Monthly water situation report

England

Summary – April 2014

April has been an average month in terms of precipitation; England received 100% of the April long term average (LTA). Rainfall totals for the time of year were higher than *normal* in the south of England and lower than *normal* in the east. Consequently soil moisture deficits (SMDs) decreased slightly in the south of England but increased elsewhere. Monthly mean river flows for April were *normal* for the time of year across most of England with the exception of some parts of the south where flows were higher than *normal*. Groundwater levels decreased at over three quarters of our indicator sites during April but remain *normal* or higher across most of England. Overall reservoir stocks decreased during April by nearly 2% with storage in England as a whole at 94% of total capacity at the end of the month.

Rainfall

In April, the highest rainfall totals fell across South Devon, Dorset and parts of Hampshire (more than 120 mm), whilst the lowest rainfall totals (less than 15 mm) fell across parts of Suffolk (Figure 1.1).

April rainfall totals were classed as *normal* for the time of year across the majority of central and northern England. In the east, rainfall totals for the hydrological areas were mostly classed as *below normal* and *notably low* whilst in the south and southwest rainfall totals were *above normal* to *exceptionally high* for the time of year in most hydrological areas. The influence of above average winter rainfall is still evident in the cumulative rainfall totals over the past six months, with most of the hydrological areas across southern and western England classed as *exceptionally high* (Figure 1.2).

Rainfall totals for April were highest in the southwest at 95 mm and lowest in the east at 22 mm. Monthly rainfall totals as a percentage of the April LTA ranged from 156% in the southwest to 47% in the east. Overall, England received 100% of the LTA rainfall (Figure 1.3).

Soil moisture deficit

At the end of April, soil moisture deficit (SMD) ranged from zero across parts of Cornwall and Devon, up to approximately 65 mm in parts of Cambridgeshire. End of April SMDs were 30 – 40 mm greater than the LTA in MORECS grid squares covering parts of Cambridgeshire and Bedfordshire; in contrast, SMDs were up to 20 mm smaller than the LTA in MORECS grid squares covering parts of Devon, Somerset, Wiltshire and Hampshire (Figure 2.1).

At the beginning of April, SMDs ranged from 1 mm in the northwest to 21 mm in the east. By the end of April, SMD increased by up to 22 mm across central, eastern and northern England. Across the south, SMD decreased by up to 4 mm (Figure 2.2).

River flows

Monthly mean river flows decreased, compared to March, at all of our indicator sites across England. April flows were in their *normal* range for the time of year at most sites, however flows at nine sites in groundwater-fed catchments of southern and southeastern England remained *above normal* to *exceptionally high* for the time of year (Figure 3.1).

River flows at the index river flow sites in central, eastern, northern and southwestern England were *normal* for the time of year. Flows at the two index sites in southeastern England were *above normal* for the time of year (Figure 3.2).

Groundwater levels

Groundwater levels decreased at the majority of indicator sites in England during April. At the end of April, groundwater levels were *normal* or higher for the time of year at all but one of the sites reported on. The exception to this is Jackaments Bottom where groundwater levels were *below normal* for the time of year (Figures 4.1 and 4.2). Groundwater levels remain *above normal* to *exceptionally high* for the time of year across most indicator sites in the Chalk of southeastern England. Priors Heyes and Skirwith in the northwest, both Sandstone, had the highest groundwater levels on record for the end of April. Groundwater levels at Priors Heyes remain high compared with historic levels because the aquifer is recovering from the effects of historic abstraction.

Reservoir storage

During April reservoir stocks increased or remained unchanged at two thirds of reported reservoirs and reservoir groups. Stocks at three reservoirs or reservoir groups decreased by more than 5% of full capacity during April, including the Teesdale and Yorkshire supply groups in the northeast and Clatworthy in the southwest. Eight reservoirs or reservoir groups were full at the end of April. Reservoir stocks were classed as *normal* or higher for the time of year at all but one of the reported sites (Figure 5.1). The capacity of Abberton Reservoir in the east has been increased; consequently, reservoir stocks are *exceptionally high* for the time of year against historic levels.

At a broader scale, overall reservoir stocks increased in the east and southeast of England, and decreased elsewhere. The largest decreases were less than 5% of total capacity, and were seen in the north of England. At the end of April, overall reservoir stocks were lowest in the northwest of England with stocks at 91% of full capacity, and highest in the southwest of England at 98% of full capacity. Overall reservoir storage for England decreased in April to 94% of total capacity (Figure 5.2).

Forward look

Temperatures during May are likely to be close to or slightly above average; precipitation is most likely to be typical for the time of year with periods of fine dry weather interspersed with showers. The southeast of England is likely to experience the warmest and driest conditions. For the three month period to July both temperatures and precipitation are likely to be typical for the time of year[1].

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

September 2014: With average (100% of the LTA) rainfall between May and the end of September 2014, cumulative river flows are likely to be *normal* at more than half 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 a third of the modelled sites (see Figure 6.1).
March 2015: With average rainfall between May 2014 and the end of March 2015, cumulative river flows are likely to be *normal* at over four fifths of the 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 *notably low* or lower at half of the modelled sites (see Figure 6.2).

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

September 2014: Nearly three quarters of modelled sites have a greater than expected chance of *above normal* or higher cumulative flows from May to September. A third of the sites have a greater than expected chance of *normal* flows, whilst less than a fifth of the sites have a greater than expected chance of *below normal* or lower cumulative flows (see Figure 6.3).
March 2015: Two thirds of all modelled sites have a greater than expected chance of *above normal* or higher cumulative flows from May 2014 to March 2015. A third of the modelled sites have a greater than expected chance of *normal* flows, whilst a quarter of the modelled sites have a greater than expected chance of *below normal* flows between May 2014 and March 2015 (see Figure 6.4).

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

September 2014: With average rainfall (100% of the LTA) from May to September 2014, groundwater levels are likely to be *normal* or higher for the time of year at all except 3 modelled sites, and *above normal* or higher at nearly half of the modelled sites. With above average rainfall (120% of the LTA) two thirds of the modelled sites are likely to be *above normal* or higher. With 80% of the LTA rainfall, all except three modelled sites are likely to have *normal* or higher groundwater levels for the time of year (see Figure 6.5).

[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.

[3] 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 2015: With average rainfall (100% of the LTA) from May 2014 to March 2015, groundwater levels are likely to be *normal* or higher for the time of year at all but one modelled site. With above average rainfall (120% of the LTA), levels are likely to be *above normal* or higher for the time of year at three quarters of the modelled sites. With below average rainfall (80% of the LTA), groundwater levels are likely to be *below normal* or lower at over a third of our modelled sites (see Figure 6.6).

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

September 2014: Nearly three quarters of modelled sites have a greater than expected chance of *above normal* or higher groundwater levels for the time of year. More than a third of the sites have a greater than expected chance of *normal* levels. Only three sites have a greater than expected chance of *below normal* or lower levels for the time of year (see Figure 6.7).
March 2015: Two thirds of the modelled sites have a greater than expected chance of levels being *above normal* or higher 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. A fifth of the modelled sites have a greater than expected chance of *below normal* or lower groundwater levels by the end of March 2015 (see Figure 6.8).

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From April 2014 we are changing the Environment Agency organisational structure so that we no longer have a Regional tier. Over the period of implementation we will be making changes to how we report the water situation to reflect our new structure. We will continue to report the water situation using Regional boundaries until we fully complete these changes.

Rainfall

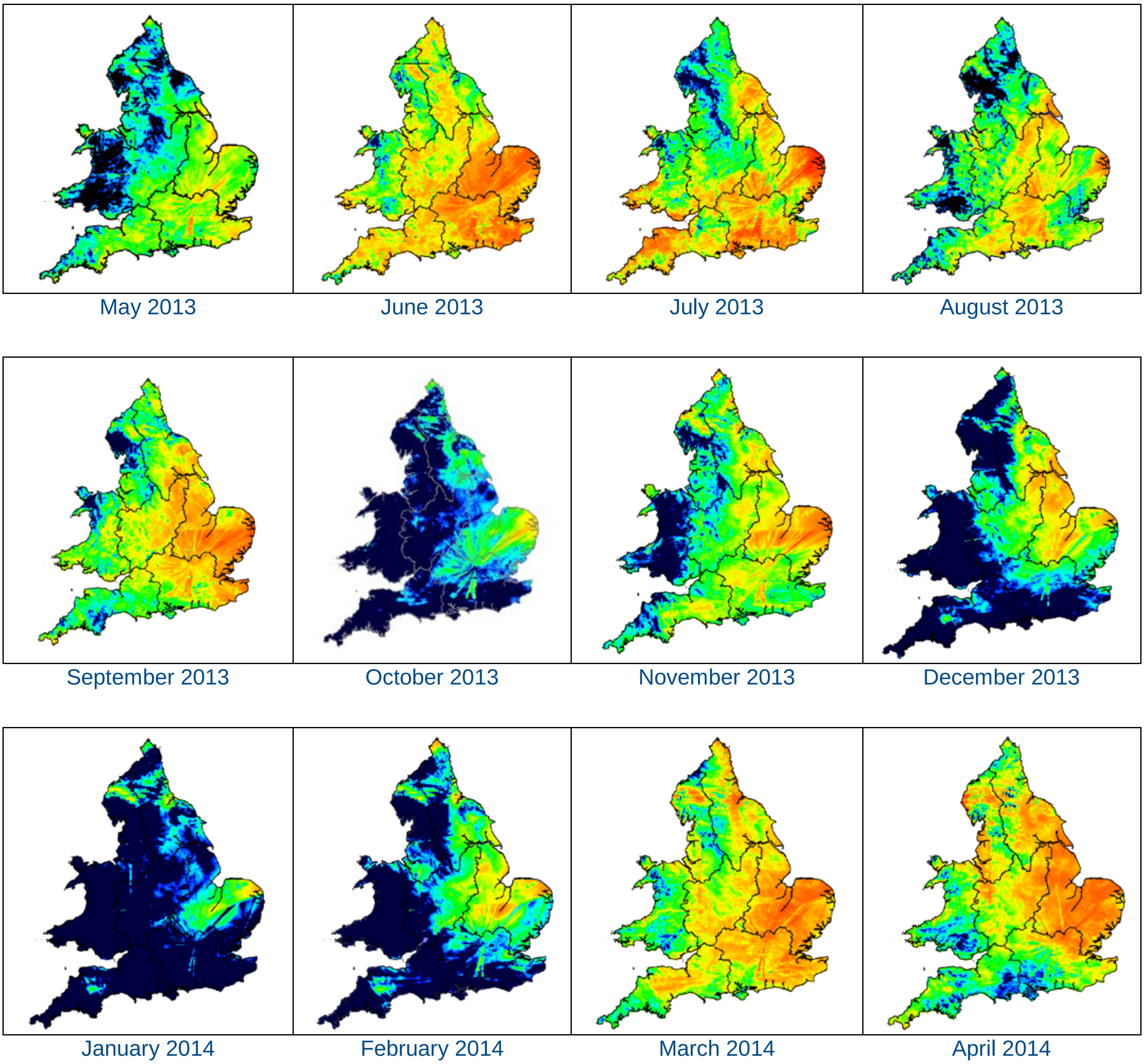
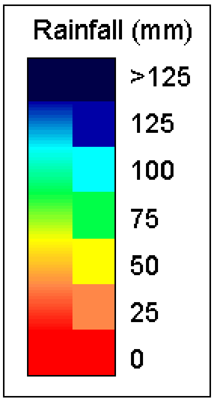


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2014). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.



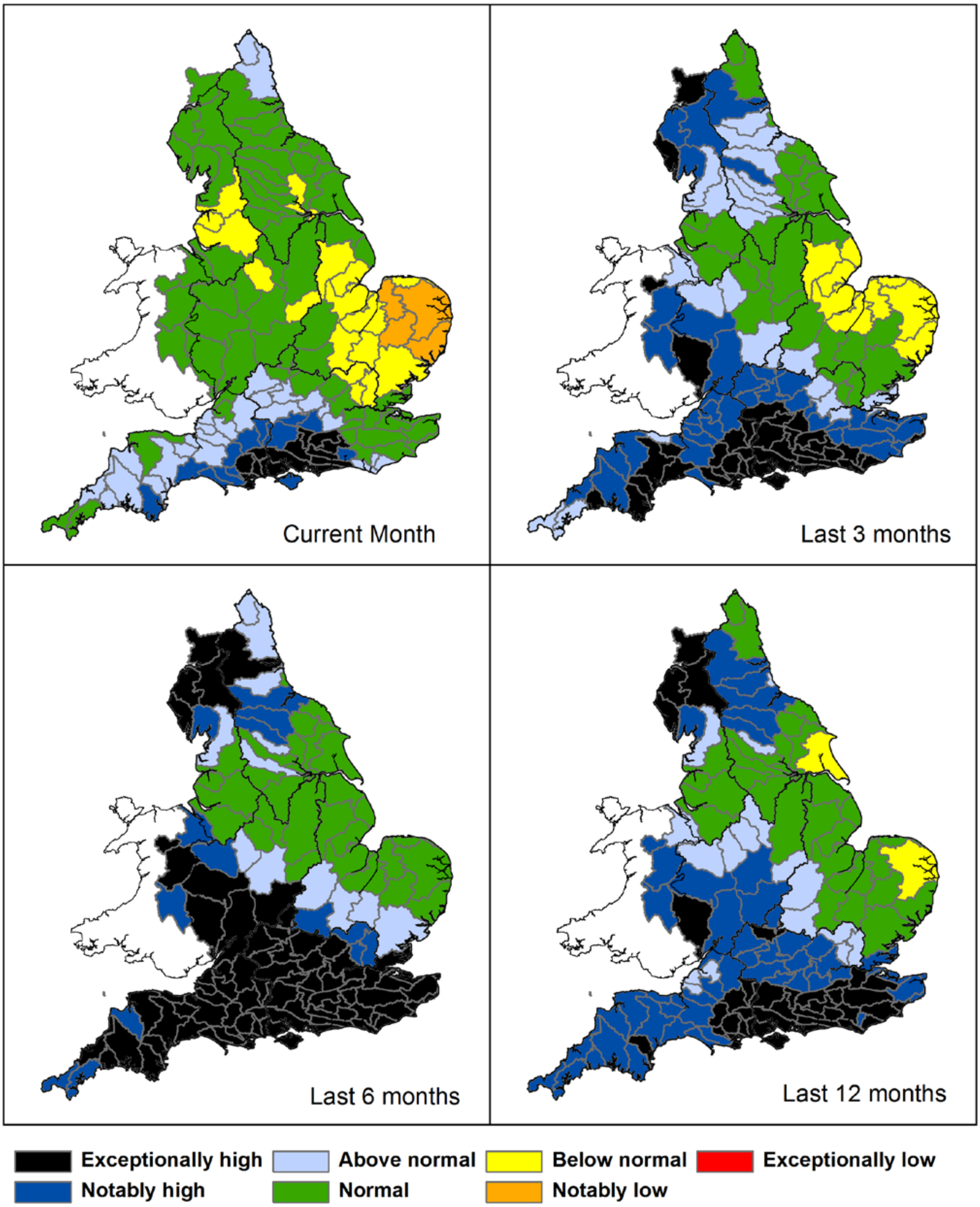


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30th April), the last three months, the last six months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2014)*. Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

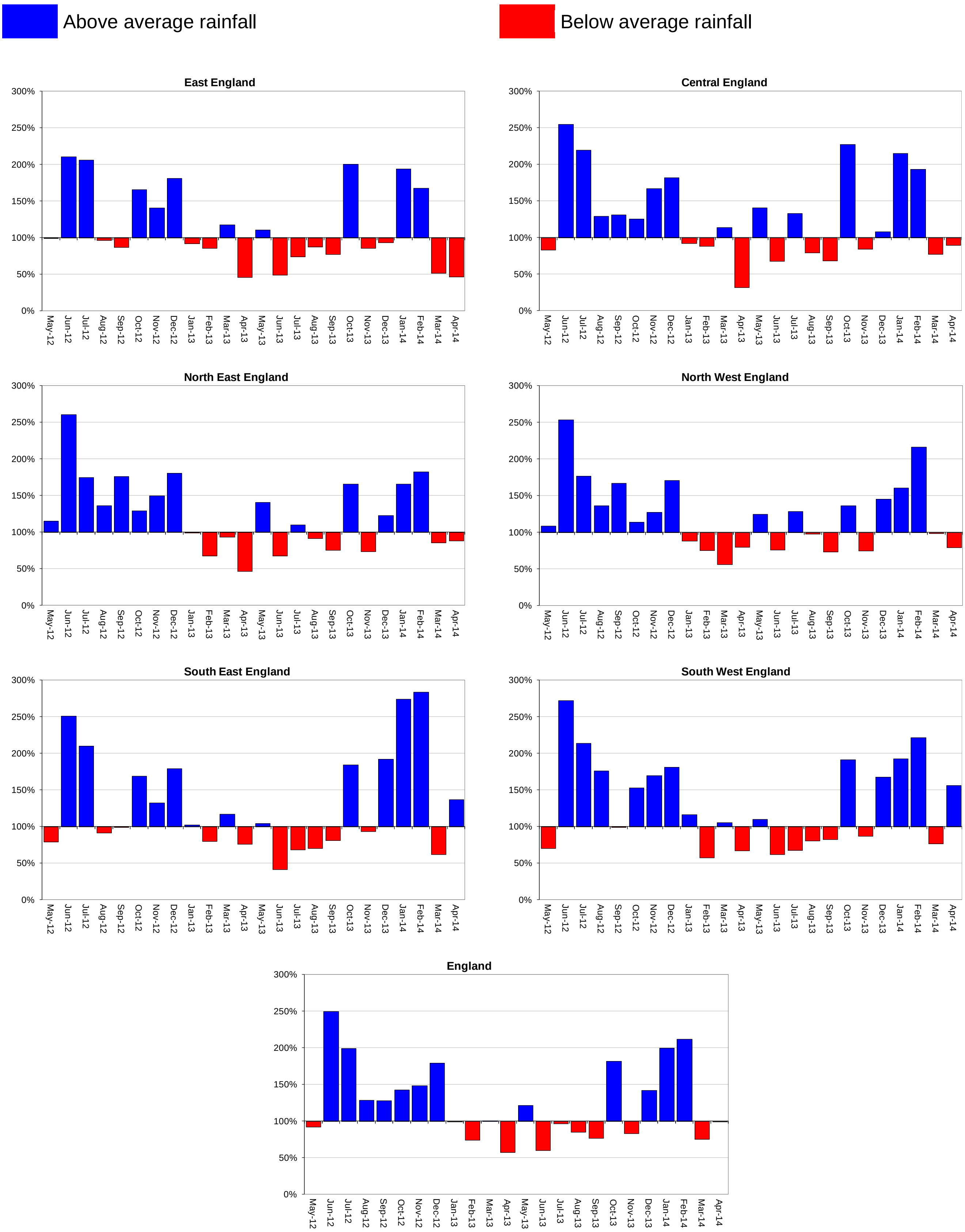


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each Environment Agency Region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2014).

Soil moisture deficit

End of March 2014[1]	End of April 2014[2]

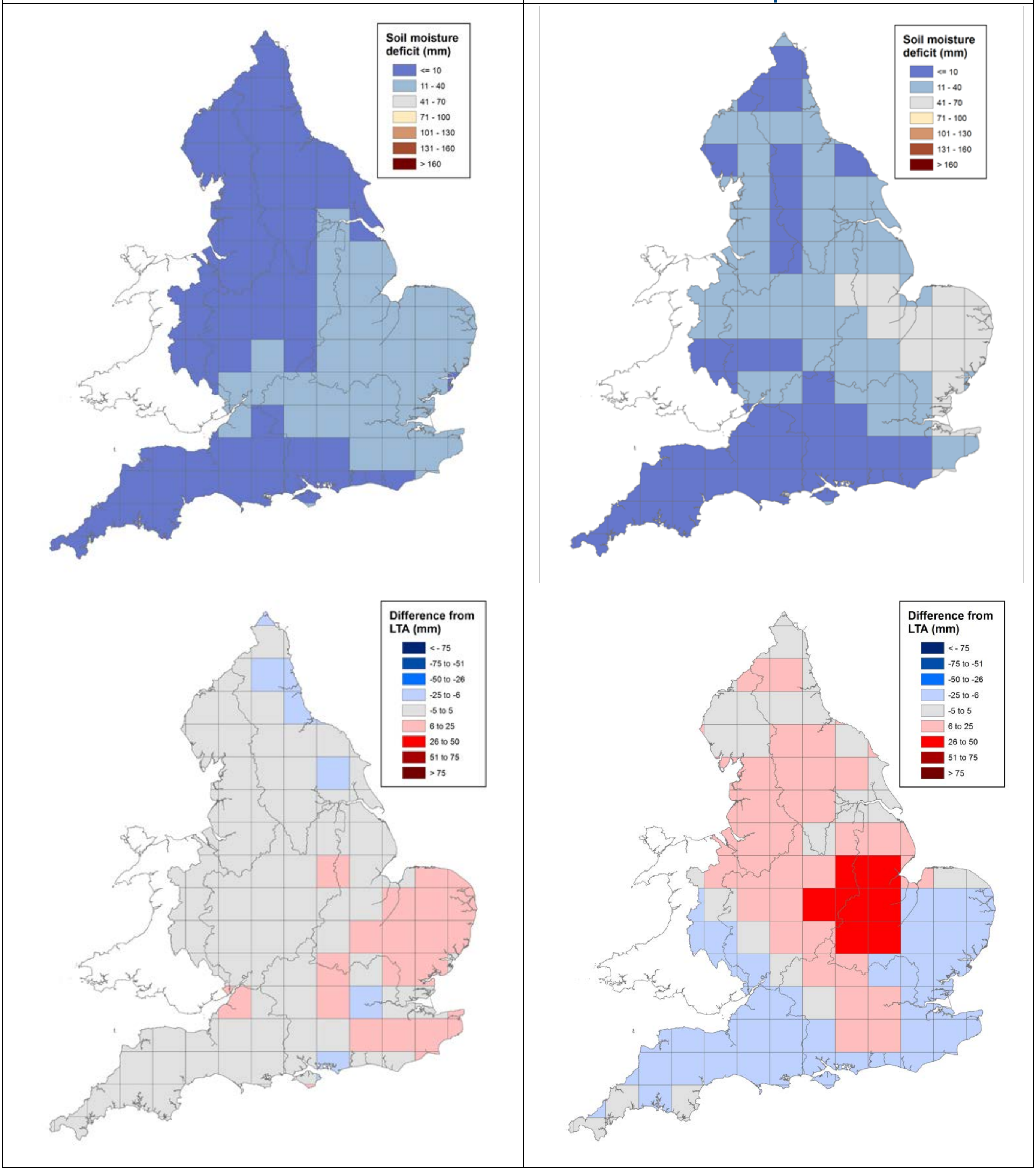
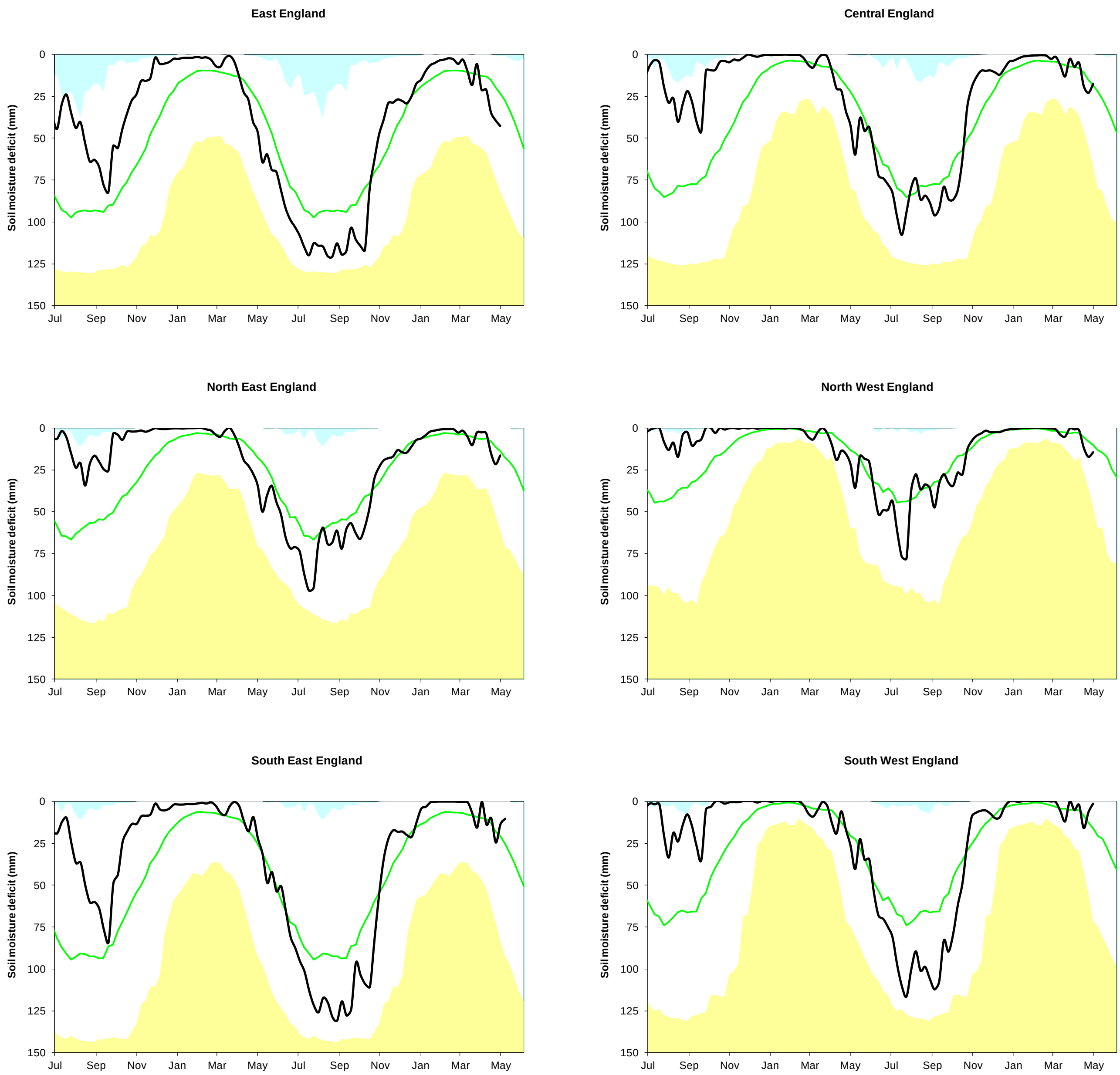


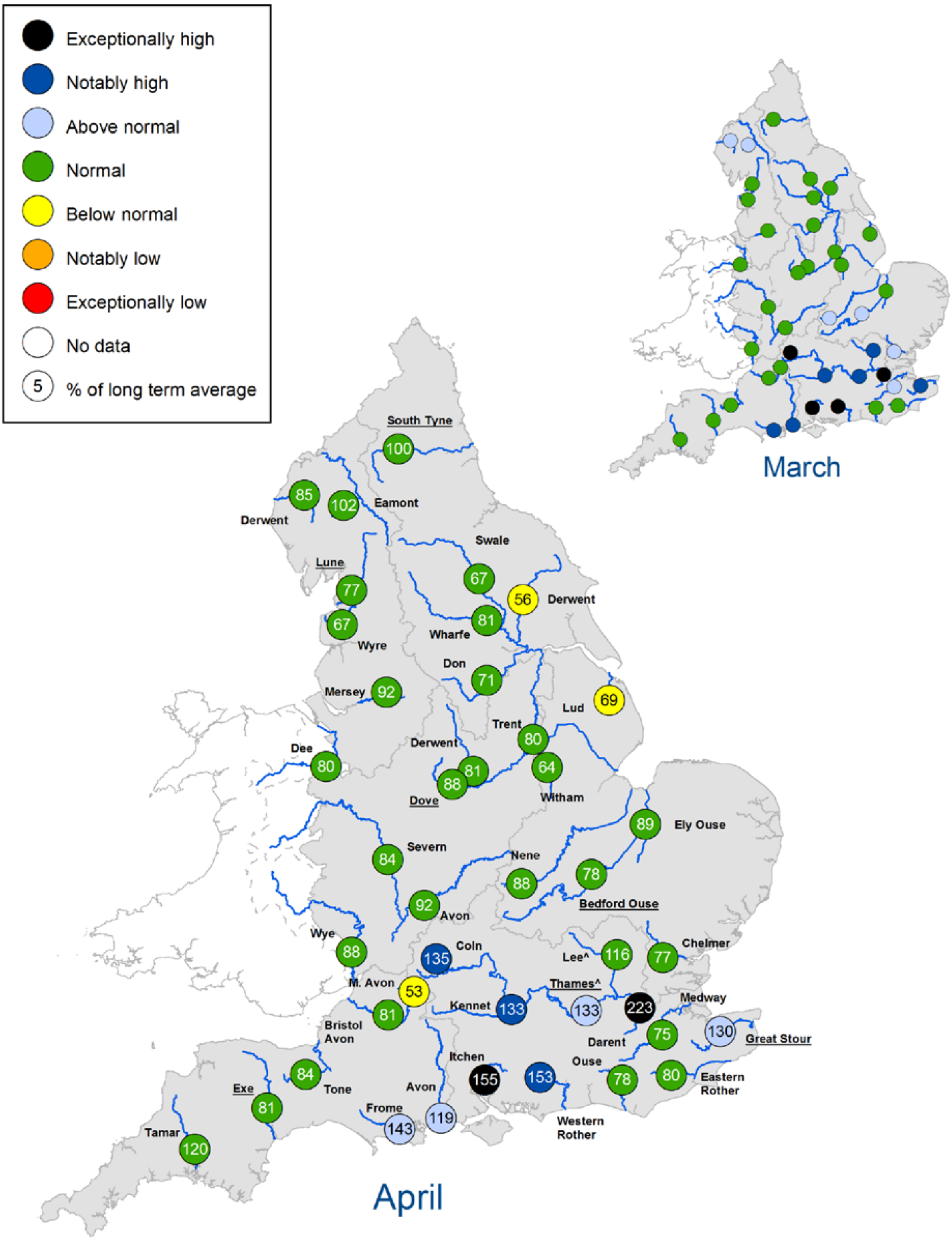
Figure 2.1: Soil moisture deficits for weeks ending 01 April 2014 [1] (left panel) and 29 April 2014 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2014). Crown copyright. All rights reserved. Environment Agency, 100026380, 2014



	Below minimum monthly level		Above maximum monthly level		Average		2012-2014

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/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 March 2014 and April 2014, expressed as a percentage of the respective long term average and classed relative to an analysis of historic March and April monthly means (Source: Environment Agency).

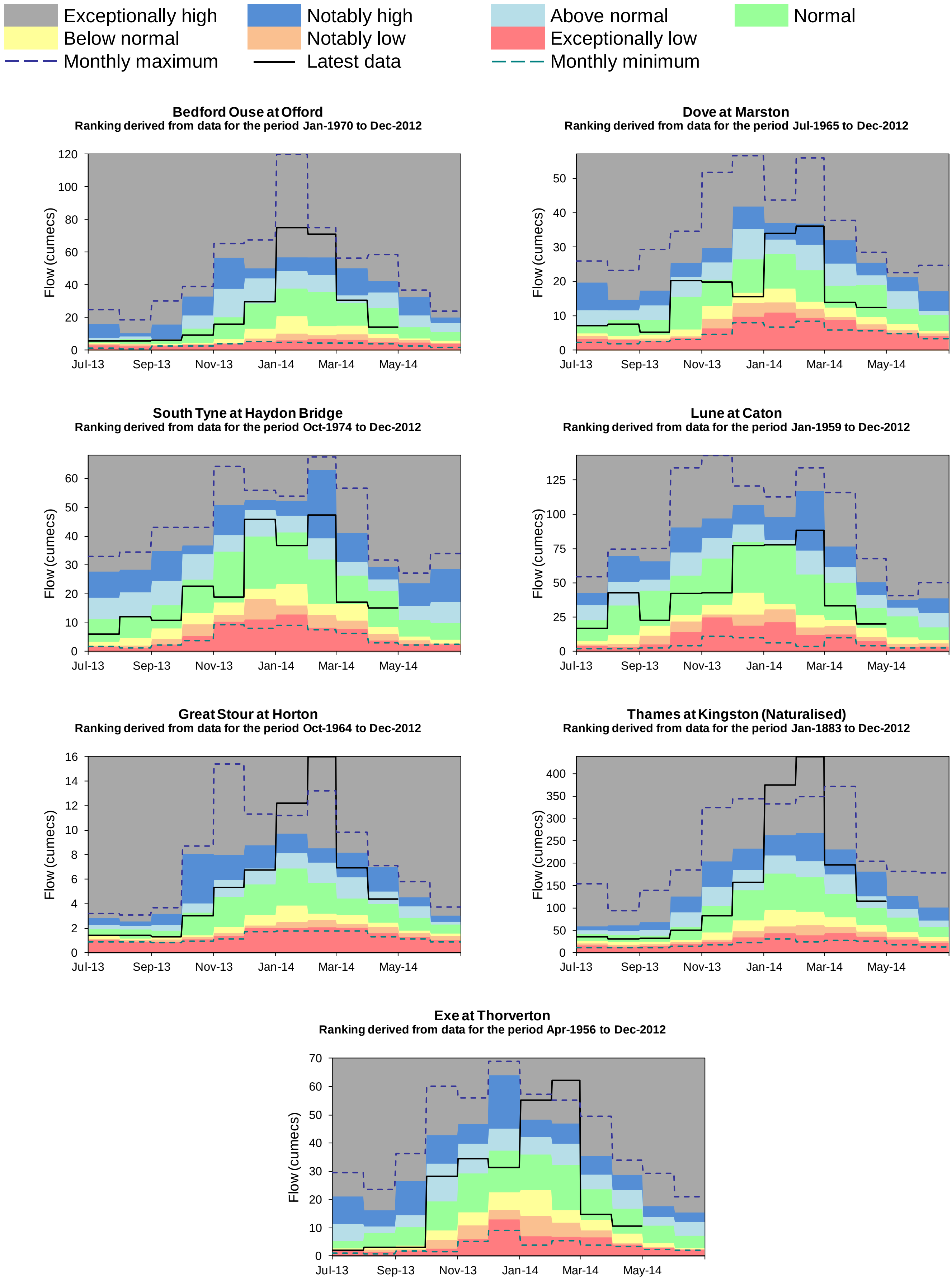
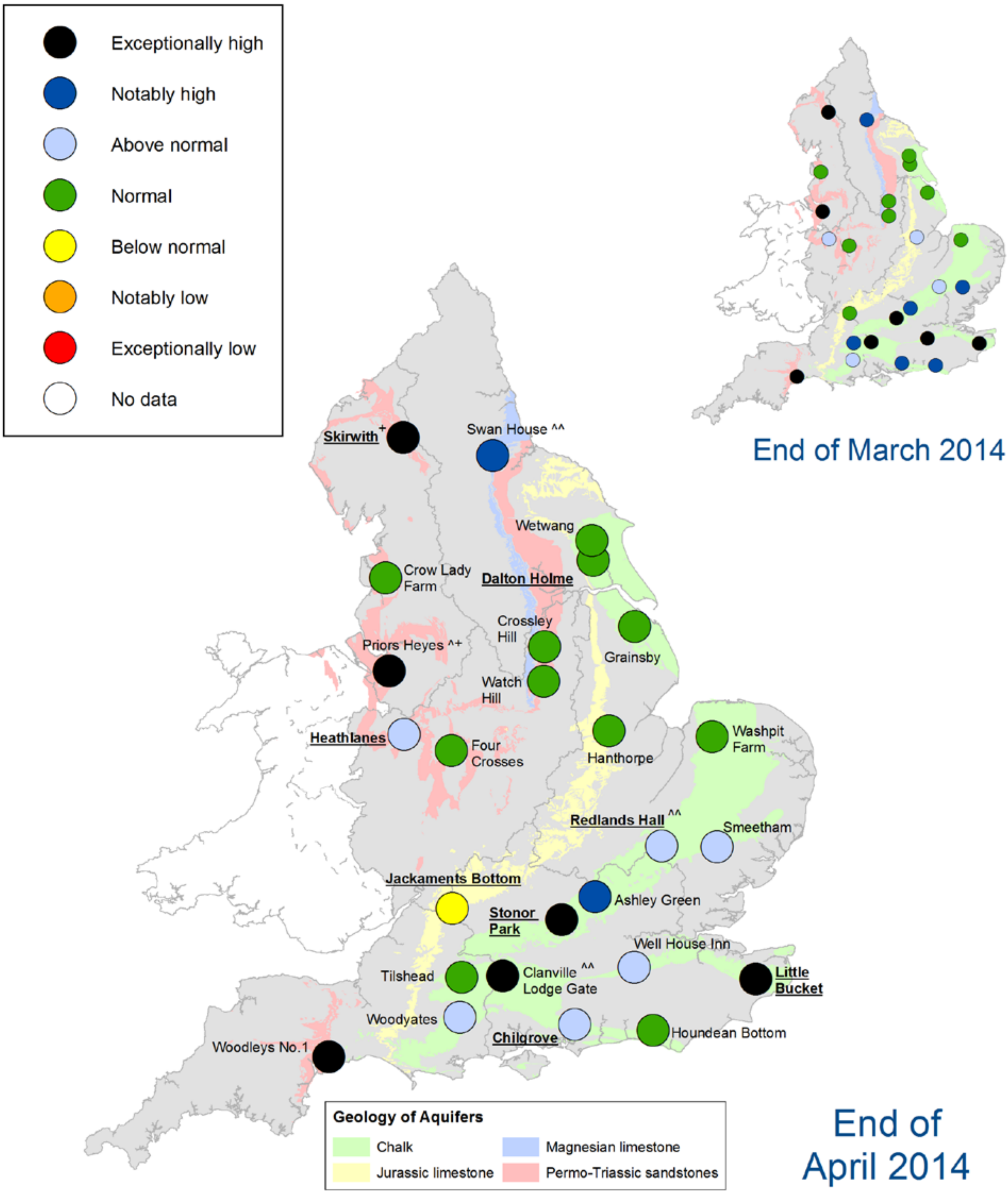


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 for the current month (note that record length varies between sites).
Highlighted sites are major aquifer index sites and are shown in the groundwater level charts in Figure 4.2

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

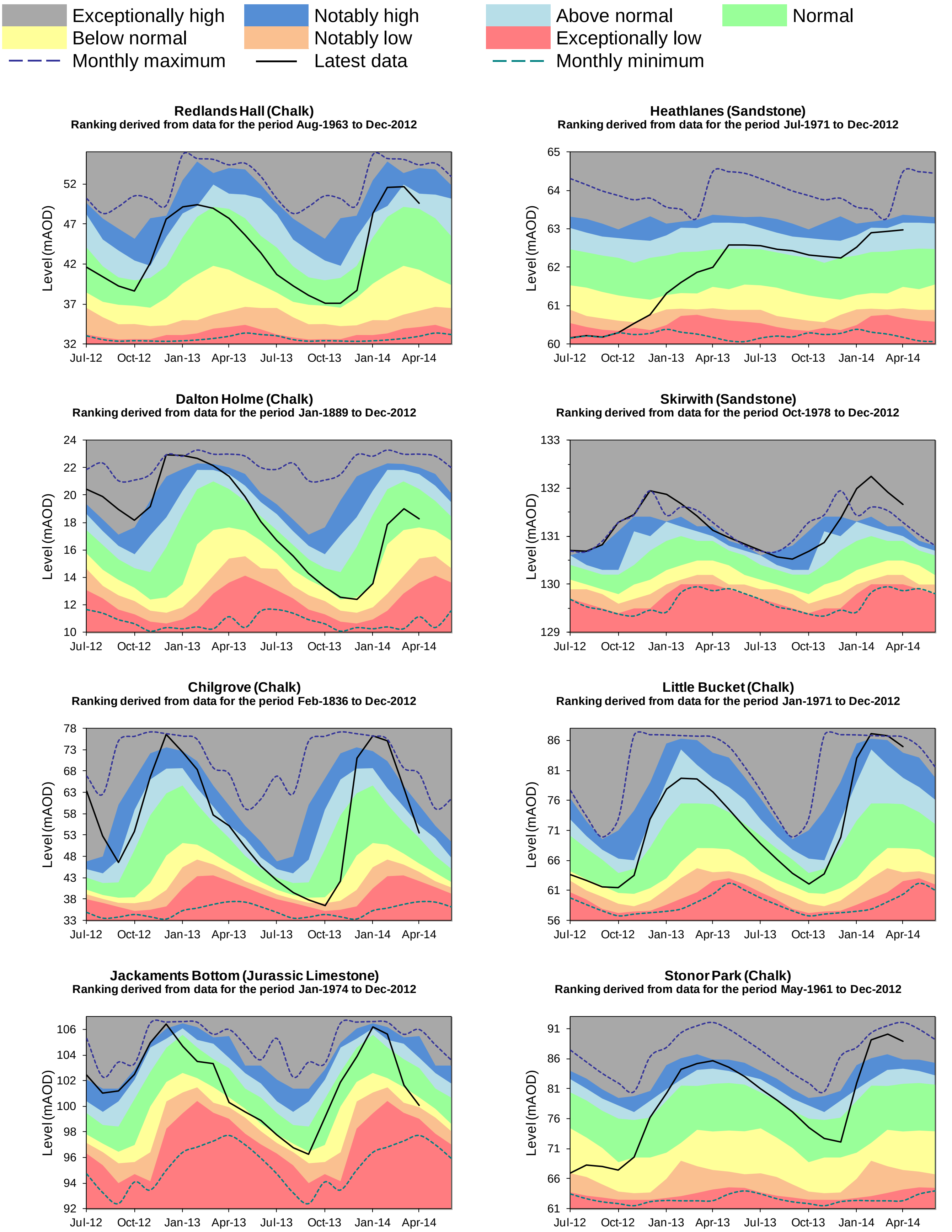
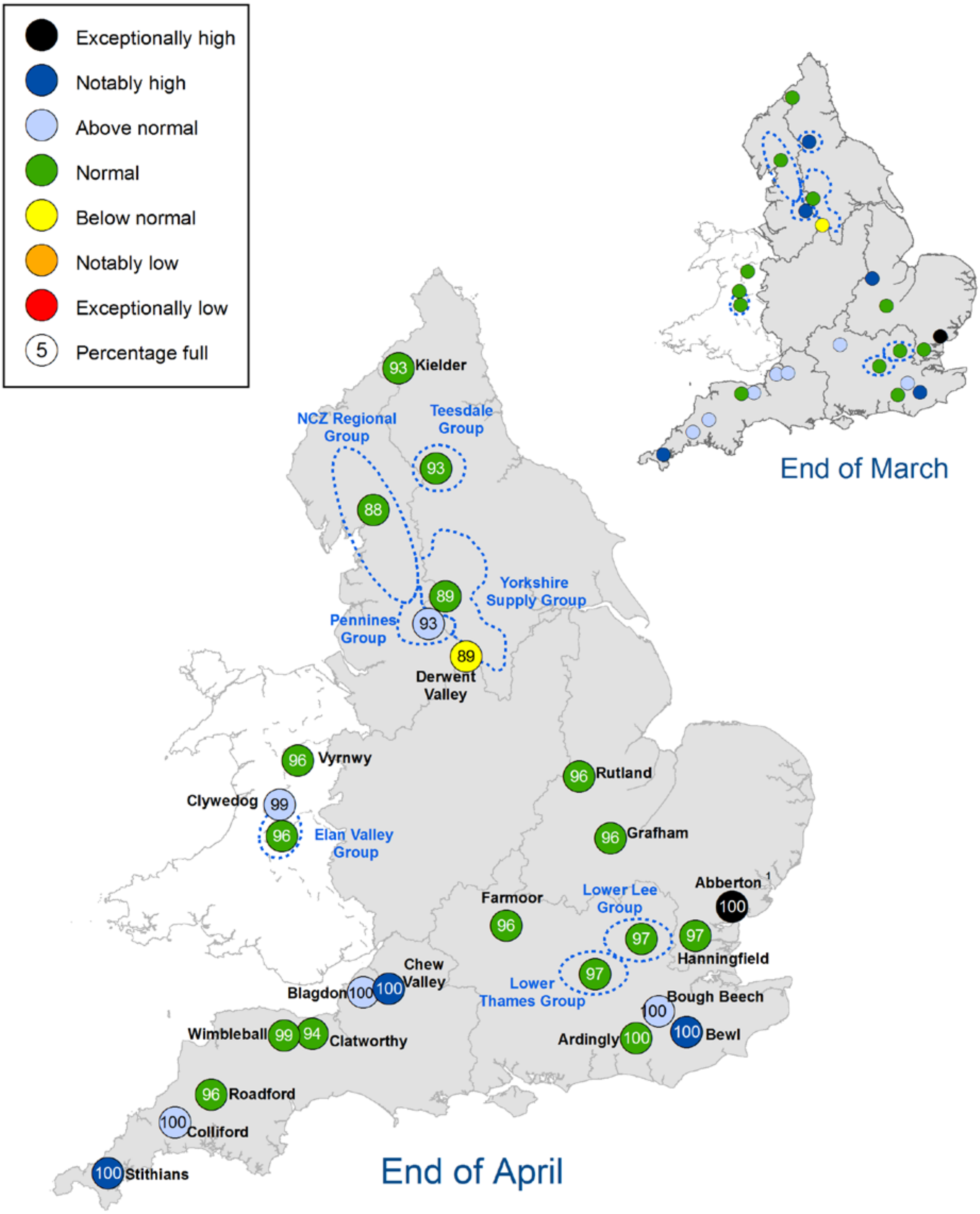


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2014).

Reservoir storage



1. Water levels are affected by engineering work at Abberton Reservoir in Essex to increase capacity
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to our Midlands and North West regions

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

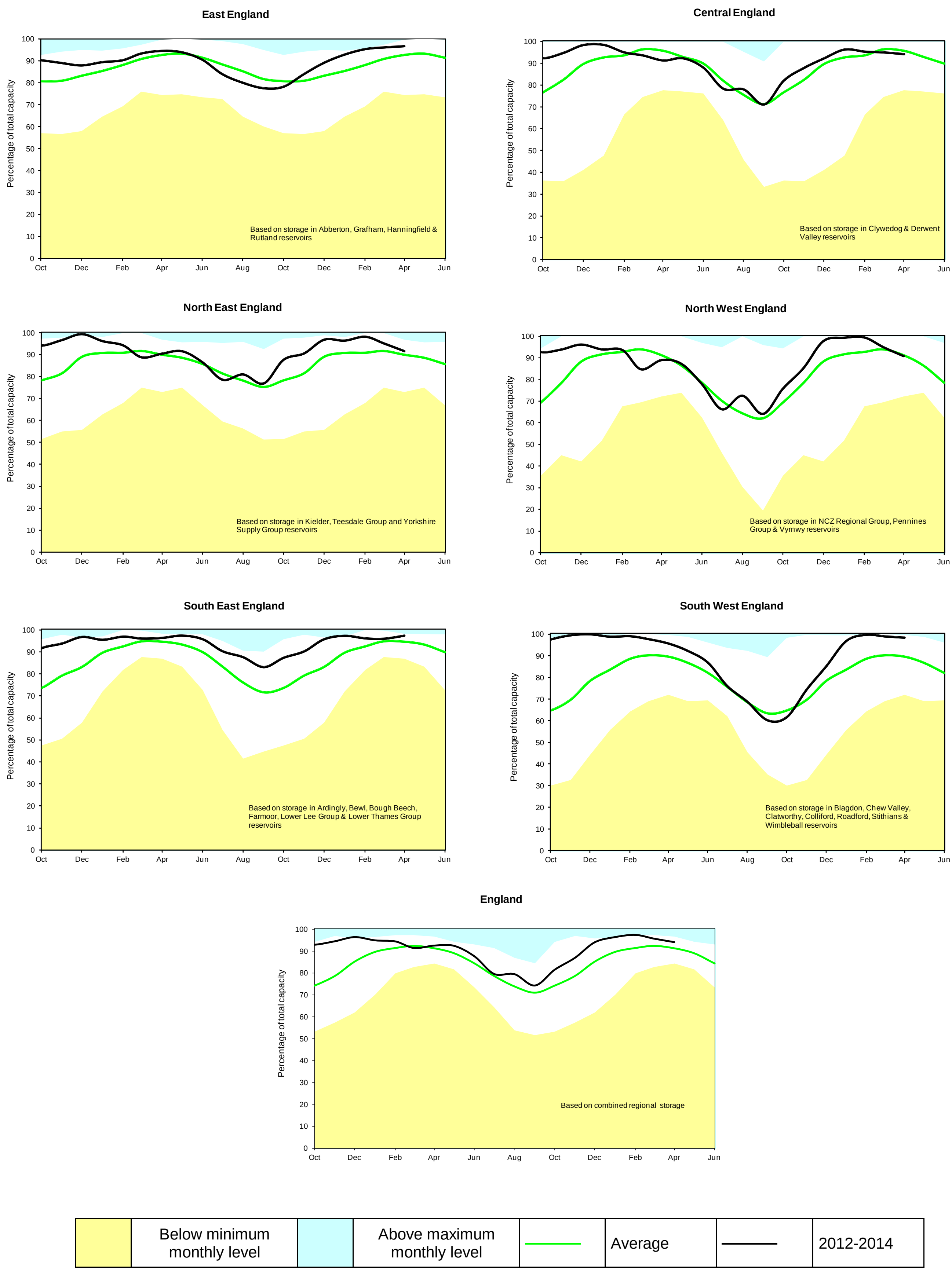


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

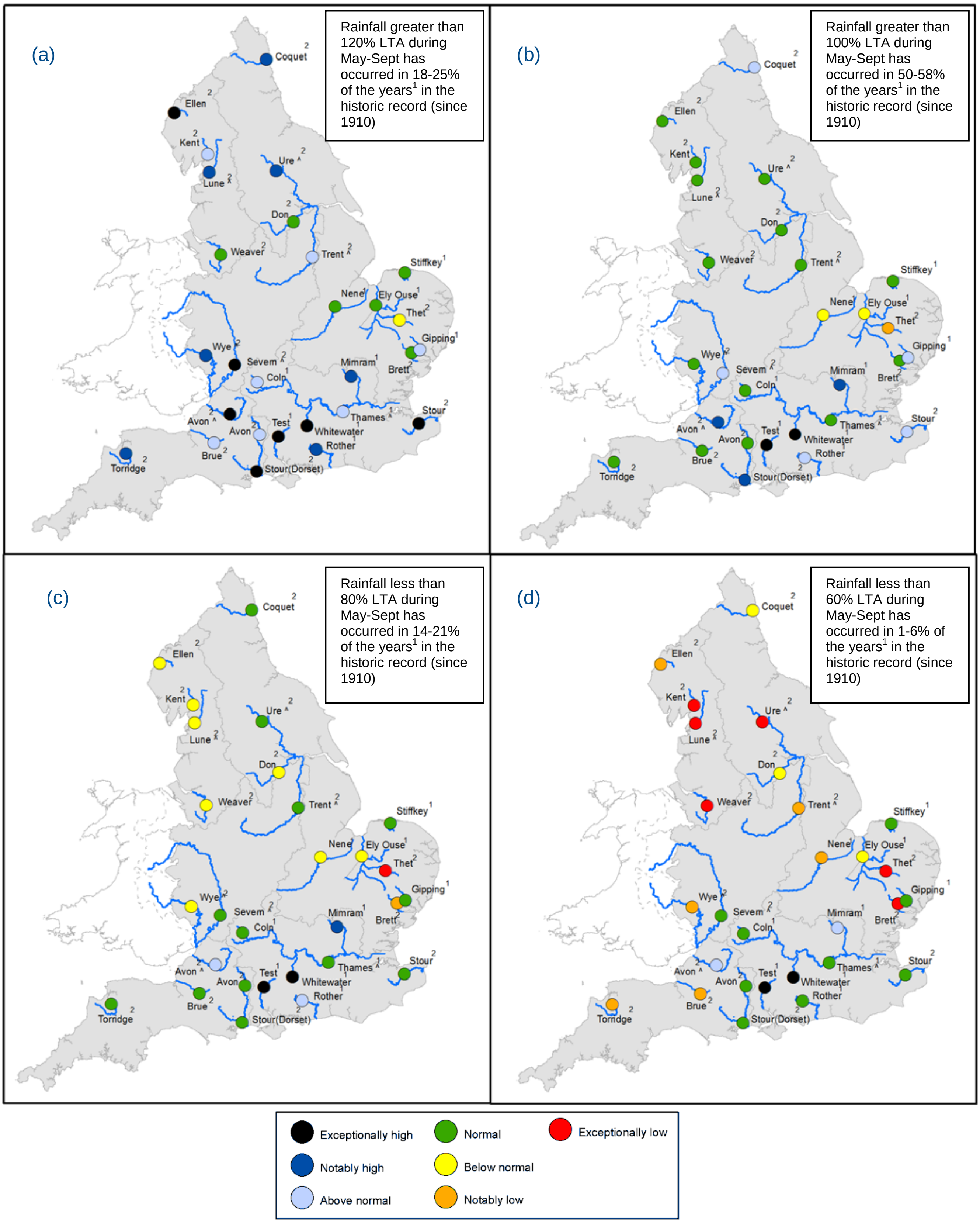


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2014 and September 2014 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*

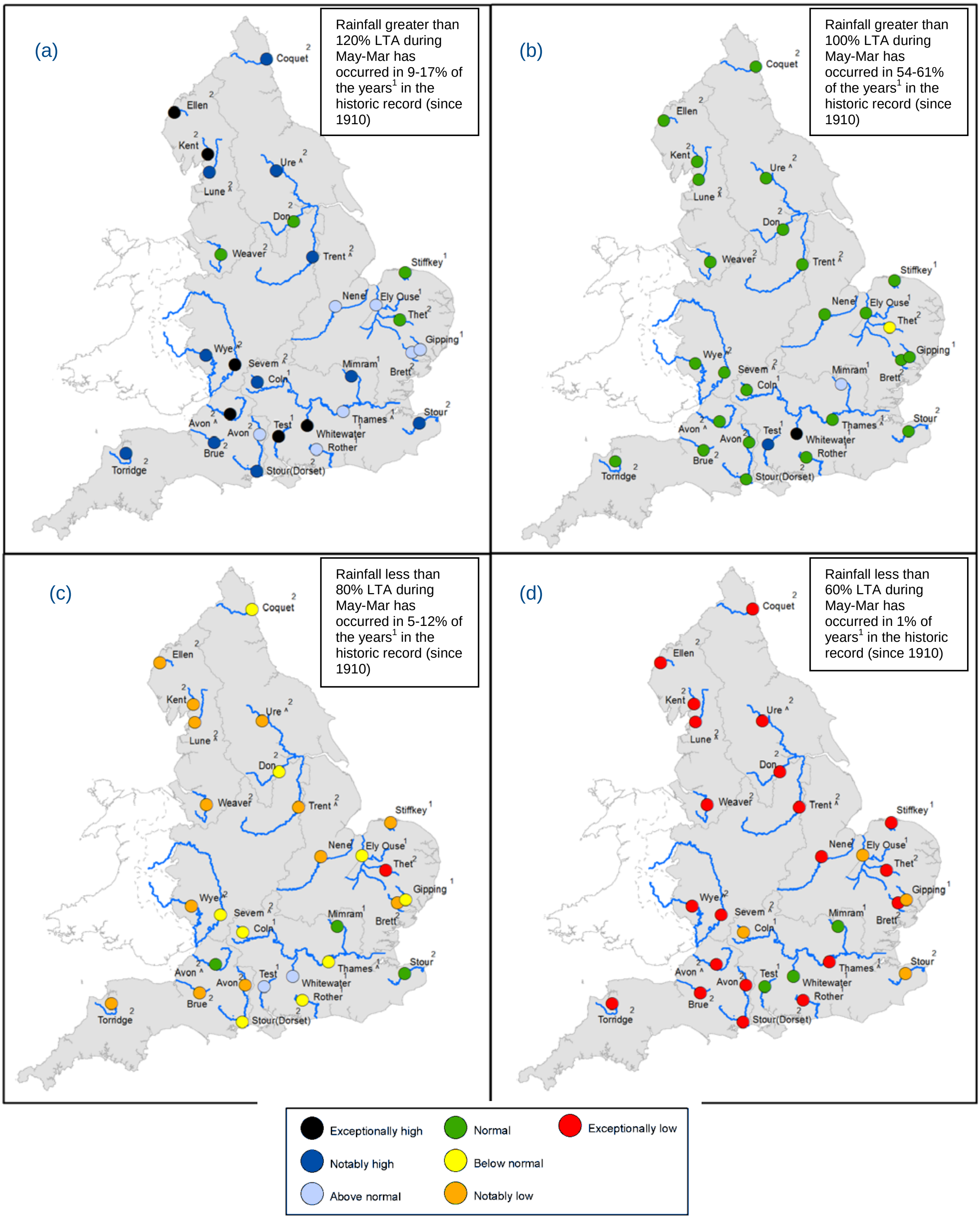


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2014 and March 2015 (Source: Centre for Ecology and Hydrology, Environment Agency)

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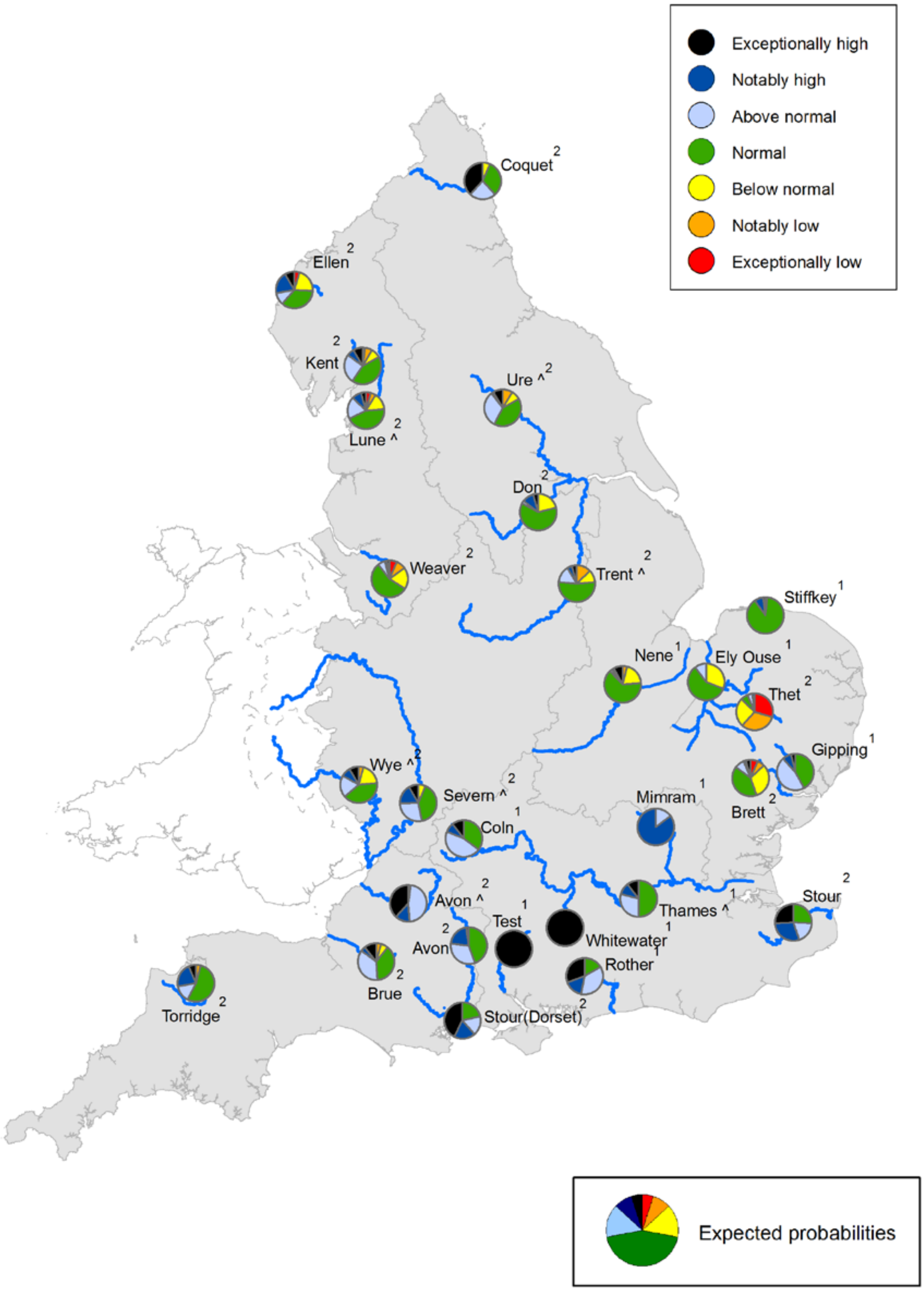

Figure 6.3: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2014. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology,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

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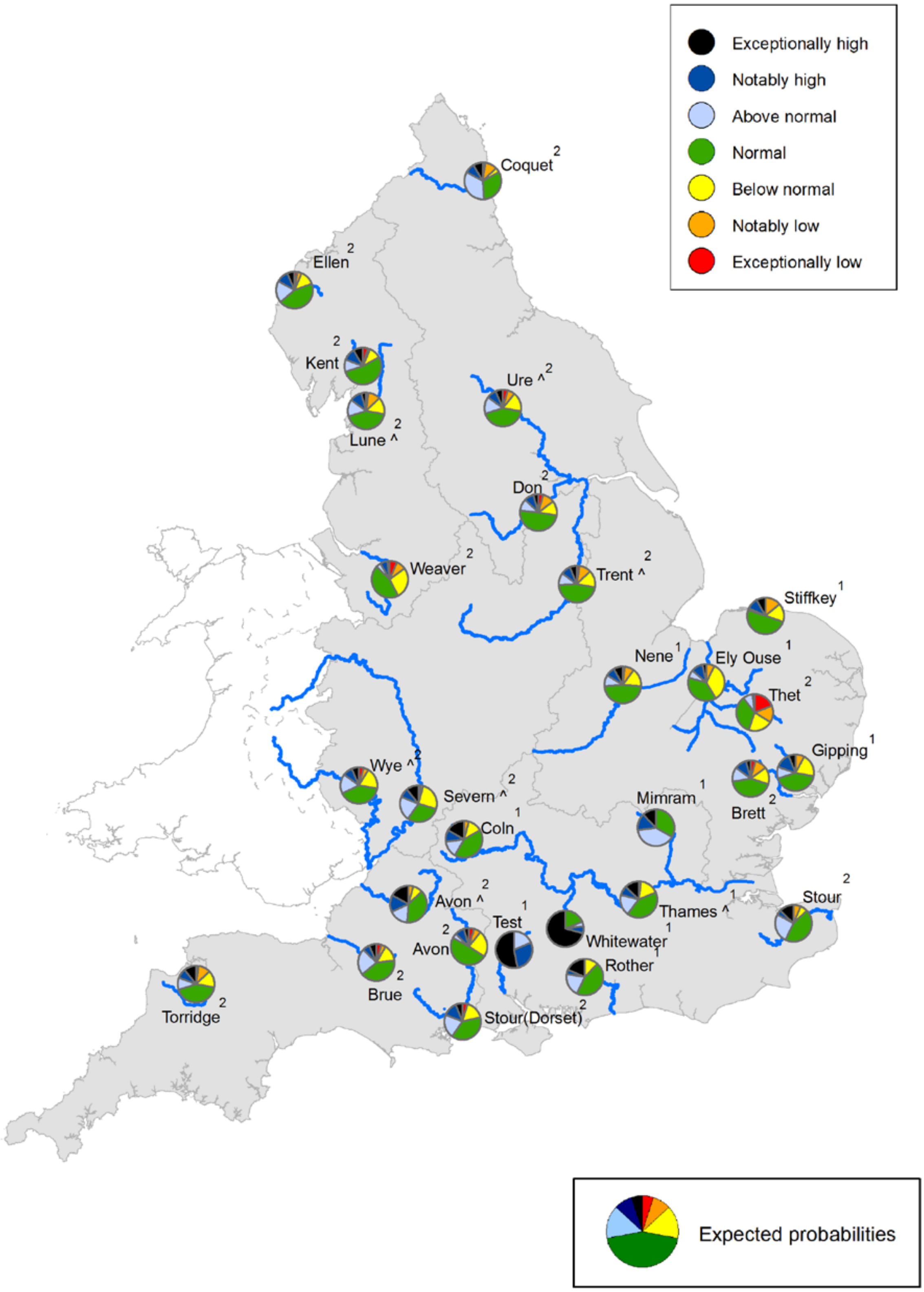

Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2015. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology,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

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

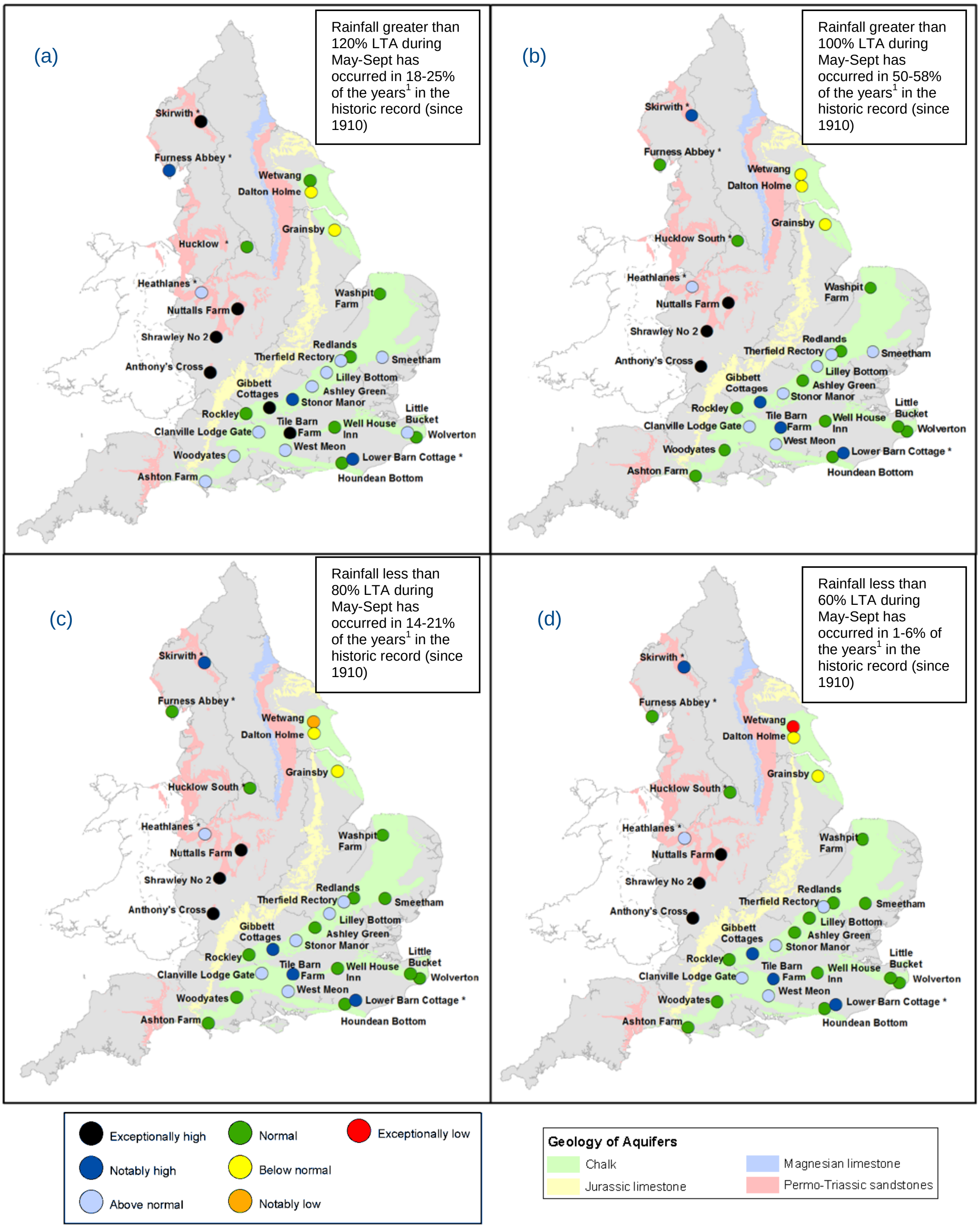

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2014. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2014 and September 2014 (Source: Environment Agency) Geological map reproduced with kind permission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

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

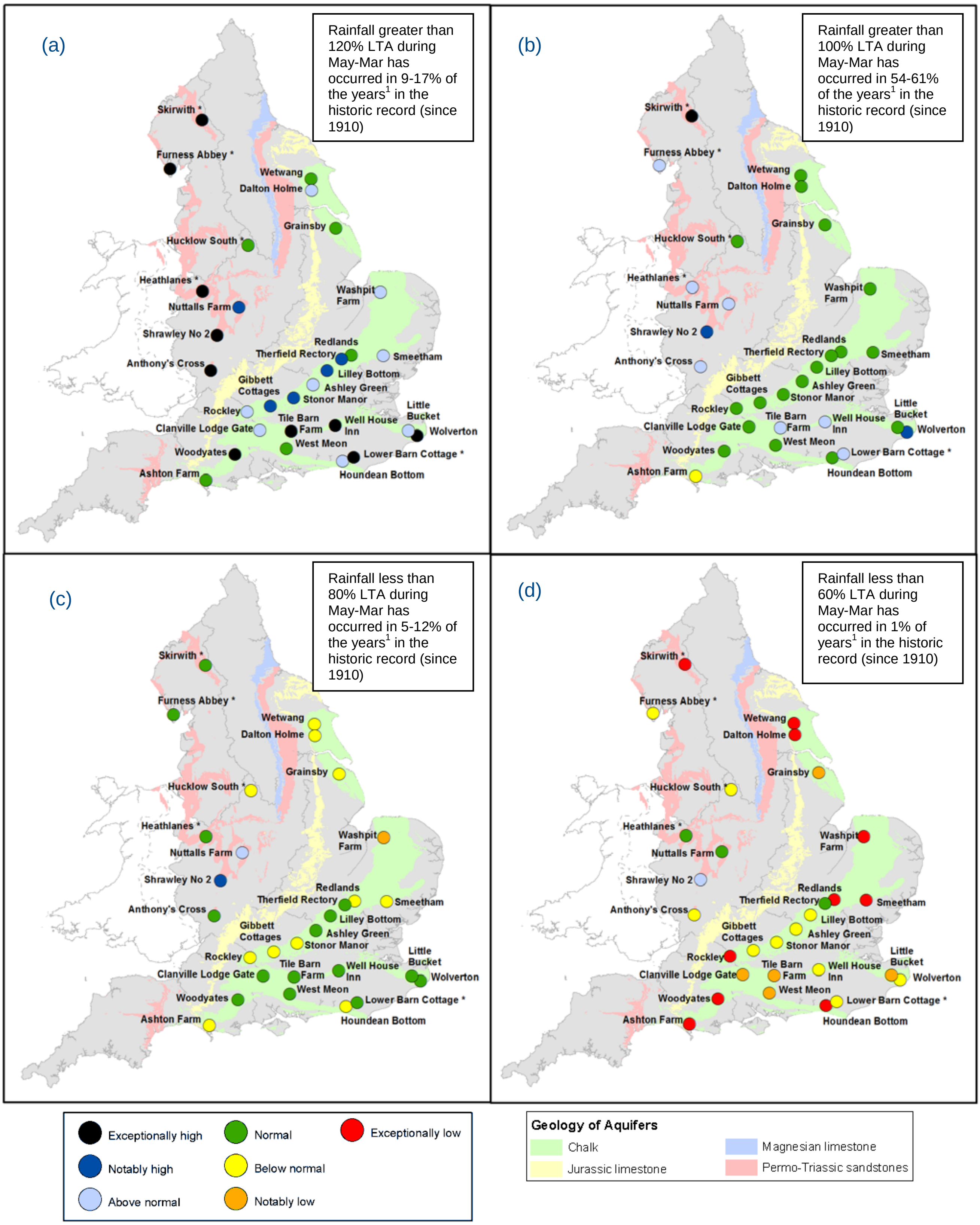

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2014 and March 2015 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2014.

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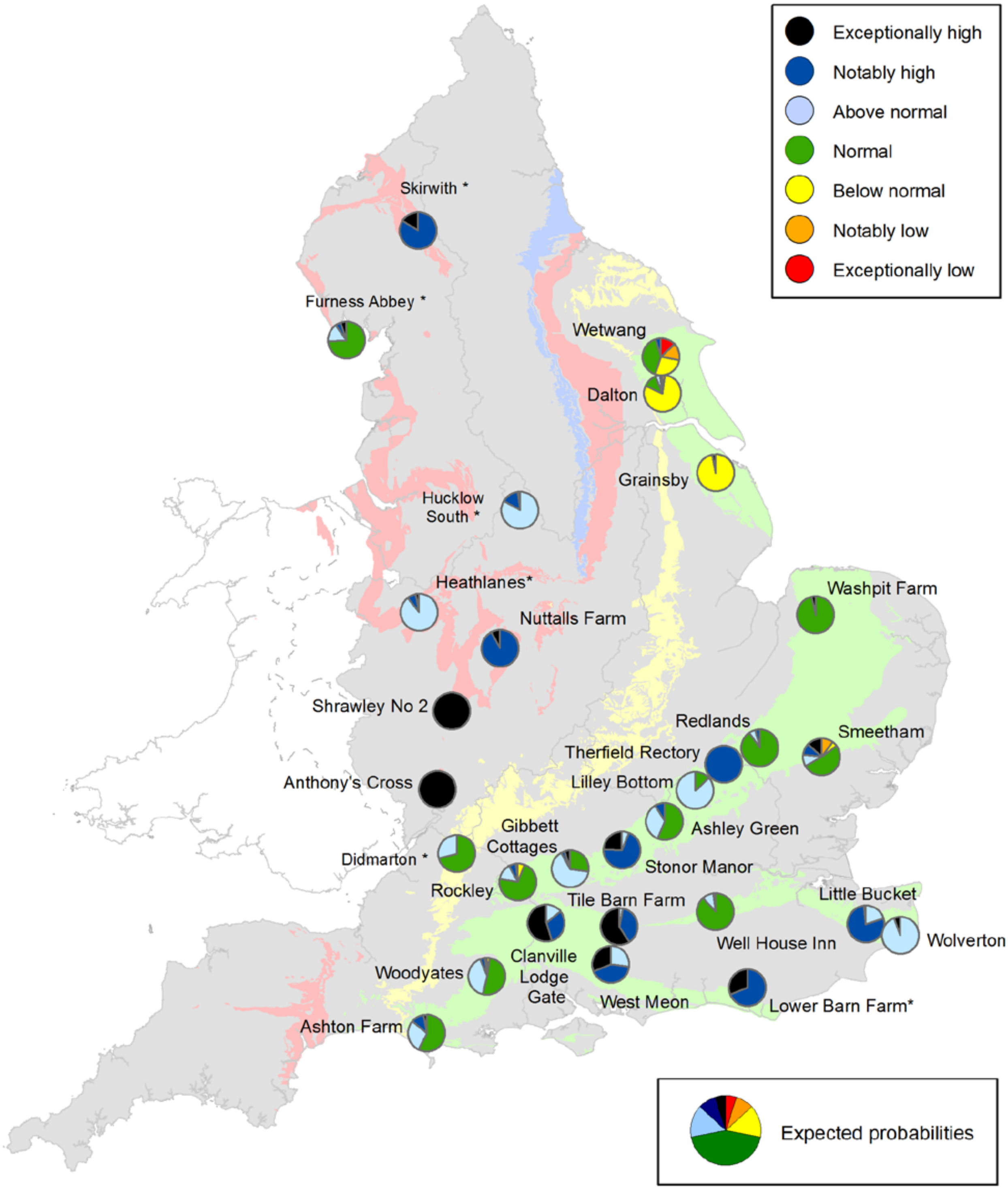
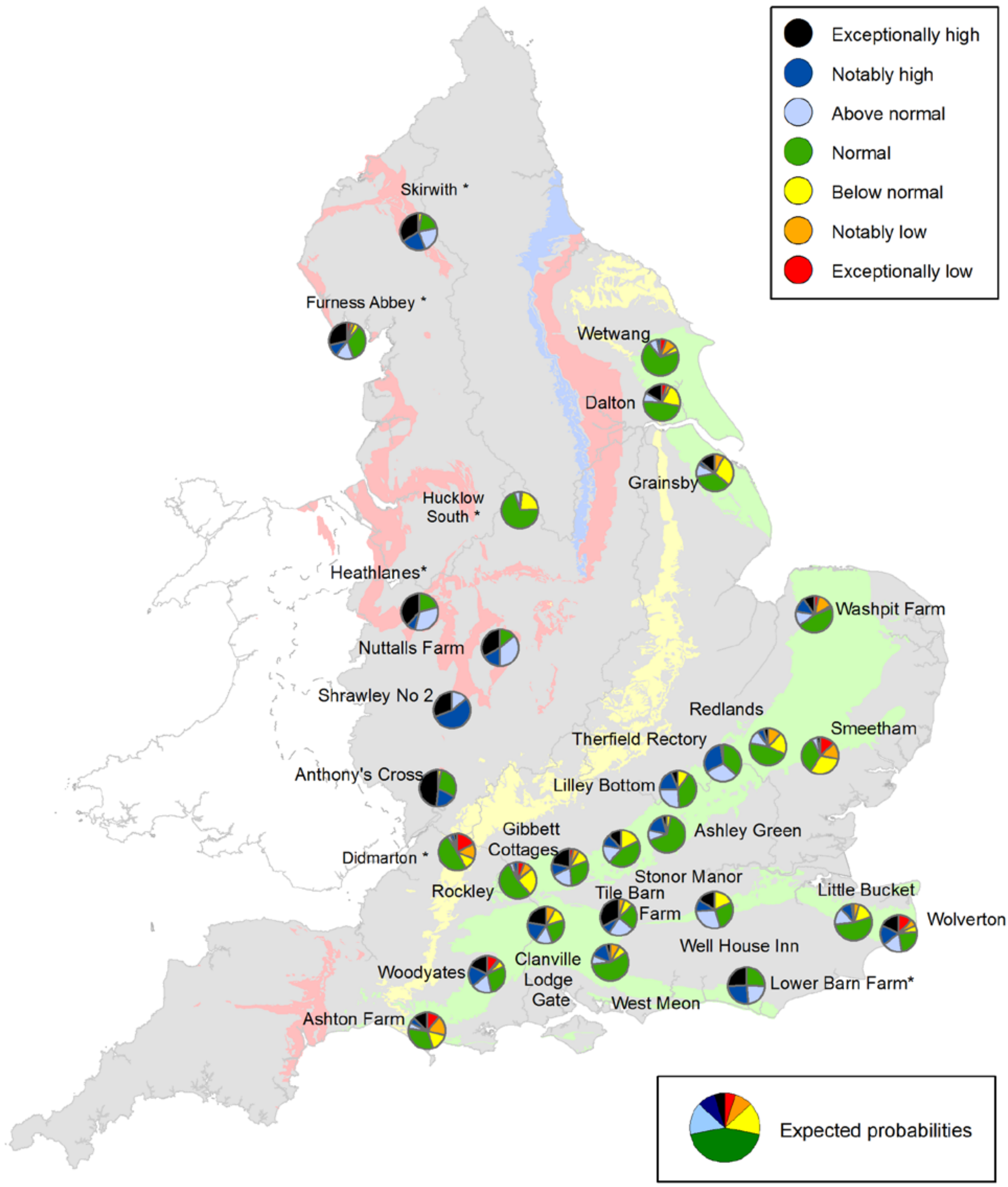
[1] This range of probabilities is a regional analysis



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

Figure 6.7: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of 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*



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 March 2015. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the time of year. (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2014.

* Projections for these sites are produced by BGS

Figure 7.1: Geographic regions

Glossary

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

Categories

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