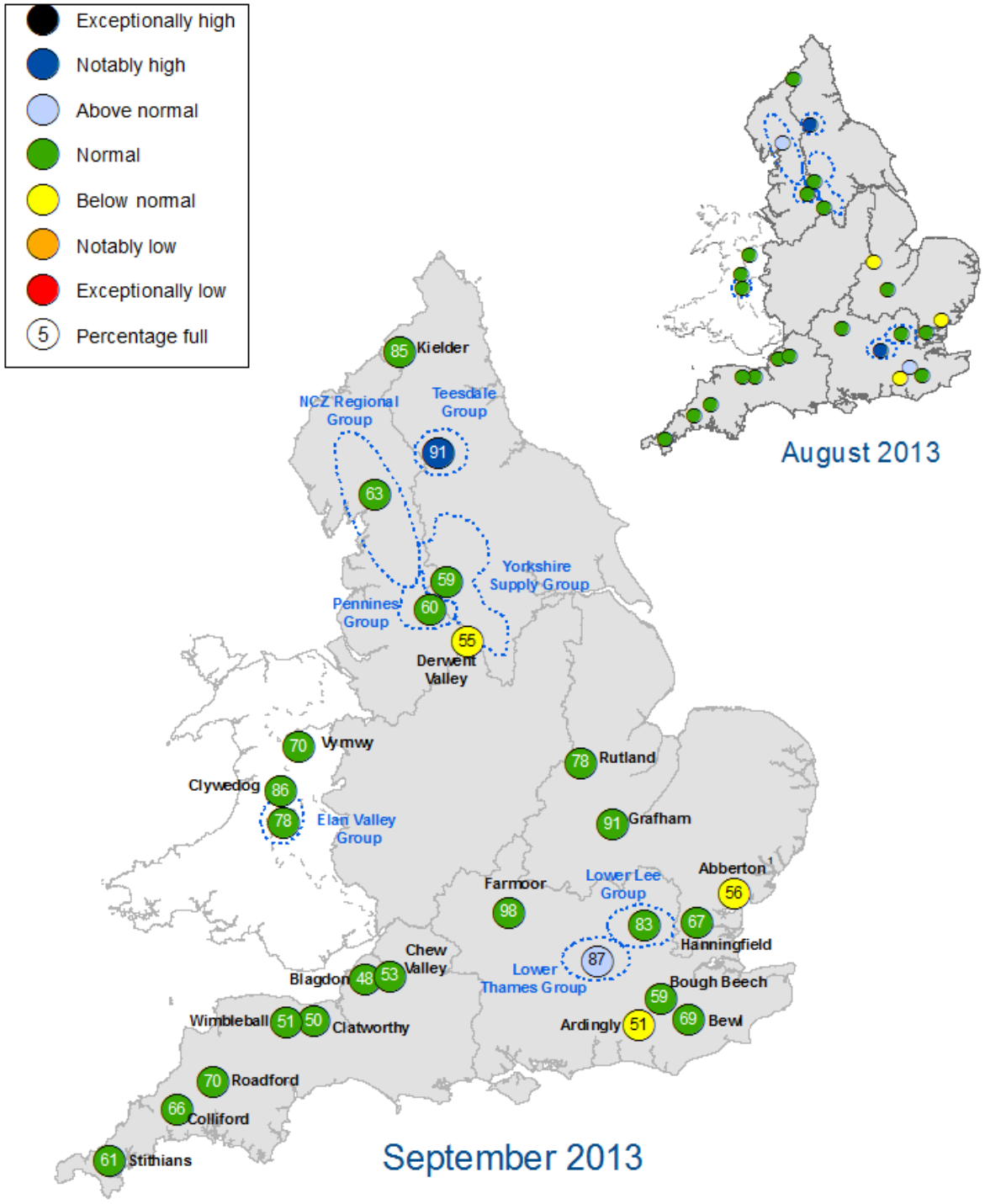


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2013).

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

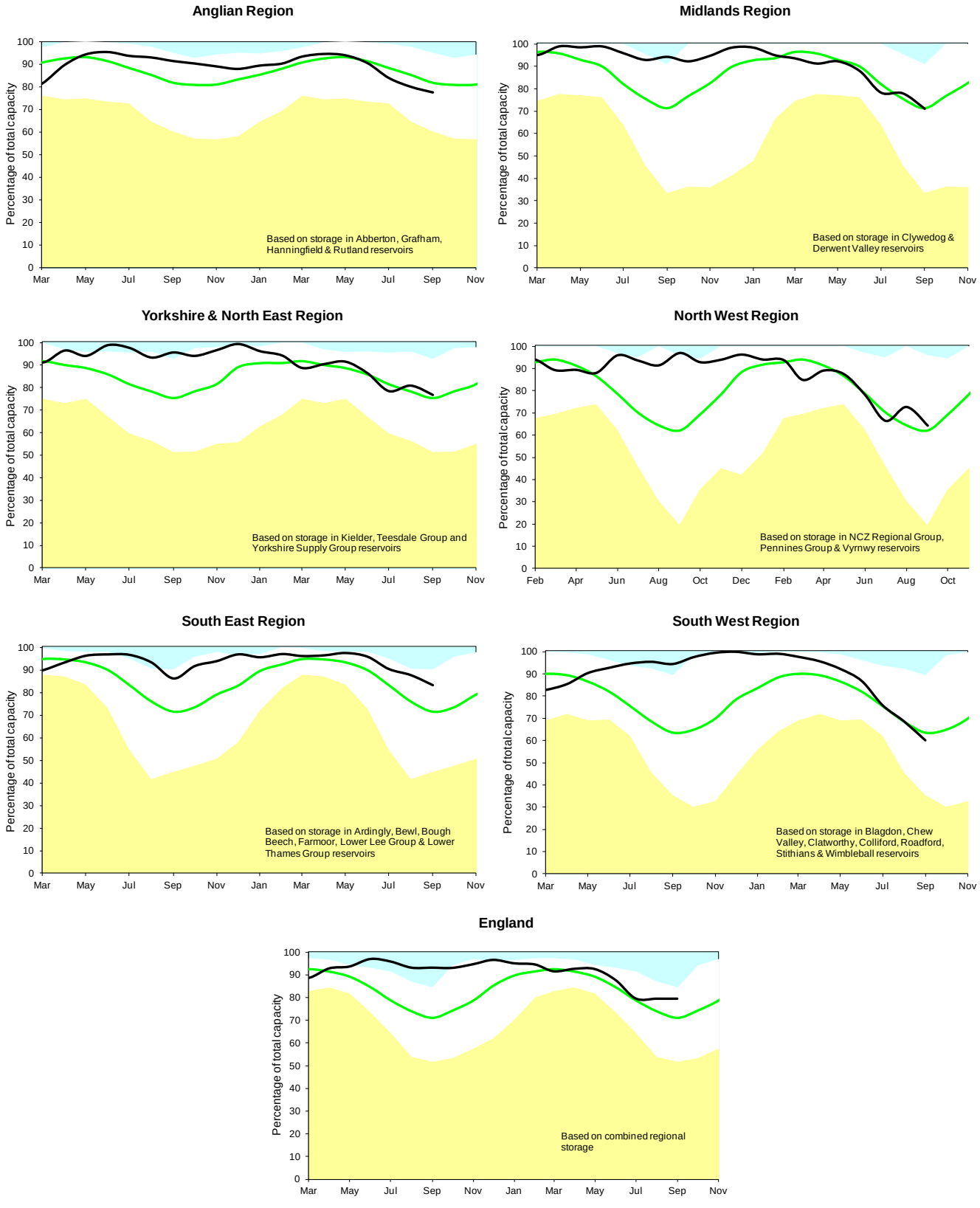


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

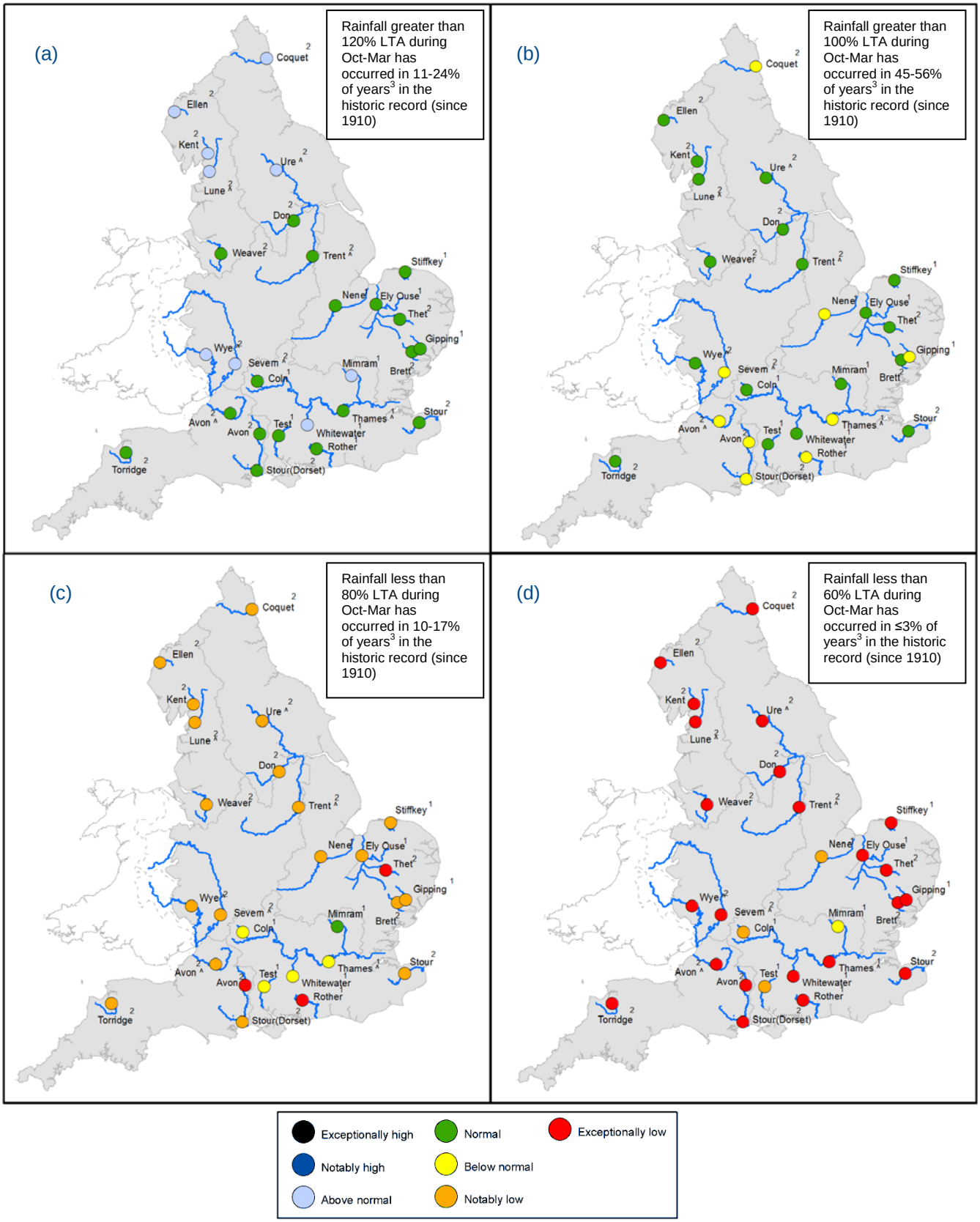
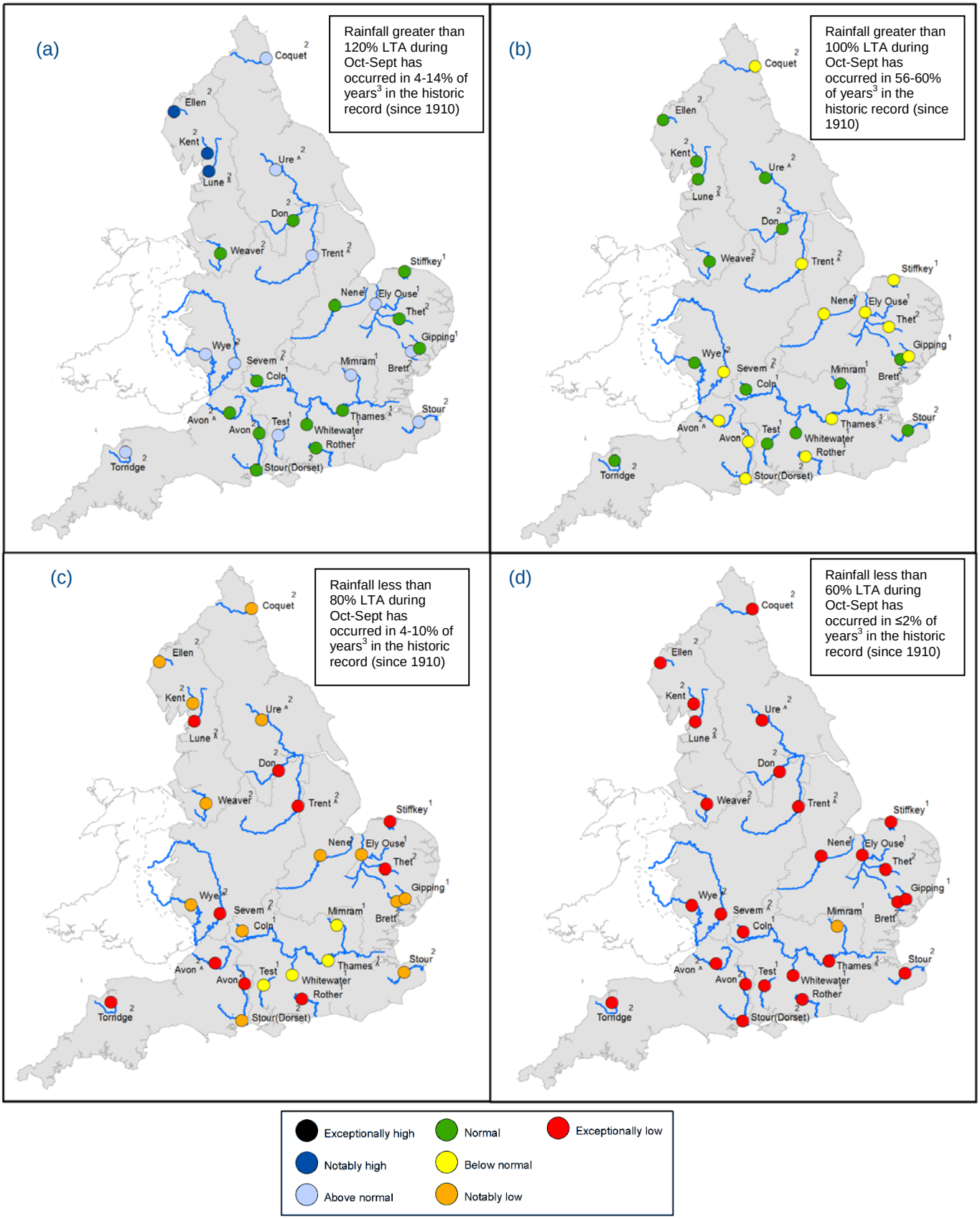


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2013 and March 2014 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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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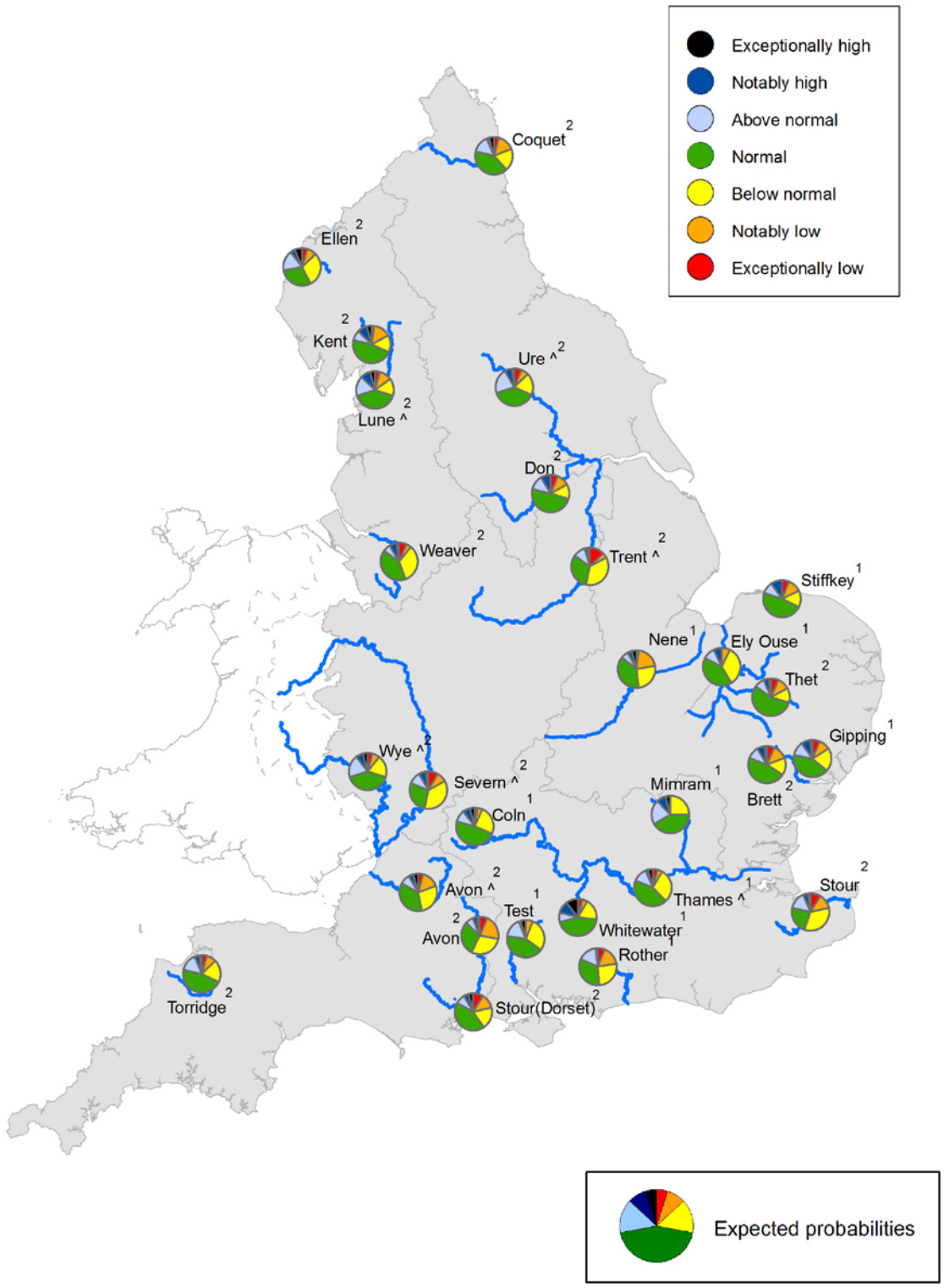

Figure 6.3: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2014. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology,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

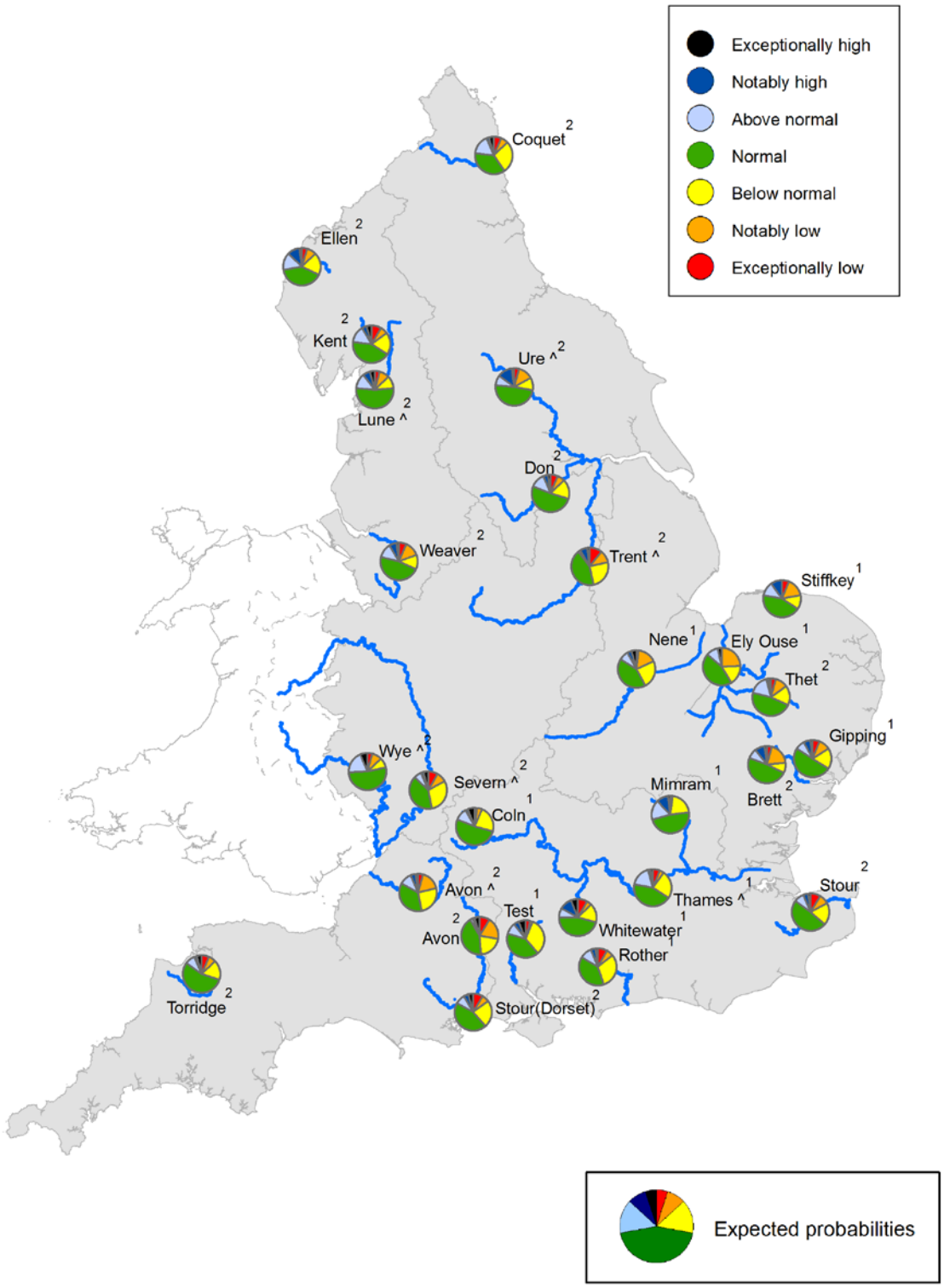

Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2014. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology,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

^ *"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

Forward look - groundwater

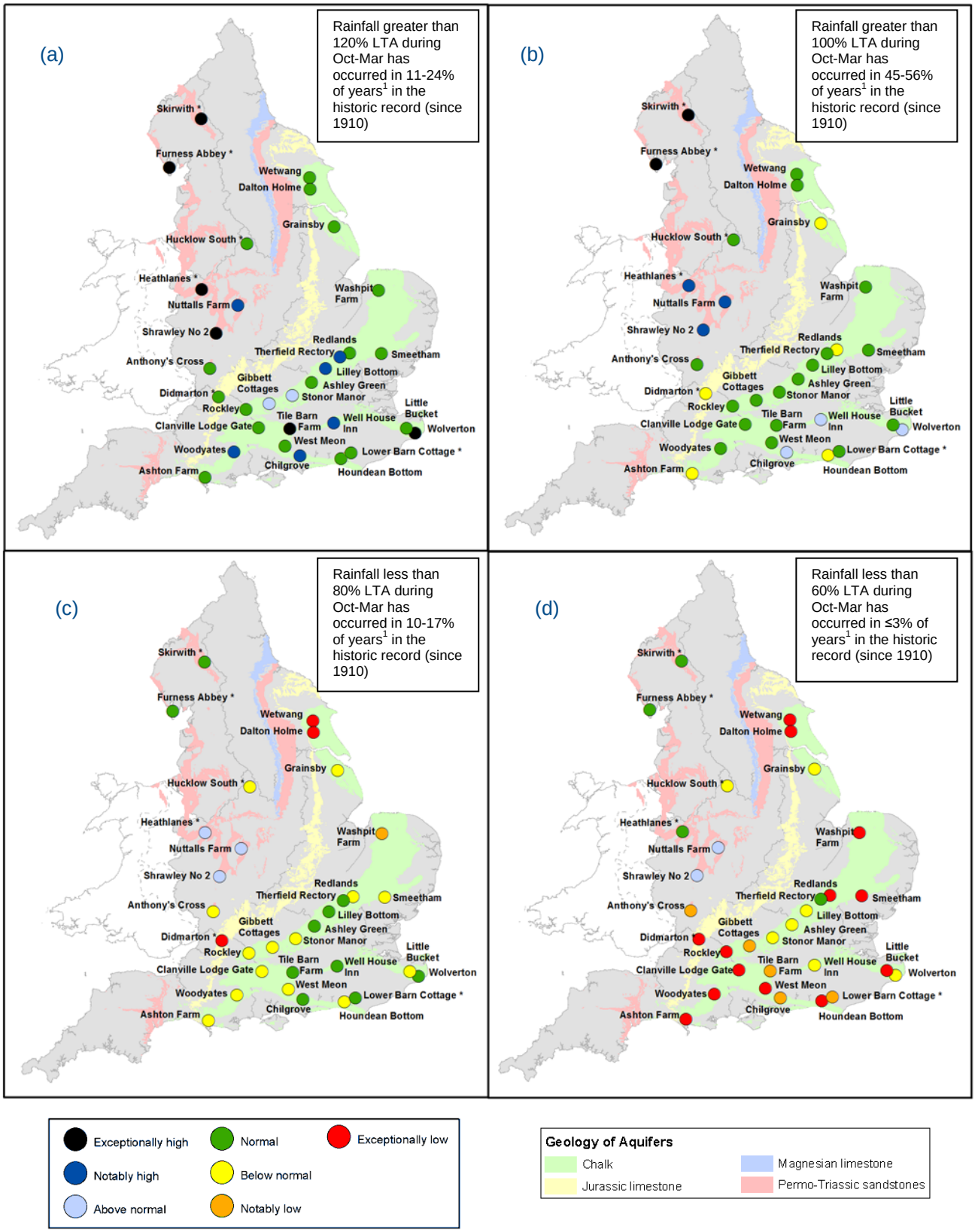

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2013 and March 2014 (Source: Environment Agency) Geological map reproduced with kind permission 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

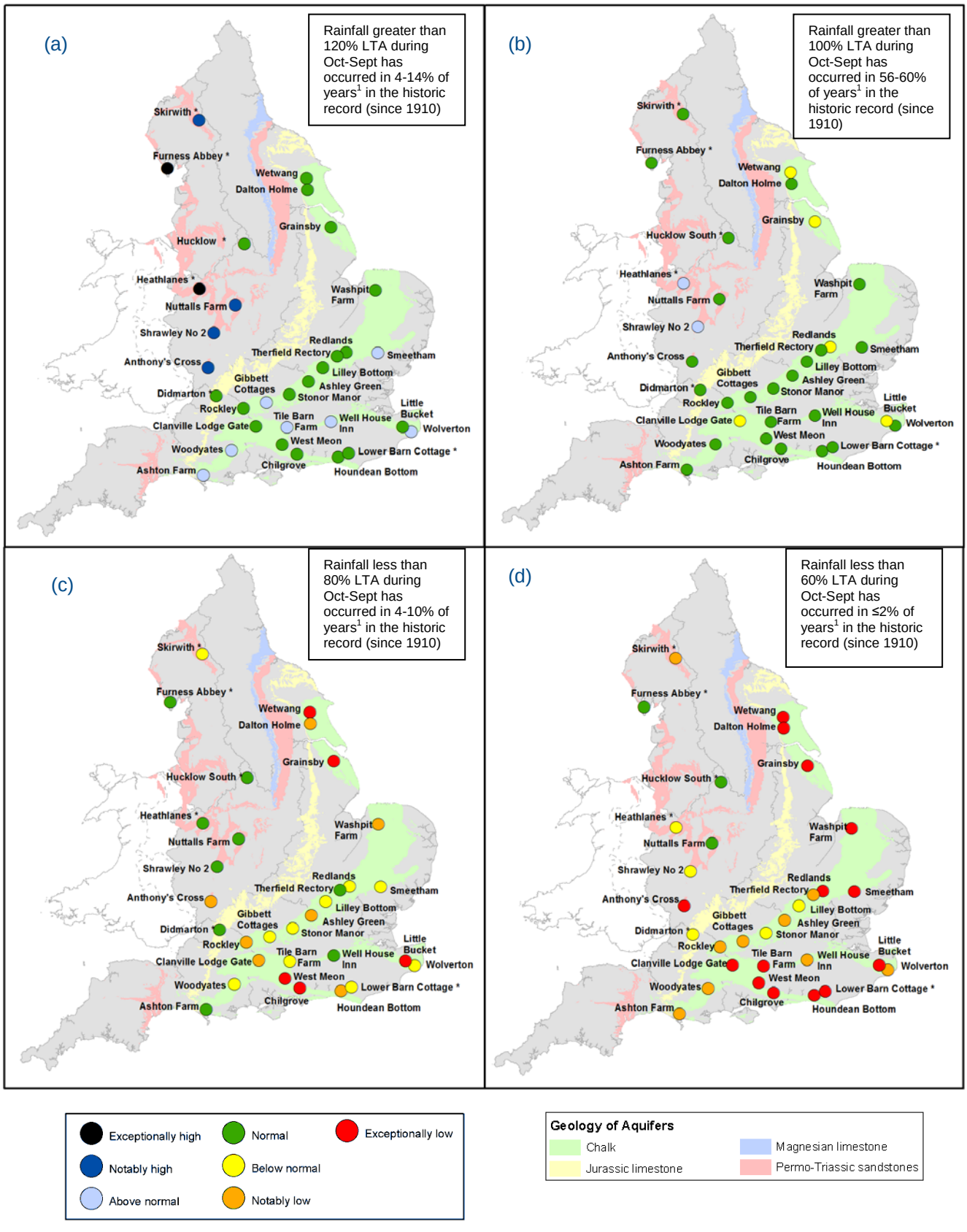

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between October 2013 and September 2014 (Source: Environment Agency) Geological map reproduced with kind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

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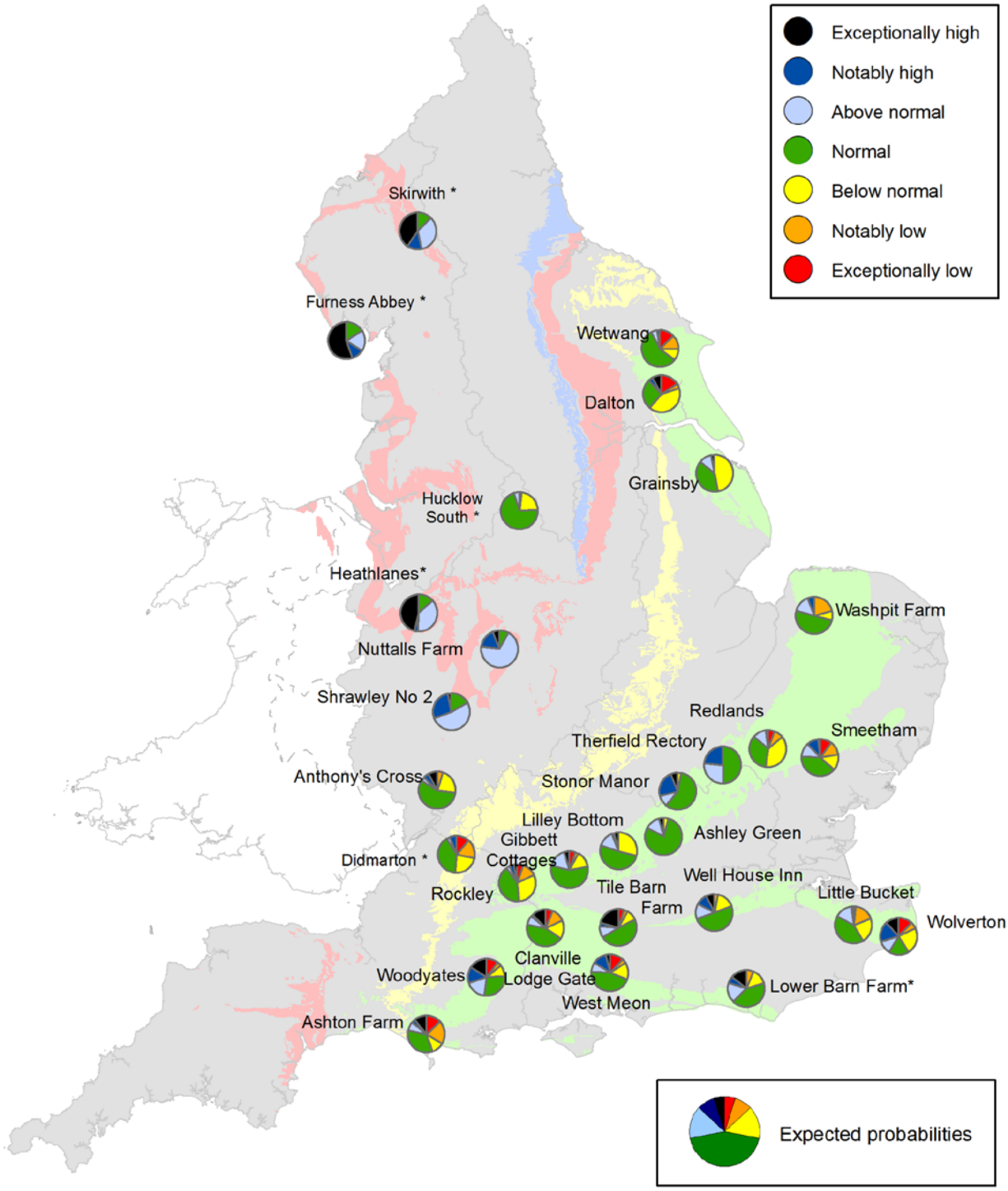
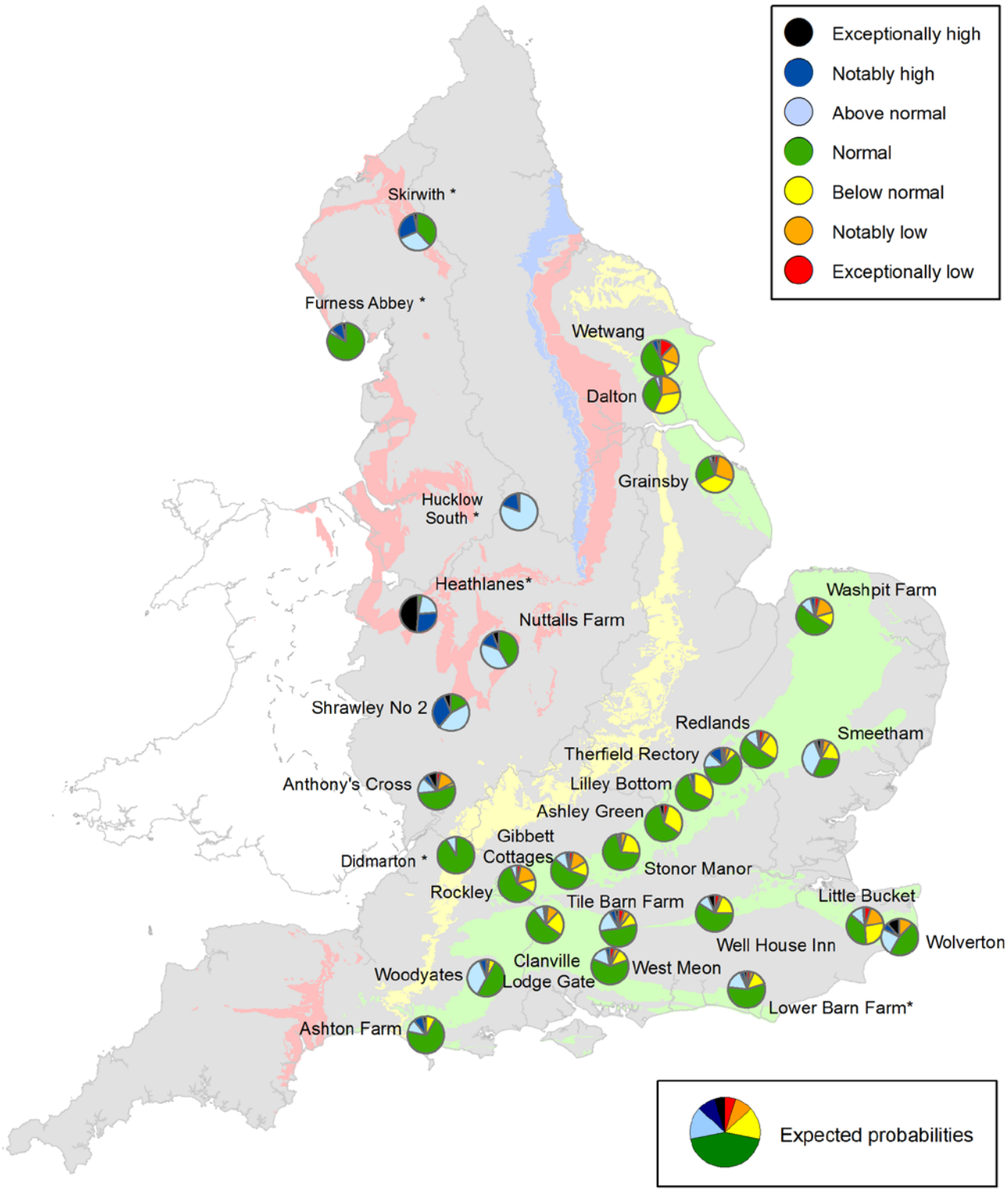


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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