Monthly water situation report

England

Summary – March 2015

Rainfall during March was below average across England at 75% of the long term average. Soil moisture deficits generally increased during the month across most parts of England and month end values were close to the long term average in many areas. Monthly mean river flows decreased compared to February at more than three-quarters of our indicator sites and were classed as **normal** for the time of year at the majority of sites. Groundwater levels decreased at the majority of indicator sites and were classed as **normal** or higher for the time of year at over four-fifths of sites. Reservoir stocks increased or remained static at the majority of sites and stocks were classed as **normal** or higher for the time of year at all but 4 sites. Overall reservoir stocks for England increased slightly to 95% of total capacity.

Rainfall

The highest rainfall totals of between 100 and 174 mm occurred across much of north-west England during March. South and east England received the lowest rainfall totals of between 12 and 21 mm. March rainfall totals were above the long term average (LTA) in almost a fifth of the hydrological areas, with much of the north-west receiving between 120 and 130% of the LTA. In contrast, parts of Kent, Sussex and Hampshire received less than 30% of the LTA, with other parts of south-west England receiving less than 40% of the LTA (Figure 1.1).

March rainfall totals were classed as **normal** for the time of year across a third of hydrological areas, with those in north-west England being **above normal** and many in south-east and south-west England were classed as **below normal**. Over the 3 and 6 month periods ending in March, cumulative rainfall totals were **normal** across most of England; however much of north-east England was **below normal** or **notably low**, particularly over the period January to March 2015. Parts of south-east and east England remain **above normal** for the time of year over the 6 and 12 month period (Figure 1.2).

At a regional scale, March rainfall totals were **normal** or higher for the time of year except in south-east and south-west England where they were classed as **below normal**. Totals ranged from 43% of the March LTA in south-east England to 121% in north-west England. Overall, England received 75% of the March LTA (Figure 1.3).

Soil moisture deficit

Soil moisture deficits (SMDs) at the end of March were higher than they were at the end of February across the majority of the MORECS grid squares covering England. At the end of March, SMDs were less than 10 mm in almost two-thirds of MORECS grid squares and between 10 and 40 mm in the remaining areas. End of month SMDs were close to the LTA across the majority of England and up to approximately 30 mm greater than the LTA in parts of east, south-east and south-west England (Figure 2.1).

End of month SMDs were 16 mm or less across all parts of England, having increased by up to 13mm in all areas. Values are close to the long term average across England (Figure 2.2).

River flows

Monthly mean river flows for March decreased compared to February at over three-quarters of our indicator sites across England, however, flows remained **normal** for the time of year at the majority of indicator sites. A quarter of our indicator sites moved to a lower class for the time of year and some sites across east and south England are now classed as **below normal** (Figure 3.1).

Monthly mean river flows were classed as normal at 6 of the 7 regional index sites; while the Bedford Ouse in east England became **below normal** for the time of year (Figure 3.2).

Groundwater levels

With **below normal** rainfall across much of south and east England, groundwater levels receded at the majority of sites during March as levels began their seasonal recessions in some of the more responsive aquifers. At the end of the month, levels were classed as **normal** or above for the time of year at over four-fifths of the indicator sites. Levels at Swan House (Wear Magnesian limestone aquifer) and Tilshead (Upper Hampshire Avon chalk aquifer) moved to a lower class to **below normal** for the time of year. Levels at Jackamounts (Burford Jurassic limestone aquifer) fell two classes to **notably low** for the time of year.

End of month groundwater levels in the major aquifers were **normal** for the time of year at the majority of index sites. Levels remained **above normal** at Heathlanes (Shropshire Middle Severn sandstone), and at Little Bucket (East Kent Stour chalk aquifer) they remained **notably high** for the time of year (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks increased or remained static at nearly two-thirds of all reported reservoirs and reservoir groups. Increases in stocks of between 6 and 9% occurred at 5 reservoirs located in east, south-east, south-west and north-west England. Decreases of between 1 and 5% have occurred at 8 reservoirs across England, but notably in the north-east. All but 2 reservoirs are within 10% of full capacity, with 7 being full. At the end of March, stocks were classed as **normal** or higher for the time of year at all but 4 reported reservoirs (Figure 5.1).

Regional-scale reservoir stocks increased during March by up to 4%, except in north-east England where stocks decreased by 3%. Reservoir stocks in south-east England remained unchanged. At the end of March, regional stocks ranged from 93% of total capacity in south-east England to 100% in central England. Overall reservoir storage for England increased slightly to 95% of total capacity (Figure 5.2).

Forward look

The rest of April is likely to remain fine and dry before slowly turning more unsettled in the last week of the month. For the period April to June, there is a slightly increased chance of above-average precipitation but uncertainty is large[1].

Projections for river flows at key sites [2]

Two thirds of modelled sites have a greater than expected chance of **normal** cumulative river flows, between April 2015 and both September 2015 and 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]

Nearly two-thirds of modelled sites have a greater than expected chance of **normal** or higher groundwater levels at the end of September 2015. By the end of March 2016 only half of the modelled sites have a greater than expected chance of **normal** 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

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

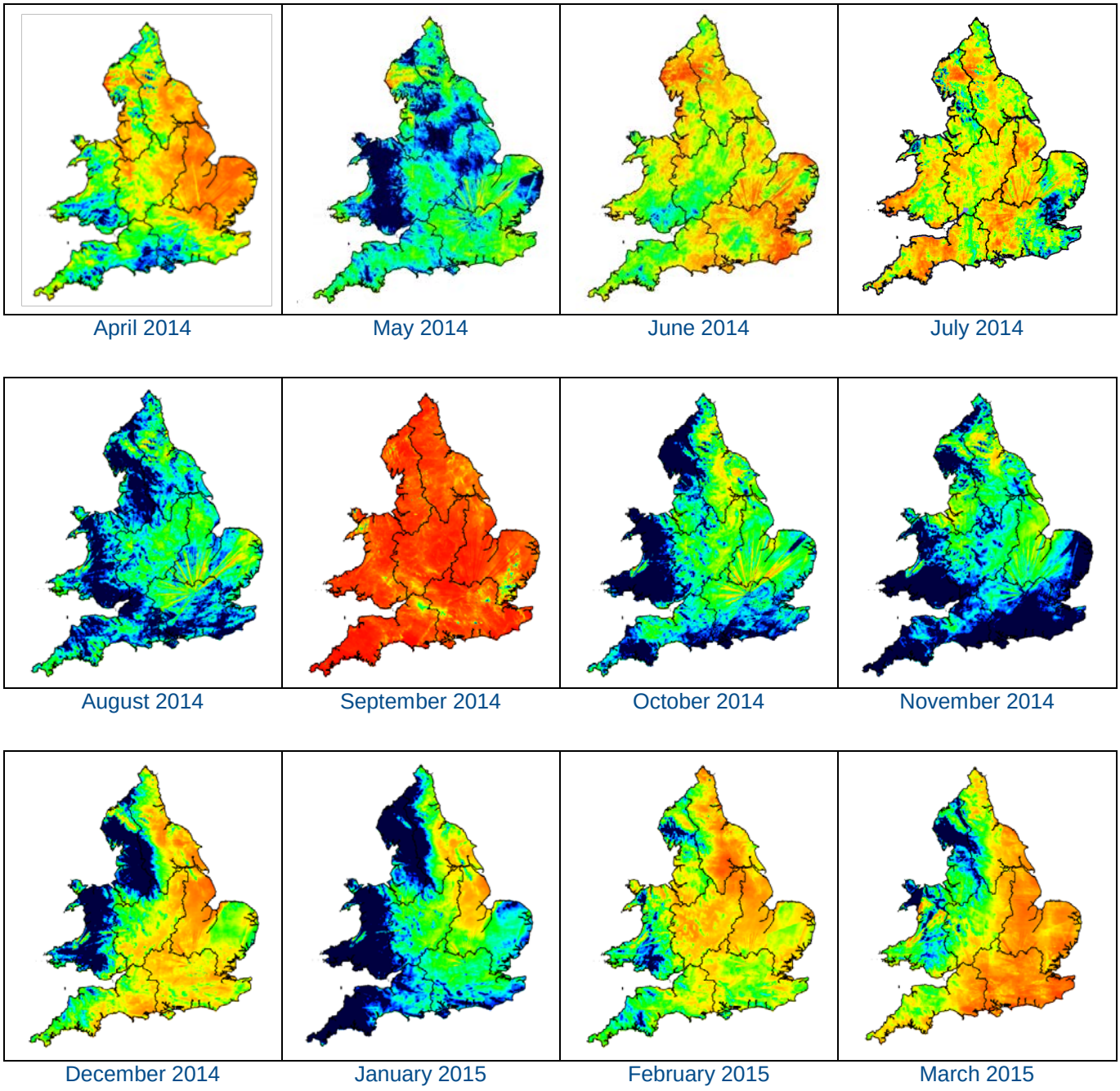


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2015). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

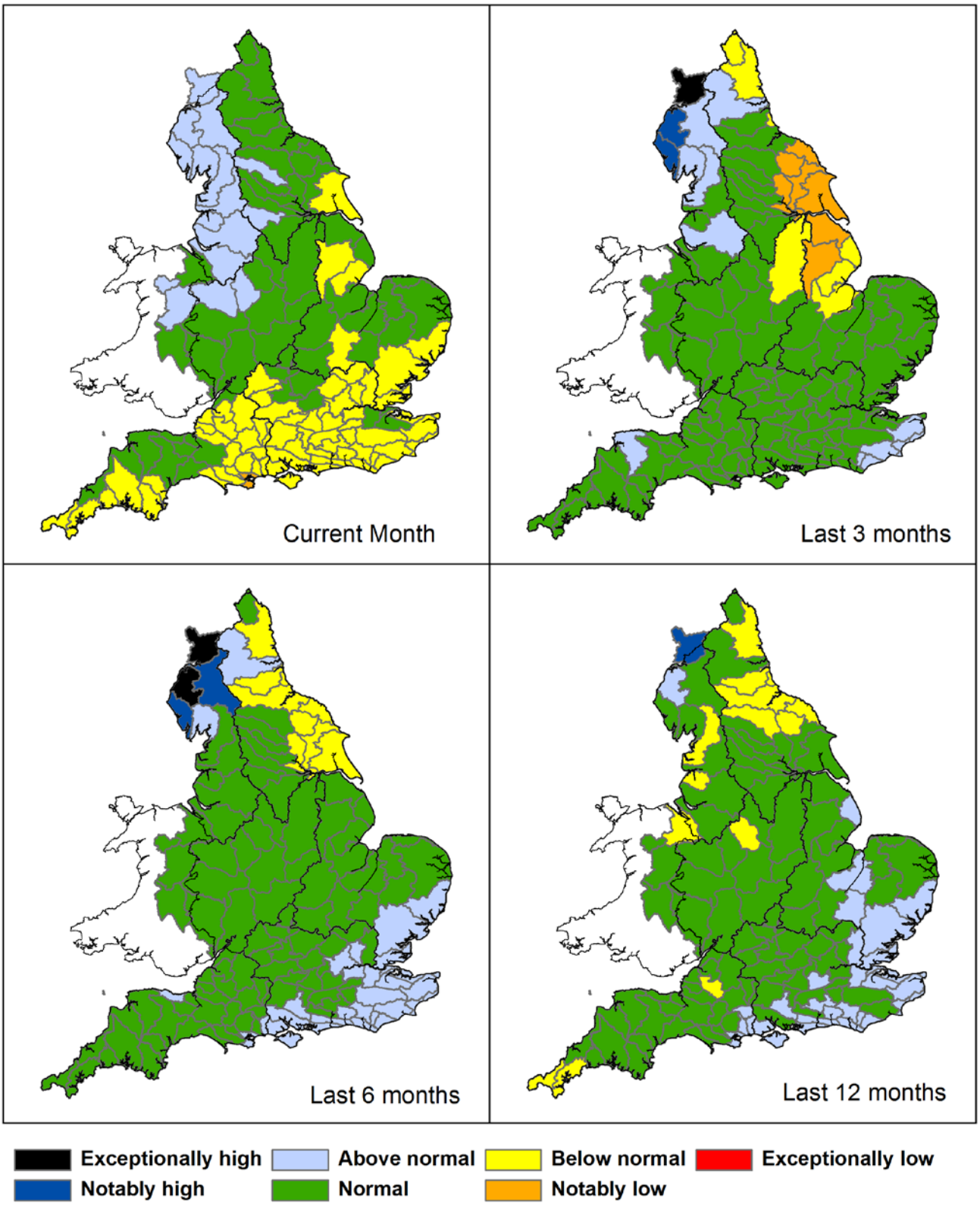


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 March), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based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

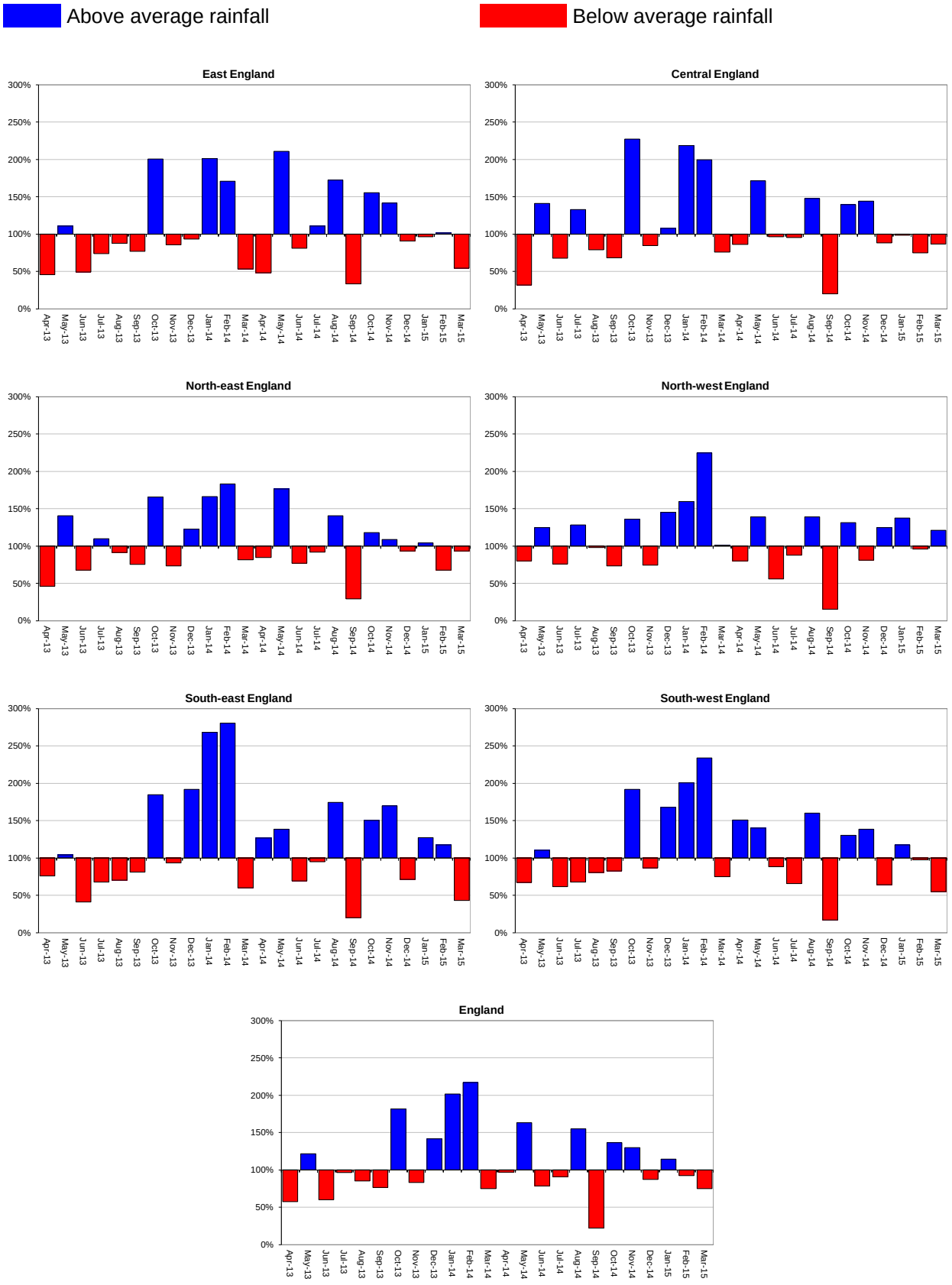


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2015).

Soil moisture deficit

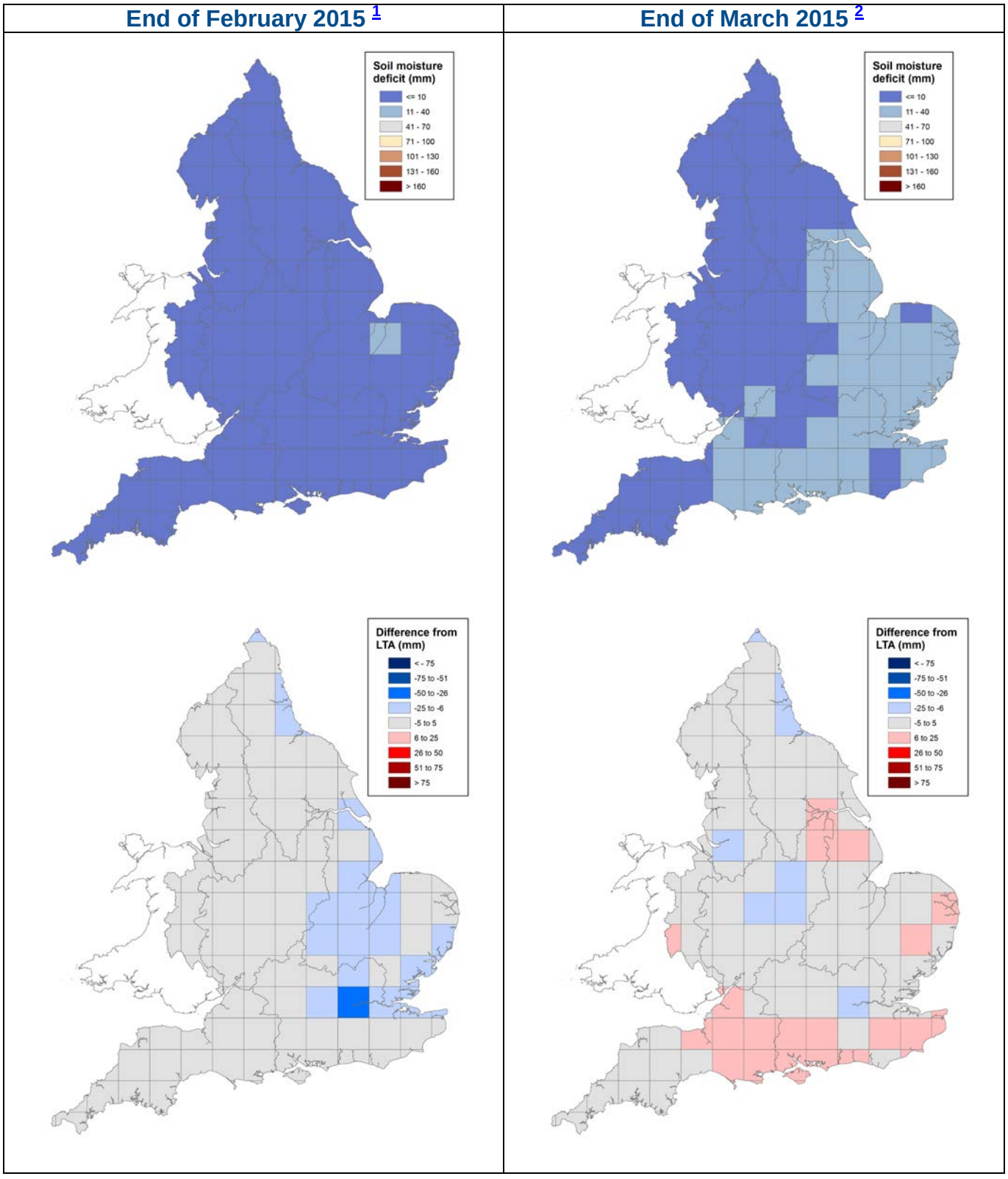


Figure 2.1: Soil moisture deficits for weeks ending 25 February 2015 [1] (left panel) and 31 March 2015 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2015). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015

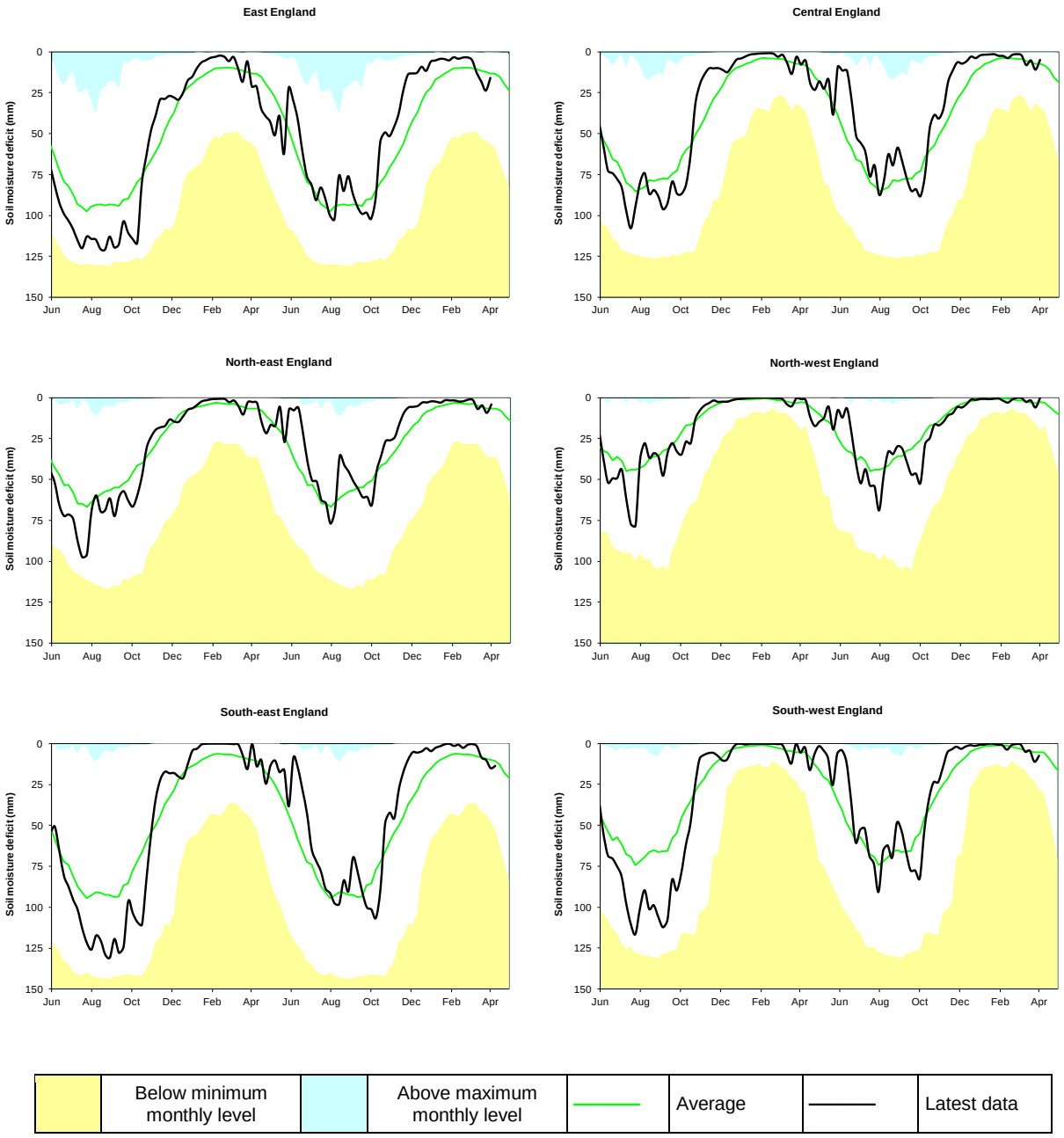
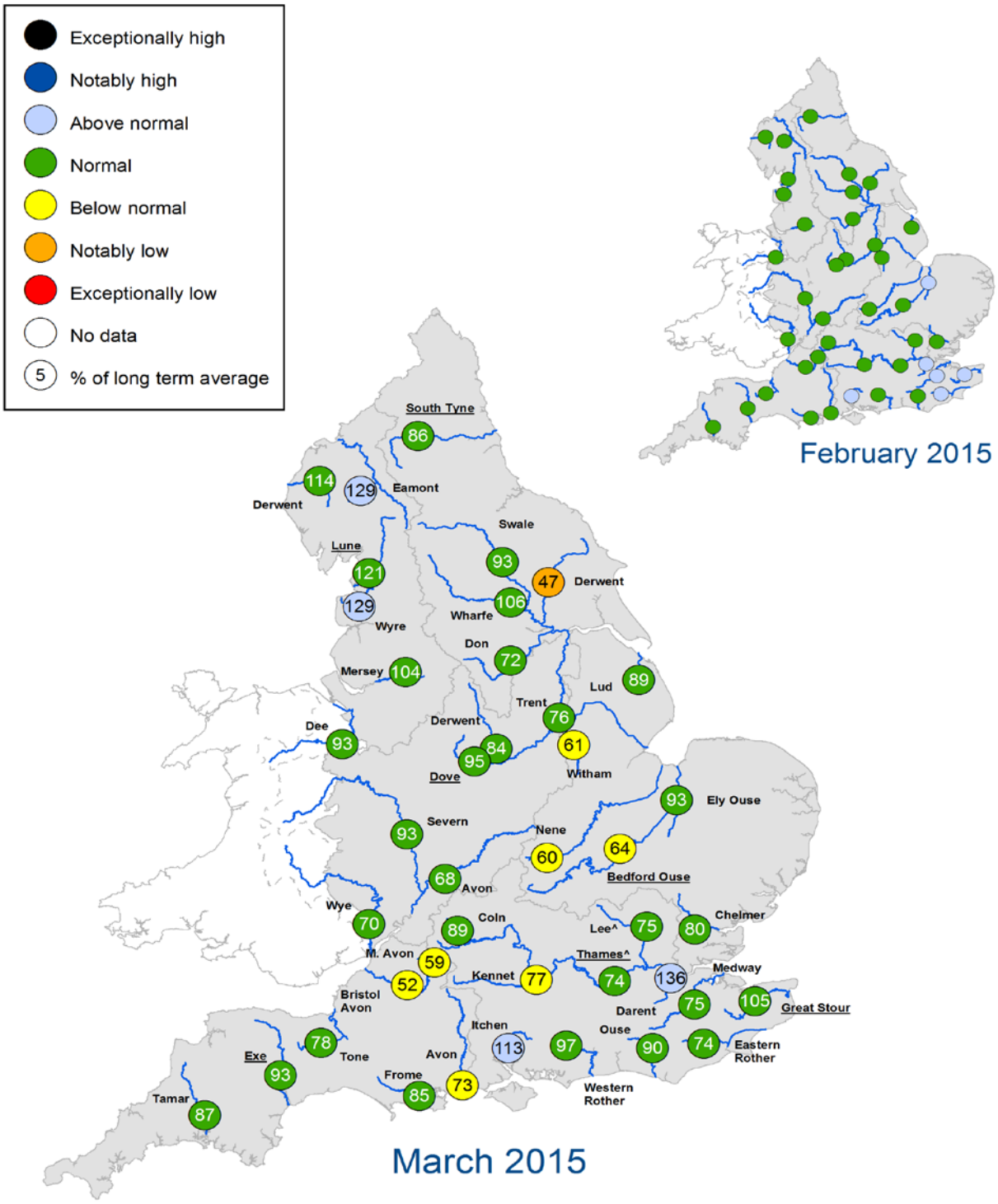


Figure 2.2: Latest soil moisture deficits for all regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2015).

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 February 2015 and March 2015, expressed as a percentage of the respective long term average and classed relative to an analysis of historic February and March monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

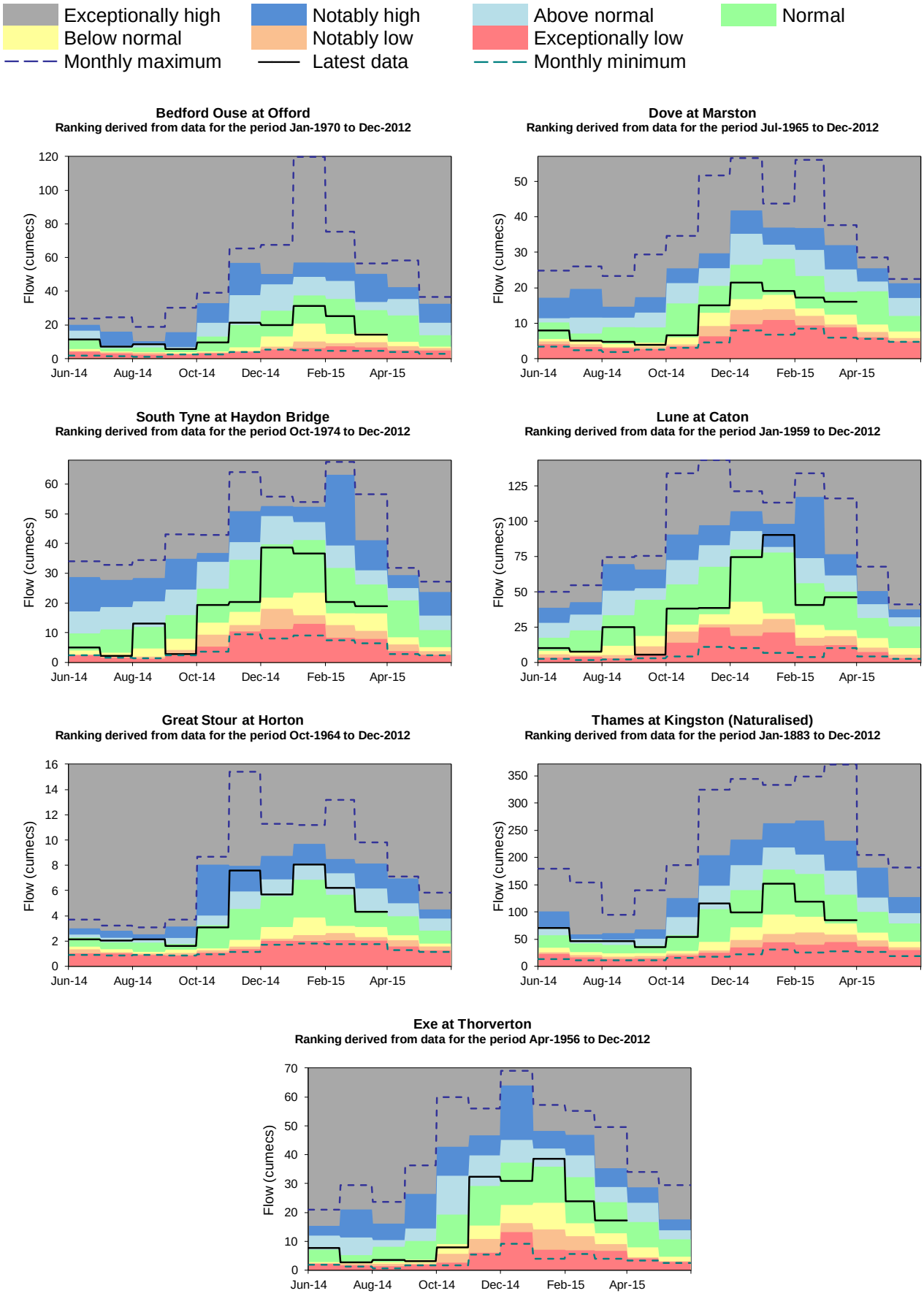
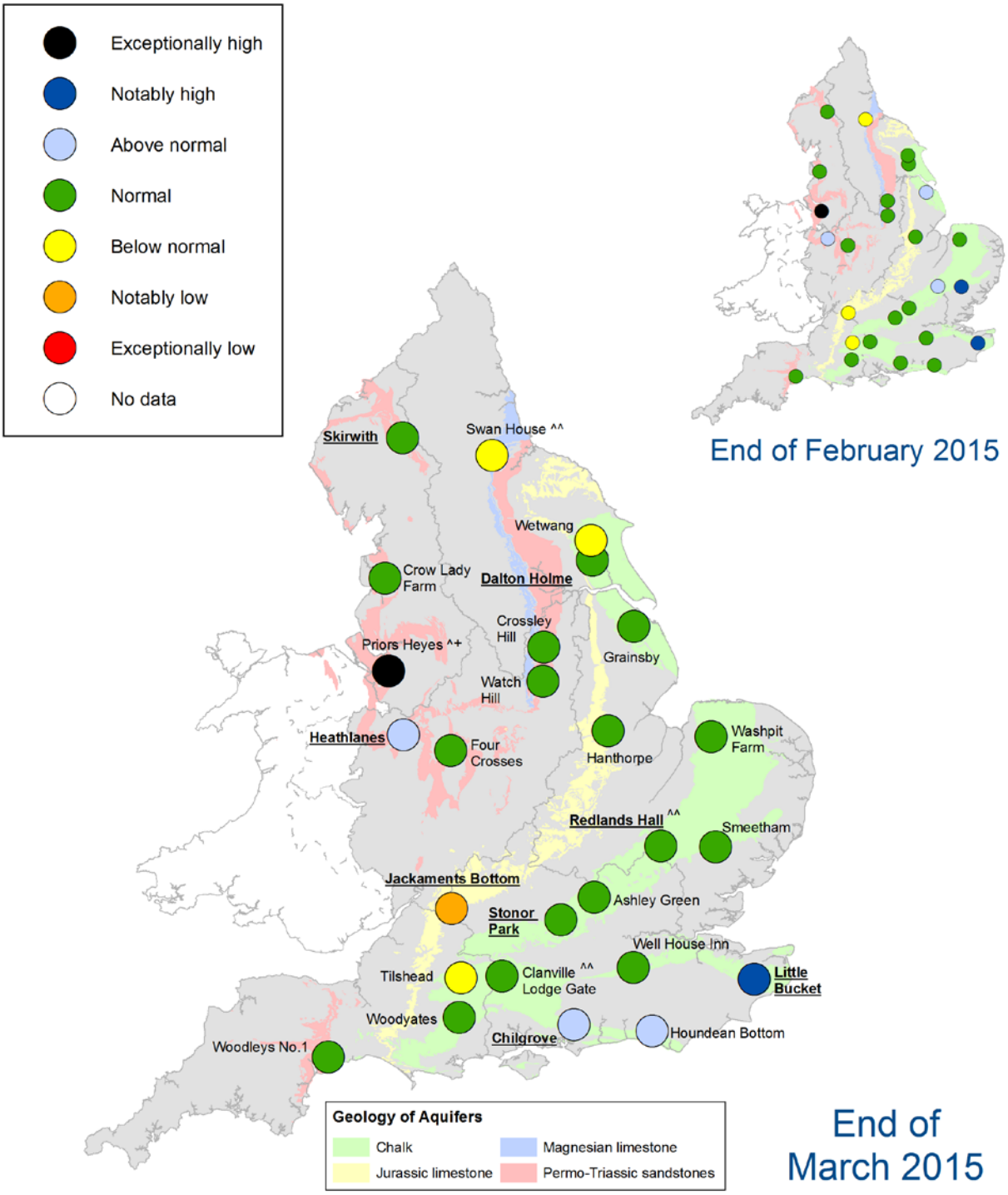


Figure 3.2: Index river flow sites for each region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 February 2015 and March 2015, classed relative to an analysis of respective historic December and January 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.

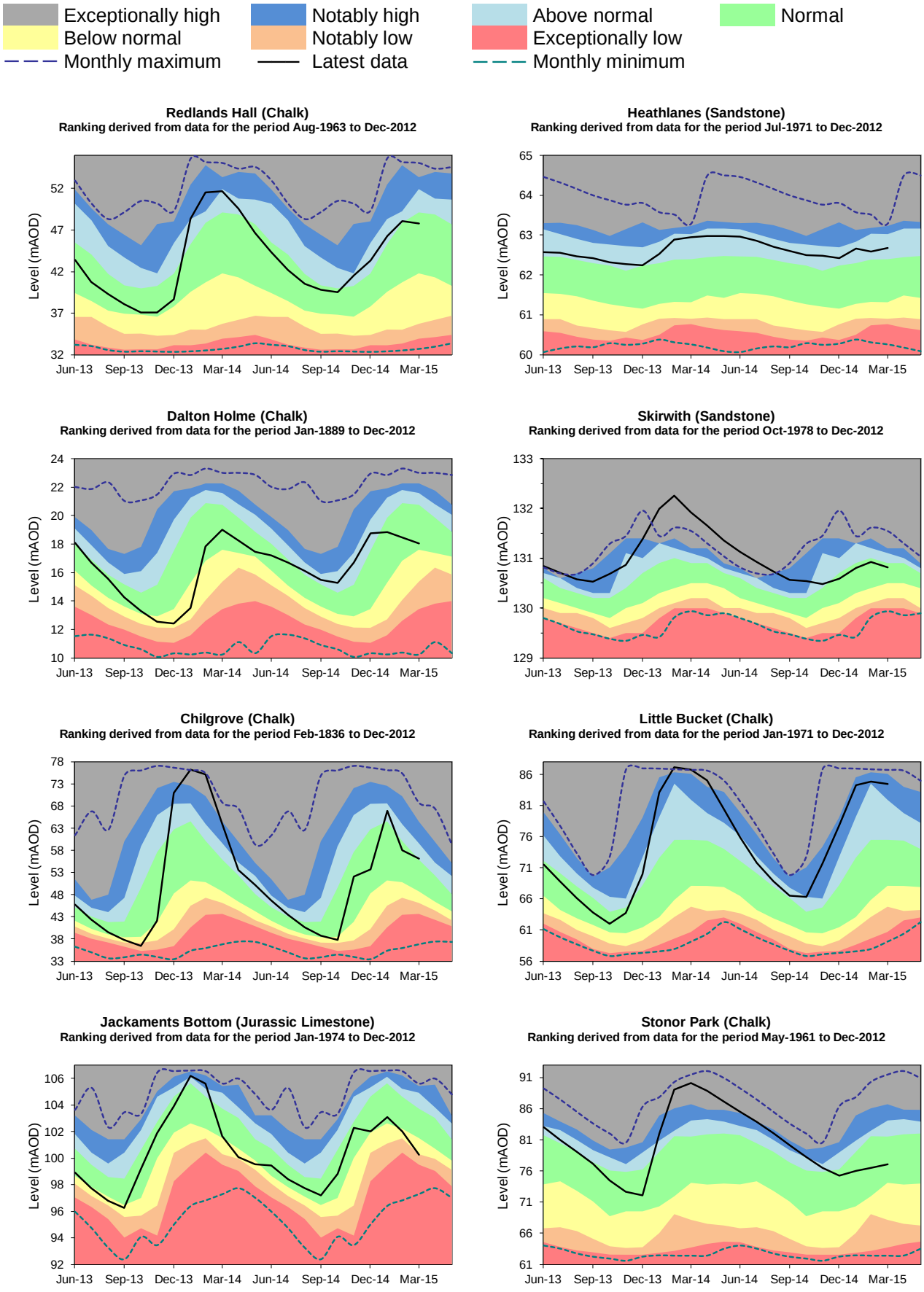
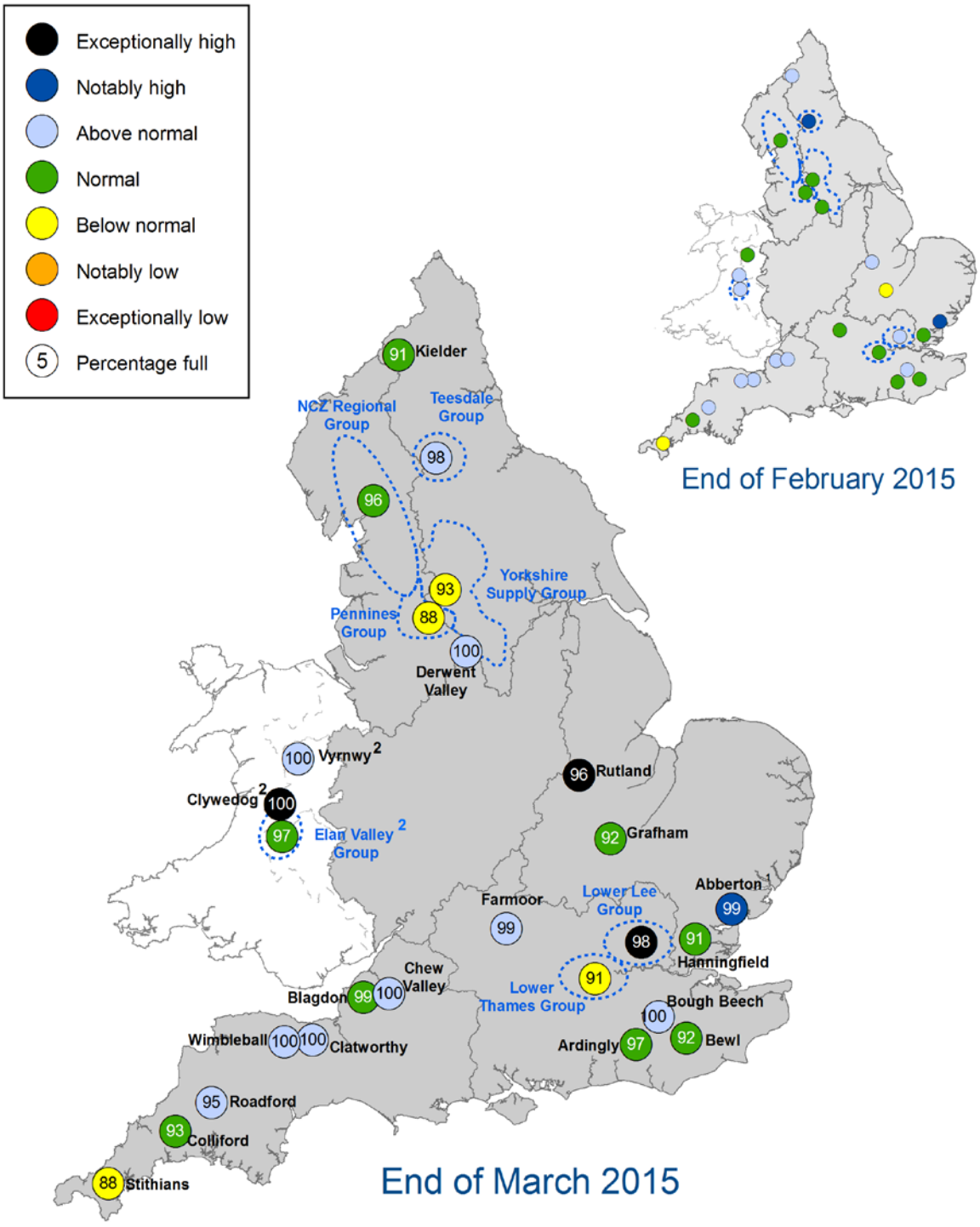


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2015).

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

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

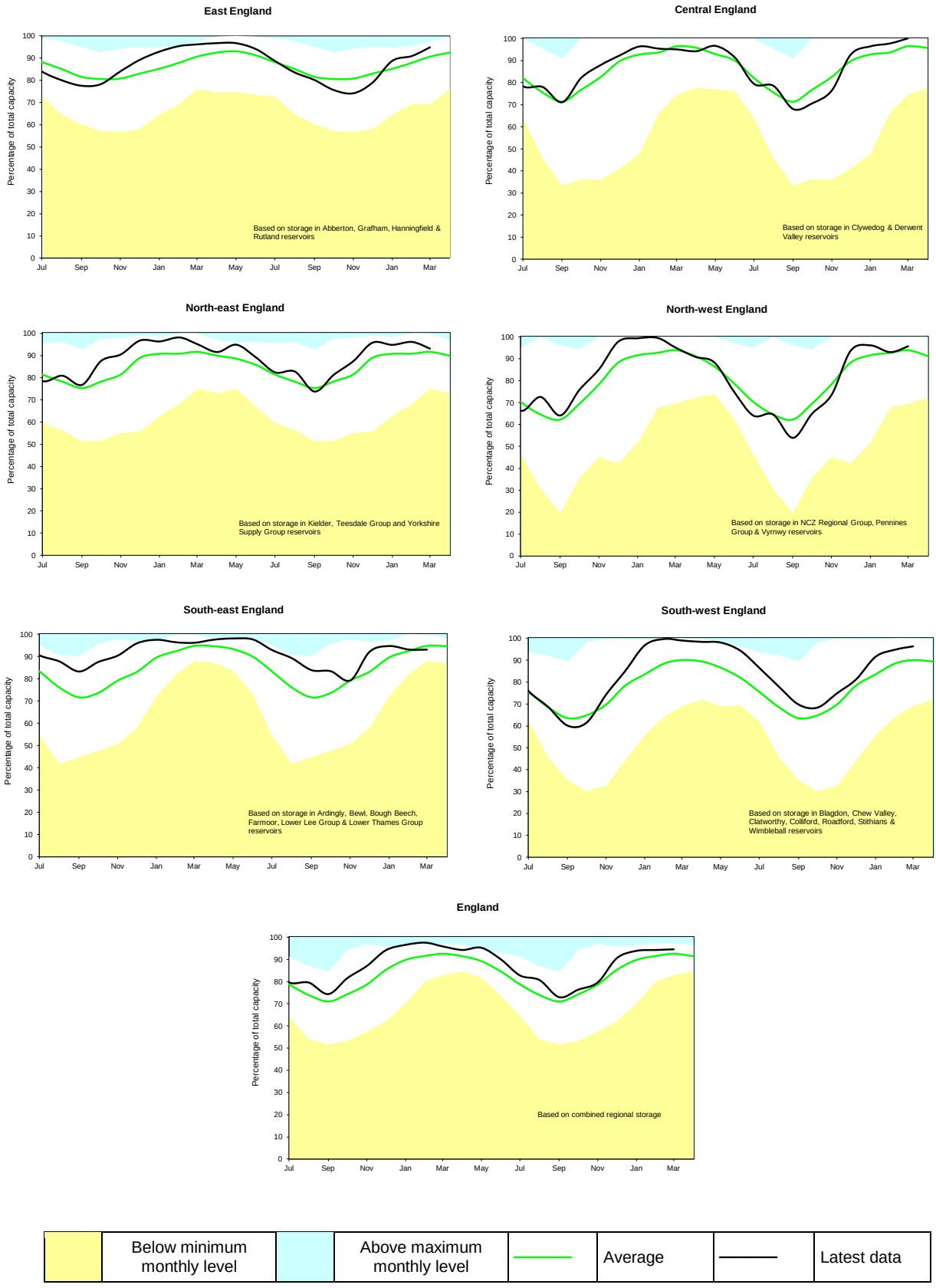


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

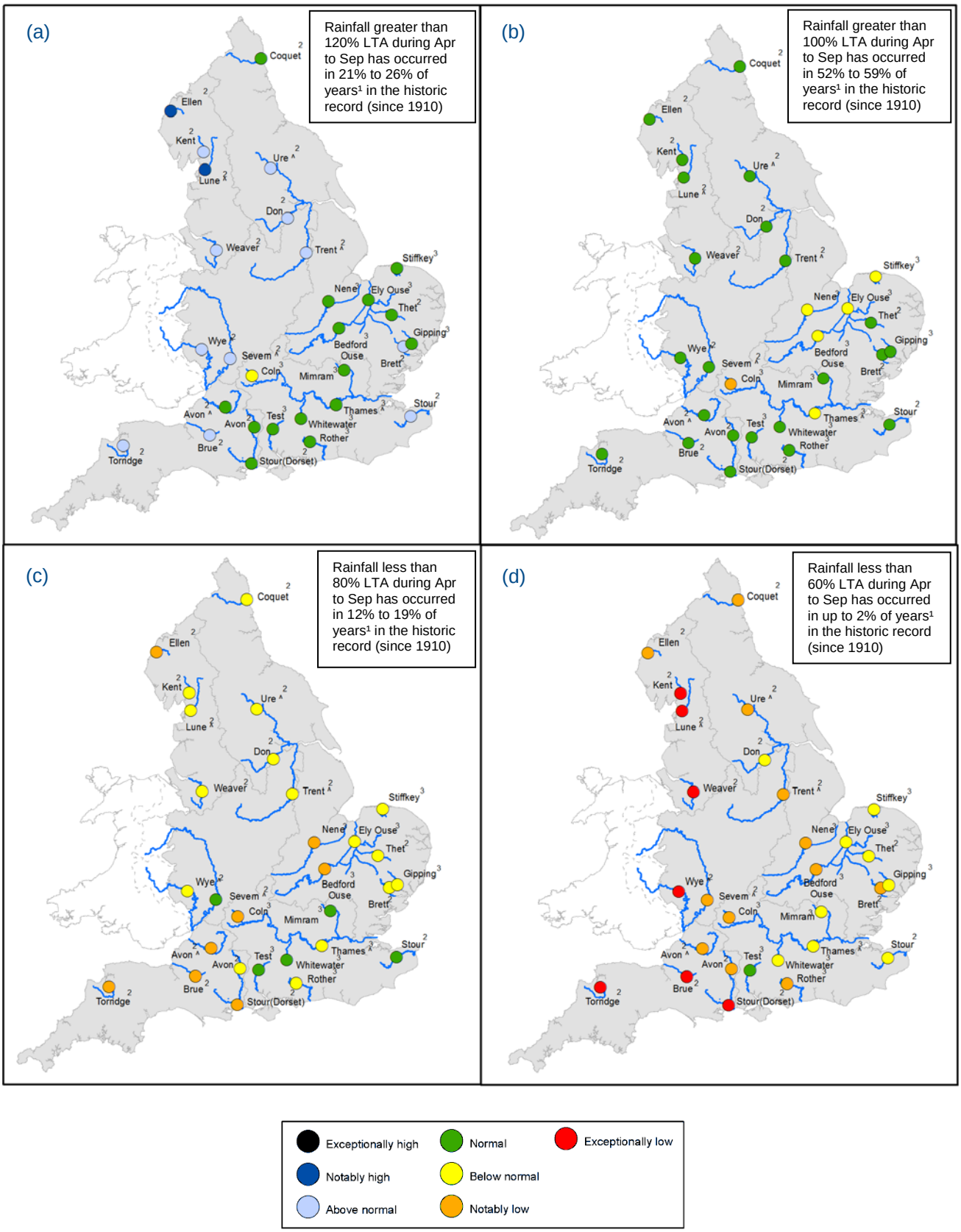


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April and September 2015 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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

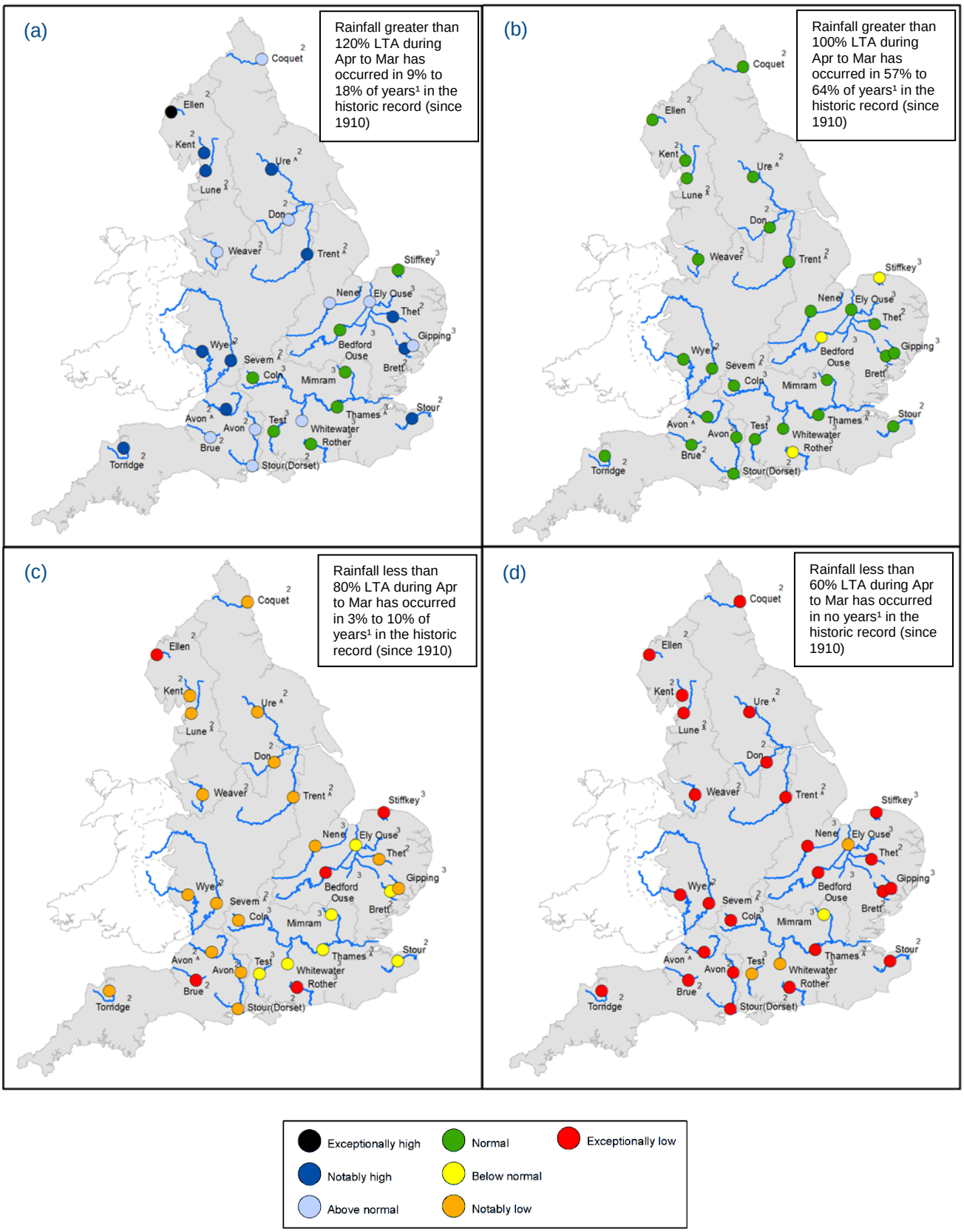


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2015 and March 2016 (Source: Centre for Ecology and Hydrology, Environment Agency)

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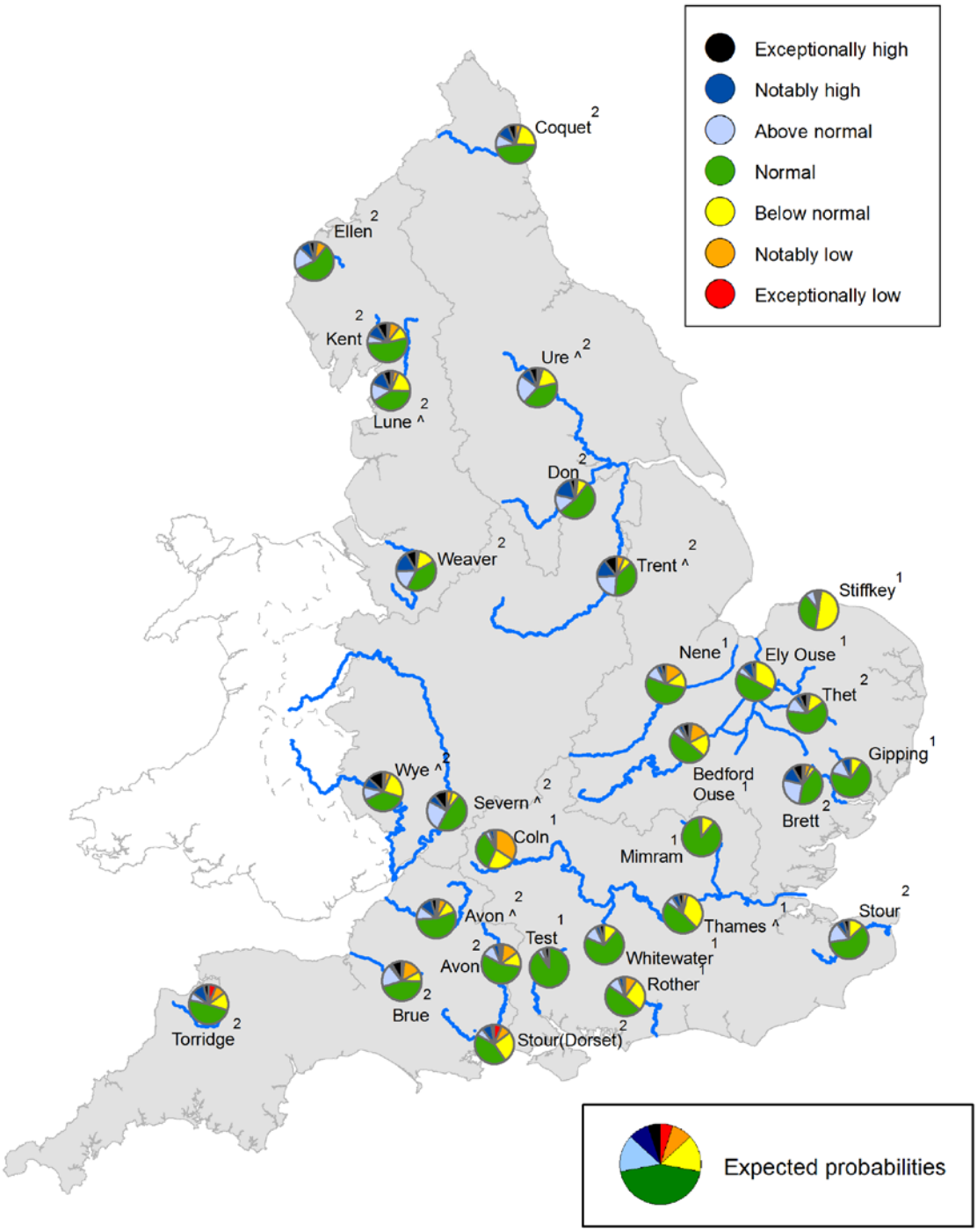

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

[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

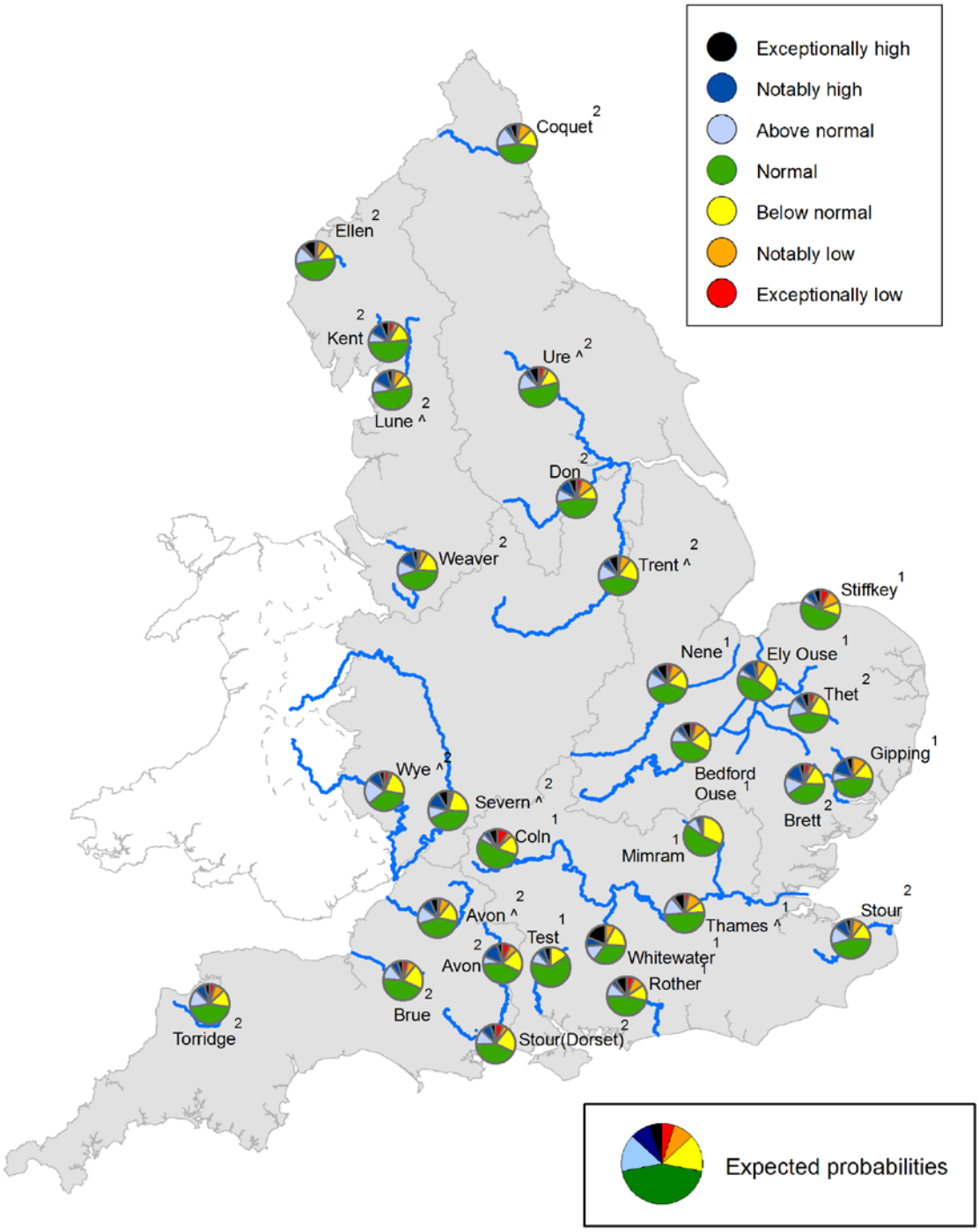

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2016. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the 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

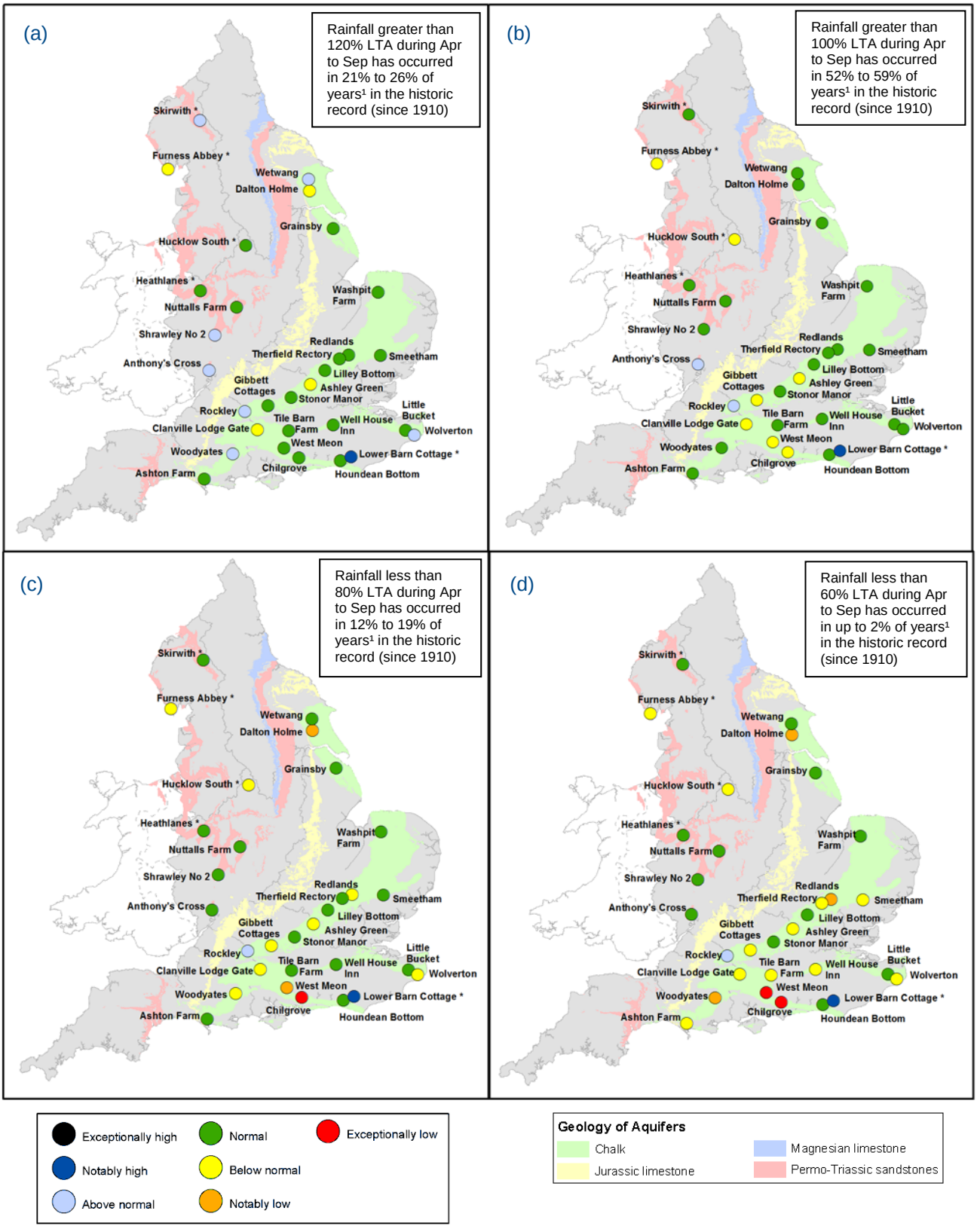


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April and September 2015 (Source: Environment Agency) Geological map reproduced with kind permission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

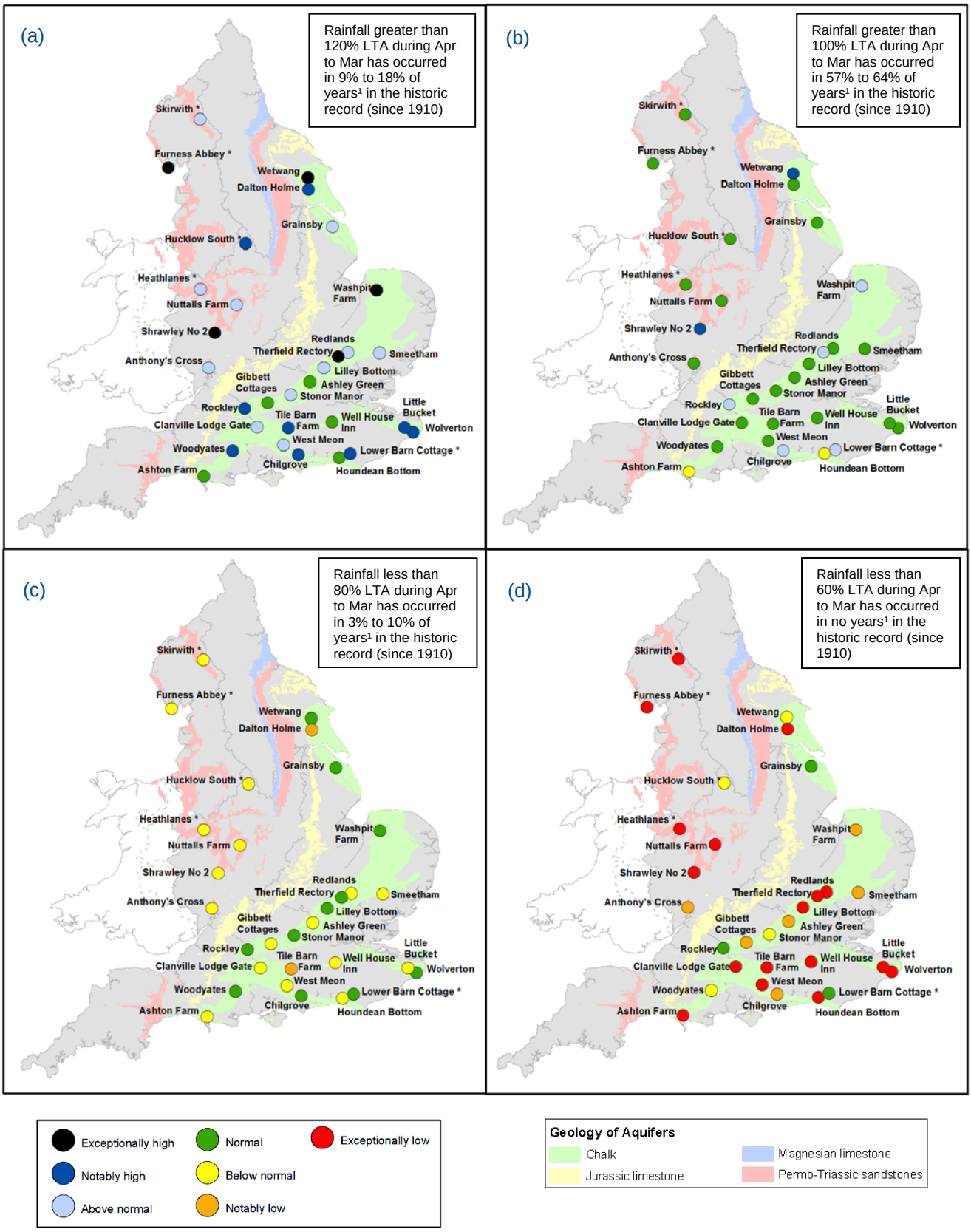
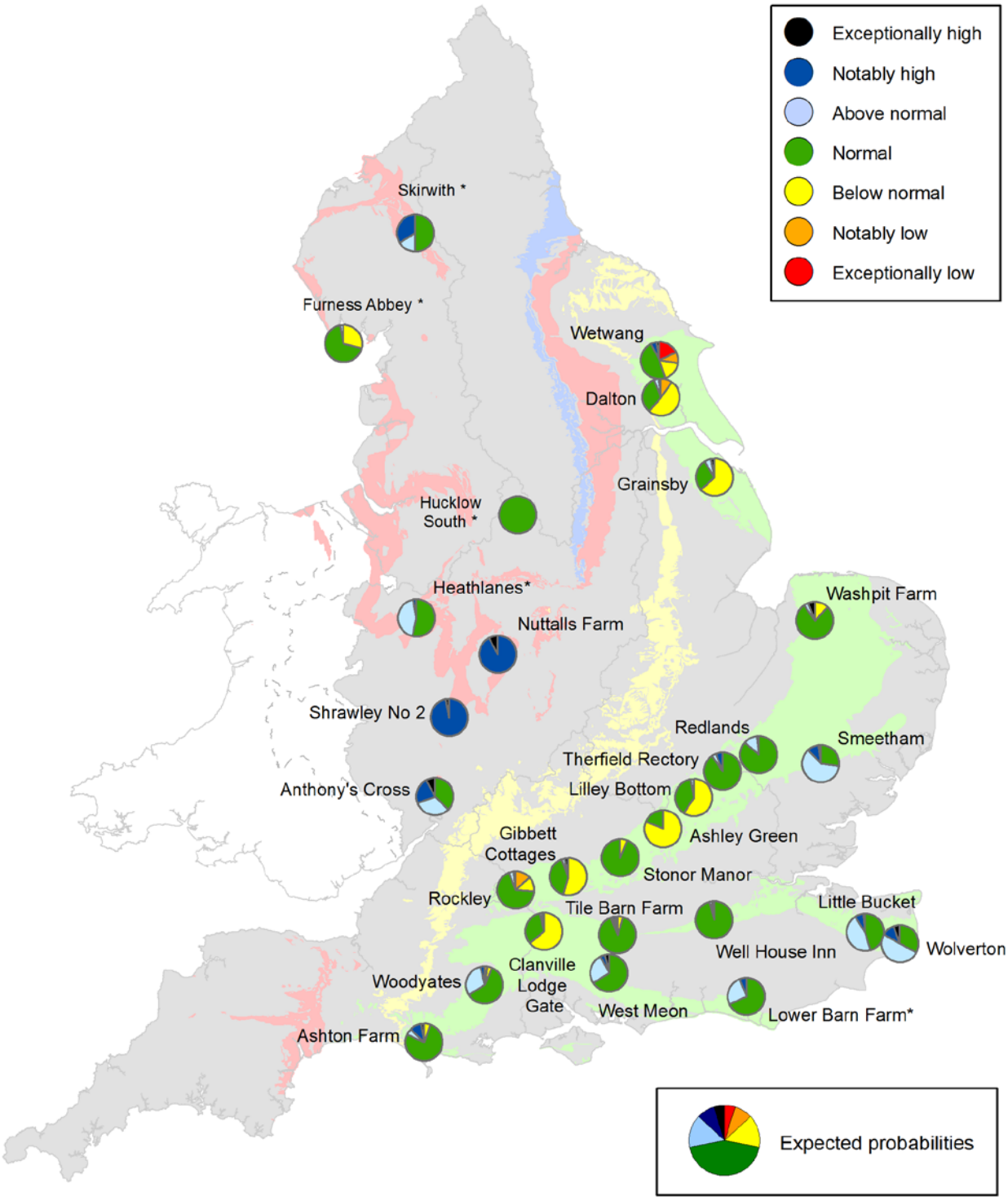


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between April 2015 and March 2016. (Source: Environment Agency) Geological map reproduced with kind permission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

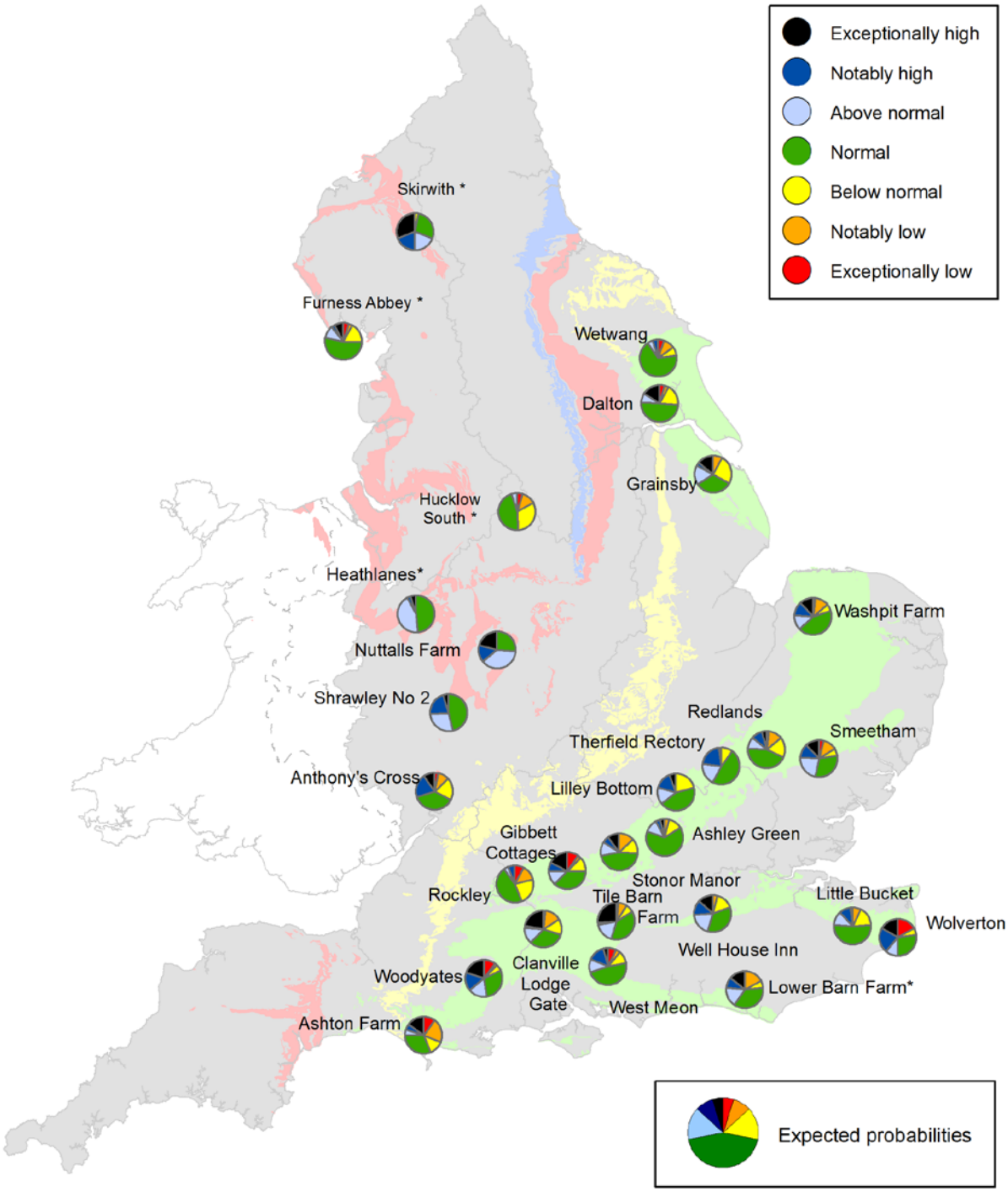
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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