Monthly water situation report

England

Summary – May 2015

Following below average rainfall in April, May's rainfall was above average across England at 135% of the long term average. However, at a more local scale, rainfall totals were well above average in north-west England but near or slightly below average in parts of east and south-east England. Soil moisture deficits decreased by up to 40mm during May across much of northern and south-west England, but increased by up to 40mm in east and south-east England. End of month SMDs were up to 50mm larger than the LTA across the eastern half of England. Monthly mean river flows decreased compared to April at just over two-thirds of indicator sites, but remain **normal** or higher for the time of year at three quarters 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 two thirds of sites. Reservoir stocks increased or remained static at the majority of sites and at the end of May were **normal** or higher for the time of year at just over two thirds of sites. Overall stocks for England increased slightly to 93% of total capacity.

Rainfall

Rainfall totals for May were highest across Cumbria and parts of Lancashire at between 125 and 180mm. The lowest rainfall totals of between 45 and 50mm occurred across parts of Essex, Kent and the Thames corridor. In contrast to April, May rainfall totals were close to or above the long term average (LTA) in the majority of hydrological areas, with the Kent and Esk catchments in Cumbria receiving just over 200% of the LTA. However parts of south-east England received below average rainfall, with the hydrological areas covering the Thames corridor receiving between 85 and 90% of the LTA (Figure 1.1).

May rainfall totals were classed as **normal** or higher for the time of year across all hydrological areas, with the majority of those in northern England ranging from **notably high** to **exceptionally high**. Over the 3 month period ending in May, cumulative rainfall totals were **below normal** or lower for the time of year across most of east, south-east and south-west England; in central and north-east England cumulative rainfall totals were generally **normal**, whilst most of north-west England was classed as **above normal** or **notably high**. The 6 month cumulative rainfall totals were **normal** or **below normal** for the time of year across most of England, whilst the 12 month cumulative totals were generally **normal** (Figure 1.2).

At a regional scale, May rainfall totals were **normal** for the time of year in south-east and south-west England, **above normal** in east and central England, **notably high** in north-east England and **exceptionally high** in north-west England. Totals ranged from 110% of the May LTA in south-east England to 178% in north-west England. Rainfall totals across England as a whole were **above normal** for the time of year at 135% of the May LTA (Figure 1.3).

Soil moisture deficit

Soil moisture deficits (SMDs) decreased by up to 40mm during May across much of northern and south-west England. Elsewhere SMDs increased, with the largest increases of 30 – 40mm occurring across parts of East Anglia and along the Thames corridor. At the end of May SMDs were between 70 and 100mm across much of east and south-east England, but smaller elsewhere, particularly north-west and south-west England where SMDs were generally smaller than 10mm. End of month SMDs were up to 50mm larger than the LTA across the eastern half of England, but up to 35mm smaller than the LTA in parts of the far north-west and south-west (Figure 2.1).

At a regional scale, SMDs decreased during May by up to 8mm in north-west and south-west England, but increased elsewhere. The largest increase of nearly 30mm occurred in east England. End of month SMDs ranged from 11mm in north-west England to 81mm in the east (Figure 2.2).

River flows

With increasing evaporative demands during May, the above average rainfall across most of England was not sufficient enough to prevent monthly mean river flows decreasing compared to April at just over two-thirds of indicator sites. However flows increased at all indicator sites in north-east and north-west England. Monthly mean flows were classed as **normal** or higher for the time of year at three-quarters of indicator sites. The remaining sites, mainly located in south-west England, were classed as **below normal** or **notably low** for the time of year (Figure 3.1).

Monthly mean river flows were classed as **normal** for the time of year at 5 of the 7 regional index sites; the South Tyne in north-east England and the River Lune in the north-west were classed as **notably high** and **exceptionally high** respectively for the time of year (Figure 3.2).

Groundwater levels

Groundwater levels continued their seasonal decline across England during May, decreasing at all indicator sites. However, at the end of the month, levels were classed as **normal** or higher for the time of year at two thirds of sites. Levels at 6 sites across north-east, south-east and south-west England were **below normal** for the time of year, whilst the levels at Jackaments Bottom (in the Burford Jurassic limestone aquifer) and Tilshead (in the Upper Hampshire Avon chalk aquifer) were **notably low** for the time of year.

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

Reservoir storage

Reservoir stocks increased by up to 6% or remained static during May at just over half of reported reservoirs and reservoir groups. Stocks decreased at all reported reservoirs in south-west England, with the largest decrease of 11% occurring at Clatworthy reservoir. However, by the end of the month, all but 7 reservoirs and reservoir groups were within 10% of full capacity. End of month stocks were classed as **normal** or higher for the time of year at all sites in east, central, north-east and north-west England. Eight sites, all located in south-east and south-west England, were classed as **below normal** or lower for the time of year (Figure 5.1).

Regional-scale reservoir stocks decreased in east and south-west England by 1 and 5% respectively, but increased by up to 4% or remained static elsewhere. At the end of May, regional stocks ranged from 89% of total capacity in south-west England to 98% in central England. Overall reservoir storage for England increased slightly to 93% of total capacity (Figure 5.2).

Forward look

June is likely to be cool with generally settled weather for much of England. At the end of June wetter conditions may arrive, however uncertainty is currently large. Further ahead, for the period June-July-August predictions are very uncertain, but above average temperatures with below average rainfall are slightly more probable[1].

Projections for river flows at key sites [2]

More than half of modelled sites have a greater than expected chance of **notably low** or lower cumulative flows by the end of September 2015 and this proportion is similar by the end of March 2016.
For scenario based projections of river flows at key sites in September 2015 see Figure 6.1.
For scenario based projections of river flows at key sites in March 2016 see Figure 6.2.
For probabilistic ensemble projections of river flows at key sites in September 2015 see Figure 6.3.
For probabilistic ensemble projections of river flows at key sites in March 2016 see Figure 6.4.

Projections for groundwater levels in key aquifers [2]

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 three quarters of sites have a greater than expected chance of **normal** or higher groundwater levels.
For scenario based projections of groundwater levels in key aquifers in September 2015 see Figure 6.5.
For scenario based projections of groundwater levels in key aquifers in March 2016 see Figure 6.6.
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2015 see Figure 6.7.
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2016 see Figure 6.8.

Authors: E & B Hydrology Team

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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.

Rainfall

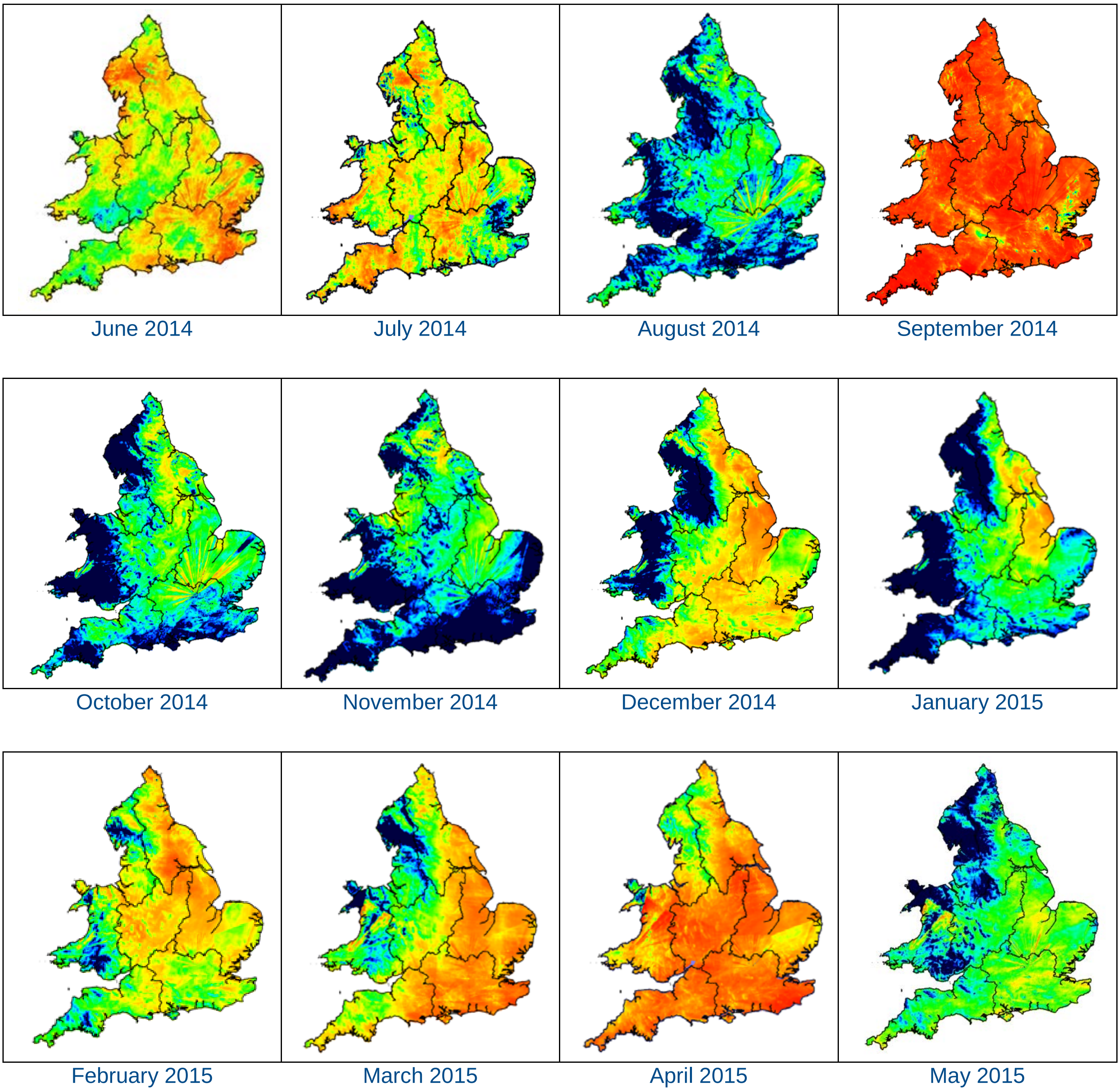
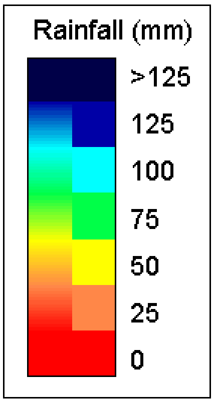


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2015). Note: Radar beam blockages in some regions may give anomalous totals in some areas.



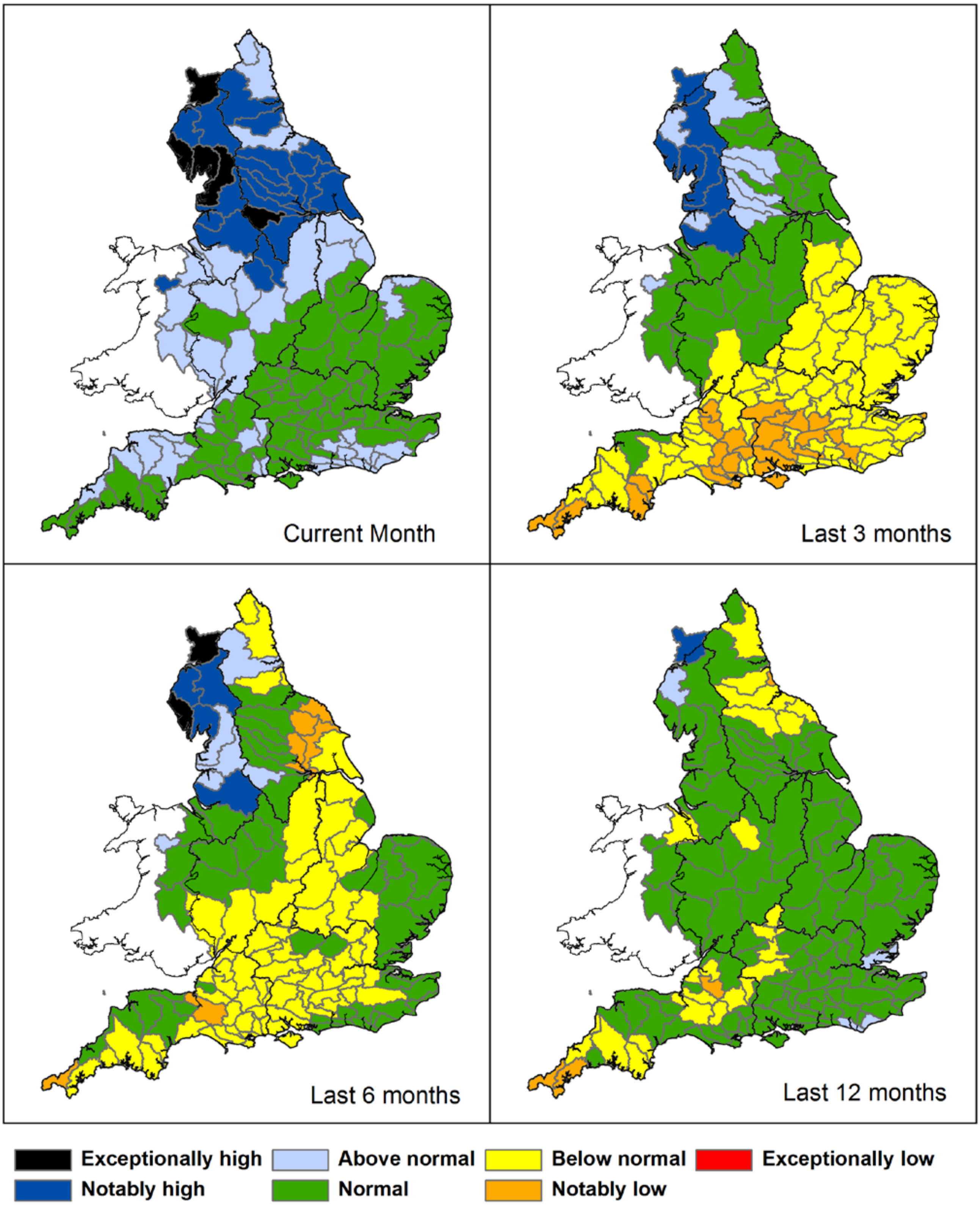


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 May), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based 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.

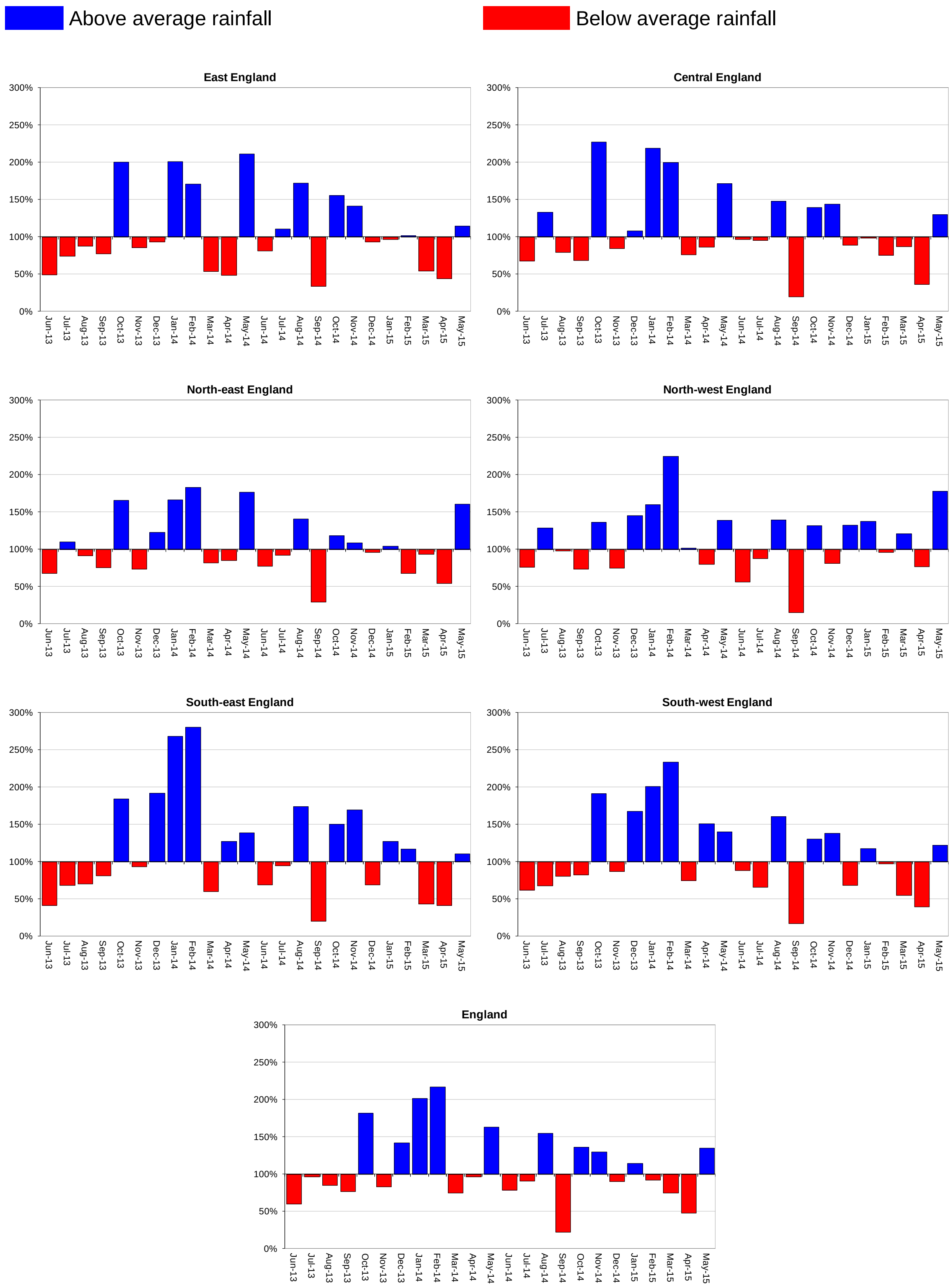


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2015).

Soil moisture deficit

End of April 2015 [1]	End of May 2015 [2]

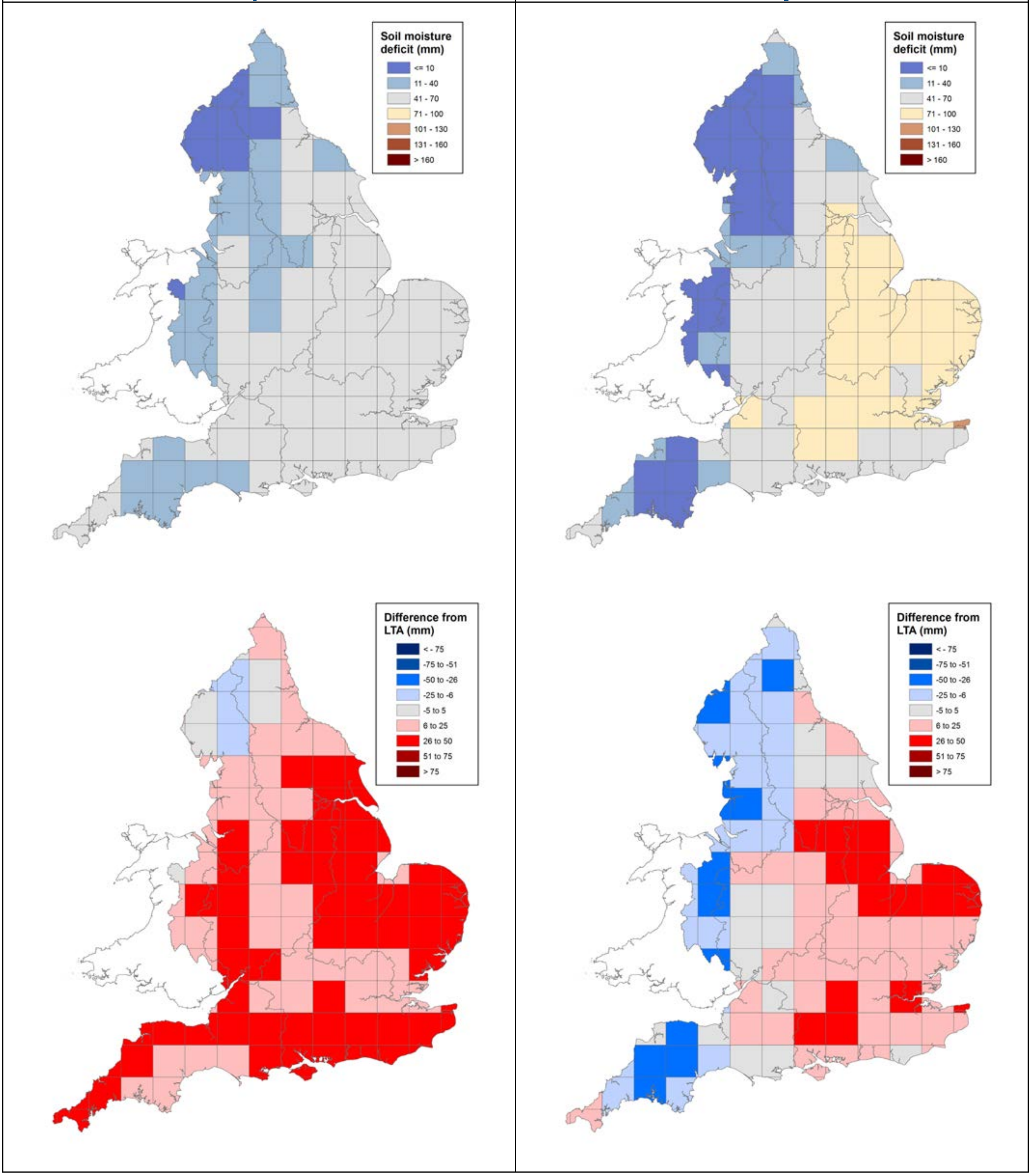


Figure 2.1: Soil moisture deficits for weeks ending 28 April 2015 [1] (left panel) and 02 June 2015 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2015). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015

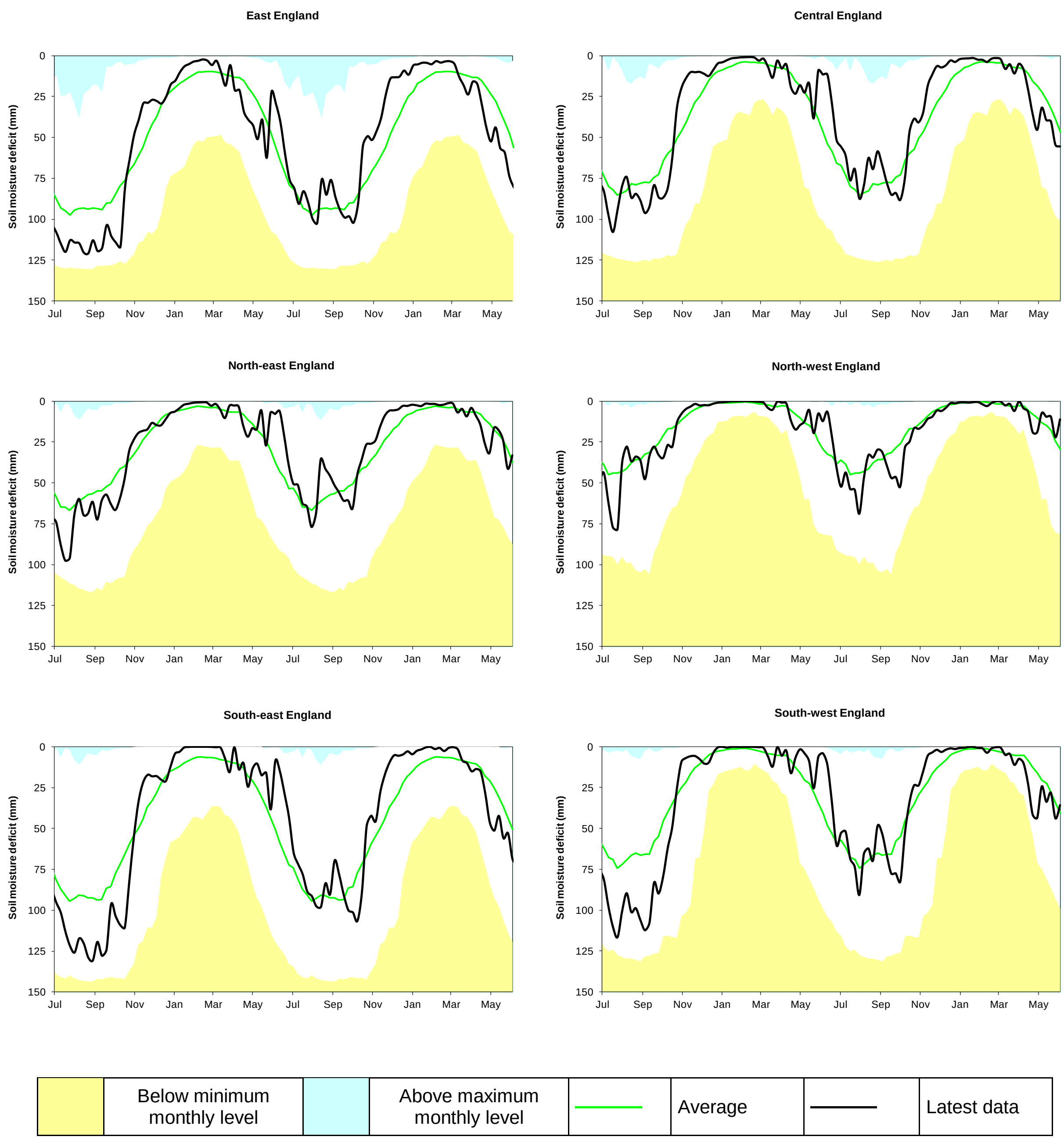
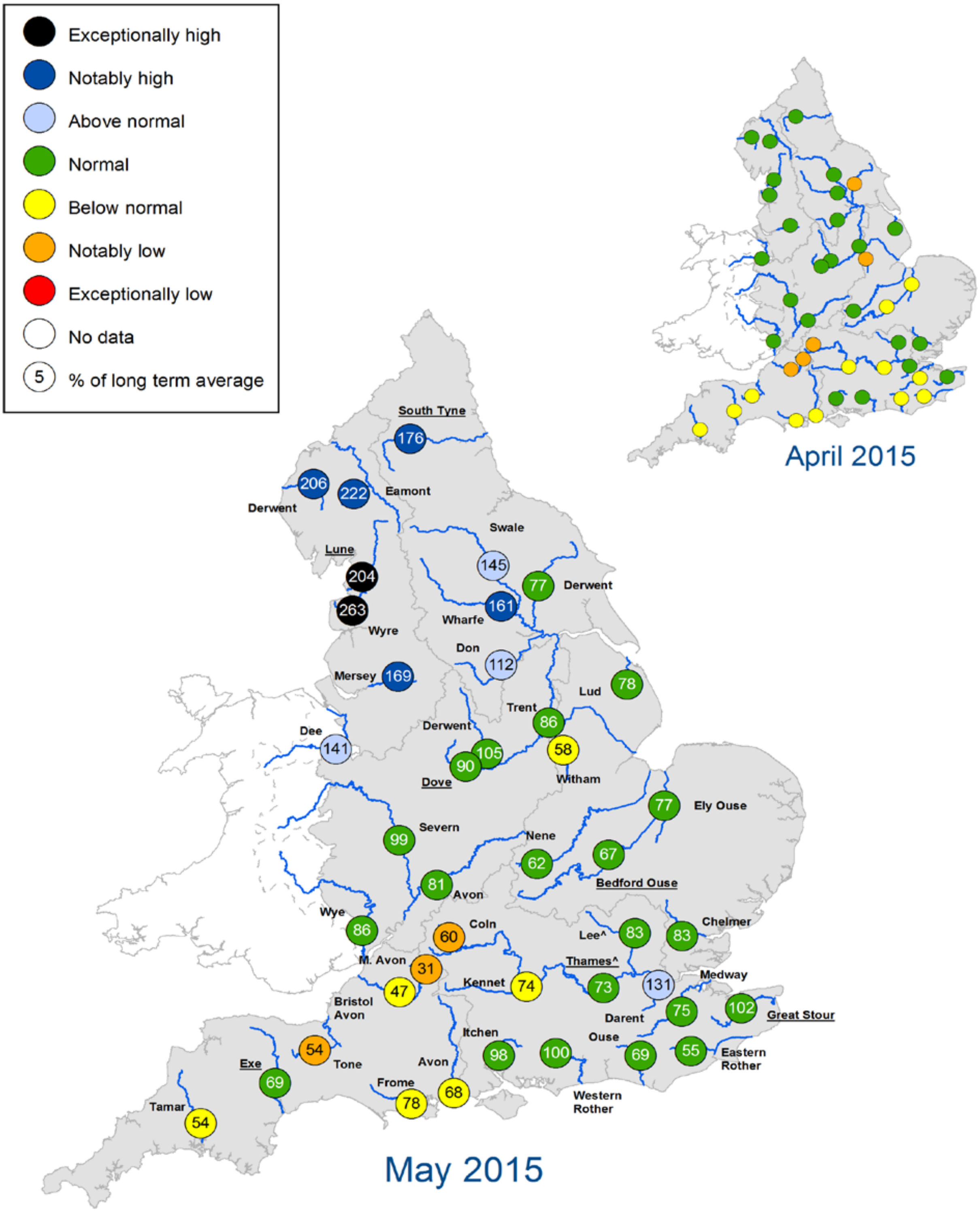


Figure 2.2: Latest soil moisture deficits for all regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2015).

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 April 2015 and May 2015, expressed as a percentage of the respective long term average and classed relative to an analysis of historic April and May monthly means (Source: Environment Agency).

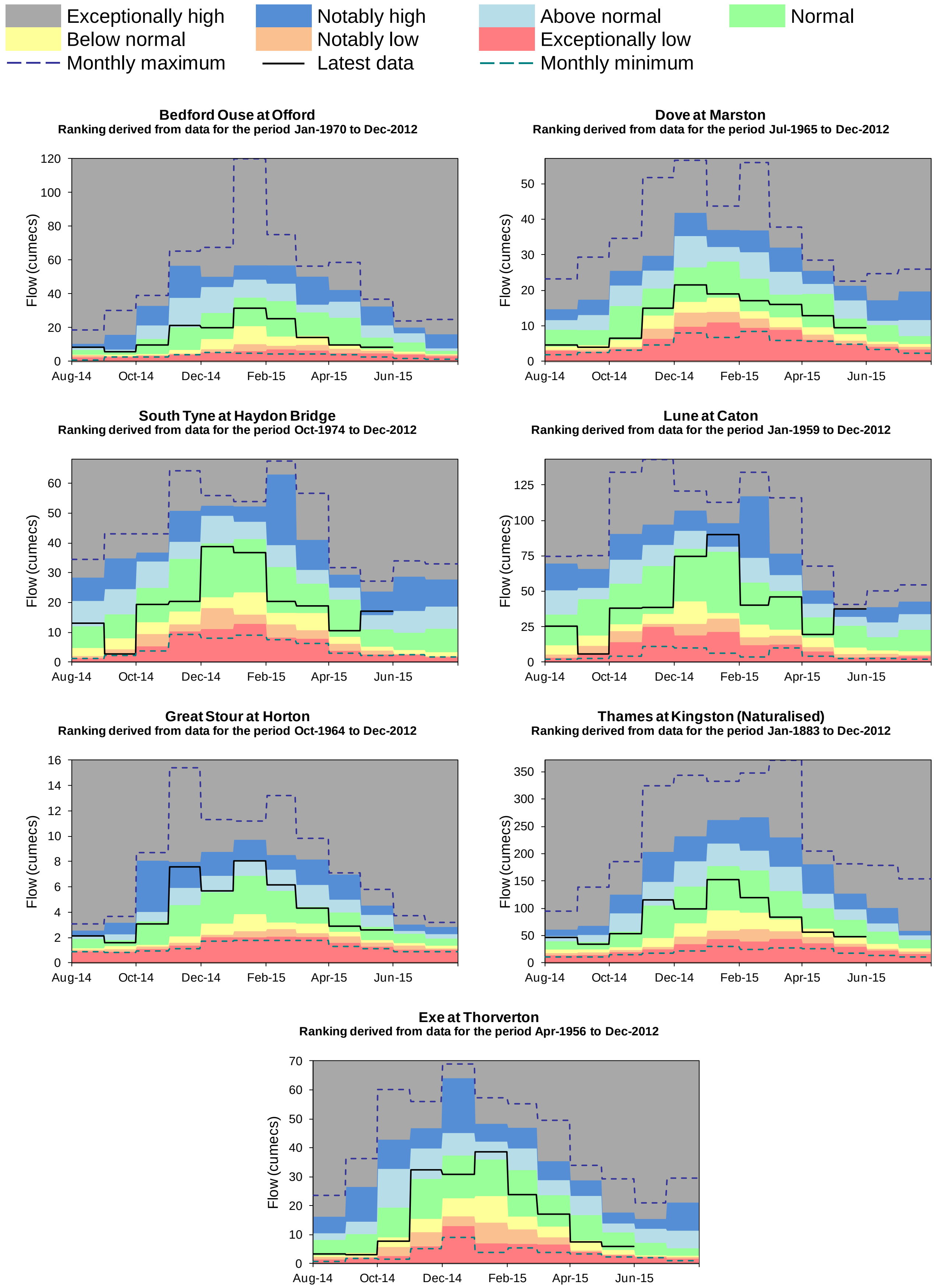
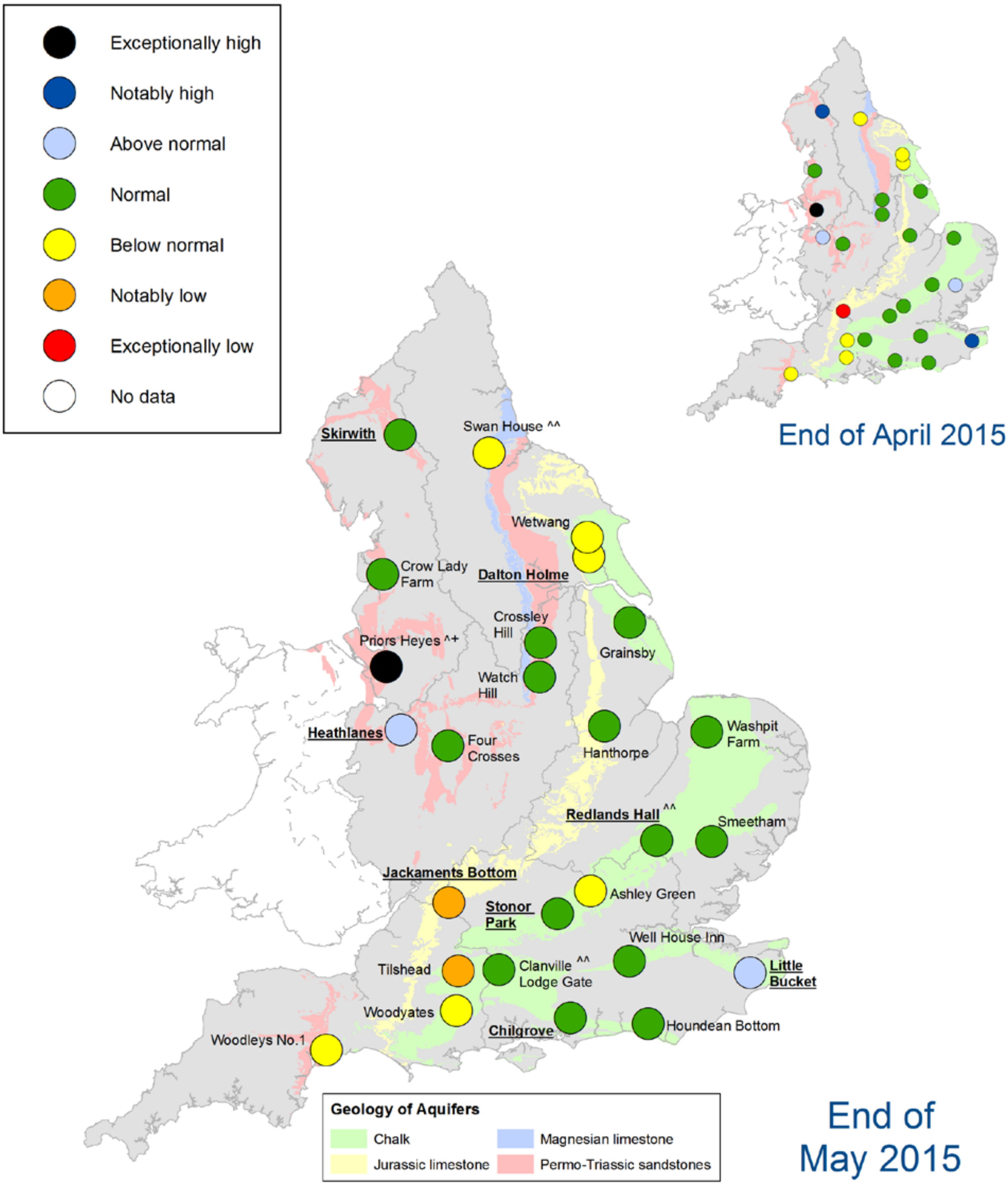


Figure 3.2: Index river flow sites for each region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 April 2015 and May 2015, classed relative to an analysis of respective historic April and May 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.

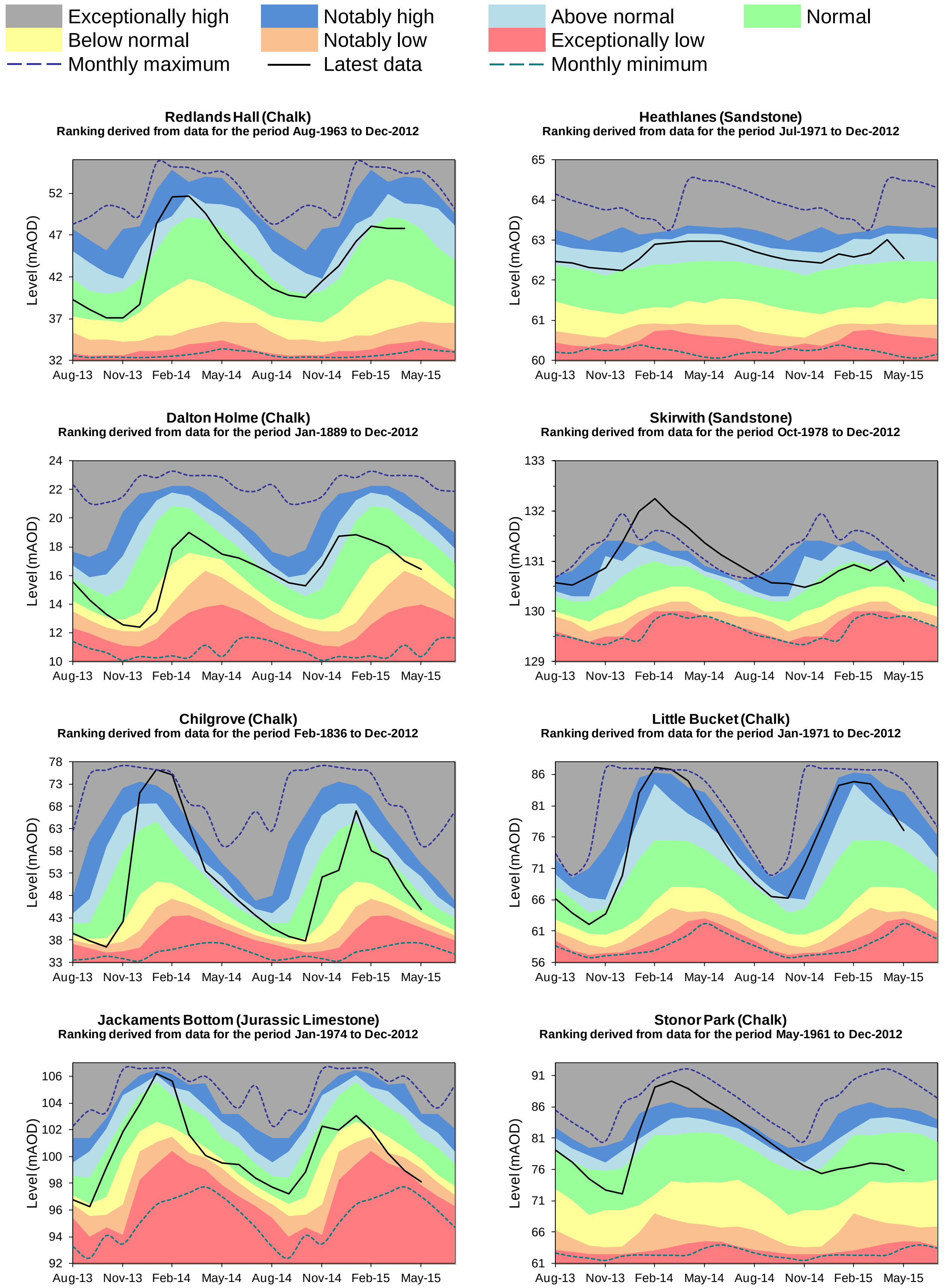
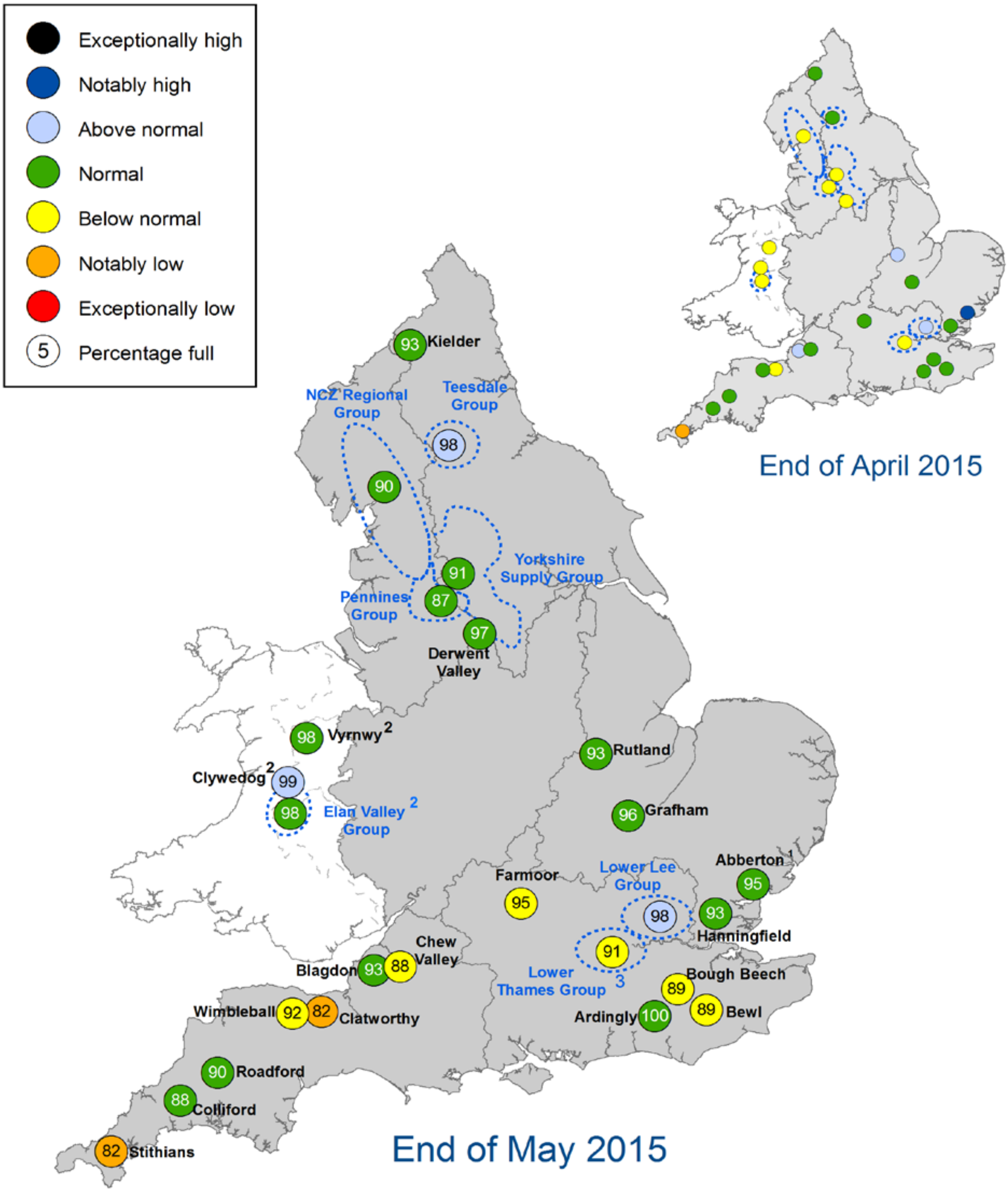


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2015).

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 Thames Group have been affected by maintenance work

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of April 2015 and May 2015 as a percentage of total capacity and classed relative to an analysis of historic April and May 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, 2015.

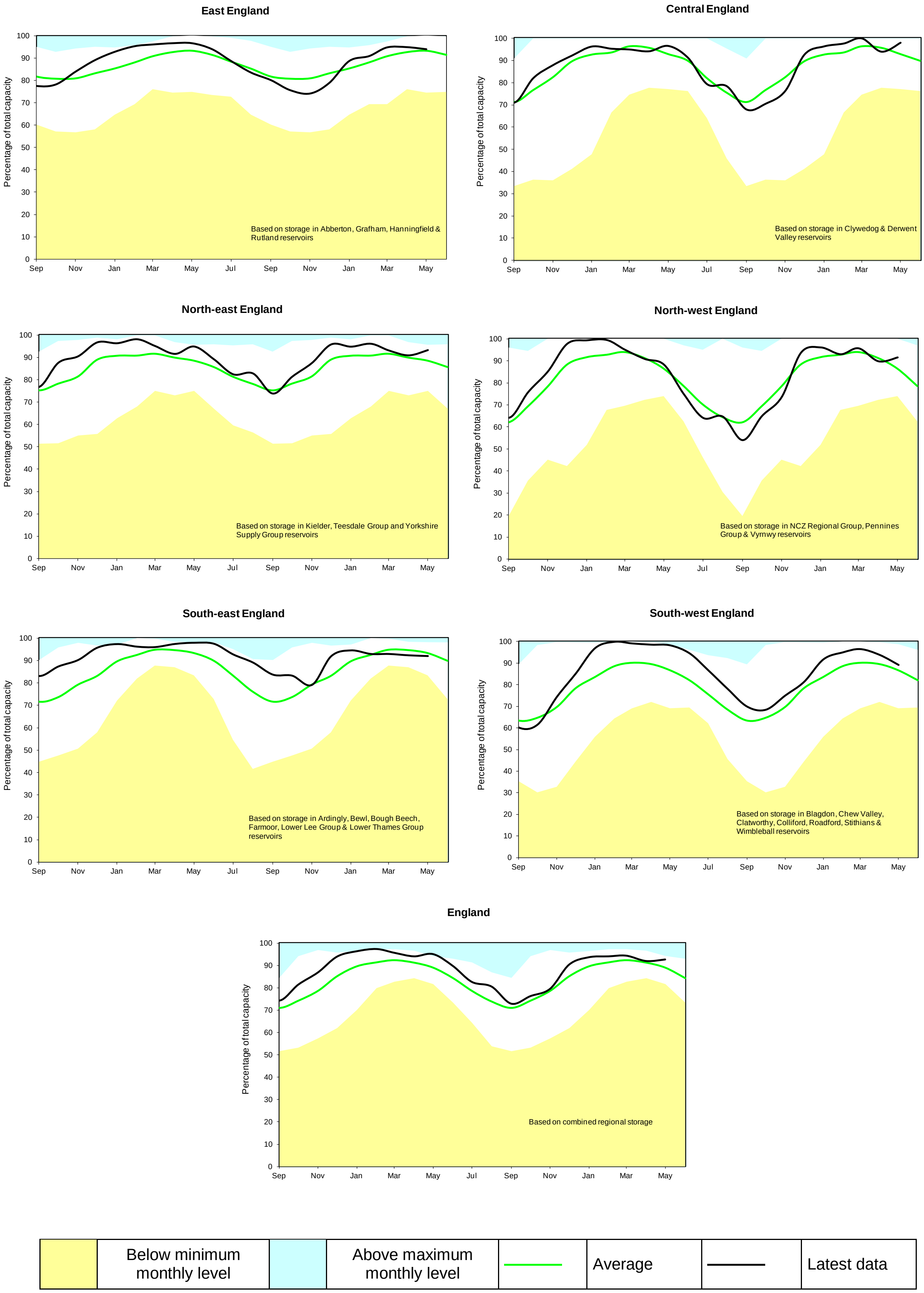


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

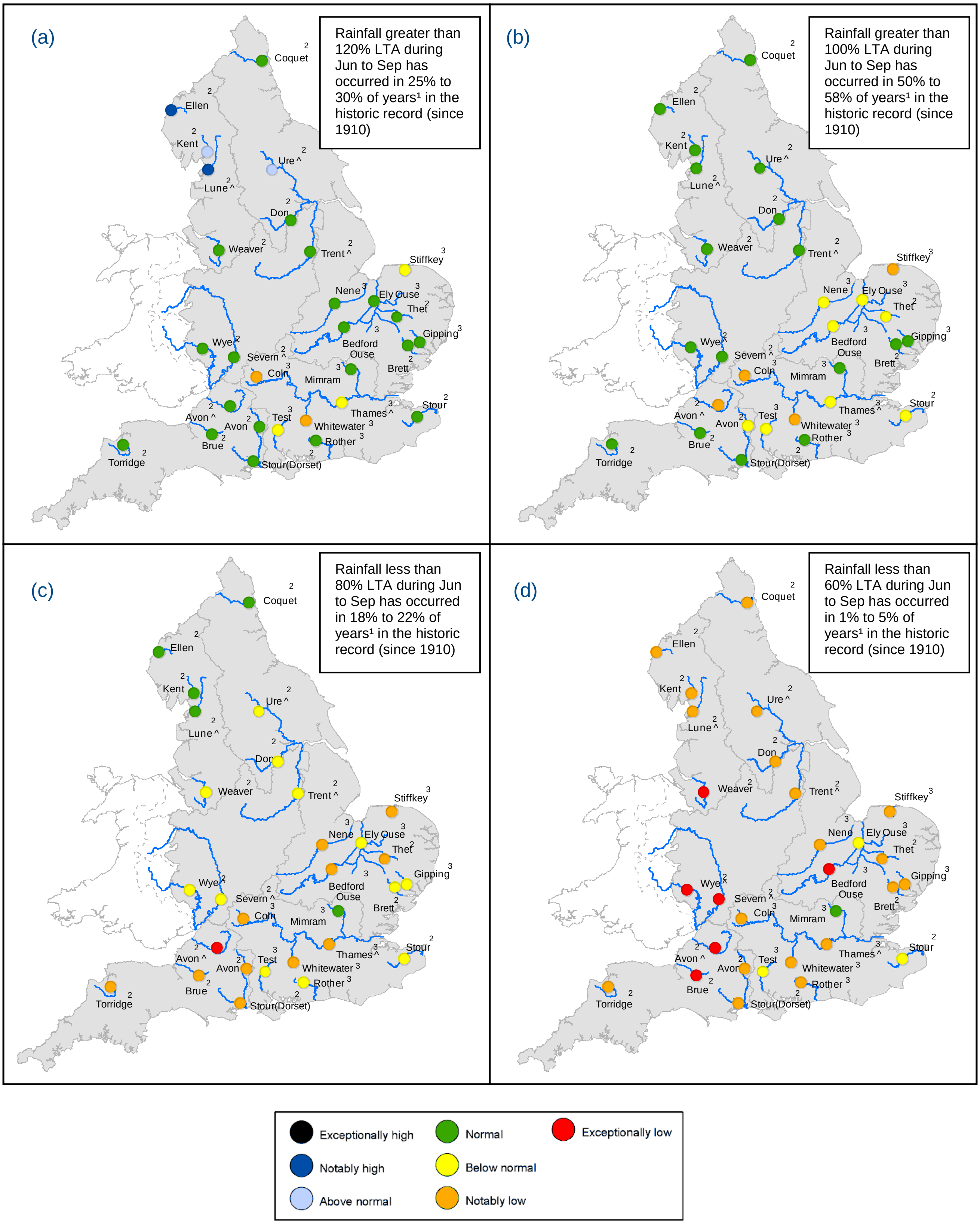


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June and September 2015 (Source: Centre for Ecology and Hydrology, Environment Agency)

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

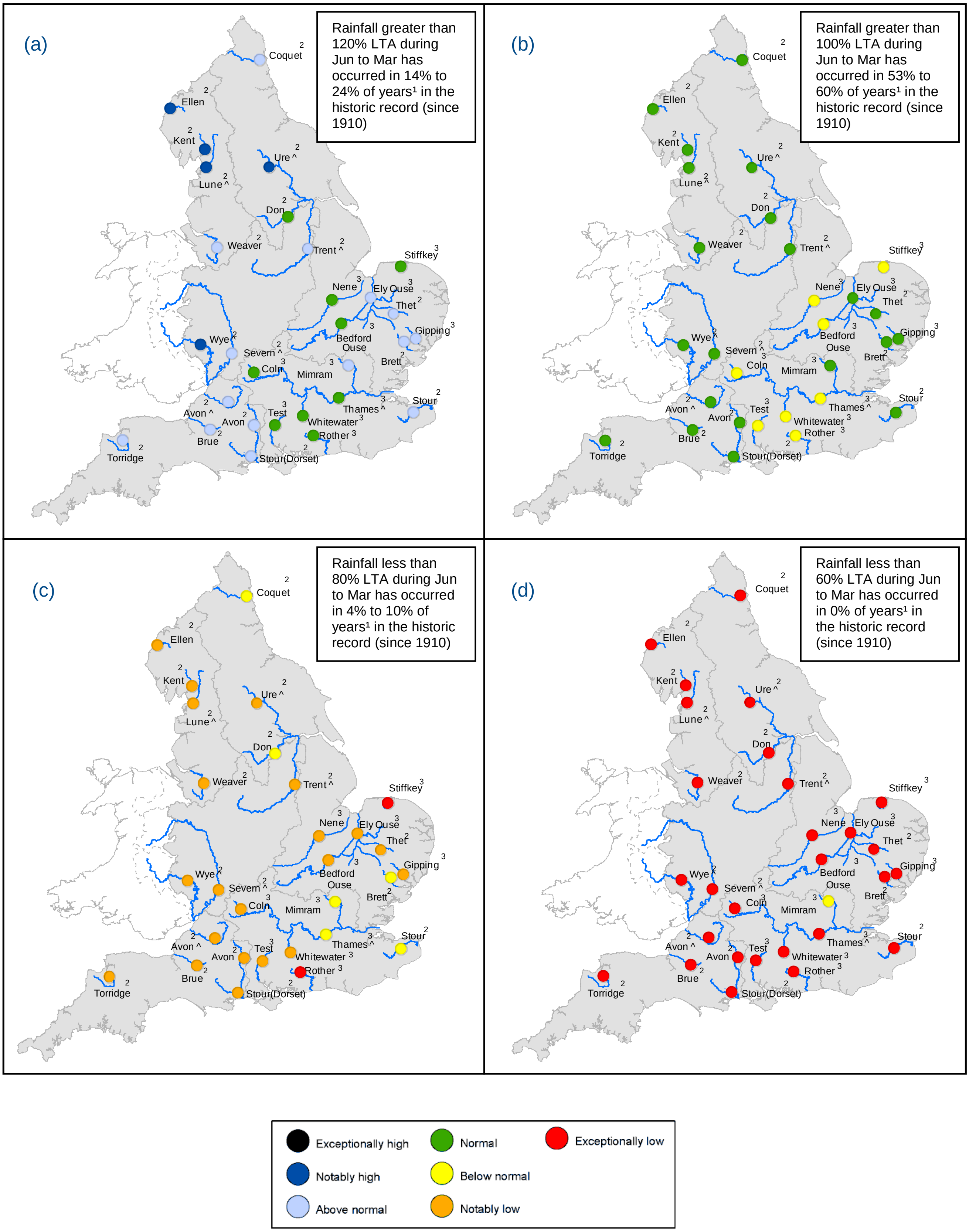


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June 2015 and March 2016 (Source: Centre for Ecology and Hydrology, Environment Agency)

[1] This range of probabilities is a regional analysis
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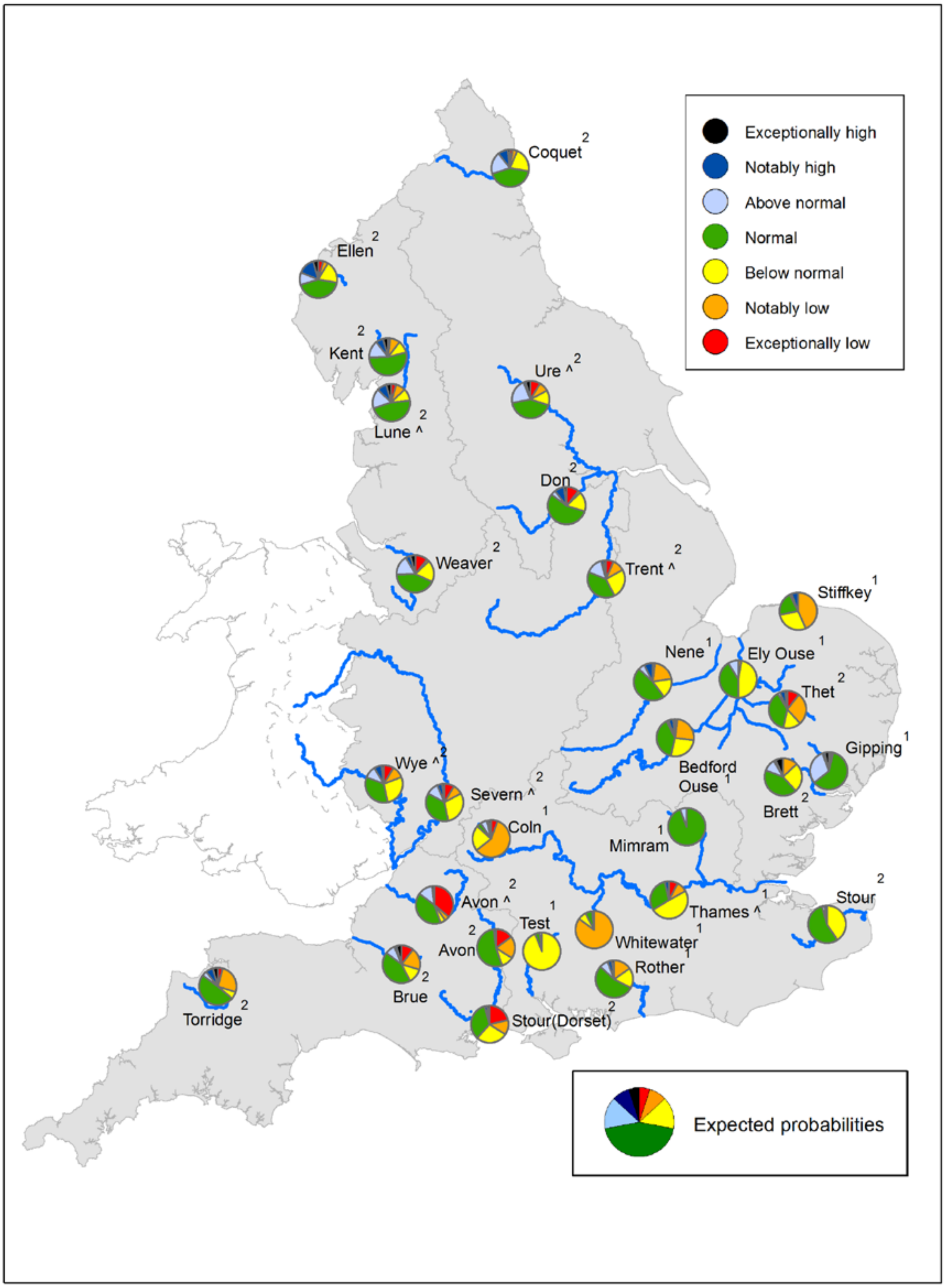
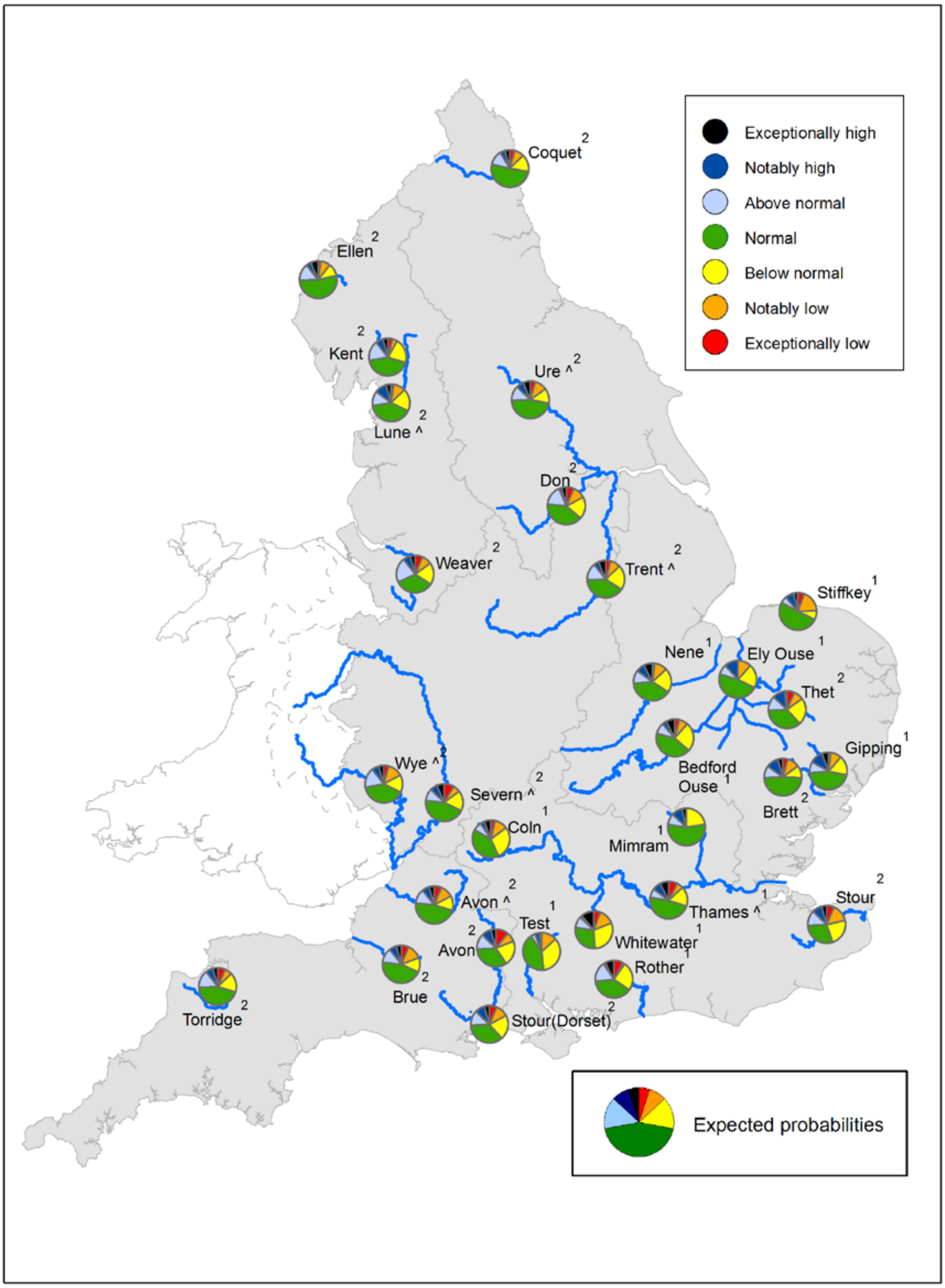


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

[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



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 6.4: 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

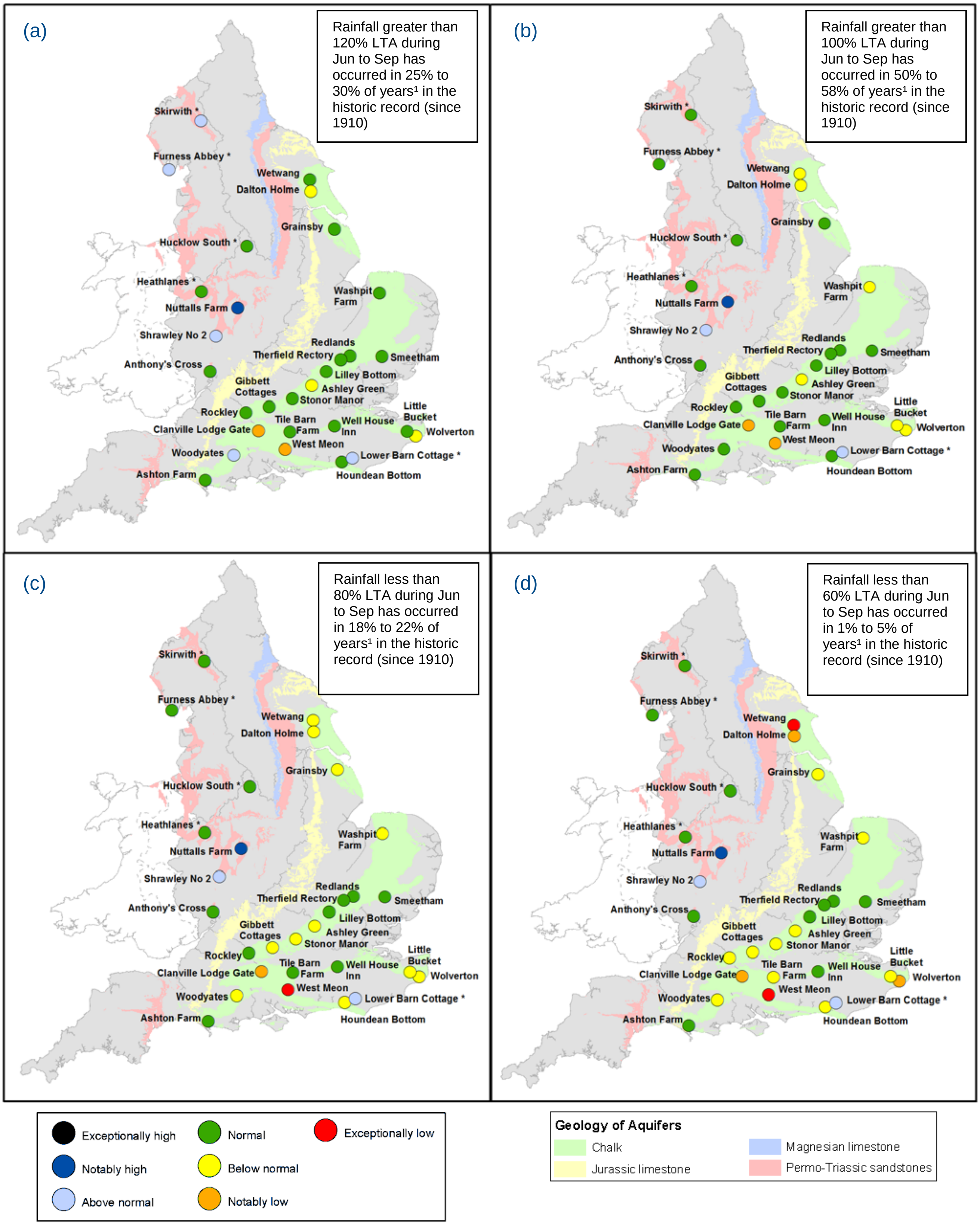


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June and September 2015 (Source: Environment Agency) Geological map reproduced with kind permission 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

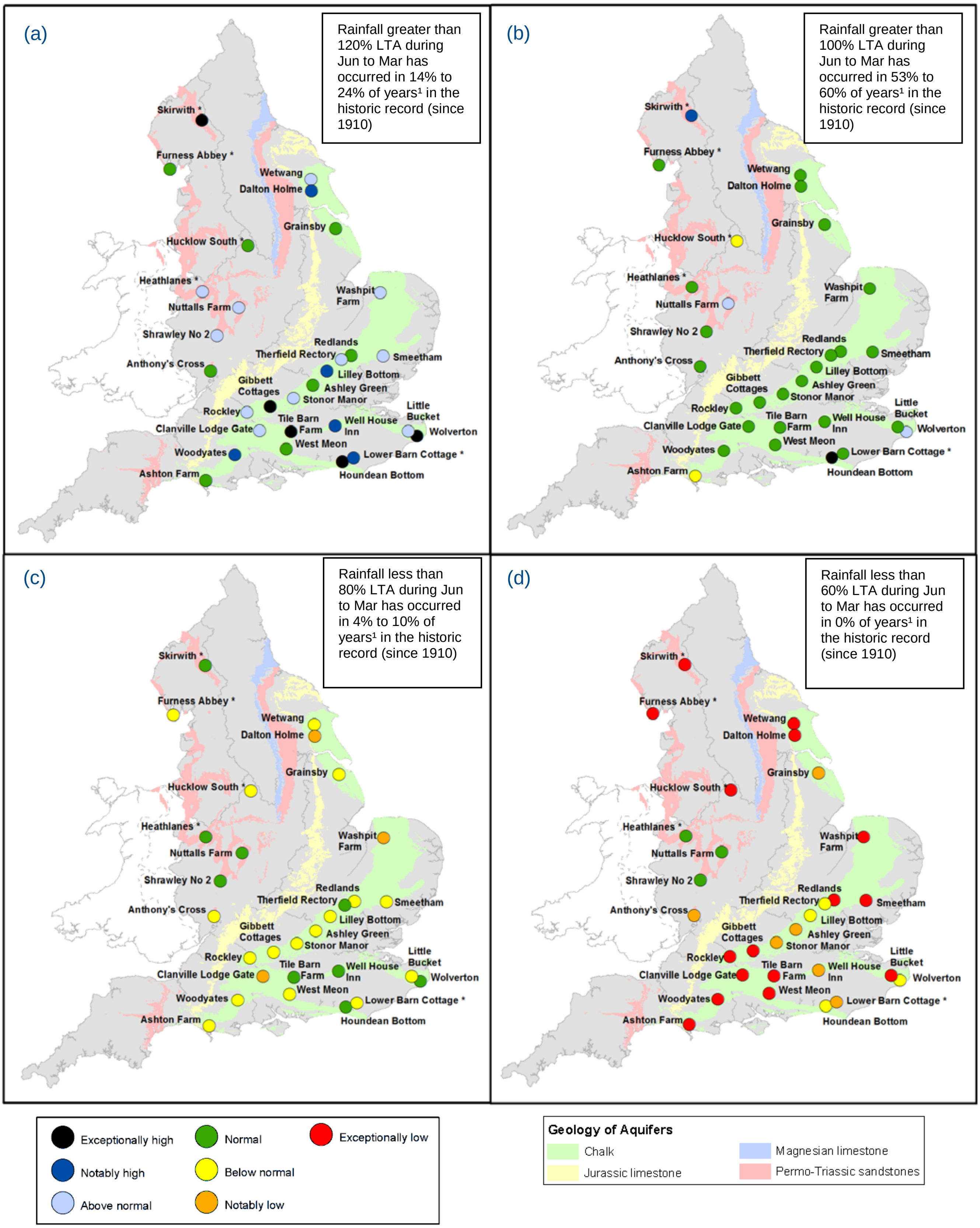
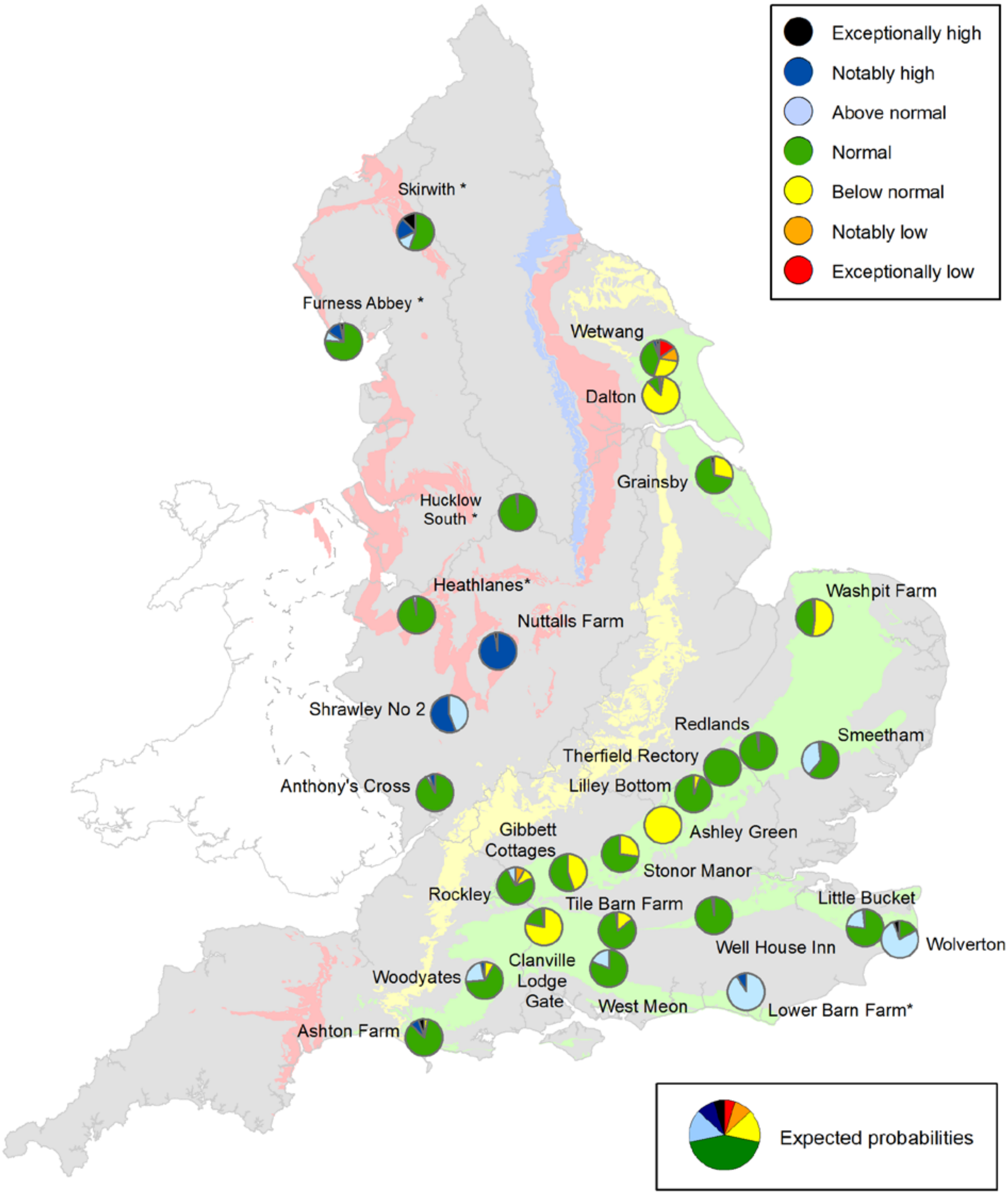


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June 2015 and March 2016 (Source: Environment Agency) Geological map reproduced with kind permission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

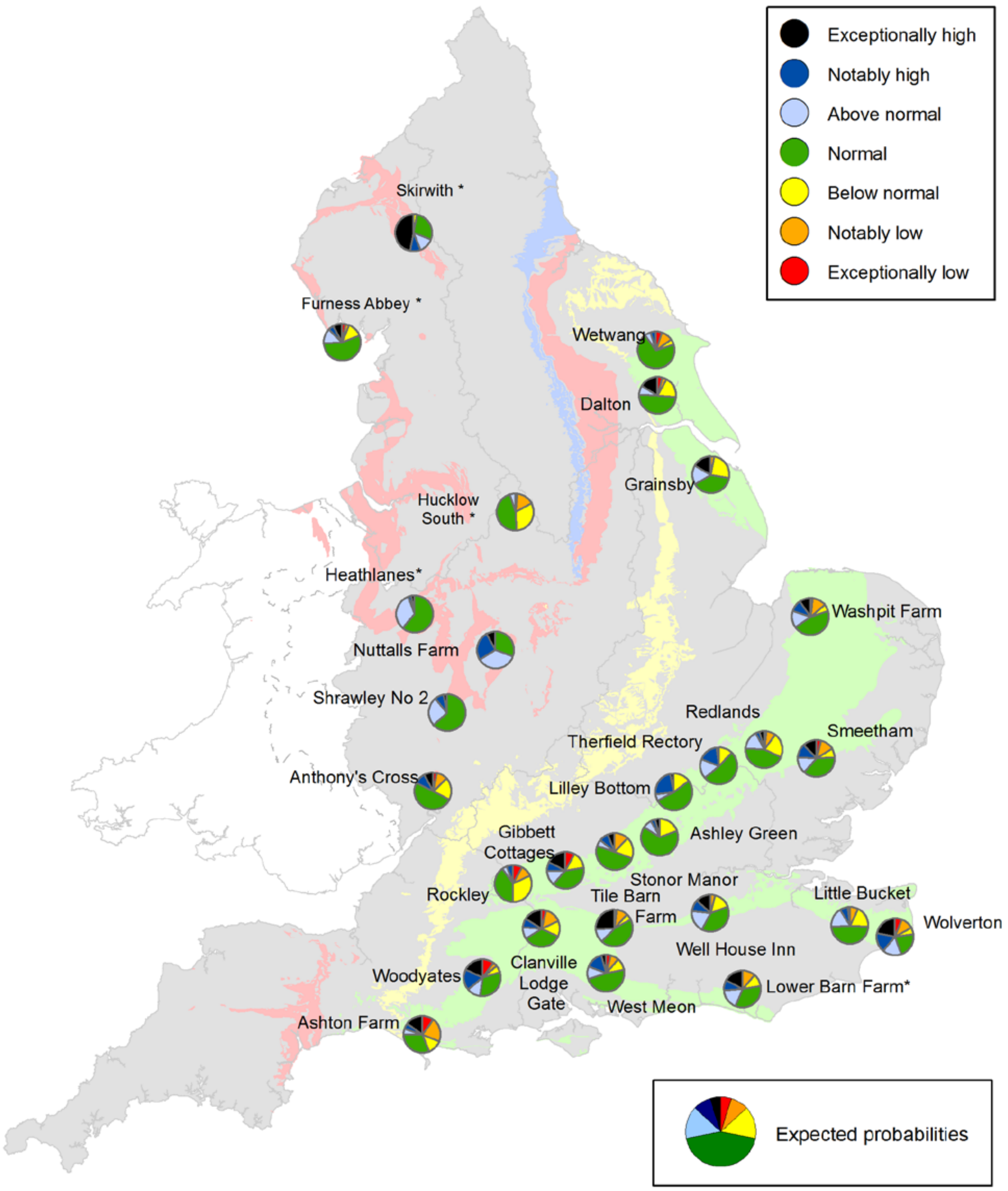
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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 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.

* 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 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