Monthly water situation report

England

Summary – April 2015

Rainfall during April was well below average across England at 48% of the long term average; however, regional rainfall totals for the first 5 days of May already exceed the totals for the whole of April across all but north-west England. Soil moisture deficits increased by up to nearly 50 mm during April and ranged between 30 and 50 mm larger than the LTA by the end of the month. Monthly mean river flows decreased compared to March, but remain **normal** for the time of year at nearly two thirds of sites. Groundwater levels decreased during the month at nearly two thirds of indicator sites, but end of month levels remain **normal** or higher at nearly three quarters of sites. Reservoir stocks decreased at the majority of sites, but remain **normal** or higher for the time of year at nearly two thirds of locations. Overall reservoir stocks for England decreased slightly to 92% of total capacity.

Rainfall

April rainfall totals were highest across Cumbria at between 60 and 80 mm. The lowest rainfall totals of between 9 and 14 mm occurred across parts of Essex, East Sussex and Hampshire. April rainfall totals were below the long term average (LTA) in all but two hydrological areas (both in Cumbria), and less than 50% of the LTA in three quarters of areas (Figure 1.1).

April rainfall totals were classed as **below normal** or lower for the time of year across the majority of hydrological areas. The hydrological areas covering Cumbria and parts of Northumbria and Lancashire were classed as **normal**. Over the 3 month period ending in April, cumulative rainfall totals were also **below normal** or lower across most of England. However the 6 and 12 month cumulative rainfall totals were **normal** across most of England (Figure 1.2).

At a regional scale, April rainfall totals were **normal** for the time of year in north-west England, **below normal** in east, north-east and south-east England and **notably low** in central and south-west England. Totals ranged from 36% of the April LTA in central England to 77% in north-west England. Overall, England received 48% of the April LTA (Figure 1.3).

Soil moisture deficit

In response to the below-average rainfall during April, soil moisture deficits (SMDs) increased across England by up to nearly 50 mm. At the end of April SMDs were between 30 and 70 mm across the majority of MORECS grid squares. End of month SMDs were up to 50 mm larger than the LTA across most of England, with only the far north having SMDs that were smaller than the LTA (Figure 2.1).

At a regional scale, SMDs increased by up to approximately 40 mm across England. End of month SMDs ranged from 19 mm in north-west England to 52 mm in east England (Figure 2.2).

River flows

Monthly mean river flows for April decreased compared to March at all but one indicator site across England. However, flows were classed as **normal** for the time of year at nearly two thirds of indicator sites. The remaining sites, mainly located in the south and parts of east England, were classed as **below normal** or **notably low** (Figure 3.1).

Monthly mean river flows were classed as **normal** for the time of year at 4 of the 7 regional index sites; the Bedford Ouse in east England, the River Thames (naturalised flow) in the south-east and the River Exe in the south-west were classed as **below normal** for the time of year (Figure 3.2).

Groundwater levels

Groundwater levels continued their seasonal decline in many places, decreasing at nearly two thirds of indicator sites across England during April. However, at the end of the month, levels were classed as **normal** or higher for the time of year at nearly three quarters of sites. Levels at 6 sites across north-east and south-west England were **below normal** for the time of year, whilst the level at Jackaments Bottom (in the faster-responding Burford Jurassic limestone aquifer) dropped to **exceptionally low** for the time of year.

End of month groundwater levels at the major aquifer index sites were **normal** or higher for the time of year at 6 of the 8 sites. Dalton Holme in the Hull and East Riding chalk aquifer was **below normal**, whilst Jackaments Bottom was **exceptionally low** for the time of year (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks decreased or remained static during April at all but 4 reported reservoirs and reservoir groups. The largest decreases of 6 to 7% occurred at 4 reservoirs located in south-west, north-east and north-west England and one reservoir located in Wales which supplies north-west England. Stocks in Ardingly and Grafham reservoirs in south-east and east England respectively increased by 3%. All but 4 reservoirs are within 10% of full capacity, with 2 being full. At the end of April, stocks were classed as **normal** or higher for the time of year at nearly two thirds of reported reservoirs. The remaining reservoirs were classed as **below normal** or lower for the time of year (Figure 5.1).

Regional-scale reservoir stocks remained static during April in east England, but decreased by up to 6% elsewhere. The largest decreases of 6% occurred in central and north-west England. At the end of April, regional stocks ranged from 91% of total capacity in north-east England to 95% in east England. Overall reservoir storage for England decreased slightly to 92% of total capacity (Figure 5.2).

Forward look

Unsettled weather is expected to prevail across much of the country during the first part of May. The latter part of the month is expected to be more settled, with temperatures becoming warmer, particularly in the south. There is a slight increased chance of above-average rainfall during the period May to July. However there is large uncertainty in the 3-month prediction because summer rainfall is more localised and therefore there will be more regional variability[1].

Projections for river flows at key sites[2]

More than three quarters of sites have a greater than expected chance of lower than **normal** cumulative river flows between May and September 2015 and between May 2015 and March 2016. However, these projections were based on river flows at the end of April and the rainfall that has fallen across England since then may have improved this outlook.

For scenario based projections of river flows at key sites in March 2015 see Figure 6.1
For scenario based projections of river flows at key sites in September 2015 see Figure 6.2
For probabilistic ensemble projections of river flows at key sites in March 2015 see Figure 6.3
For probabilistic ensemble projections of river flows at key sites in September 2015 see Figure 6.4

Projections for groundwater levels in key aquifers[3]

More than two thirds of modelled sites have a greater than expected chance of **normal** groundwater levels at the end of September 2015. At the end of March 2016 more than half of sites have a greater than expected chance of **normal** groundwater levels.

For scenario based projections of groundwater levels in key aquifers in March 2015 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2015 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2015 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2015 see Figure 6.8

Authors: E & B Hydrology Team

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.
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Rainfall

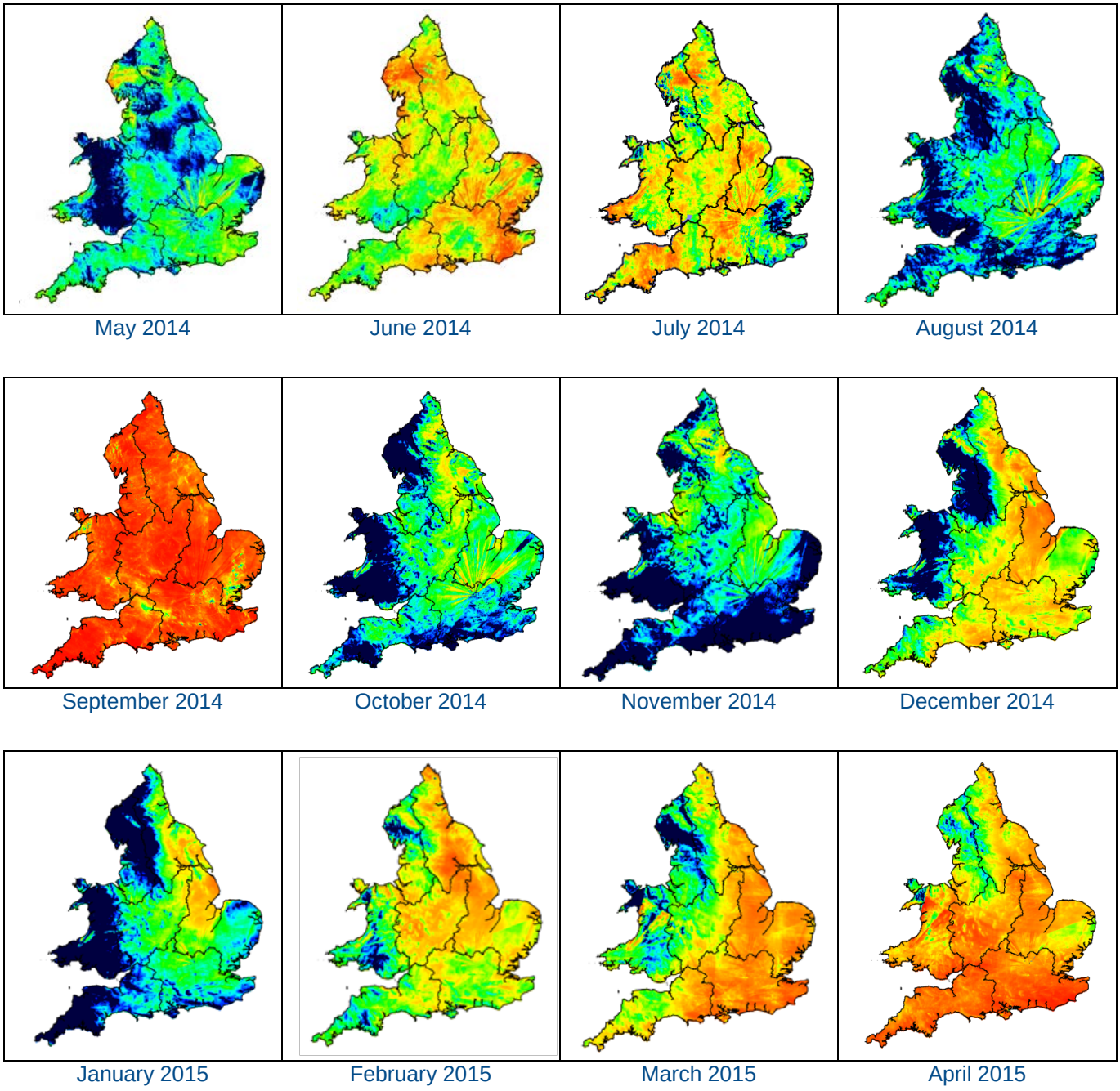
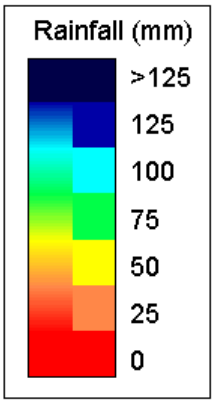


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2015). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.



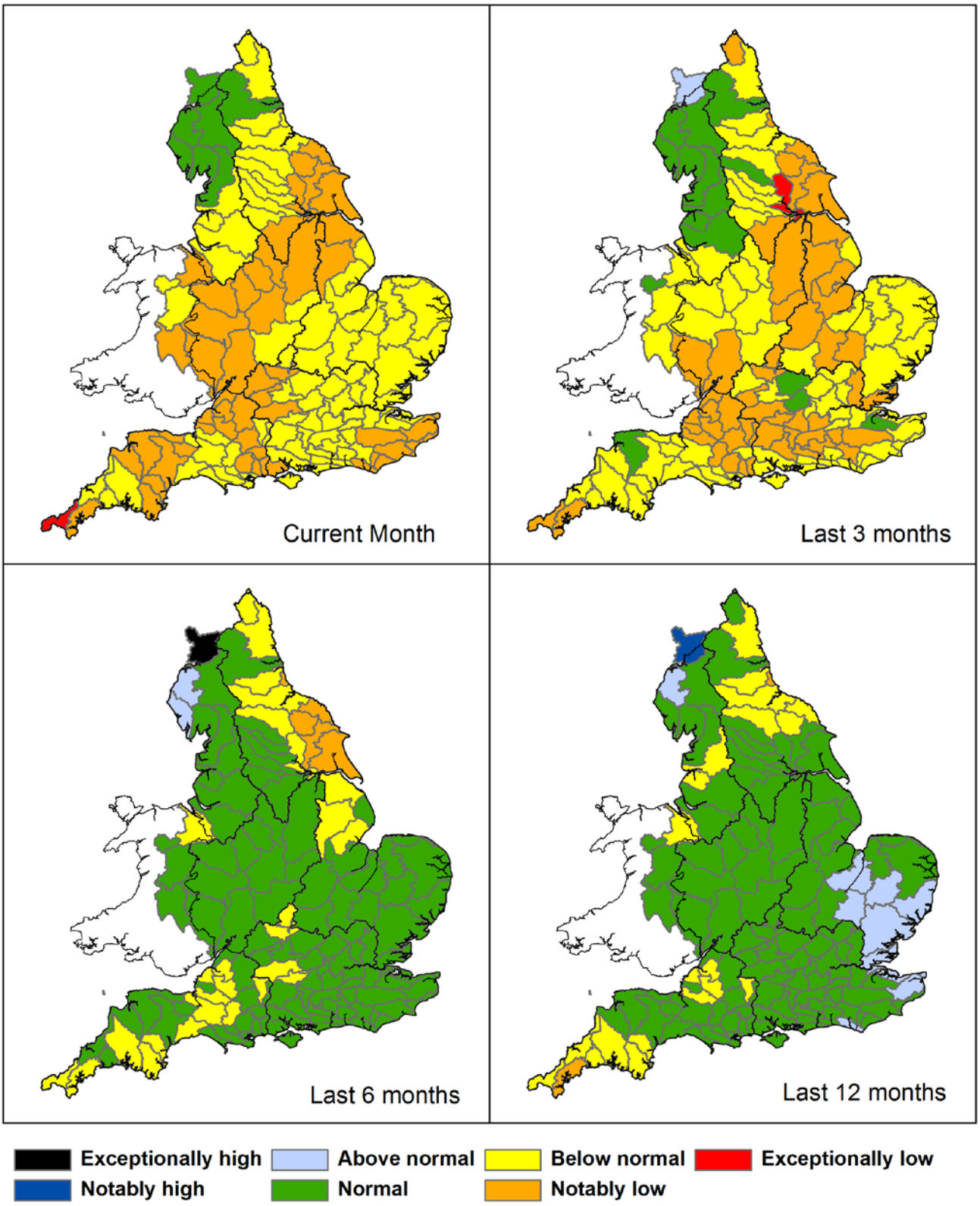


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 April), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2015).* Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

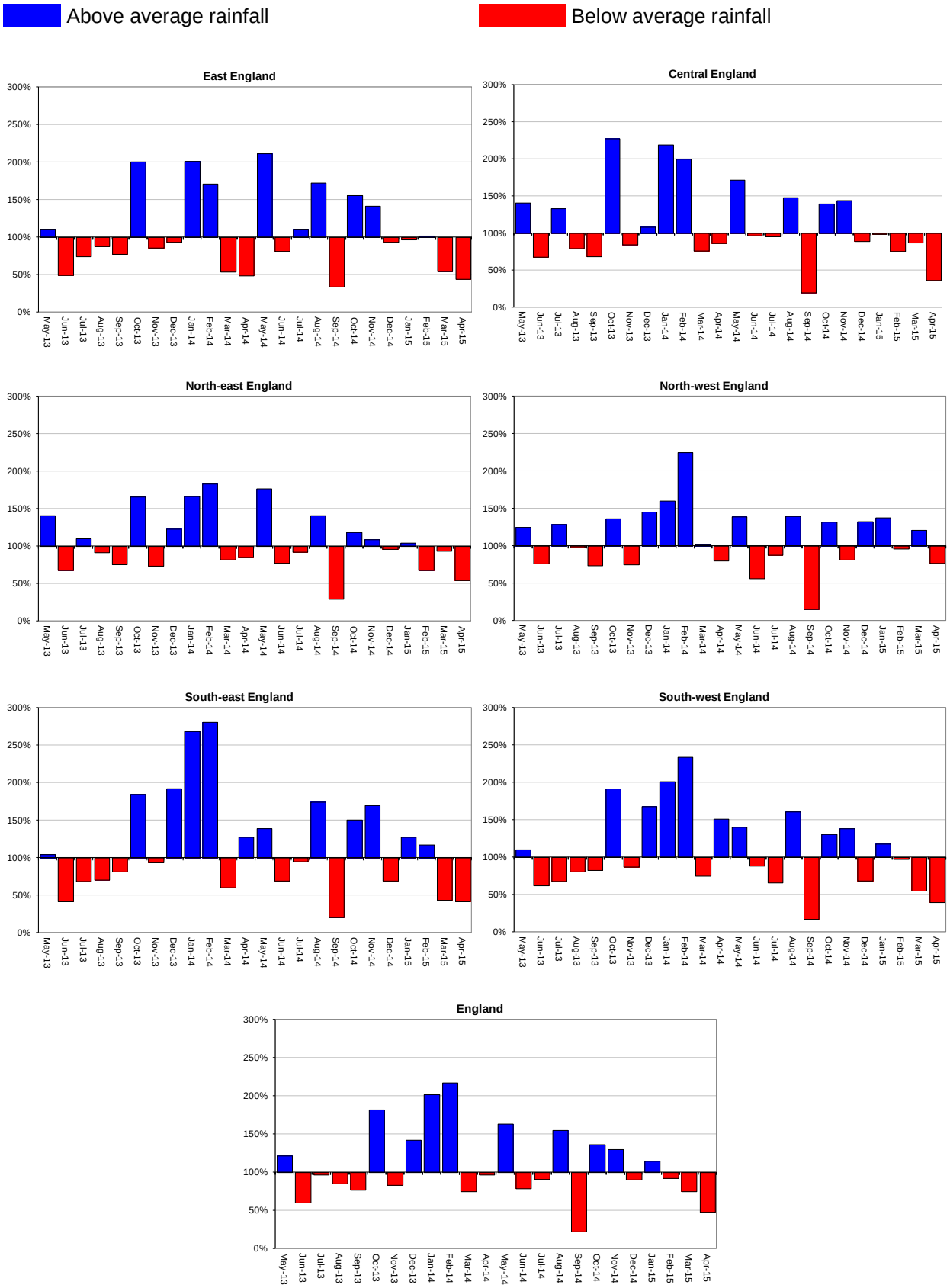


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2015).

Soil moisture deficit

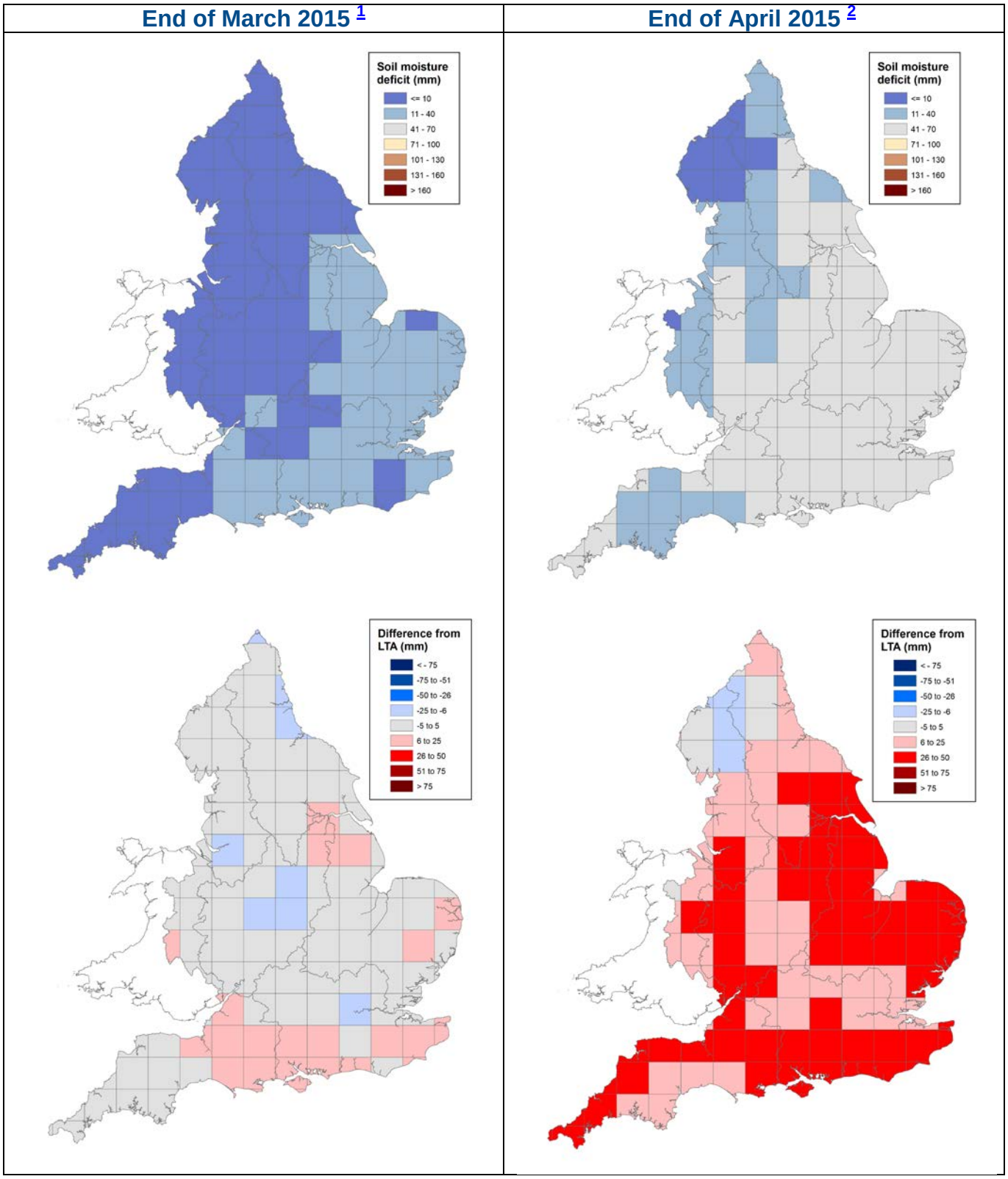


Figure 2.1: Soil moisture deficits for weeks ending 31 March 2015 [1] (left panel) and 28 April 2015 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2015). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015

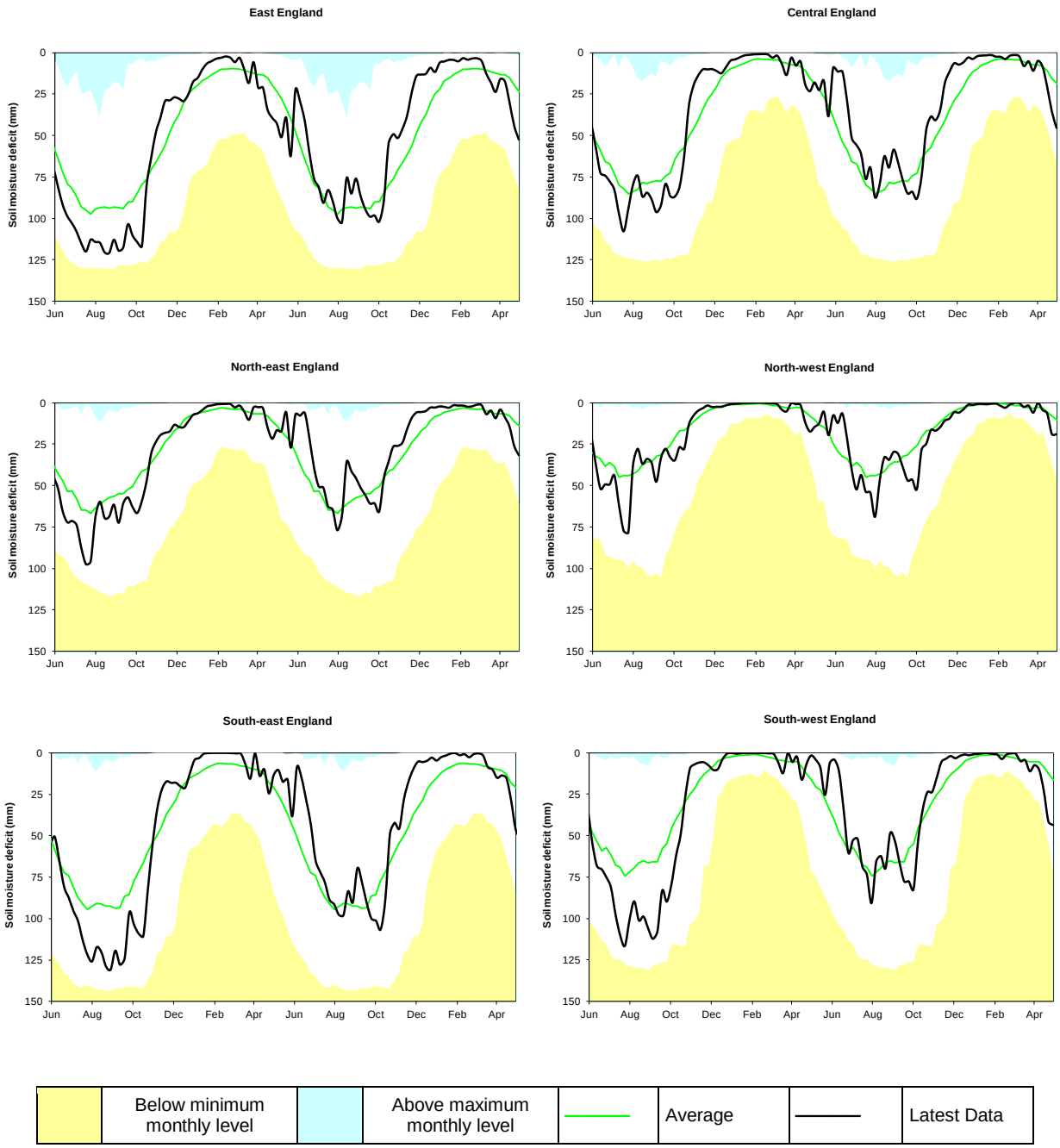
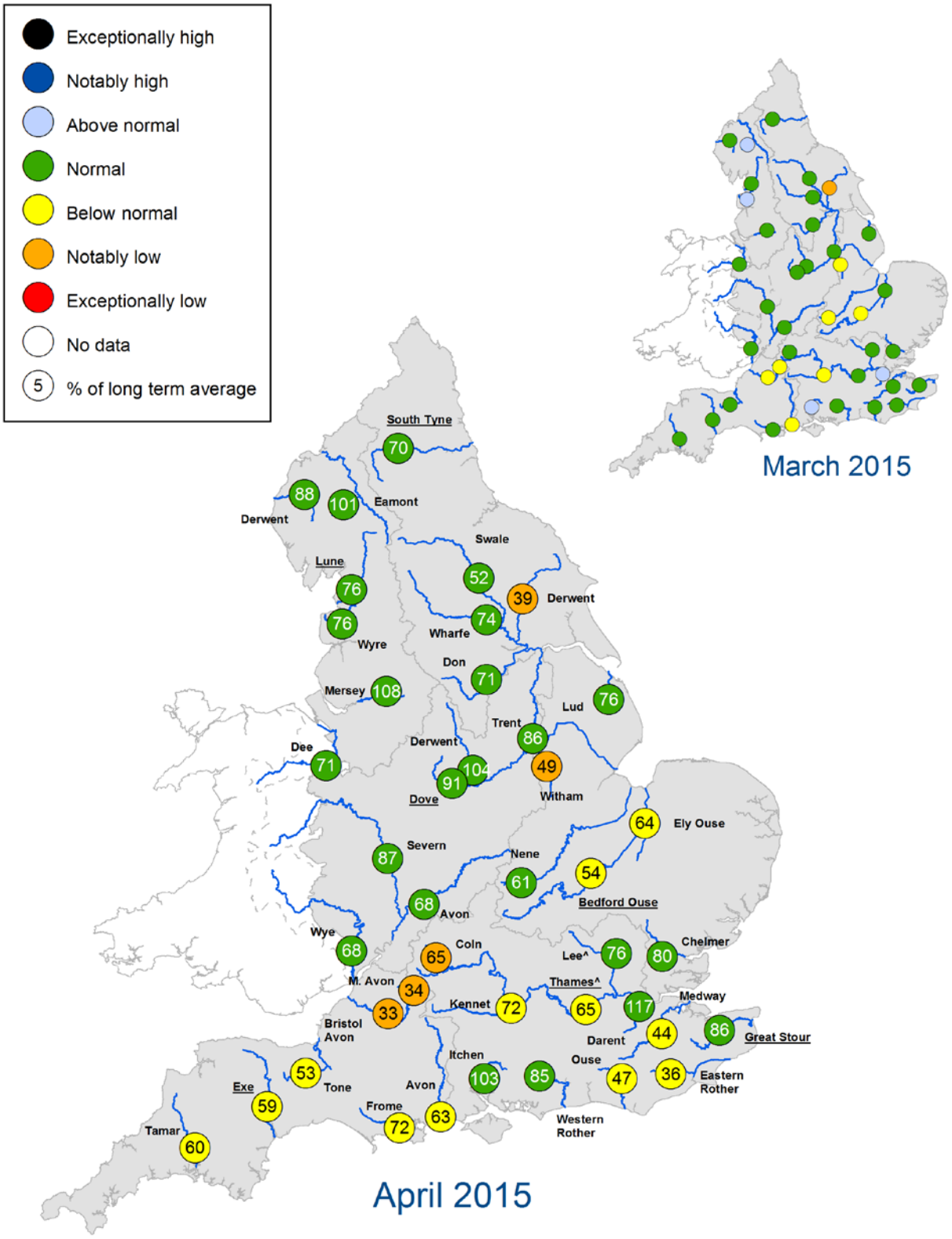


Figure 2.2: Latest soil moisture deficits for all regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2015).

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 and April 2015, 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). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

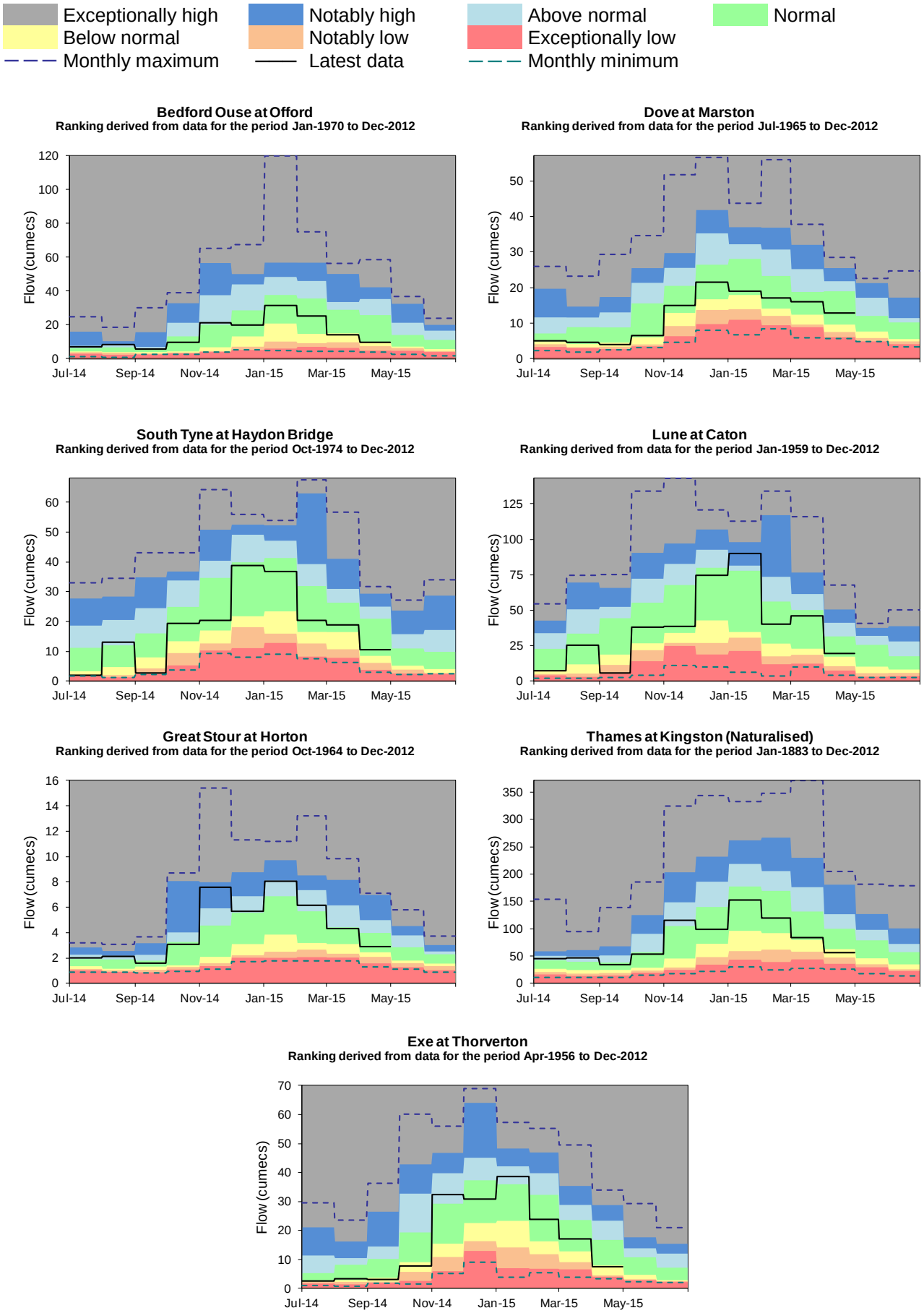
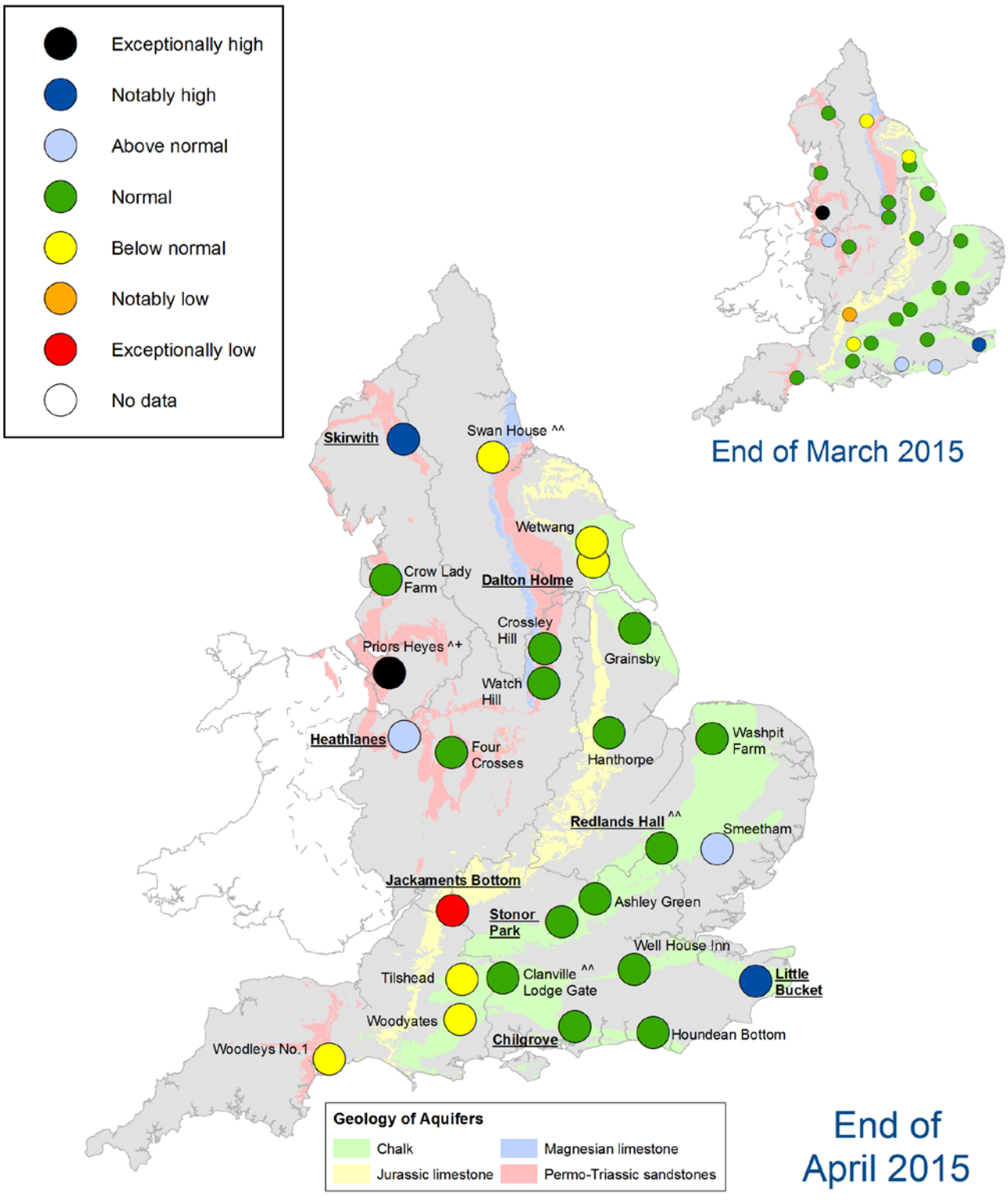


Figure 3.2: Index river flow sites for each region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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/lowest 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 and April 2015, 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, 2015.

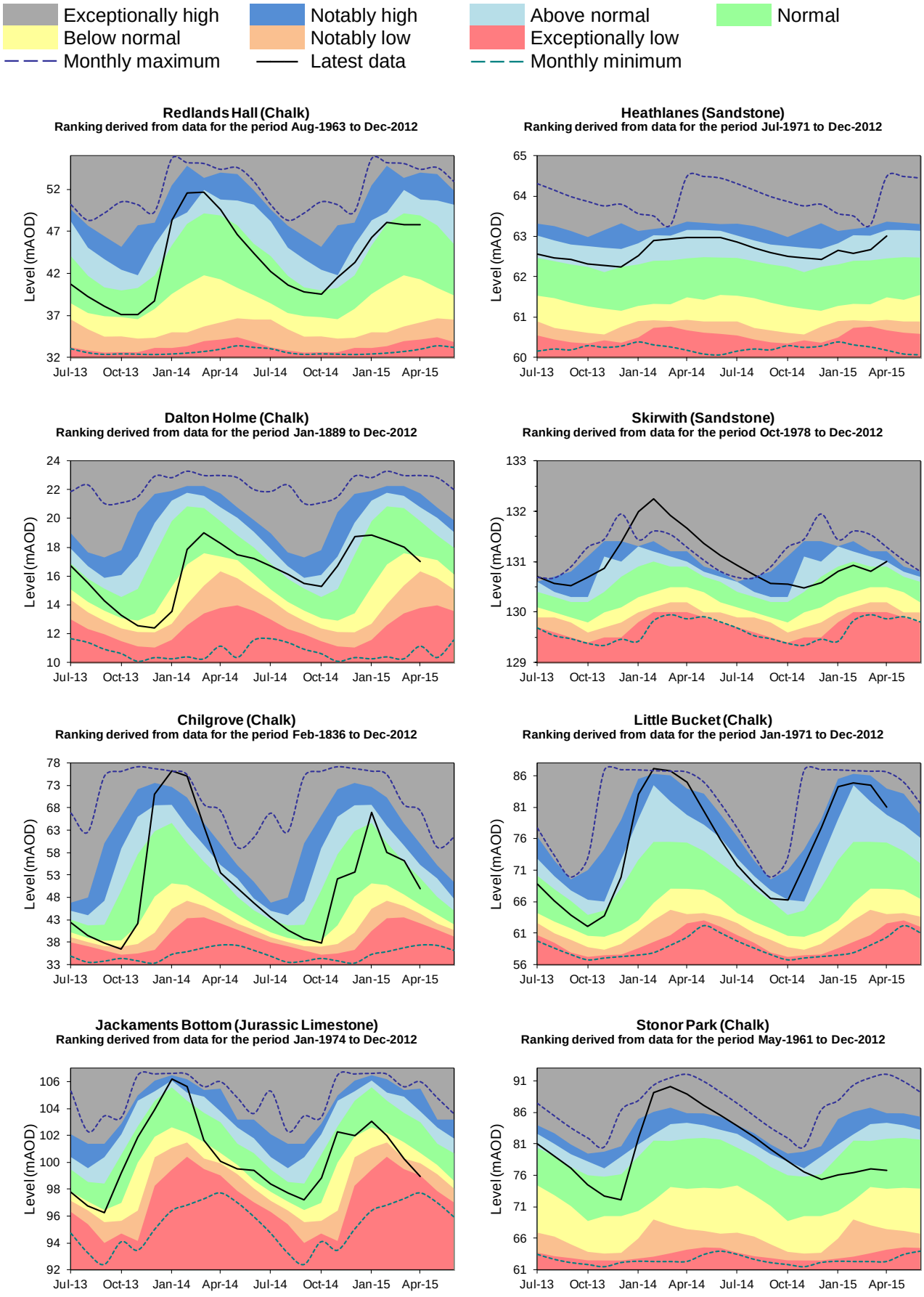
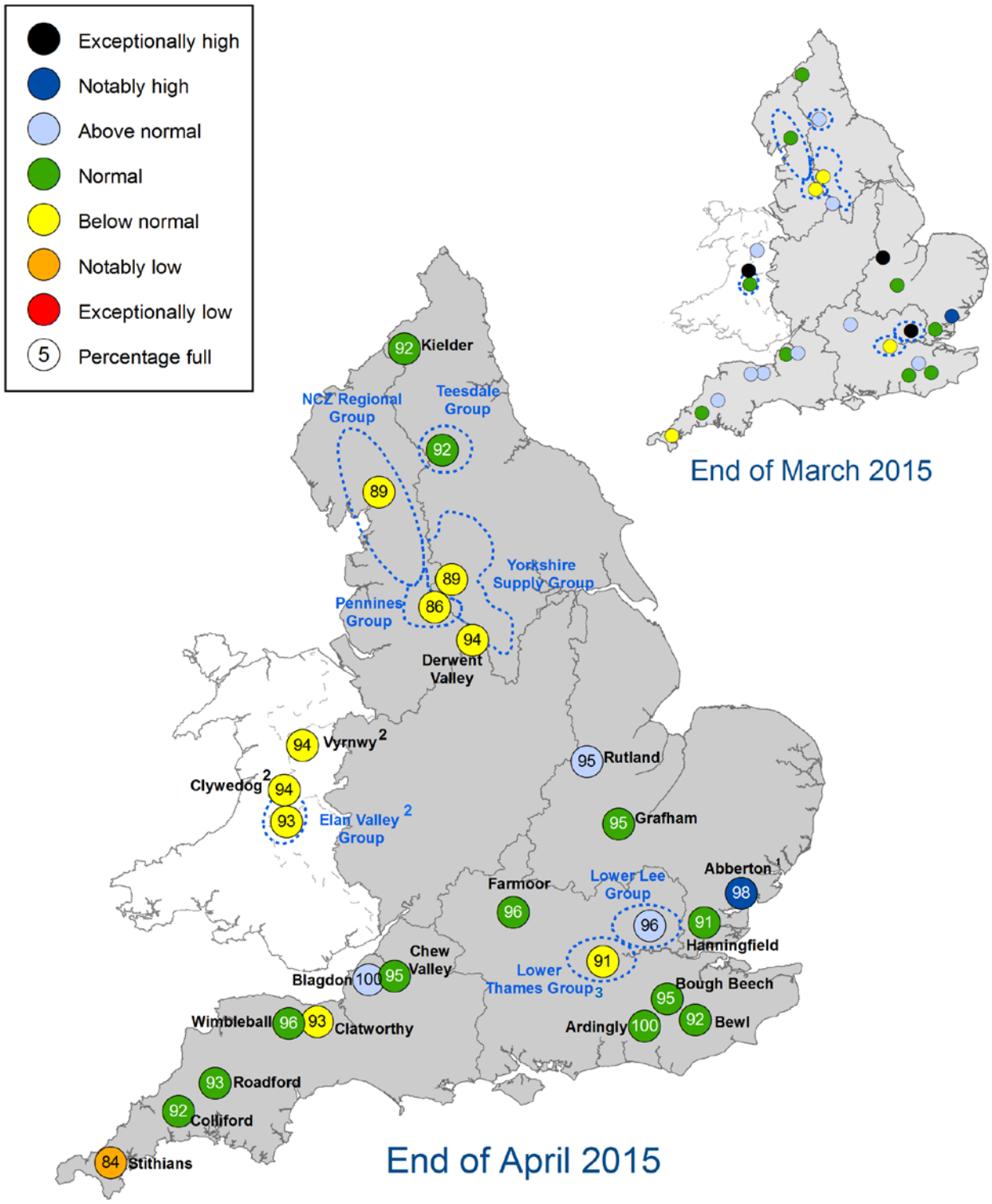


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2015).

Reservoir storage



1. Water levels have been 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 central and northwest England
3. Stocks in the Lower ThamesGroup have been affected by maintenance work.

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end March and April 2015 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.

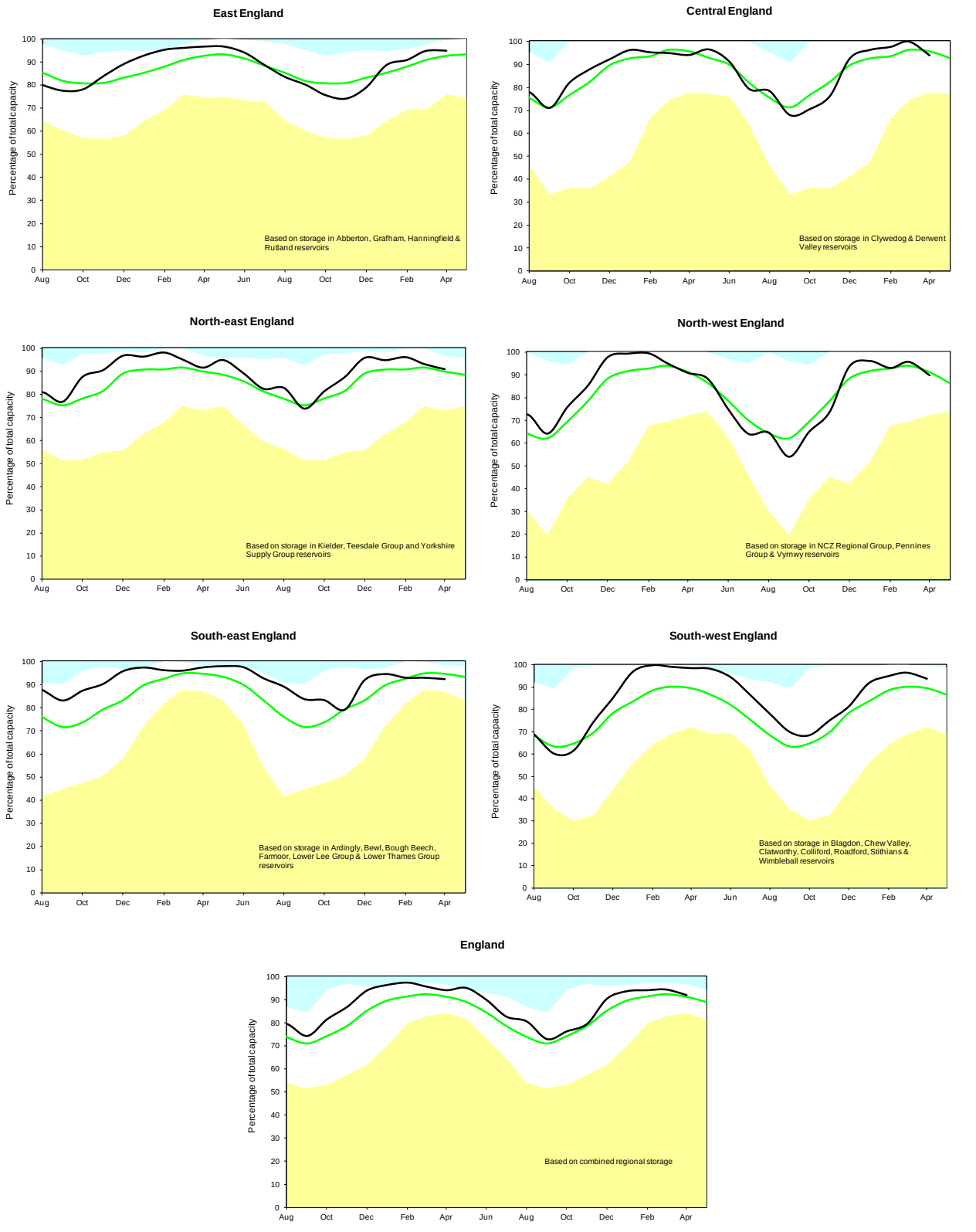


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

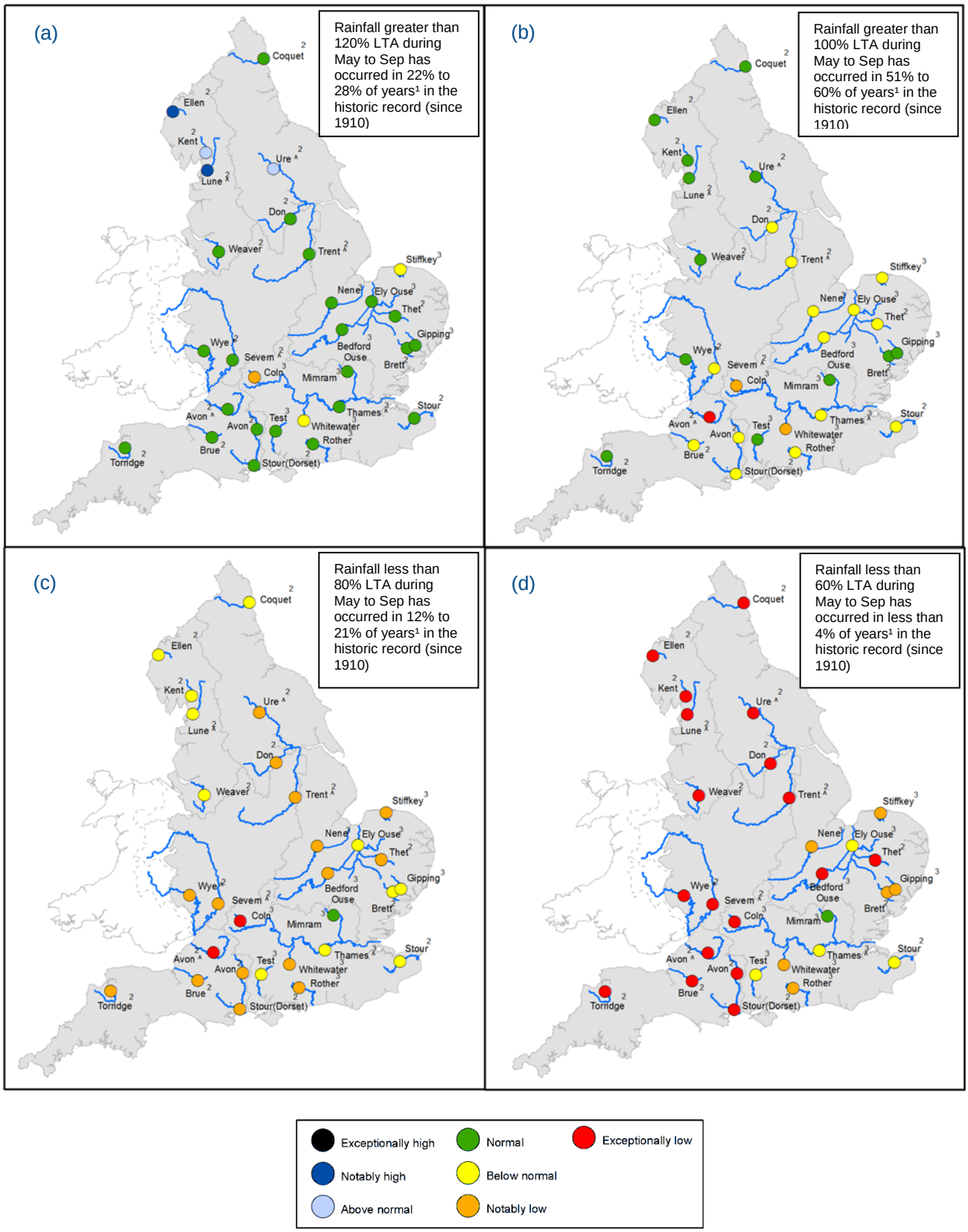


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May and September 2015 (Source: Centre for Ecology and Hydrology, Environment Agency).

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

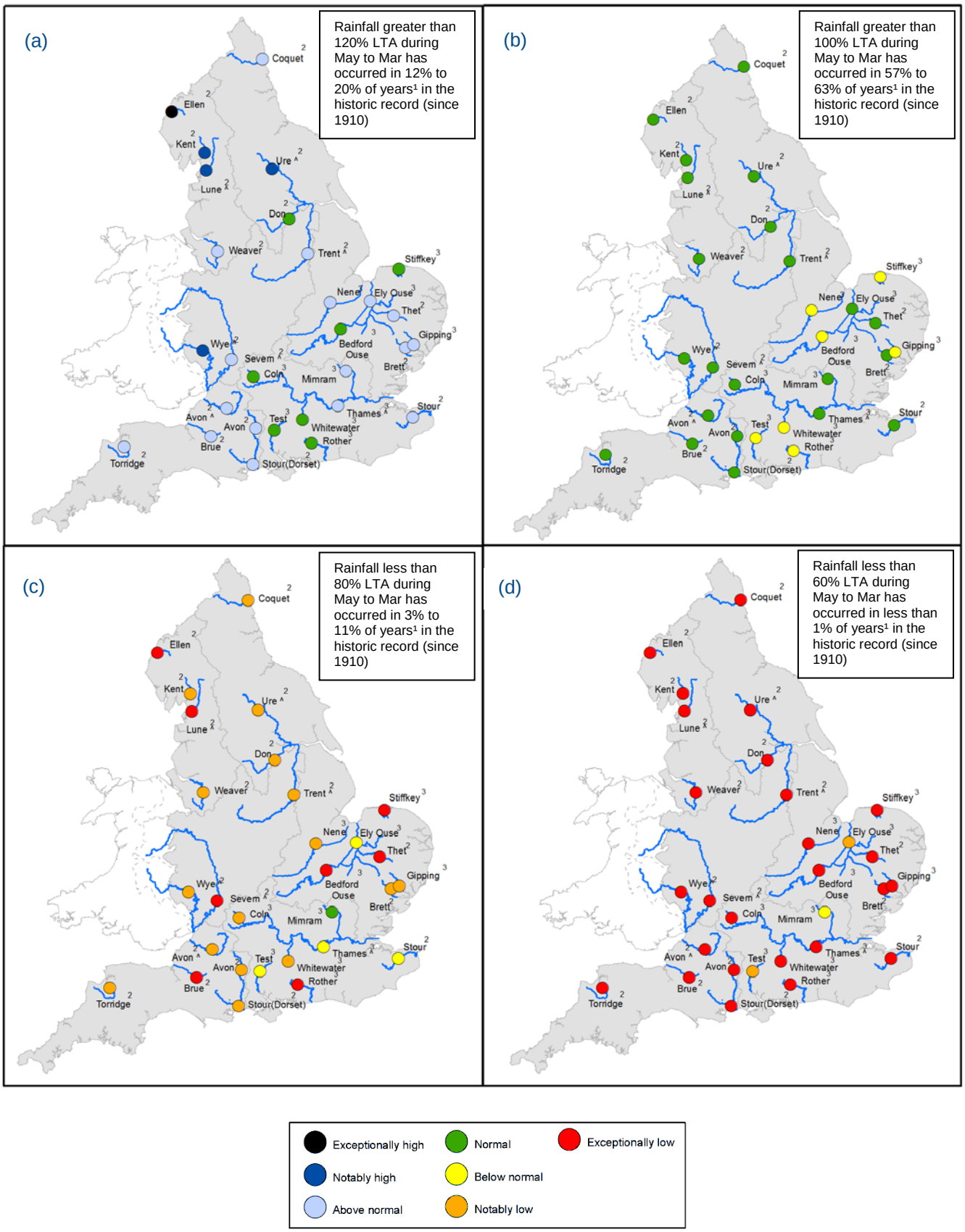


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2015 and March 2016 (Source: Centre for Ecology and Hydrology, Environment Agency).

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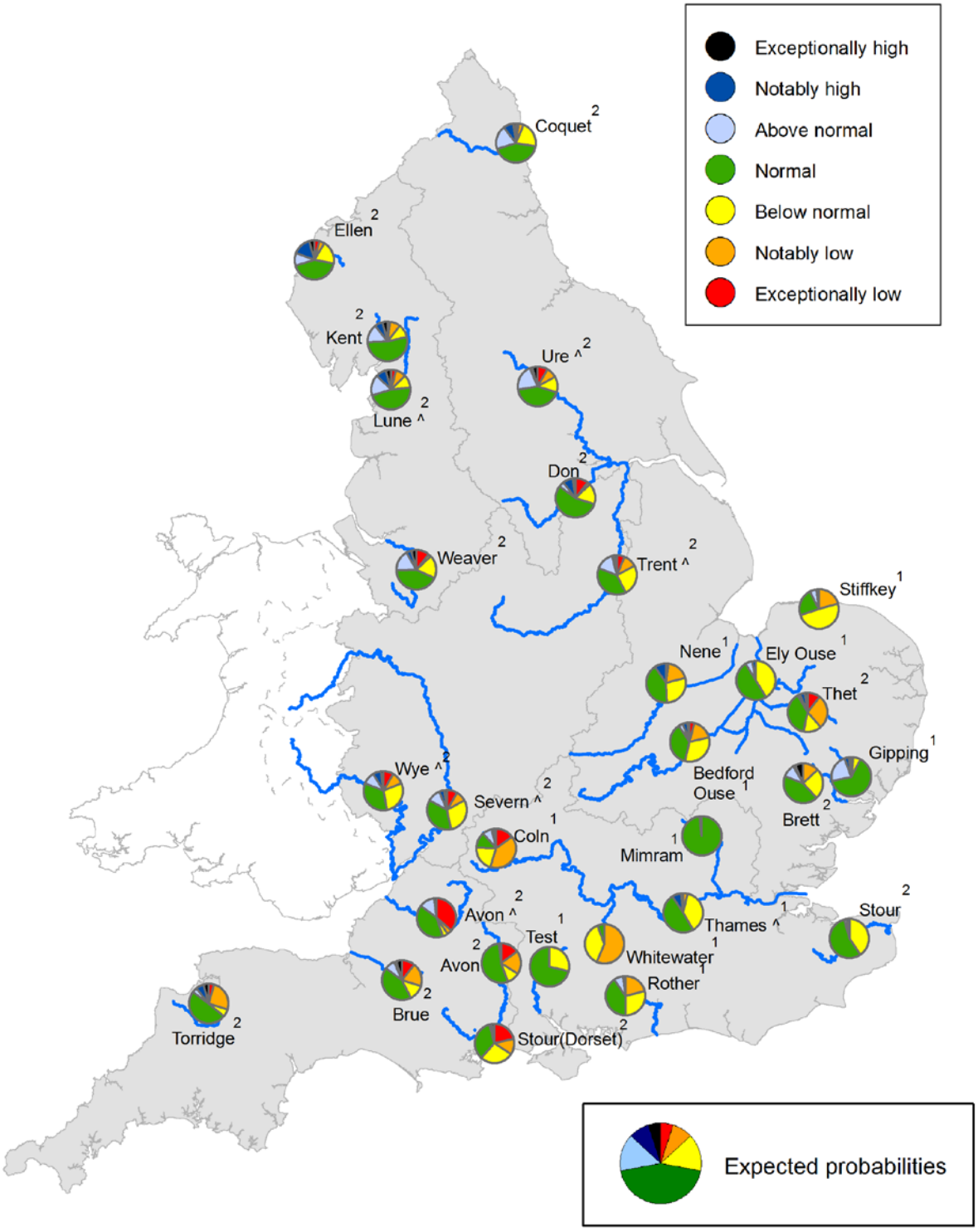

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

Figure 6.3: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 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).

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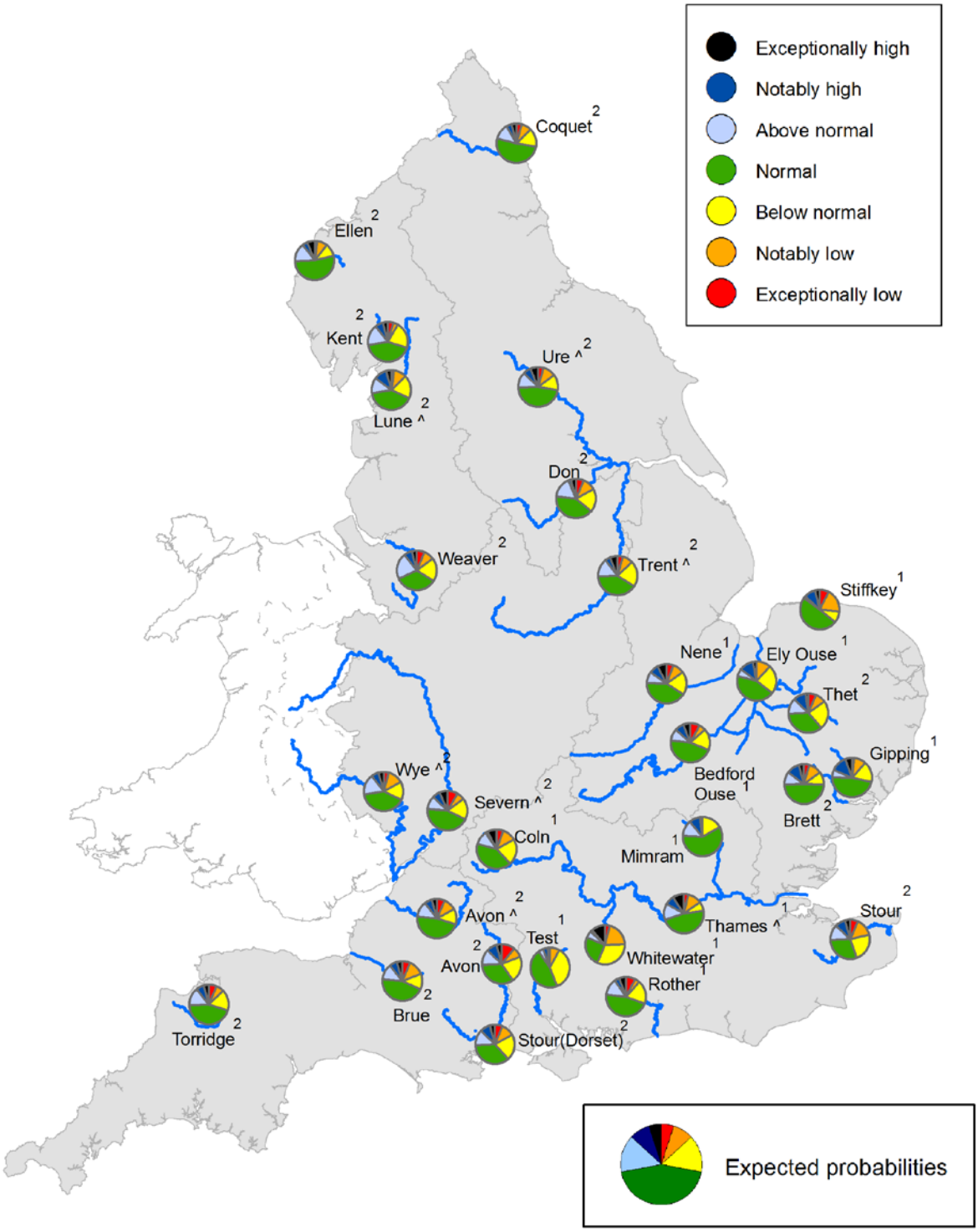

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2016. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

[1] Projections for these sites are produced by the Environment Agency
[2] Projections for these sites are produced by CEH
^ "Naturalised" flows are projected for these sites

Forward look - groundwater

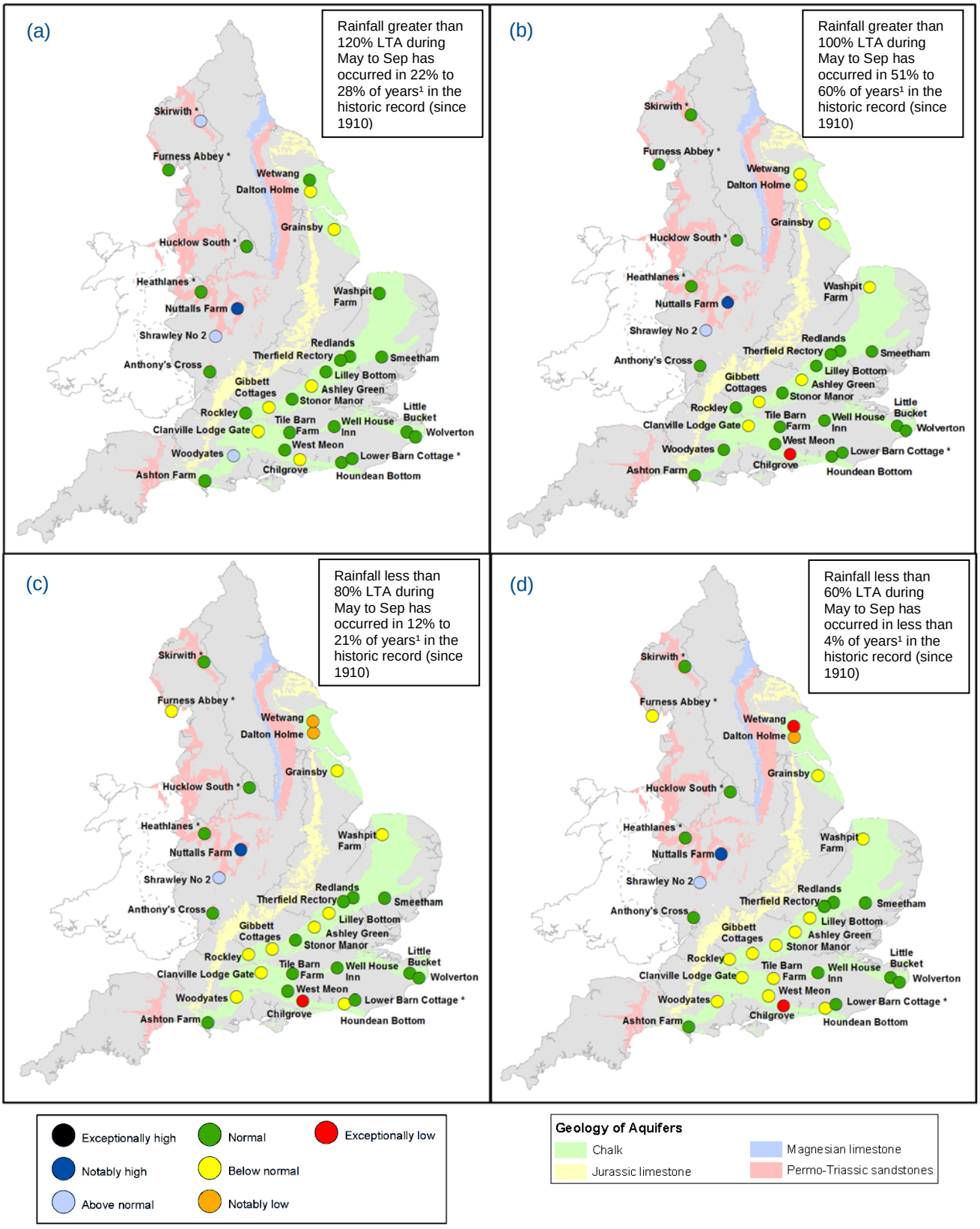

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May and September 2015 (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2015.

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

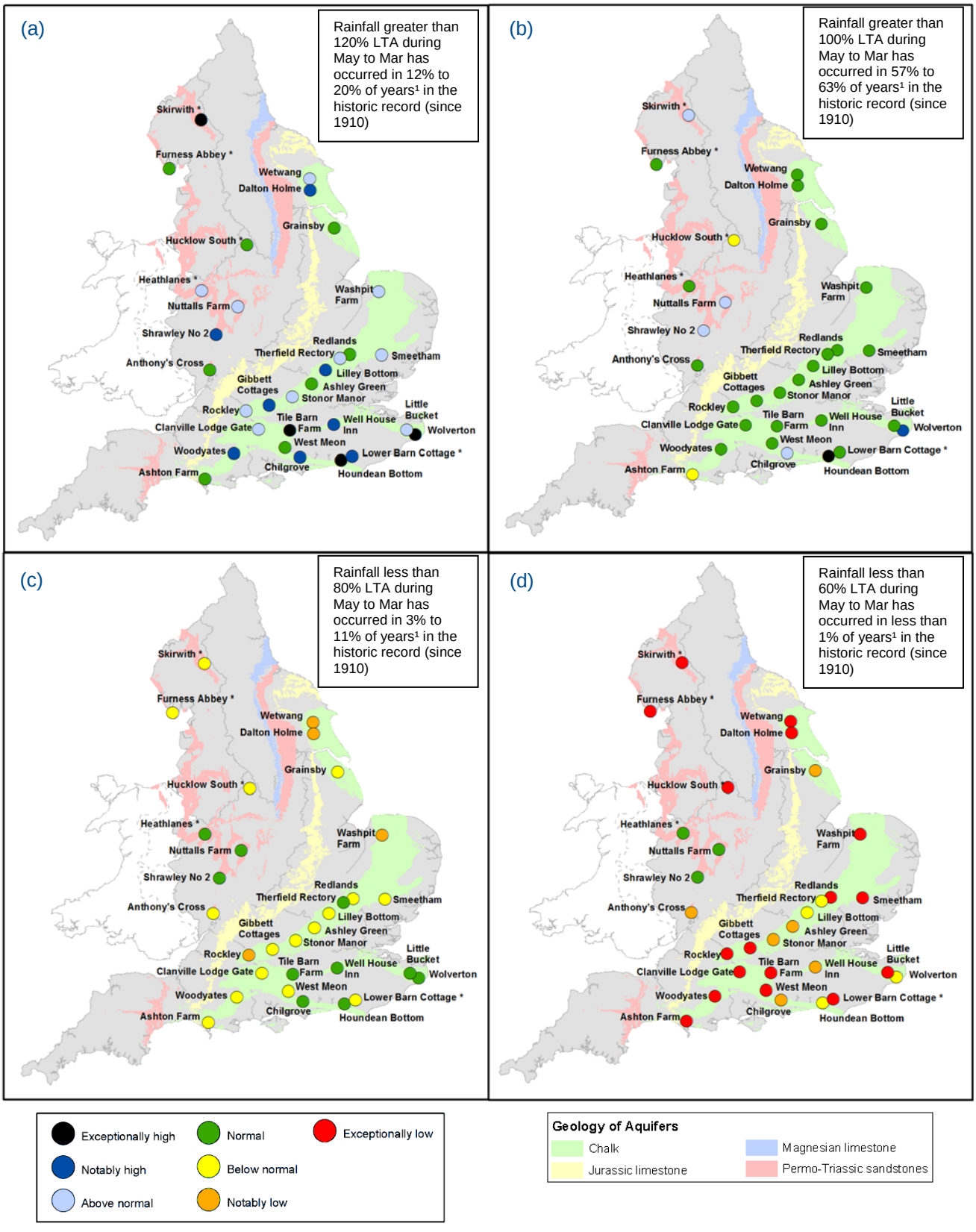

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2015 and March 2016 (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2015.

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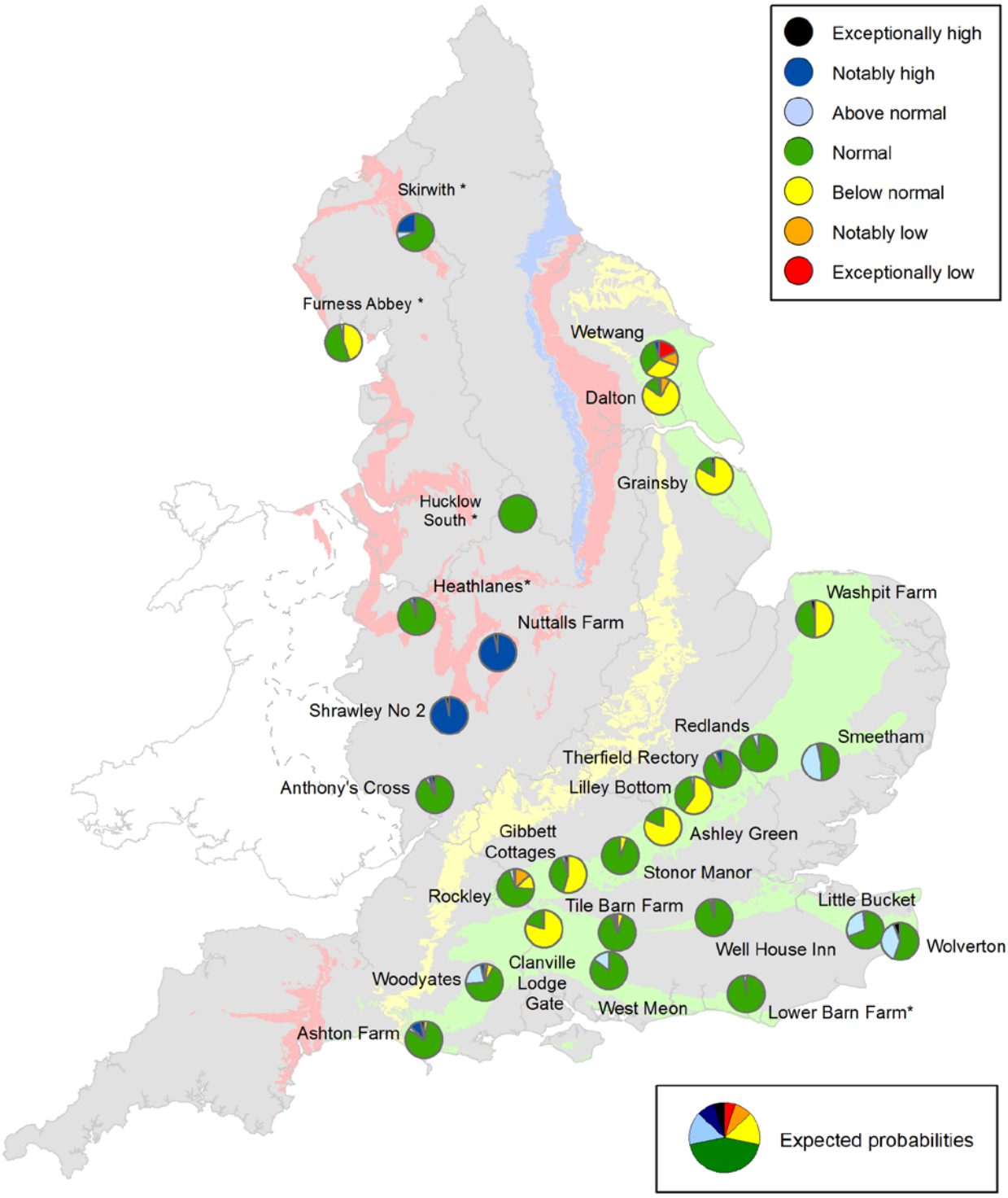

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 September 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, 2015.

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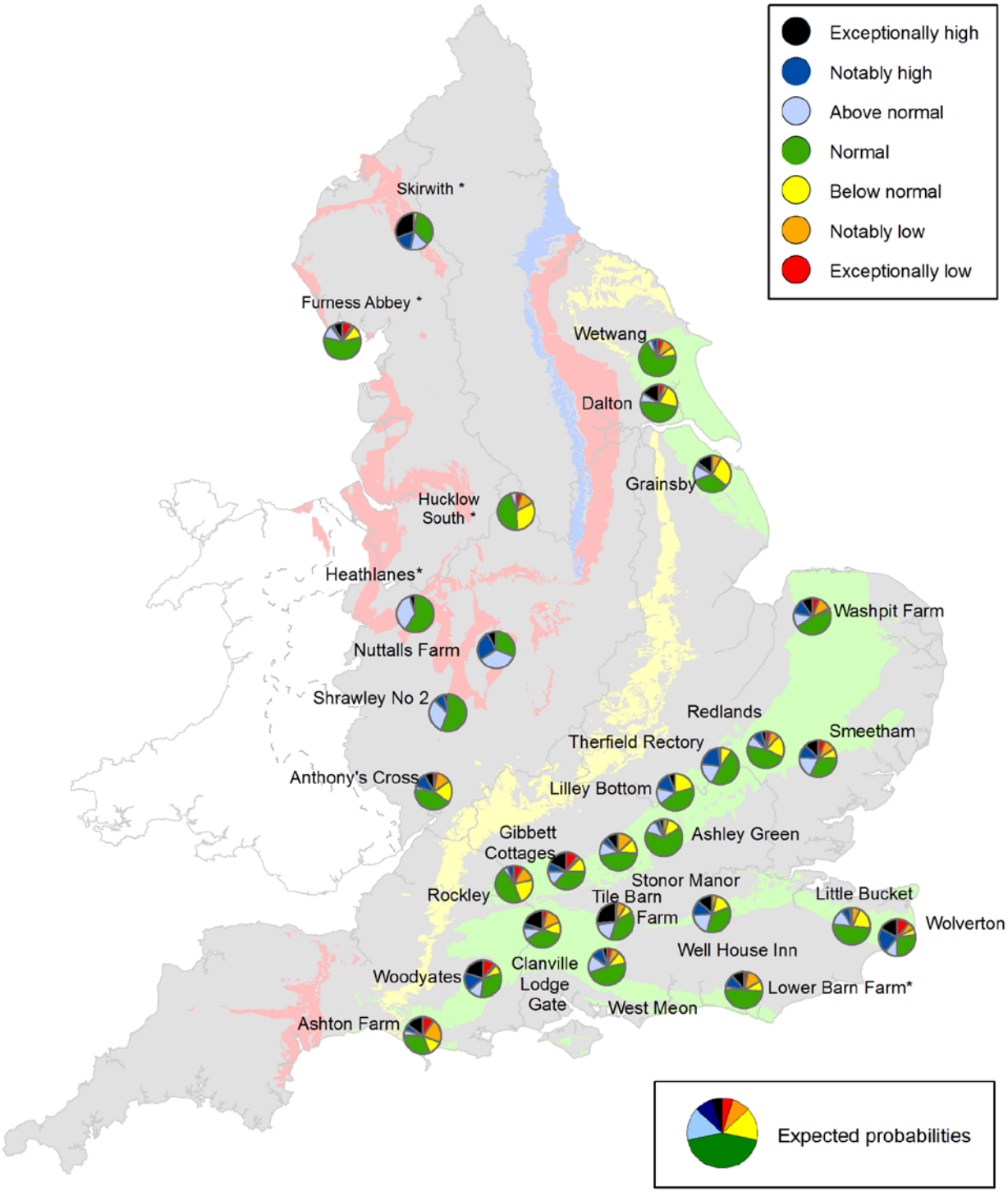

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2016. 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, 2015.

* 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