Monthly water situation report

England

Summary – June 2018

It was the third driest June on record (since 1910) and the driest June since 1925 across England. The June rainfall total for England was 15mm, which was 25% of the 1961-90 monthly long-term average (24% of the 1981-2010 LTA). The hot and dry weather meant that soil moisture deficits have developed and were larger than average across the whole country by the end of the month. Despite the low rainfall totals, monthly mean river flows were classed as normal or above at over half the indicator sites. End of month groundwater levels were classed as normal or higher for the time of year at all but two indicator sites across England. Reservoir stocks fell at all but one reservoir and reservoir group across England during June. Stocks decreased by over 10% of capacity at nine reservoirs or reservoir groups. Hot and dry weather is expected to prevail across England during July, with occasional interludes of wetter weather in the form of frontal rain from the west/north-west and thundery showers from the south.

Rainfall

June rainfall totals were well below average across England. The highest rainfall totals were in parts of north-west England, with the River Esk and River Eden catchments in Cumbria receiving 65mm (78% of LTA) and 61mm (86% of LTA) respectively. The lowest rainfall totals were in the south and east of England, with the River Darent in Kent and Poole Harbour and the Purbeck Hills receiving 1mm (2% of LTA) during June (Figure 1.1).

Very low monthly rainfall totals were widespread, with less than 5mm of rainfall recorded in over half the hydrological areas in England. Provisionally record low June rainfall totals (records from 1910) were recorded in 21 hydrological areas. June rainfall totals were classed as exceptionally low for the time of year in over two-thirds of hydrological areas. Rainfall totals classed in the normal range were only recorded in four hydrological areas (Figure 1.2).

At a regional scale, June rainfall totals for north-east and north-west England were classed as below normal with 48% and 49% of LTA respectively. Rainfall totals were classed as exceptionally low in the rest of England. South-east England provisionally received the lowest rainfall total for June on record with 3mm (5% of LTA) (Figure 1.3). The June rainfall total for England was 15mm, which was 25% of the 1961-90 monthly long-term average (24% of the 1981-2010 LTA).

Soil moisture deficit

The widespread warm and dry weather dried out soils across England. Soil moisture deficits (SMDs) continued to increase throughout June. At the end of June SMDs were greater than 100mm across nearly half of England, with generally larger SMDs in the south and east of England, and lower SMDs in the north-west (Figure 2.1). SMDs were larger than average for the time of year across all regions of England (Figure 2.2).

River flows

June monthly mean river flows decreased at all but one (Haydon Bridge, Northumberland) of the indicator sites across England, compared to May. However, despite the dry weather conditions, monthly mean river flows were classed as normal or above at over half the indicator sites. The river flows in south-east England did not particularly reflect the record low rainfall totals for June. This is because groundwater levels here were generally still normal or higher for the time of year. Below normal flows were recorded at just under one-third of indicator sites. Notably low monthly mean flows were recorded on the Rivers Mersey, Lune and Wyre in north-west England and on the River Torridge in the south-west. These are in areas where river flows are less influenced by groundwater and more responsive to rainfall patterns (Figures 3.1 and 3.2).

Groundwater levels

Groundwater levels decreased at all but two indicator sites during June. The two sites (Crossley Hill and Coxmoor) which saw levels increase are in slower responding sandstone aquifers. End of month groundwater levels were classed as normal or higher for the time of year at almost all indicator sites across England. The only exceptions

to this were at Crow Lady Farm (Fylde and Preston sandstone aquifer) where the groundwater level was classed as below normal and Crossley Hill (Idle and Torne sandstone aquifer) where the groundwater level was classed as notably low (although continuing to rise as noted above) (Figure 4.1). End of month levels at the major aquifer index sites were all higher than at this time last year (Figure 4.2).

Reservoir storage

Reservoir stocks decreased at all reservoirs and reservoir groups across England during June, except for at Carsington and Ogden reservoirs. Here, total storage increased from 86% of capacity at the end of May to 89% at the end of June. Reservoir stocks decreased by over 10% of capacity at nine reservoirs or reservoir groups. Stocks in the Pennines Reservoir Group (north-west England) decreased from 82% of capacity at the end of May to 64% at the end of June. Total stocks in the Derwent Valley reservoirs (Derbyshire) decreased by 17% to 69% of capacity at the end of June (Figure 5.1). Stocks remain classed as normal for the time of year at most reservoir or reservoir groups. Total reservoir storage for England was below the LTA for the time of year, at the end of June (Figure 5.2).

Forward look

Hot and dry weather is expected to prevail across England during July, with occasional interludes of wetter weather in the form of frontal rain from the west/north-west and thundery showers from the south. For the 3-month period July-August-September, below average precipitation is more likely than above average precipitation[1].

Projections for river flows at key sites[2]

Nearly 75% of the modelled sites have a greater than expected chance of cumulative river flows being normal for the time of year by the end of September 2018. Just over 75% of the modelled sites have a greater than expected chance of cumulative flows being below normal 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]

Just over 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. Just over two-fifths 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 the Environment Agency in partnership with the Centre for Ecology and Hydrology, British Geological Survey, Met Office (www.hydoutuk.net).

Rainfall

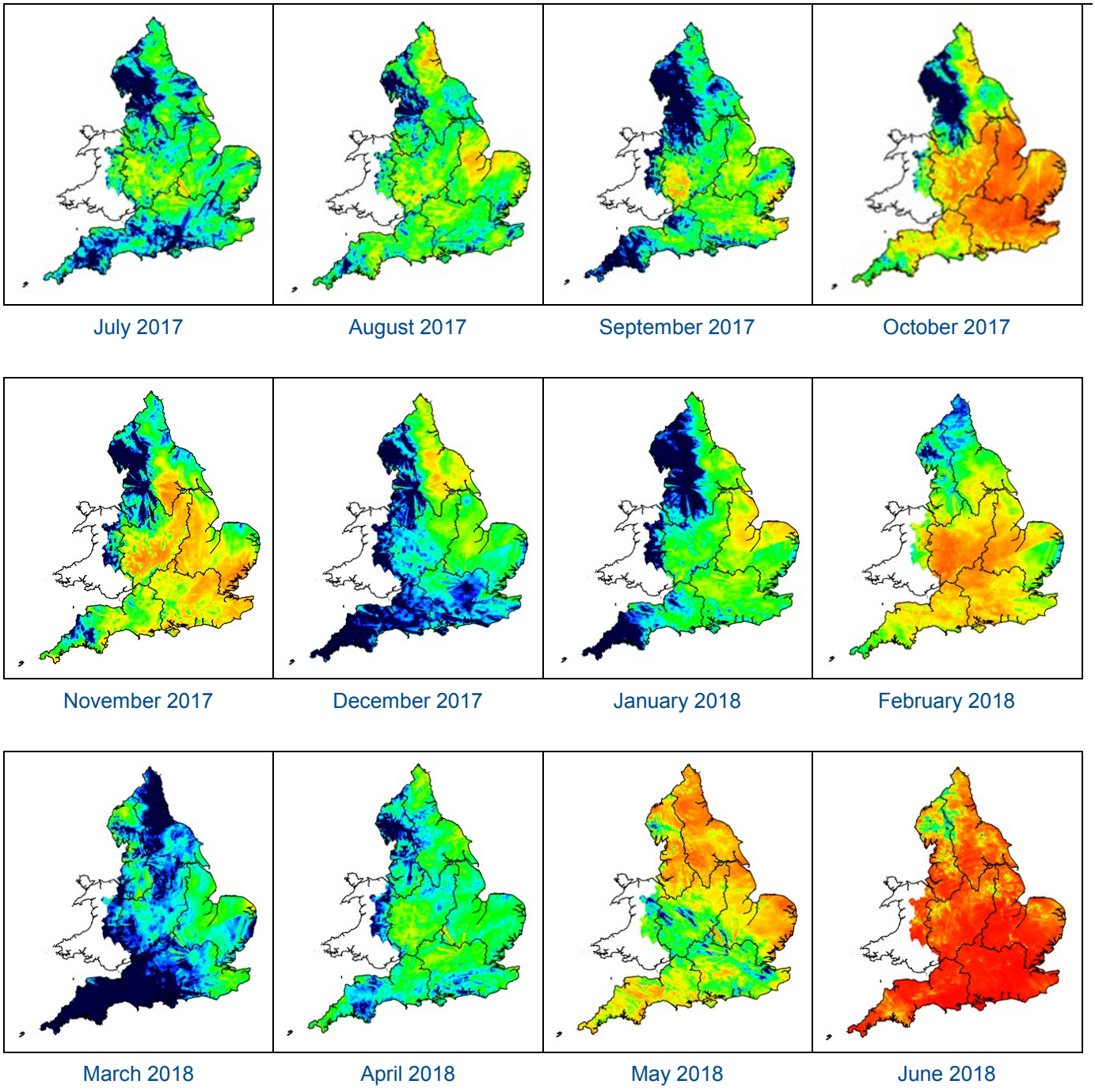


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2018). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.

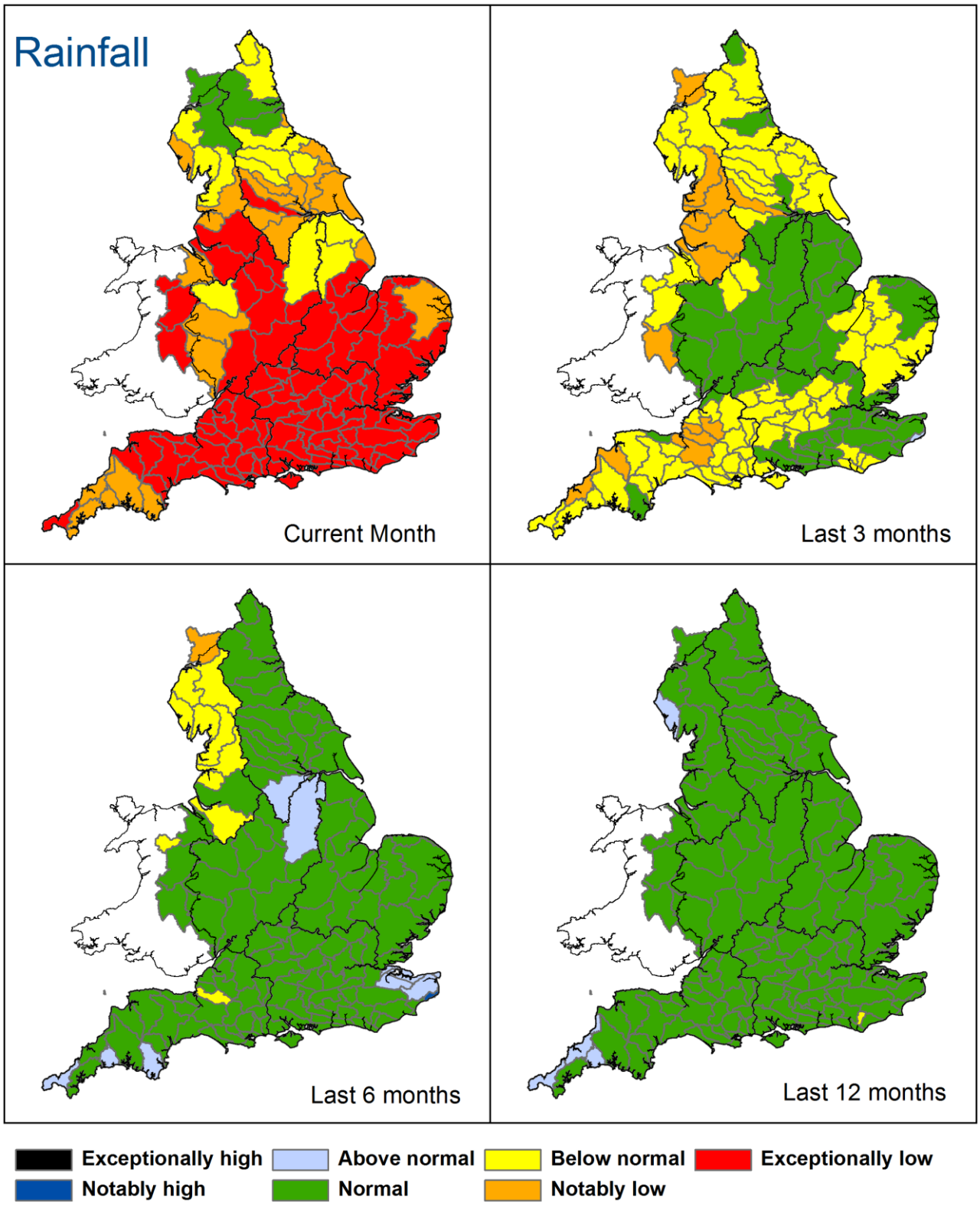


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 June), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 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

Above average rainfall

Below average rainfall

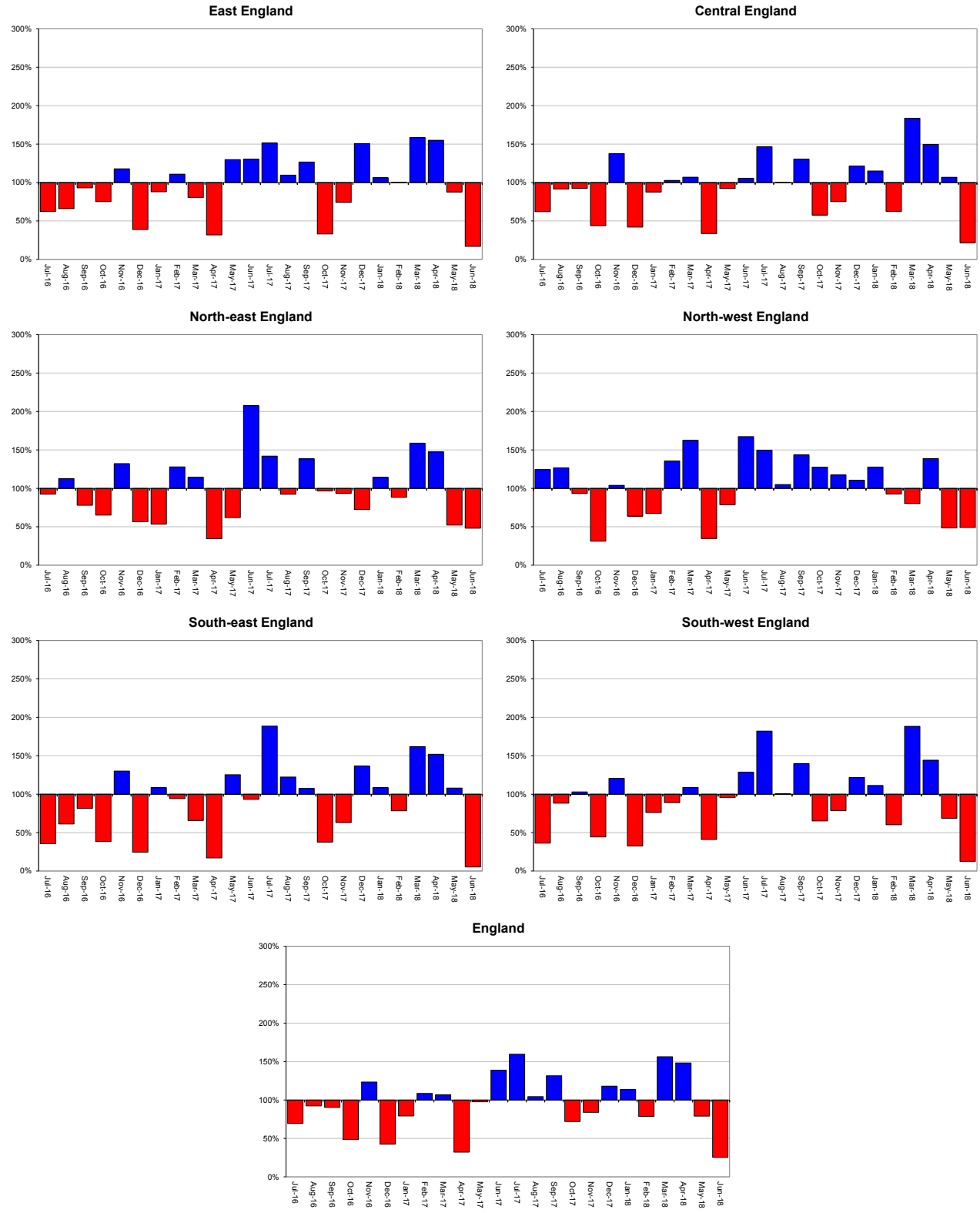


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2018).

Soil moisture deficit

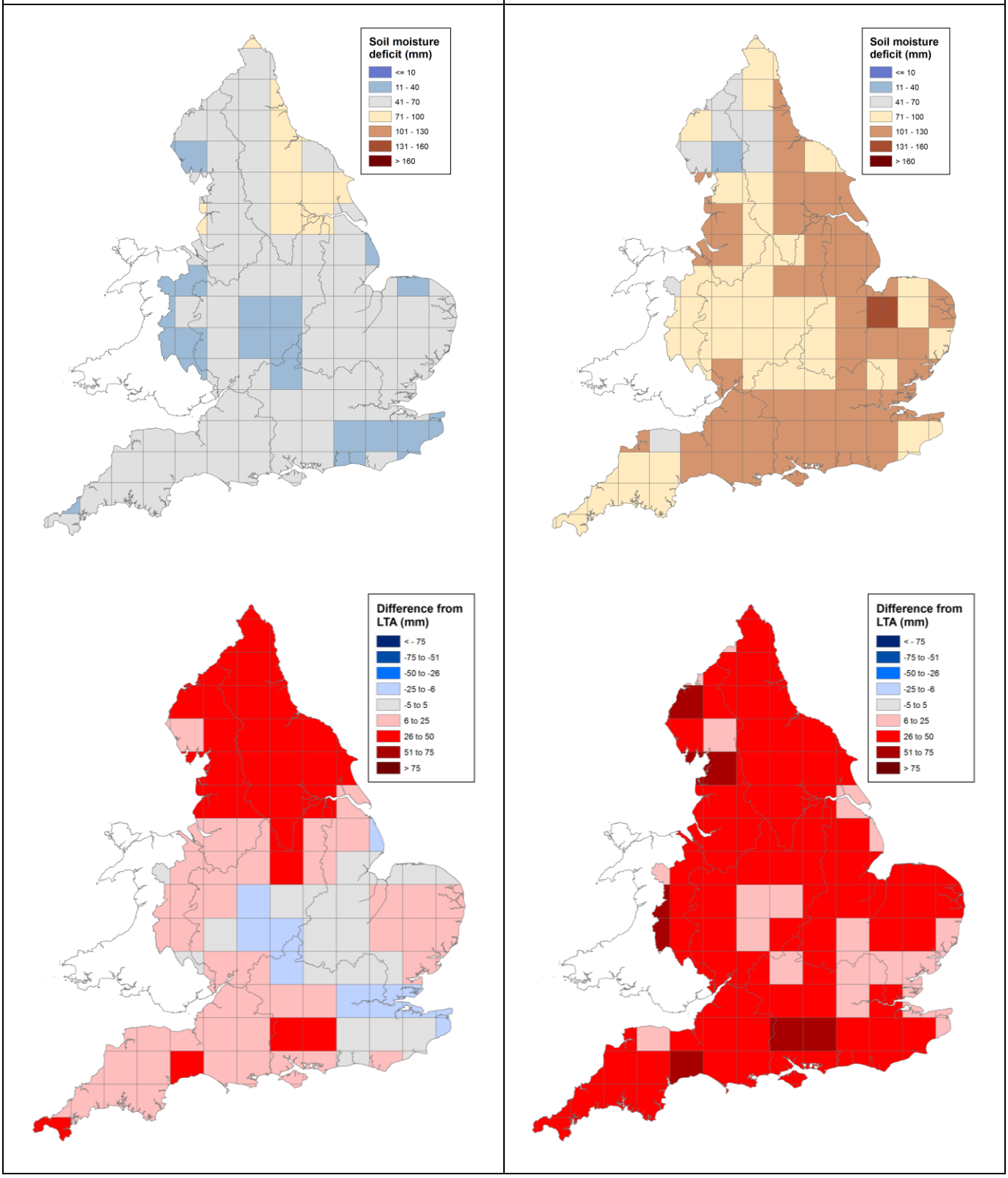
End of May 2018[1]	End of June 2018[2]
	

Figure 2.1: Soil moisture deficits for weeks ending 29 May 2018[1] (left panel) and 26 June 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

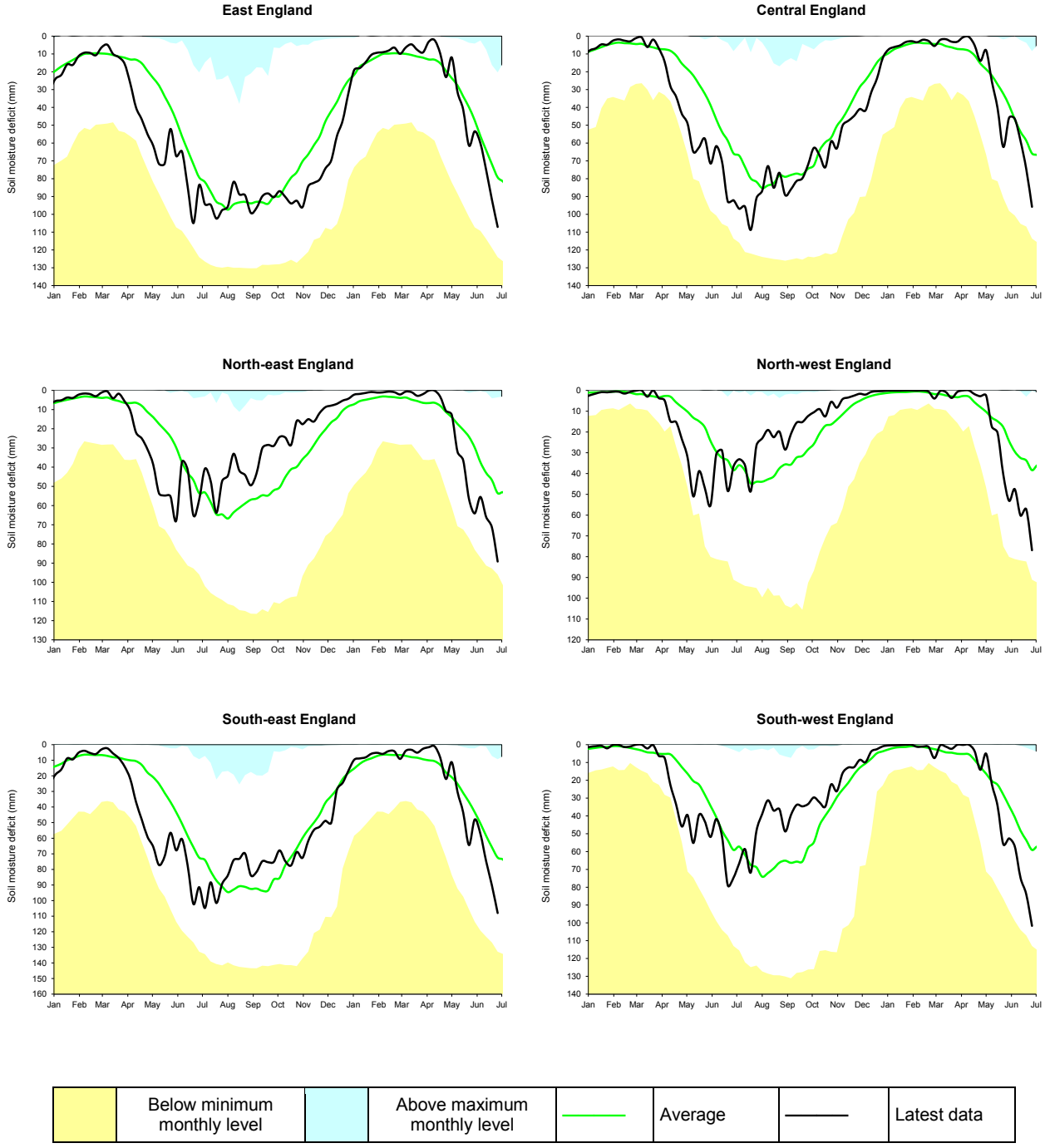
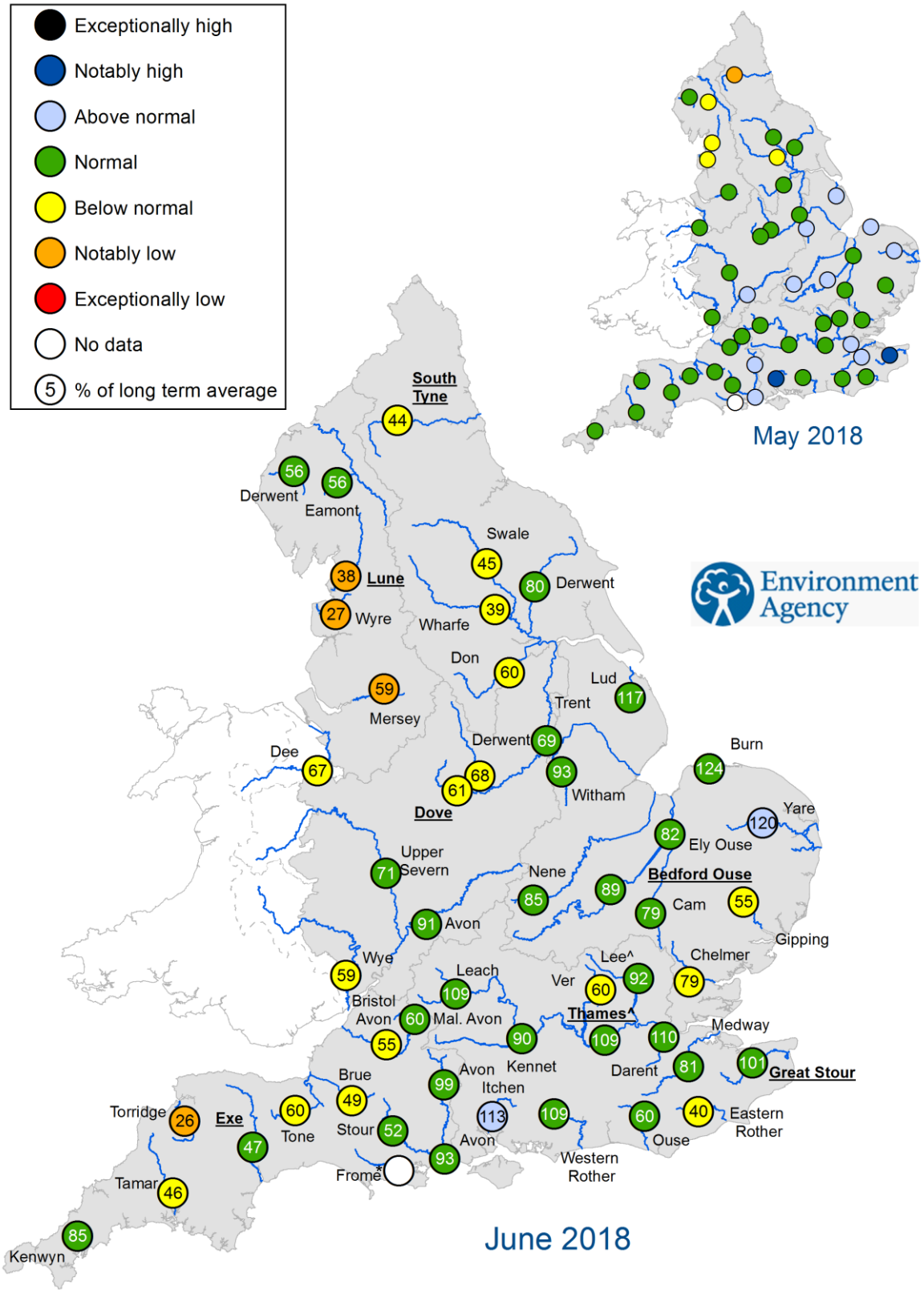


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2018).

River flows



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

* Data unavailable for River Frome at East Stoke due to technical problems at site

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 May and June 2018, expressed as a percentage of the respective long term average and classed relative to an analysis of historic May and June monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.

River flow charts

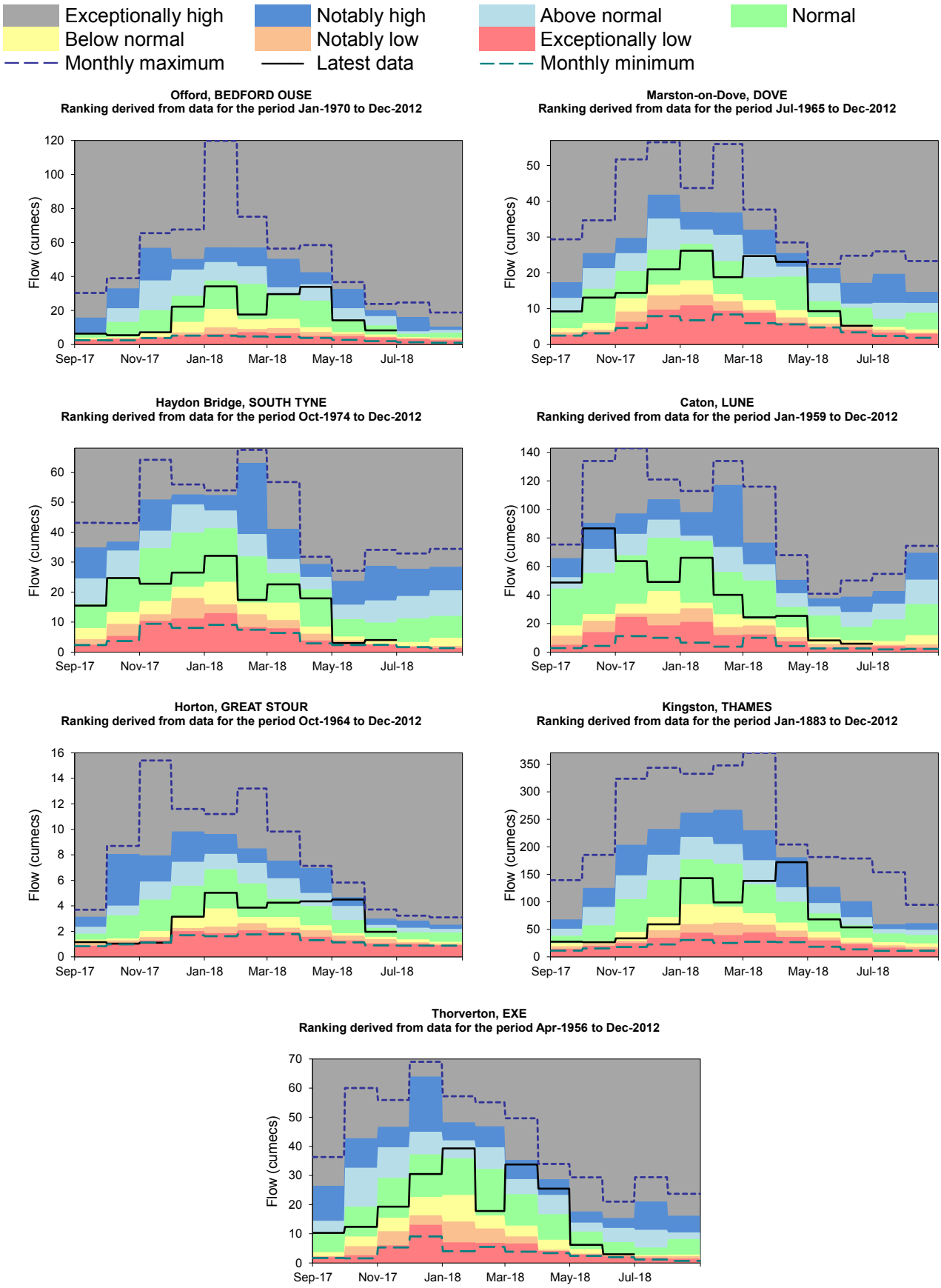
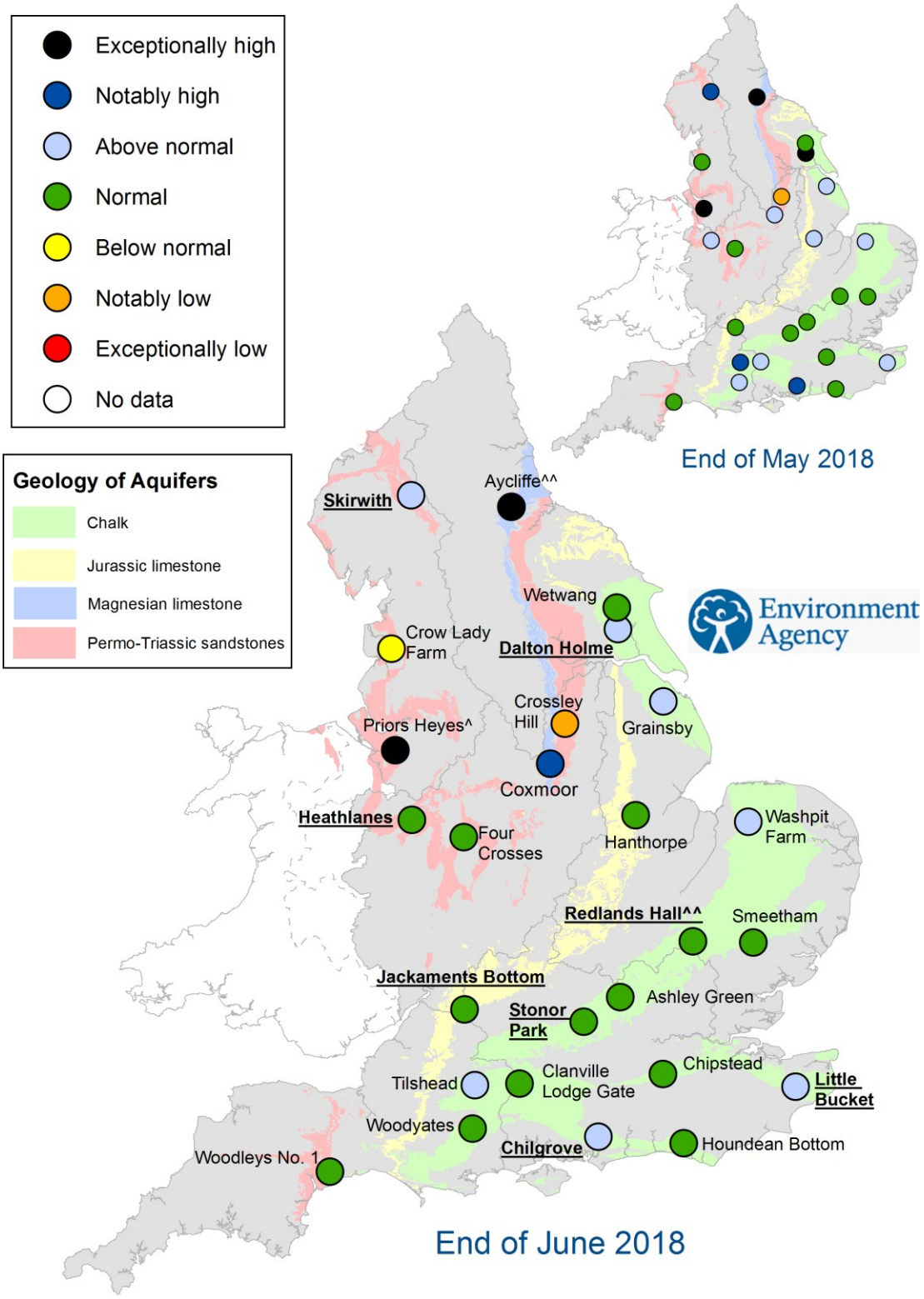


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 May and June 2018, classed relative to an analysis of respective historic May and June 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

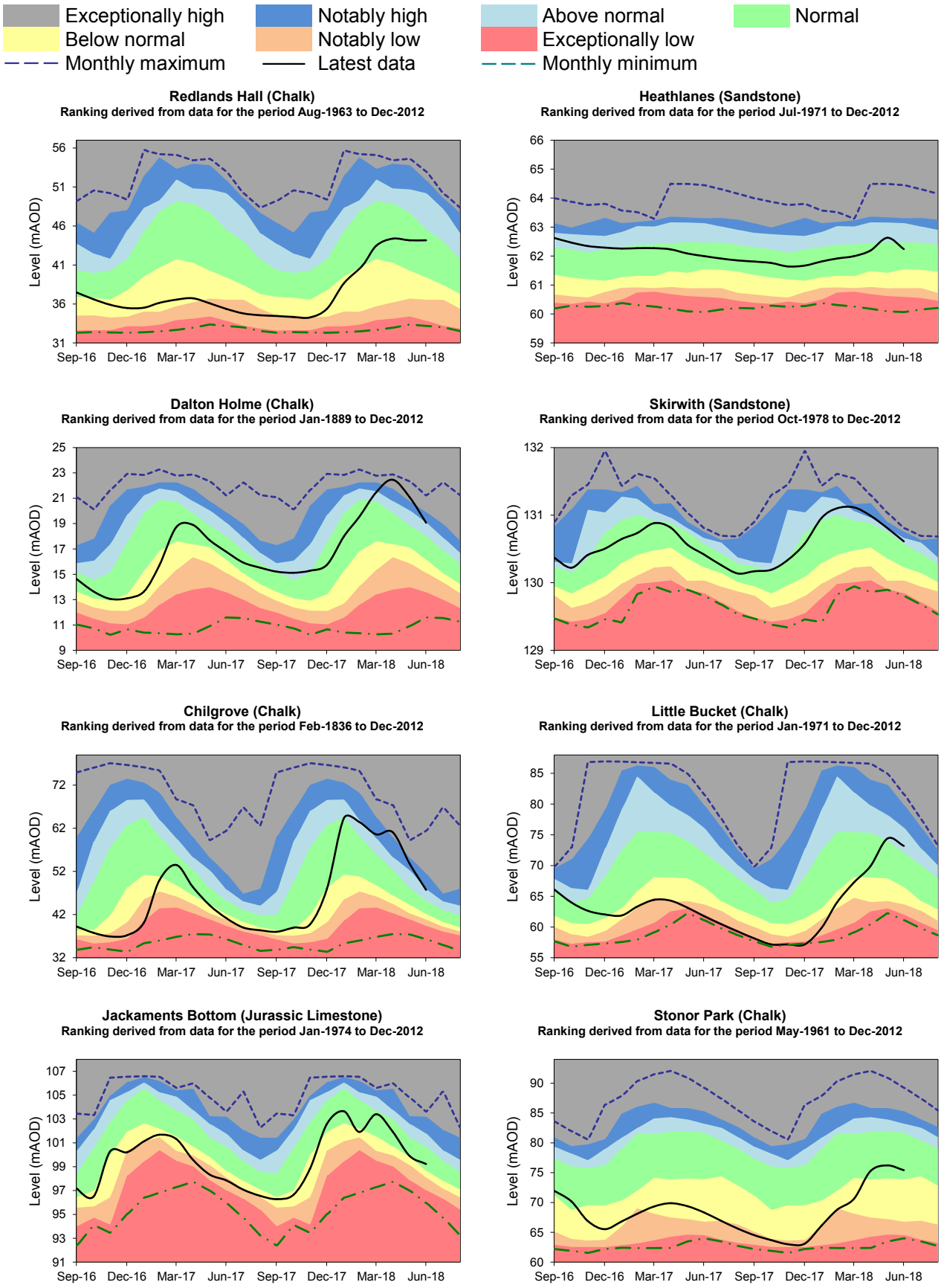
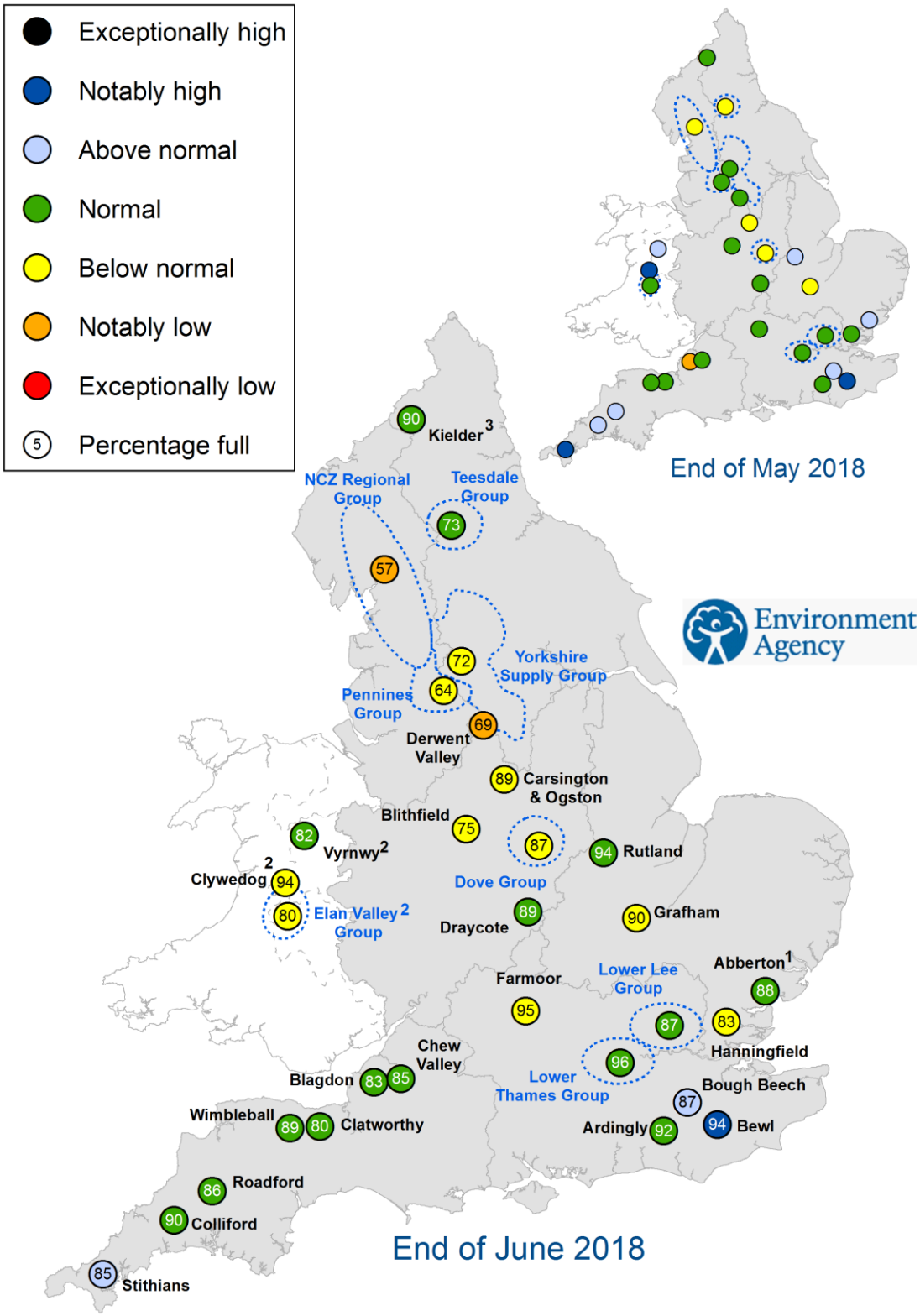


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2018).

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 May and June 2018 as a percentage of total capacity and classed relative to an analysis of historic May and June values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate to control curves or triggers for drought actions. As well as for public water supply, some reservoirs are drawn down to provide flood storage, river compensation flows or for reservoir safety inspections. In some cases current reservoir operating rules may differ from historic ones. Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.

Reservoir storage charts

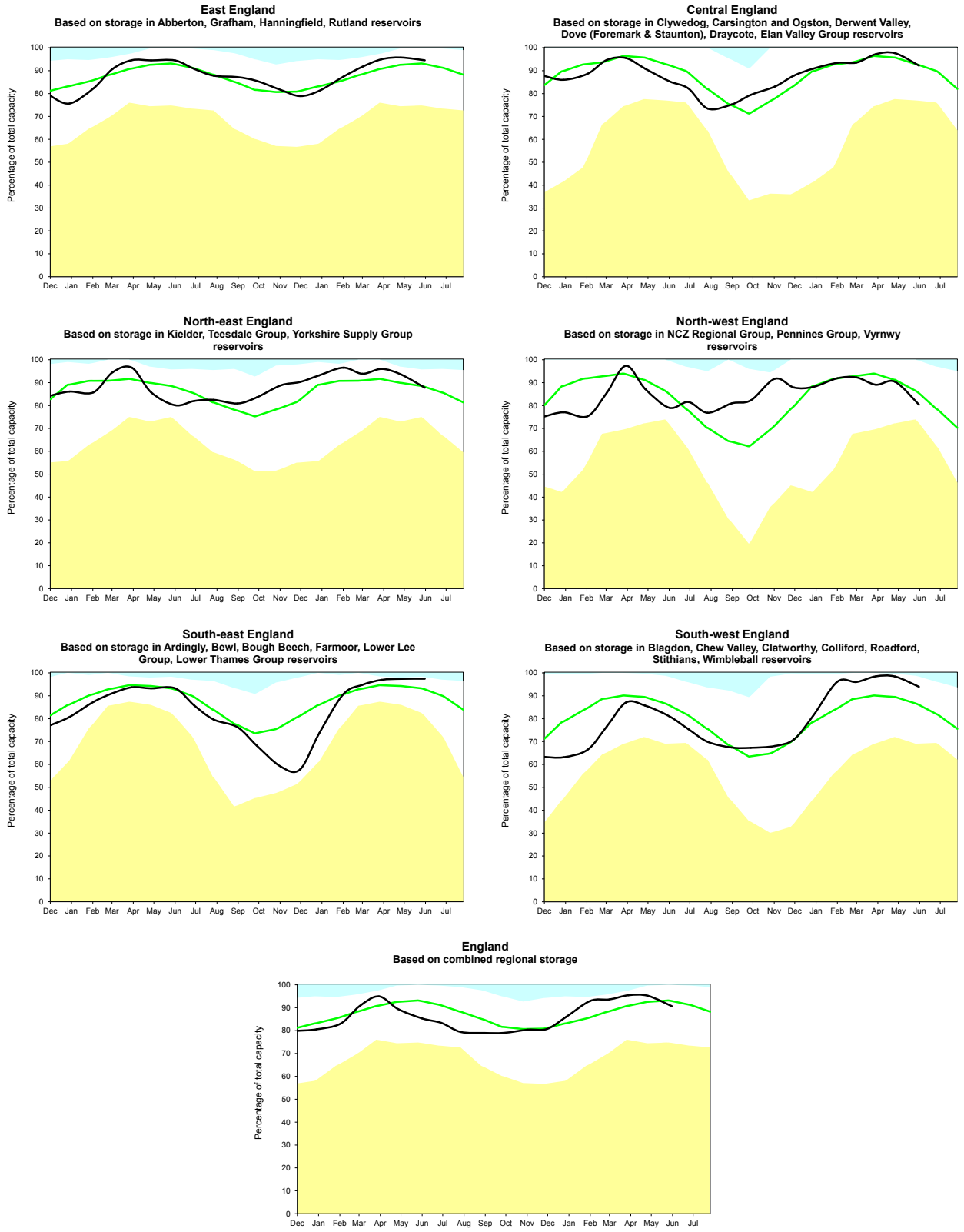


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

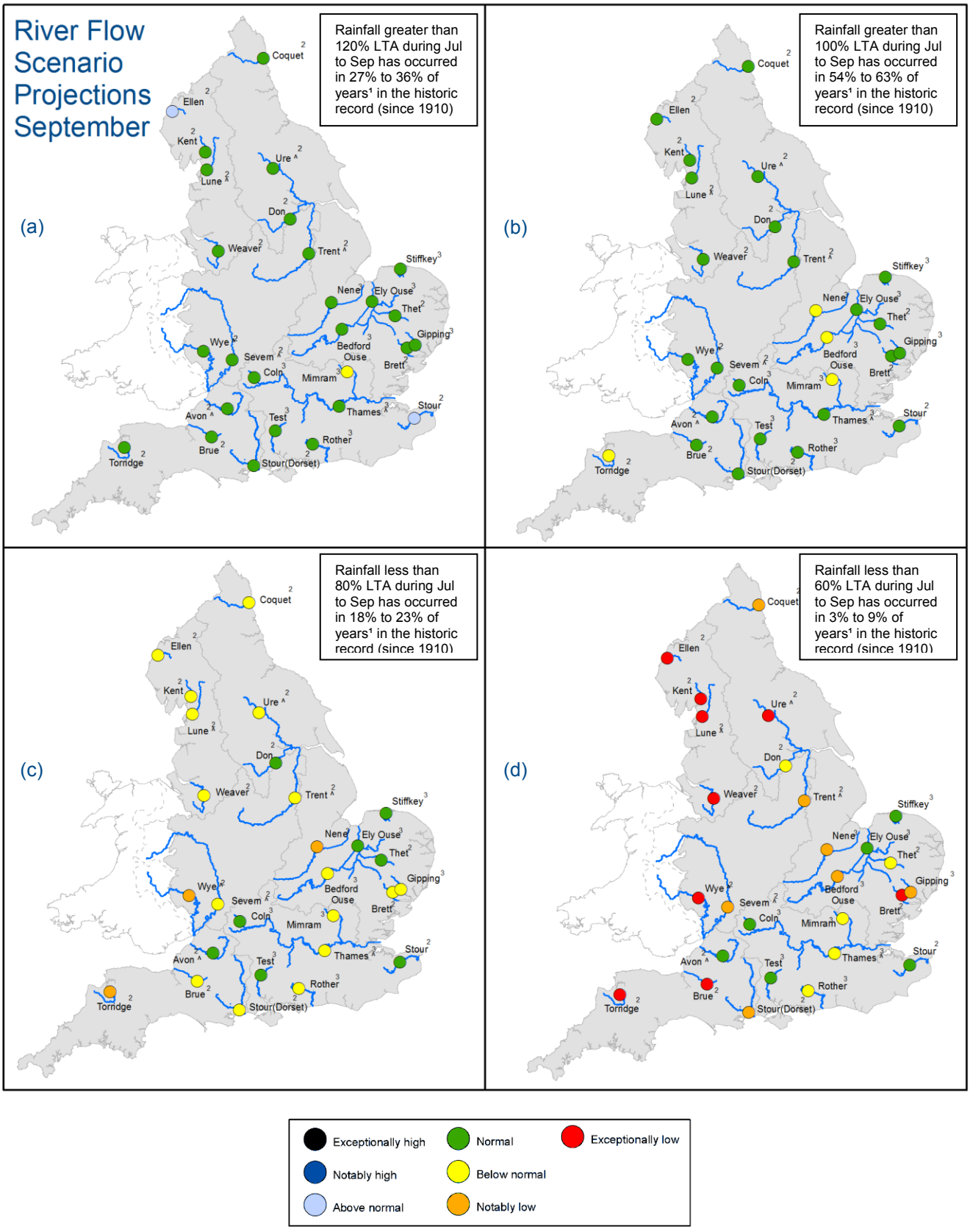


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2018. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July and September 2018 (Source: Centre for Ecology and Hydrology, Environment Agency).

[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*

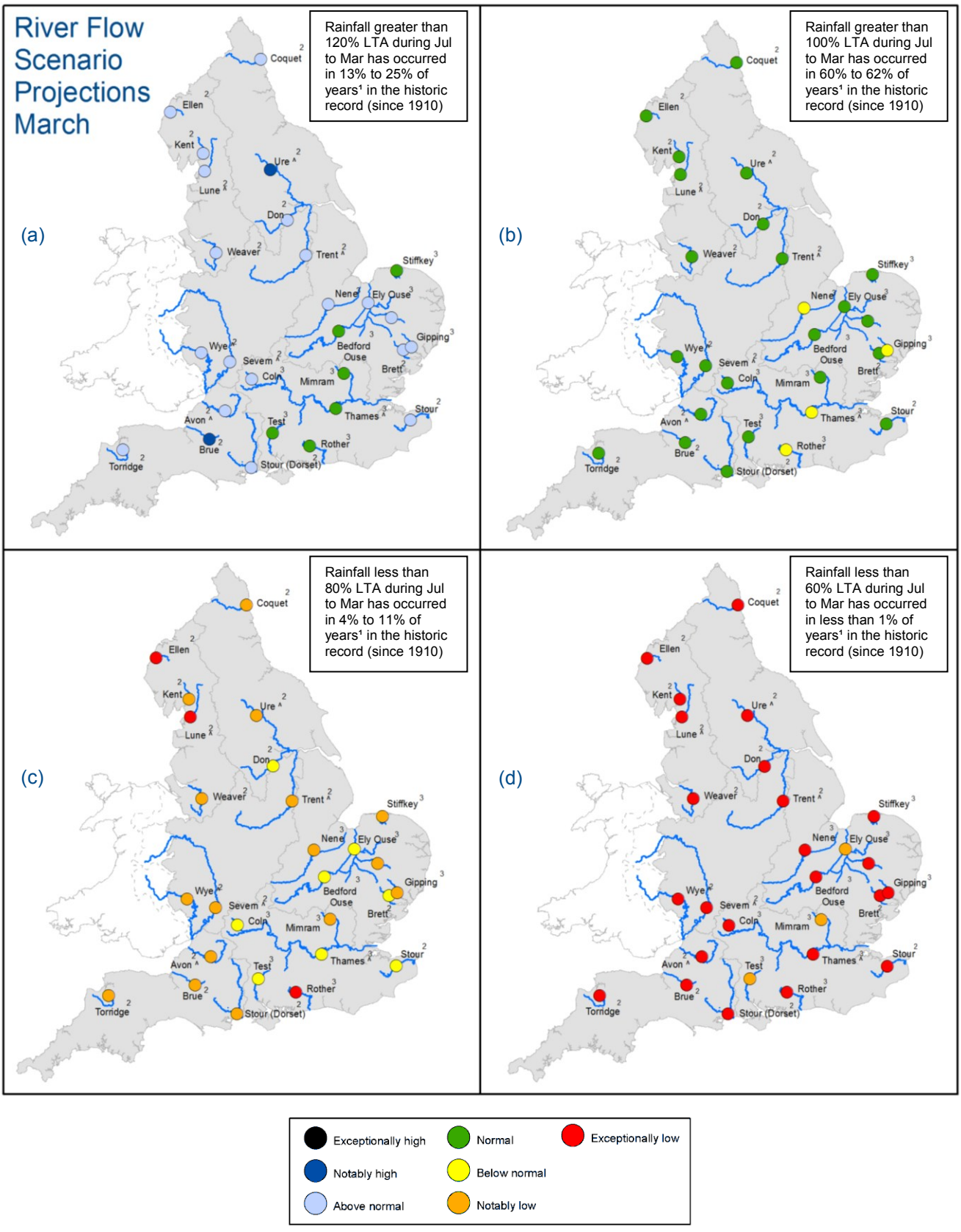


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2018 and March 2019 (Source: Centre for Ecology and Hydrology, Environment Agency).

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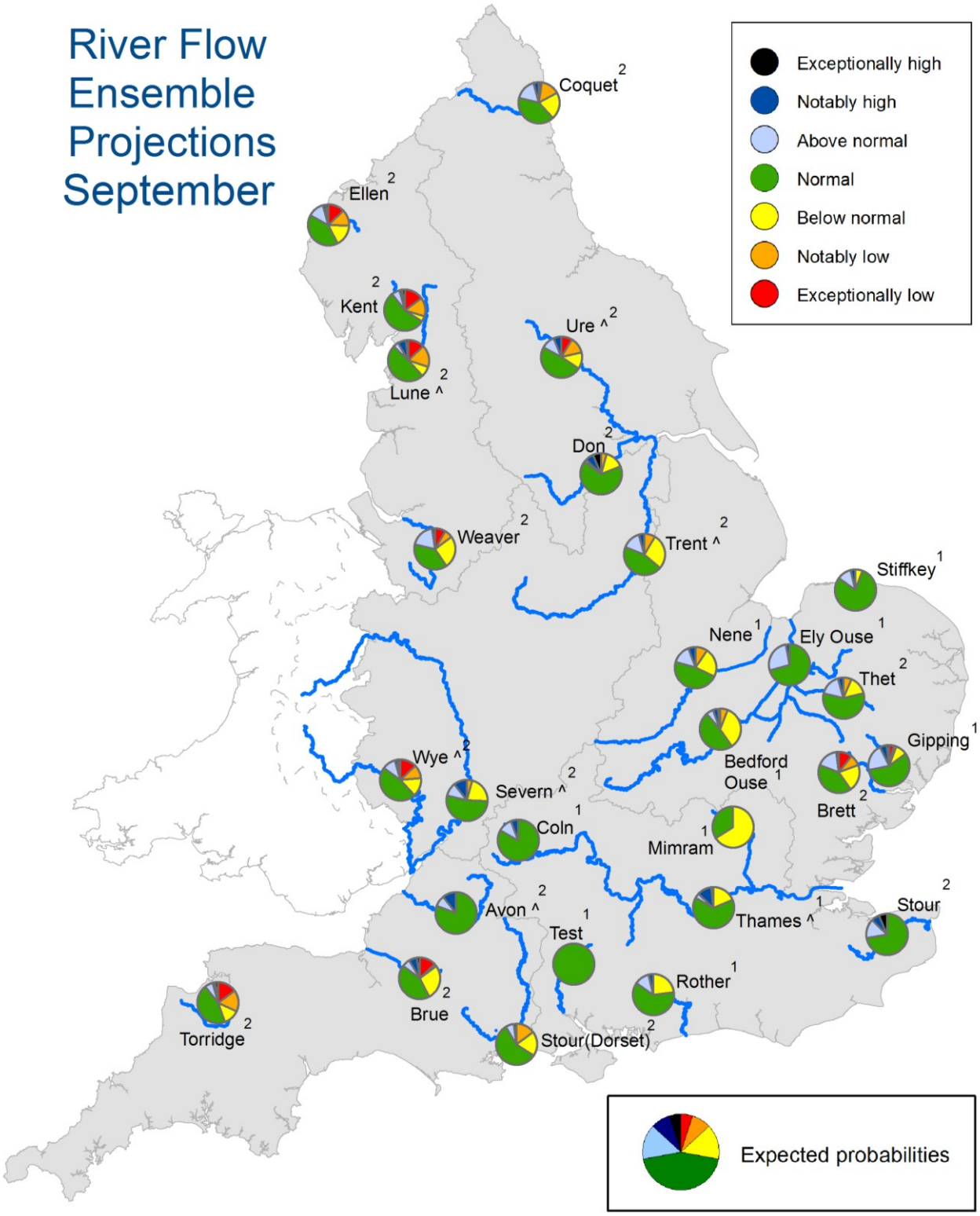

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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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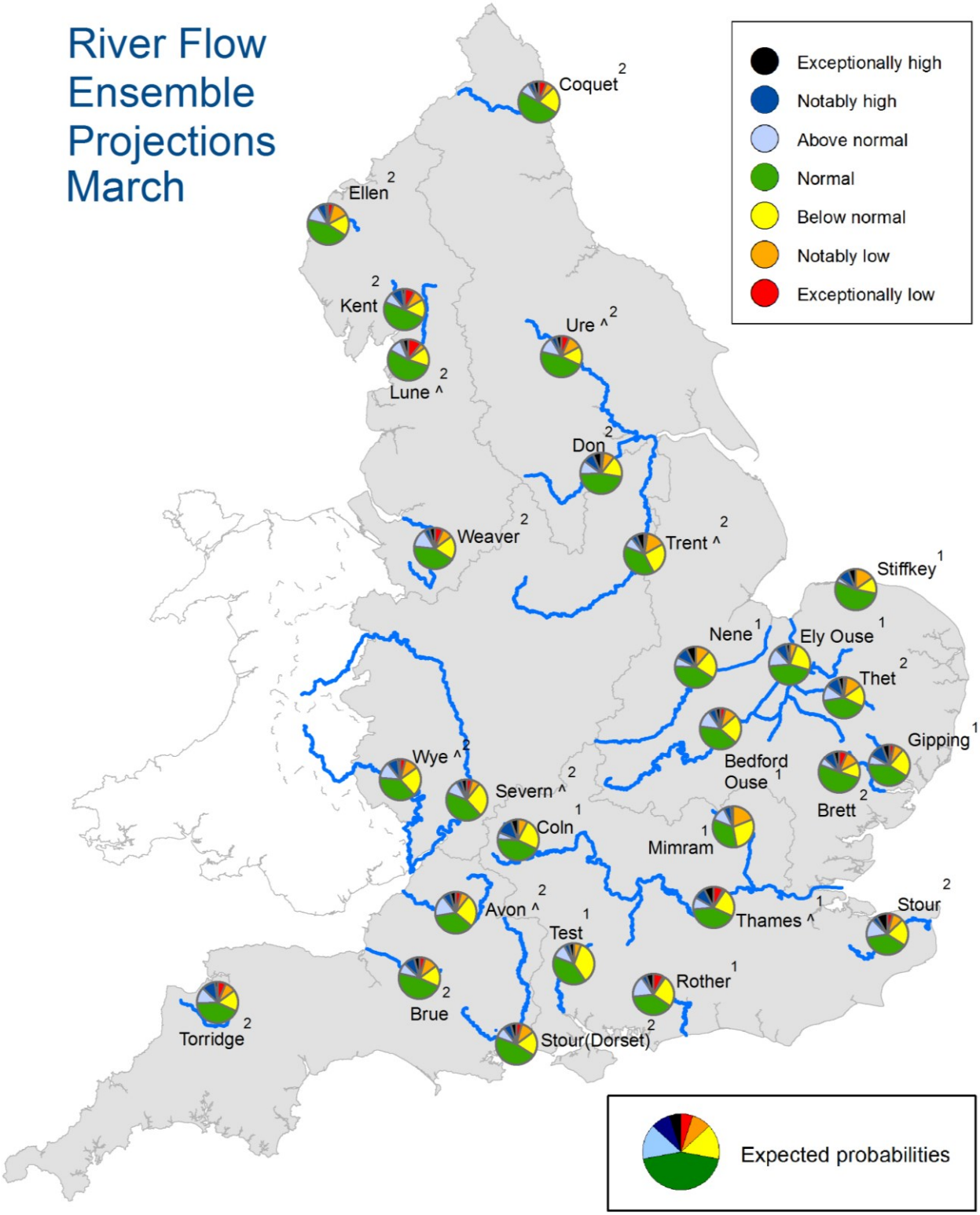
^"Naturalised" flows are projected for these sites



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 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

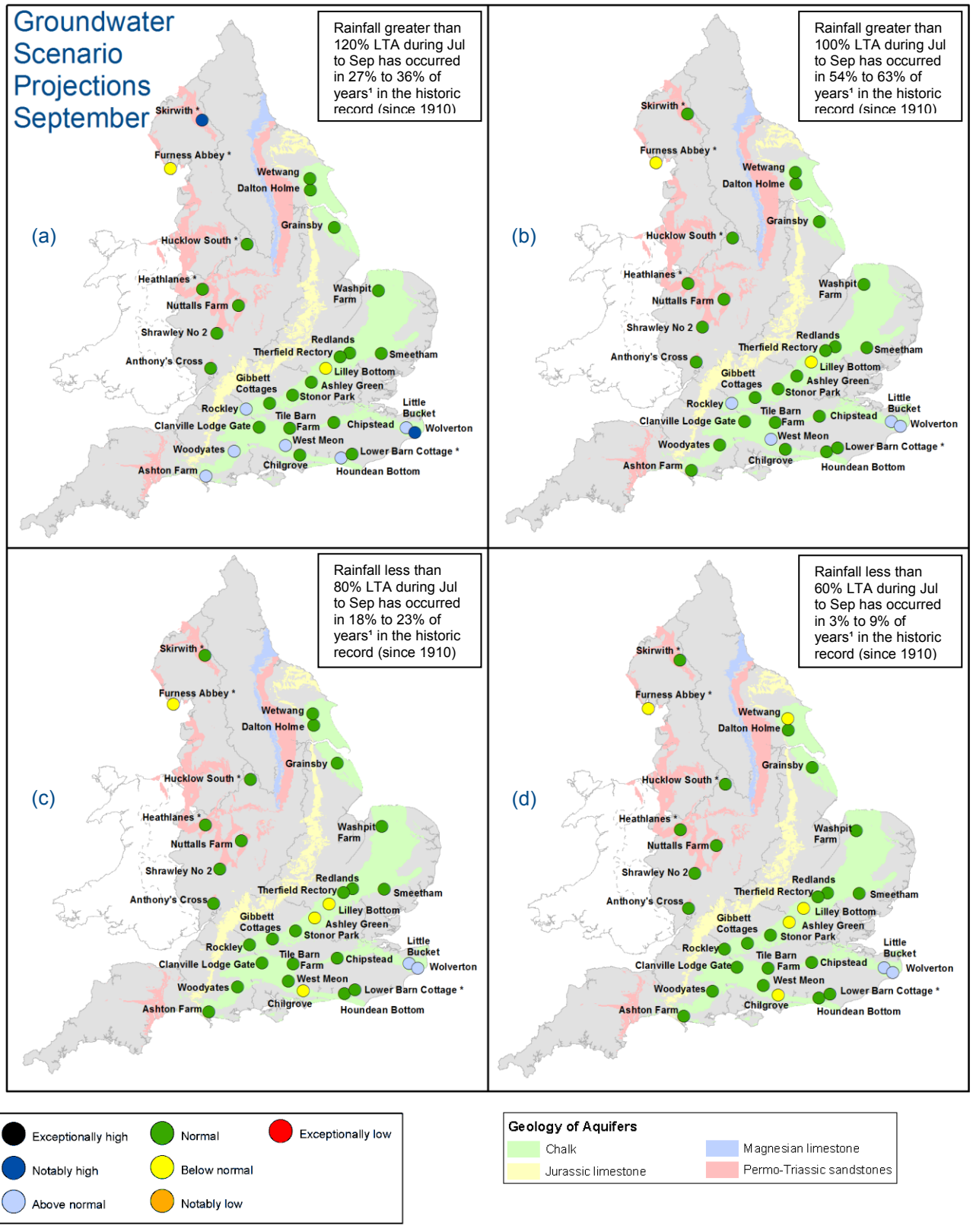


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July and September 2019 (Source: Environment Agency). Geological map reproduced with kind permission 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

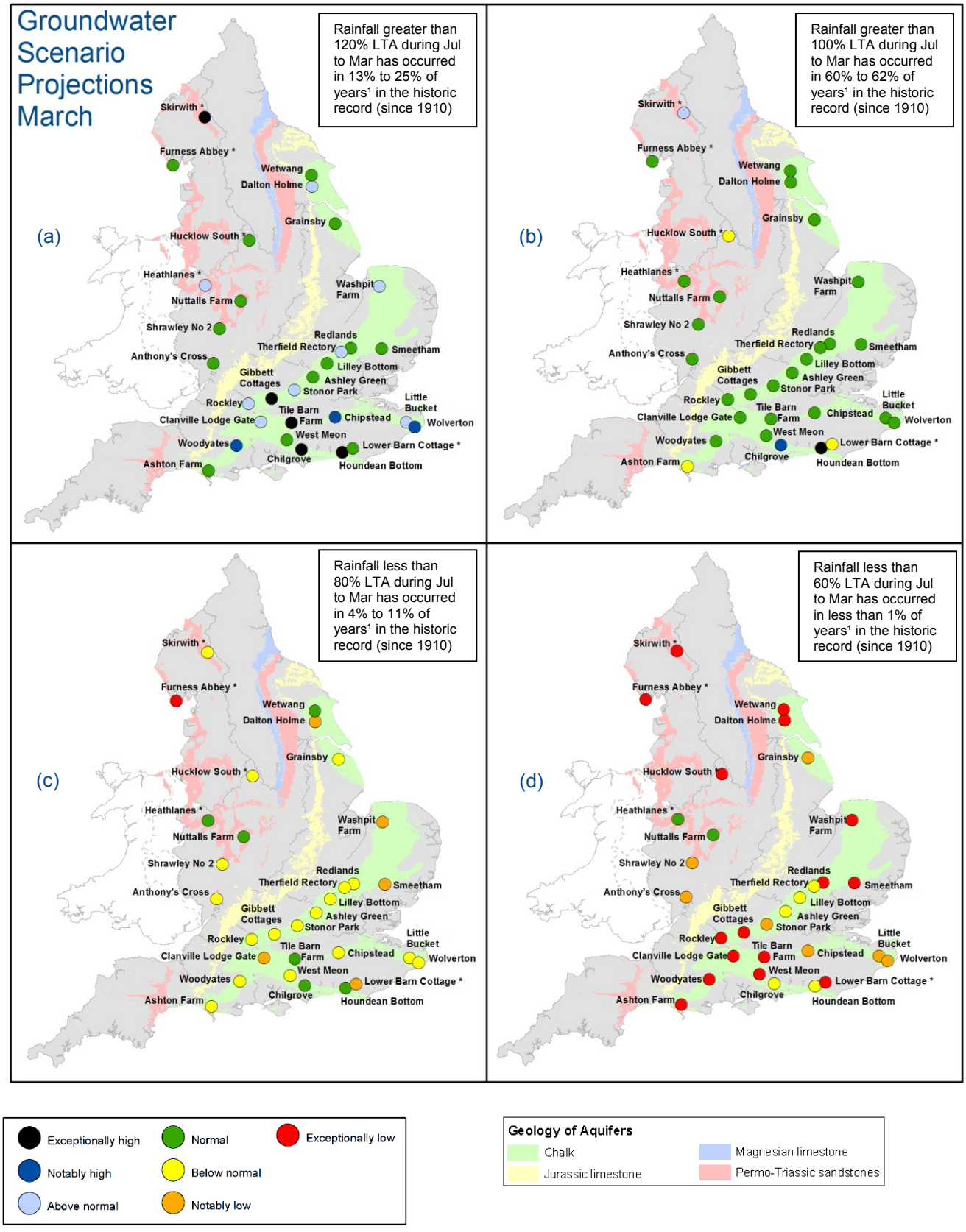


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2018 and March 2019 (Source: Environment Agency). Geological map reproduced with kind permission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

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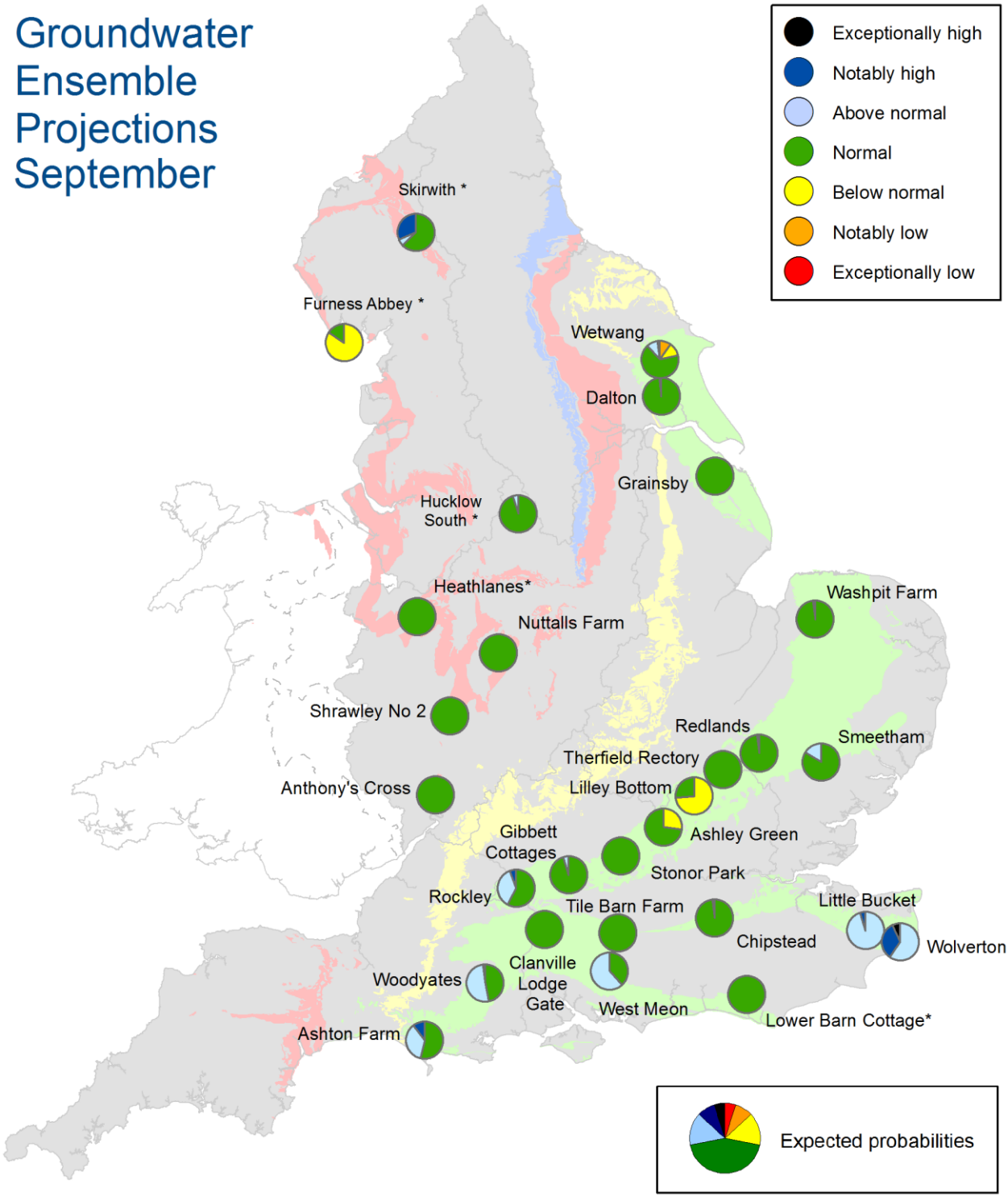
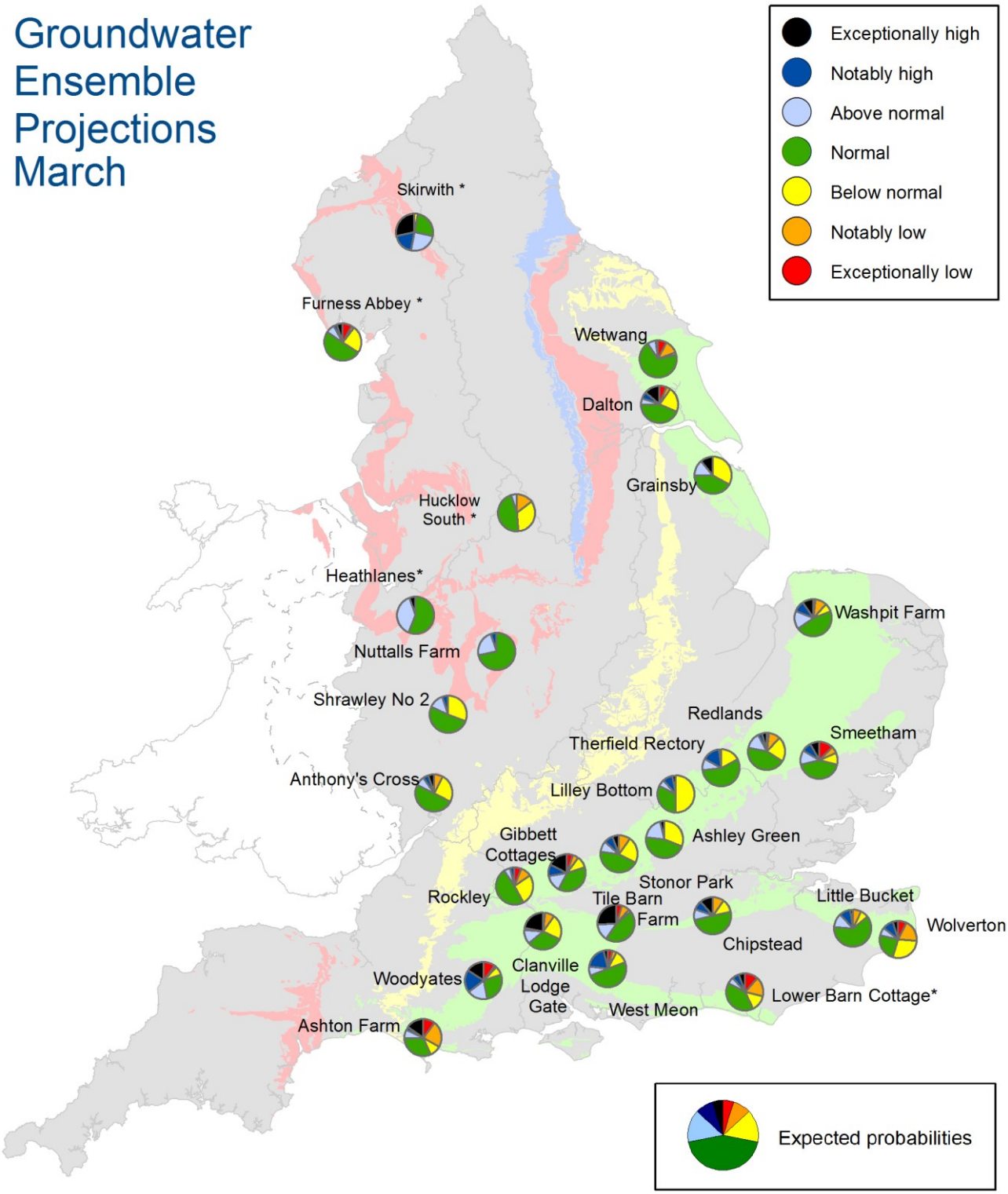
[1] This range of probabilities is a regional analysis



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 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*



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