# Monthly water situation report

## England

### Summary – June 2017

Rainfall totals for June were above the long term average (LTA) for the month in most parts of the country and particularly high in parts of northern England. For England as a whole, the June rainfall total was 140% of the 1961-90 LTA. Soils remain drier than average for the time of year in central and southern England, with soil moisture deficits for the end of June of more than 100mm across some parts. Monthly mean river flows decreased compared to May at just over half the indicator sites and are lower than normal for the time of year at a third of the sites. Groundwater levels decreased at almost all indicator boreholes. Reservoir stocks decreased at the majority of reported reservoirs or reservoir groups. Overall reservoir storage for England is 83% of total capacity, a small decrease compared to May.

### Rainfall

Rainfall totals for June were significantly higher than for May. Rainfall totals were below 40mm in parts of central England but for most of England rainfall totals were above 60mm. The highest rainfall totals were in north-west England where some catchments received more than 150mm. Rainfall totals were above the long term average (LTA) for June across over half the hydrological areas in England. Some hydrological areas in northern England had rainfall totals that were more than 250% of the LTA while some in central England had rainfall totals that were less than 75% of the LTA (Figure 1.1).

June rainfall totals were classed as normal or above normal for the time of year for over three quarters of hydrological areas across England. For hydrological areas in northern England, and parts of Devon, rainfall totals were notably high or exceptionally high (coastal parts of north Yorkshire, Durham and Northumberland) for the time of year. The rainfall accumulations over the previous 12-month period are below normal or lower across most parts of England. (Figure 1.2).

Overall, rainfall totals for June ranged from 99% of the LTA in south-east of England to 213% in north-east England. Across England as a whole, monthly rainfall totals were 140% of the 1961-90 LTA for June (137% of the 1981-2010 LTA) (Figure 1.3).

### Soil moisture deficit

Soil moisture deficits (SMDs) decreased in response to above average rainfall in northern England during June but generally increased elsewhere. End of the month SMDs were smaller than for May in northwest England and parts of Devon but larger elsewhere (soils were drier across more than three quarters of England); SMDs ranged from 0 to 115mm. Soils were much drier than the June LTA across the west Midlands, and parts of central and southern England (Figure 2.1).

At a regional scale, soils were wetter at the end of June than at the end of May for northern England but drier elsewhere. End of month SMDs ranged from nearly 30mm in north-west England to nearly 100mm in central England. Soils were close to average across east, north-east and north-west England but drier than average elsewhere (Figure 2.2).

### River flows

Compared with May, monthly mean river flows for June decreased at slightly more of the indicator sites across England than those where increases were seen. River flows were classed as lower than normal at a third of the indicator sites; nearly a quarter of sites were classed as higher than normal for the time of year (Figure 3.1).

At the regional index sites, monthly mean river flows ranged from notably low for the time of year on the Great Stour at Horton in south-east England to notably high on the Lune at Caton in north-west England (Figure 3.2).

## Groundwater levels

Groundwater levels decreased at all except one of the indicator sites during June compared to the end of May. End of month groundwater levels were lower than normal at over half of the indicator sites. End of month groundwater levels at the major aquifer index sites ranged from normal for the time of year at Heathlanes (Shropshire sandstone), Dalton Holme (Hull and East Riding chalk) and Skirwith (Carlisle Basin and Eden Valley sandstone) to exceptionally low for the time of year at Little Bucket (East Kent Stour chalk) (Figures 4.1 and 4.2)

## Reservoir storage

During June, reservoir stocks decreased at over three-quarters of all the reported reservoirs or reservoir groups. Notable decreases of 10% occurred at the Blithfield, Bough Beech and Clatworthy reservoirs. Reservoir stocks at all reported sites and groups in north-east and north-west England either increased very slightly or there was no net change in storage. End of month stocks were classed as normal or higher for the time of year just over half of all reported reservoirs or reservoir groups. The remaining sites were classed as below normal or lower for the time of year, although stocks in the Teesdale Group have been affected by operational activities to Cow Green reservoir (Figure 5.1).

Reservoir stocks decreased in all regions compared with the end of May with the exception of north-west and north-east England. The largest decrease of 8% occurred in south-east England. End of June stocks ranged from 75% of total capacity in south-west England to 91% in east England. Overall storage for England decreased by 2% to 83% of total capacity (Figure 5.2).

## Forward look

The beginning of July is likely to be dry and settled in south and east England, with more unsettled conditions affecting north-east and north-west England, with significant rainfall totals possible. Towards the middle of July, a period of more unsettled weather is expected, with showers and possibly longer spells of rain occurring across England at times, especially in north-west England. The rain is likely to be interspersed with drier spells, especially in south and east England. The second half of July is expected to be drier, more settled and warmer, although north-west England is likely to remain unsettled. Over the 3 month period July to September for the UK, above average rainfall is slightly more probable than below average[1].

**Projections for river flows at key sites[2]**

Two-thirds of the modelled sites have a greater than expected chance of cumulative river flows being below normal or lower by both the end of September 2017 and the end of March 2018.

For scenario based projections of cumulative river flows at key sites by September 2017 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2018 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2017 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2018 see Figure 6.4

**Projections for groundwater levels in key aquifers[2]**

A quarter of the modelled sites have a greater than expected chance of notably low or lower groundwater levels for the time of year at the end of September 2017. By March 2018, half of all the modelled sites have a greater than expected chance of below normal or lower groundwater levels for the time of year.

For scenario based projections of groundwater levels in key aquifers in September 2017 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2018 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2017 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2018 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

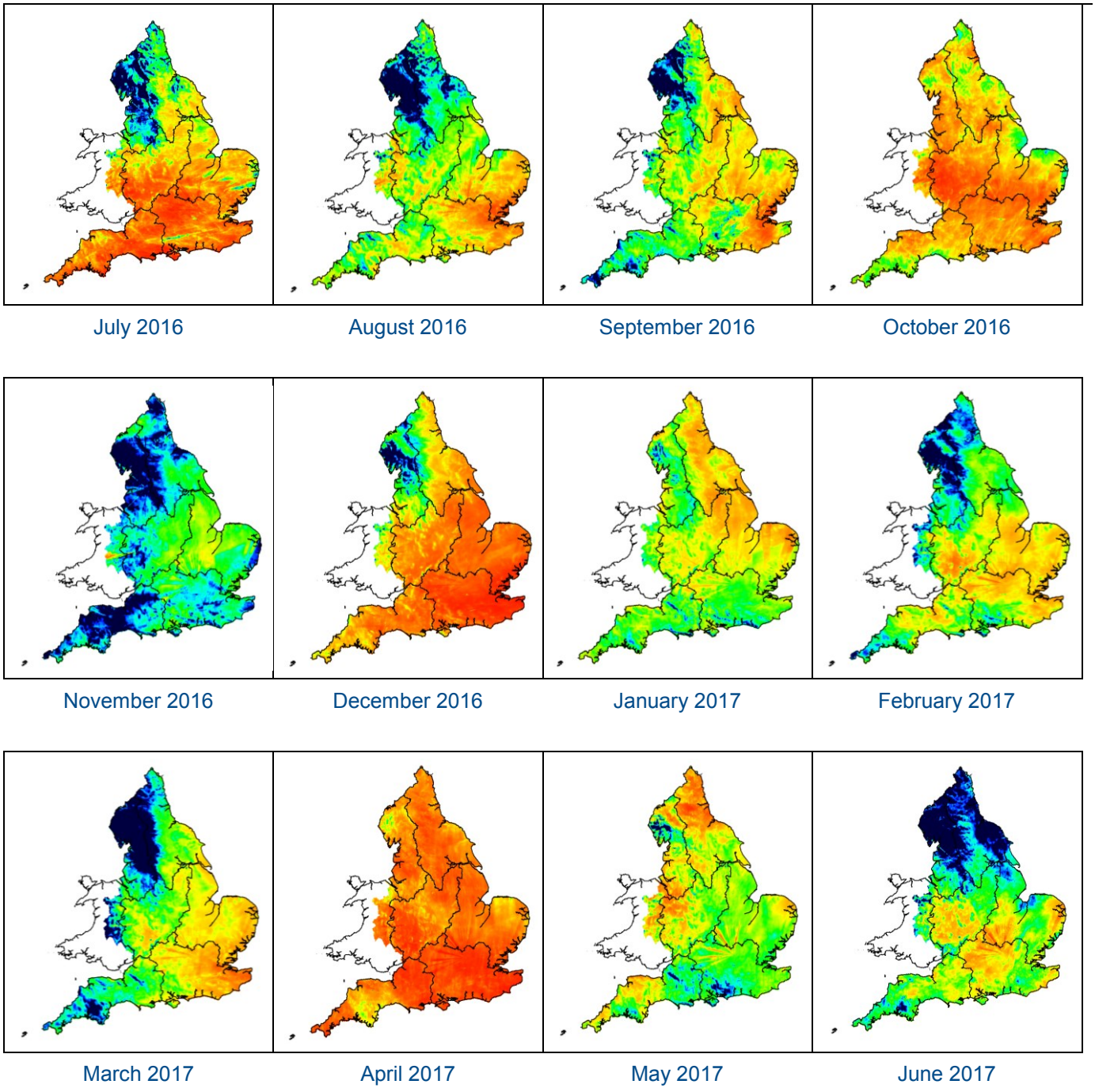



**Figure 1.1**: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2017). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2017.

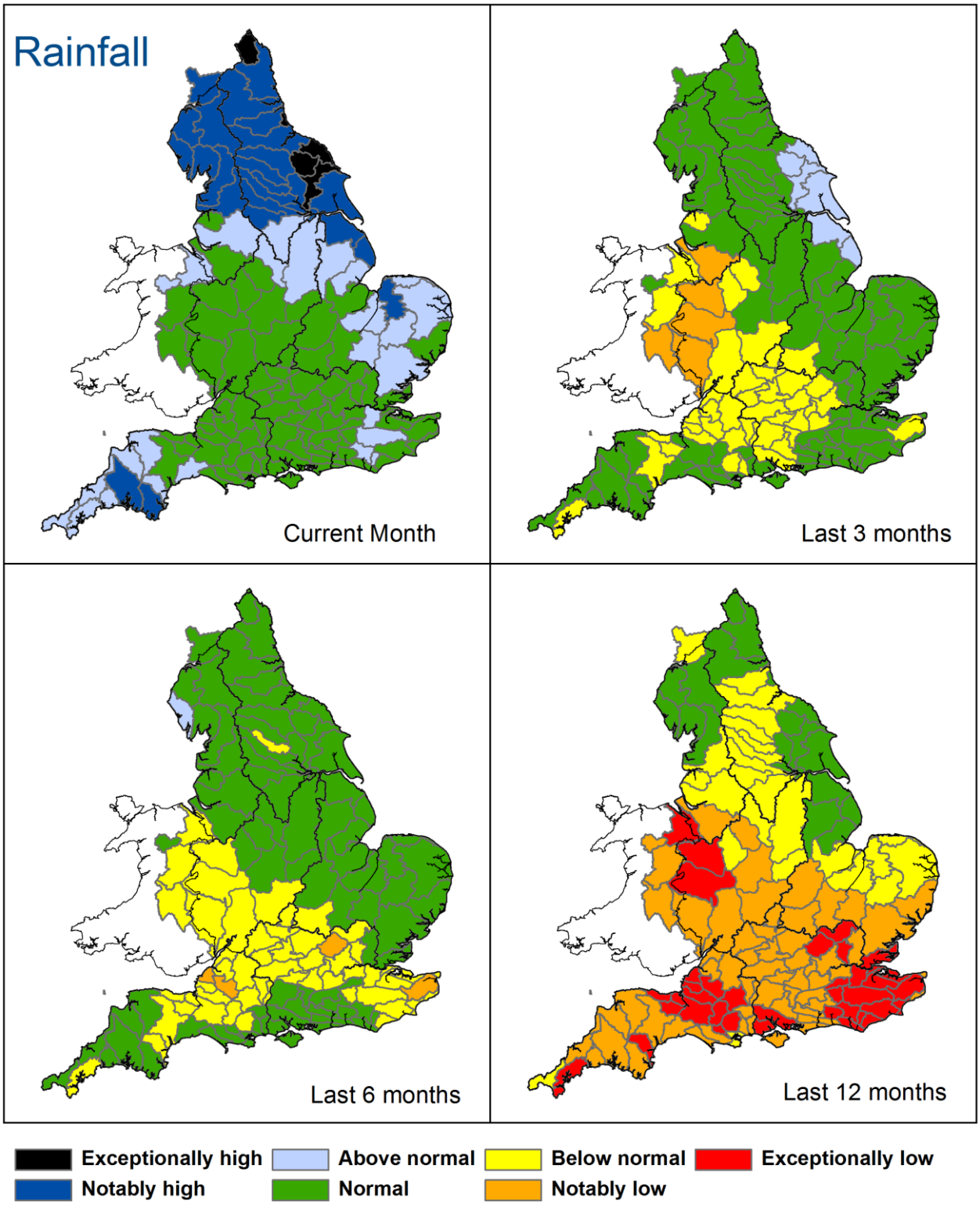



**Figure 1.2**: Total rainfall for hydrological areas across England for the current month (up to 30 June), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2017).* 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, 2017.

## Rainfall charts

Above average rainfall

Below average rainfall

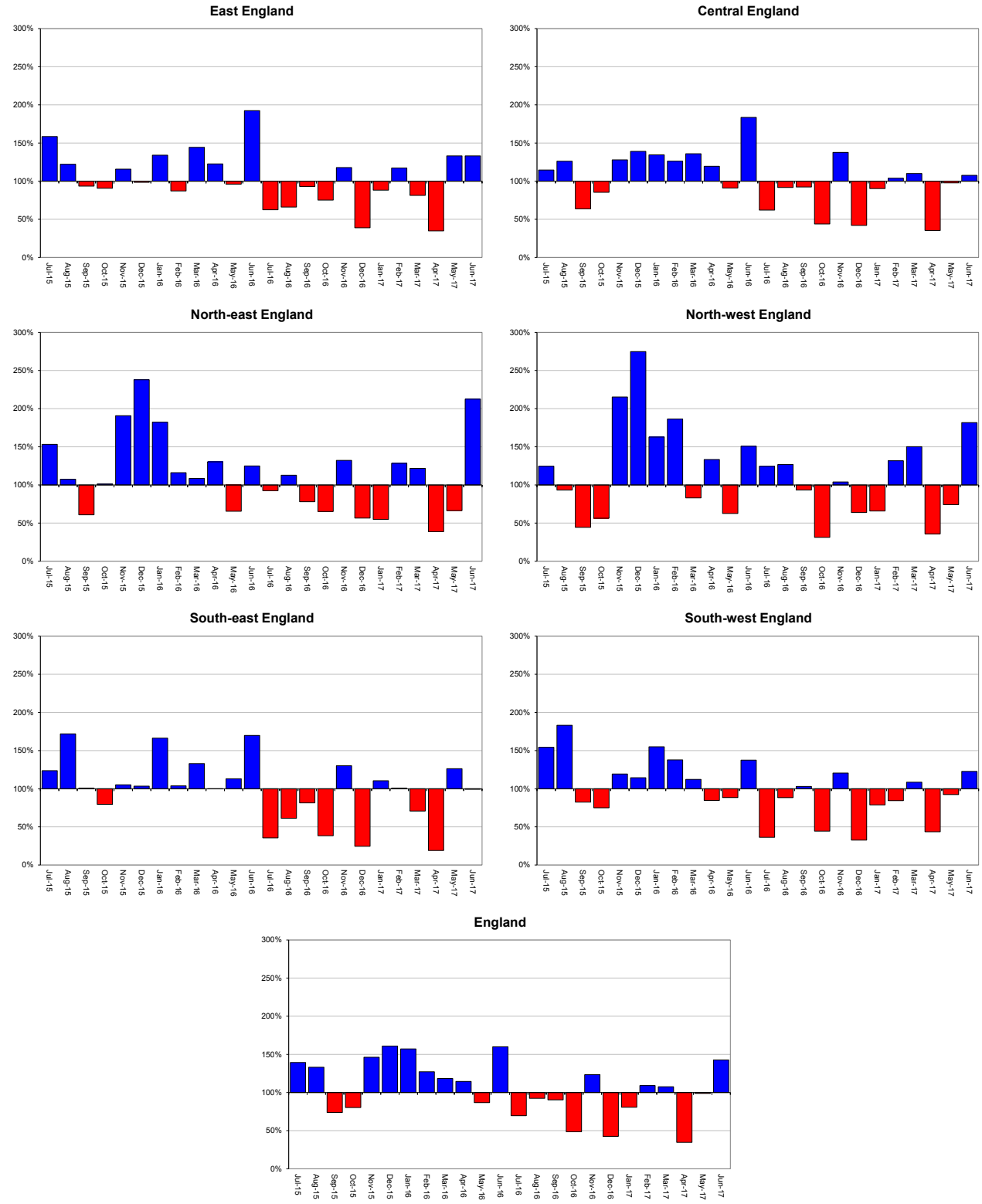



**Figure 1.3**: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2017).

# Soil moisture deficit

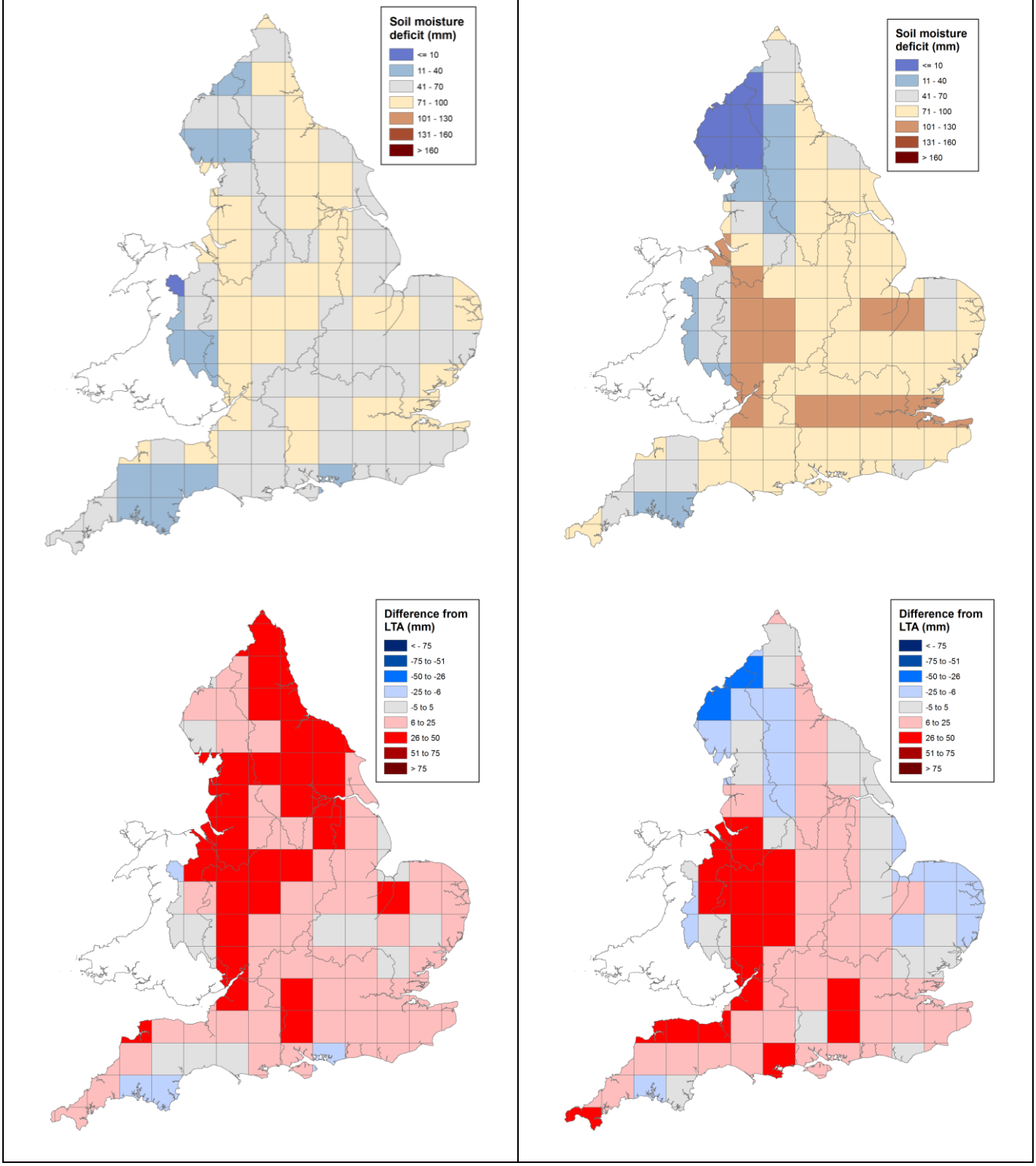
| End of May 2017[1] | End of June 2017[2] |
|---|---|
|  | |



**Figure 2.1**: Soil moisture deficits for weeks ending 30 May 2017 [1] (left panel) and 27 June 2017 [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, 2017). Crown copyright. All rights reserved. Environment Agency, 100026380, 2017

# Soil moisture deficit charts

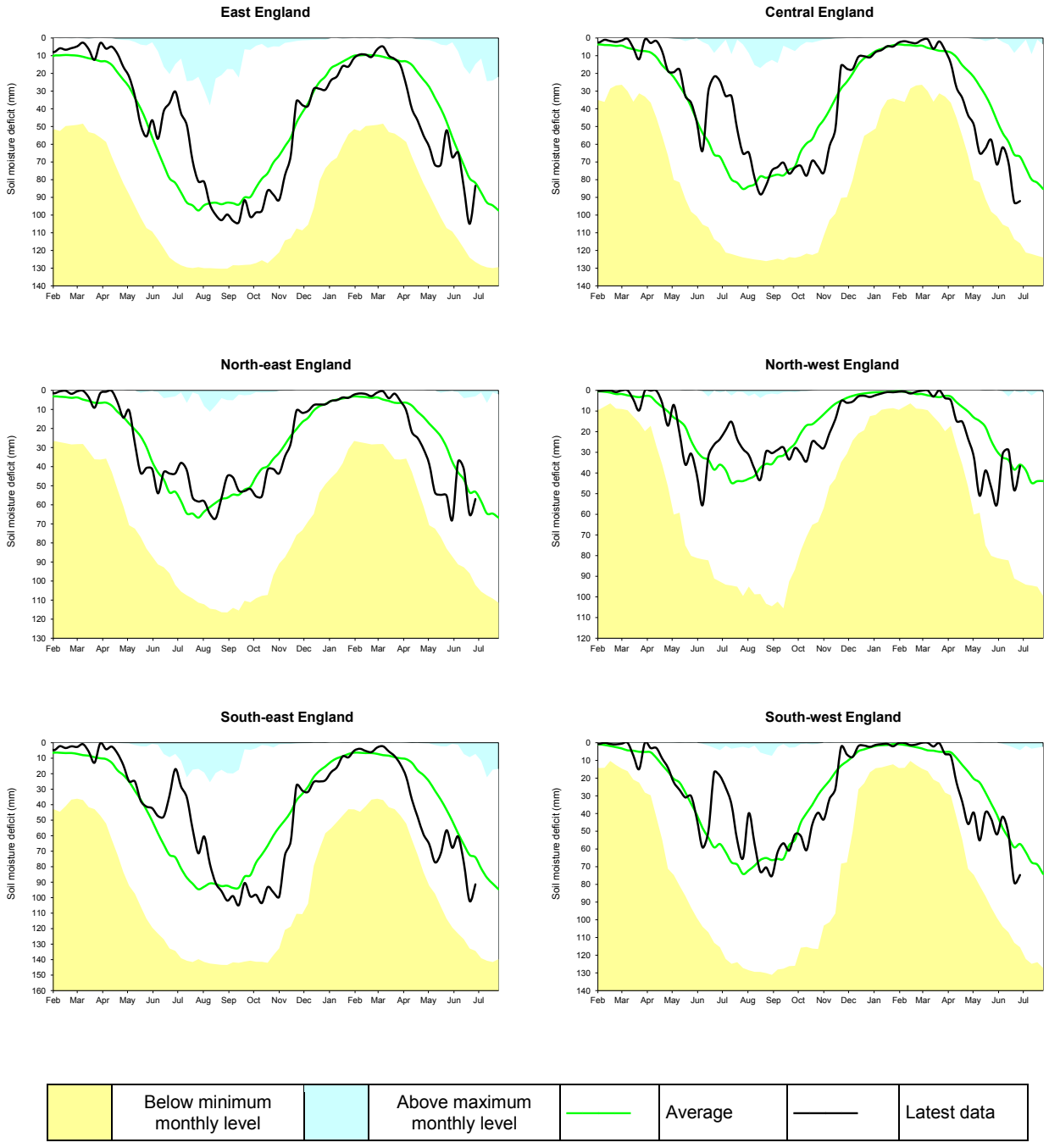
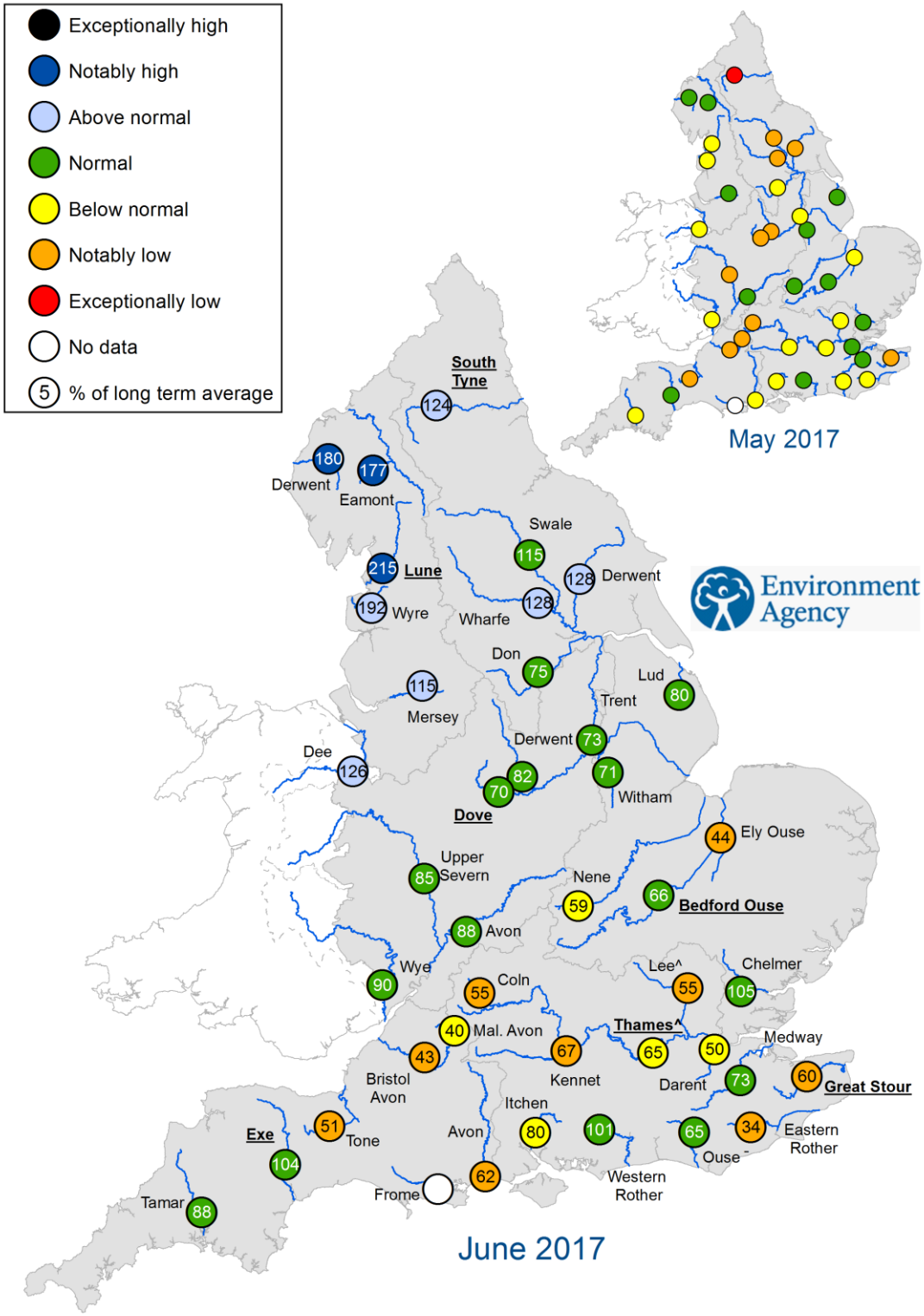



**Figure 2.2**: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2017).

# River flows




^ "Naturalised" flows are provided for the 'Thames at Kingston' and the 'Lee at Feildes Weir'
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 2017 and June 2017, 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, 2017.

## River flow charts

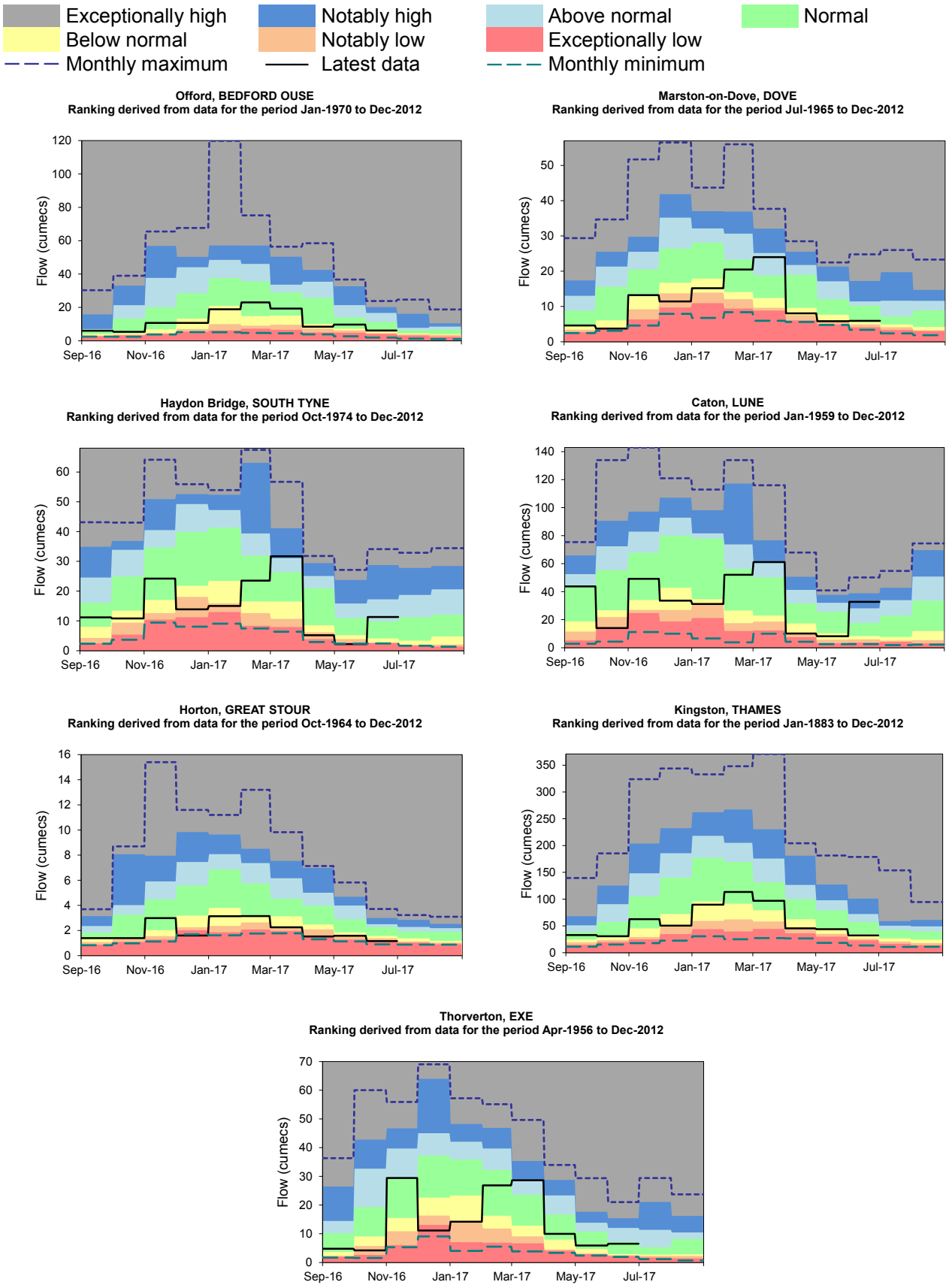
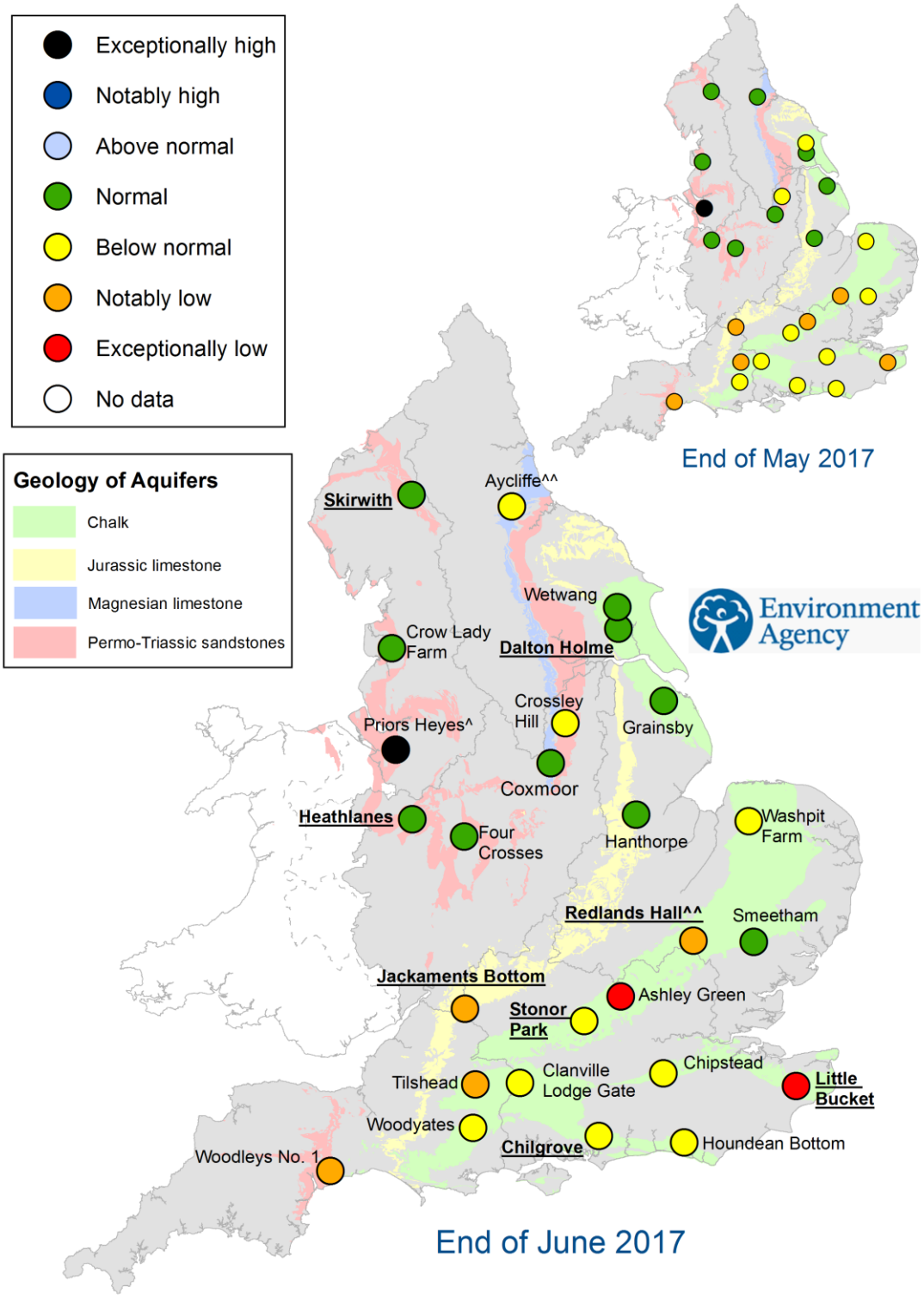



**Figure 3.2**: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

# 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 2017 and June 2017, 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, 2017.

## Groundwater level charts

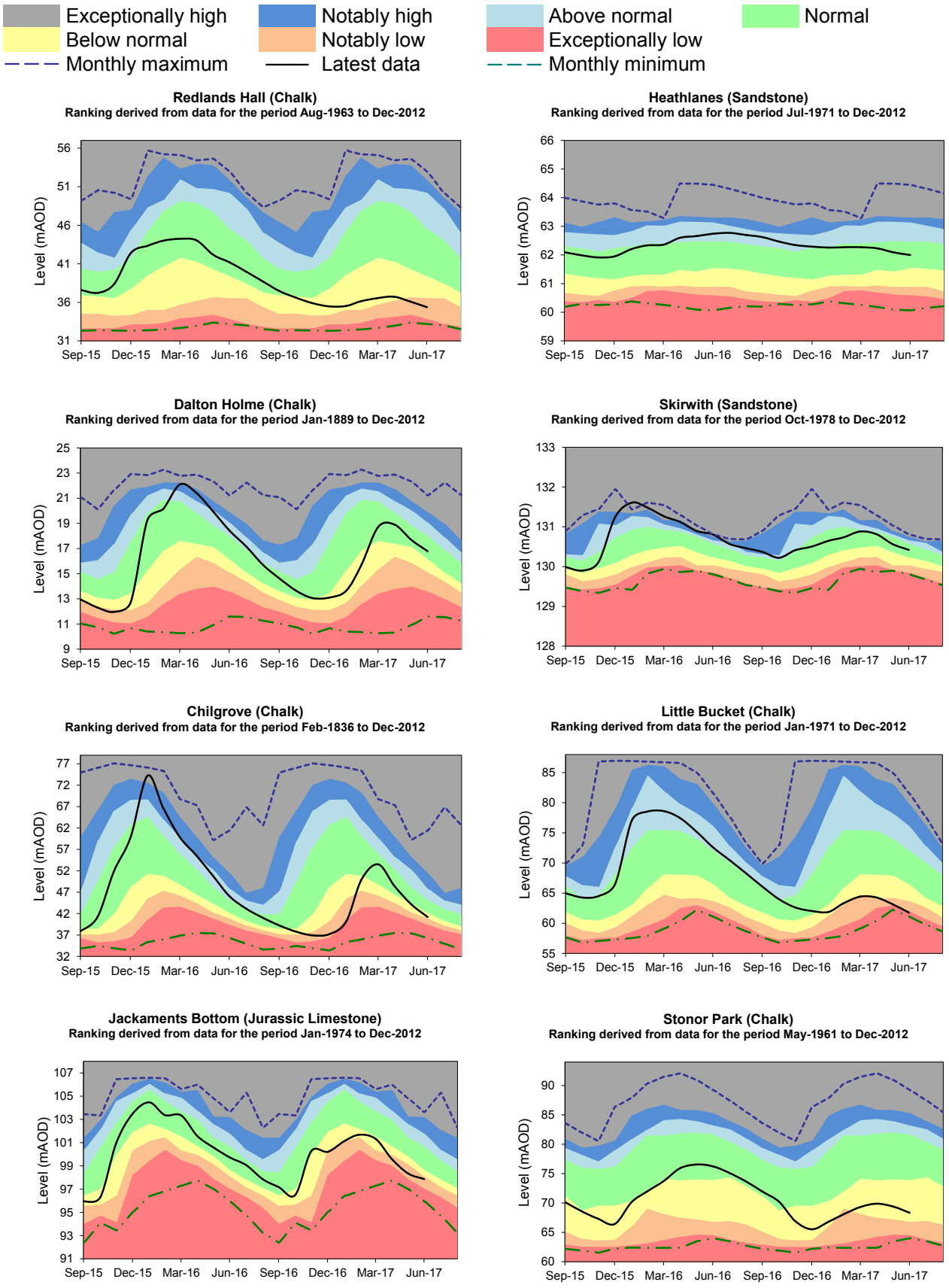
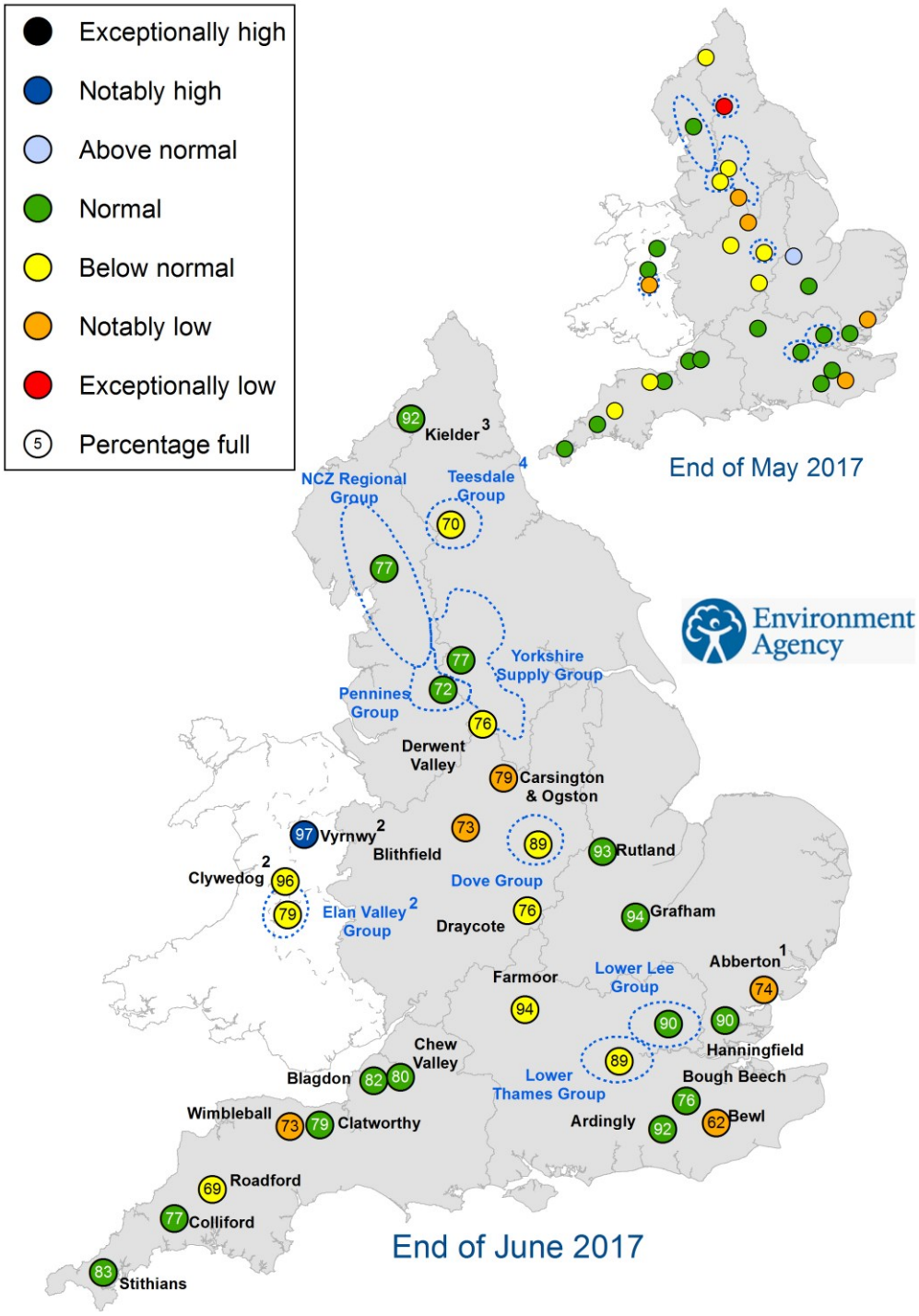



**Figure 4.2**: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2017).

# 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. Current levels at Kielder will be deliberately lower than historical levels during a trial of a new flood alleviation control curve
4. Current levels in the Teesdale Group have been affected by maintenance work on Cow Green reservoir

**Figure 5.1**: Reservoir stocks at key individual and groups of reservoirs at the end of May 2017 and June 2017 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, 2017.

# Reservoir storage charts

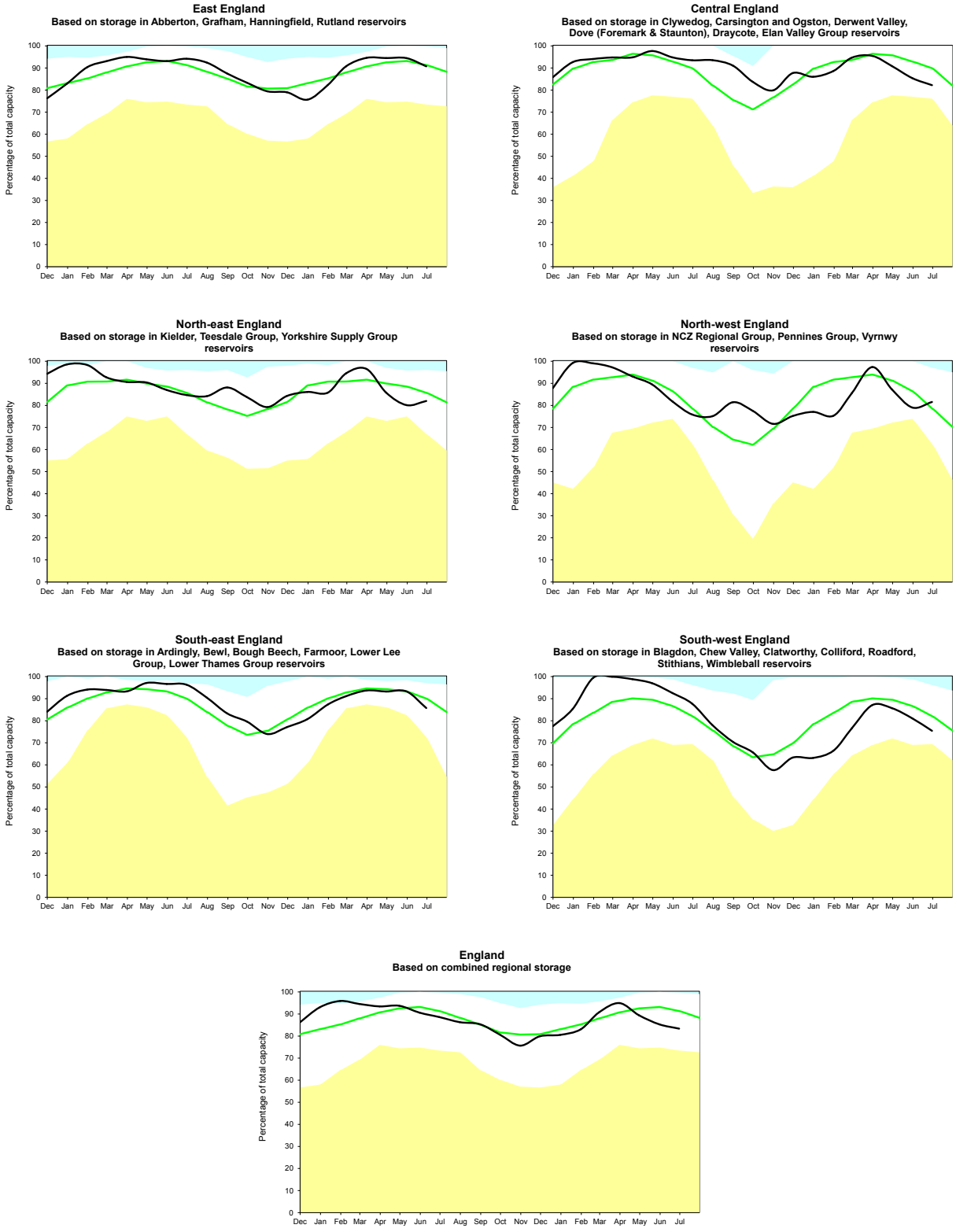



**Figure 5.2**: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

# Forward look – river flow

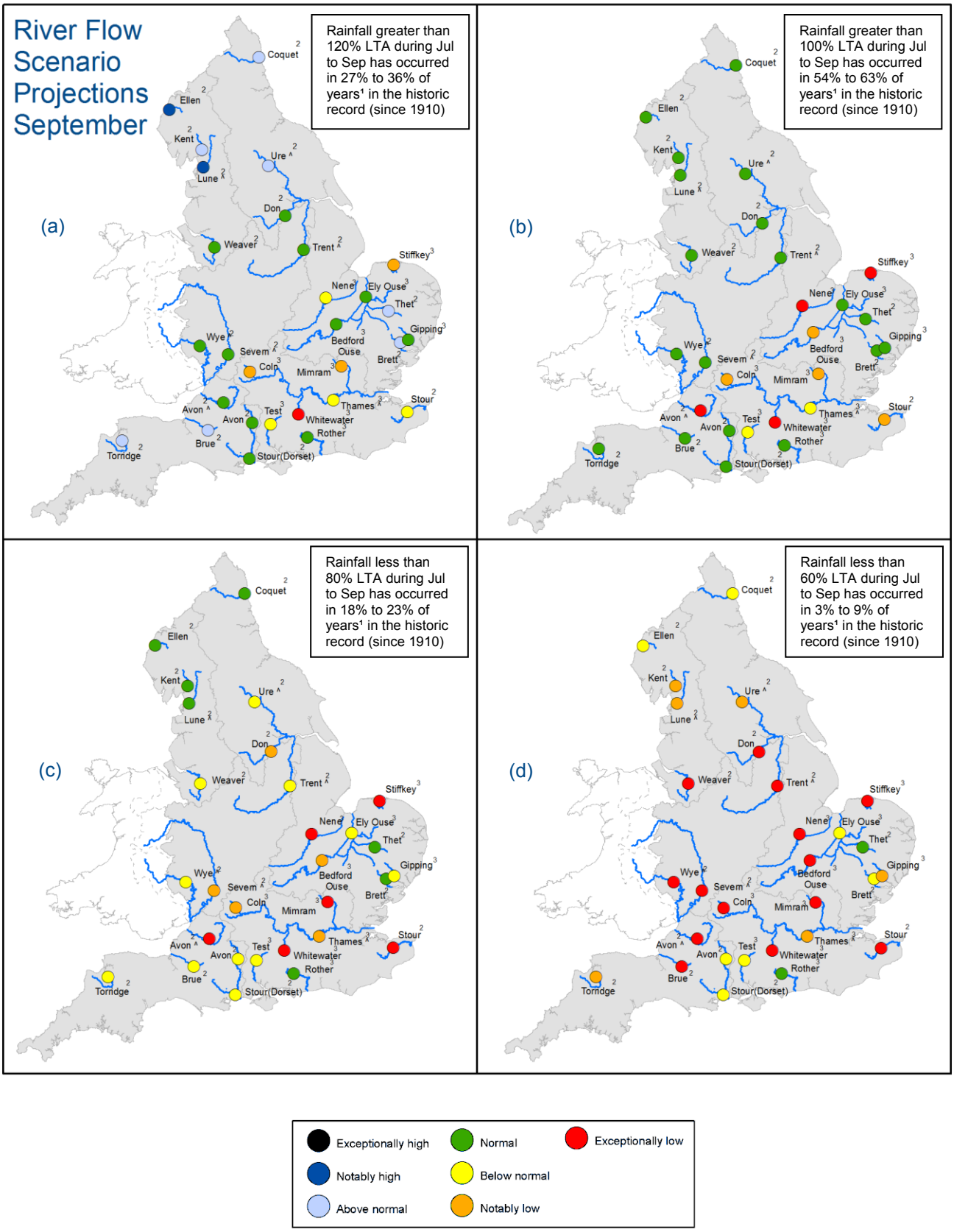



**Figure 6.1**: Projected river flows at key indicator sites up until the end of September 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2017 and September 2017 (Source: Centre for Ecology and Hydrology, Environment Agency).

[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*

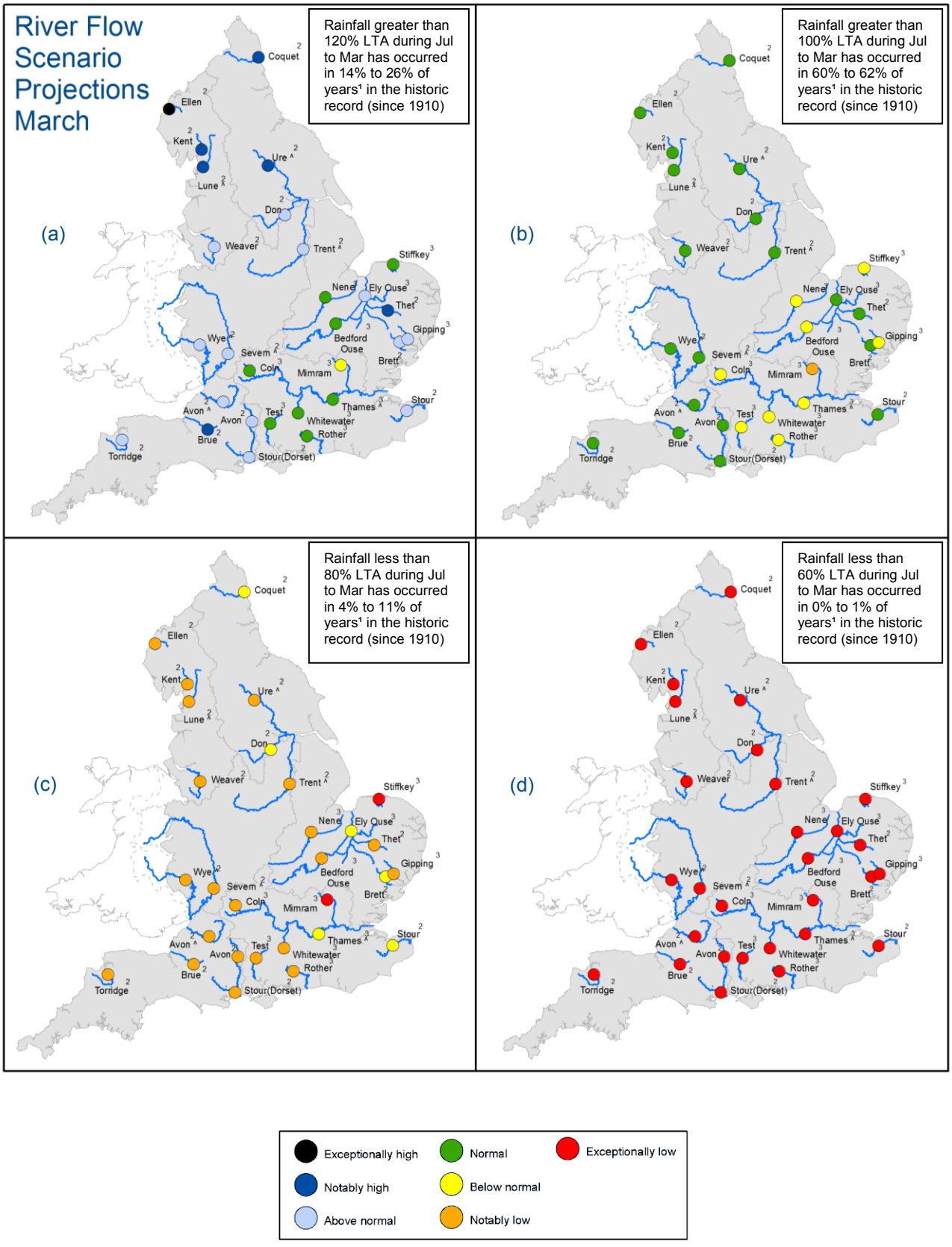



**Figure 6.2**: Projected river flows at key indicator sites up until the end of March 2018. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2017 and March 2018 (Source: Centre for Ecology and Hydrology, Environment Agency).

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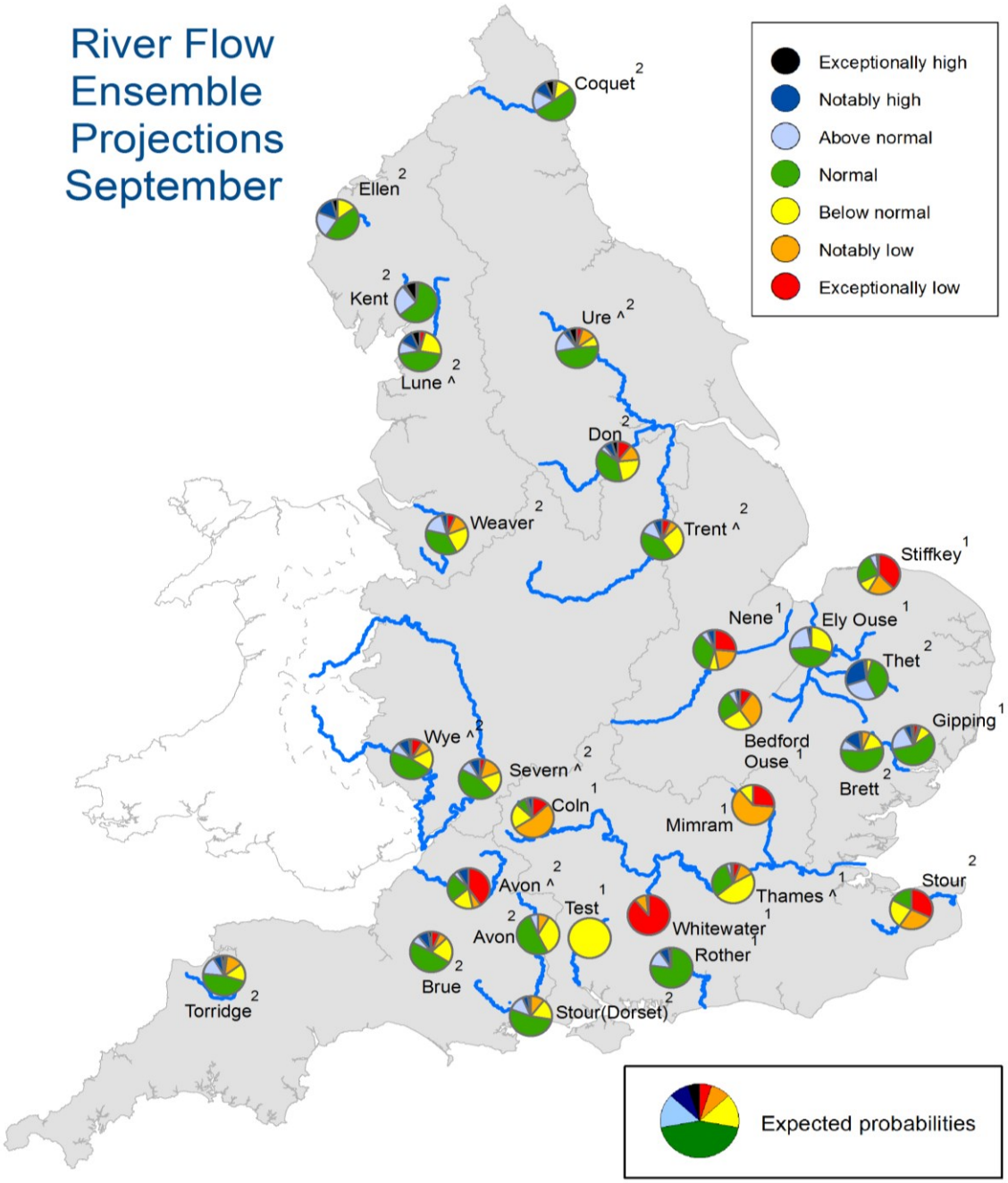
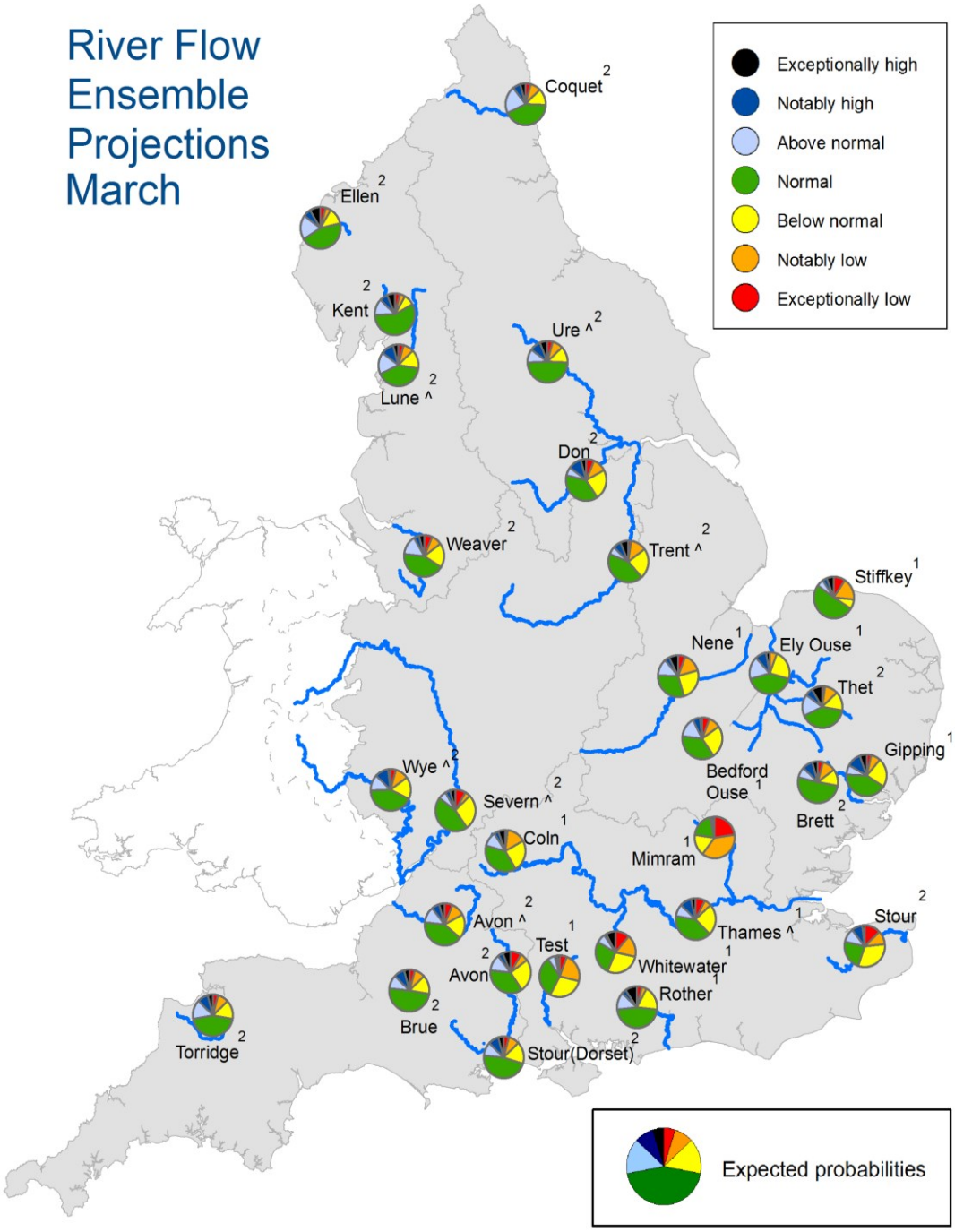



*Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels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




*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 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).

[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

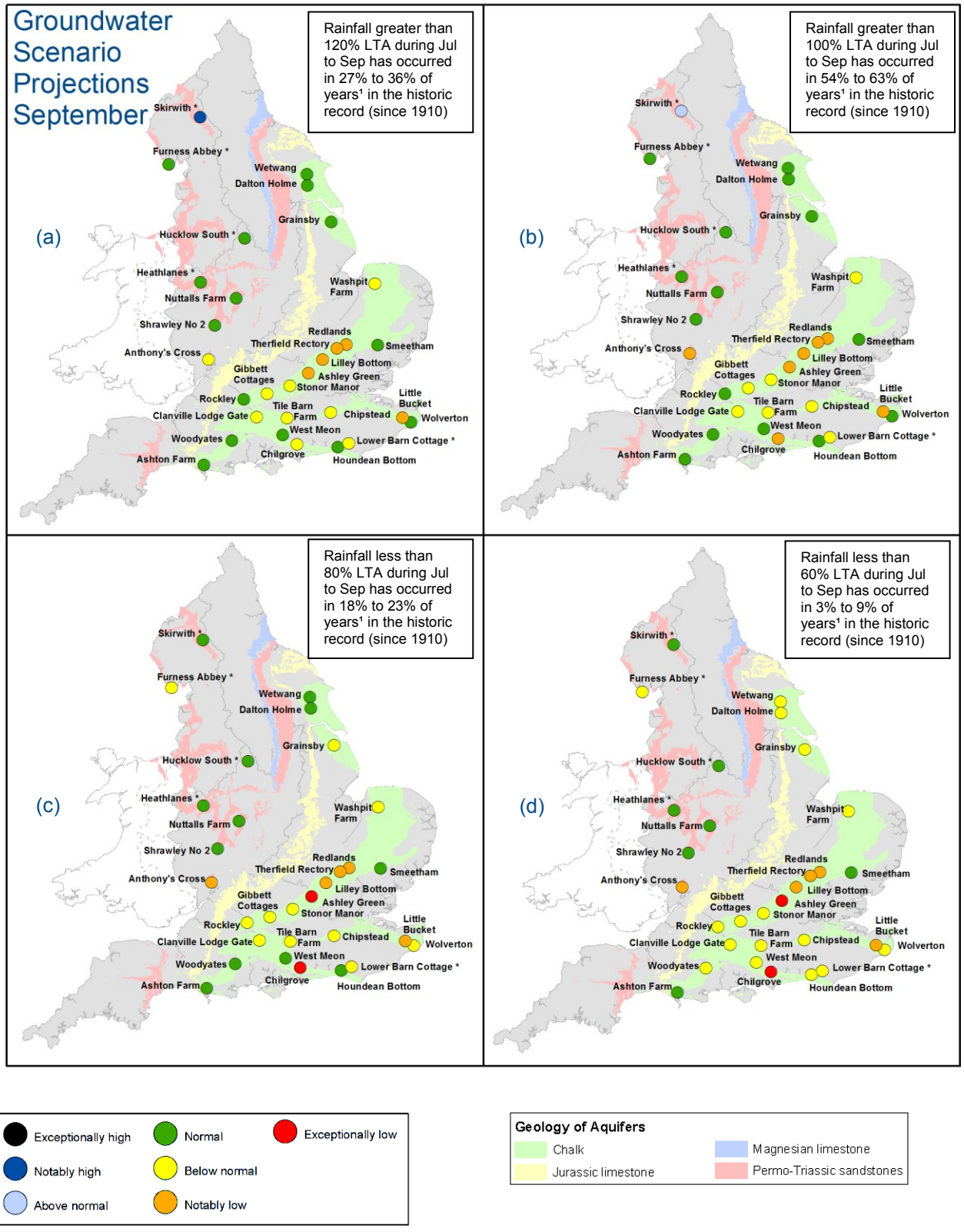



**Figure 6.5**: Projected groundwater levels at key indicator sites at the end of September 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2017 and September 2017 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2017.

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

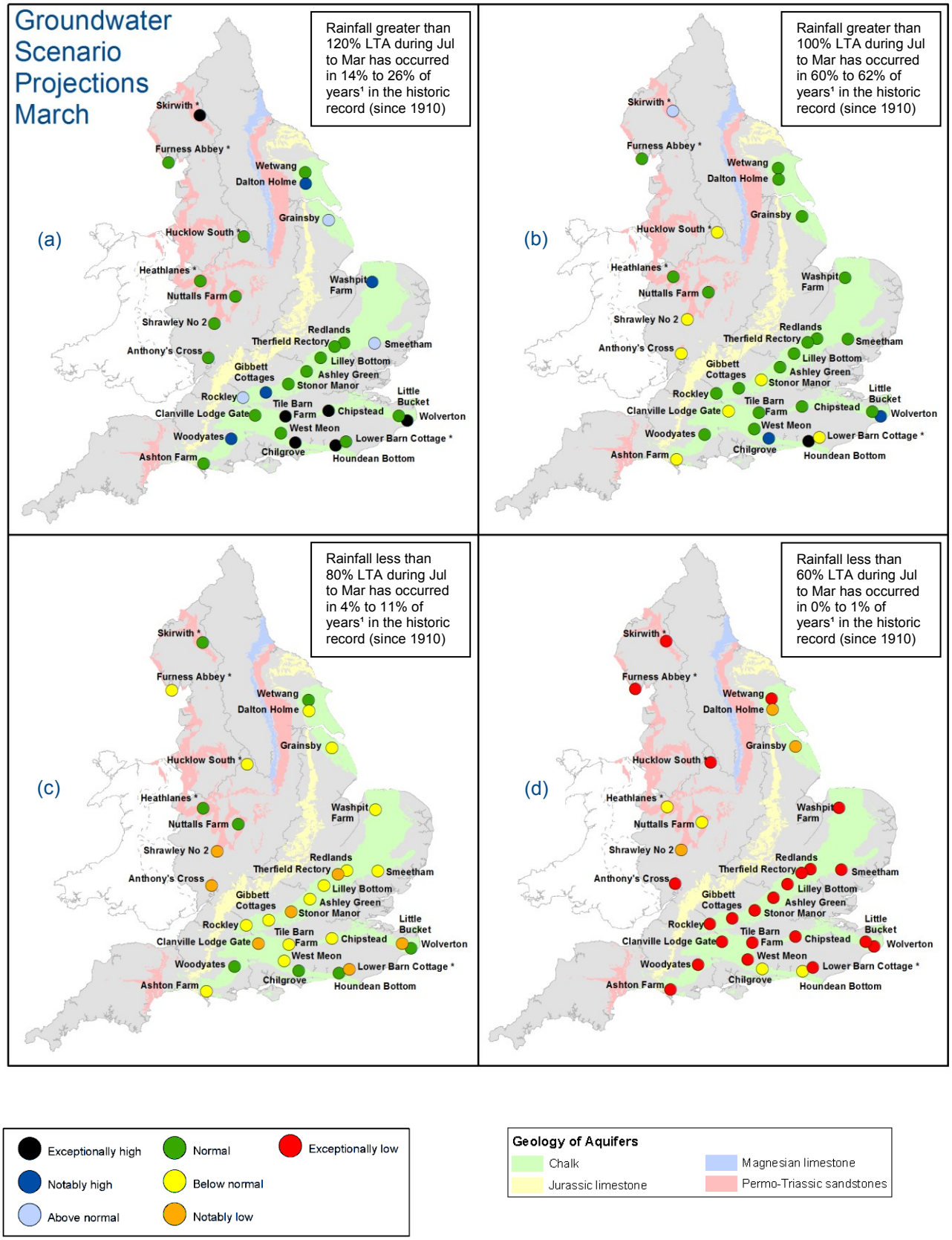



**Figure 6.6**: Projected groundwater levels at key indicator sites at the end of March 2018. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between July 2017 and March 2018 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2017.

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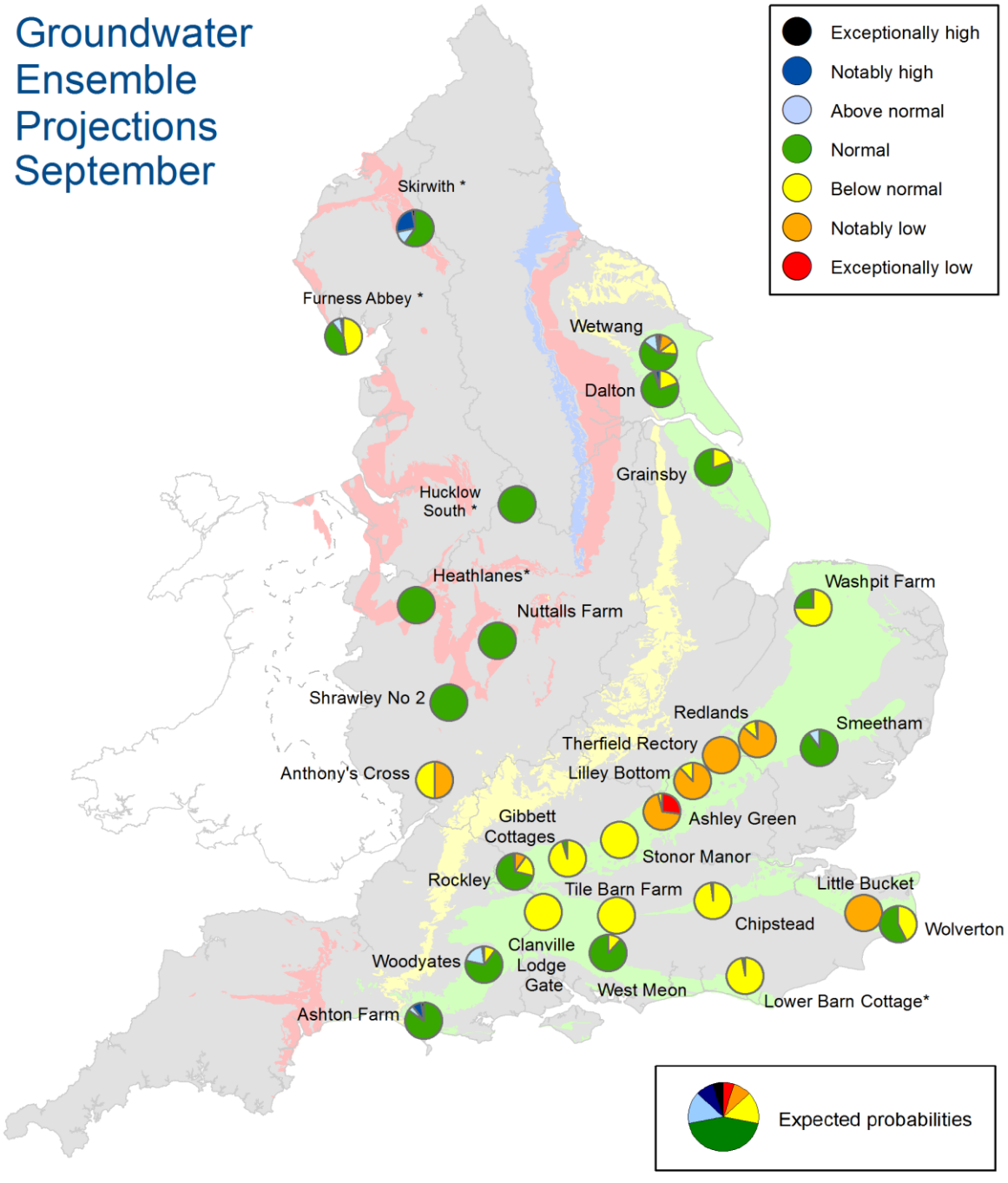
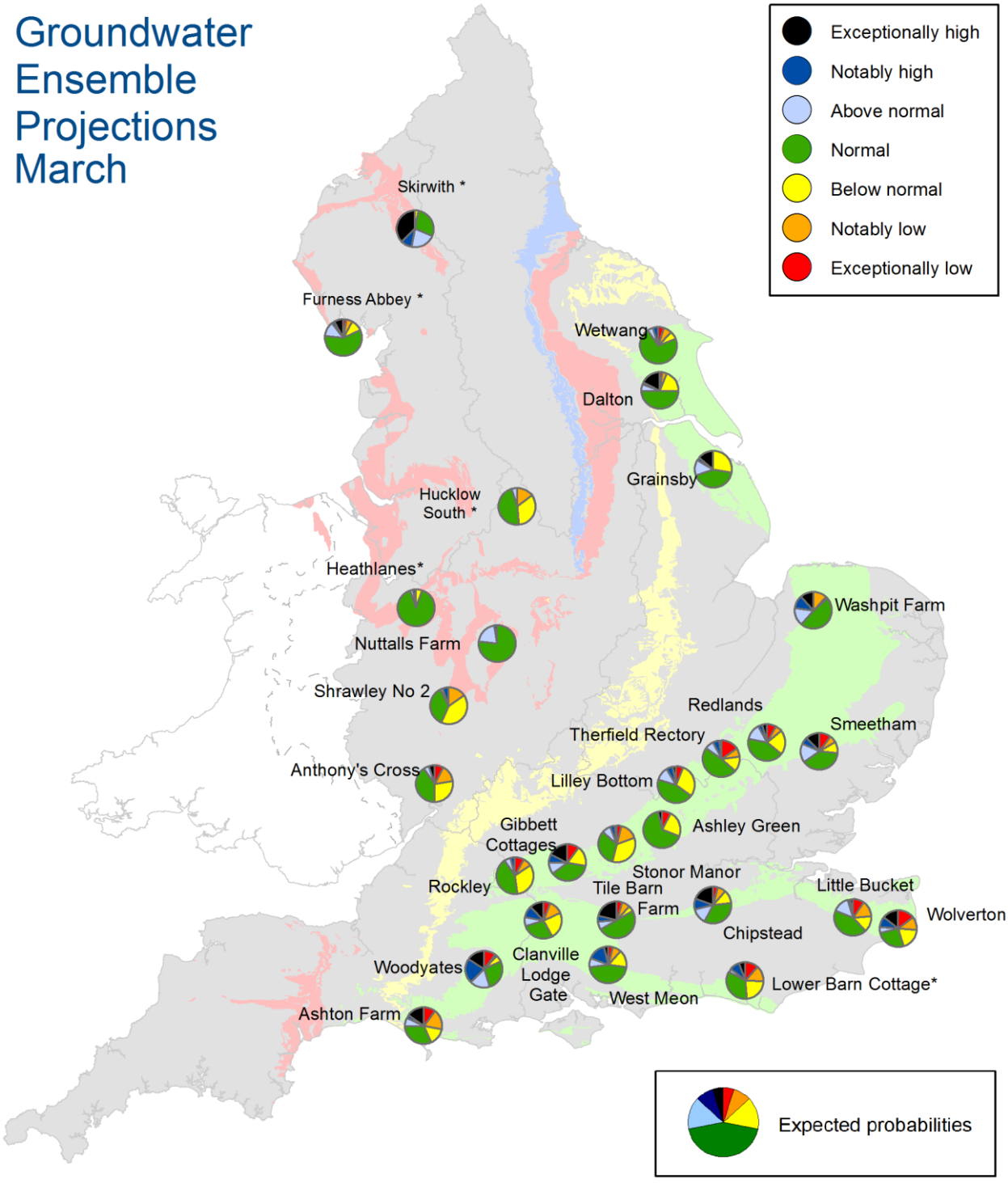



*Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels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

**Figure 6.7**: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 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, 2017.

** 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 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, 2017.

* 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 |