Monthly water situation report

England

Summary – June 2013

June has been a month of below average rainfall, with England receiving 58% of the June long term average (LTA). Consequently, soil moisture deficits (SMDs) increased during June reaching more than 100mm in much of eastern and southeastern England. Monthly mean river flows for June were *normal* for the majority of sites across England, although flows have decreased at all of our reported indicator sites. Groundwater levels decreased at 80% of sites reported on, but remained *normal* or higher across the principal aquifers of England. Overall reservoir stocks decreased during June with storage supplying England as a whole at 88% of total capacity.

Rainfall

June rainfall totals were highest in our North West Region at 60mm. In our remaining regions totals ranged from 22mm (South East Region) to 39mm (Yorkshire and North East Region) (Figure 1.1). Locally, the highest rainfall totals (more than 95mm) fell in the Esk catchment in Cumbria, while the lowest rainfall totals (less than 16mm) fell in South London and Kent.

Rainfall totals for the whole of June were classed as *normal* or *below normal* for the time of year for the majority of hydrological areas reported on. In large parts of northeastern and northwestern England, rainfall totals for June were *normal,* whereas for large parts of central and southern England, June rainfall totals were *below normal*. Much of East Anglia and Kent received rainfall totals that were *notably low* for the time of year. Cumulative rainfall totals over the past 12 months to June 2013 were *above normal* or *notably high* for the majority of England. The southeast of England and East Anglia generally received *normal* cumulative rainfall totals over the past 12 months (Figure 1.2).

Monthly rainfall totals as a percentage of the June LTA were below average in all of our Regions, ranging from 40% in our South East Region to 76% in our North West Region (Figure 1.3). England as a whole received 58% of the June LTA rainfall. At least three out of the past six months have experienced below average rainfall in all of our Regions.

Soil moisture deficit

During June, soil moisture deficits (SMDs) increased in all of our Regions due to increased evapotranspiration and below average rainfall totals. At the end of June, SMDs ranged from less than 40mm in parts of northwest England, the Welsh borders and parts of southwest England, to more than 100mm in much of eastern and southeastern England, and parts of southwestern England (Figure 2.1). The month end SMDs were 6-50mm greater than the LTA for the end of June in the majority of MORECS grid squares. Approximately one fifth of the MORECS grid squares had month end SMDs that were less than the LTA, in Cornwall, Cumbria, Lancashire and the Welsh borders (Figure 2.1).

At the beginning of June, SMDs ranged from 20mm in our North West Region to 70 mm in our Anglian Region. SMDs increased steadily throughout June in all of our Regions except North West Region, where SMDs have decreased since mid-June following significant rainfall in parts of this region. However, the end of June SMD still shows an increase in North West Region, compared with the end of May. The end of June SMDs were between 15 and 20 mm greater than the LTA in four of our Regions, including Anglian, North East, South East and South West Regions (Figure 2.2).

River flows

River flows have decreased at all of our reported indicator sites across England. Compared with May, 85% of sites have also shown a decrease in monthly mean flows for June expressed as a percentage of the LTA (Figure 3.1).

Monthly mean river flows for June were classed as *normal* at more than 80% of our indicator sites across England. These included all sites in our Anglian, Midlands and North West Regions, and the majority of sites in our other regions. Each of our Yorkshire and North East, South East and South West Regions had one site where monthly mean flows were *below normal,* and two sites (the Swale at Catterick Bridge in our Yorkshire and

North East Region and the Tone at Bishops Hull in our South West Region) were *notably low* for June. In our South East Region, two sites had monthly mean flows that were *above normal* for the time of year, the Itchen at Allbrook and Highbridge and the Western Rother at Iping Mill (Figure 3.1).

River flows at the regional index sites were *normal* for the time of year, with the exception of the South Tyne at Haydon Bridge in our Yorkshire and North East Region, where monthly mean river flows were *below normal* for June (Figure 3.2).

Groundwater levels

Groundwater levels decreased at 80% of indicator sites in England during June. Increases in groundwater levels were seen at five of the indicator sites, two in our Midlands Region and three sites in our North West Region, all of which are in slower responding sandstone aquifers. At the end of June, groundwater levels were *normal* at the majority of sites reported on, and all sites had levels that were *normal* or higher for the time of year (Figures 4.1 and 4.2).

Groundwater levels for the end of June were classed as *exceptionally high* for three sites, including Swan House in our North East Region, and Skirwith and Priors Heyes in our North West Region. Both of these North West Region sites had the highest level on record for the end of June. Note that Priors Heyes remains high compared to historic levels because the aquifer is recovering from the effects of historic abstraction.

Reservoir storage

During June, reservoir stocks decreased or remained static in all of the reported reservoirs, with the exception of Farmoor reservoir in our South East Region, where storage increased marginally by 1%. Stocks decreased by more than 7% in nearly half of all reported reservoirs, with decreases of this magnitude seen across all of our Environment Agency Regions.

Despite the decreases, reservoir storage remained *normal* or higher for the time of year for the majority of reservoirs or reservoir groups supplying England. Stocks in Derwent Valley Reservoir supplying our Midlands Region and the Pennines Group of reservoirs supplying our North West Region were classed as *below normal* for the time of year (Figure 5.1). Storage in Abberton Reservoir supplying our Anglian Region was *notably low* for June (levels are affected by ongoing engineering works).

At a regional scale, reservoir stocks decreased by between 2 and 5% in all Regions, except our North West Region where reservoir stocks decreased by 9%. At the end of June, regional reservoir stocks were lowest in our North West Region at 78%, and highest in our South East Region at 96% of capacity. Overall reservoir storage for England decreased during June to 88% of total capacity (Figure 5.2).

Forward look

July is likely to remain dry and warm in the south, with showers possible at times. In the north, unsettled weather could dominate the middle of the month, particularly in the west. Further ahead, average to below average temperatures are most probable for the period July to September, with equal probabilities of high, low and average precipitation[1].

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

September 2013: With average (100% of the LTA) rainfall between July and the end of September 2013, river flows are likely to be *normal* or higher at over two thirds of our modelled sites. With 120% of the LTA rainfall, river flows are likely to be *above normal* or higher at nearly half of the modelled sites. With 80% of the LTA rainfall river flows are likely to be *below normal* or lower at over half of the modelled sites (see Figure 6.1).
March 2014: with average rainfall between July and the end of March 2014, river flows are likely to be *normal* at over four fifths of modelled sites. With above average rainfall (120% of the LTA), flows are likely to be *above normal* or higher at four fifths of our modelled sites. With below average rainfall (80% of the LTA), river flows are likely to be *below normal* or lower at all but one of the modelled sites (see Figure 6.2).

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

September 2013: Nearly two thirds of modelled sites have a greater than expected chance of *normal flows* from July to September. Nearly half of the sites have a greater than expected chance of *below normal* flows, whilst a third of the sites have a greater than expected chance of *exceptionally high* flows (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.

March 2014: Nearly half of all modelled sites have a greater than expected chance of *normal* flows from July 2013 to March 2014. Over two thirds of modelled sites have a greater than expected chance of *below normal* flows, whilst nearly two thirds of modelled sites have a greater than expected chance of *notably high* flows between July 2013 and March 2014 (see Figure 6.4).

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

September 2013: With average rainfall (100% of the LTA) from July to September, groundwater levels are likely to be *normal* or higher for the time of year at all except one modelled site, and *above normal* or higher at a third of modelled sites. With above average rainfall (120% of the LTA) all sites will be *normal* or higher. With 80% of the LTA rainfall, all except two modelled sites are likely to have *normal* or higher groundwater levels for the time of year (see Figure 6.5).

March 2014: With average rainfall (100% of the LTA) from July 2013 to March 2014, groundwater levels are likely to be *normal* or higher for the time of year at all except one modelled site, and *above normal* or higher at one fifth of the modelled sites. With below average rainfall (80% of the LTA), groundwater levels are likely to be *below normal* at just over half of our modelled sites. With above average rainfall (120% of the LTA), levels are likely to be *above normal* for the time of year at a third of the modelled sites (see Figure 6.6).

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

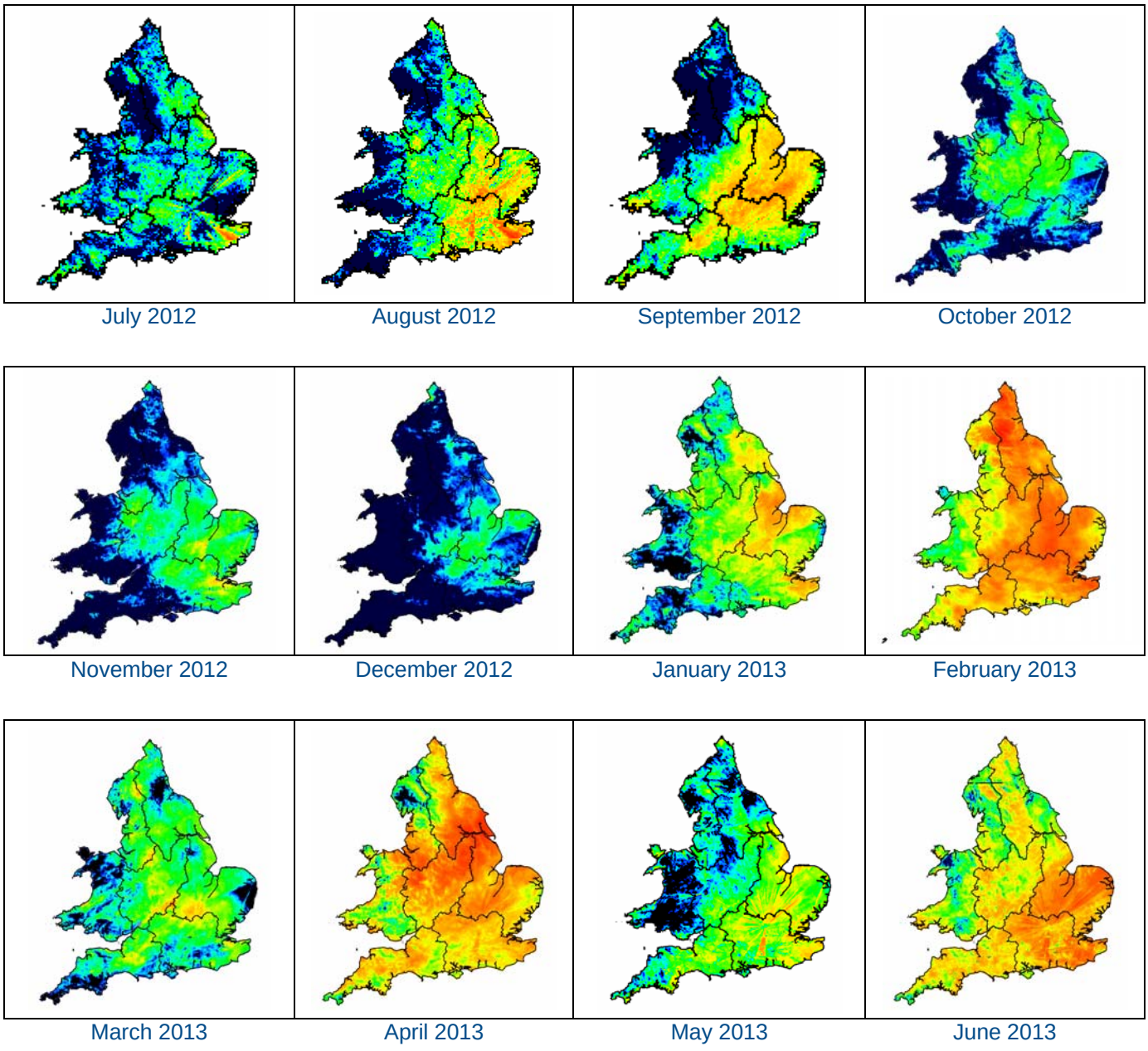
September 2013: More than two thirds of modelled sites have a greater than expected chance of *normal* groundwater levels for the time of year. 40% of the sites have a greater than expected chance of *above normal* levels. Only one site, Wetwang, in our North East region has a greater than expected chance of *below normal* levels for the time of year (see Figure 6.7).

March 2014: Half of the modelled sites have a greater than expected chance of levels being *normal* for the time of year. Nearly two thirds of the modelled sites have a greater than expected chance of *exceptionally high* groundwater levels for the time of year. A third of all modelled sites have a greater than expected chance of *exceptionally low* groundwater levels by the end of March 2014 (see Figure 6.8).

Authors: Natalie Armitage 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



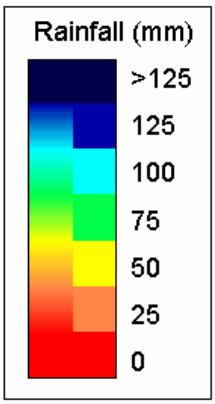


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2013). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2013.

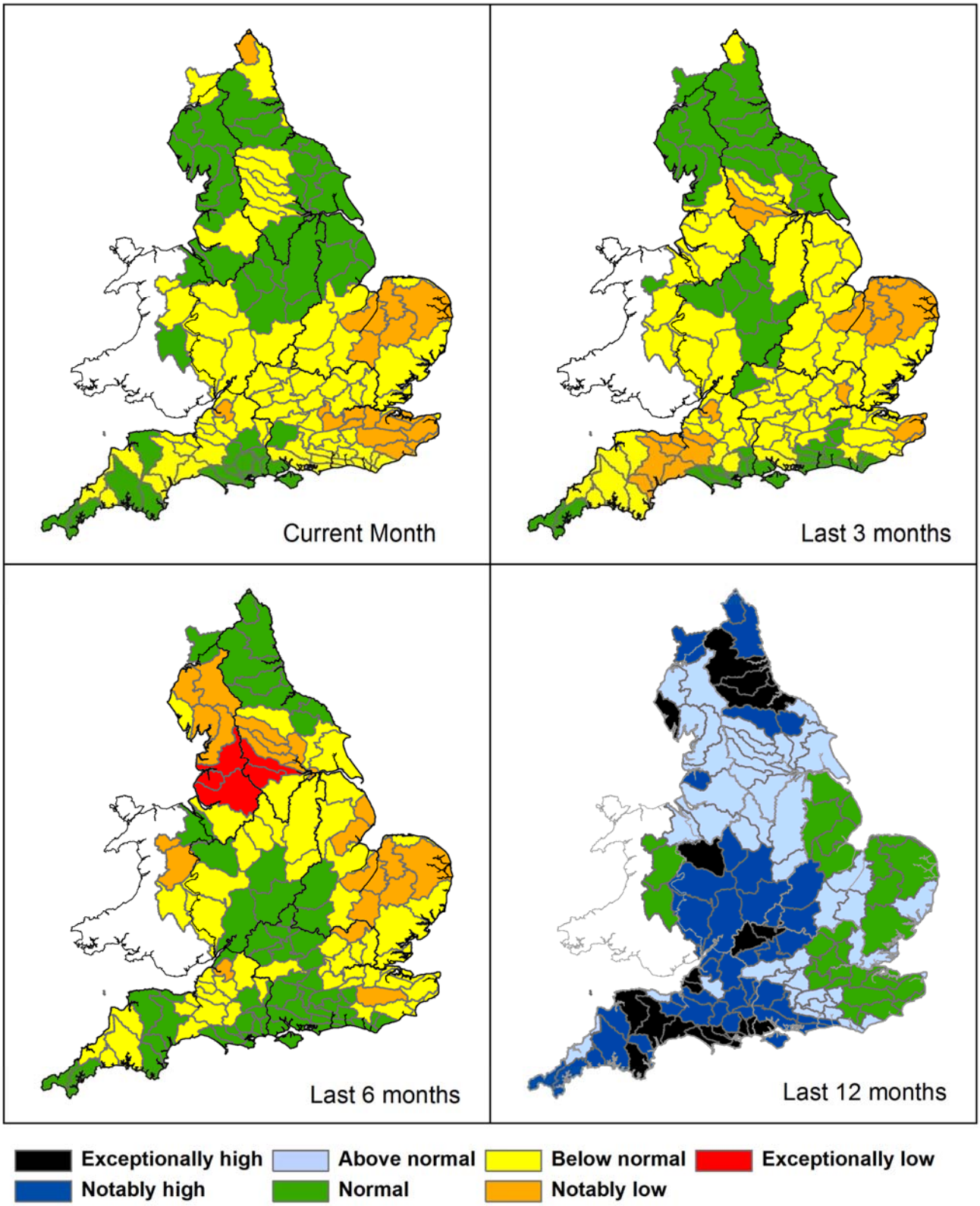


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30th June), the last three months, the last six months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre)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

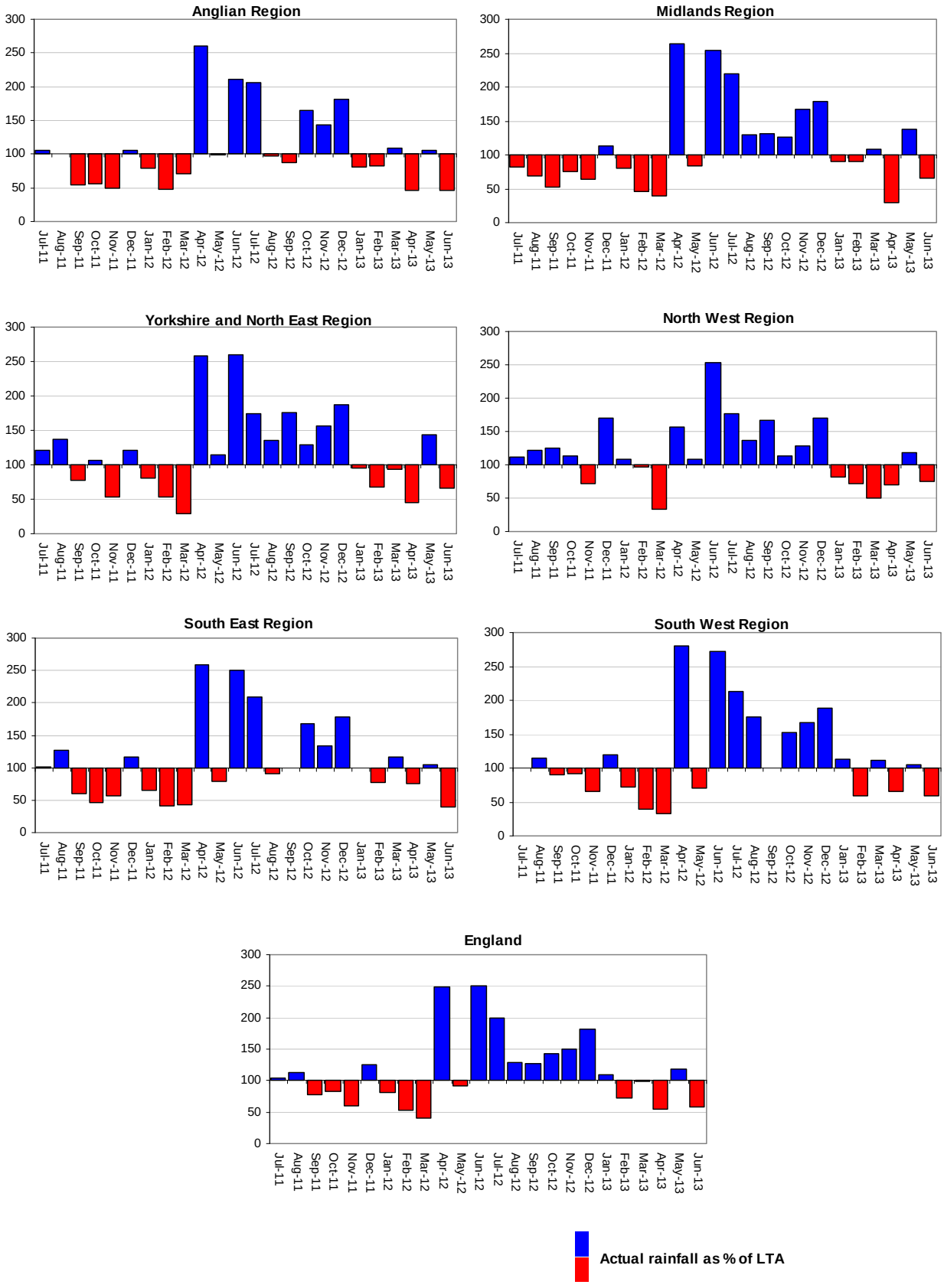


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each Environment Agency Region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2013).

Soil moisture deficit

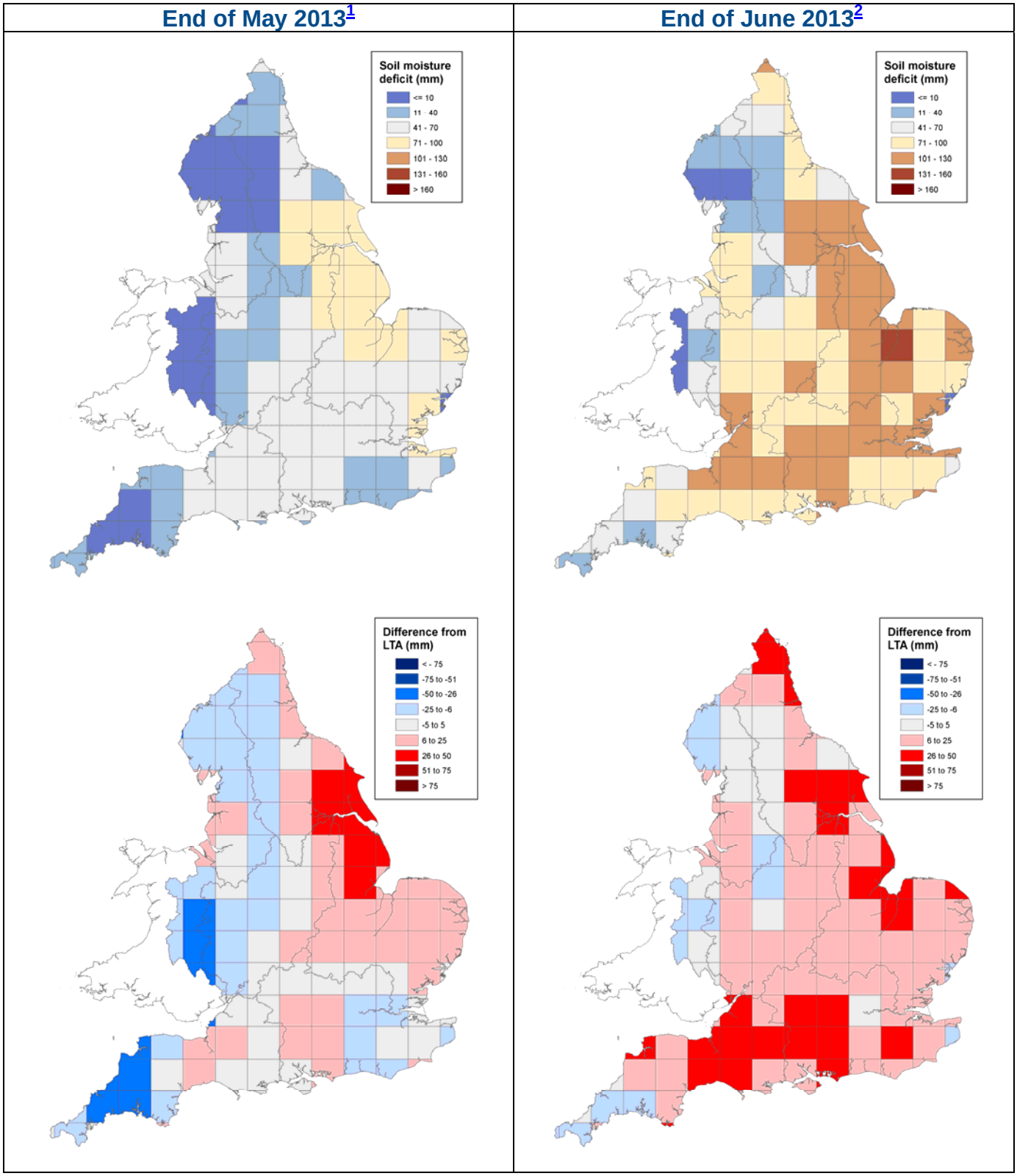


Figure 2.1: Soil moisture deficits for weeks ending 28 May 2013 [1] (left panel) and 03 July 2013 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2013). Crown copyright. All rights reserved. Environment Agency, 100026380, 2013

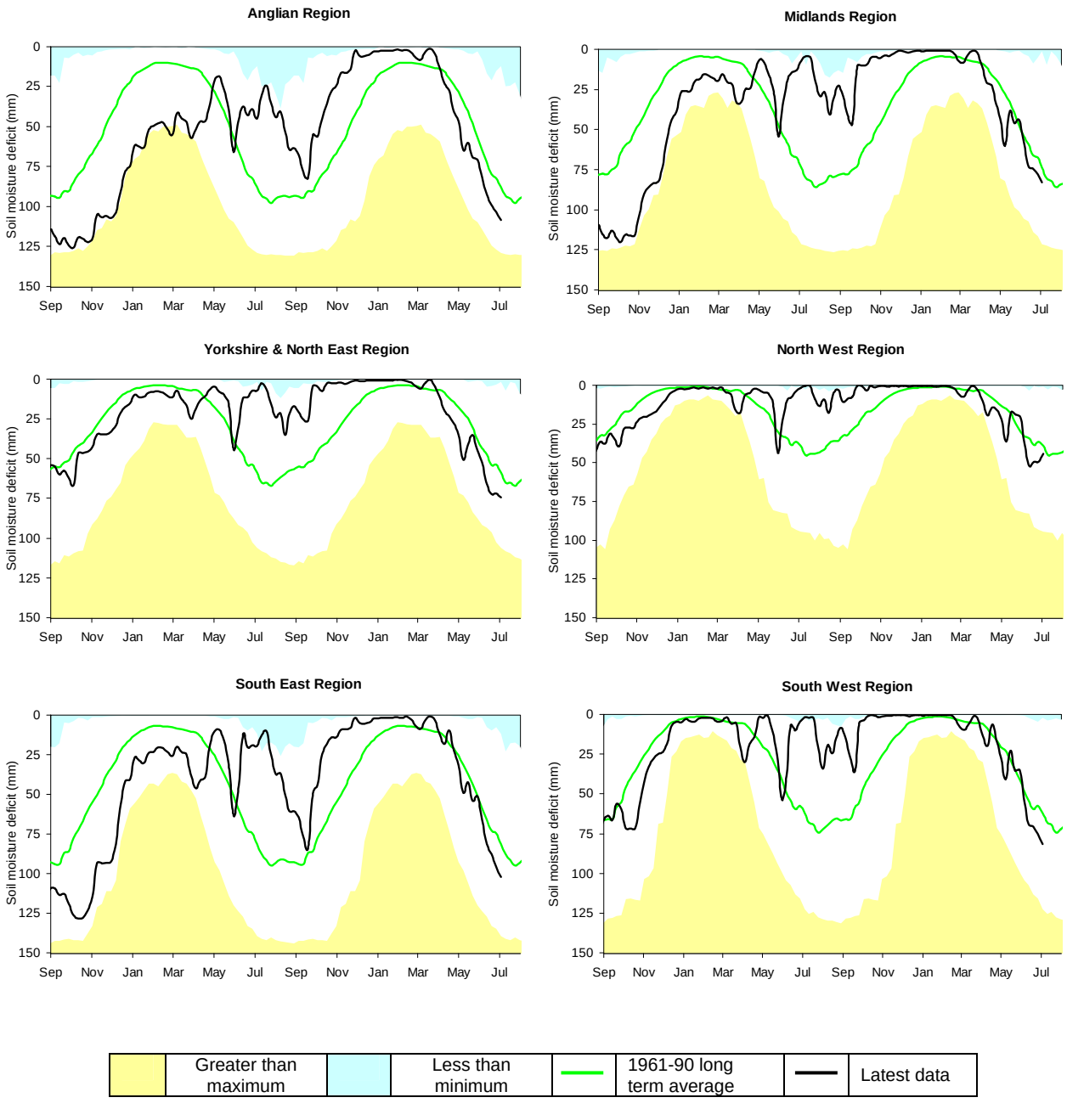
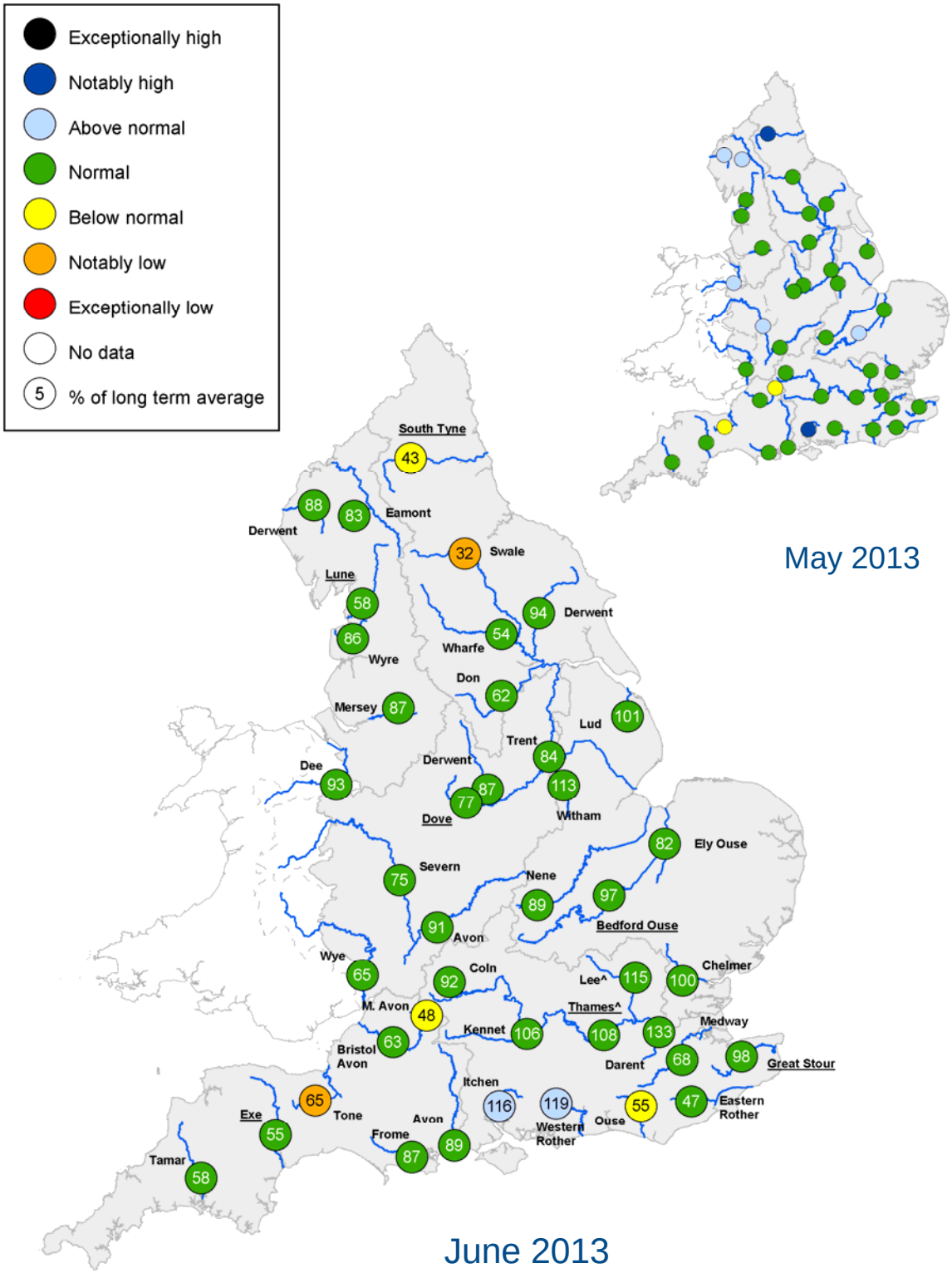


Figure 2.2: Latest soil moisture deficits for all Environment Agency Regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2013).

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

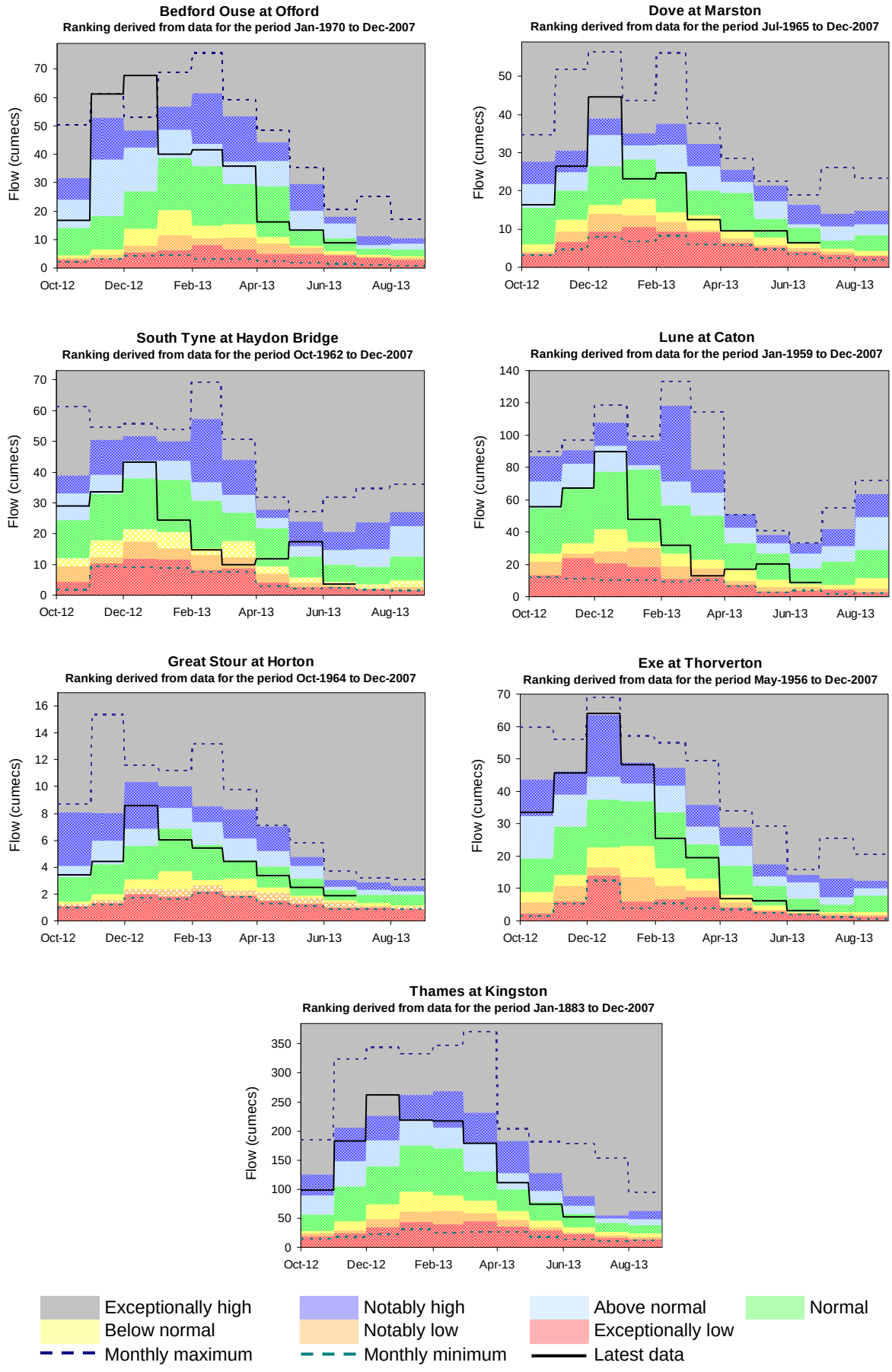
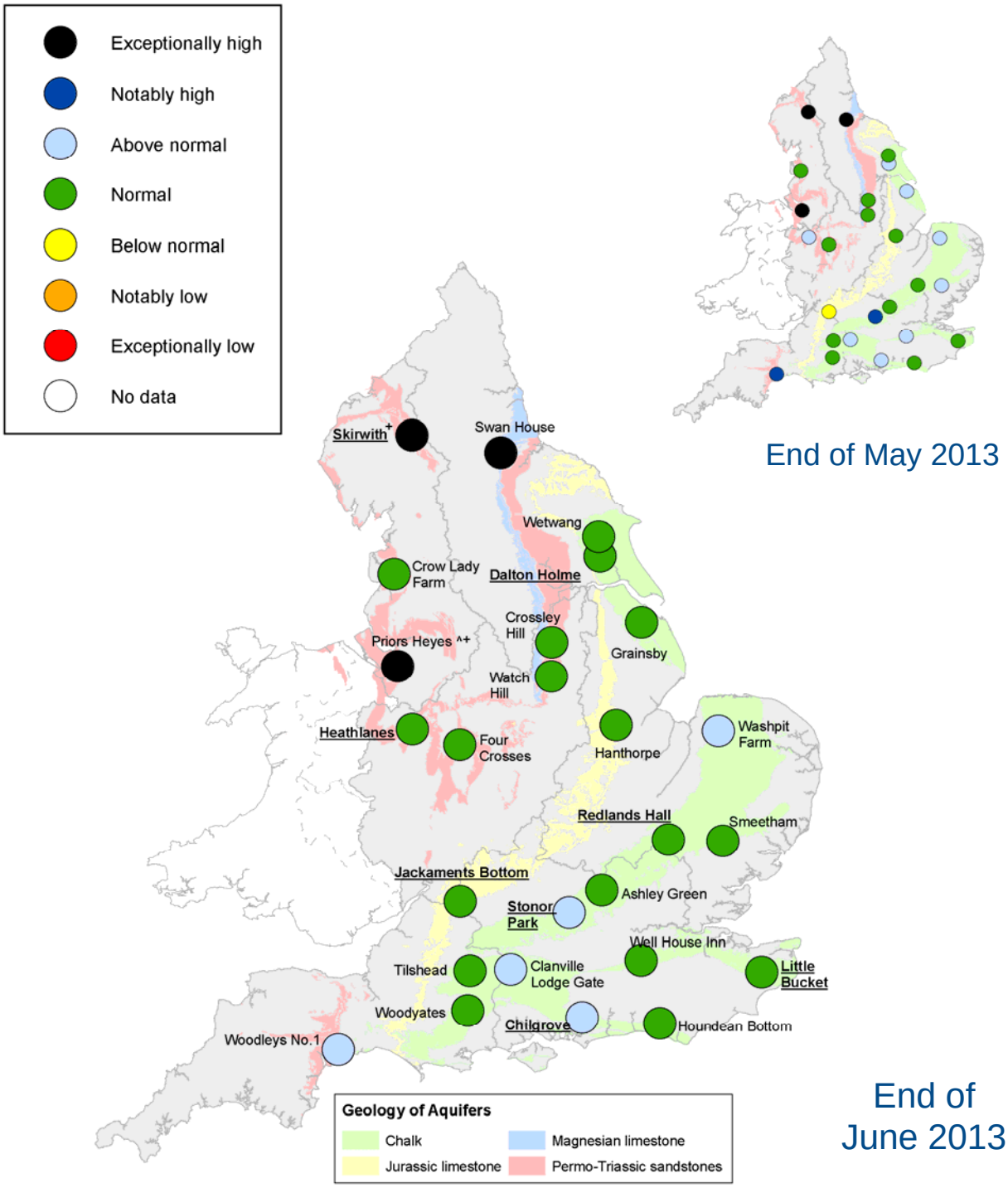


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 May 2013 and June 2013, classed relative to an analysis of respective historic May and June 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.

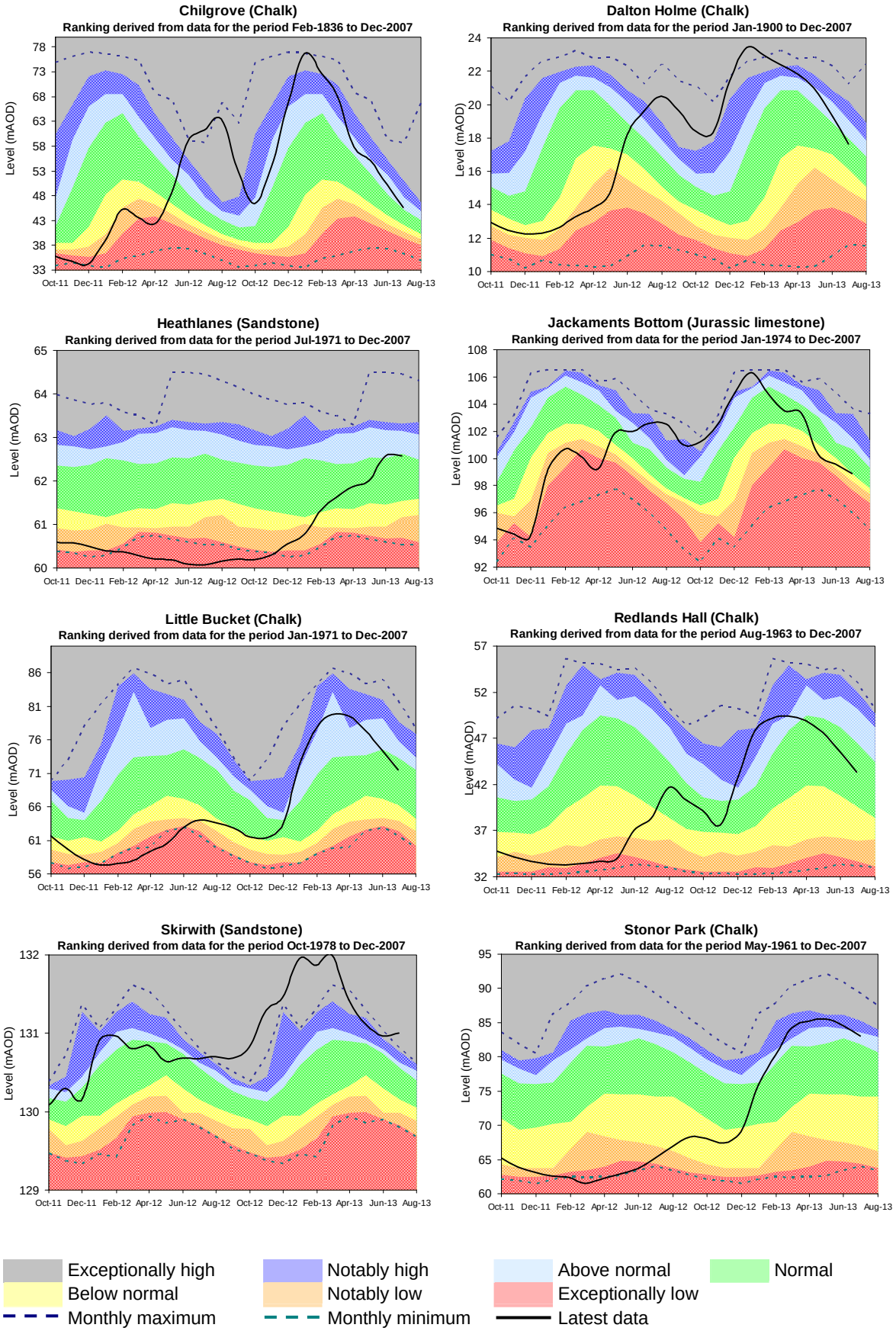
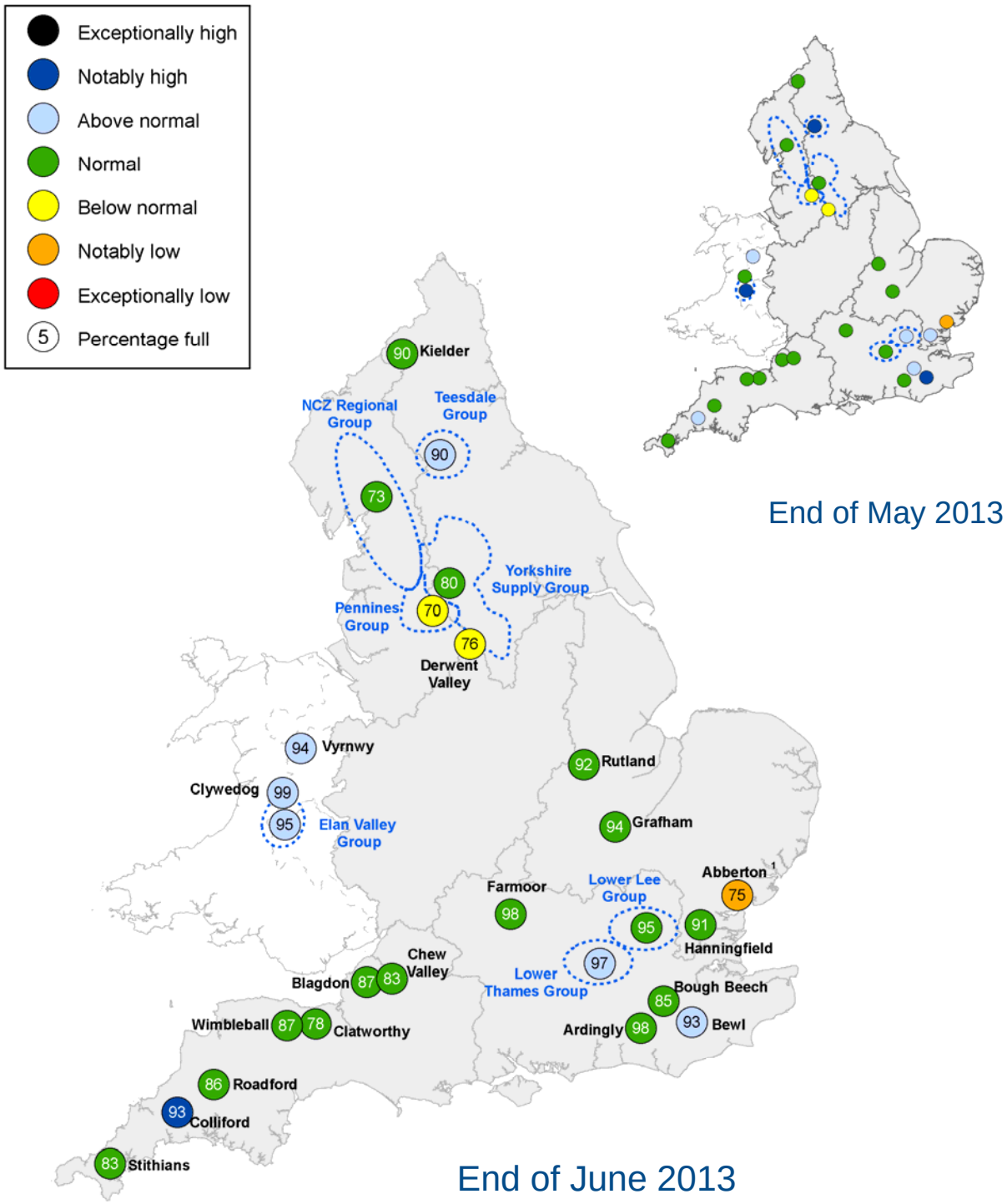


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2013).

Reservoir storage



1. The level at Abberton Reservoir in Anglian Region is affected by ongoing engineering works to increase capacity by 60% - works are expected to be complete by the end of 2013.
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 May 2013 and June 2013 as a percentage of total capacity and classed relative to an analysis of historic May and June 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

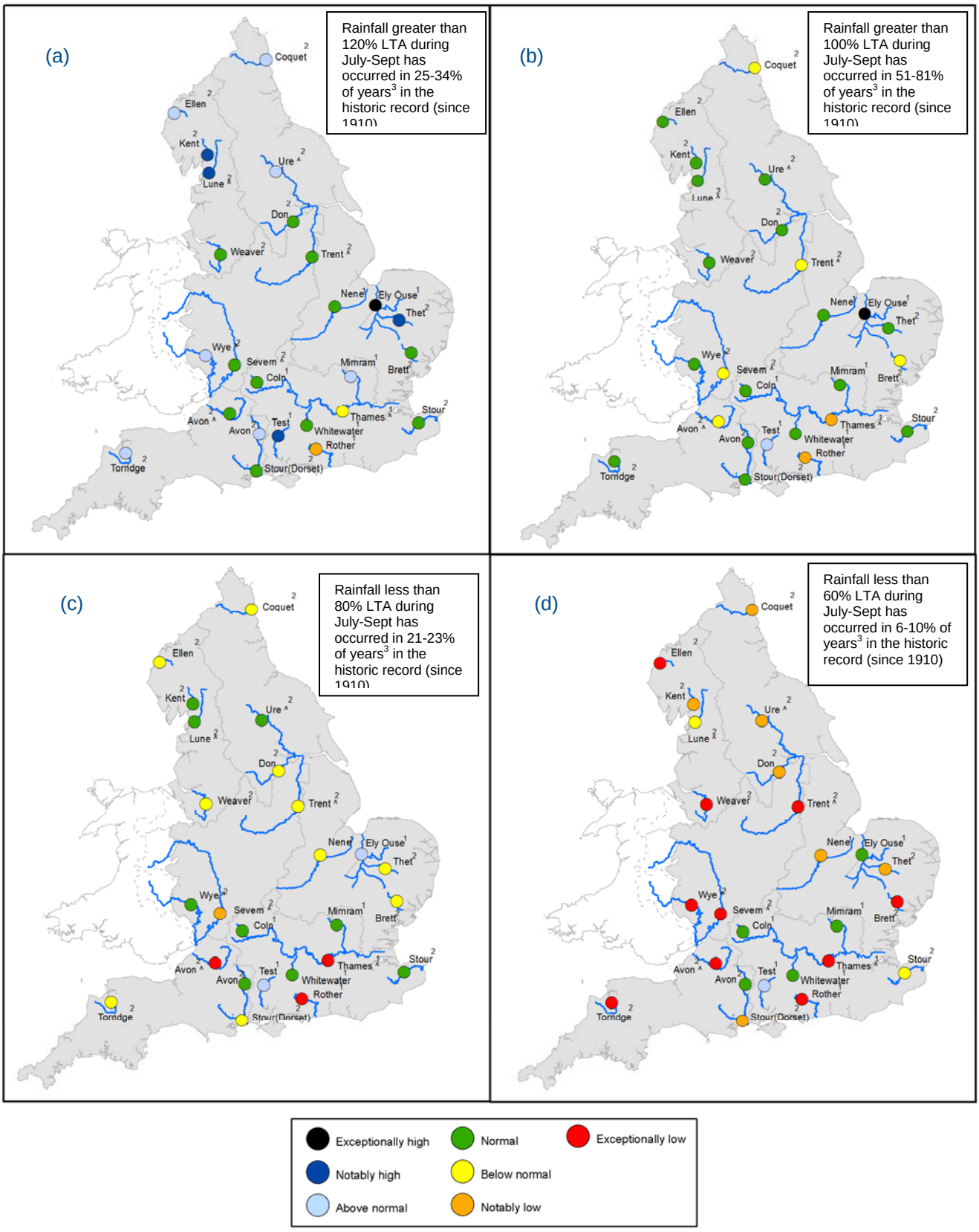
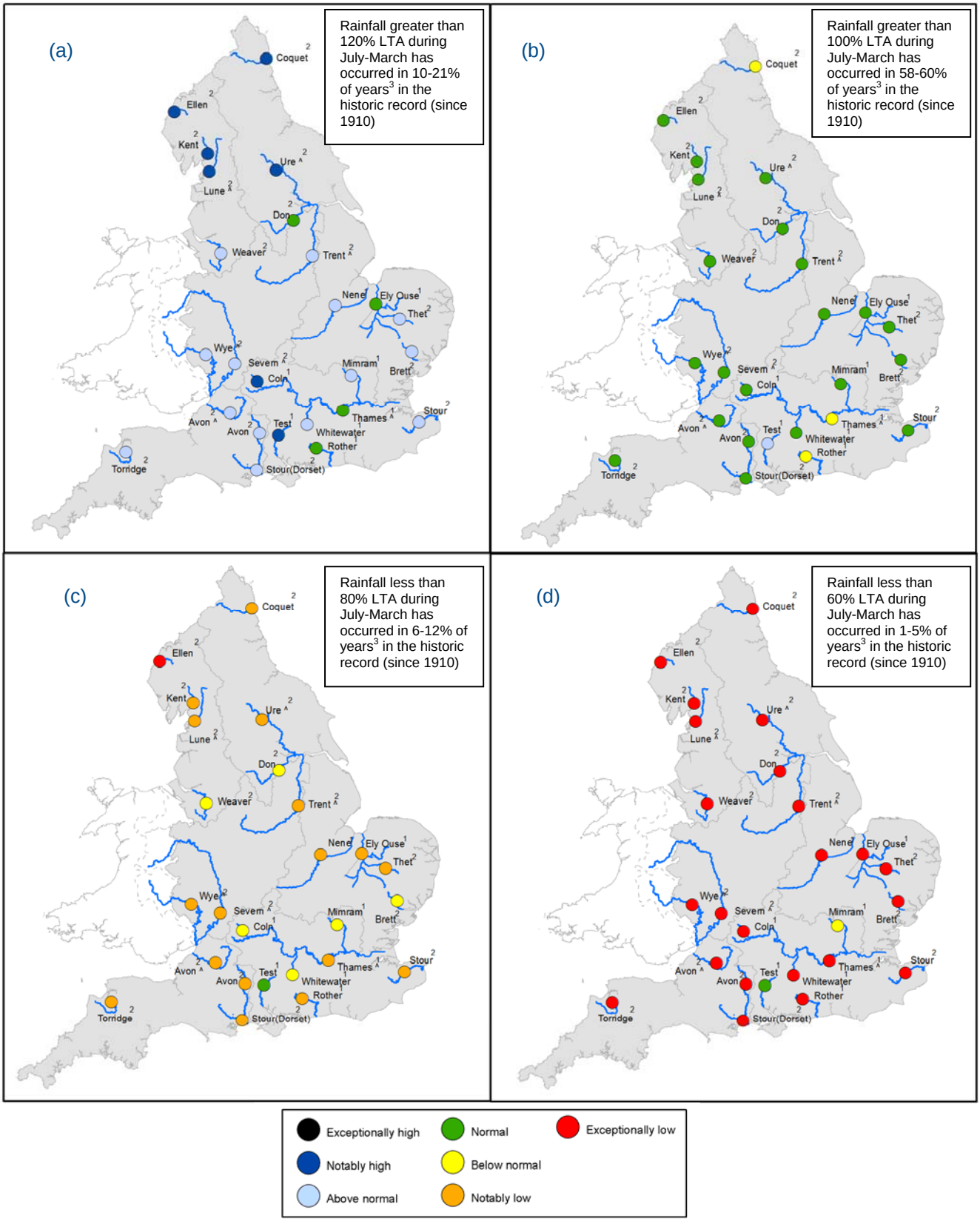


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2013. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2013 and September 2013 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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



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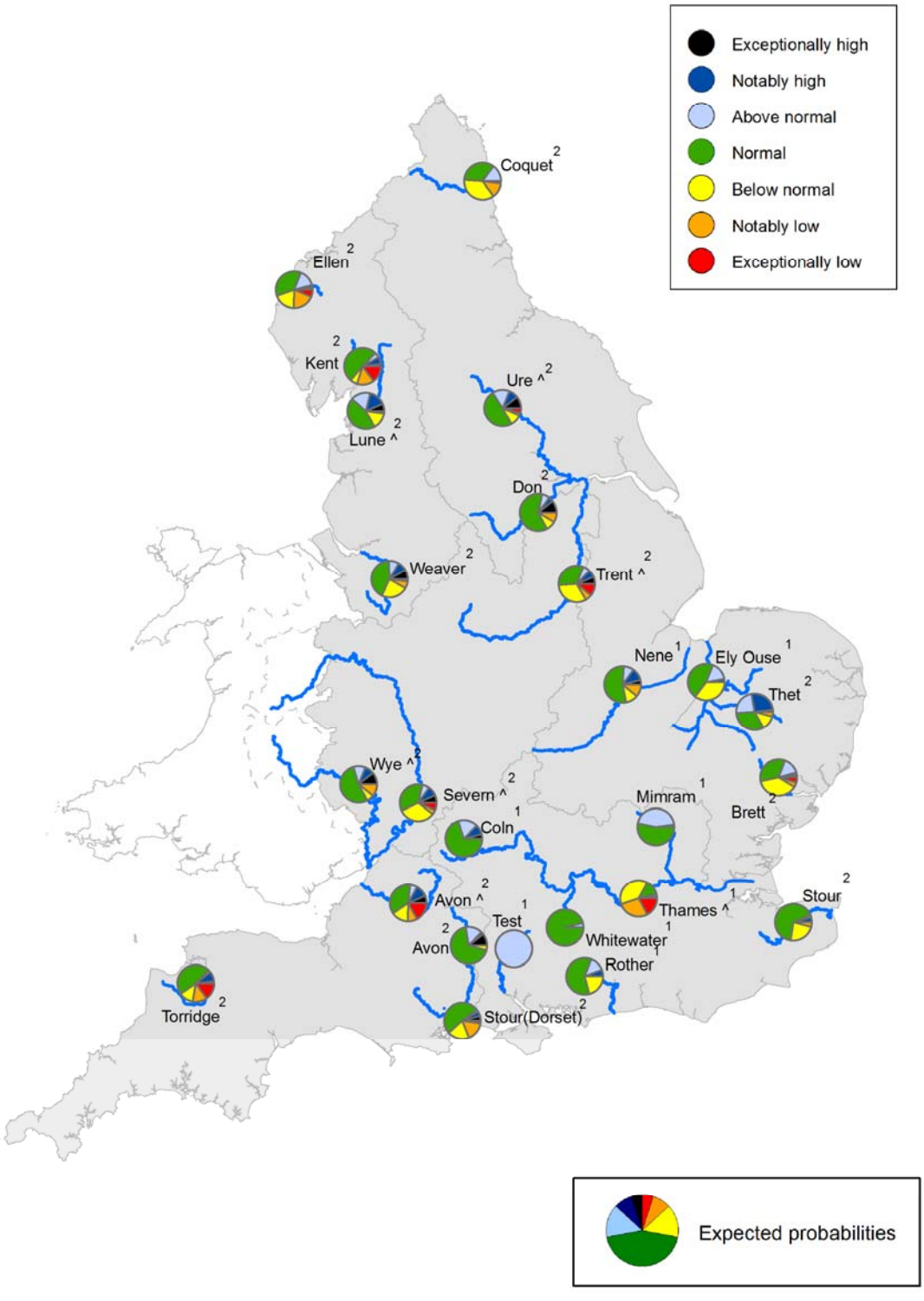

Figure 6.3: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2013. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, 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

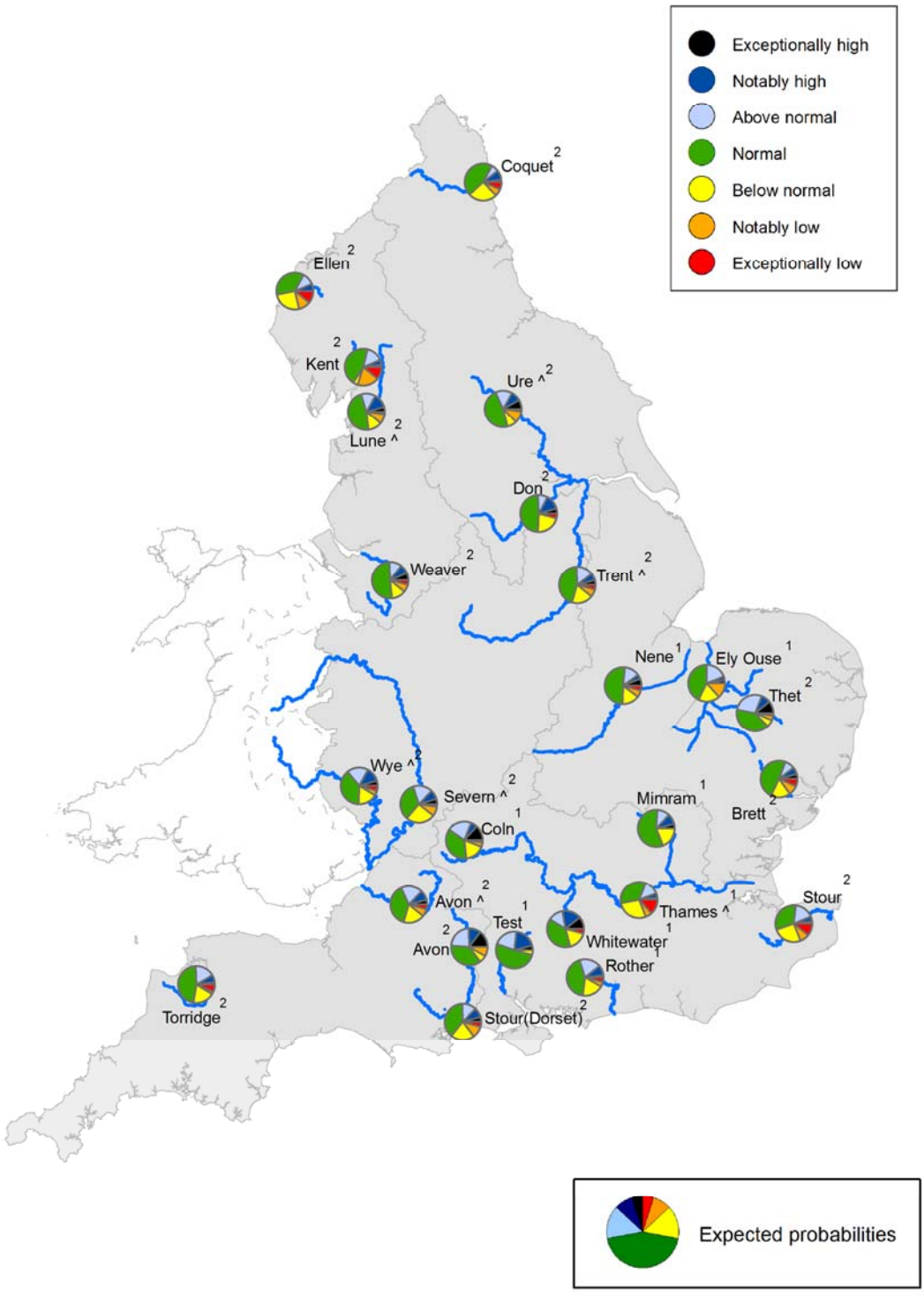

Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2014. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology,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

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Forward look - groundwater

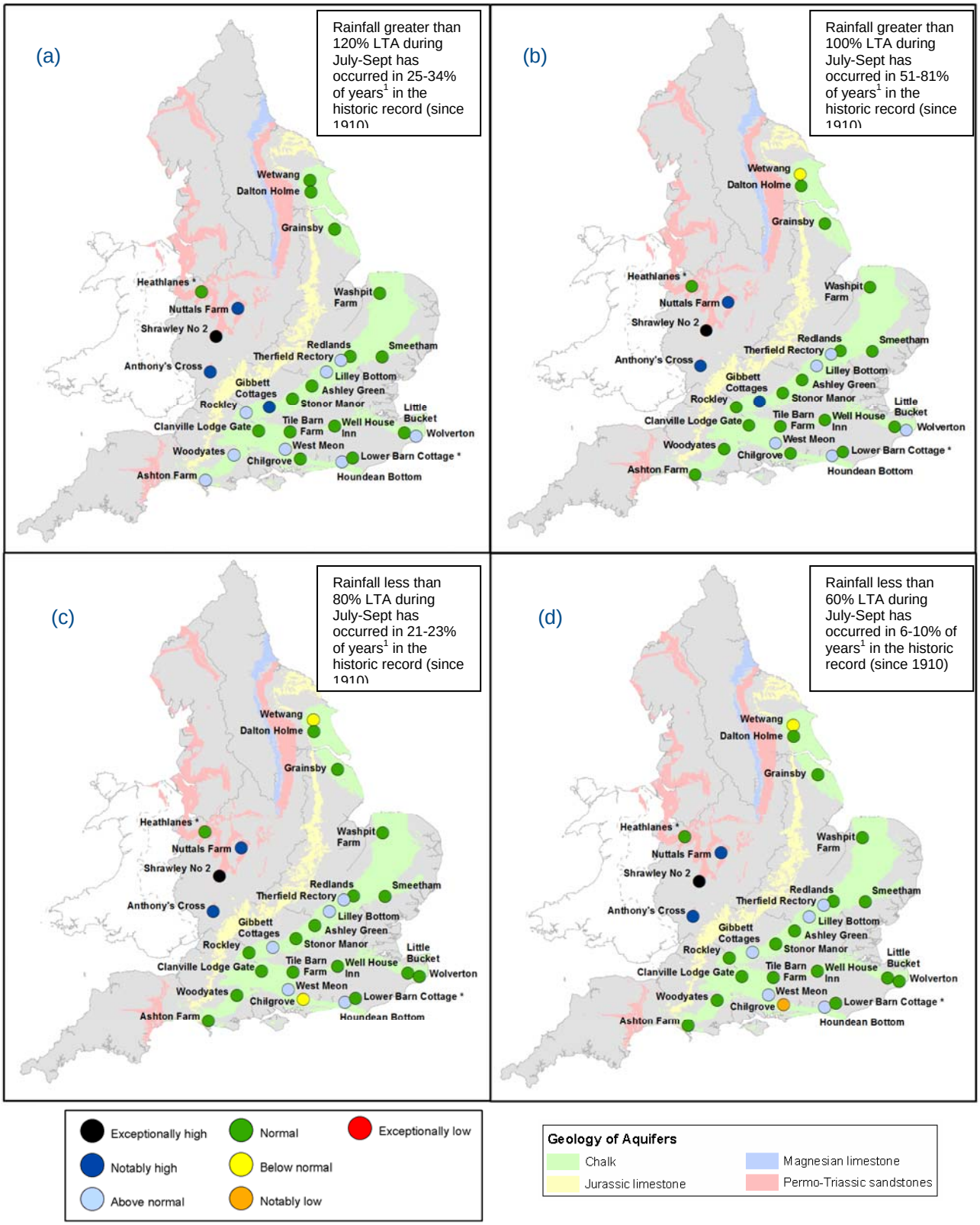

Figure 6.5: Projected groundwater levels at key indicator sites up until the end of September 2013. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2013 and September 2013 (Source: Environment Agency) Geological map reproduced with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

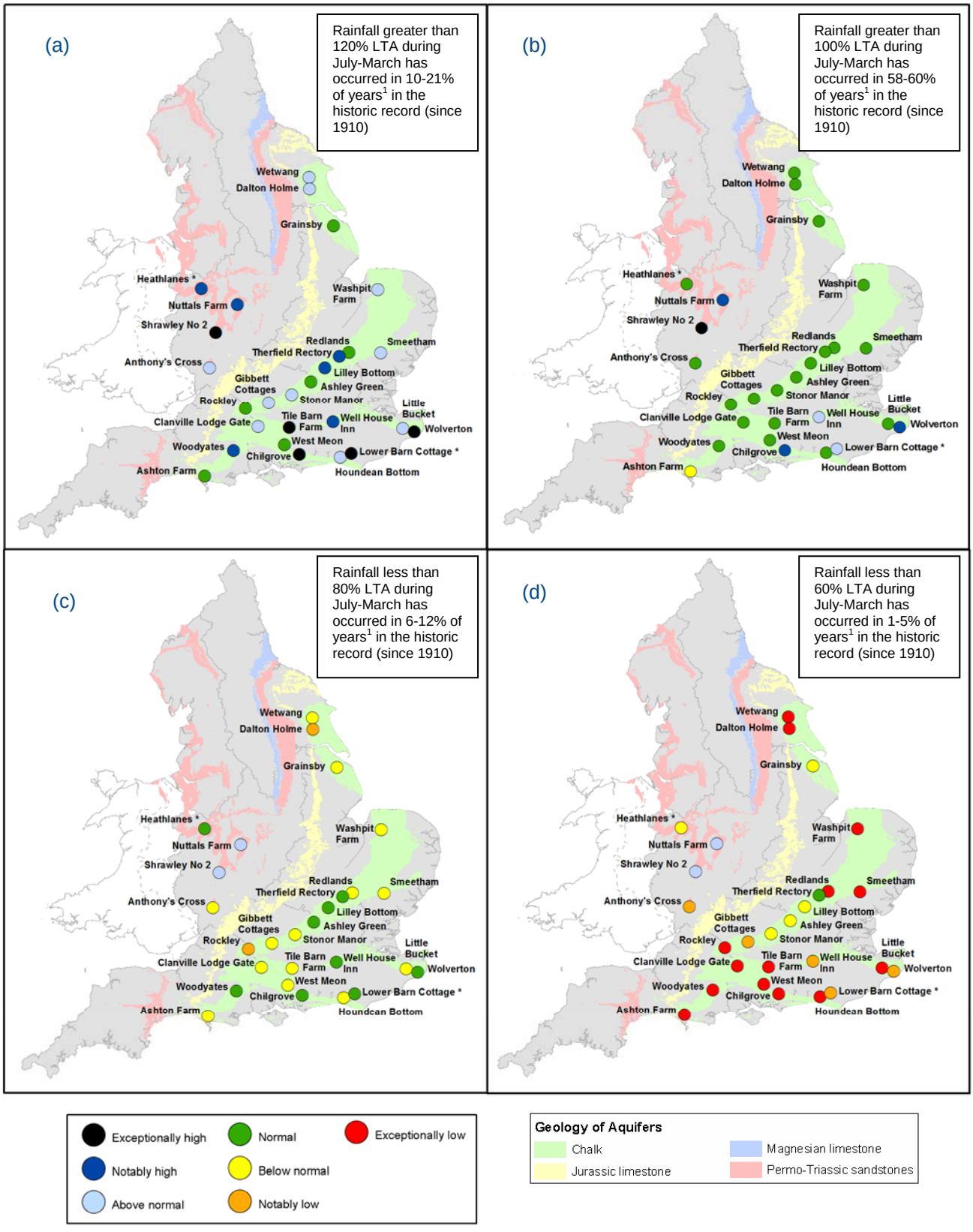

Figure 6.6: Projected groundwater levels at key indicator sites up until the end of March 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2013 and March 2014 (Source: Environment Agency) Geological map reproduced with kind permission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

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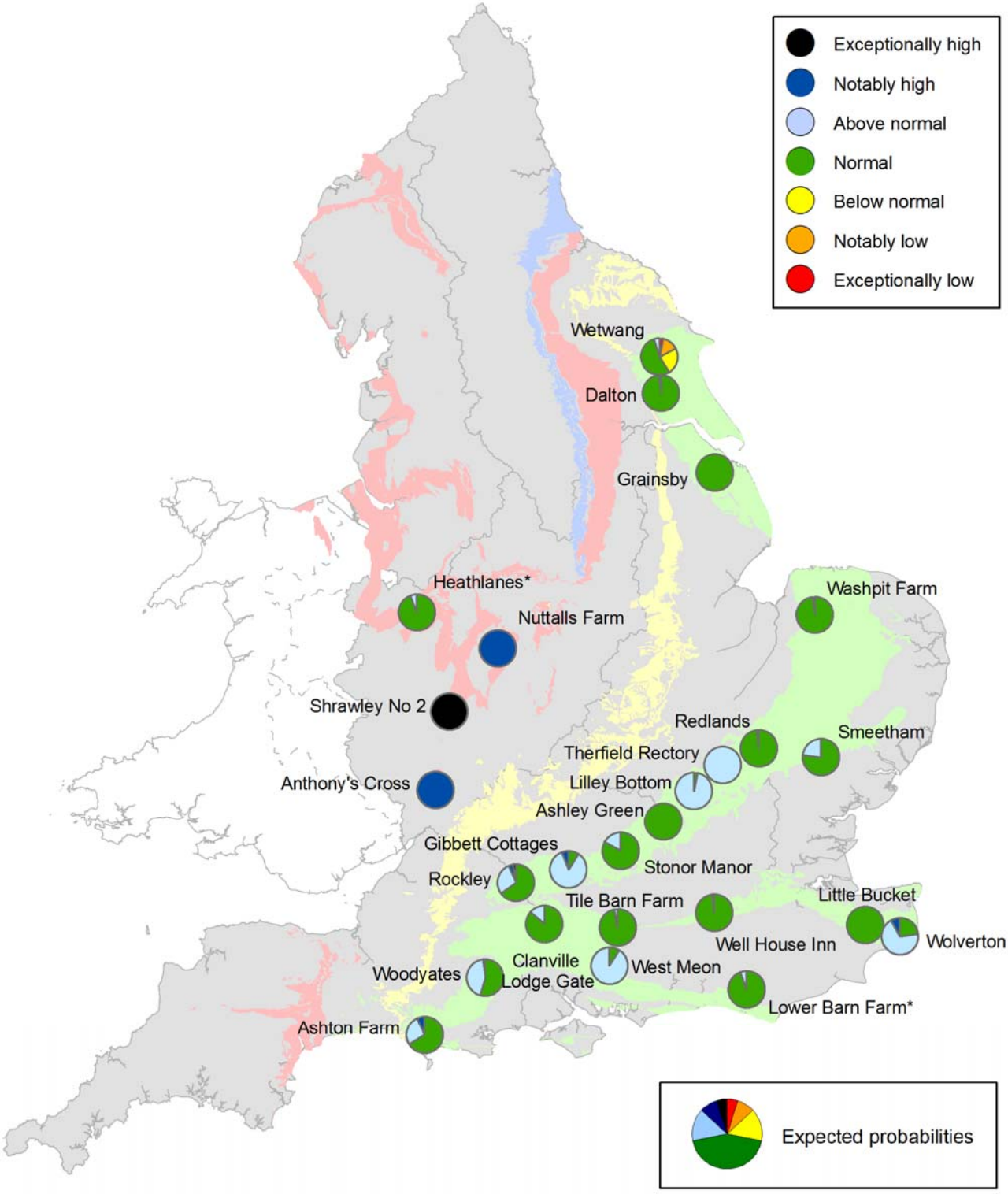
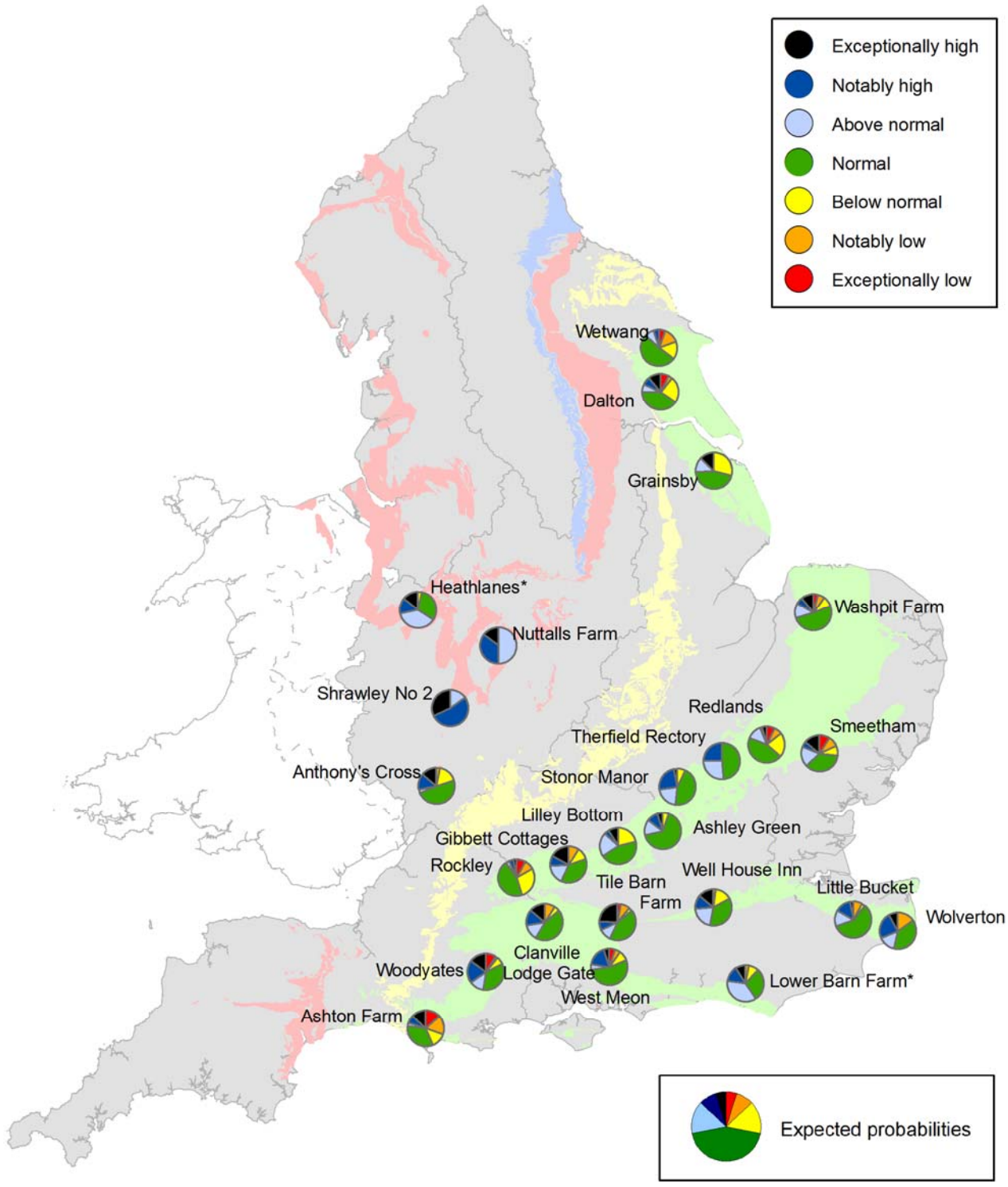


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

Figure 7.1: Environment Agency Region Location Map