Monthly water situation report

England

Summary – January 2016

For the third consecutive month, rainfall totals were above average across England at 165% of the long term average. As such, soil moisture deficits have either remained close to zero or decreased across most of England. River flows were normal or higher for the time of year at all indicator sites, with half of sites being notably high or exceptionally high. Groundwater levels increased at almost all indicator sites and were classed as normal or higher for the time of year at all but 2 sites. Reservoir stocks increased at almost three-quarters of reported reservoirs and reservoir groups and were normal or higher for the time of year at almost all reservoirs and reservoir groups. Overall reservoir storage for England increased to 96% of total capacity.

Rainfall

Rainfall totals for January ranged from less than 60mm in Essex and parts of Cambridgeshire, to more than 280mm in parts of Cumbria. Monthly rainfall totals were above the January long term average (LTA) in all hydrological areas across England. Many hydrological areas in north-east England and some on the south coast of England received more than twice the January LTA rainfall (Figure 1.1).

January rainfall totals were above normal or higher for the time of year across most of England. Most hydrological areas in north-east England and many on the south coast of England received exceptionally high rainfall for the time of year (Figure 1.2). Over the 3, 6 and 12 month periods to the end of January, cumulative rainfall totals were classed as exceptionally high in north England, and generally normal to above normal elsewhere.

At the regional scale January rainfall totals ranged from 135% of the LTA in east England to 196% in north-east England. The 3 month period to the end of January 2016 was the wettest 3 month period on record (since 1910) in north-east, and north-west England. Rainfall totals across England as a whole were above average for the time of year at 163% of the January LTA (Figure 1.3).

Soil moisture deficit

Soil Moisture Deficits (SMDs) decreased, or remained at zero across much of England during January. The largest decreases of up to 45mm were in parts of east England. At the end of January, SMDs were at or close to zero across most of north and west England. In east and south-east England SMDs generally ranged from 5 to 17mm (Figure 2.1). End of month SMDs were close to the LTA across most of England.

At a regional scale, SMDs decreased or remained constant across all regions during January. At the end of the month SMDs were close to zero in north-east, north-west and south-west England. In central, east and south-east England SMDs were all under 10mm. At the end of January soils were wetter than average in all regions (Figure 2.2).

River flows

Monthly mean river flows for January increased at almost three-quarters of indicator sites across England compared with December and all sites were classed as normal or higher for the time of year. Just over half of sites across England were notably high or exceptionally high for the time of year. The monthly mean flows for the River Swale at Crakehill (Topcliffe) and the Derwent at Buttercrambe (both in Yorkshire) represent the highest January monthly mean on record (Figure 3.1).

Monthly mean river flows were classed as normal for the time of year at 3 out of the 7 regional index sites. The River Exe at Thorverton in south-west England was exceptionally high for January and the River Dove at Marston-on-Dove and the naturalised flows for the River Thames at Kingston were notably high (Figure 3.2).

Groundwater levels

Groundwater levels rose at the majority of indicator sites during January. At the end of the month, groundwater levels were normal for the time of year at just over half of indicator sites and were above normal at all but 2 of the remaining sites. Below normal levels for the end of January were recorded at Ashley Green (East Chilterns Chalk aquifer) and Stonor (South West Chilterns) but are now rising.

End of month groundwater levels at the major aquifer index sites were normal for the time of year at 4 out of the 8 sites. Skirwith (in the Carlisle Basin and Eden Valley sandstone aquifer) and Chilgrove (Chichester Chalk) levels were exceptionally high for the time of year (Figures 4.1 and 4.2)

Reservoir storage

Reservoir stocks increased at the majority of reported reservoirs and reservoir groups during January. There was little change in three reservoir or reservoir groups with stocks in the remaining reservoirs and reservoir groups remaining unchanged. The largest increases in storage were at Blagdon Reservoir (26%) and Chew Valley Lake (25%) in south-west England.

End of month stocks were classed as normal or higher for the time of year at almost all reservoir and reservoir groups. Sites supplying parts of central and south England were below normal or lower for the time of year. Levels in the Dove group remain classified as exceptionally low for the time of year owing to ongoing operational issues. (Figure 5.1)

With many reservoirs now close to being full, overall increases in regional-scale reservoir stocks are smaller than they have been in recent months. The largest increase of 14% was in south-west England. Regional-scale reservoir stocks remained unchanged in north-west and north-east England during January. At the end of January, regional stocks ranged from 90% of total capacity in east England to 99% in north-west and south-west England. Reservoir storage for England increased to 96% of total capacity, an increase of 3% since December (Figure 5.2).

Forward look

February is likely to remain unsettled with showers and heavy rain at times, also occasional snowfall on hills, particularly in north and central England. Through the month south England may see drier periods. Longer term, for the period February-March-April, above and below average precipitation is equally probable. However indications are that below-average temperatures are more probable than above average temperatures[1].

Projections for river flows at key sites[2]

Half of the modelled sites have a greater than expected chance of notably high or higher cumulative flows between February and March 2016. Between February and September 2016, two thirds of modelled sites have a greater than expected chance of above normal or higher cumulative flows.

For scenario based projections of cumulative river flows at key sites by March 2016 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2016 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2016 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2016 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

Nearly half of the modelled sites (mainly in the chalk aquifer near the south coast and in sandstone aquifers of north-west England) have a greater than expected chance of above normal or higher groundwater levels at the end of March 2016. At the end of September 2016, a third of modelled sites have a greater than expected chance of above normal or higher groundwater levels.

For scenario based projections of groundwater levels in key aquifers in March 2016 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2016 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2016 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 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 (www.hydoutuk.net).

Rainfall

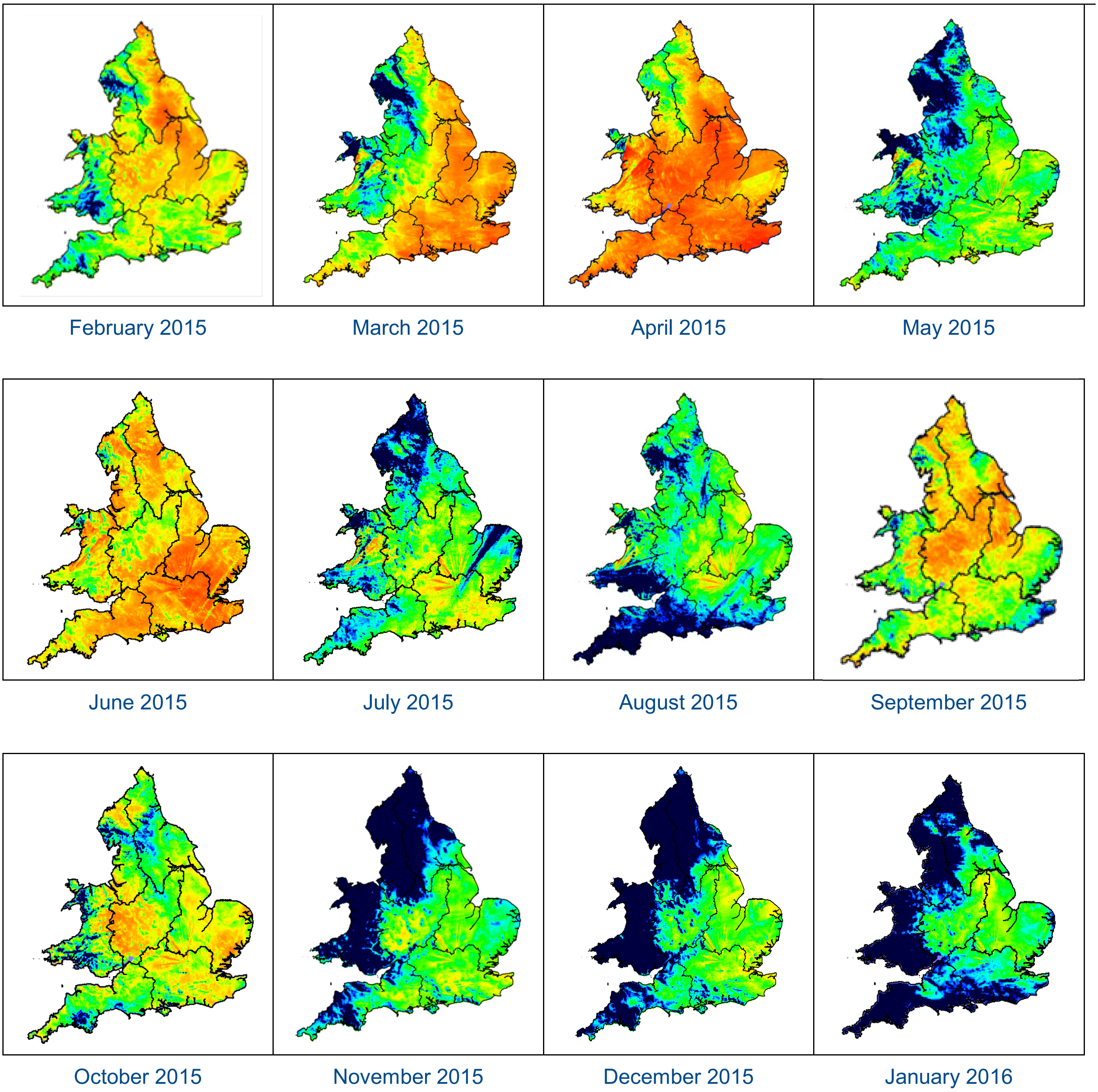
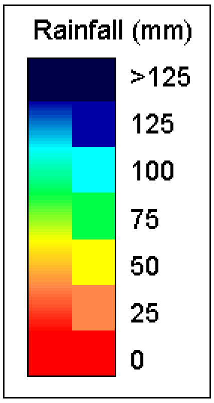


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2016). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.



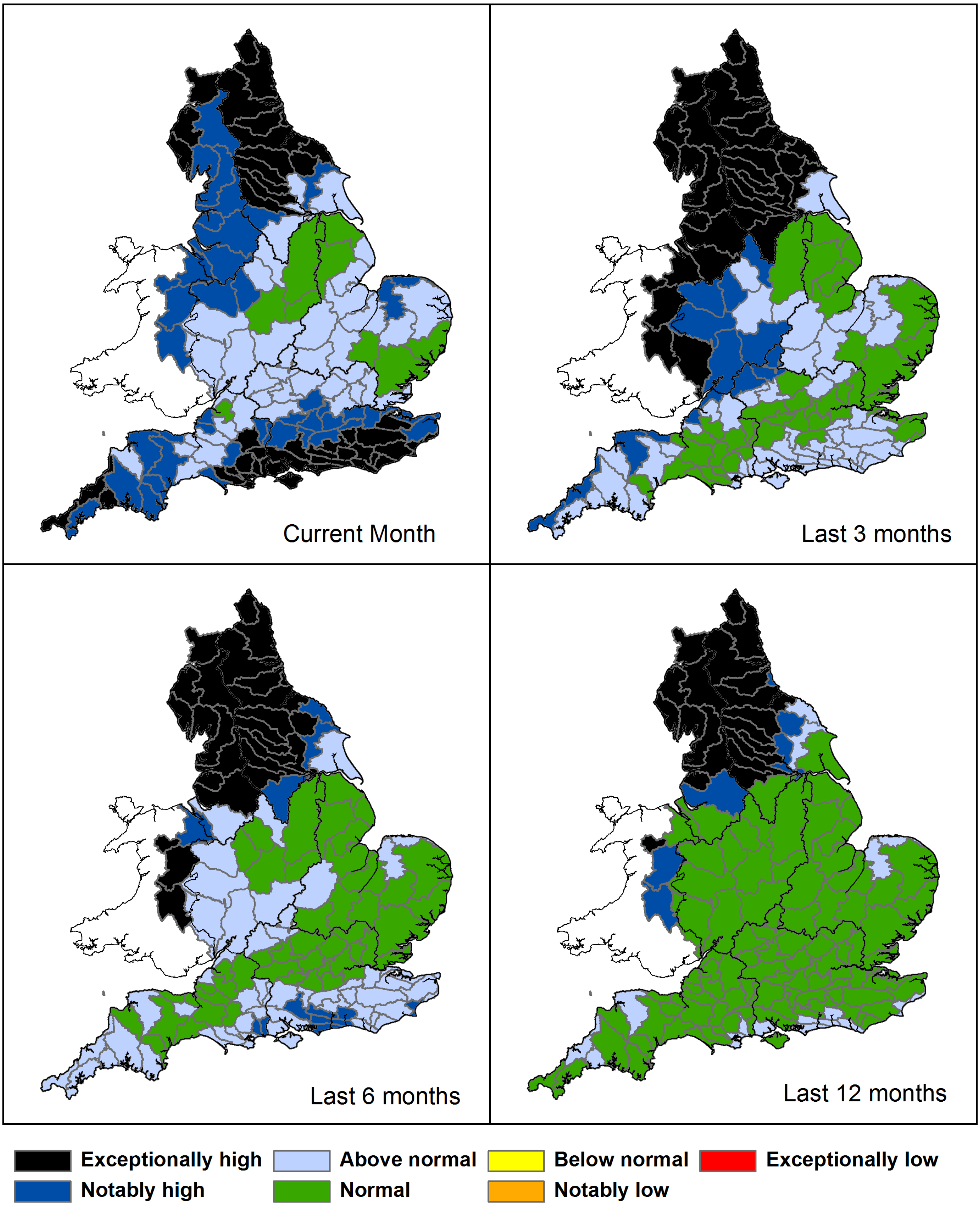


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 January), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2016).*

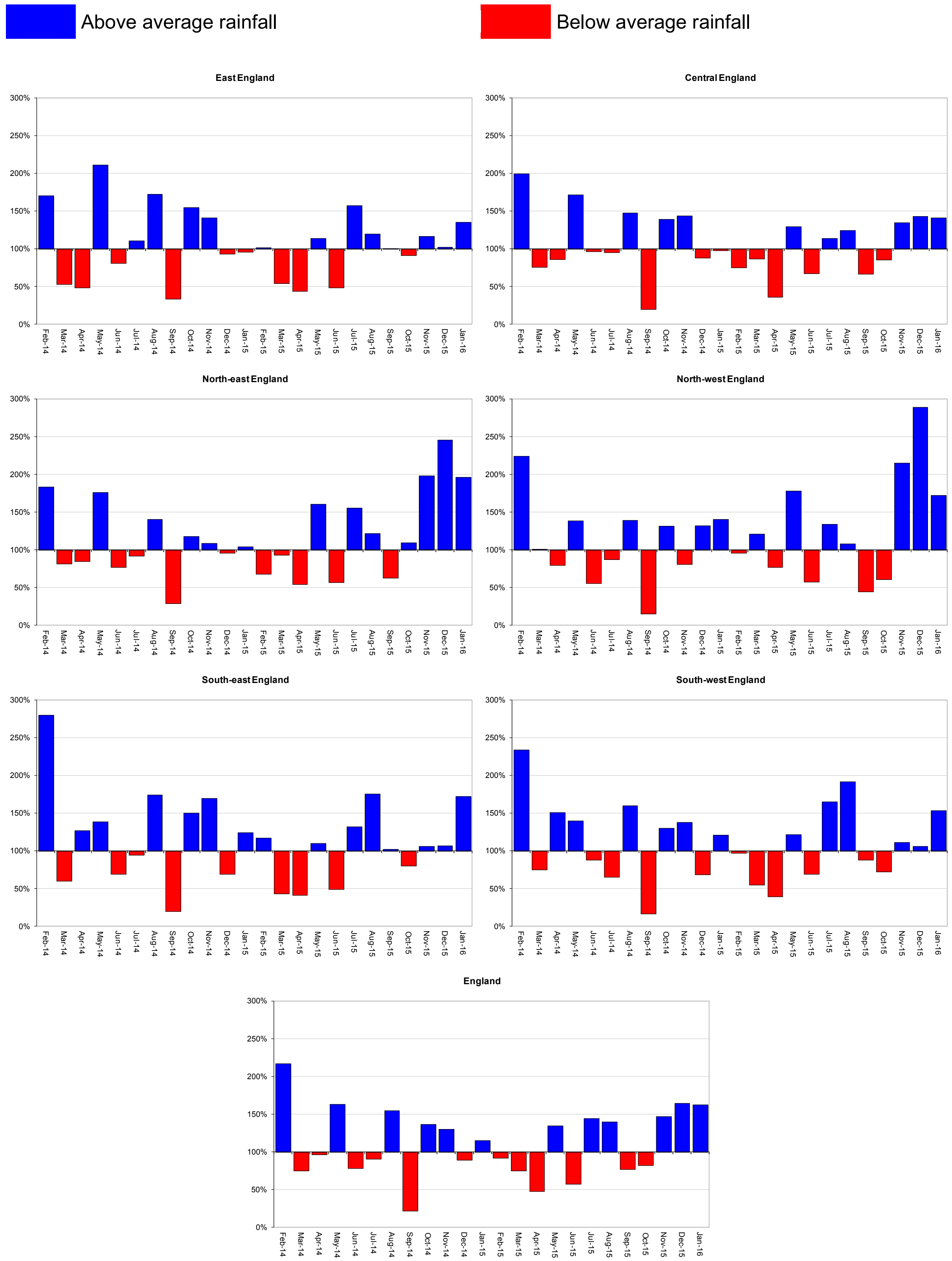


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2016).

Soil moisture deficit

End of December 2015[1]	End of January 2016[2]

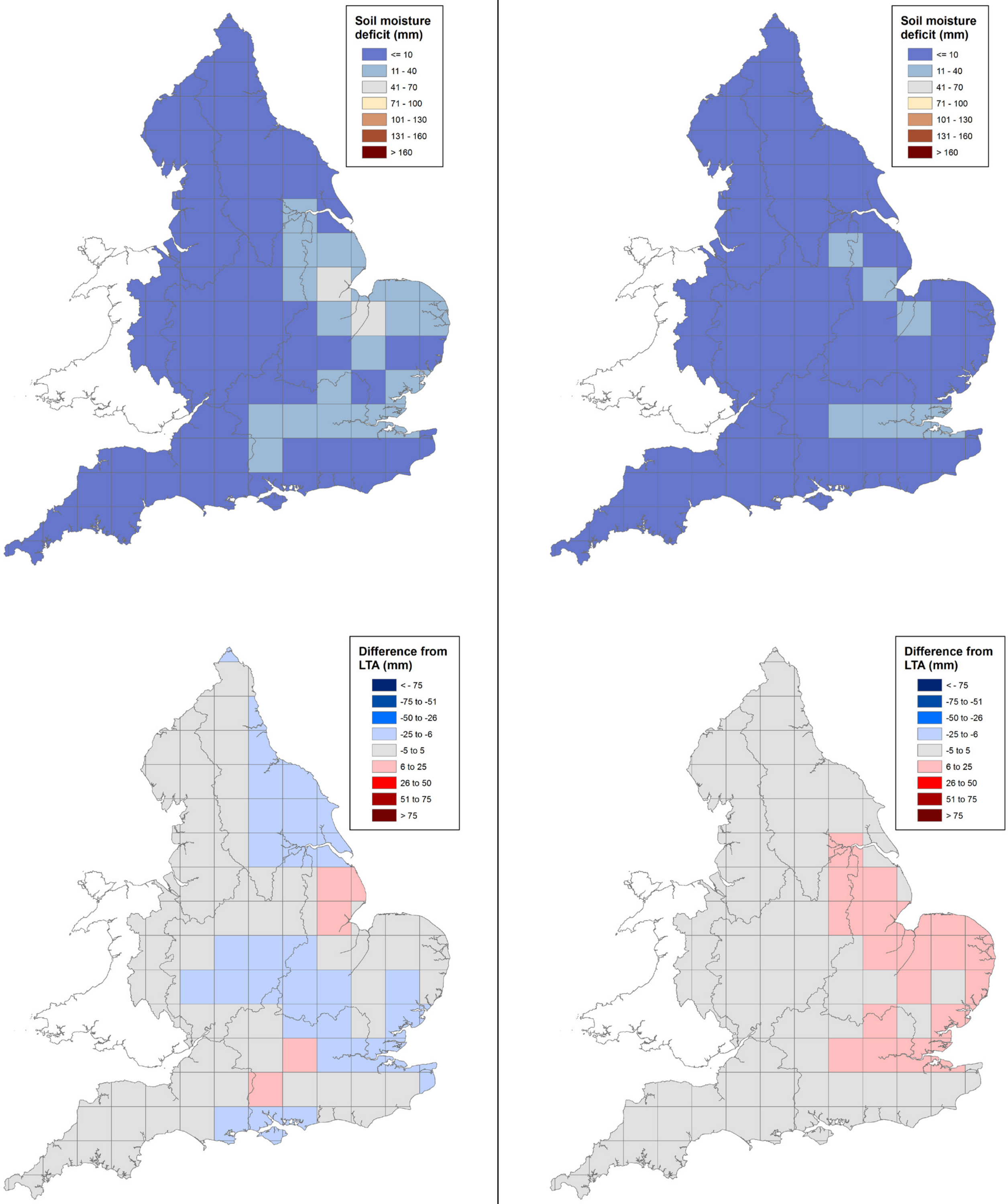


Figure 2.1: Soil moisture deficits for weeks ending 29 December 2015 [1] (left panel) and 2 February 2016 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2016). Crown copyright. All rights reserved. Environment Agency, 100026380, 2016

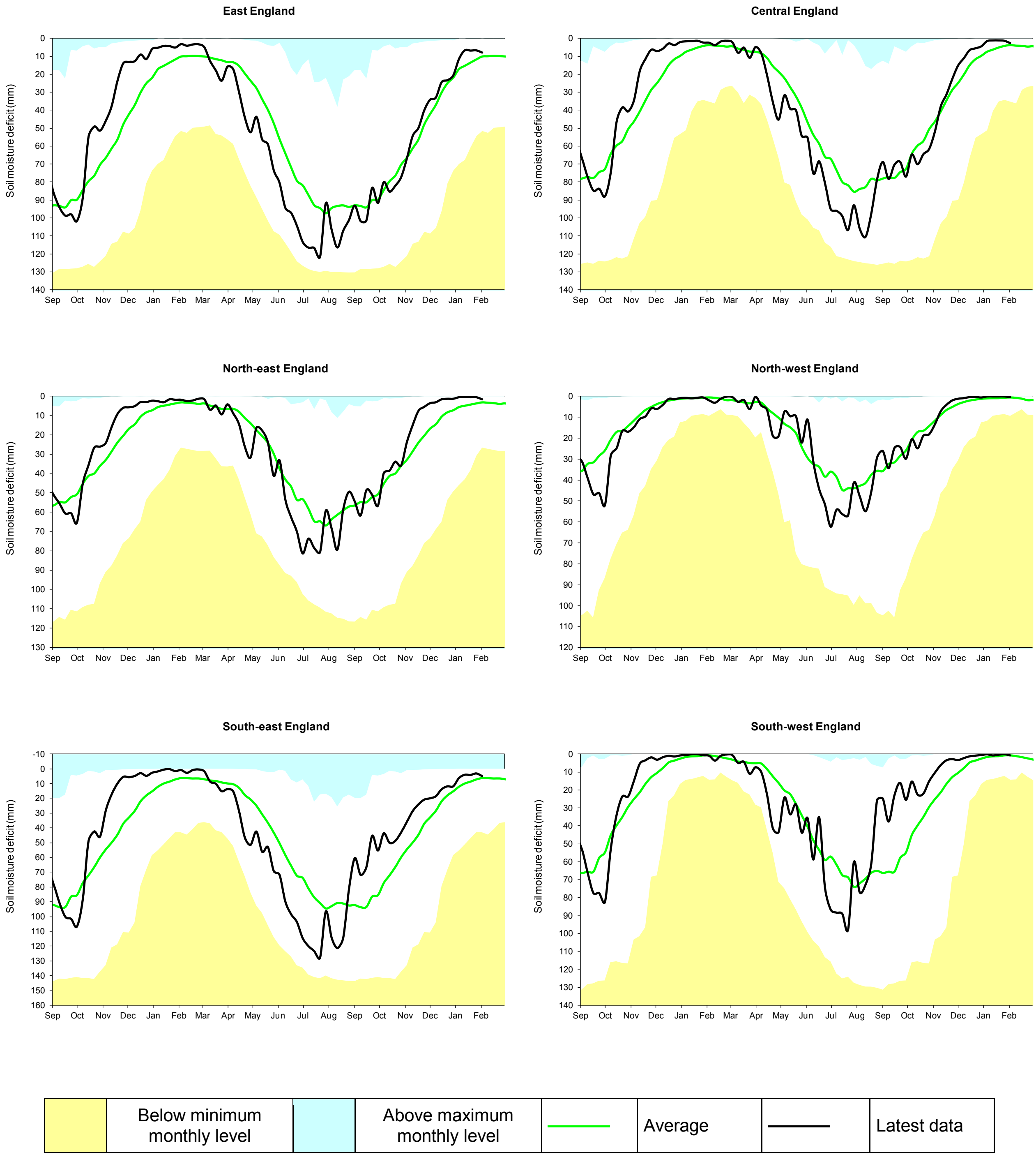
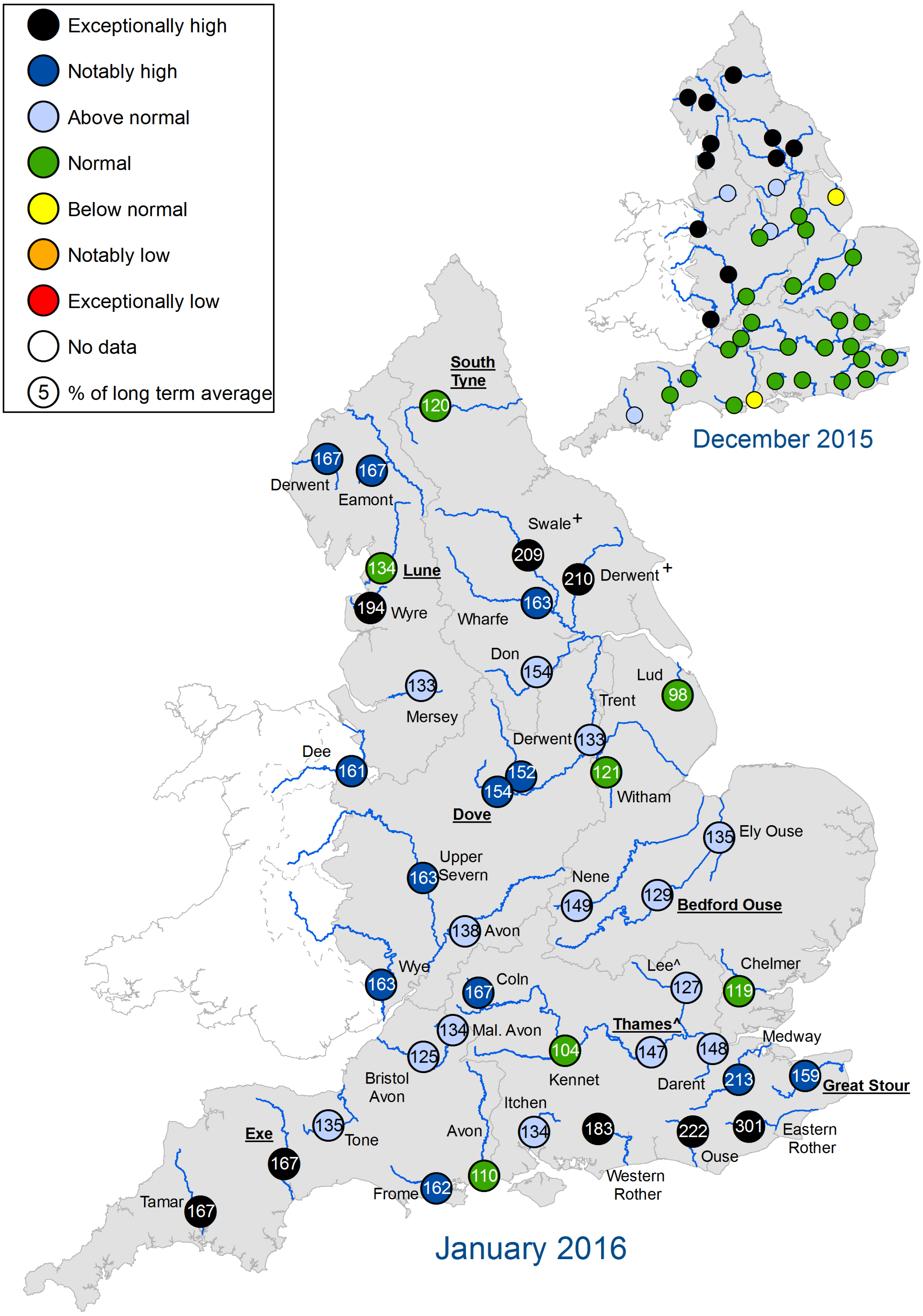


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2016).

River flows



^ “Naturalised” flows are provided for the ‘Thames at Kingston’ and the ‘Lee at Feildes Weir’

\+ Monthly mean flow is the highest 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 December 2015 and January 2016, expressed as a percentage of the respective long term average and classed relative to an analysis of historic December and January monthly means (Source: Environment Agency).

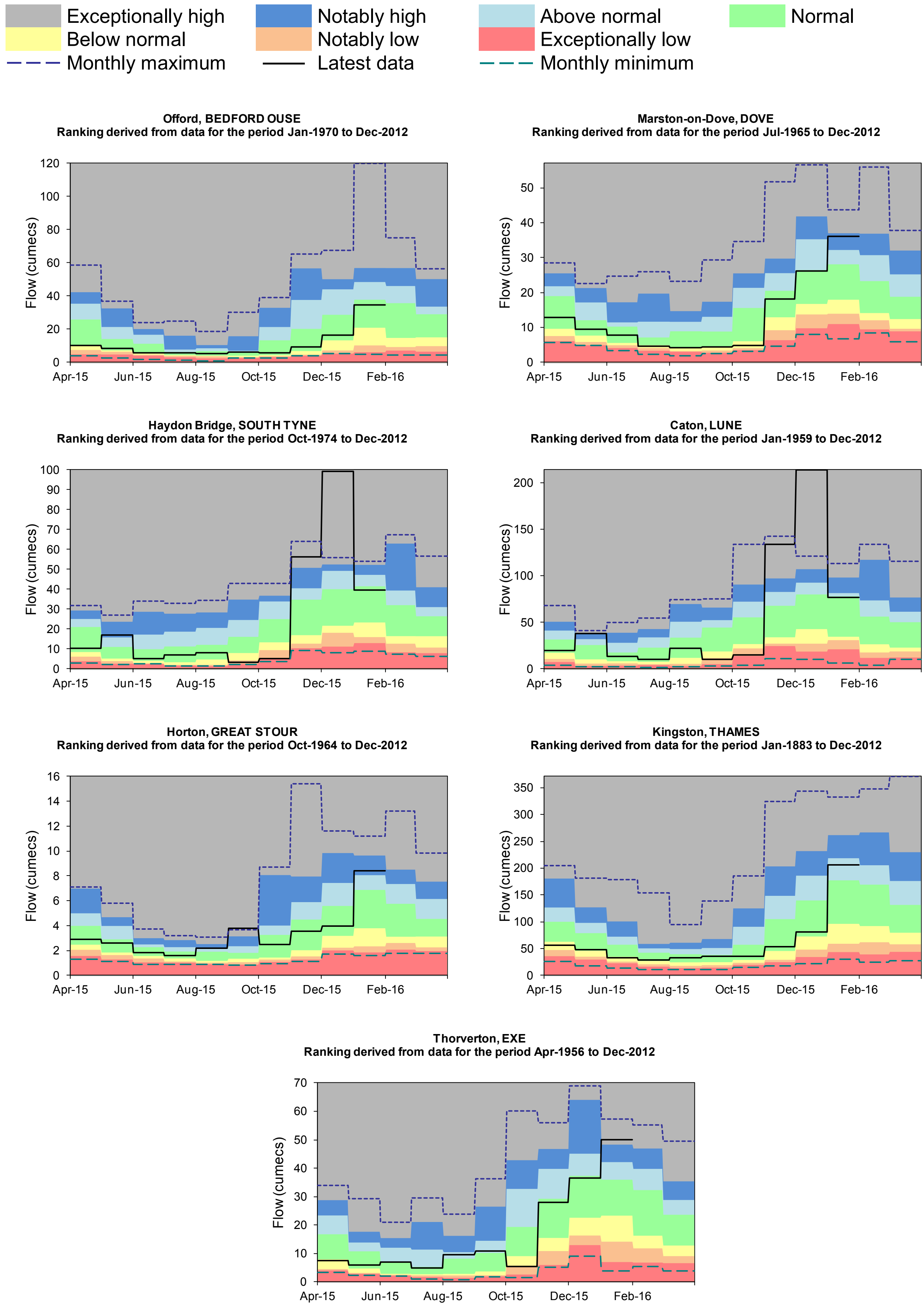
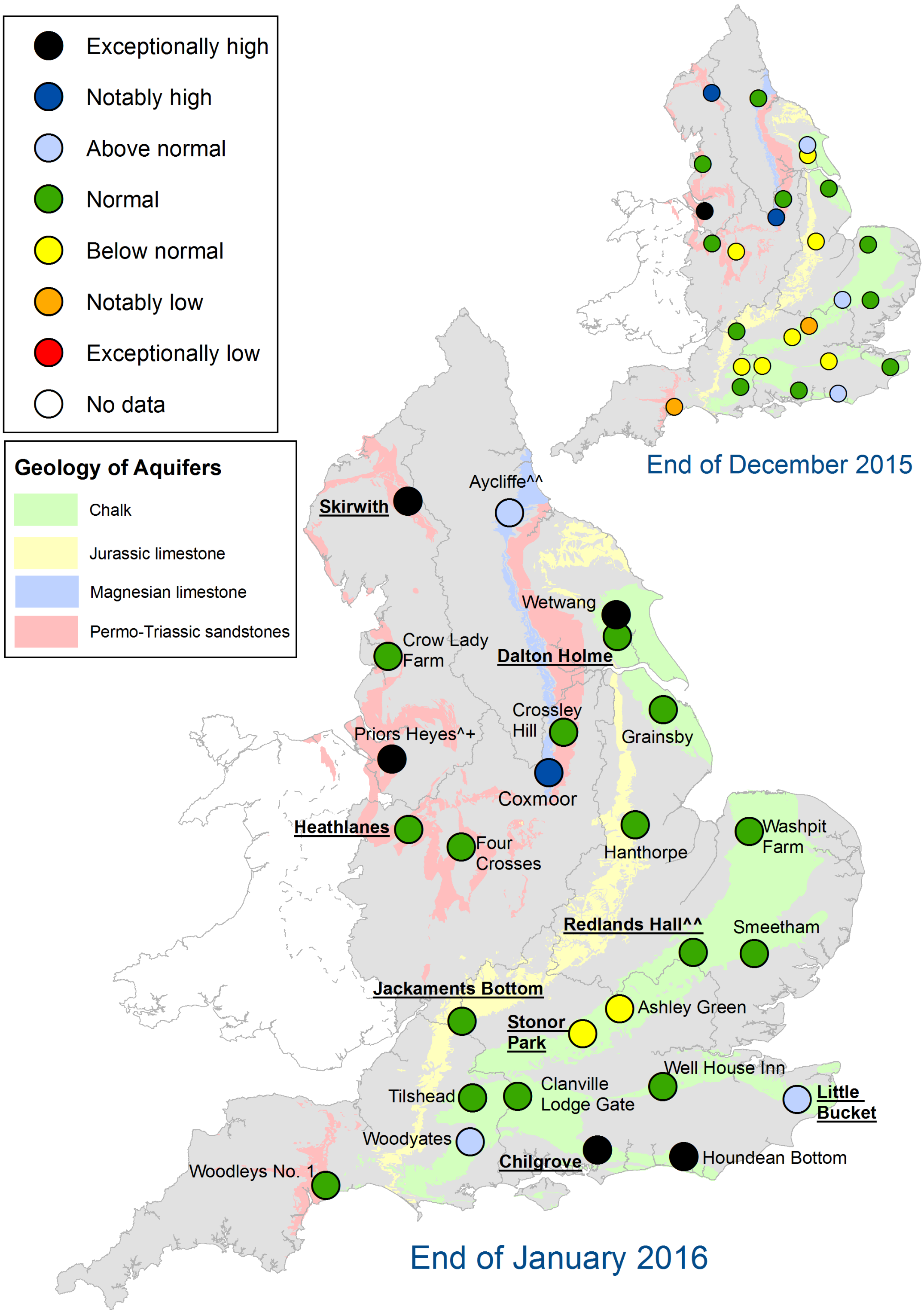


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 December 2015 and January 2016 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, 2016.

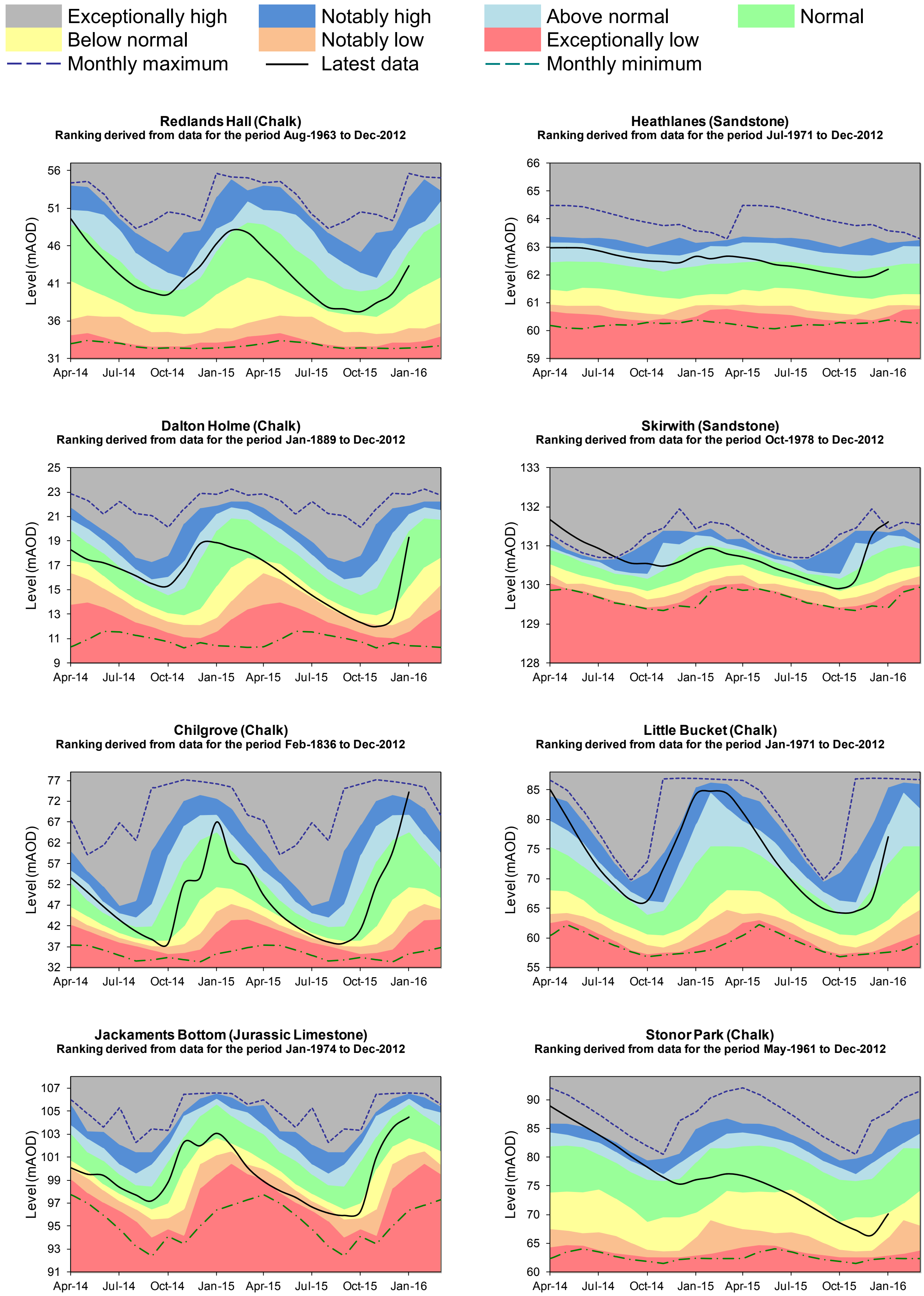
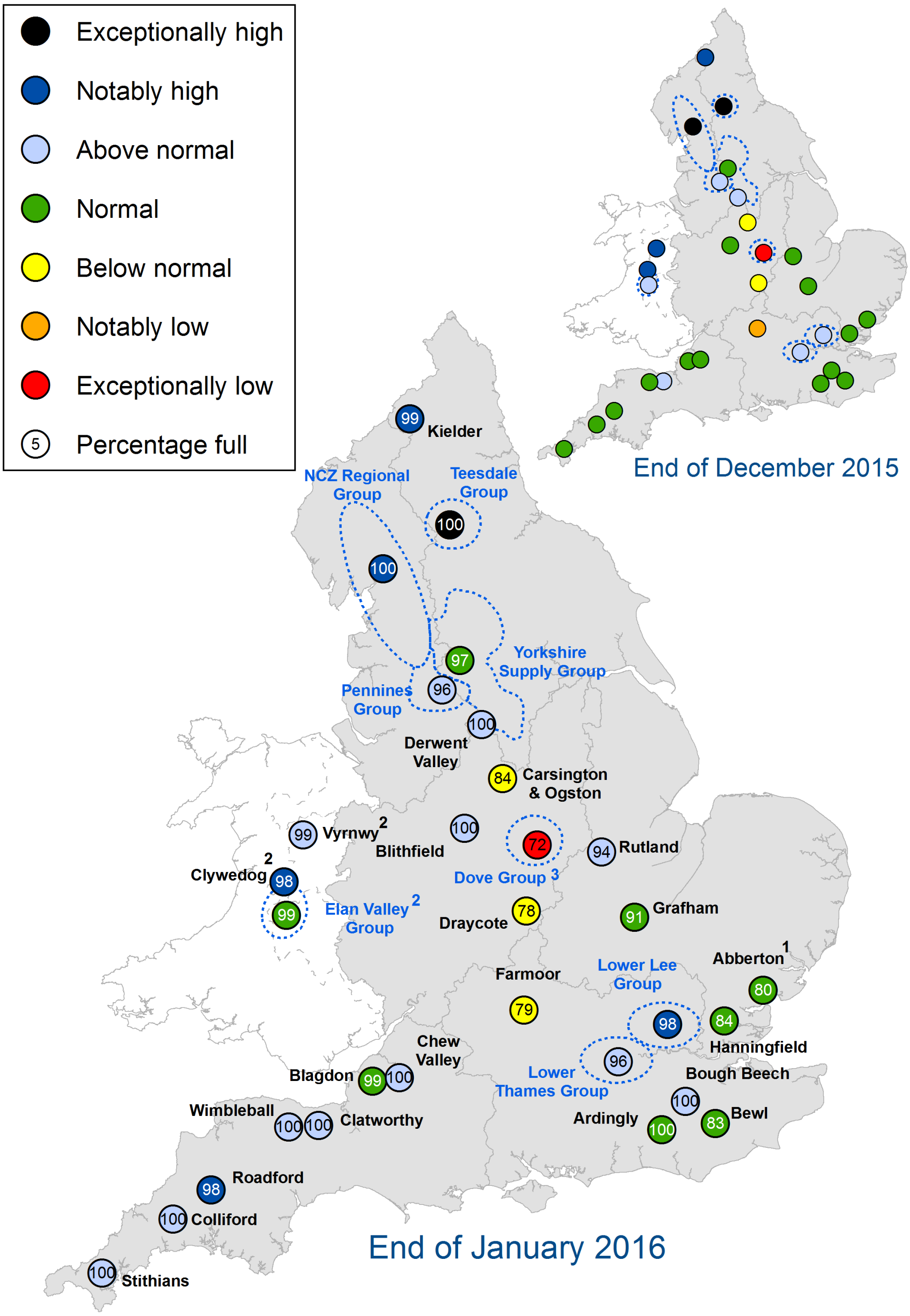


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2016).

Reservoir storage



1. Engineering work at Abberton Reservoir in east England to increase capacity has been completed
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to Central and north-west England
3. Levels at the Dove reservoir group are recovering after levels were lowered for operational reasons in 2015

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of December 2015 and January 2016 as a percentage of total capacity and classed relative to an analysis of historic December and January 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.

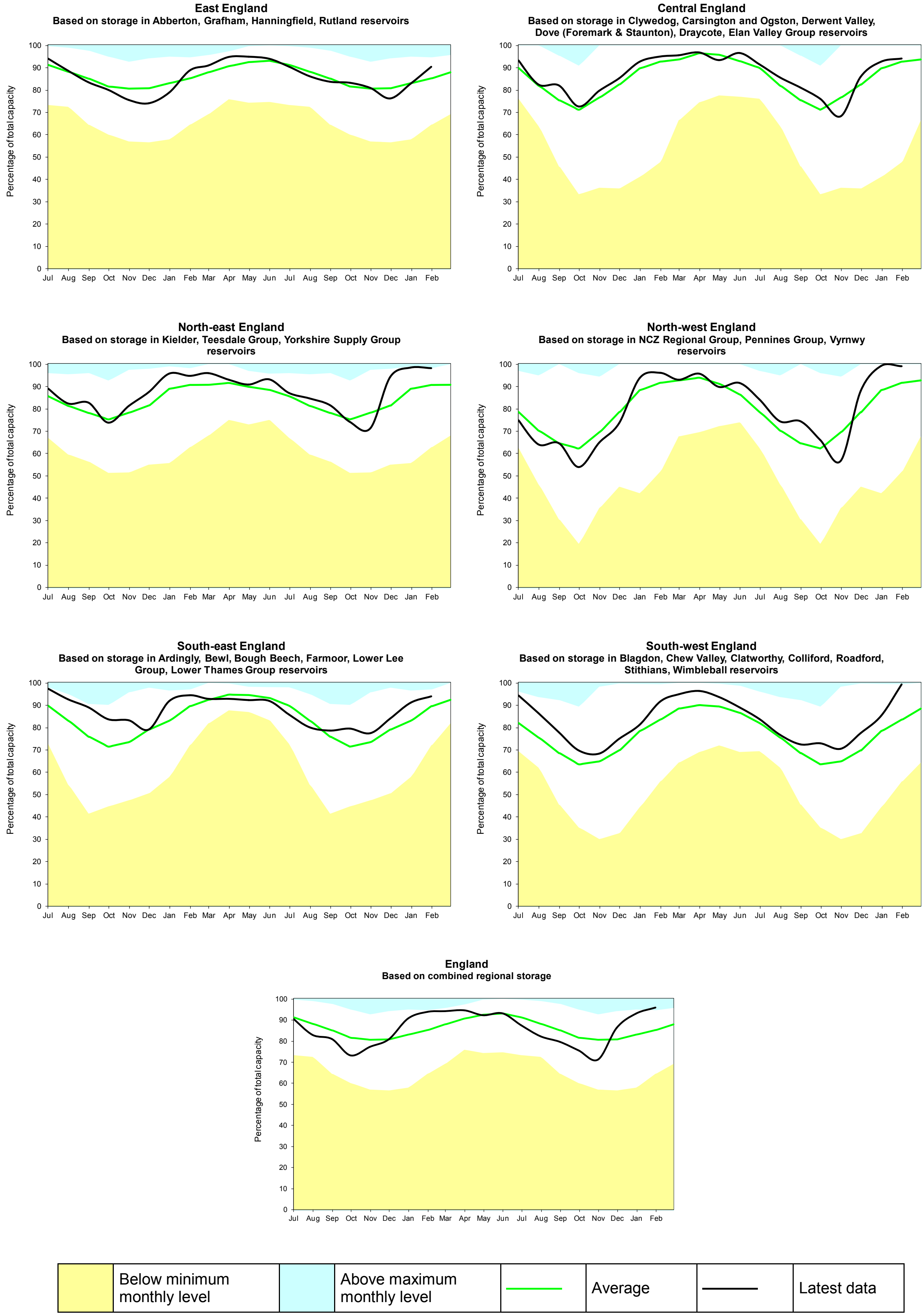


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

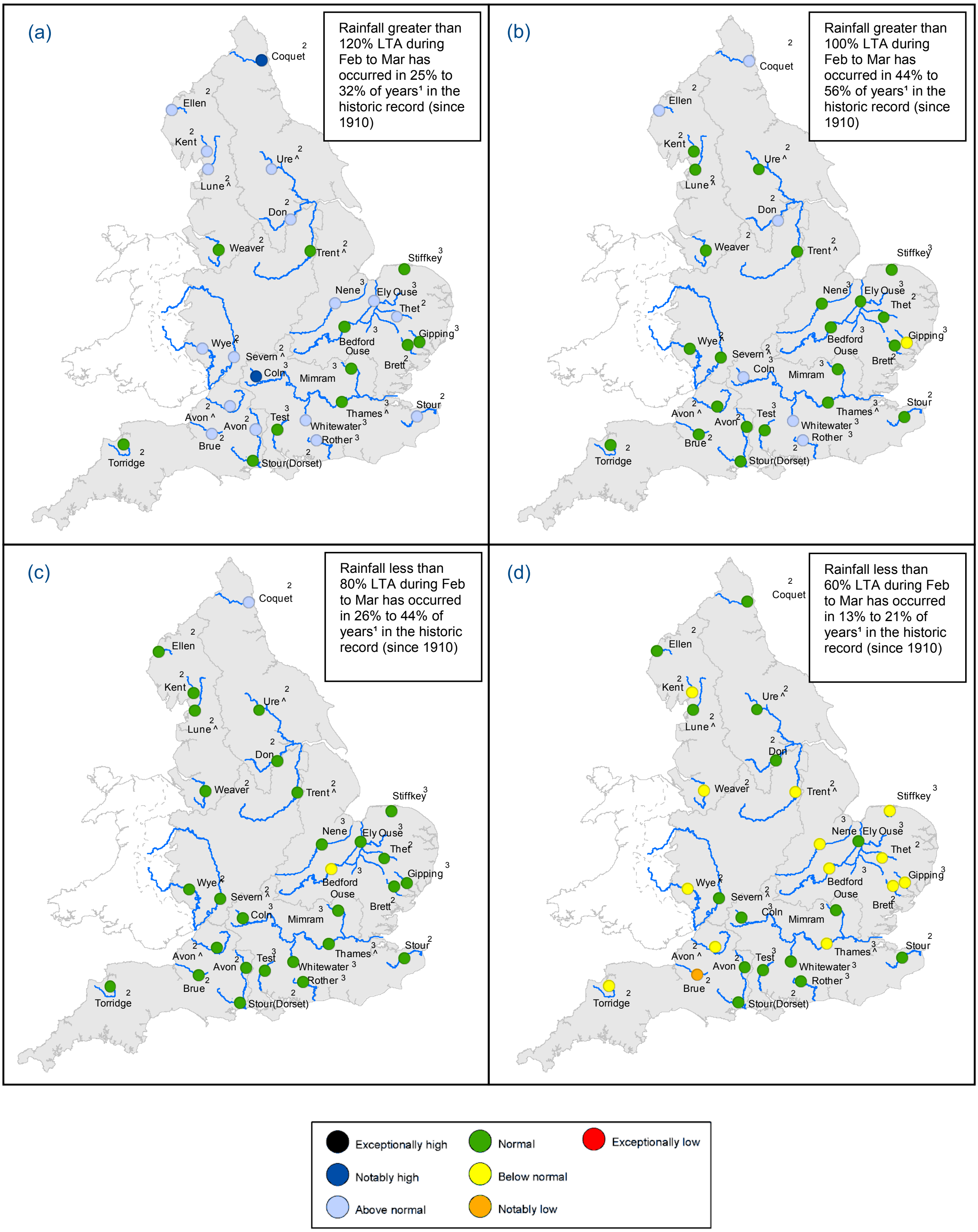


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between February and March 2016 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*

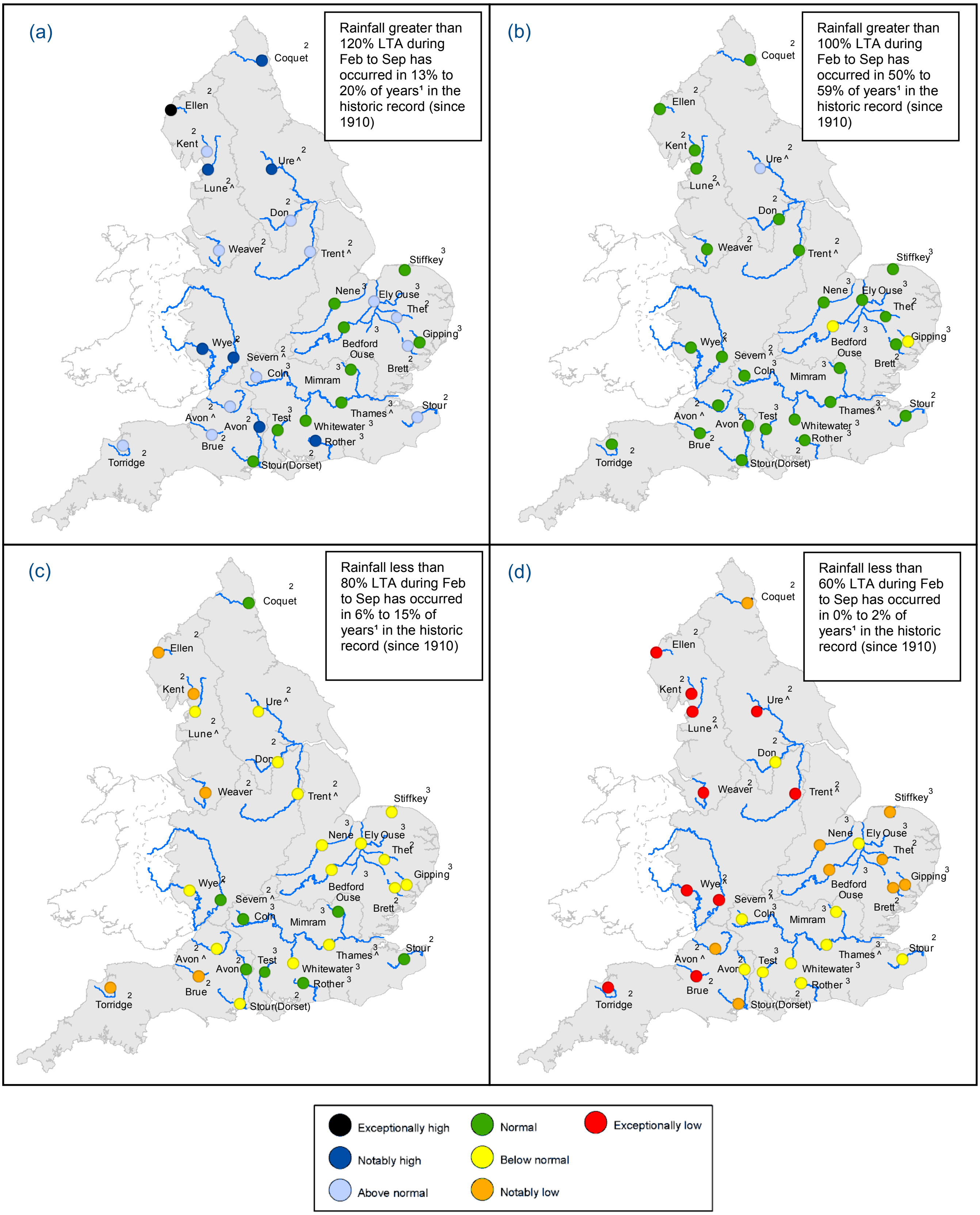


Figure 6.2: Projected river flows at key indicator sites up until the end of September 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between February and September 2016 (Source: Centre for Ecology and Hydrology, Environment Agency)

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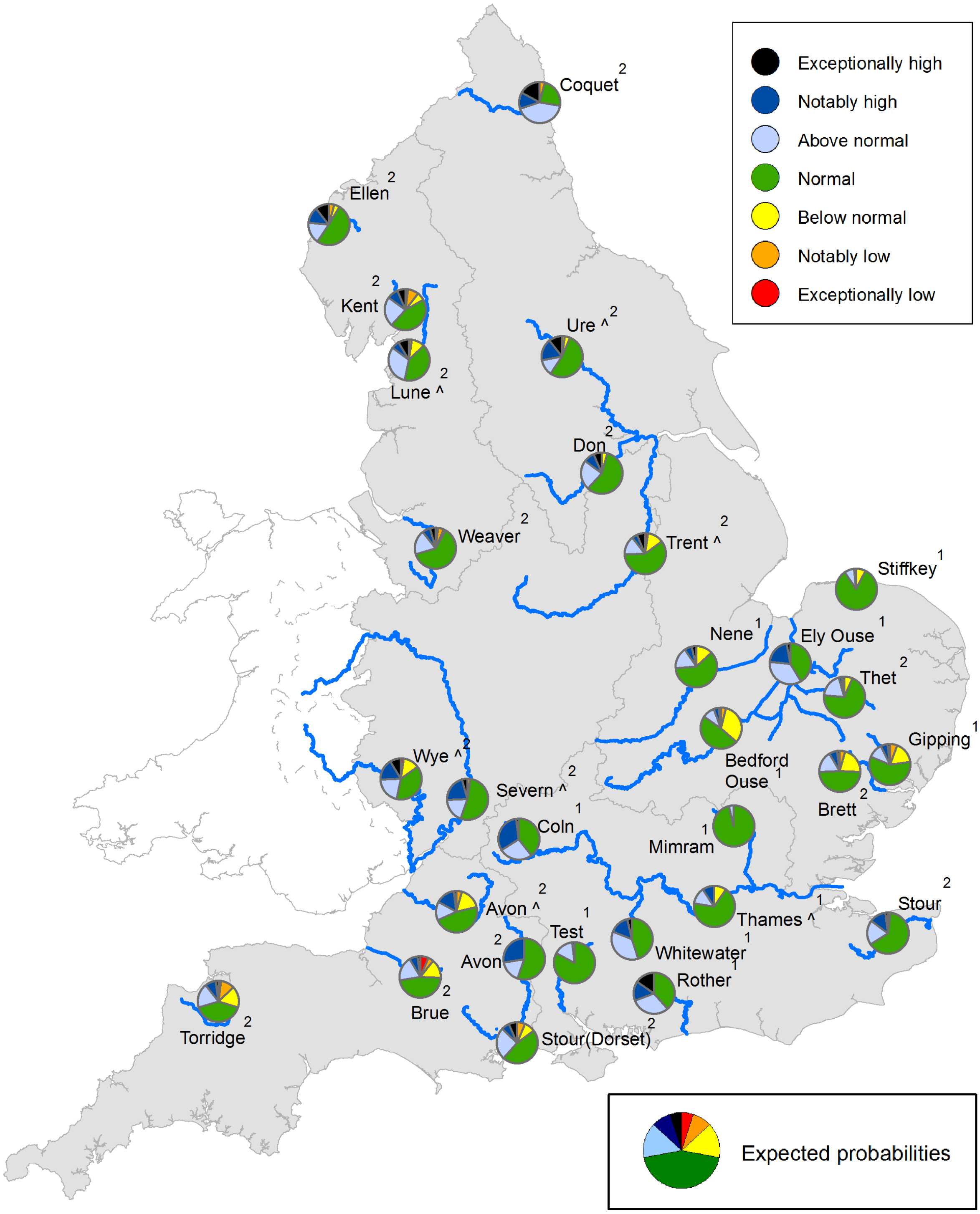

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

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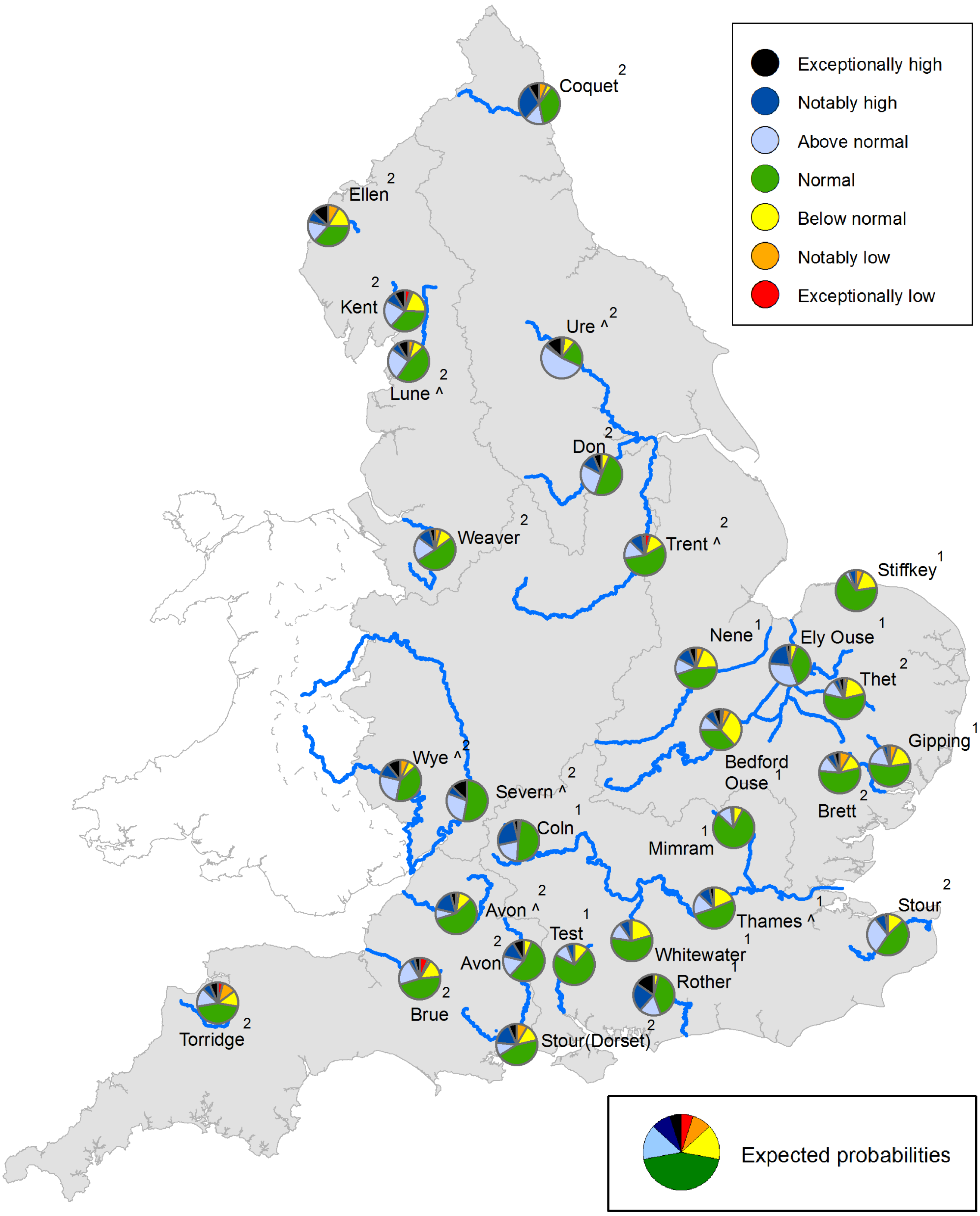

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 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).

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Forward look - groundwater

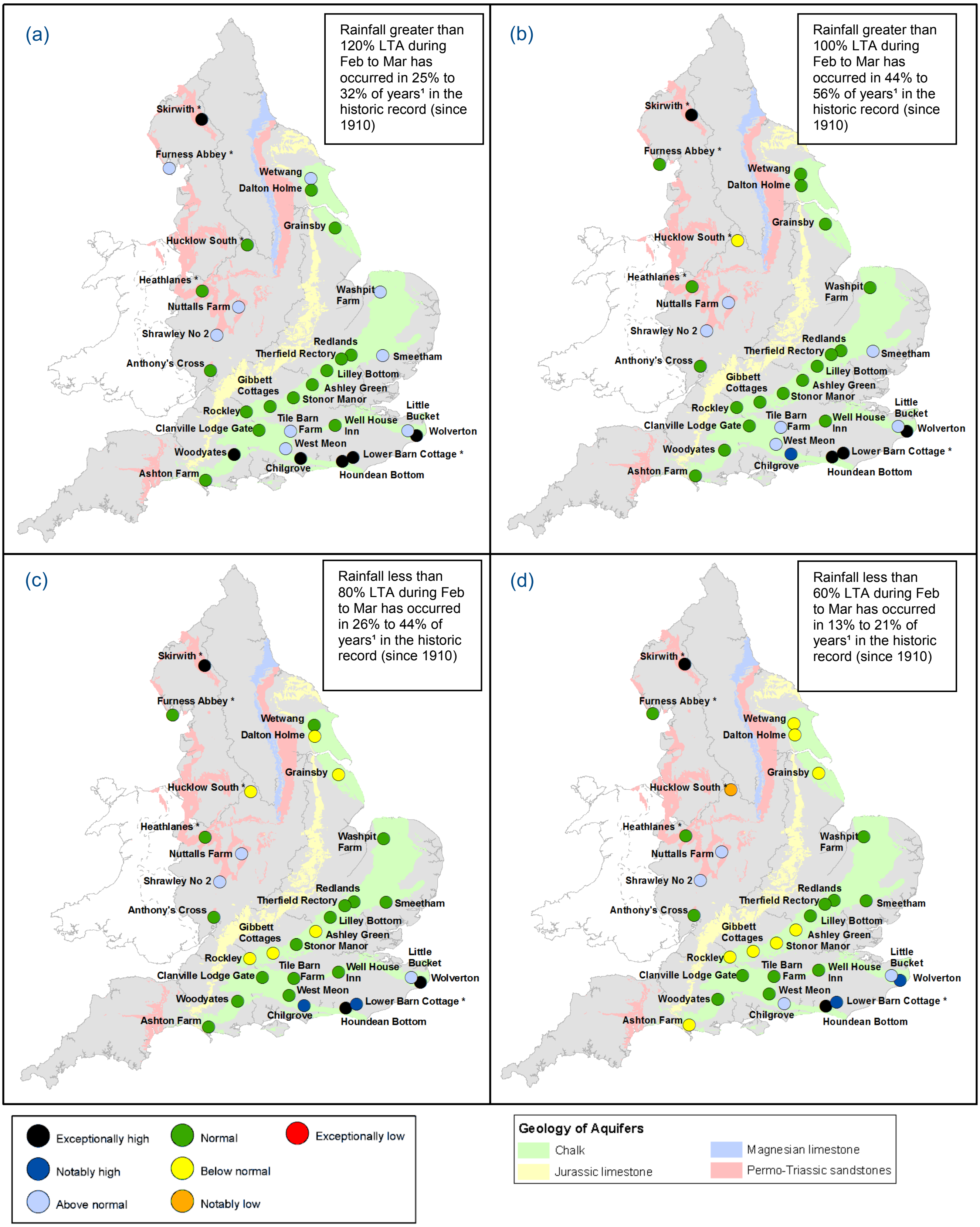

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between February and March 2016 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2016.

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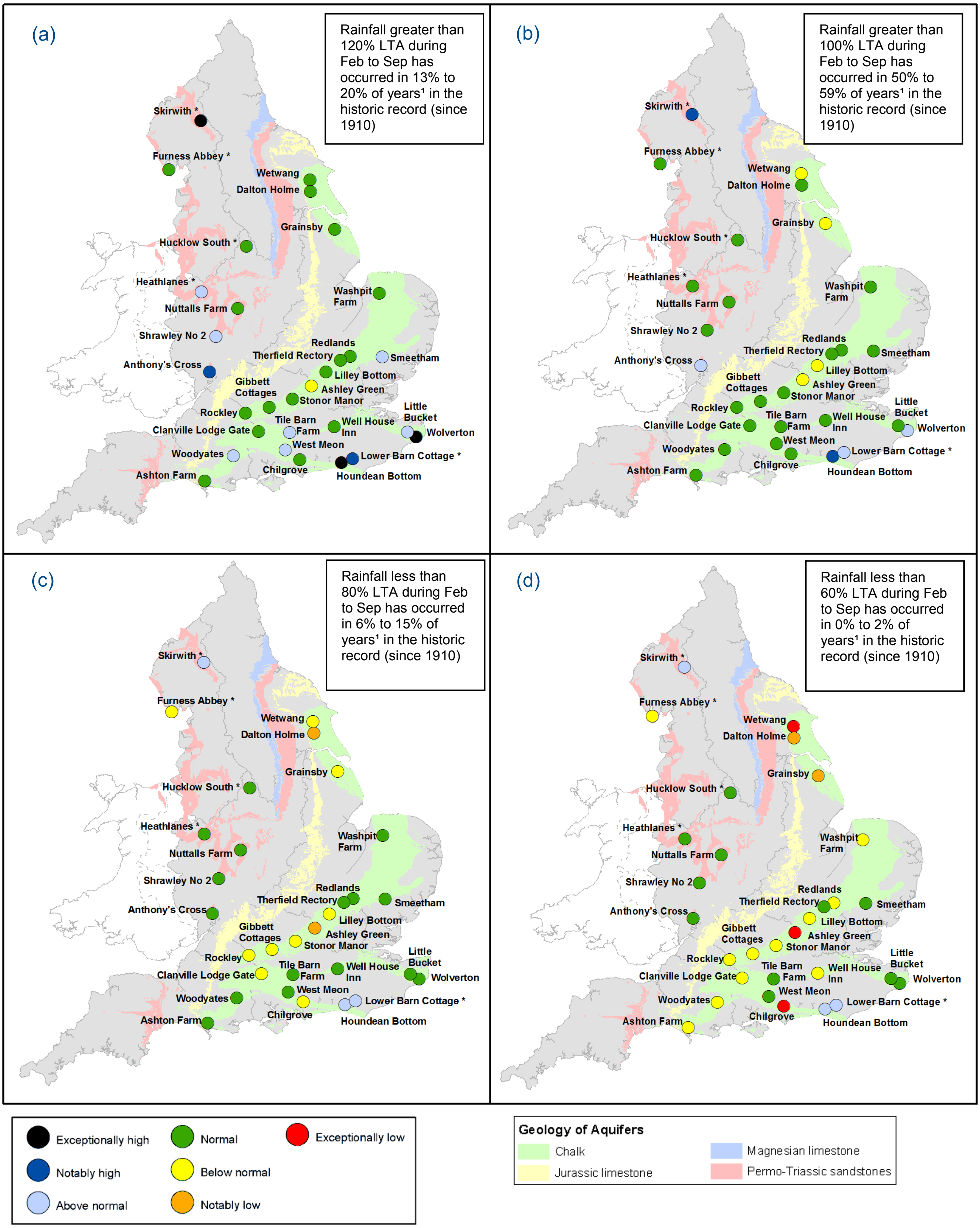

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between February and September 2016 (Source: Environment Agency) Geological map reproduced with kind permission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

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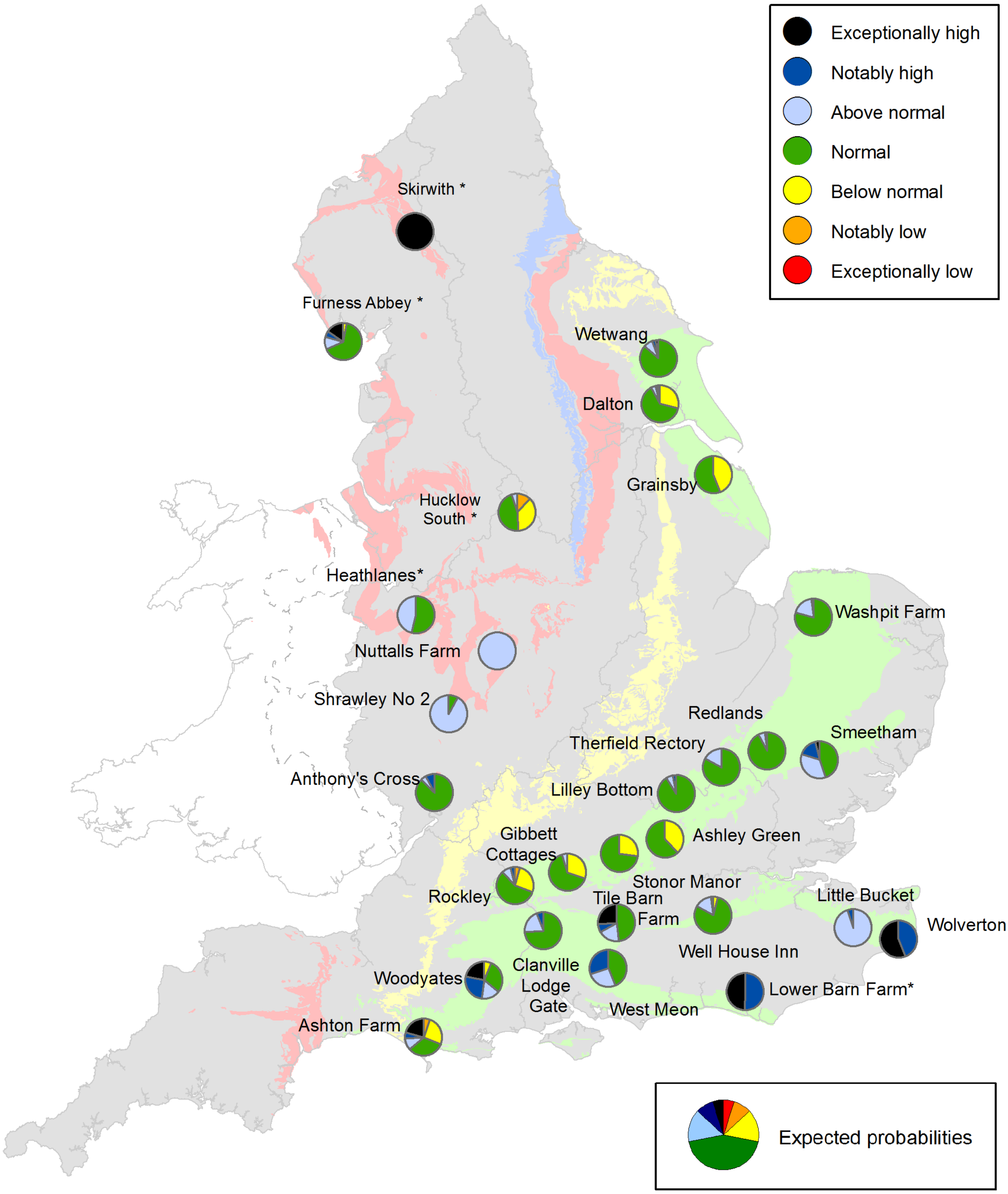
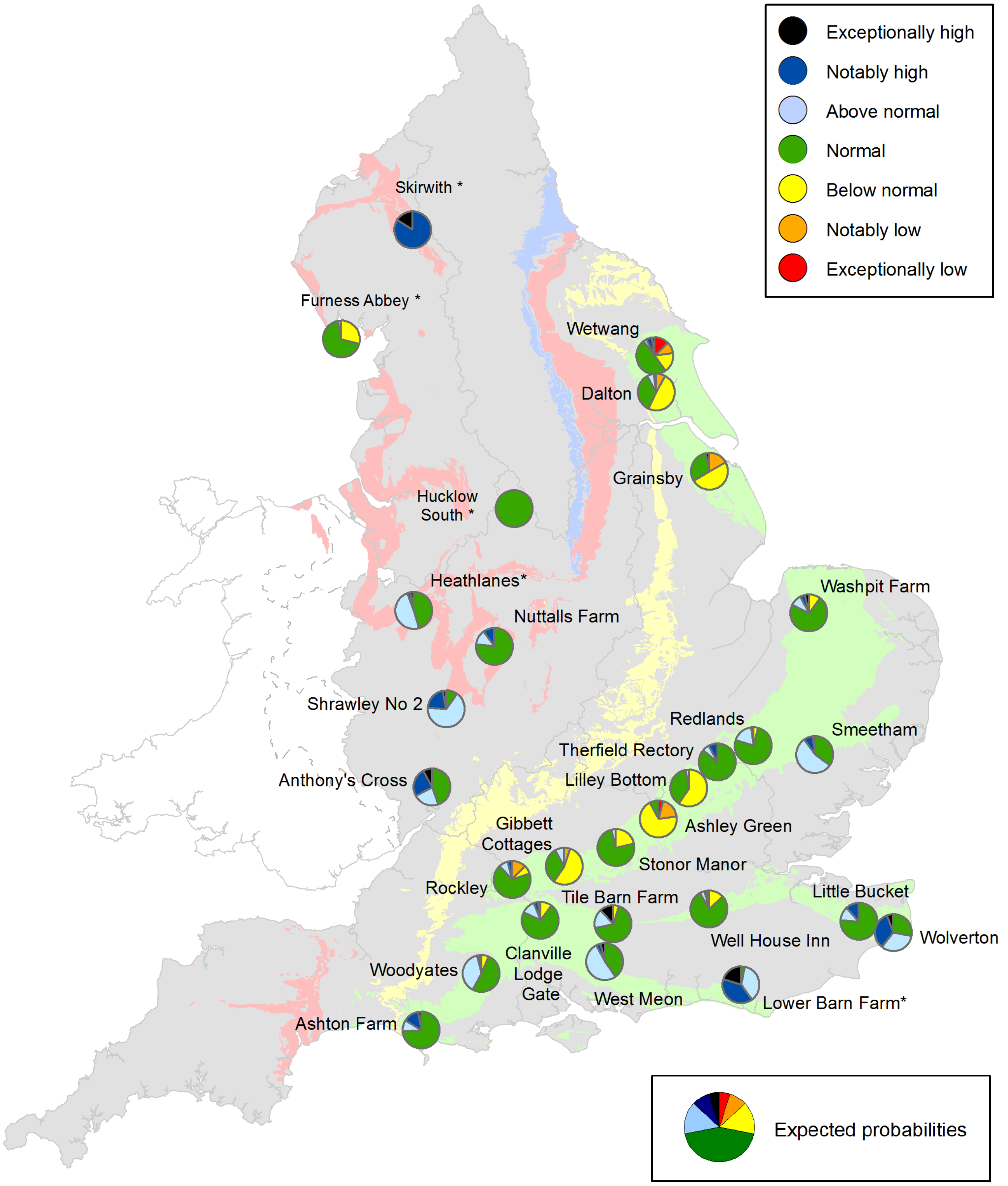
[1] This range of probabilities is a regional analysis



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 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, 2016.

** 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 September 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, 2016.

* 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