Monthly water situation report

England

Summary – May 2016

Although May has been considerably drier than April, especially in the north and west, the average rainfall for England has been above average for the seventh consecutive month. Monthly mean river flows have decreased at all indicator sites, but remain normal across much of England. Soil moisture deficits increased across most of England, as expected for the time of year. Groundwater levels decreased at the majority of indicator sites, but remain normal or higher at all but one of the sites. Reservoir stocks decreased at just over two-thirds of reported reservoirs and reservoir groups during May.

Rainfall

Rainfall totals for May ranged from less than 35 mm over the north Pennines to more than 80 mm in parts of south-west and south-east England. Monthly rainfall totals were above the May long term average (LTA) in just over one-third of hydrological areas across England, with the Berkshire Downs hydrological area receiving more than 150% of the May LTA rainfall. A quarter of hydrological areas received rainfall of less than 75% of the LTA, with the Esk (Dumfries) and Eden (Cumbria) receiving less than 50% of the long term average for May (Figure 1.1).

For much of England, rainfall totals for May were normal or above normal for the time of year. Parts of north-west and north-east England and also parts of Cornwall were below normal or lower for the time of year. Over the three month period to the end of May, cumulative rainfall totals were above normal or higher for much of central, eastern and southern England and were normal or below for the time of year elsewhere, particularly in north and west and south-west England where (Figure 1.2).

At the regional scale, May rainfall totals ranged from 64% of the LTA in north-west England to 114% in south-east England. The six-month period ending in May was the wettest on record for north-east and north-west England. Rainfall totals across England as a whole were above average for the seventh consecutive month, at 114% of the May LTA (Figure 1.3).

Soil moisture deficit

Soil Moisture Deficits (SMDs) increased across almost all of England during May, with the largest increases occurring in central, north-east and north-west England. At the end of May, values were between 41 mm and 70 mm across two-thirds of England and between 11 mm and 40 mm in most others areas (Figure 2.1).

End of month SMDs were less than the long term average (LTA) for the end of May in most of east and south-east England and parts of central, north and south-west England. SMDs were greater than the end of May LTA in many parts of north-east, north-west and south-west England (Figure 2.1).

At a regional scale, SMDs increased during the month in all regions compared to the previous month. Values at the end of May ranged from 41 mm in north-east and north-west England, to 48 mm in central England (Figure 2.2).

River flows

Monthly mean river flows for May decreased compared with April at all indicator sites across England. The majority of our indicator sites were classed as normal or higher for the time of year, with almost three-quarters of sites being normal. Six sites in parts of the north-east, north-west and south-west of England were below normal or lower for the time of year (Figure 3.1).

At our regional index sites, monthly mean river flows were classed as normal for the time of year at Offord (Bedford Ouse), Marston-on-Dove (River Dove) and Horton (Great Stour) and below normal at Haydon Bridge (South Tyne), Caton (River Lune) and Thorverton (River Exe). The River Thames at Kingston was above normal for the time of year (Figure 3.2)

Groundwater levels

Groundwater levels decreased at three-quarters of indicator sites during May. At the end of the month, groundwater levels were normal for the time of year at more than half of the indictor sites and were above normal or higher at all but one of the remaining sites. Crossley Hill (Nottinghamshire and Doncaster Permo-Triassic sandstone) continues to be below normal for the time of year (Figure 4.1).

End of month groundwater levels at the major aquifer index sites were normal or higher for the time of year. Three of our indicator sites, Redlands (Cambridge and Ely Ouse chalk), Jackaments Bottom (Burford Jurassic limestone) and Stonor Park (south-west Chilterns chalk) were normal for the time of year. Heathlanes (Shropshire sandstone), Dalton Holme (Hull & East Riding chalk), Chilgrove (Chichester chalk) and Little Bucket (East Kent Stour chalk) were above normal and Skirwith (Carlisle Basin and Eden Valley sandstone) was notably high for the time of year (Figure 4.2).

Reservoir storage

Reservoir stocks decreased at just over two-thirds of reported reservoirs and reservoir groups during May. Reservoir stocks either stayed the same or increased slightly at the remaining reservoirs or reservoir groups. The largest increase in storage was at Kielder Reservoir (2%) and the largest decrease was for the Teesdale group and NCZ Regional group (11%). End of month stocks were classed as normal or higher for the time of year at the majority of reservoirs and reservoir groups. A number of reservoirs and reservoir groups supplying parts of north-east, north-west, central and east England were classed as below normal for the time of year (Figure 5.1).

At the regional scale, reservoir stocks at the end of May had decreased compared to the end of April in all parts of England. The largest decrease of 8% was in the north-west of England. Month end regional stocks for the end of May ranged from 82% of total capacity in north-west England to 97% in south-east England. Reservoir storage at the end of May for England decreased slightly compared to April, with stocks being 91% of total capacity (Figure 5.2).

Forward look

June is likely to see unsettled weather mid-month for most of England with showers and heavy rain in places probable at times. After this, drier spells are expected, particularly in the south. Further ahead, for the period June-July-August there are no strong climatology signals favouring high or low precipitation[1].

Projections for river flows at key sites[2]

By the end of September 2016 two thirds of sites have a greater than expected chance of normal cumulative flows. By the end of March 2017, over half of the sites have a greater than expected chance of above normal or higher cumulative flows, but nearly a quarter of sites have a greater than expected chance of below normal or lower cumulative flows.

For scenario based projections of cumulative river flows at key sites by September 2016 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2017 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2016 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2017 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

At the end of September 2016 all but one of the projection sites have a greater than expected chance of normal or higher groundwater levels for the time of year. At the end of March 2017, the projections show a similar picture with the majority of sites having a greater than expected chance of normal or higher groundwater levels for the time of year.

For scenario based projections of groundwater levels in key aquifers in September 2016 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2017 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2016 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2017 see Figure 6.8

Authors: E&B Hydrology Team

1 Source: Met Office
2 Information produced for the Hydrological Outlook a partnership between the Environment Agency, Centre for Ecology and Hydrology, British Geological Survey and the Met Office (www.hydoutuk.net).

Rainfall

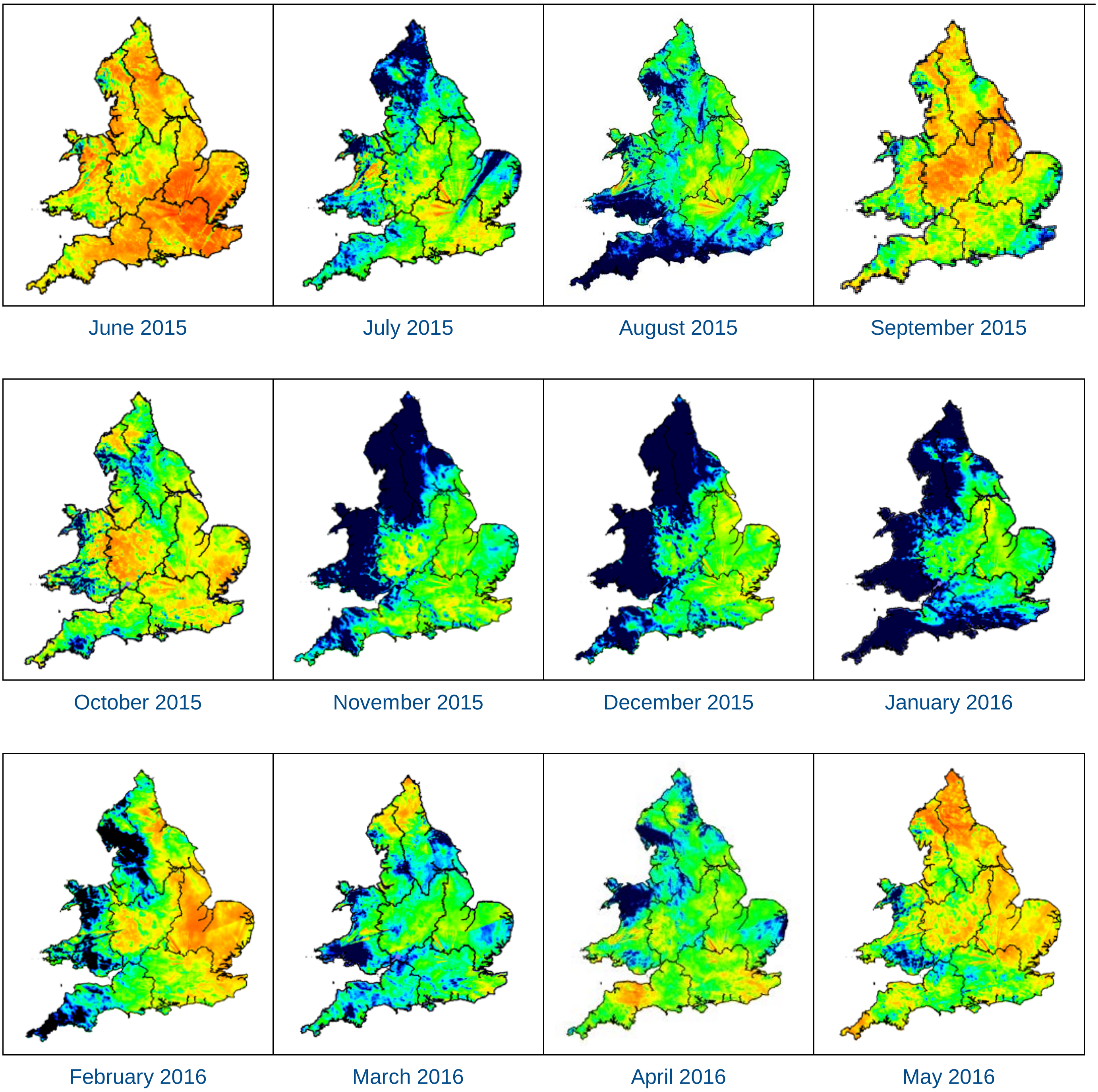
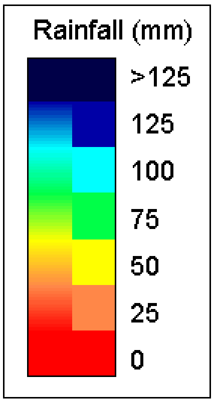


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2016). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.



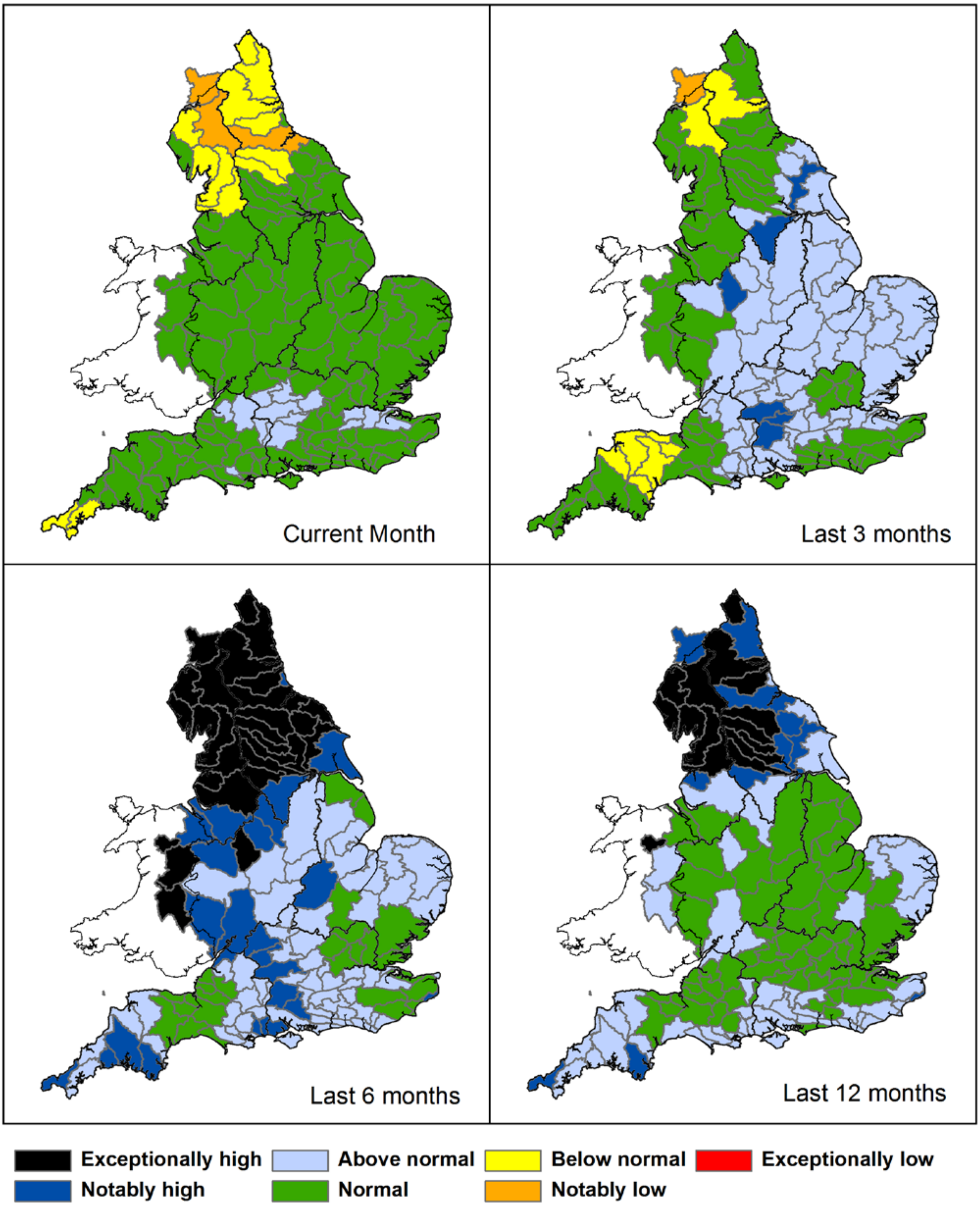


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 May), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2016).* Provisional data based on Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

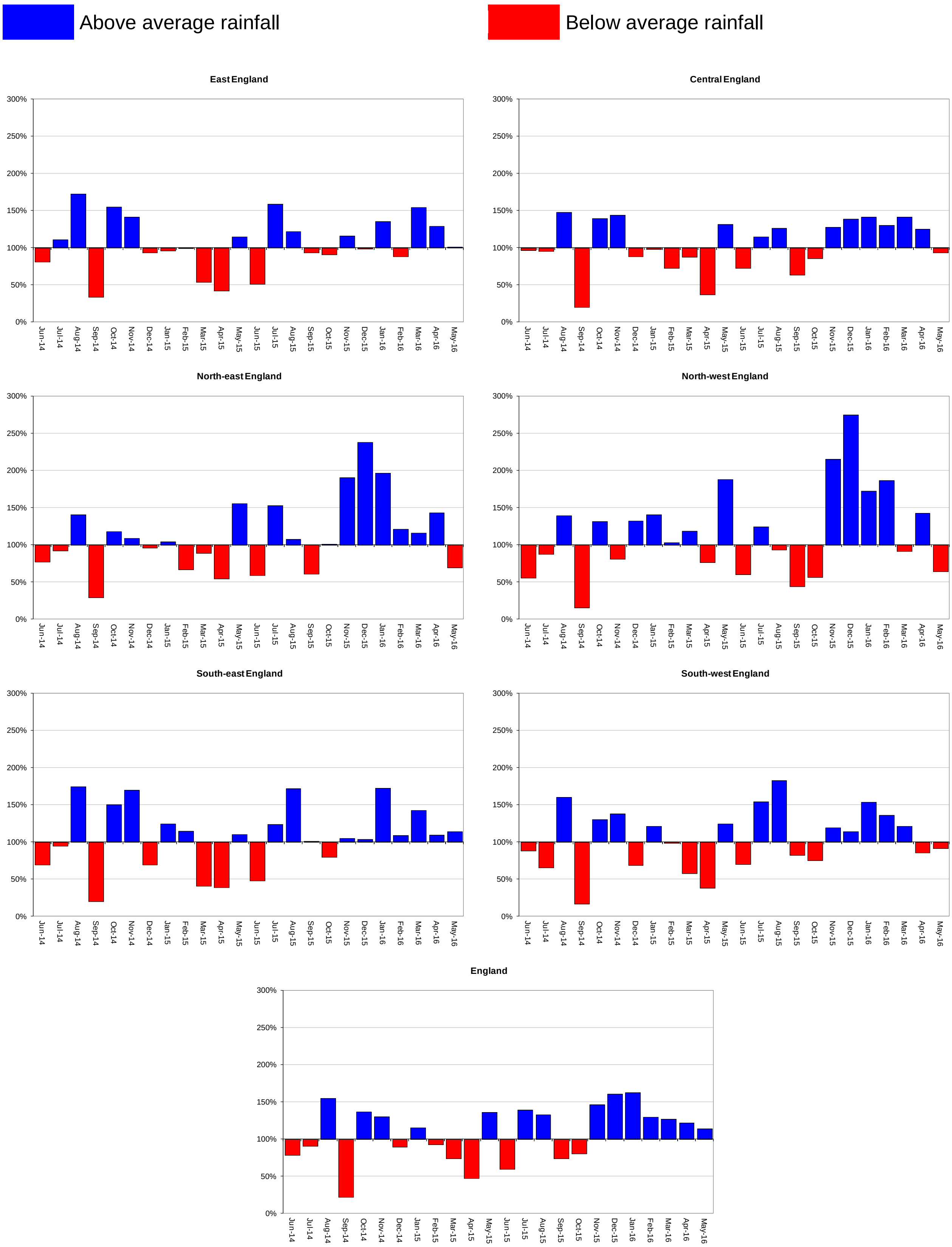


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each geographic region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2016).

Soil moisture deficit

End of April 2016[1]	End of May 2016[2]

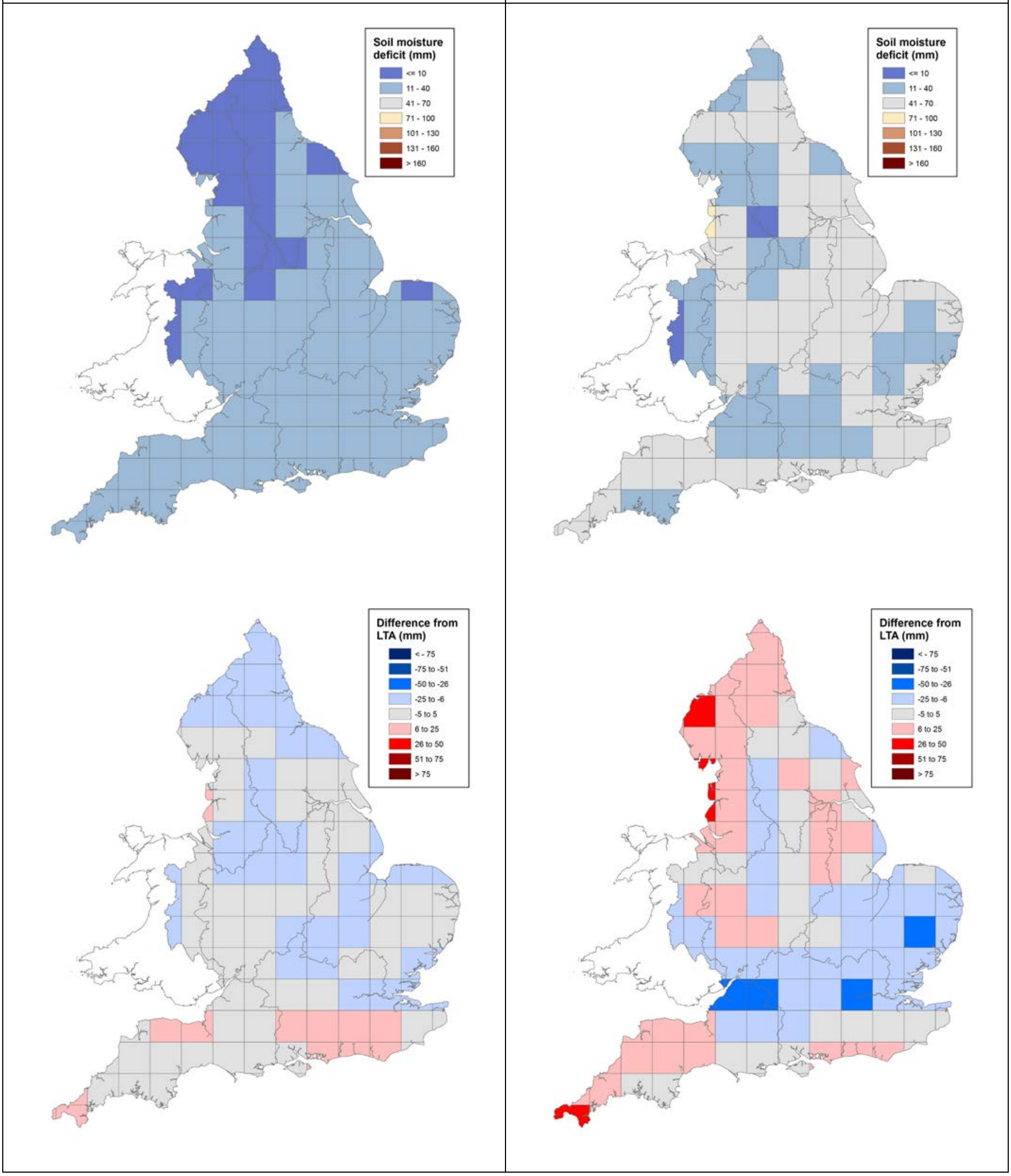


Figure 2.1: Soil moisture deficits for weeks ending 03 May 2016 [1] (left panel) and 31 May 2016 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2016). Crown copyright. All rights reserved. Environment Agency, 100026380, 2016

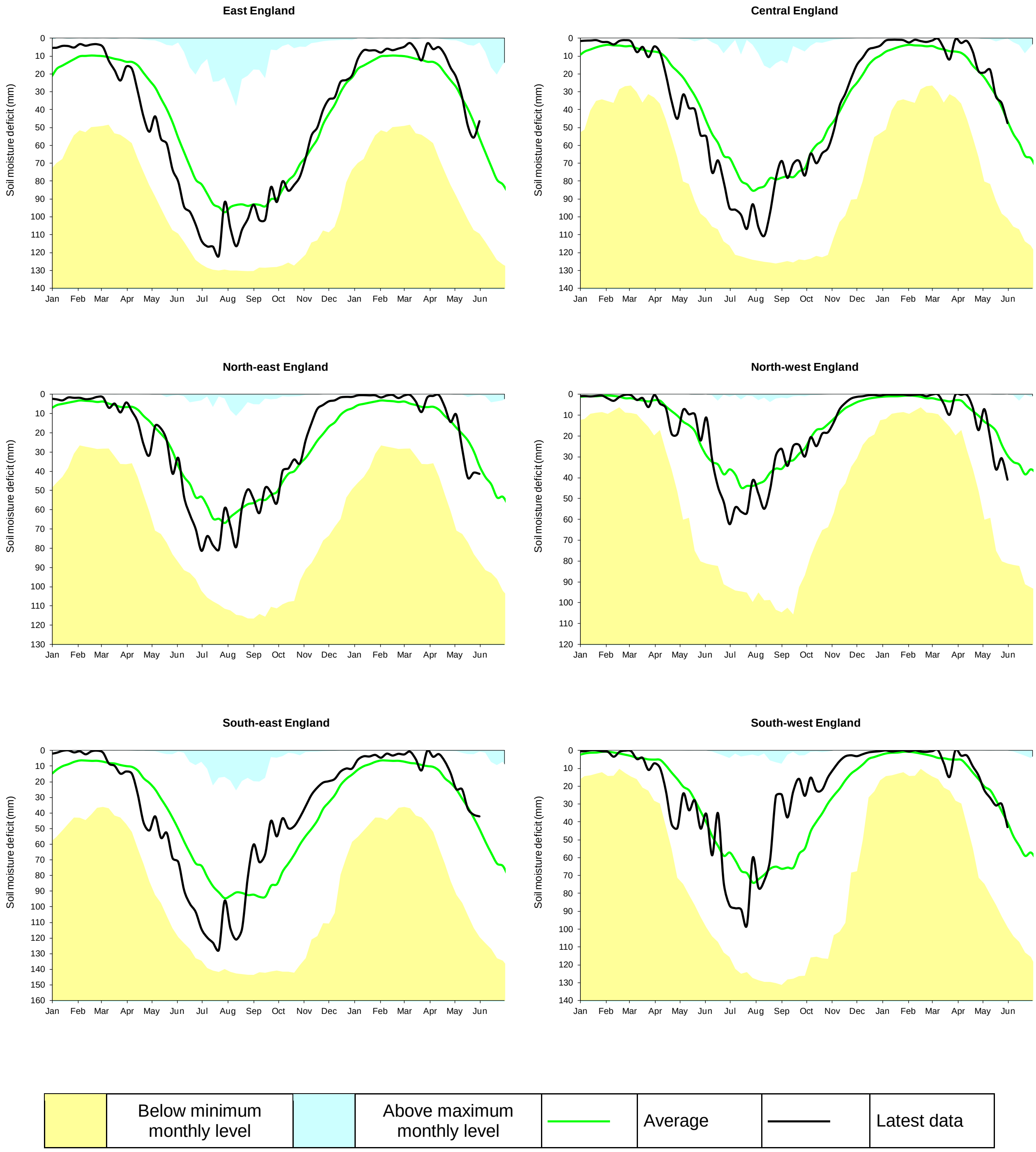
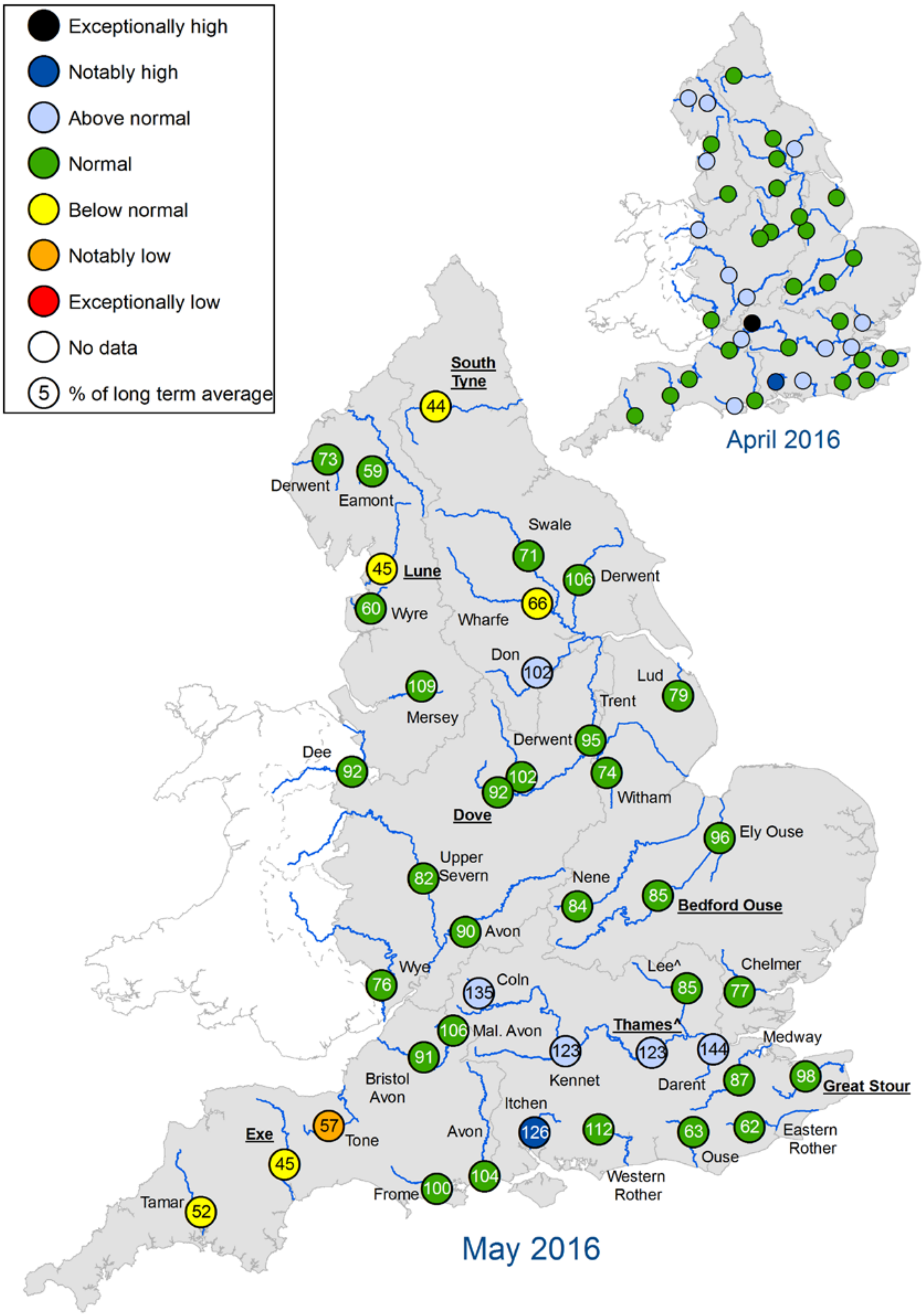


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2016).

River flows



^ "Naturalised" flows are provided for the 'Thames at Kingston' and the 'Lee at Feildes Weir'

+/- Monthly mean flow is the highest/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 2016 and May 2016, 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). Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

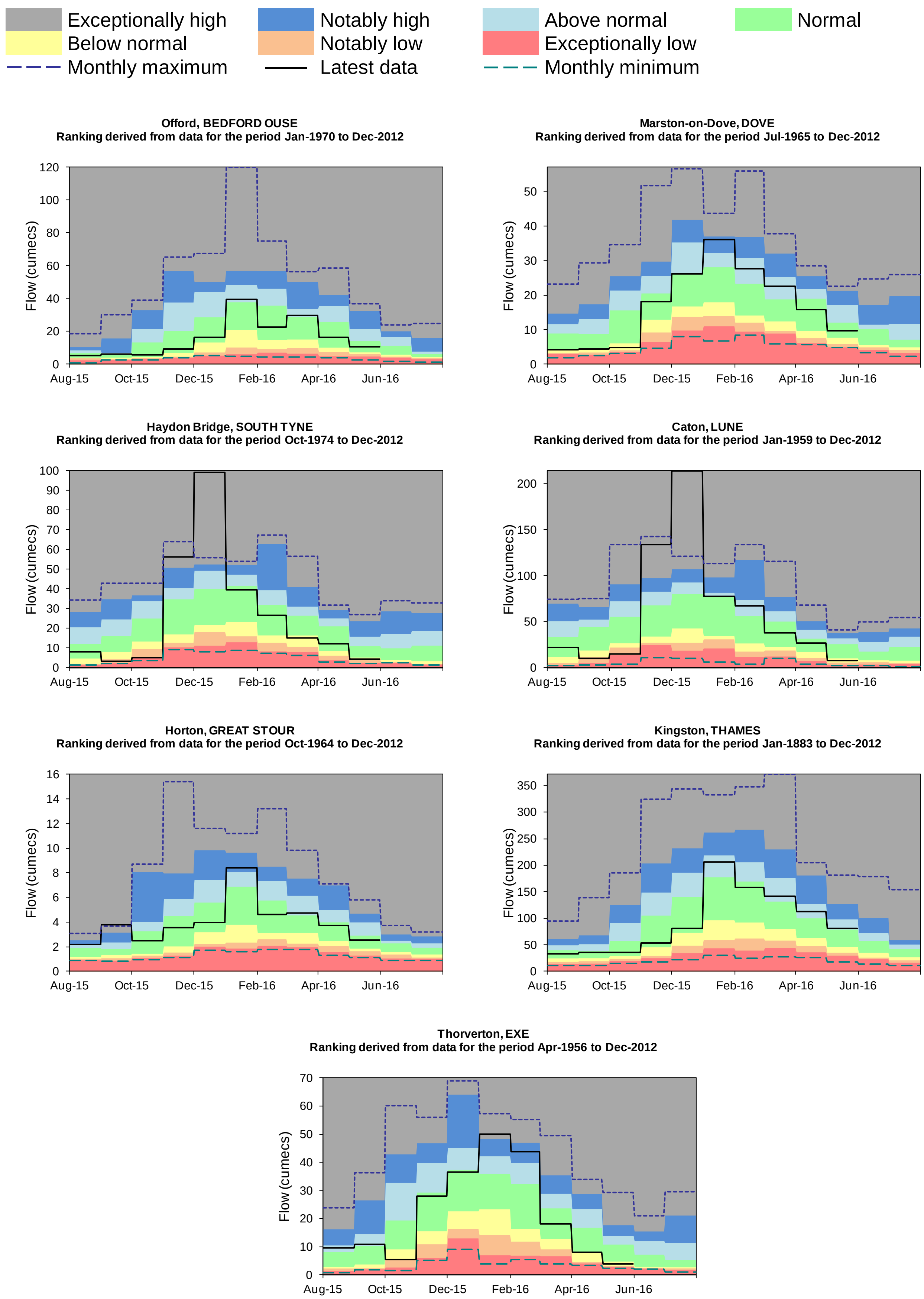
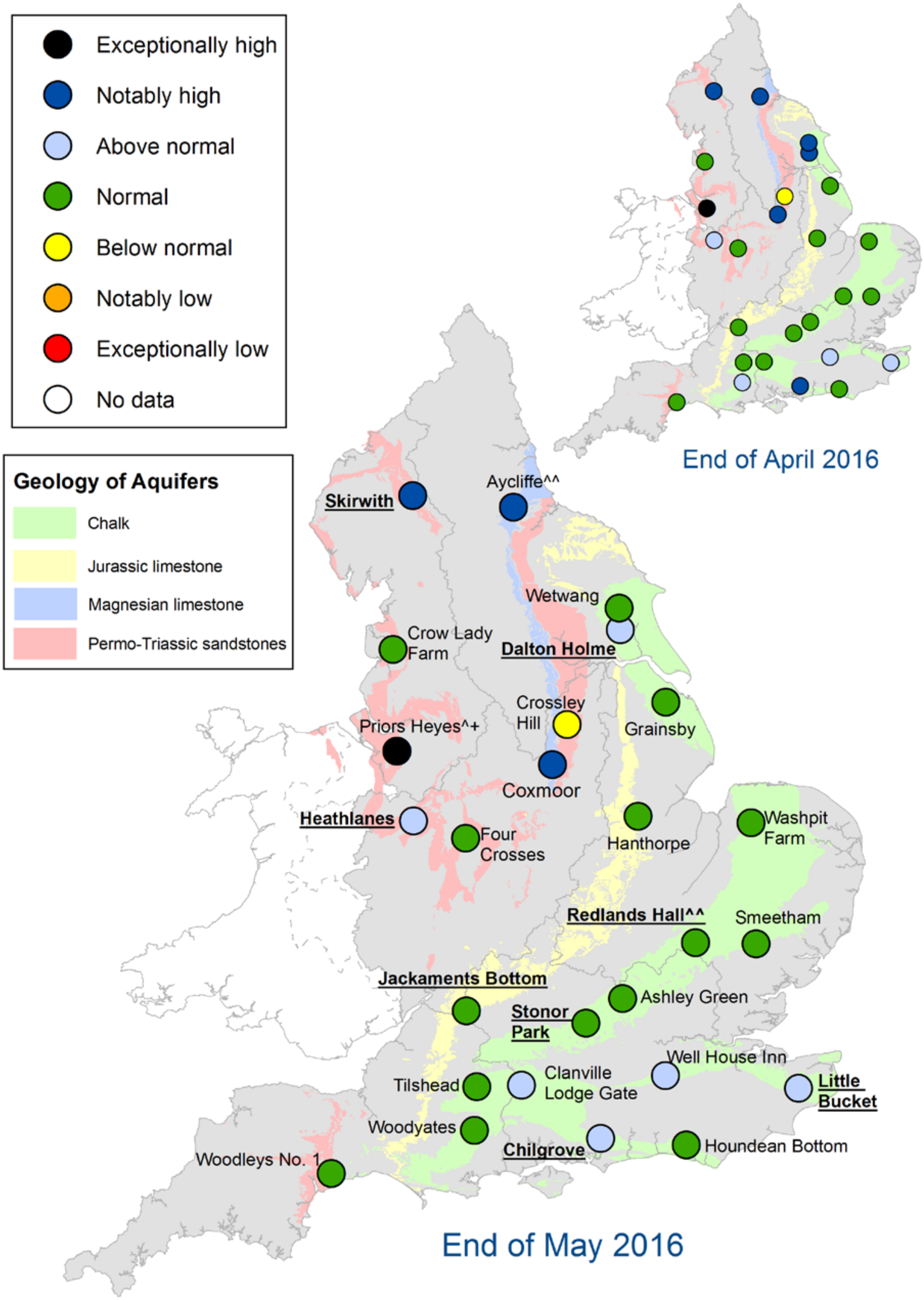


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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/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 2016 and May 2016, 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, 2016.

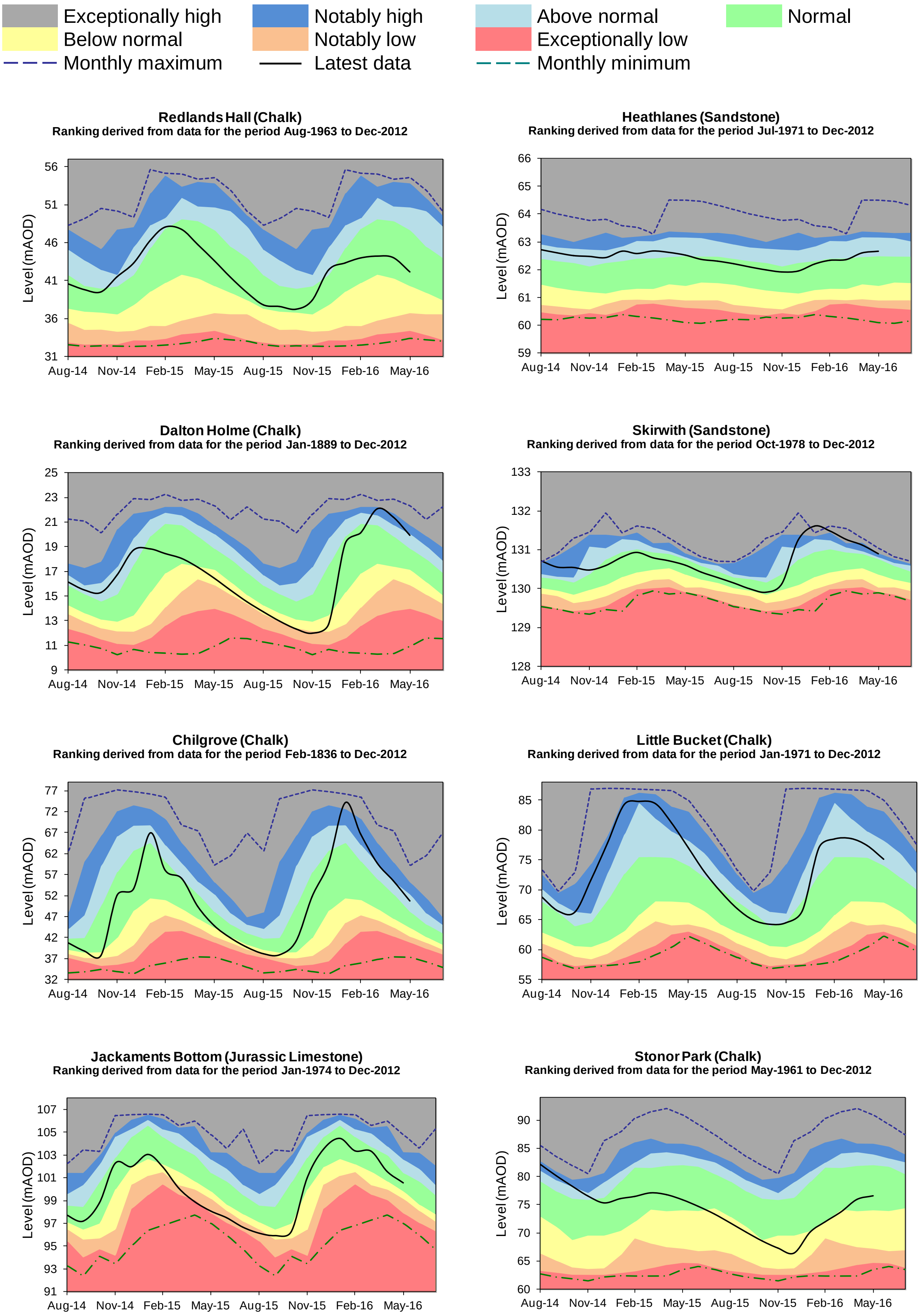
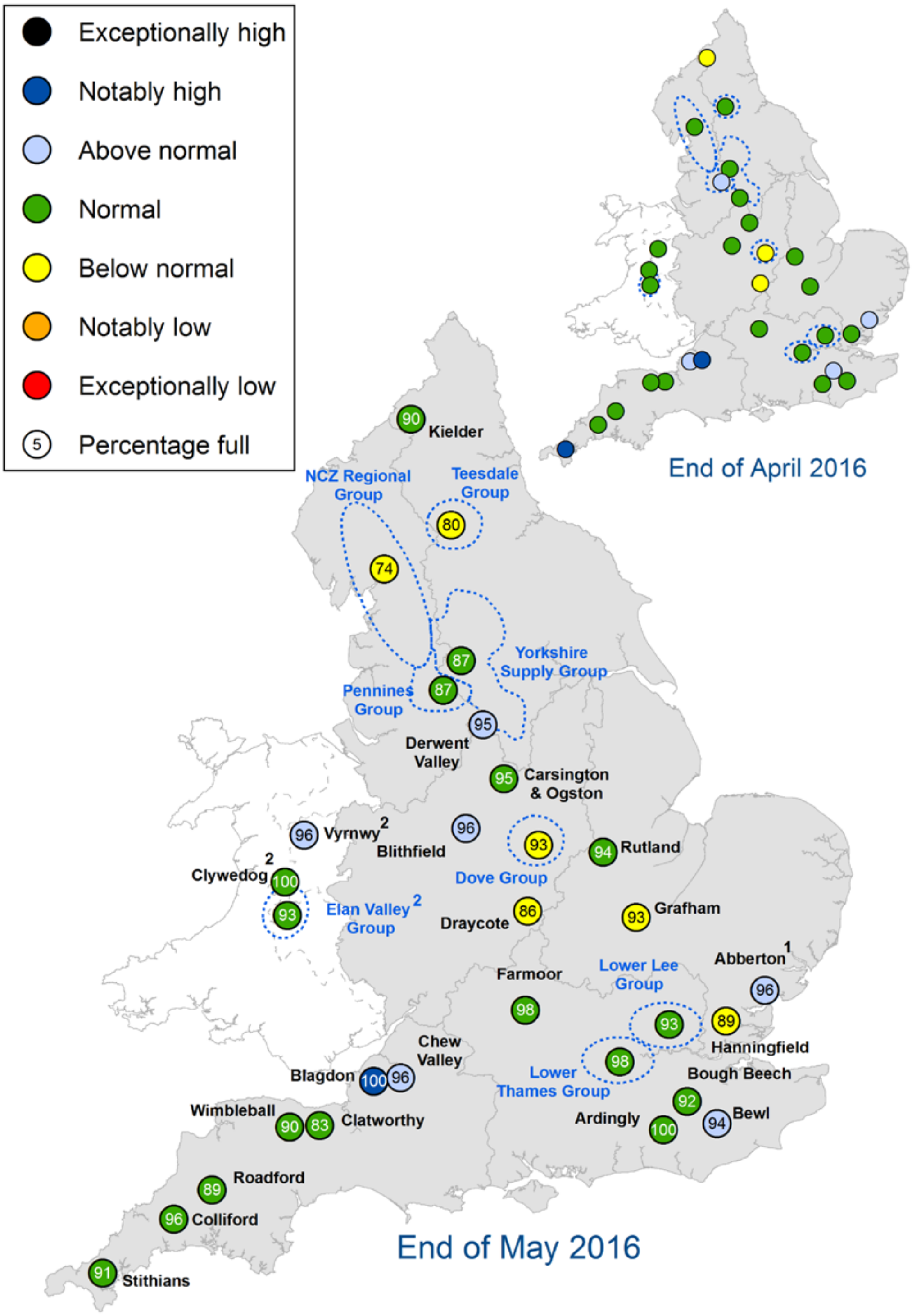


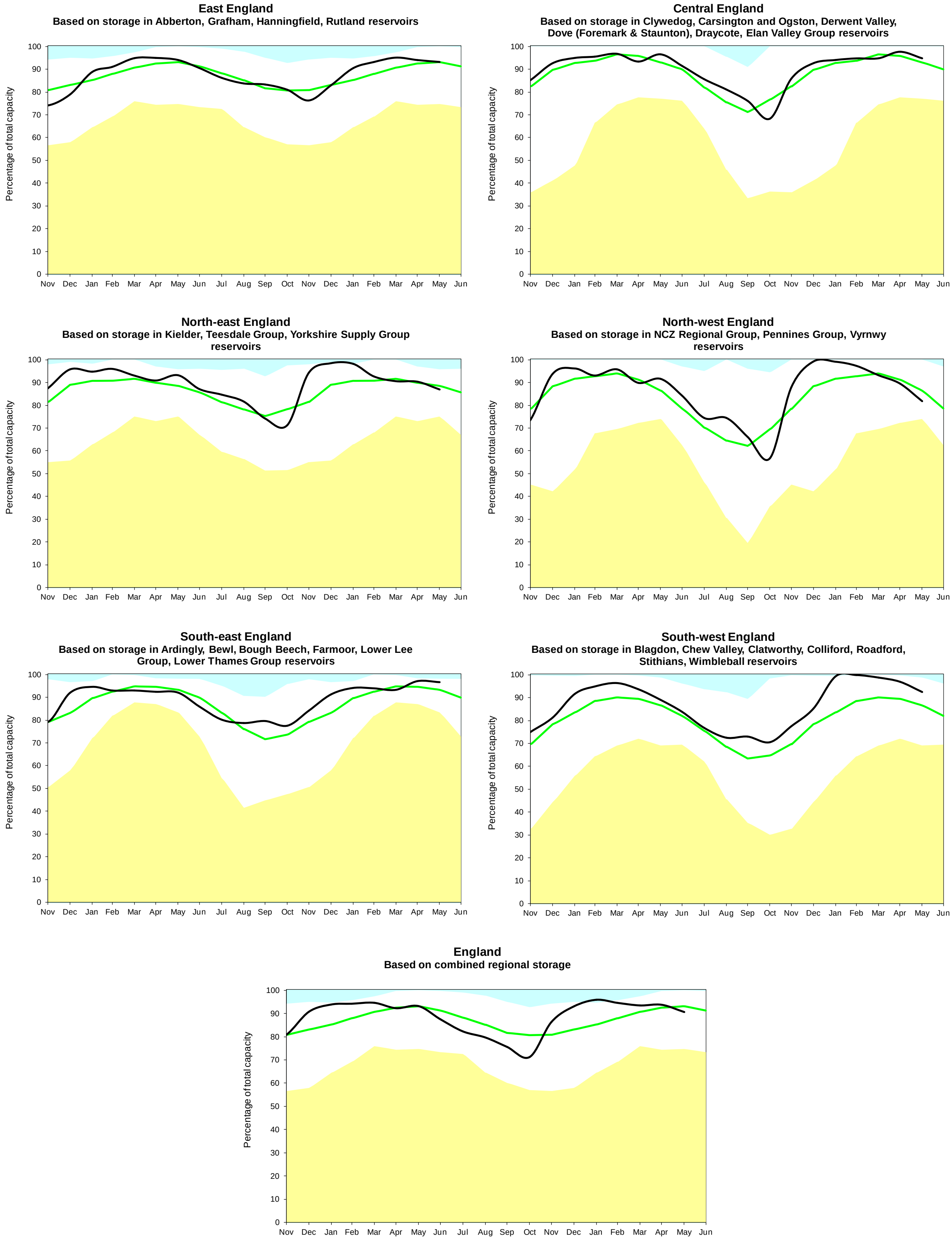
Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2016).

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

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of April 2016 and May 2016 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.



	Below minimum monthly level		Above maximum monthly level		Average		Latest data

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

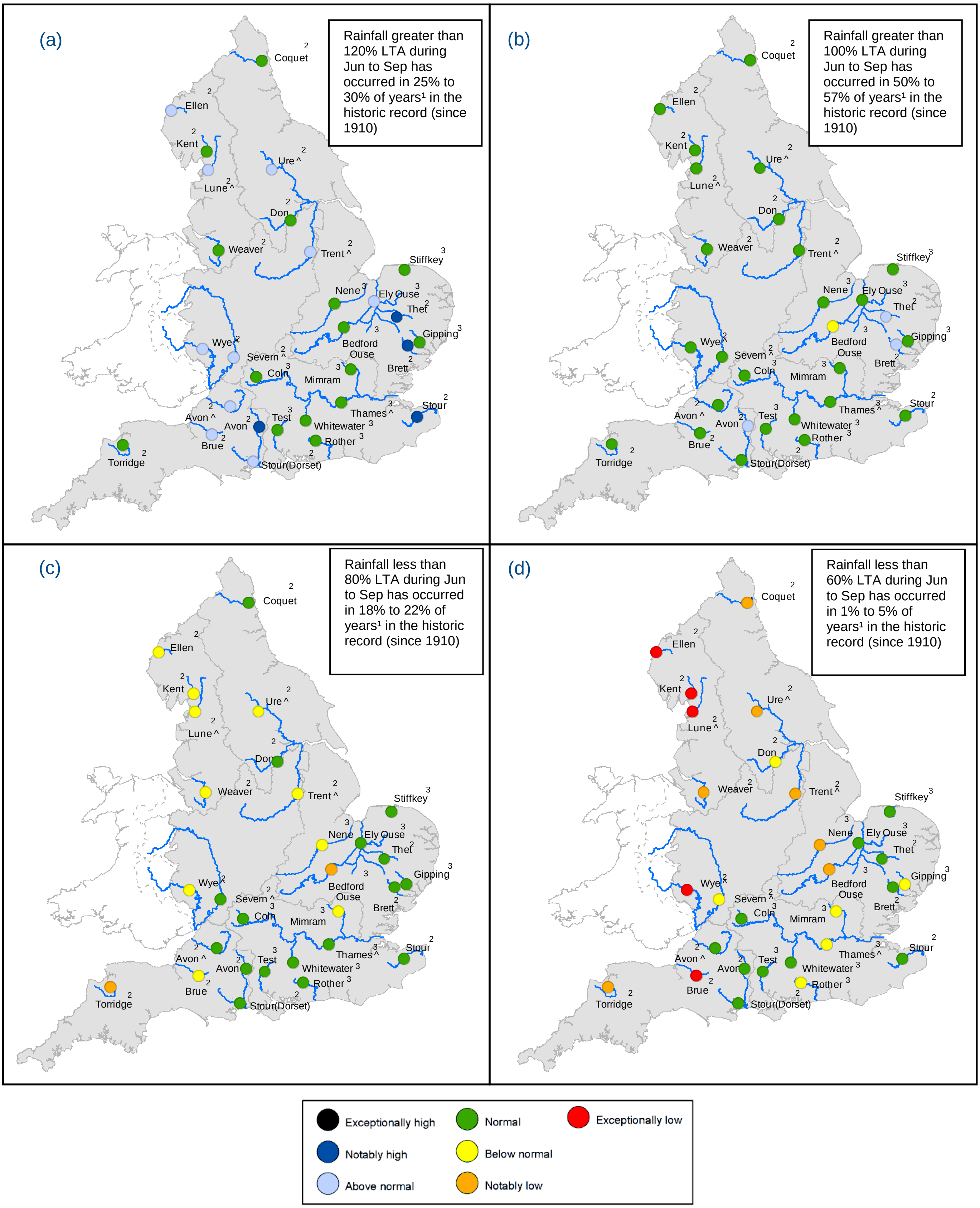


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June and September 2016 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*

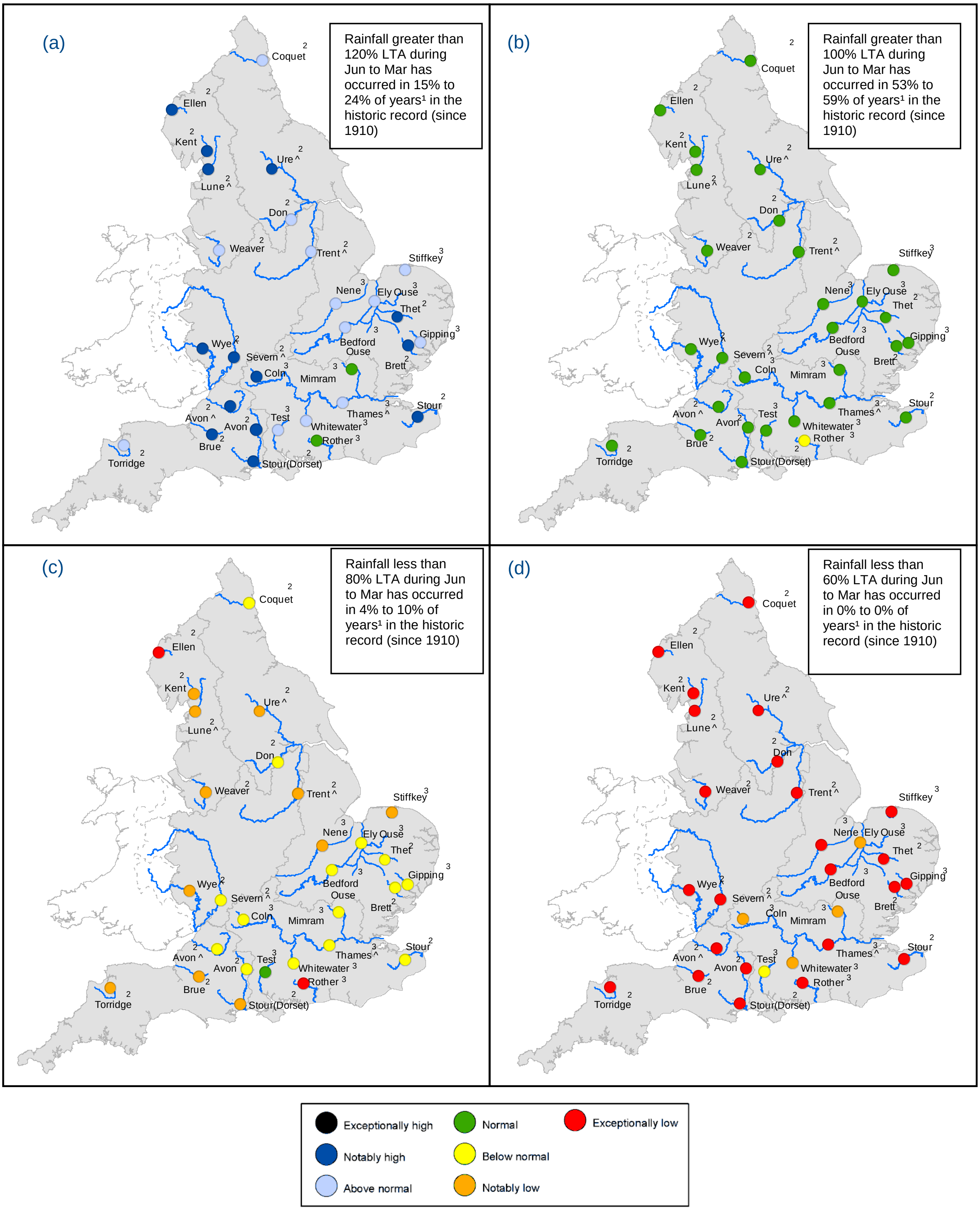


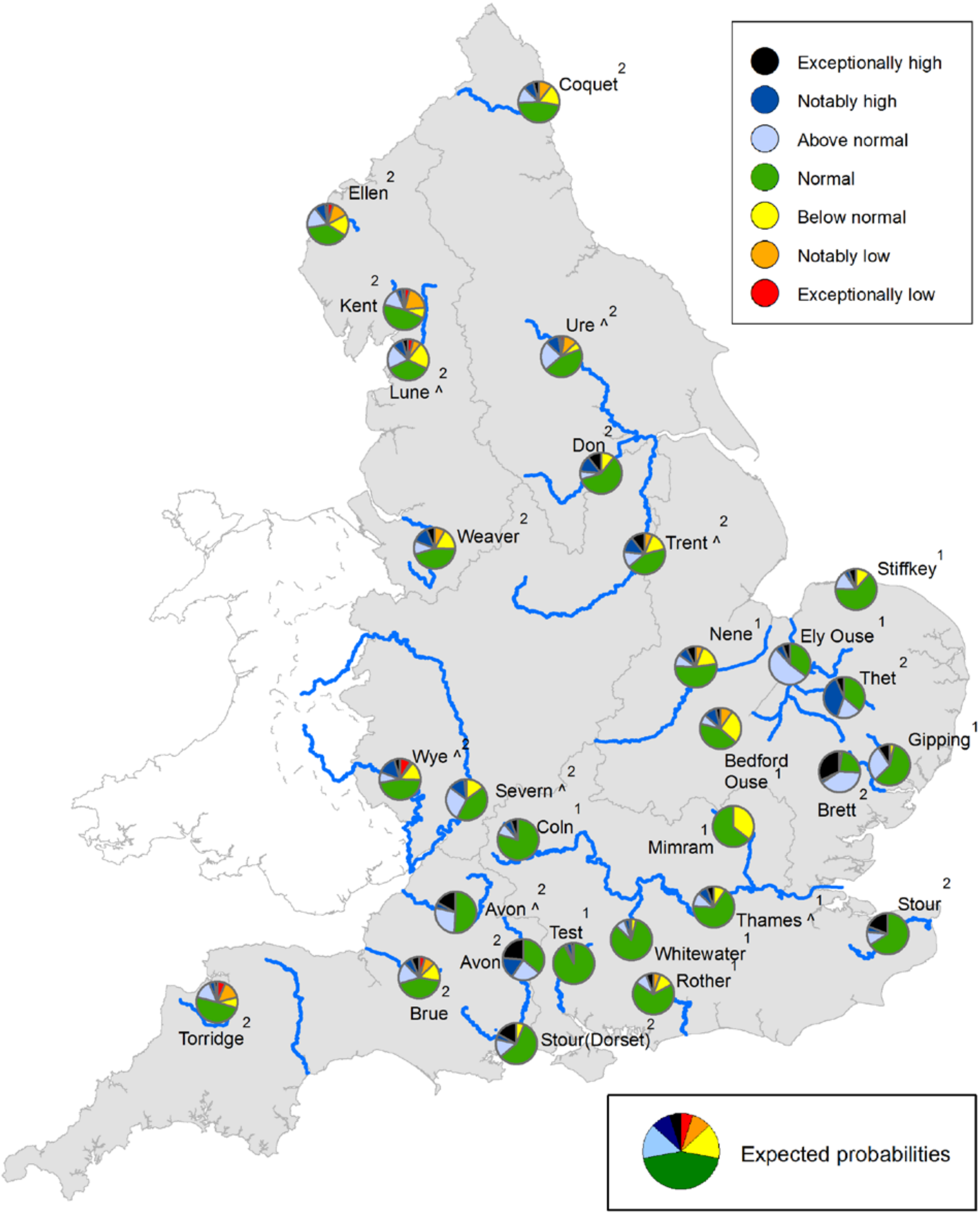
Figure 6.2: Projected river flows at key indicator sites up until the end of March 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June 2016 and March 2017 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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

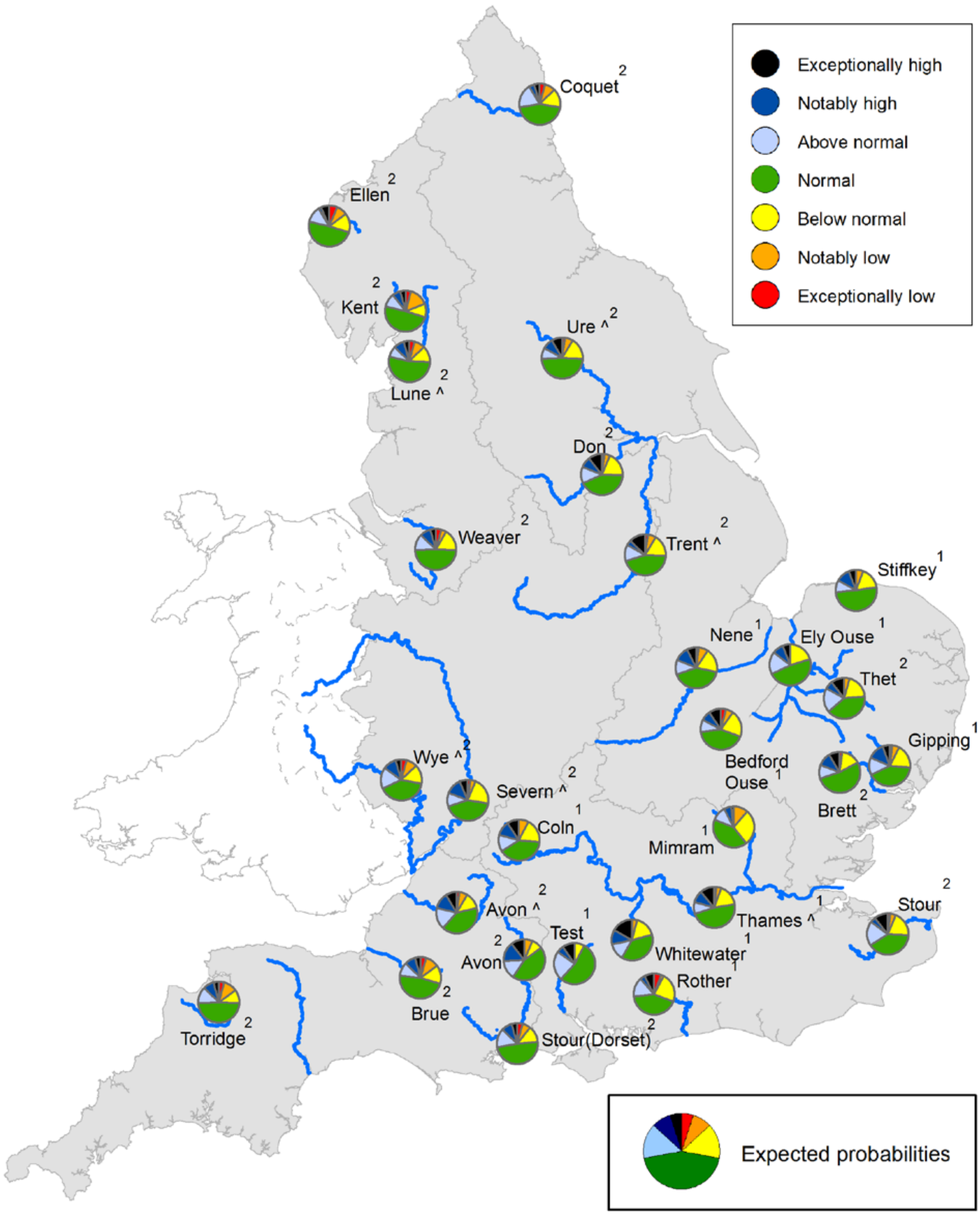
^ *"Naturalised" flows are projected for these sites*



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 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



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 2017. 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

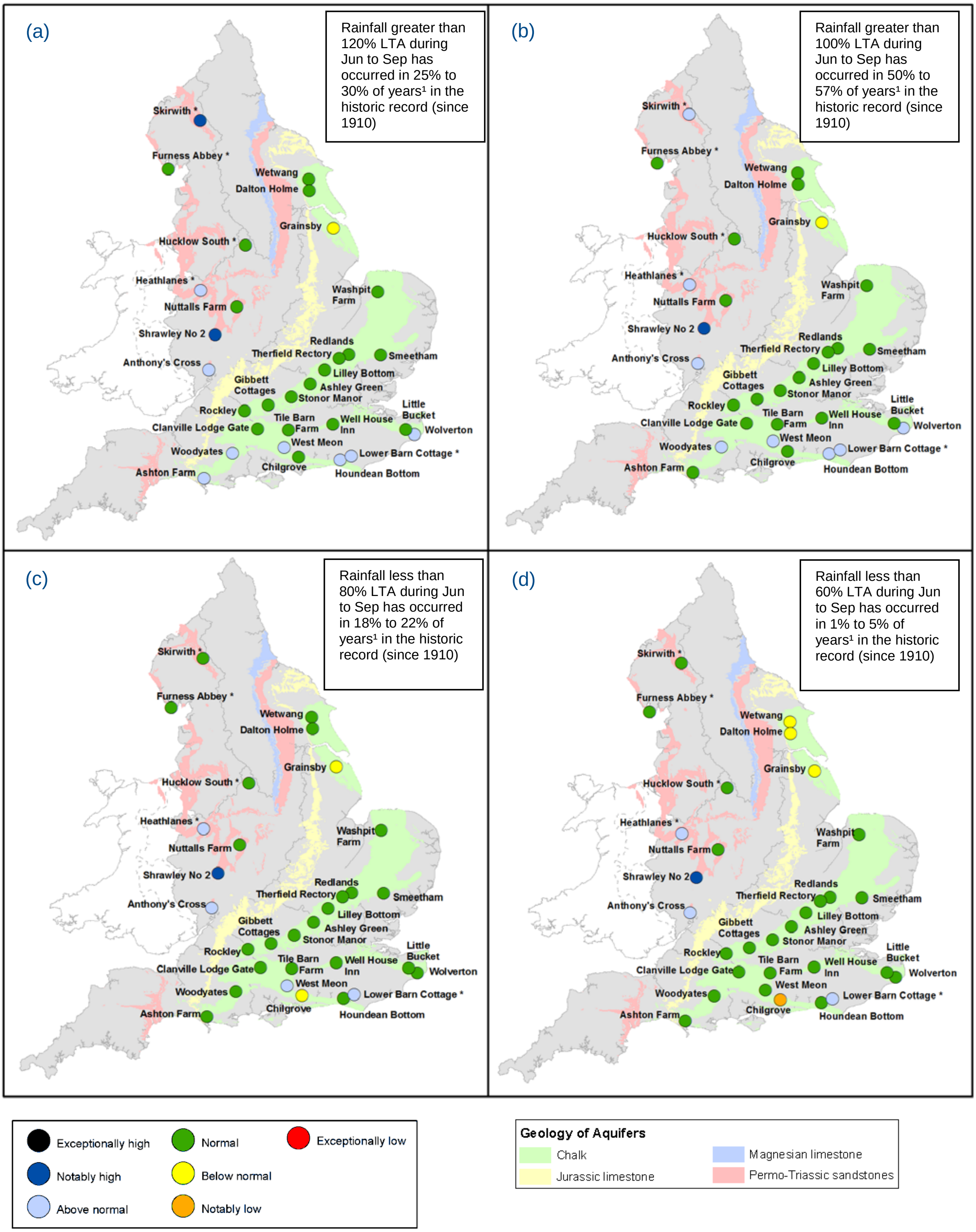


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June and September 2016 (Source: Environment Agency) Geological map reproduced with kind permission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

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

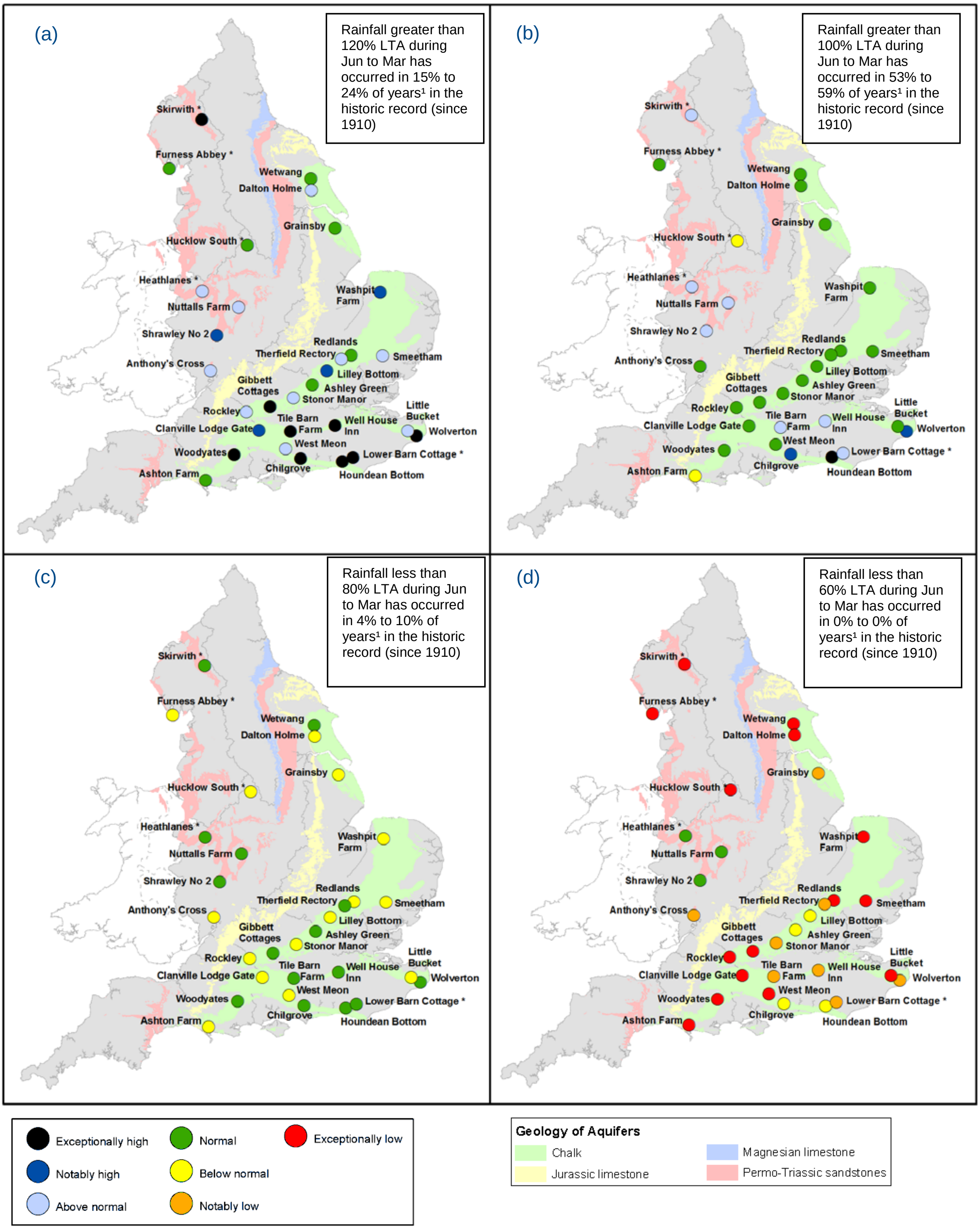
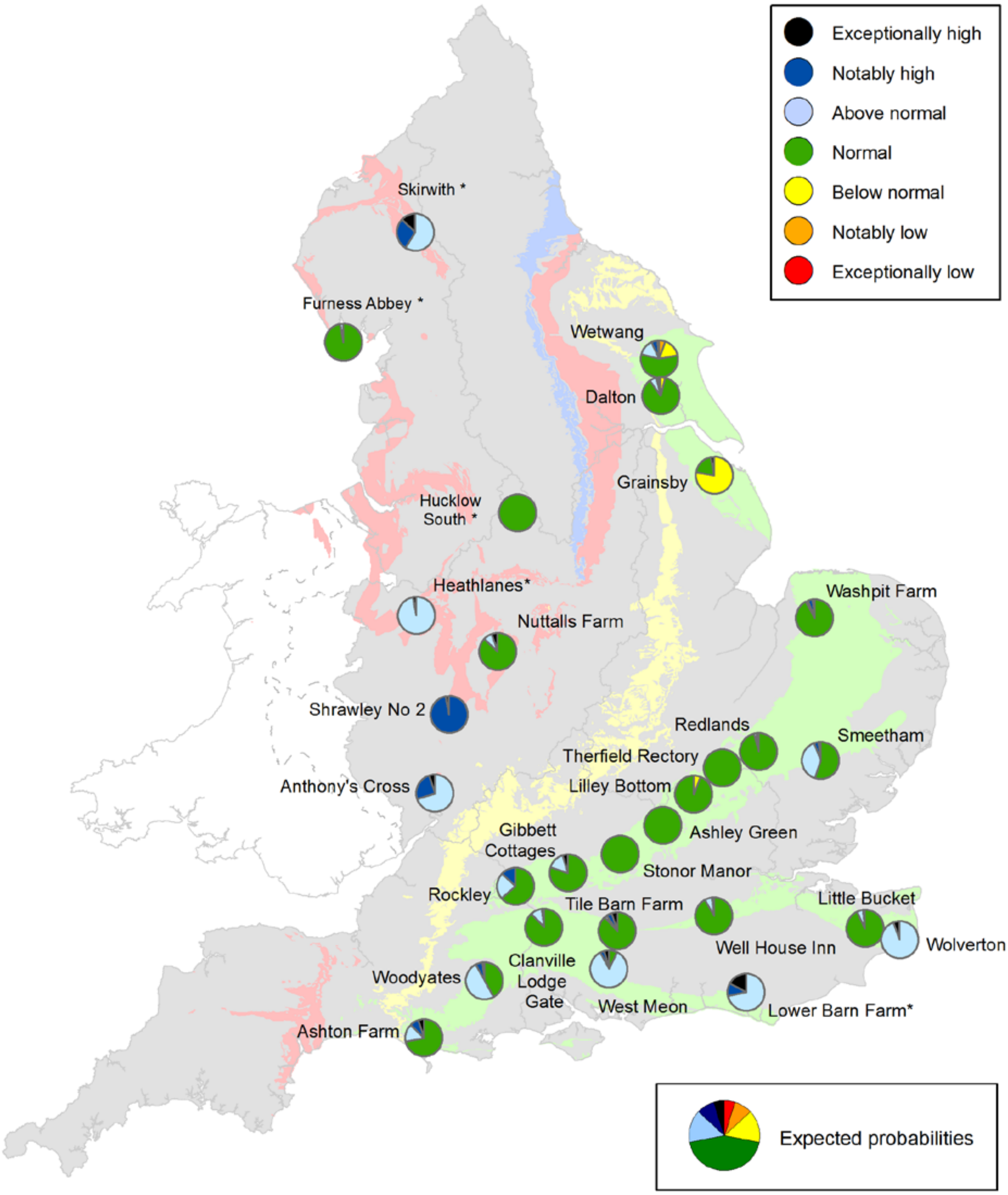


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between June 2016 and March 2017 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2016.

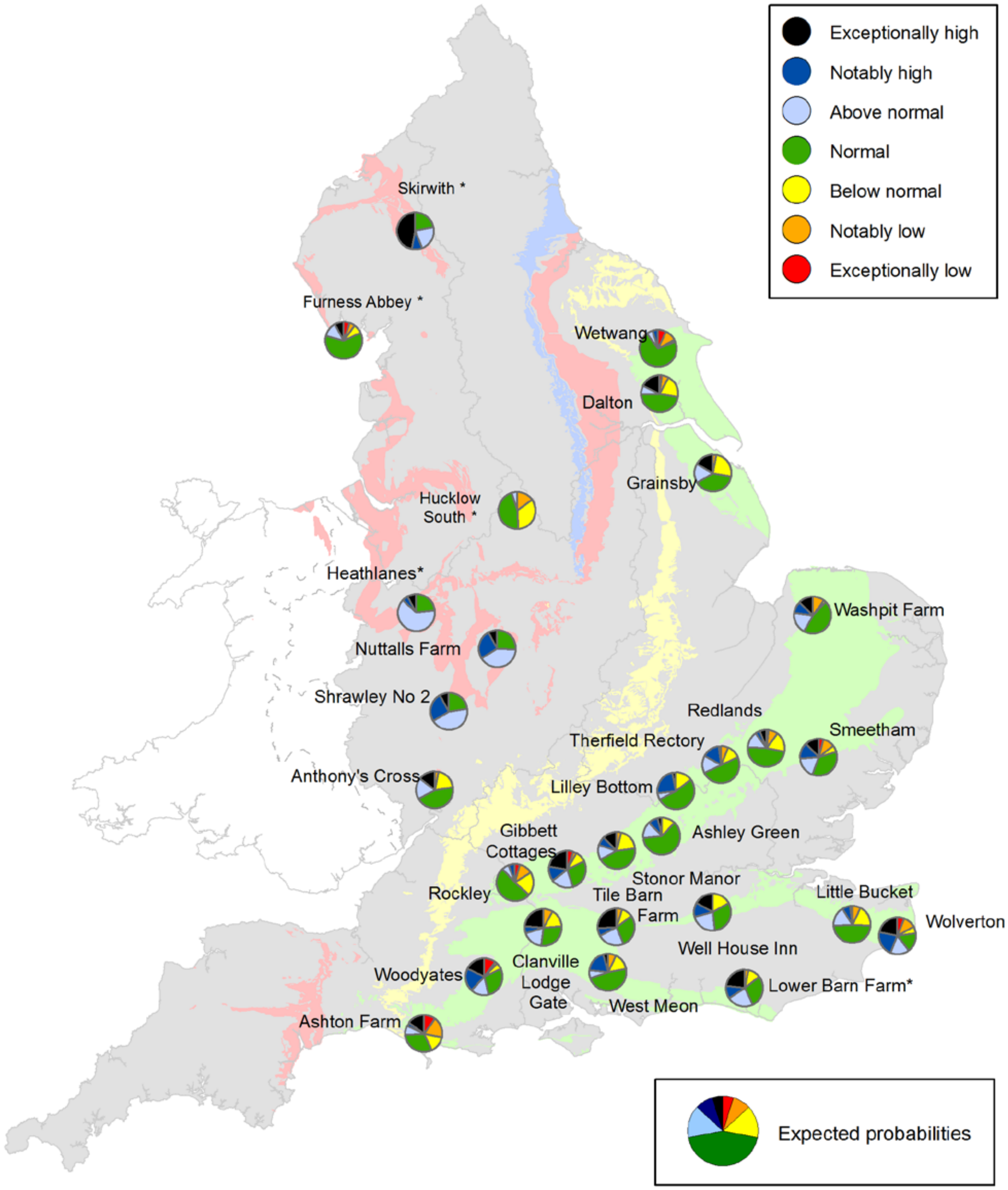
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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 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 March 2017. 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