Monthly water situation report

England

Summary – April 2018

April rainfall was well above average across England for the second consecutive month at 145% of the monthly long term average. Rainfall totals were above normal or notably high for the time of year across the majority of hydrological areas. End of month soil moisture deficits remained close to zero across most of the country. Monthly mean river flows were higher in April than in March at just over half of indicator sites and were normal or higher for the time of year at all sites. Groundwater recharge continued at the majority of sites during April, with end of month levels being normal or higher for the time of year at all but three sites. Reservoir stocks increased or remained at full capacity at just over half of reported reservoirs and reservoir groups and were classed as normal or higher for the time of year at all but two sites at the end of April. Overall reservoir storage for England remained at 95% of total capacity at the end of April.

Rainfall

April rainfall totals were highest across south Devon, Kent and part of north Wales (which drains into England) at between approximately 120 and 130mm, and lowest across parts of the Thames catchment, Essex and Suffolk at between 50 and 60mm. However rainfall totals were above average in all but one hydrological area (the cross-border Esk catchment), ranging from 109% of the April Long Term Average (LTA) in the Upper Thames hydrological area to 230% in the Dover Chalk area (Figure 1.1).

April rainfall totals were classed as normal or higher for the time of year across all hydrological areas, with the majority being above normal or notably high. Rainfall totals in the Dover Chalk, Stour and Thanet Chalk hydrological areas in east Kent were exceptionally high for the time of year. It was provisionally the 2nd wettest April on record (since records began in 1910) and the wettest since 2000 in the Dover Chalk hydrological area. It was also provisionally the 5th wettest April on record in the Stour and Thanet Chalk hydrological areas and the wettest since 2012. The 3, 6 and 12 month cumulative rainfall totals were normal to exceptionally high across all but one hydrological area (Figure 1.2). It was provisionally the wettest March-April period on record in the Exe, West Somerset Streams and Tone hydrological areas in south-west England and the Dover Chalk area in south-east England. It was also provisionally within the top 5 wettest March-April periods on record in a further 44 hydrological areas across England.

At a regional scale, April rainfall totals were well above average across all regions, ranging from 139% in north-west England to 155% in east England. It was provisionally the 3rd wettest March-April period on record and the wettest since 2000 in south-west England. The March-April period was also notable in central and north-east England (5th wettest and wettest since 1998), south-east (6th wettest and wettest since 2001) and east England (7th wettest and wettest since 2012). The monthly rainfall total for England was 81mm which was 145% of the 1961-90 LTA (138% of the 1981-10 LTA) (Figure 1.3).

Soil moisture deficit

Despite the above average April rainfall, end of month soil moisture deficits (SMDs) were slightly larger than at the start of the month. This was a result of the warmer than average second half of the month which was also relatively dry. At the end of April SMDs were at or close to zero across most of the country, with slightly larger deficits of between 11 and 30mm across parts of north-east, east and south-east England (Figure 2.1). At the end of April, soils were generally wetter than average across most of England, apart from the far north-east where soils were slightly drier than average. At a regional scale, soils were slightly drier at the end of April than at the start of the month, with deficits ranging from 2mm in north-west England to 13mm in north-east England. Soils were wetter than average across all regions at the end of April (Figure 2.2).

River flows

April monthly mean flows increased compared to March at just over half of the indicator sites across England. River flows were classed as normal or higher for the time of year at all indicator sites and were in the range notably high to exceptionally high at nearly two-thirds of sites. Flows in the rivers Yare in Norfolk, the Trent in central England

and the Frome in Dorset were the highest April monthly mean flows on record. Flows at the regional index sites in central (River Dove) and south-east (naturalised flows on River Thames) England were notably high for the time of year, whilst the remaining index sites were above normal or normal (Figure 3.2).

Groundwater levels

In response to the above average rainfall, groundwater recharge continued during April, with levels rising at all but 4 indicator sites. End of month groundwater levels were normal or higher for the time of year at all but 3 indicator sites, with 4 sites in chalk aquifers being exceptionally high for the time year: Tilshead (Upper Hampshire Avon chalk), Chilgrove (Chichester chalk), Woodyates (Upper Dorset Stour chalk) and Dalton Holme (Hull and East Riding chalk). Levels at Ashley Green (East Chilterns chalk aquifer) in south-east England and Crow Lady Farm (Fylde and Preston sandstone aquifer) in north-west England remained below normal for the time of year, whilst Crossley Hill (Idle Torne sandstone aquifer) was notably low (Figures 4.1 and 4.2). End of month levels at the major aquifer index sites were all normal or higher for the time of year.

Reservoir storage

Reservoir stocks increased or remained at full capacity at just over half of reservoirs and reservoir groups during April. The largest increases occurred at the Lower Lee reservoir group (6%) in south-east England and Stithians and Draycote reservoirs (both 5%) in south-west and central England respectively. Stocks decreased at 13 reservoirs and reservoir groups across England, with the largest decreases occurring at the Teesdale reservoir group (7%) in north-east England and Farmoor reservoir (5%) in south-east England. However, end of month stocks were classed as normal or higher for the time of year at all but 2 sites: Carsington and Ogston reservoir group in central England and Farmoor reservoir in south-east England were classed as below normal (Figure 5.1).

Regional reservoir stocks decreased by 2% in north-east England during April but increased slightly or remained unchanged elsewhere. End of April stocks ranged from 90% of total capacity in north-west England to 98% in central and south-west England. Overall storage for England remained unchanged at 95% of total capacity (Figure 5.2).

Forward look

The weather for May is expected to be mixed, with thundery showers, spells of heavy rain and cooler temperatures interspersed with drier, warmer and more settled conditions. For the 3-month period May-June-July, at the UK scale, above average precipitation is slightly more likely than below average precipitation[1].

Projections for river flows at key sites[2]

Nearly two-thirds of the modelled sites have a greater than expected chance of cumulative river flows being normal or higher for the time of year by the end of September 2018. Four-fifths of the modelled sites have a greater than expected chance of cumulative flows being normal or higher by the end of March 2019.

For scenario based projections of cumulative river flows at key sites by September 2018 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2019 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2018 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2019 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

Approximately 90% of the modelled sites have a greater than expected chance of groundwater levels being normal or higher for the time of year at the end of September 2018. Nearly two-thirds of the modelled sites have a greater than expected chance of levels being normal or higher at the end of March 2019.

For scenario based projections of groundwater levels in key aquifers in September 2018 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2019 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2018 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2019 see Figure 6.8

Authors: National Water Resources 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

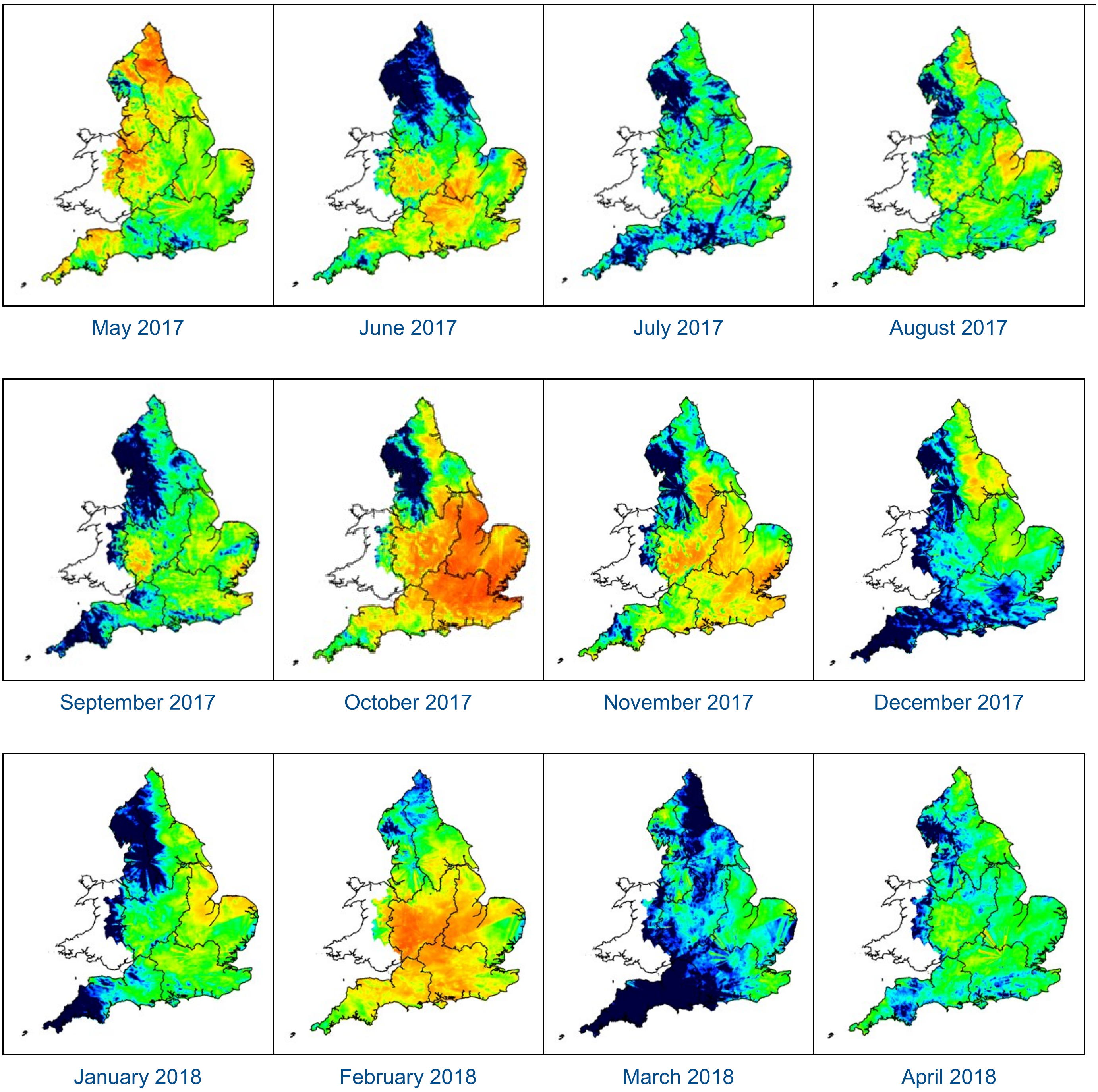
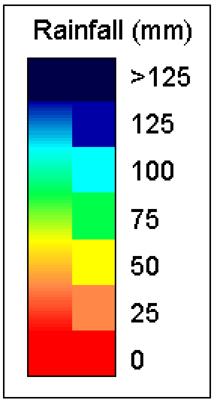


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2018). Note: Images may sometimes include straight lines originating from the centre of the radar, resulting from tall trees and buildings located near the radar installation affecting its performance. This does not reflect actual conditions on the ground. Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.



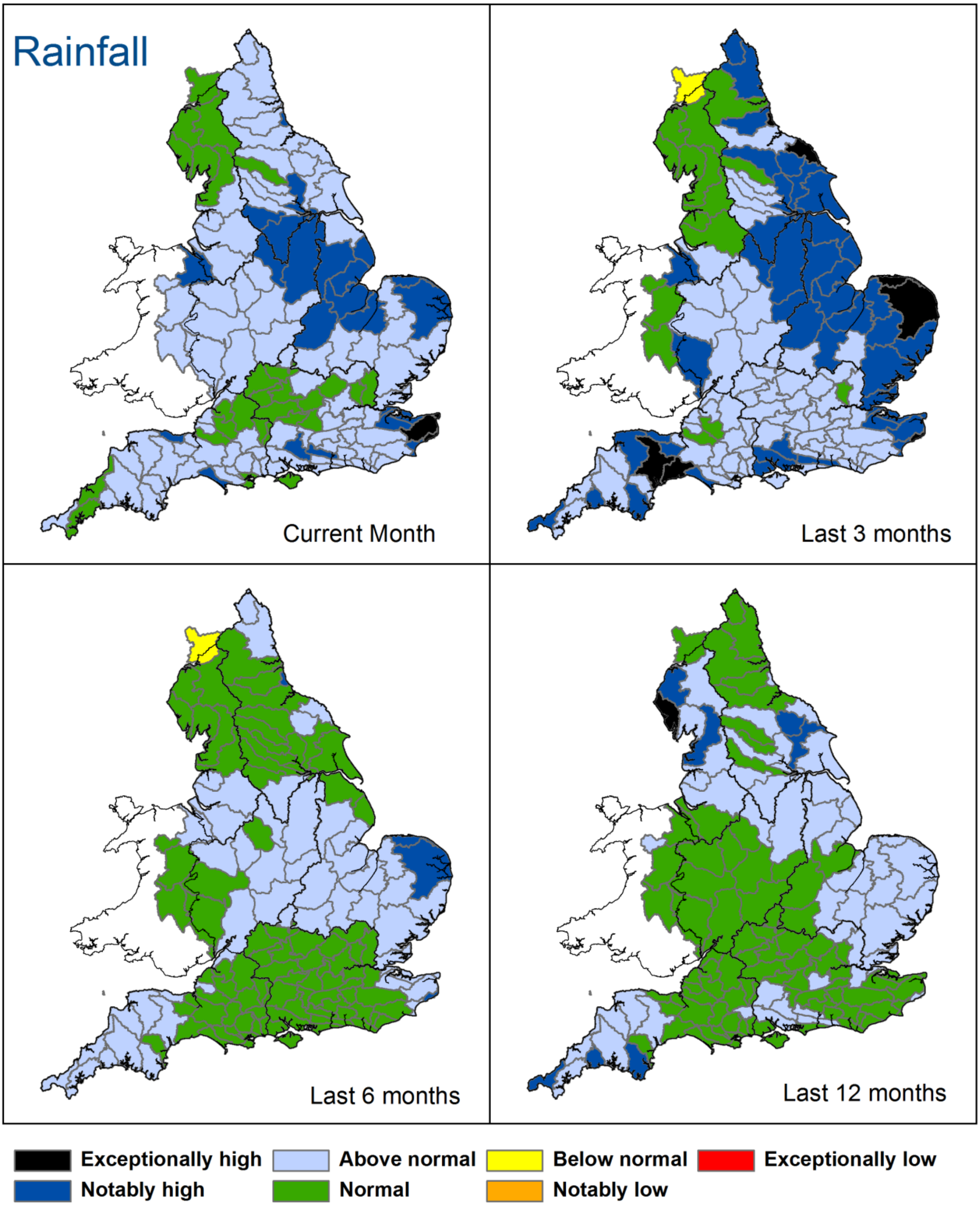


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 April), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2018).* 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, 2018.

Rainfall charts

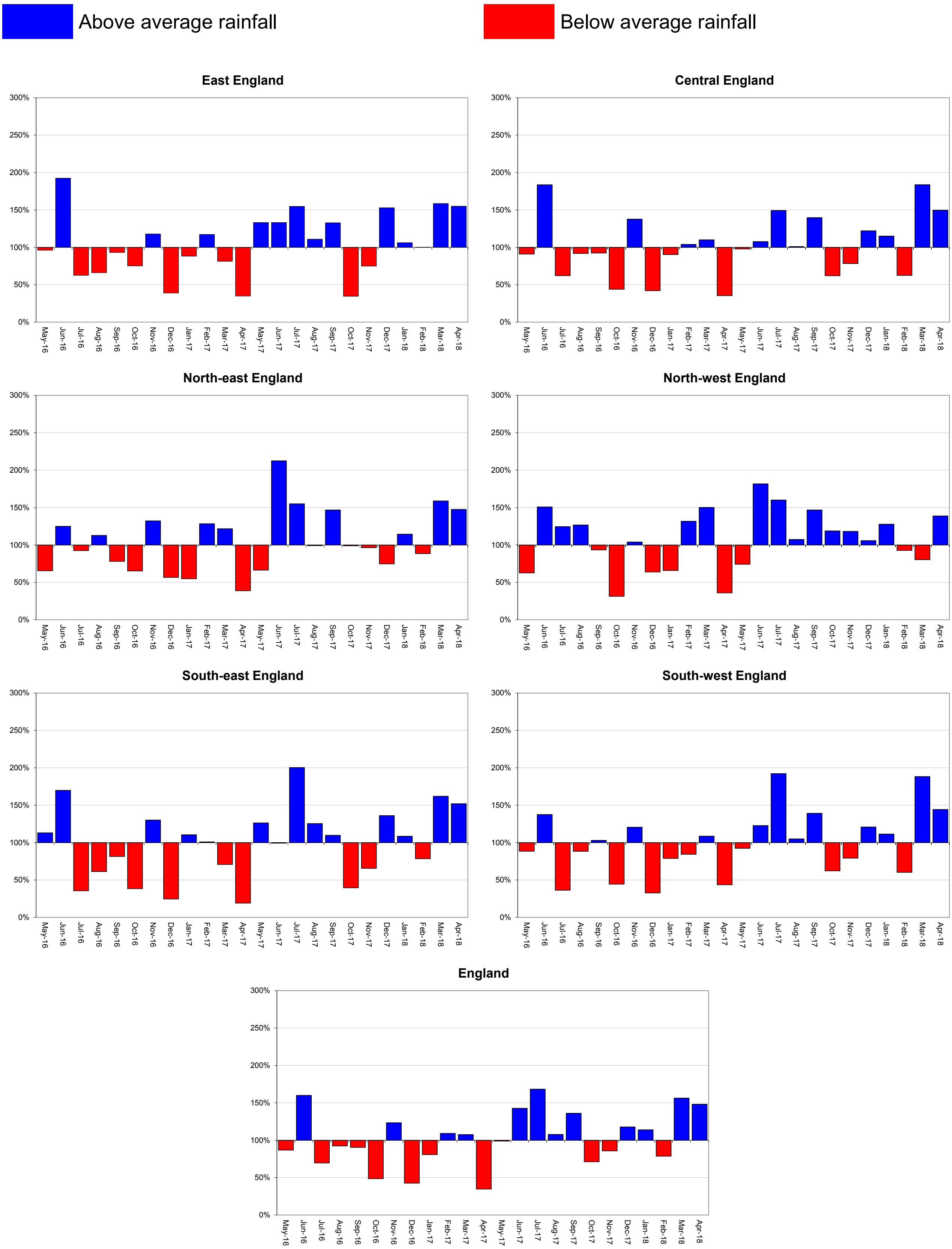


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2018).

Soil moisture deficit

End of March 2018[1]	End of April 2018[2]

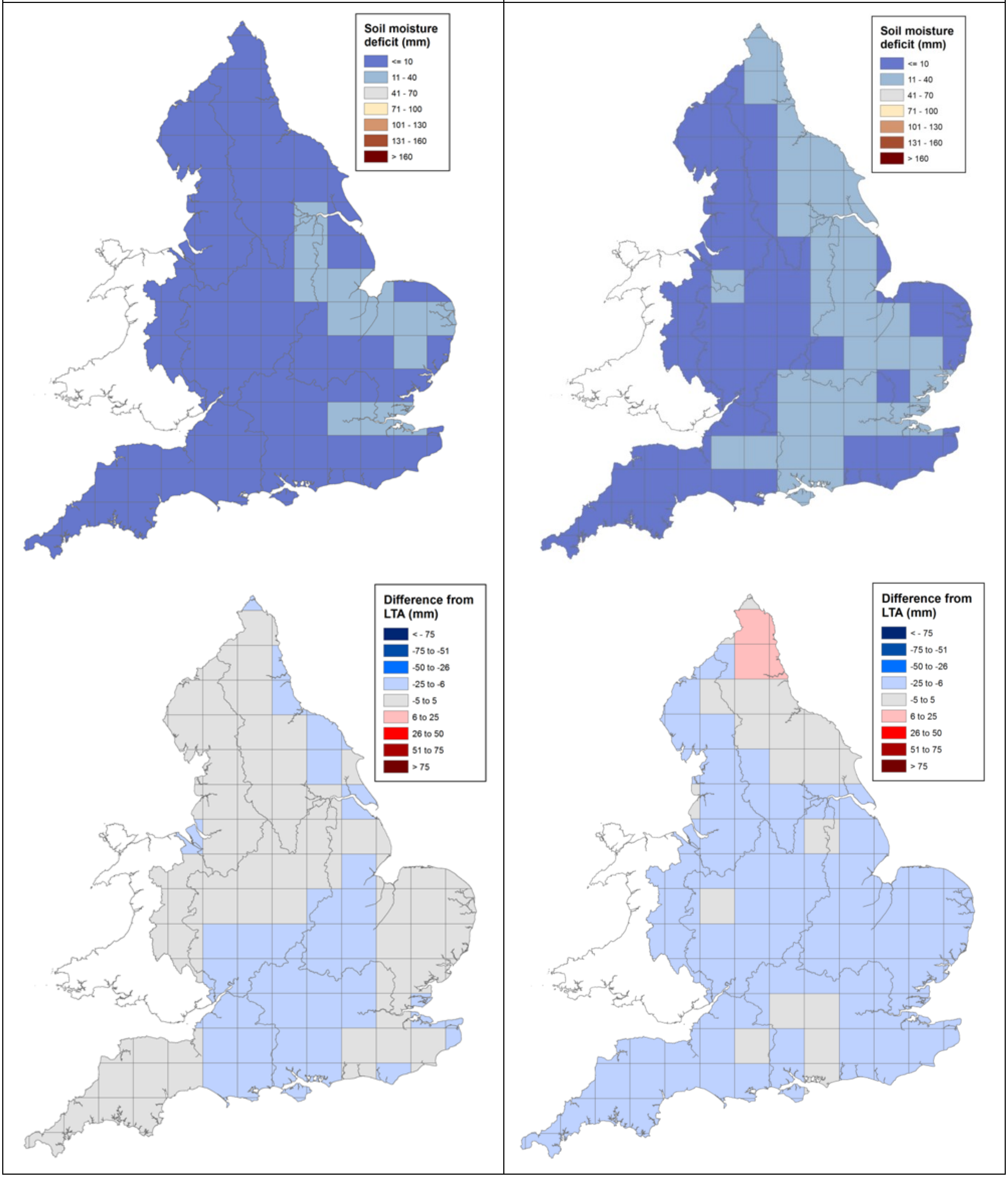


Figure 2.1: Soil moisture deficits for weeks ending 27 March 2018[1] (left panel) and 01 May 2018[2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2018). Crown copyright. All rights reserved. Environment Agency, 100026380, 2018

Soil moisture deficit charts

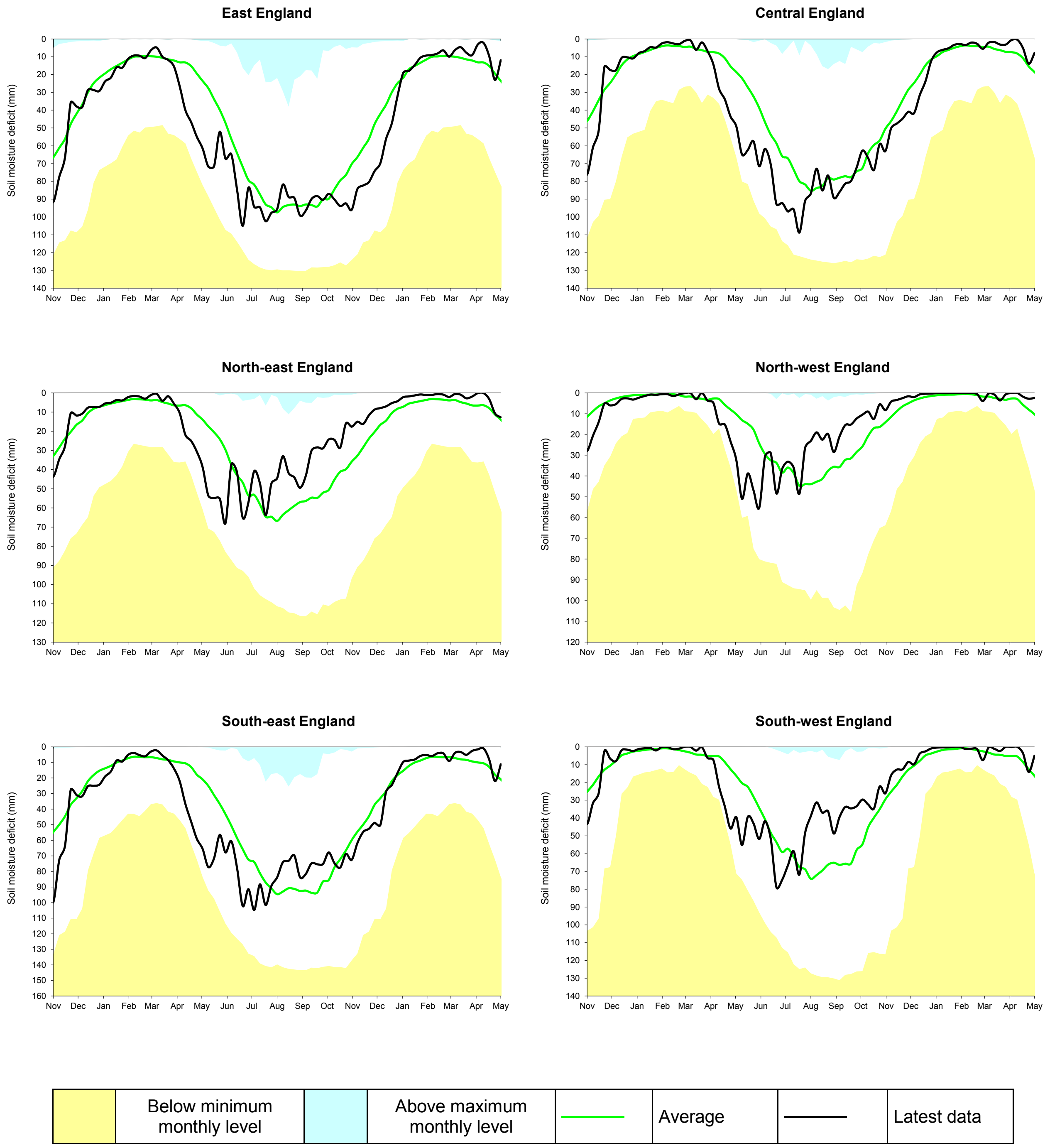
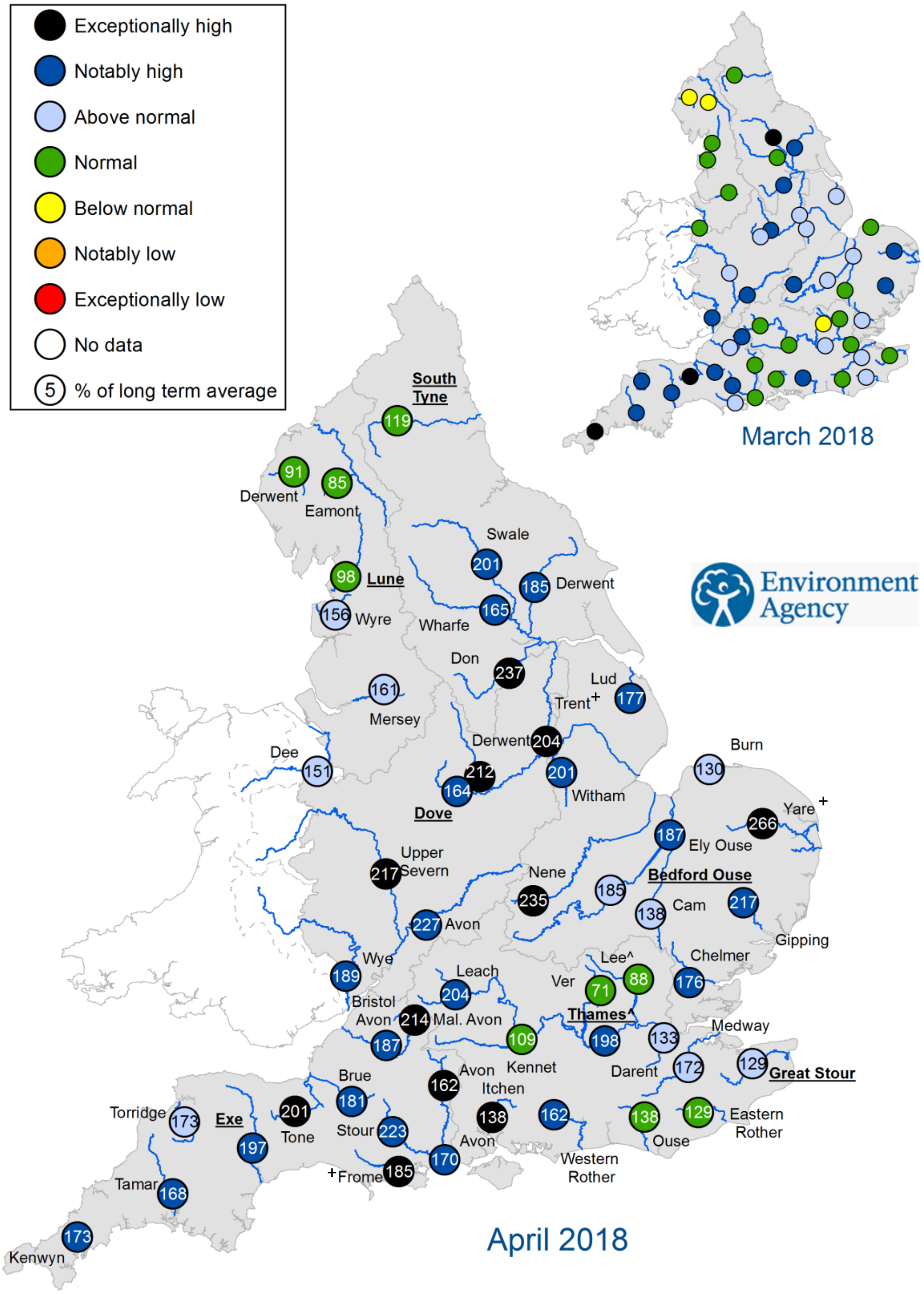


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2018).

River flows



^ “Naturalised” flows are provided for the River Thames at Kingston and the River 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 March and April 2018, expressed as a percentage of the respective long term average and classed relative to an analysis of historic March and April monthly means (Source: Environment Agency).

River flow charts

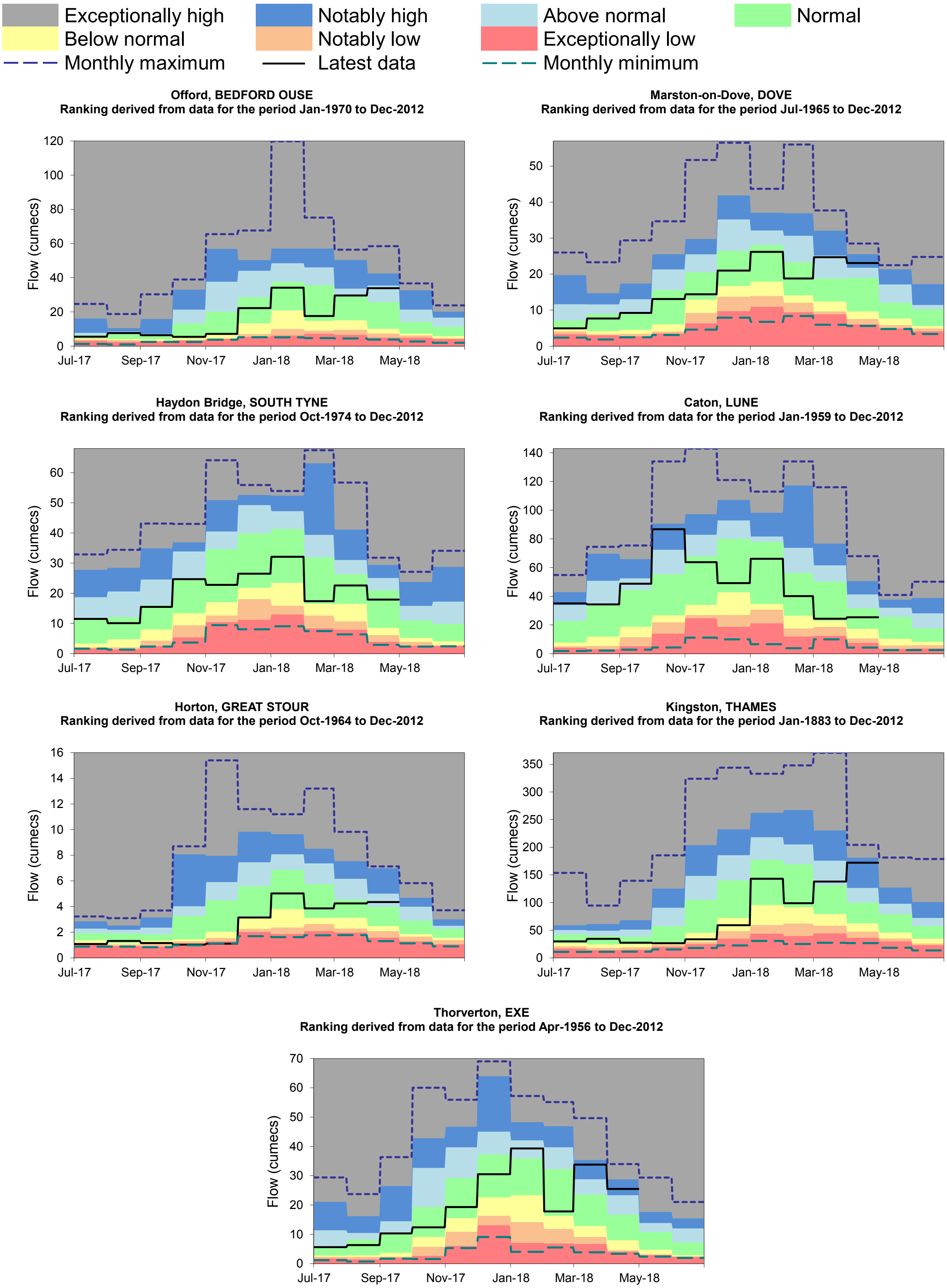
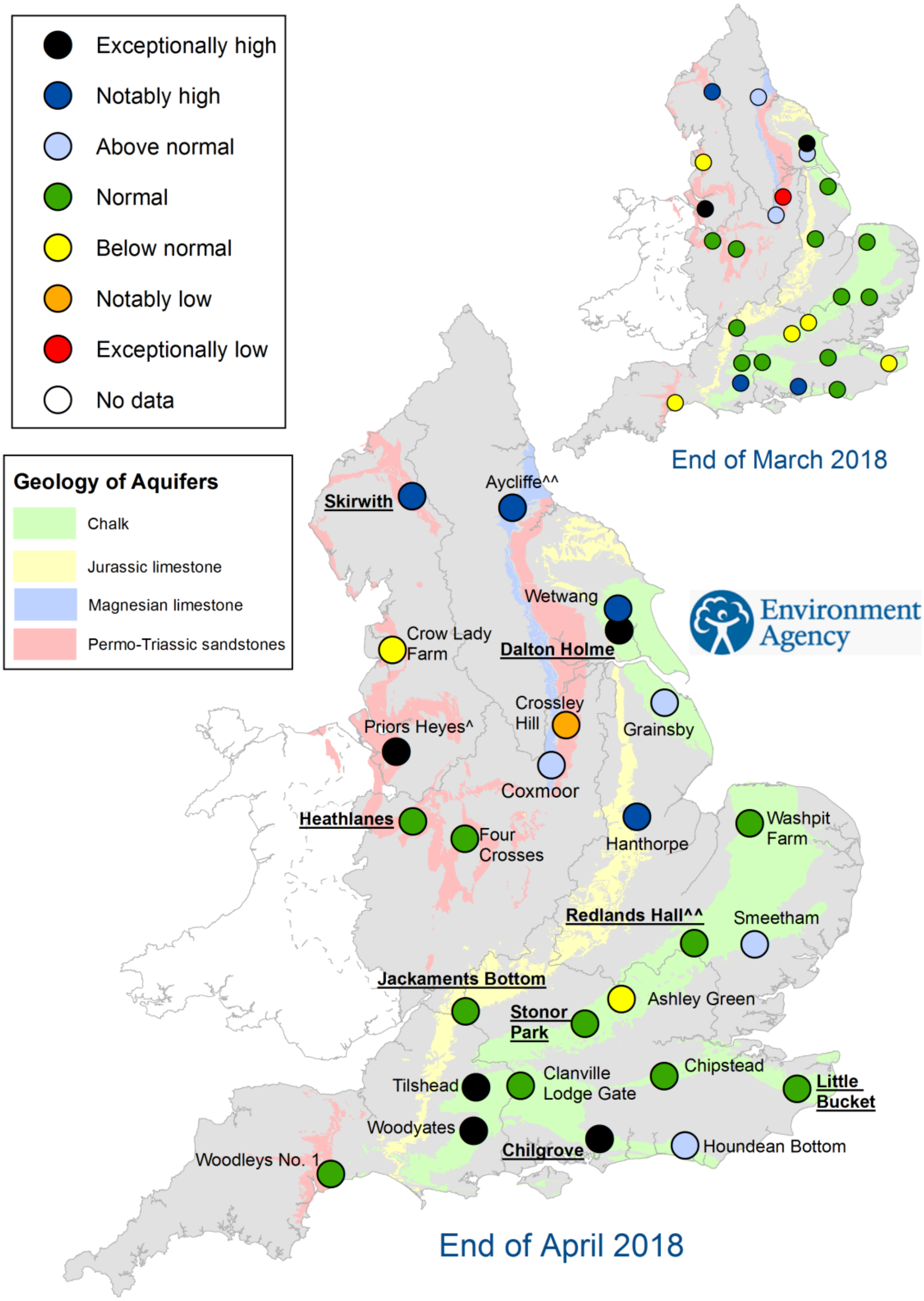


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
Underlined sites are major aquifer index sites and are shown in the groundwater level charts in Figure 4.2

Figure 4.1: Groundwater levels for indicator sites at the end of March and April 2018, classed relative to an analysis of respective historic March and April levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.

Groundwater level charts

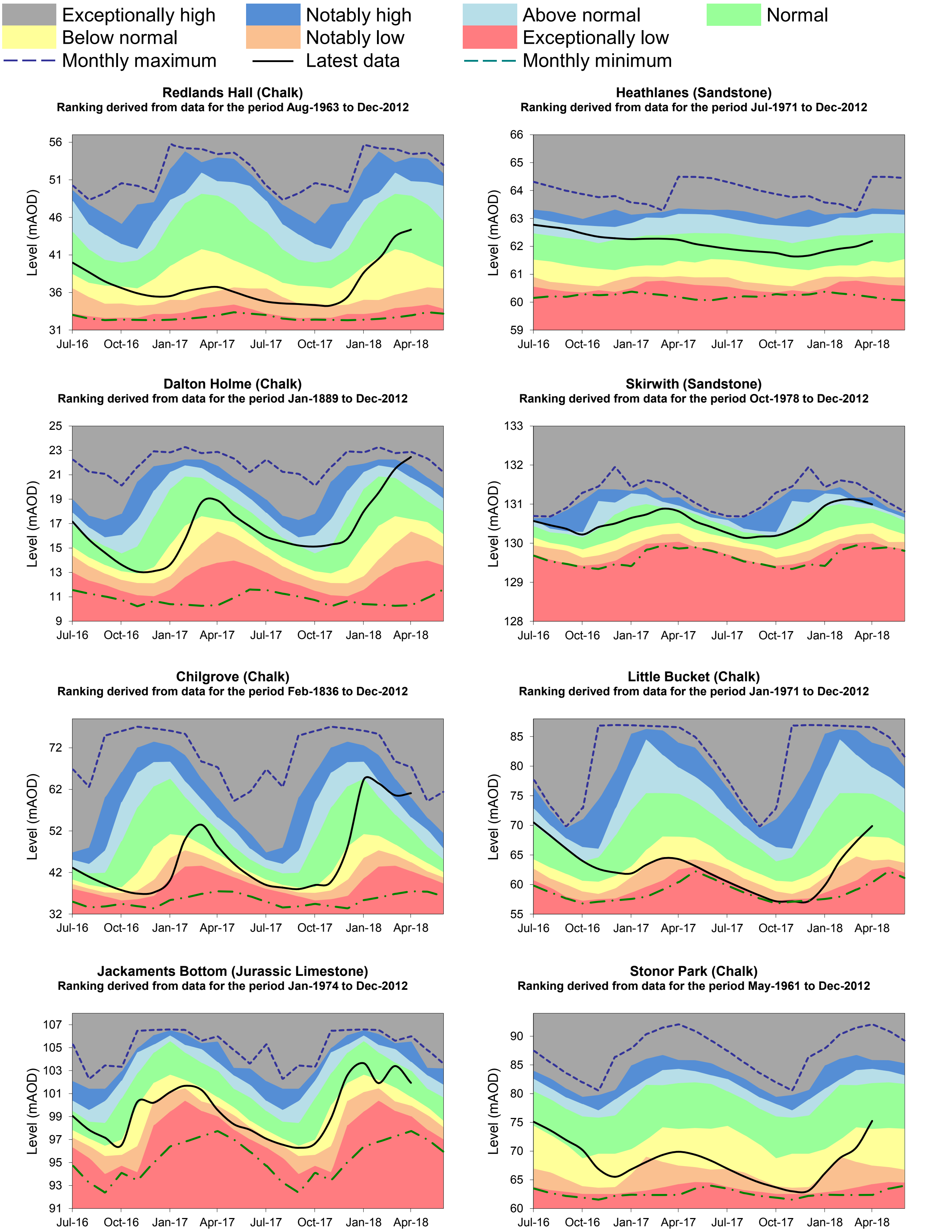
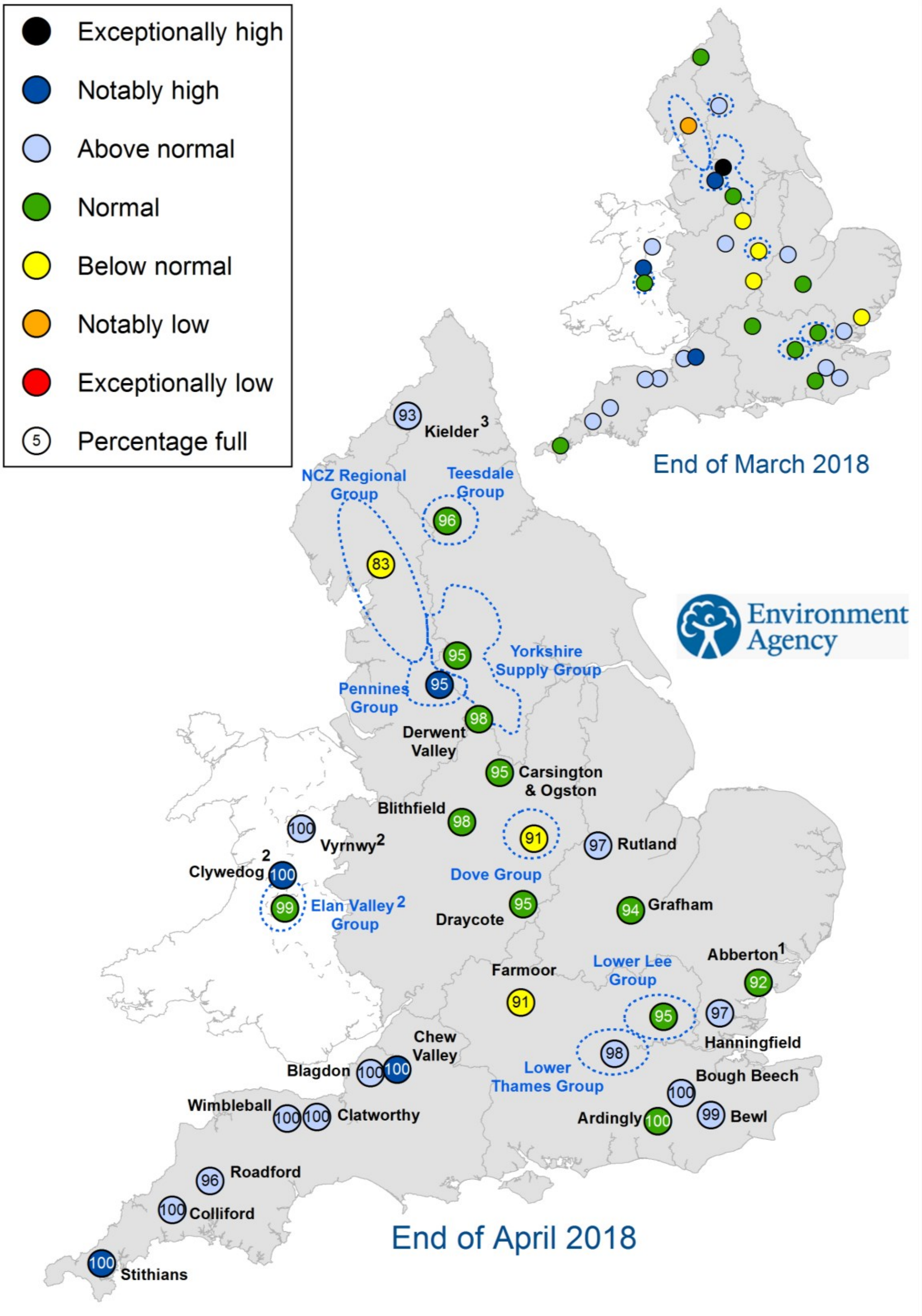


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2018).

Reservoir storage



1. Current levels at Abberton Reservoir in east England are relative to increased capacity
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to Central and north-west England
3. Current levels at Kielder are lower than historical levels due to the implementation of a new flood alleviation control curve

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of March and April 2018 as a percentage of total capacity and classed relative to an analysis of historic March and April values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate to control curves or triggers for drought actions. As well as for public water supply, some reservoirs are drawn down to provide flood storage, river compensation flows or for reservoir safety inspections. In some cases current reservoir operating rules may differ from historic ones.

Reservoir storage charts

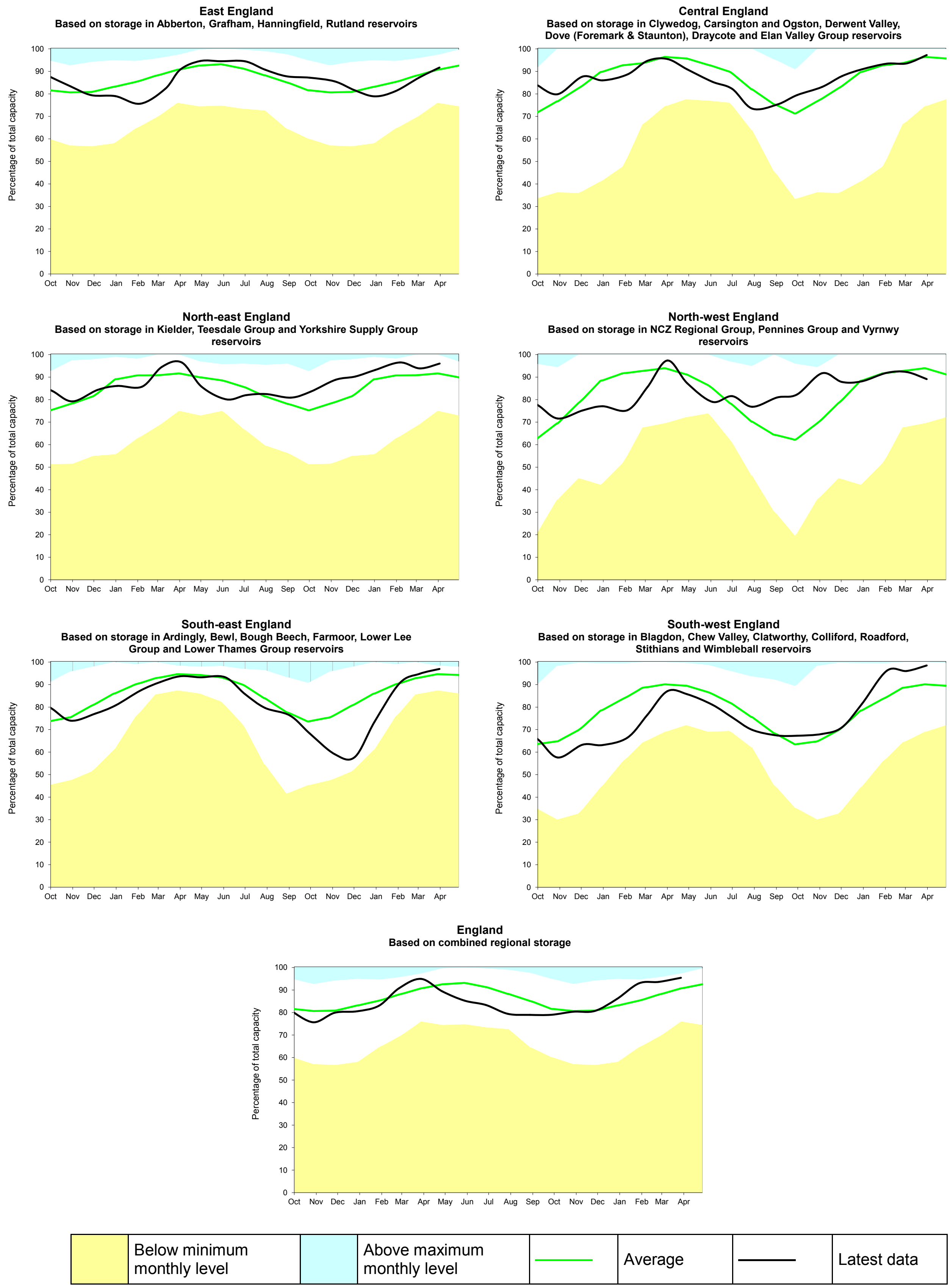


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

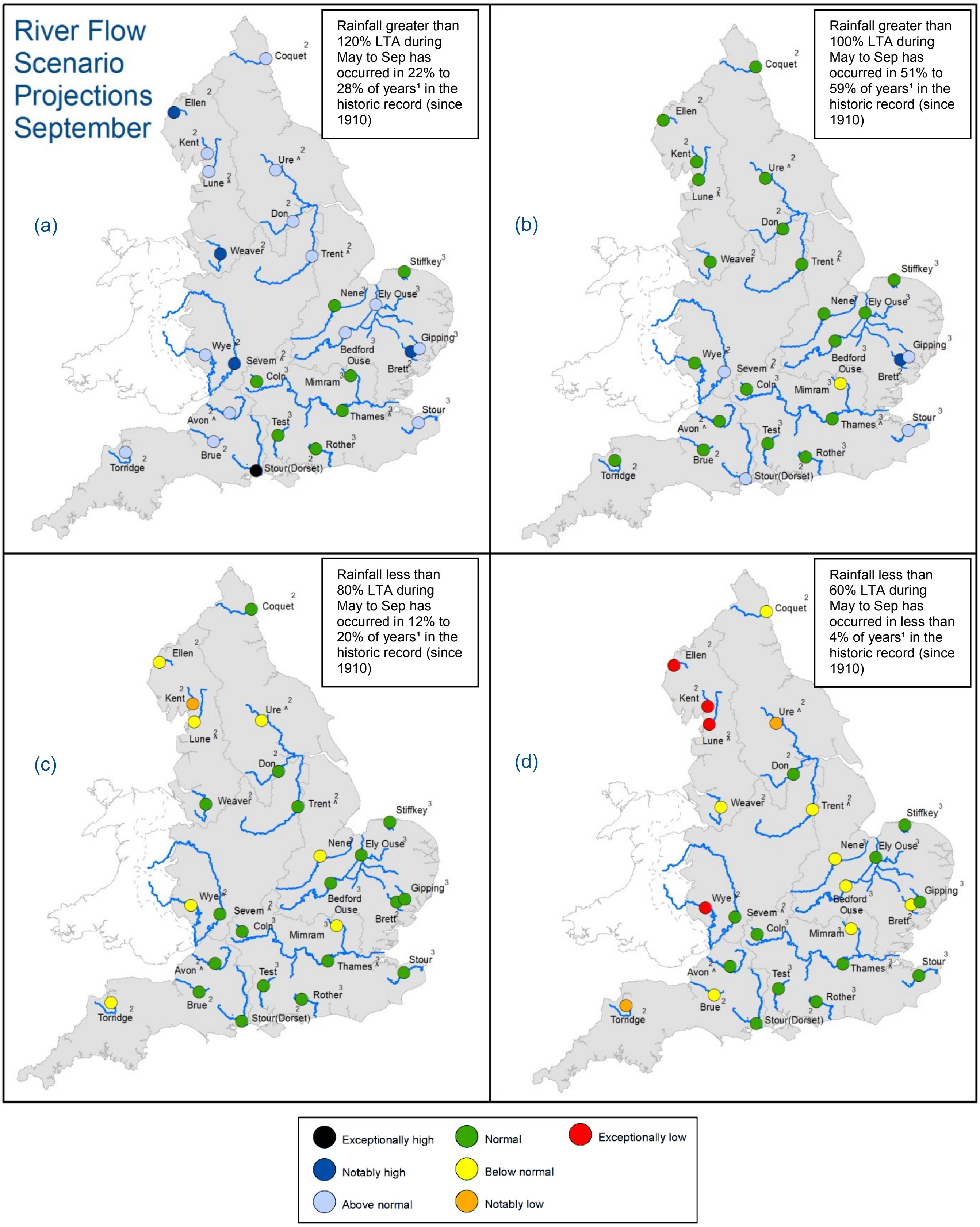


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2018. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May and September 2018 (Source: Centre for Ecology and Hydrology, Environment Agency).

[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*

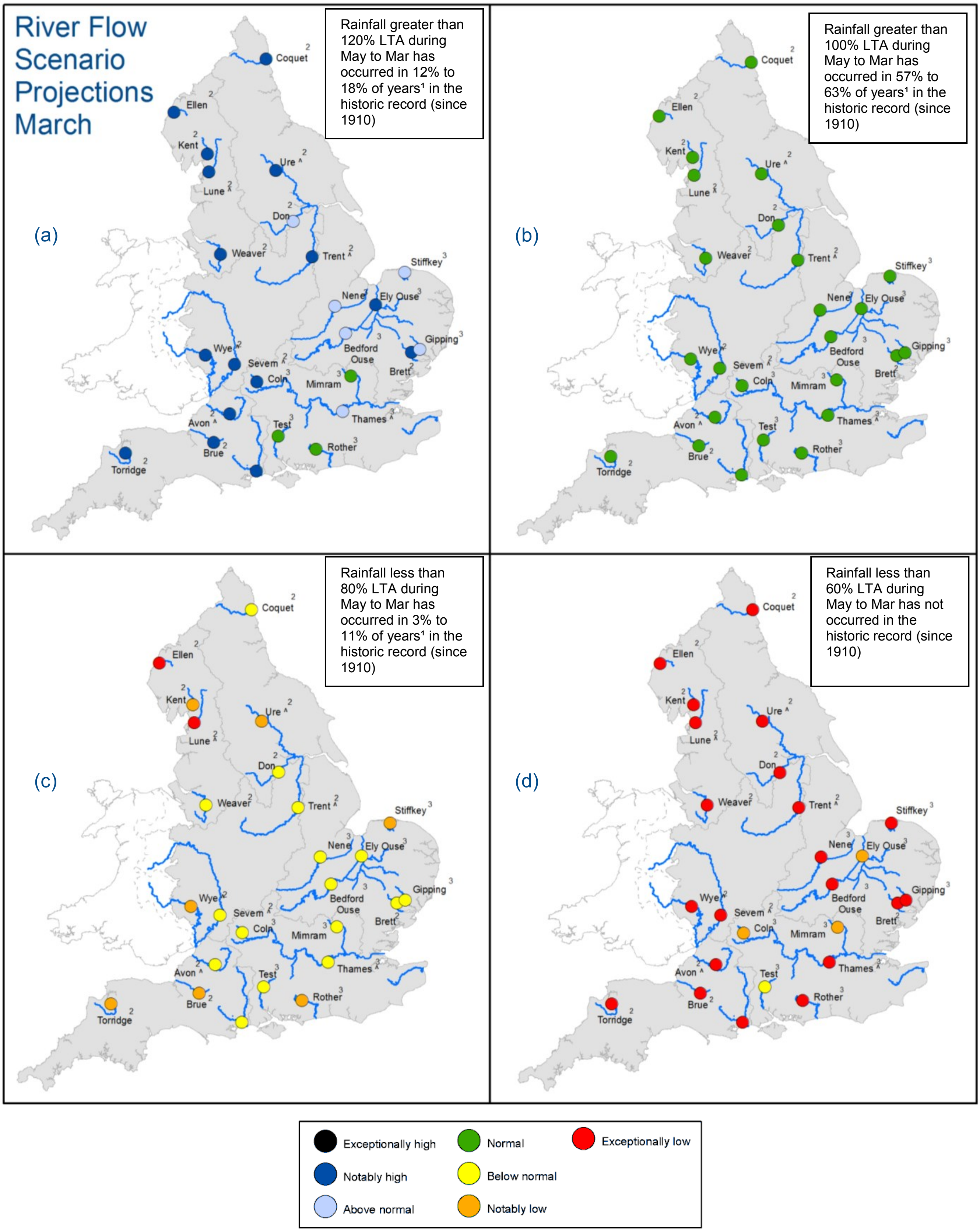


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2018 and March 2019 (Source: Centre for Ecology and Hydrology, Environment Agency).

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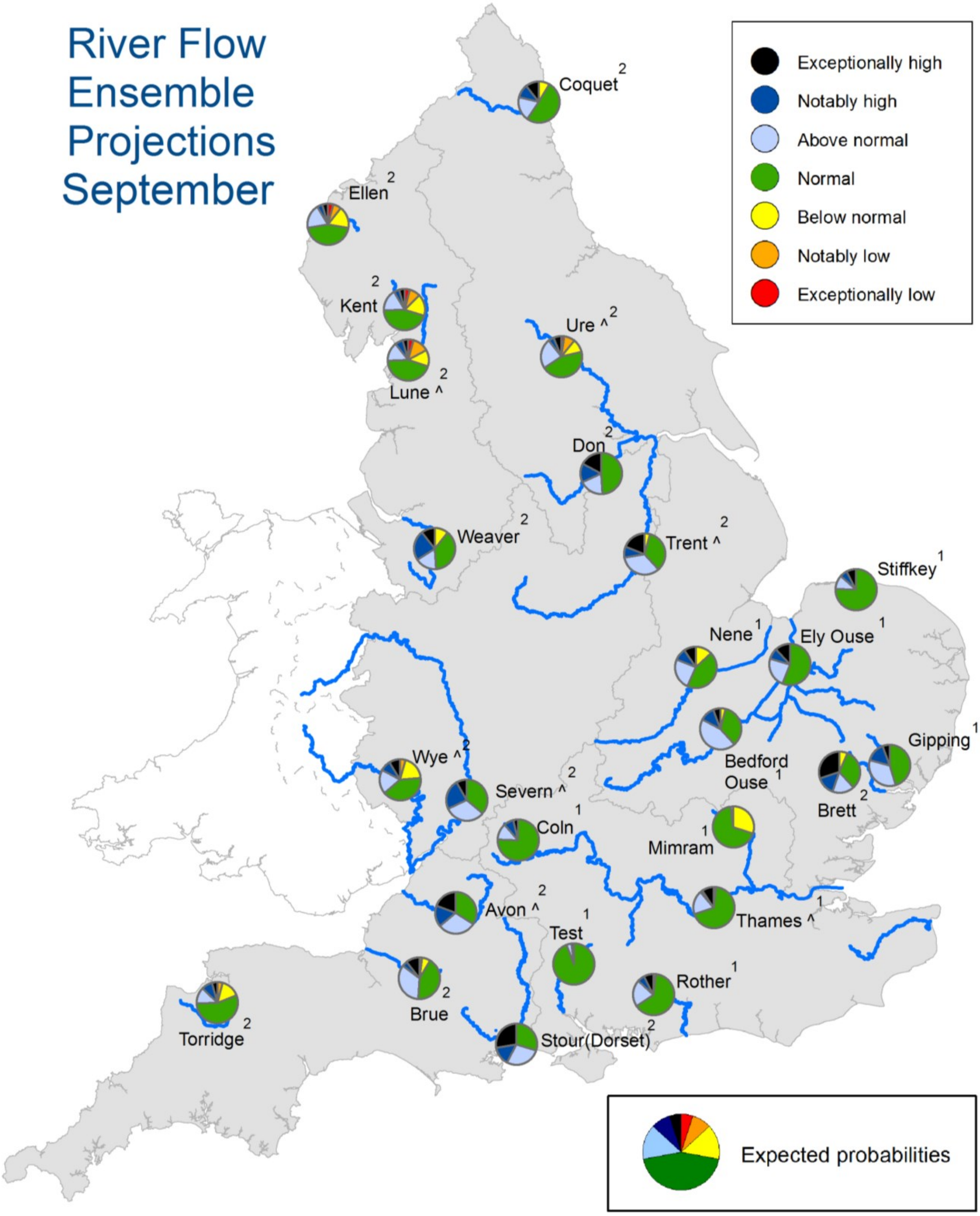

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2018. 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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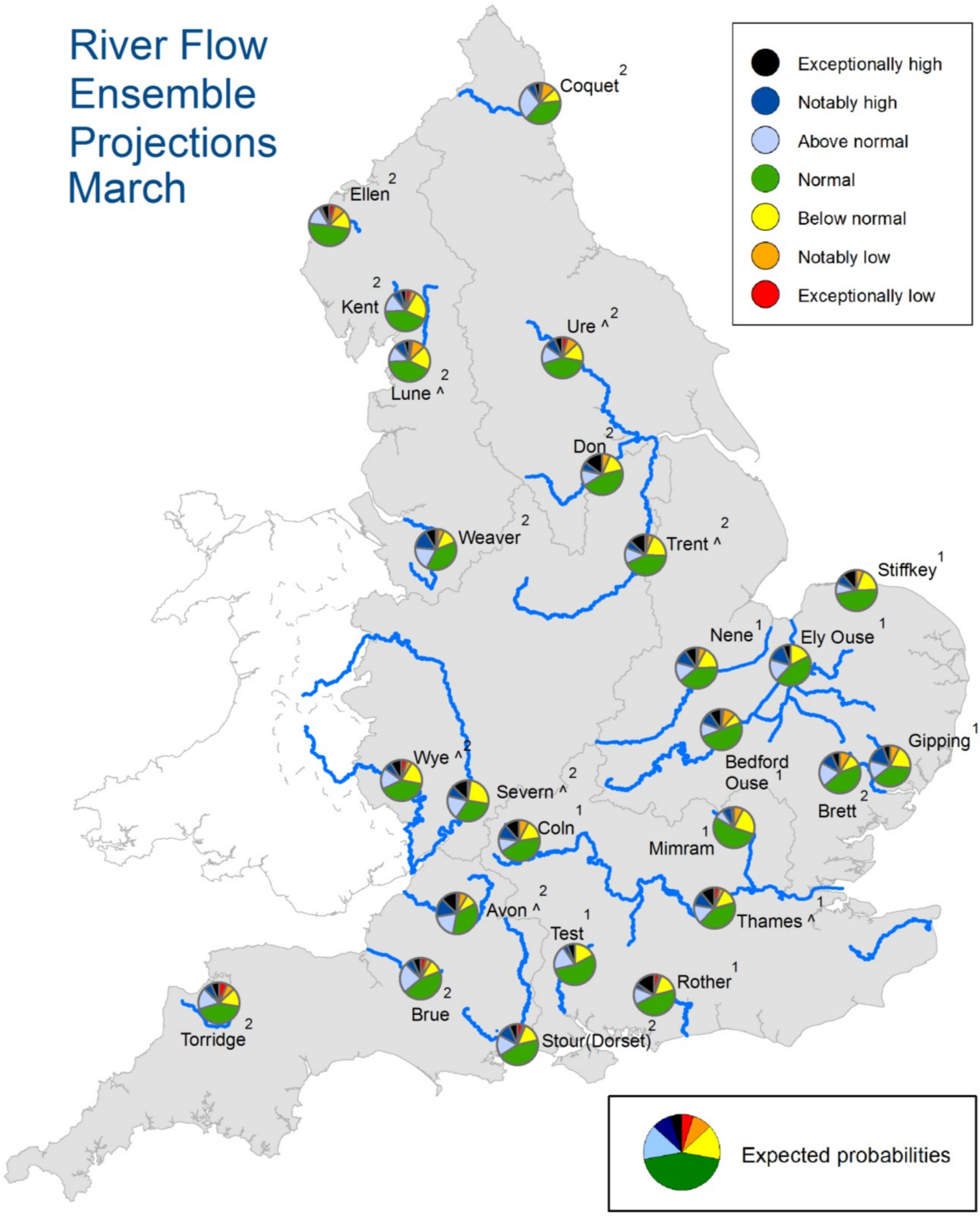


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 March 2019. 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

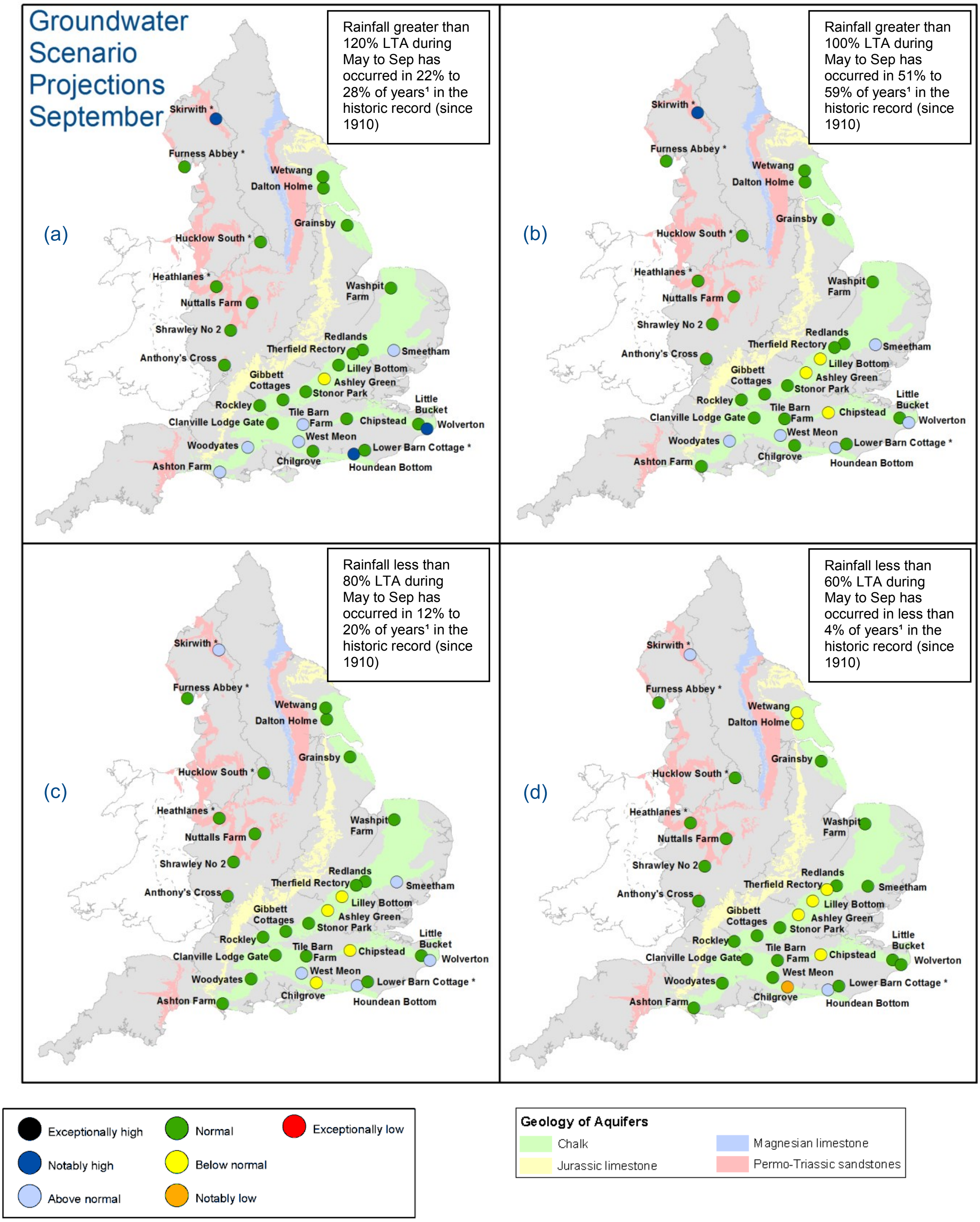


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2018. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May and September 2018 (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2018.

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

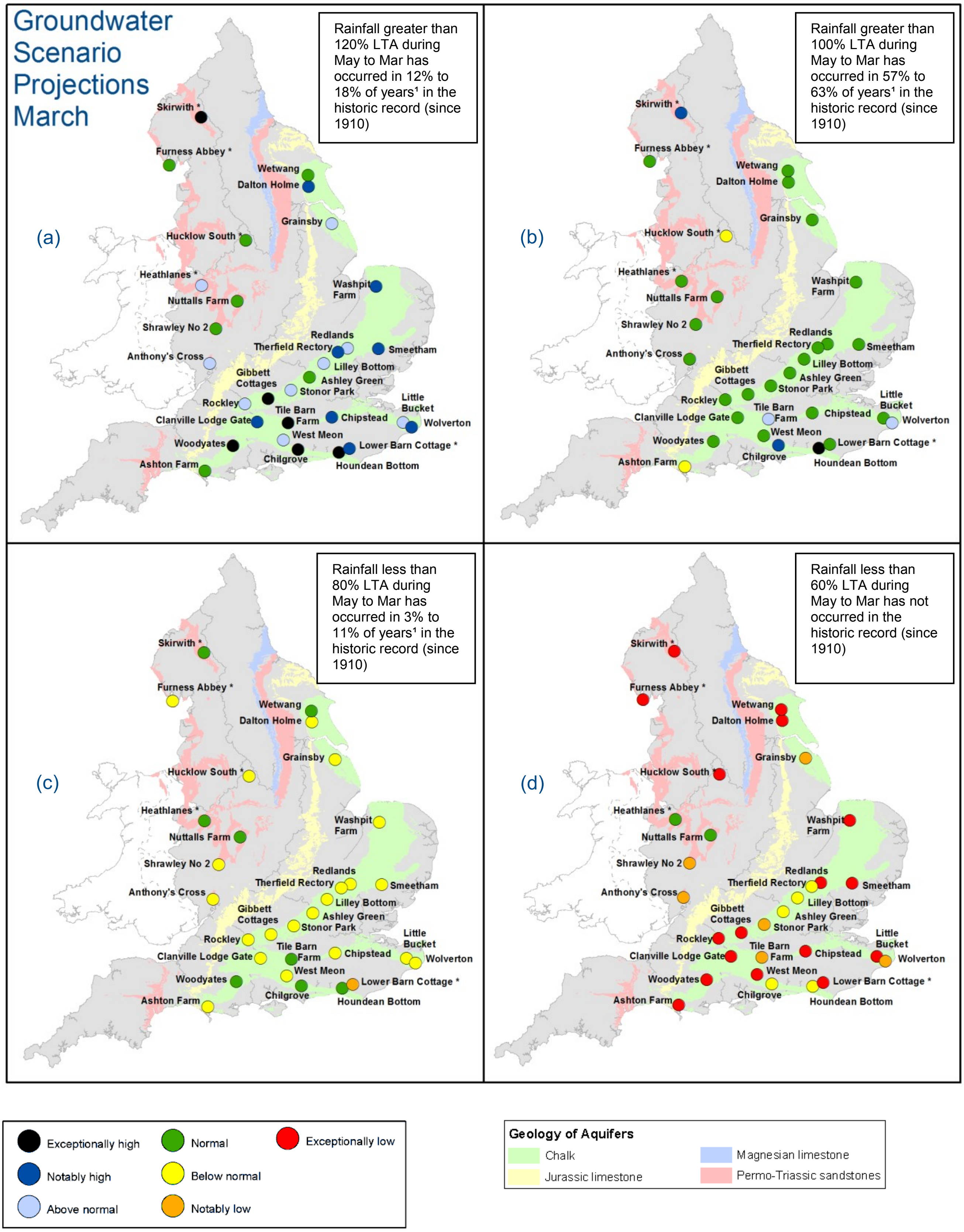
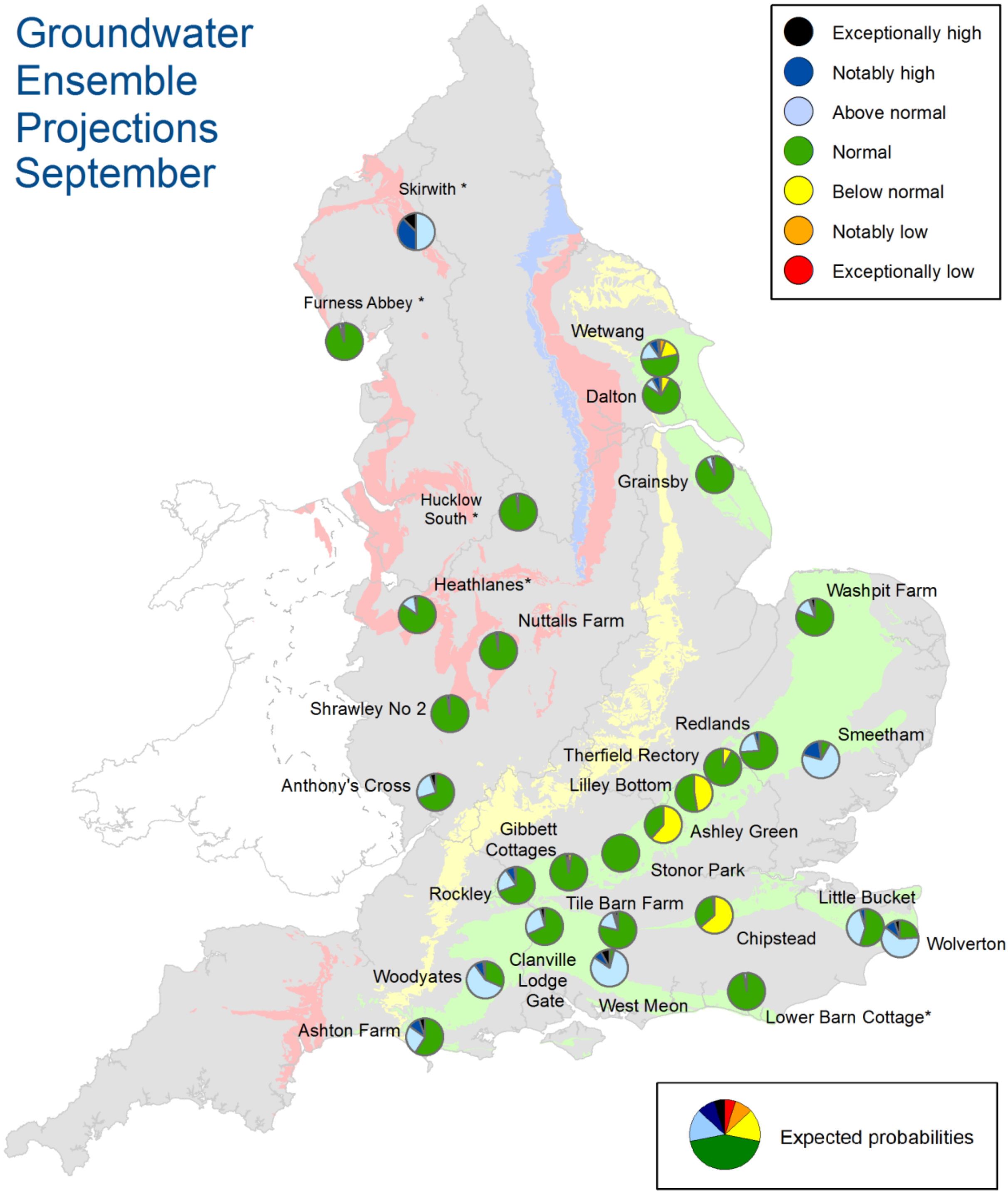


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2018 and March 2019 (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2018.

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

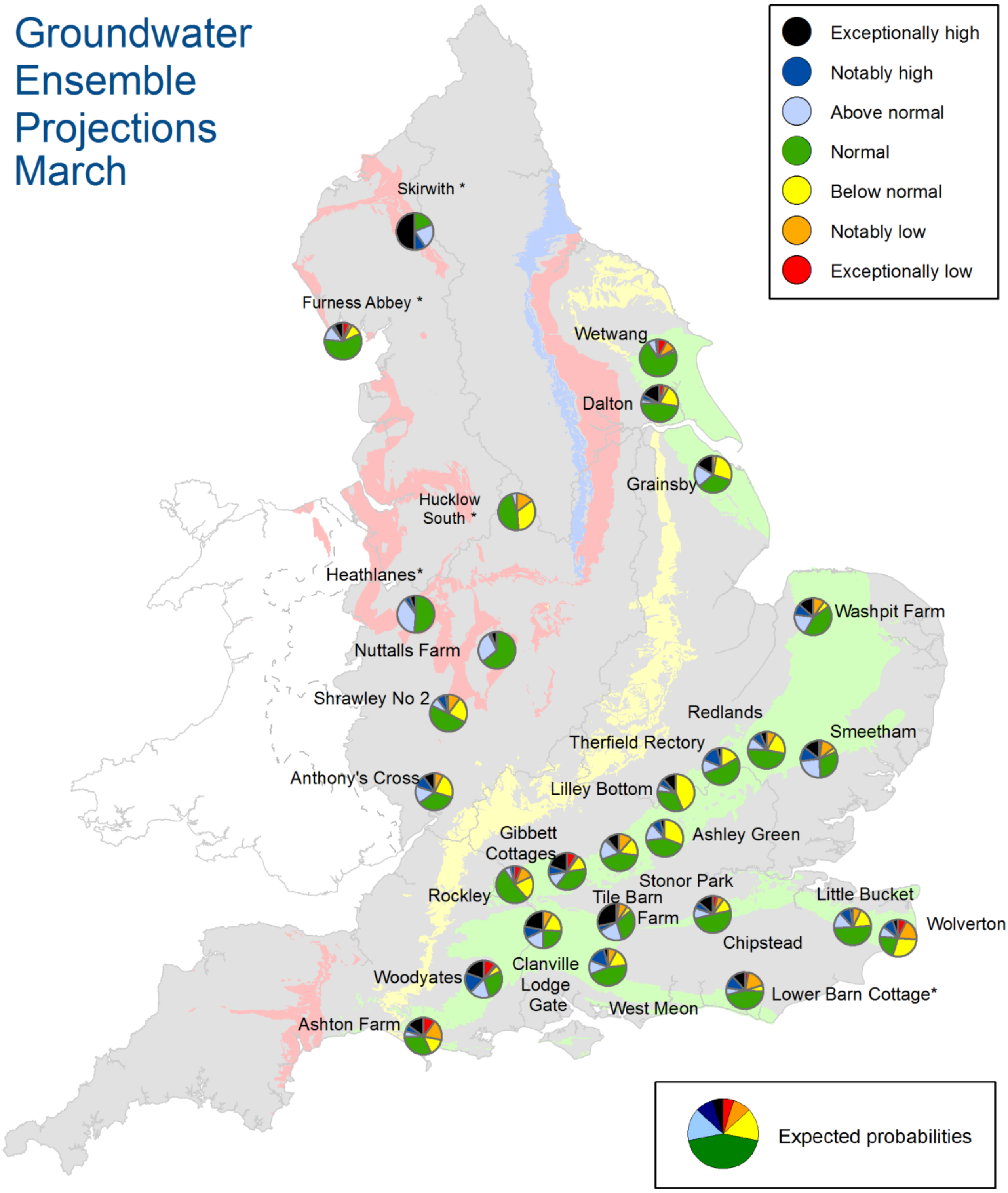


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2018. 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, 2018.

** Projections for these sites are produced by BGS*

Groundwater Ensemble Projections March



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 2019. 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, 2018.

* 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. For rainfall and soil moisture deficit, the period refers to 1961-1990, unless otherwise stated. For other parameters, the period may vary according to data availability
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