Monthly water situation report

England

Summary – July 2018

July rainfall totals were below average across most of England for another month, although widespread rain at the end of July did relieve the pressure from earlier hot and dry conditions. For the 3 month period from May to July England received 54% of the 1961-90 rainfall long term average (LTA) (52% of the 1981-2010 LTA); this was the second driest May to July for England on record and the driest since 1921 (records since 1910). Soils dried further during July and were significantly drier that the LTA across England, but did become wetter in response to rainfall at the end of the month. River flows for July were lower than those for June, particularly in northern and western England. Groundwater levels were lower by the end of the month but remain normal or higher for most of England. Reservoir stocks reduced across most of England and are at historic lows for the time of year for the country as a whole.

Rainfall

July rainfall totals were below average across most of England for another month. The highest rainfall totals were in parts of northeast England, with the River Swale, Ure and Nidd catchments in North Yorkshire receiving between 59 mm to 70 mm (99% to 108% of LTA). The lowest rainfall totals were in southeast England, with the East Chilterns receiving 17mm (34% of LTA) during July (Figure 1.1).

Low monthly rainfall totals were widespread with 20 hydrological areas across England (out of a total of 138) provisionally within the top ten driest July totals on record (records from 1910). July rainfall totals were classed as below normal for the time of year in half the hydrological areas and notably low in over a third of hydrological areas. Rainfall totals classed as normal were recorded in 20 hydrological areas. For the 3 month period from May to July all hydrological areas received less than 75% of their LTA and over half were classed as exceptionally low; 13 hydrological areas were the driest since records began and a further 12 were the driest since 1921 for this period. For the 6 month period from February to July, 17 hydrological areas (mainly in northwest England) were the driest since 1984 (Figure 1.2).

At a regional scale, July rainfall totals for northeast, northwest and southwest England were classed as below normal with 78%, 70% and 62% of LTA respectively. Rainfall totals were classed as notably low in the rest of England. The July rainfall total for England was 36mm, which was 60% of the 1961-90 monthly LTA (57% of the 1981-2010 LTA). For the 3 month period from May to July England received 54% of the 1961-90 LTA which was the driest for this period since 1921(Figure 1.3).

Soil moisture deficit

Continued warm and dry weather further dried out soils across England during July although there was widespread wetting of soils during the rainfall towards the end of the month. Despite this, however, soil moisture deficits (SMDs) were larger (drier) at the end of the month compared to the start across 80% of the country, with the largest SMDs in southeast England.

Compared to the LTA, over 90% of the country had SMDs that were more than 10 mm greater (drier) than the LTA; 10% of the country had SMDs that were more than 50 mm greater than the LTA. SMDs are usually greater in July than in June and apart from a few parts of the country that experienced the heaviest rainfall the deficit relative to the LTA remained broadly similar at the end of July compared to the end of June (Figure 2.1).

Soils were significantly drier than average, for the time of year, across all regions of England at the end of July – with all regions also showing a wetting of soils at the end of the month in response to rainfall. Northwest England in particular was notable for having SMDs that were significantly drier than the historic record during July until the rain in the final week of the month. (Figure 2.2)

River flows

July monthly mean river flows decreased or remained similar compared to June at all but two of the indicator sites across England (the River Dee near the Welsh border and the River Wharfe in Yorkshire). Two indicators sites (Haydon Bridge on the South Tyne and The Ely Ouse at Denver in East Anglia) had monthly mean flows that were the lowest on record for July. Approximately one third of indicator sites had monthly mean flows classed as normal, one third had flows classed as below normal and one third had flows classed as either notably low or exceptionally low. Rivers with flows in the lowest classes were mainly in north or southwest England. Elsewhere rivers supported by groundwater generally had monthly mean flows that fell within the higher classes (as was also the case in the previous month).

Compared to June nearly half the indicator sites remained in the same river flow class, almost 30% of sites changed to one lower class and just over 20% of sites changed to two or three lower classes; only two sites changed to a higher class (the River Gipping in Suffolk and the River Mersey near Manchester) (Figure 3.1 and Figure 3.2).

Groundwater levels

Groundwater levels decreased at all but two indicator sites during July; as was the case in June these two sites (Crossley Hill and Coxmoor) are in slower responding sandstone aquifers. End of month groundwater levels were classed as normal or higher for the time of year at nearly all of the indicator sites across England. The only exceptions to this were at Crow Lady Farm (Fylde and Preston aquifer), Crossley Hill (Idle Torne sandstone aquifer) and Stonor Park (Chalk) where the groundwater levels were classed as below normal (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks reduced at nearly all reservoirs and reservoir groups across England during July, except for at Farmoor reservoir (where total storage increased from 95% of capacity at the end of June to 98.3% at the end of July). Reservoir stocks reduced by 10% or more at four fifths of the indicator reservoirs or reservoir groups. Stocks at the Clatworthy and Blagdon reservoirs (southwest England) reduced by 21% and 20% respectively to 59% and 63% of capacity respectively during July.

Just over a third of reservoirs and reservoir groups had stocks classed as normal for the time of year at the end of July; the rest were lower than normal apart from Bewl reservoir and Bough Beech reservoir (both in southeast England) which were notably high and above normal respectively. Over half the reservoirs and reservoir groups changed to a lower class during the month, nearly all of the rest remained in the same class (Figure 5.1).

Regional reservoirs stocks decreased for all regions, ranging from a 7% decrease in East England to a 16% decrease in Central England. Stocks were below the LTA for all regions and close to historic lows in central and northwest England. Total reservoir storage for England reduced by 13% to 69.8%; this is the lowest value for the end of July in the historic record (Figure 5.2).

Forward look

Unsettled showery weather (with the chance of spells of heavy rain in the north) is expected to continue through mid-August, probably with below average temperatures in the northwest and above average temperatures in the southeast. Towards the end of August more settled conditions may become established with the chance of drier and brighter spells – particularly in the southeast. During September it may slowly become drier in the north too – with expected above average temperatures. For the 3-month period August-September-October, below average precipitation is more likely than above 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 below normal or lower for the time of year by the end of September 2018. By the end of March 2019, all except two of the modelled sites have a greater than expected chance of being below normal or lower for the time of year.

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 80% 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. By the end of March 2019, nearly two-thirds of the

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).

modelled sites have a greater than expected chance of groundwater levels being below normal or lower for the time of year.

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

Rainfall

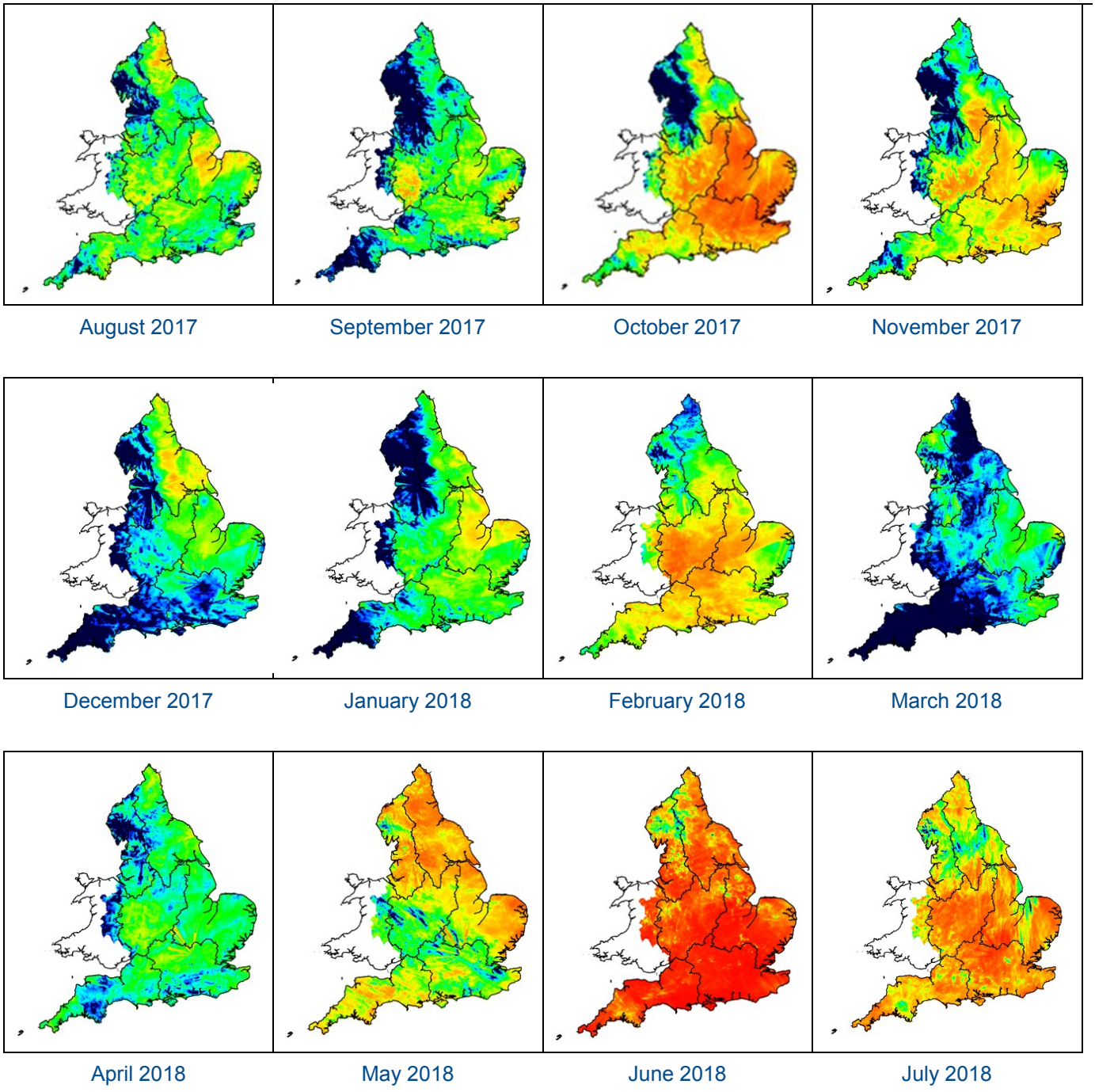


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2018). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2018.

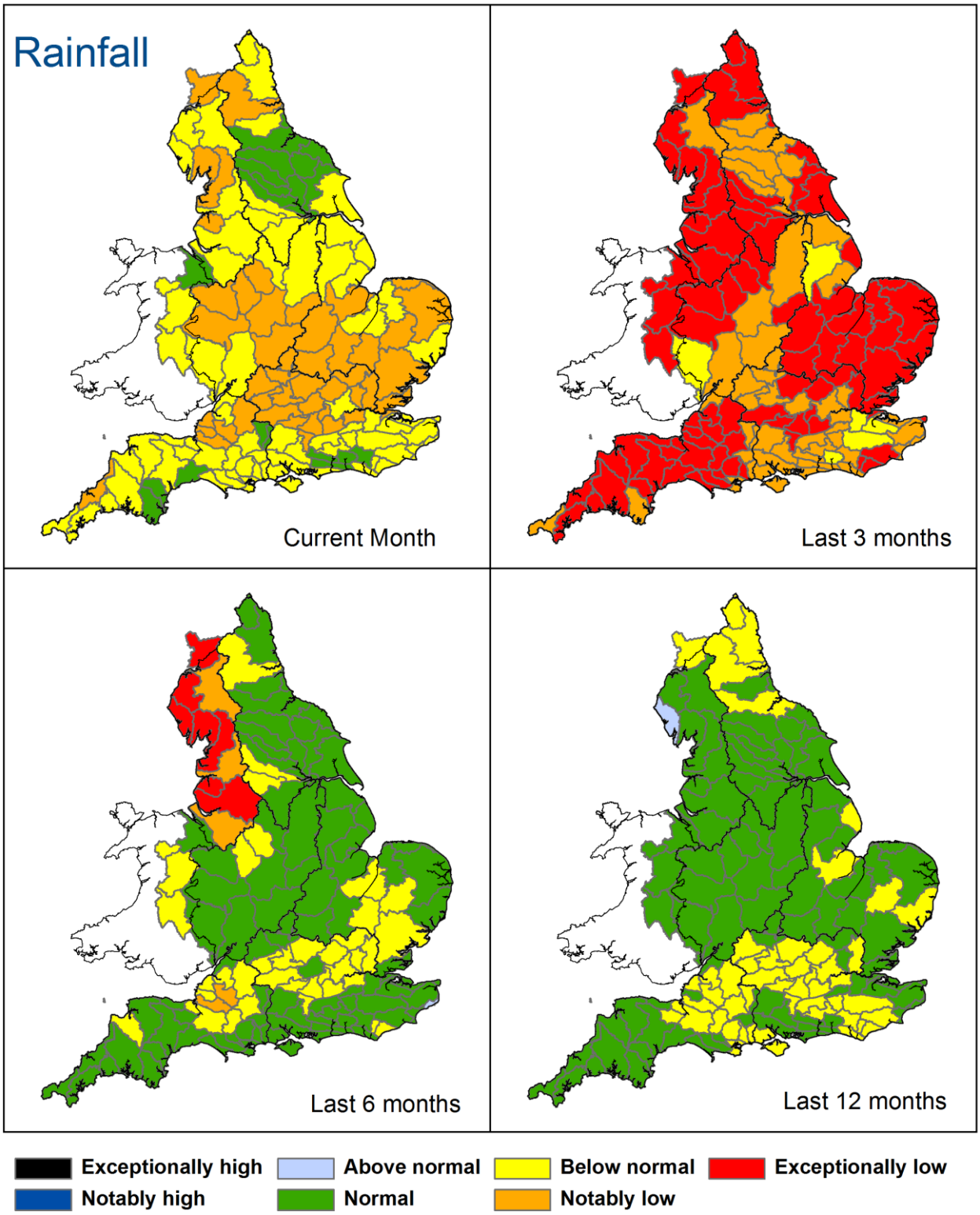


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 July) the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 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

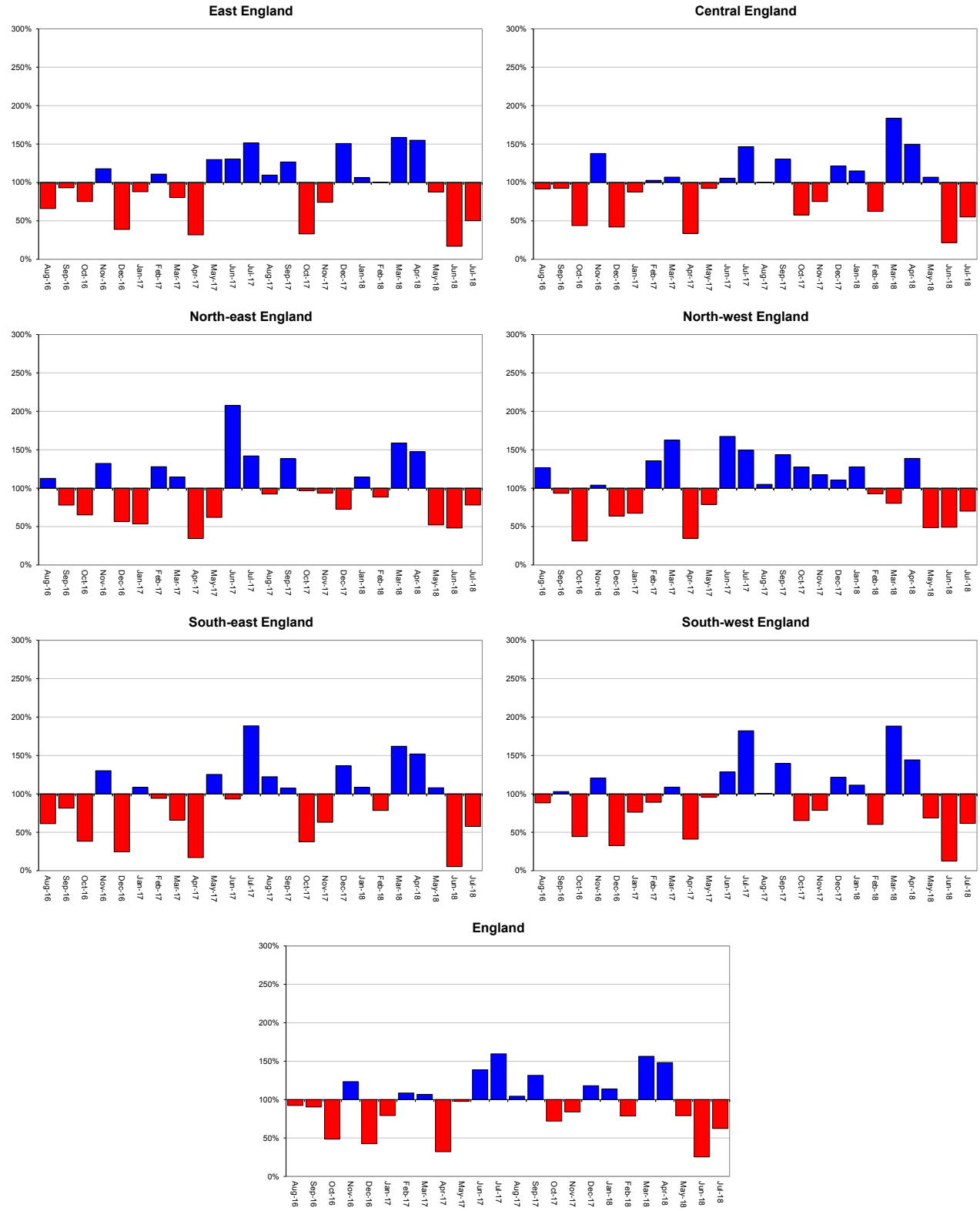


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2018).

Soil moisture deficit

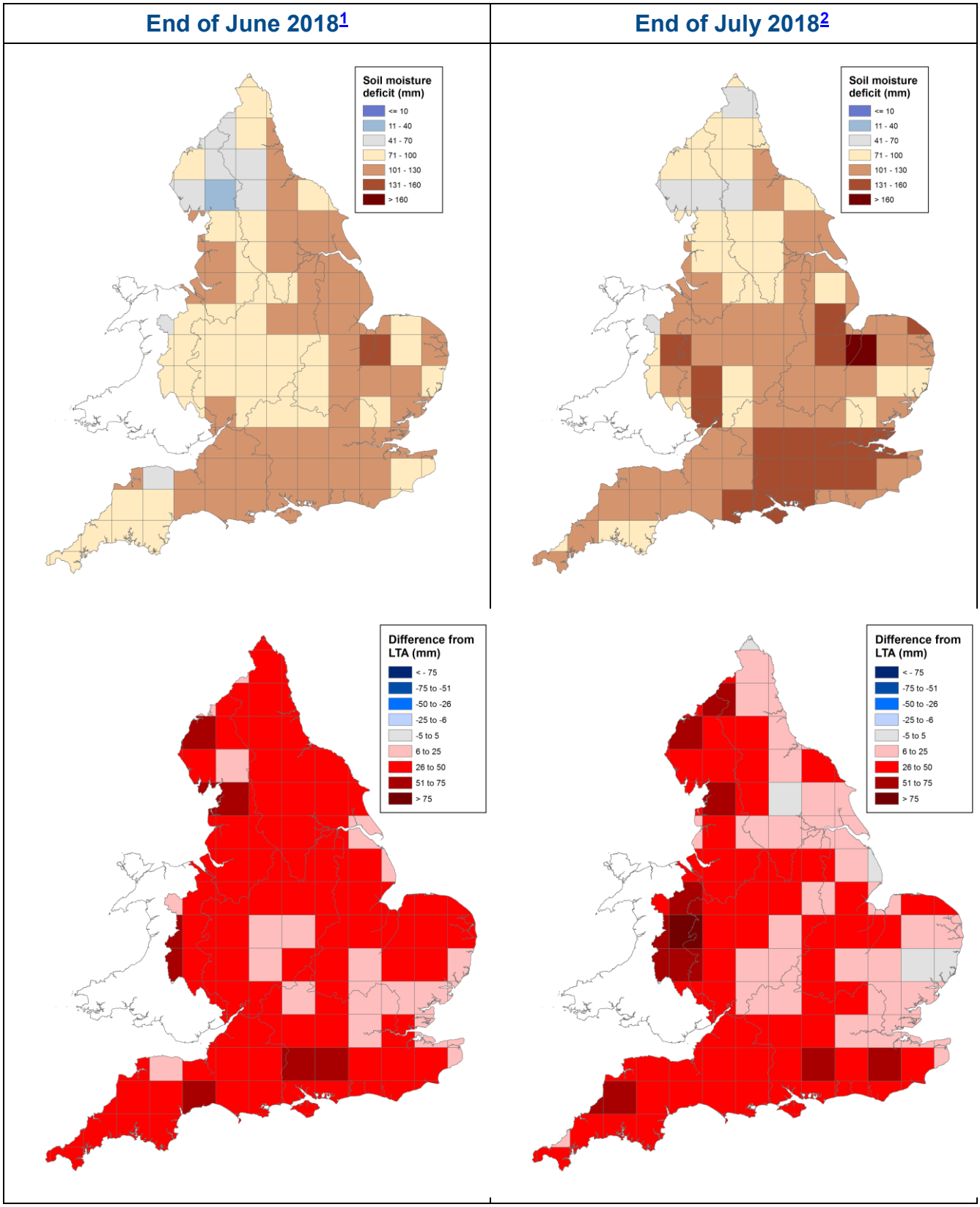


Figure 2.1: Soil moisture deficits for weeks ending 26 June 2018 [1] (left panel) and 31 July 2018 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2018). Crown copyright. All rights reserved. Environment Agency, 100026380, 2018

Soil moisture deficit charts

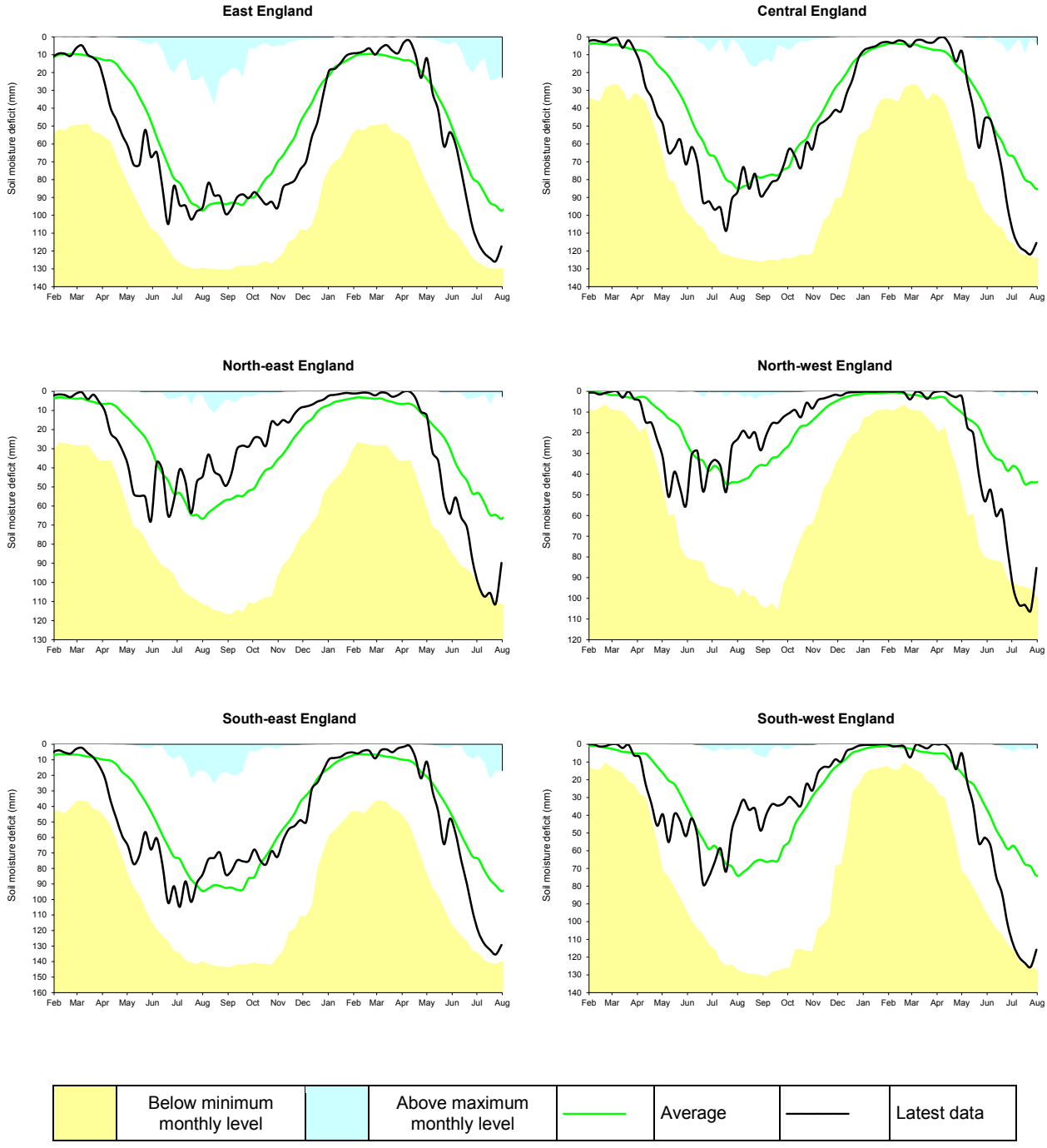
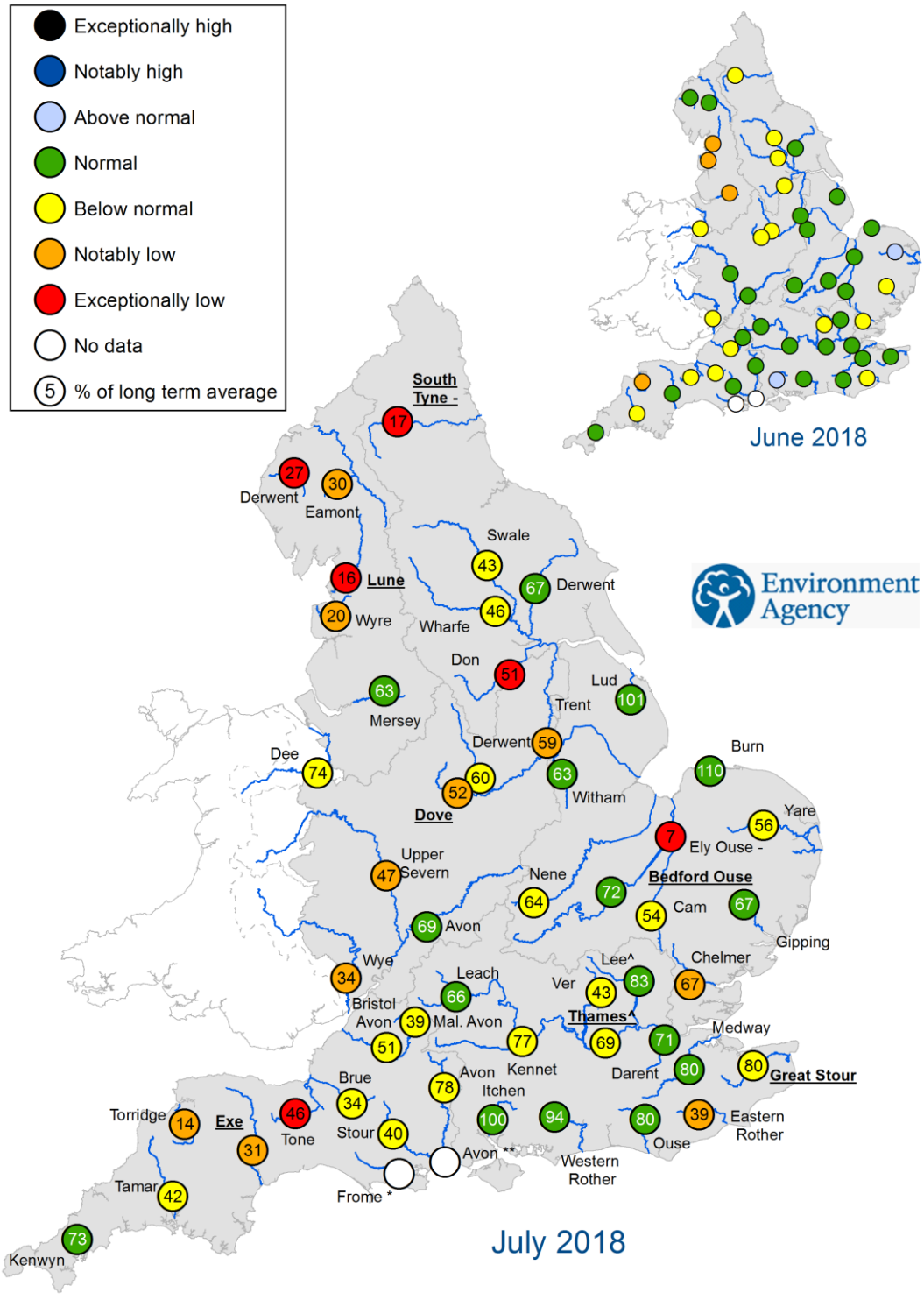


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2018).

River flows



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

* East Stoke gauging station currently not operational due to in-channel maintenance issues.

** Knapp Mill gauging station currently being bypassed due to bank breach.

\- Monthly mean flow is the 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 June and July 2018, expressed as a percentage of the respective long term average and classed relative to an analysis of historic June and July monthly means (Source: Environment Agency).

River flow charts

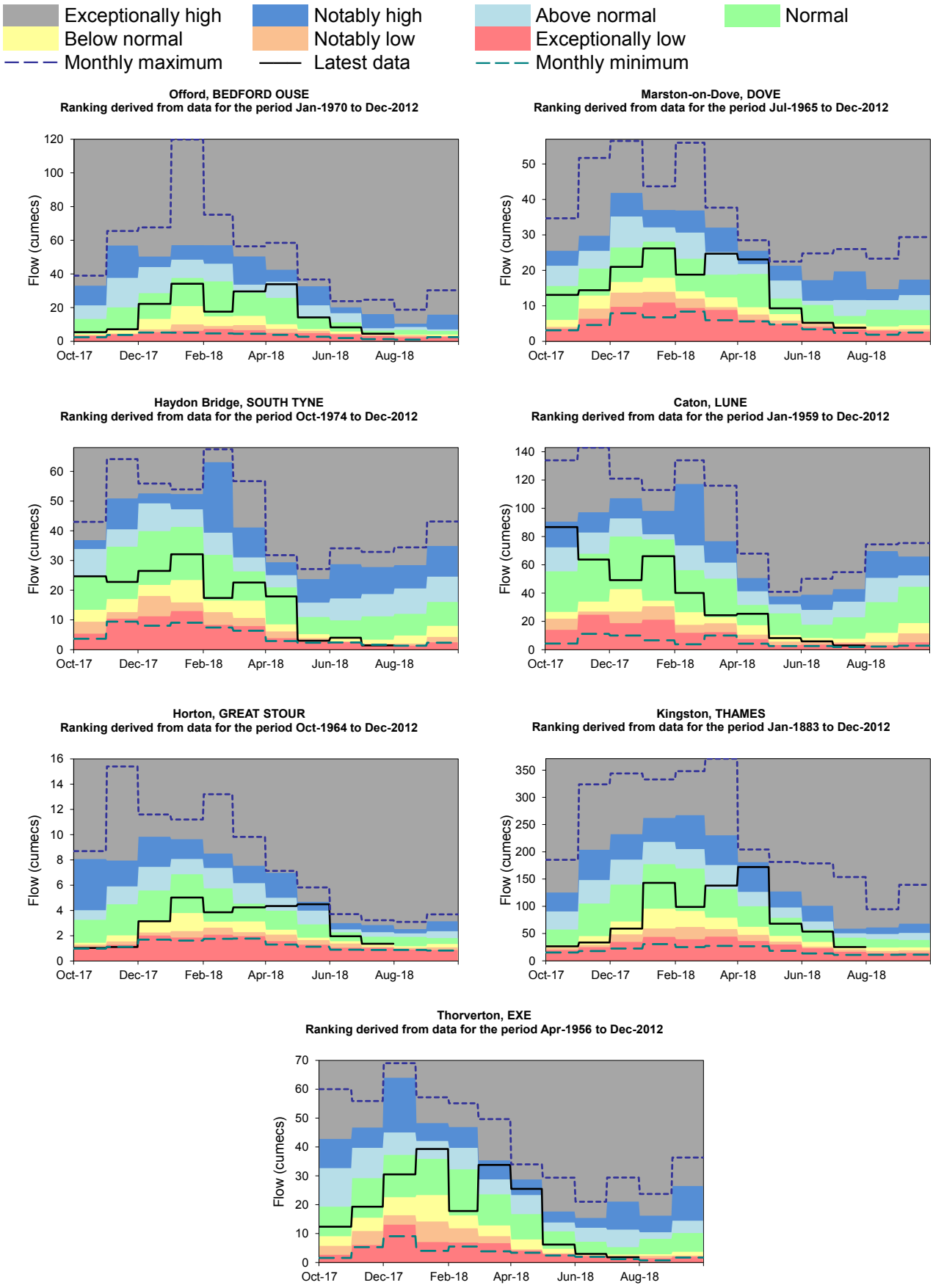
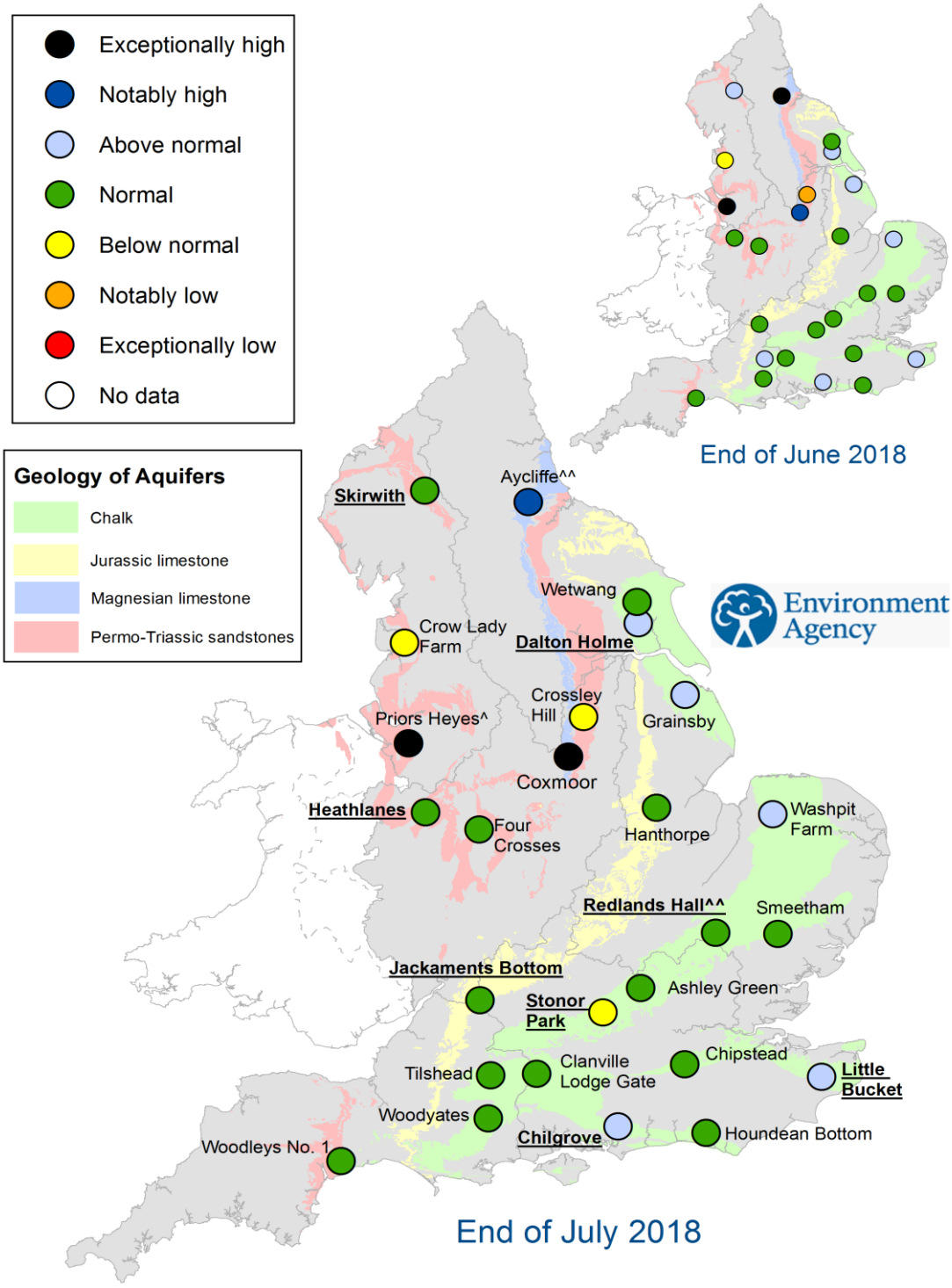


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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

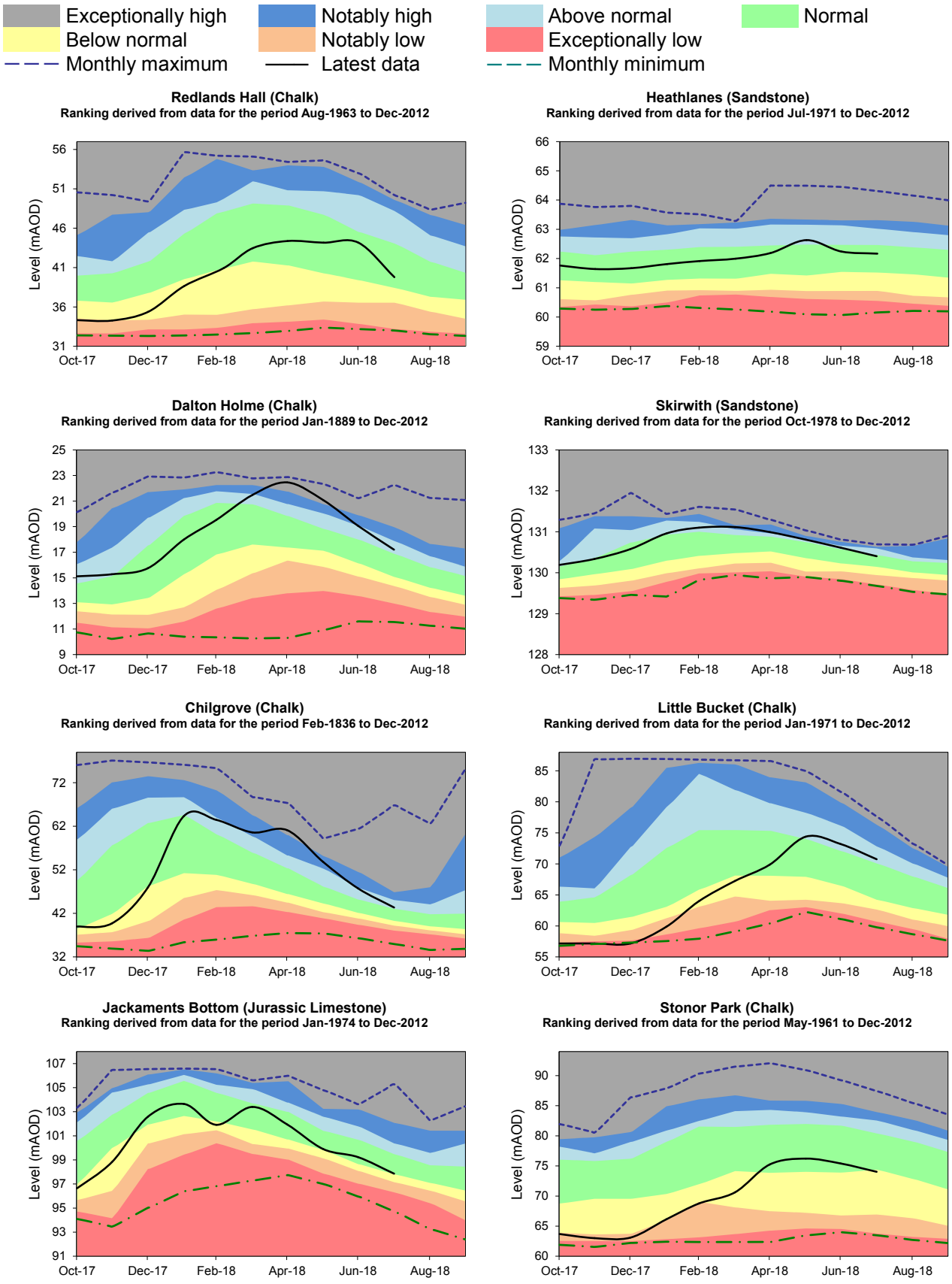
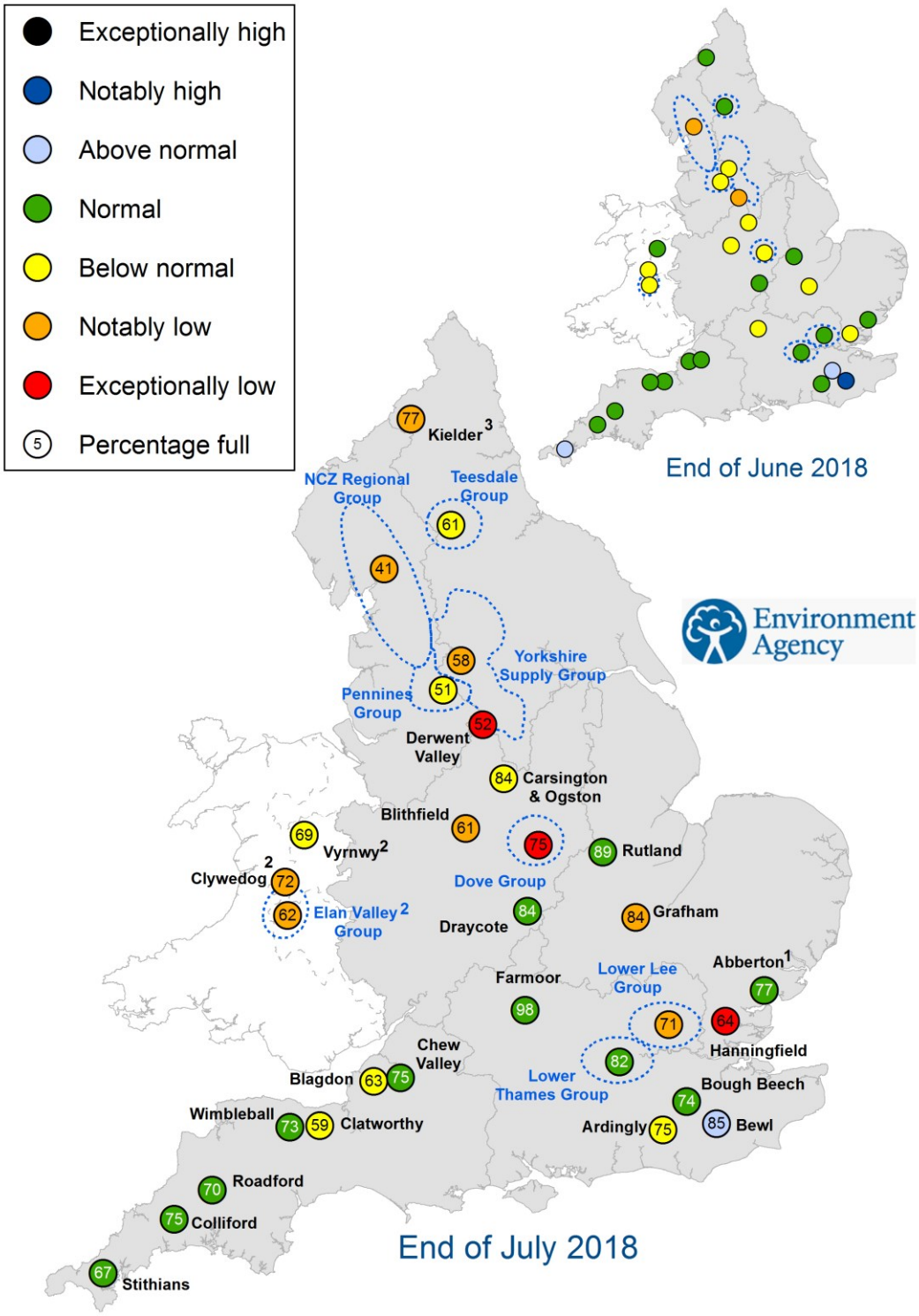


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2018).

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 June and July 2018 as a percentage of total capacity and classed relative to an analysis of historic June and July 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

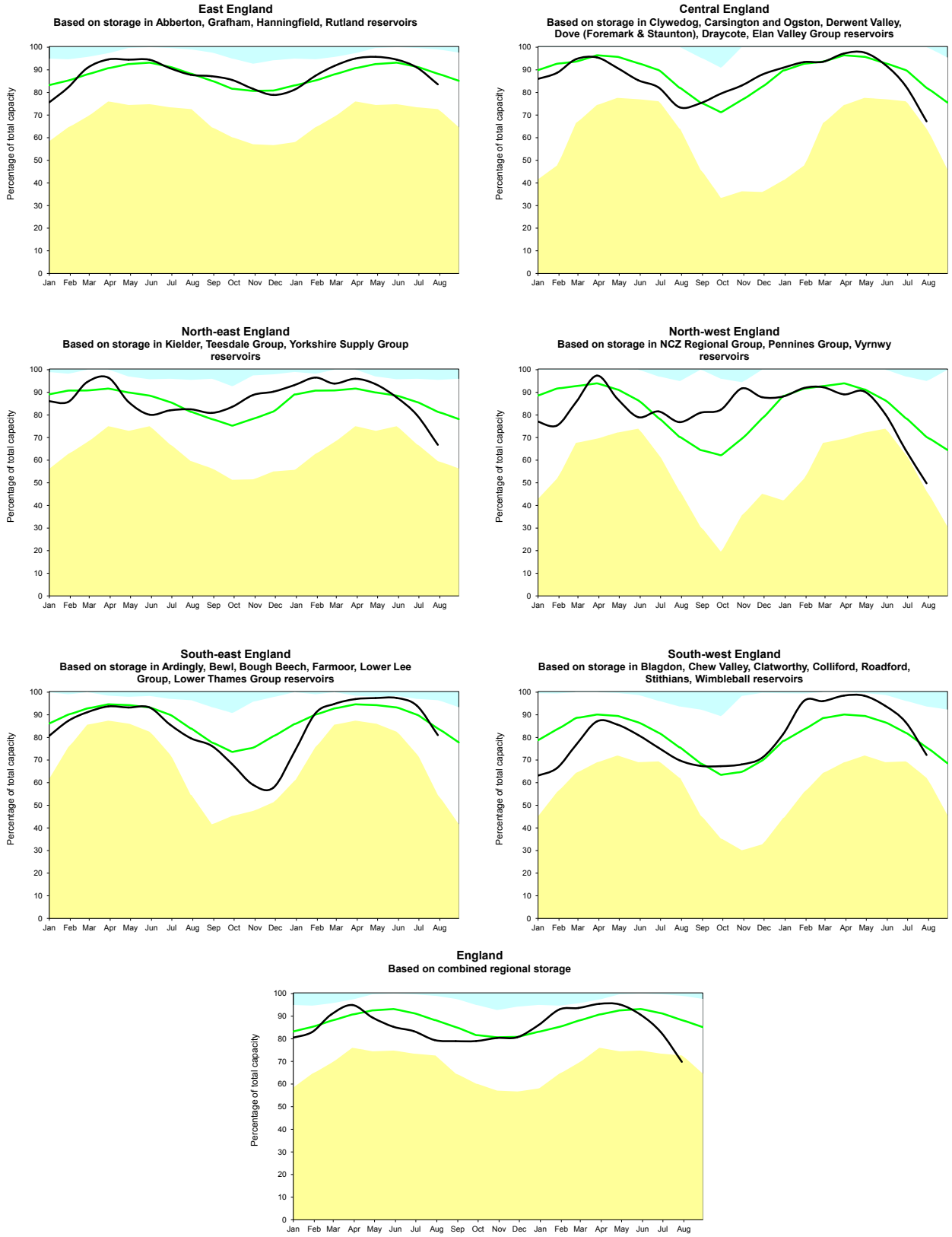


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

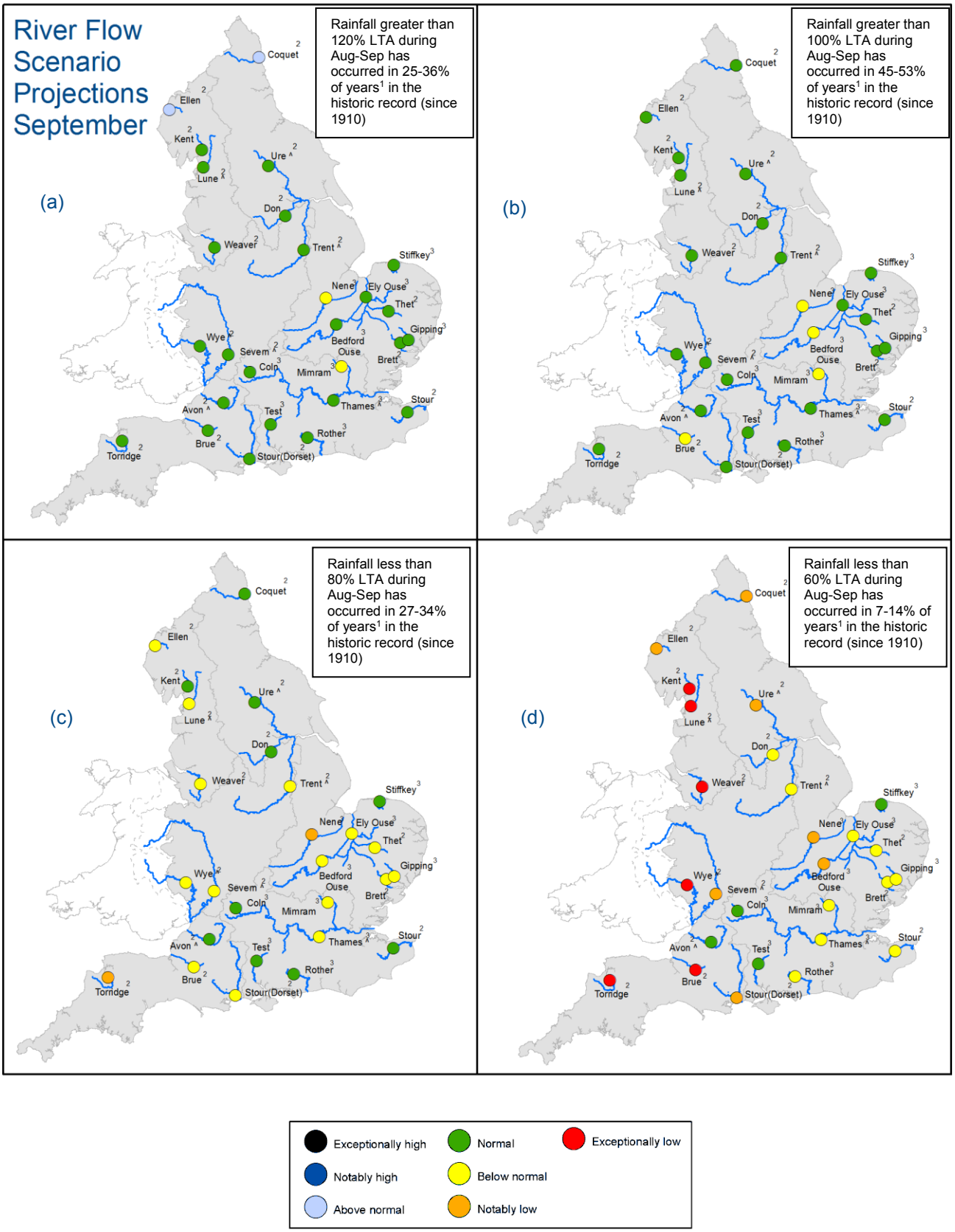


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2018. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2018 and September 2018 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*

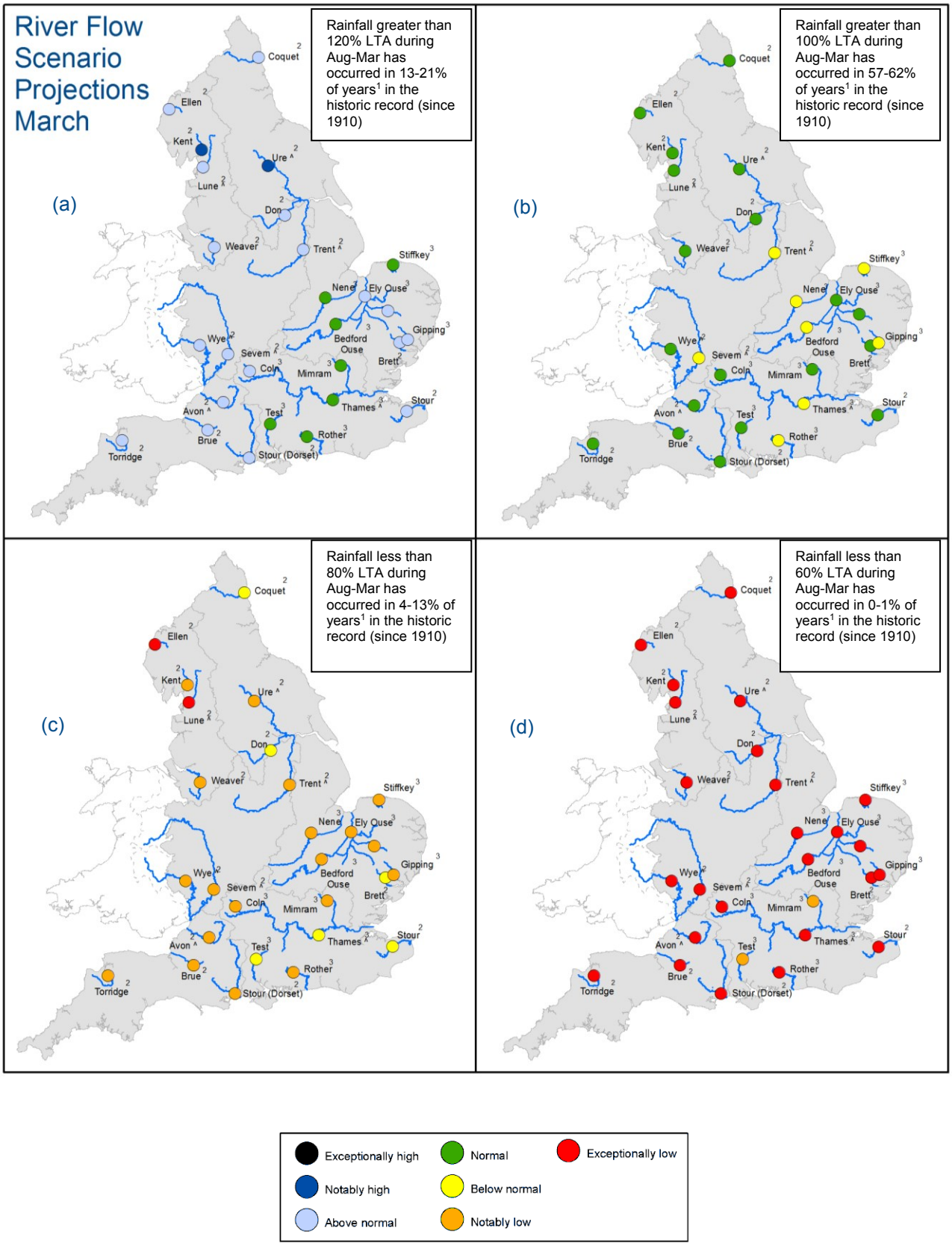


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2018 and March 2019 (Source: Centre for Ecology and Hydrology, Environment Agency)

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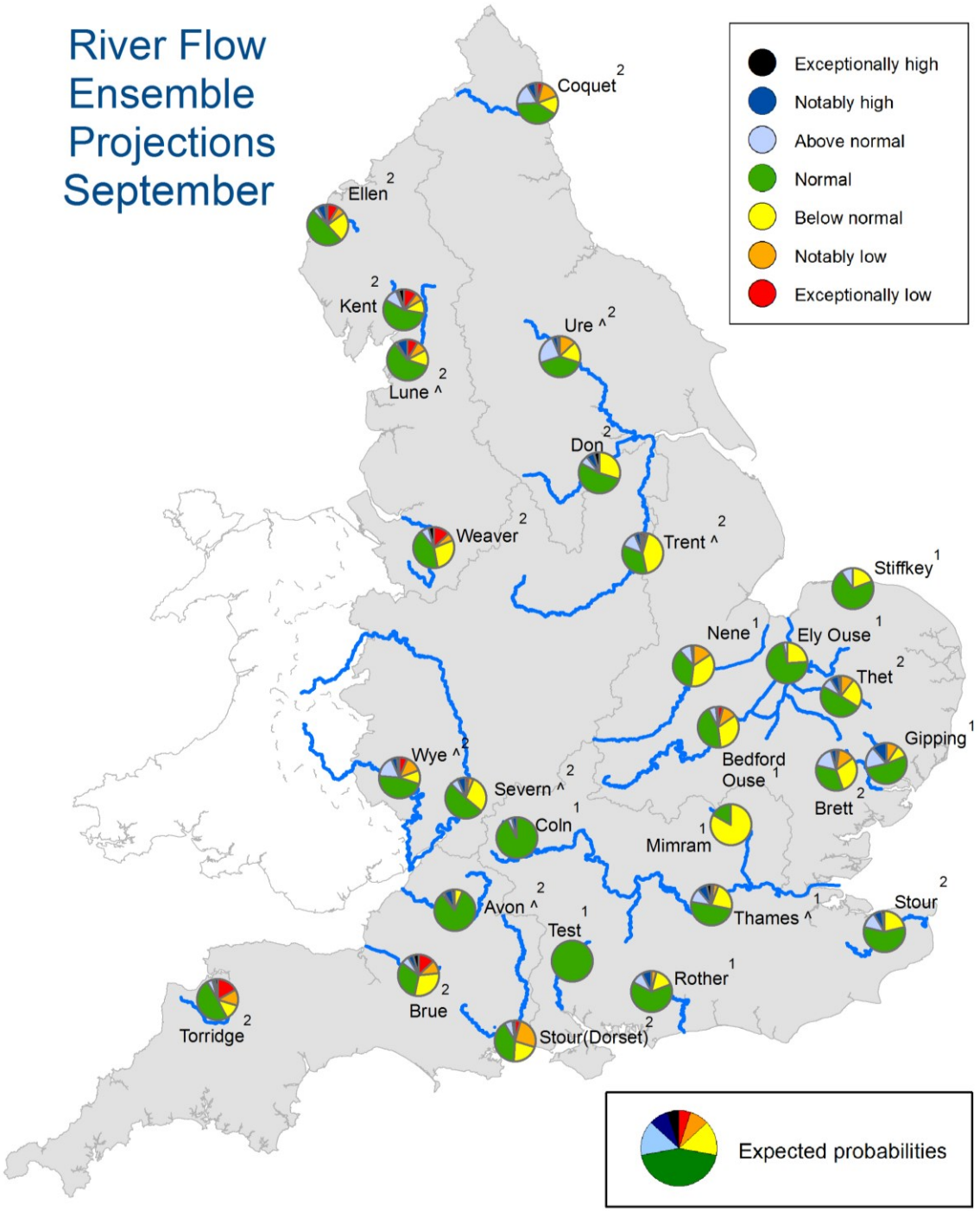

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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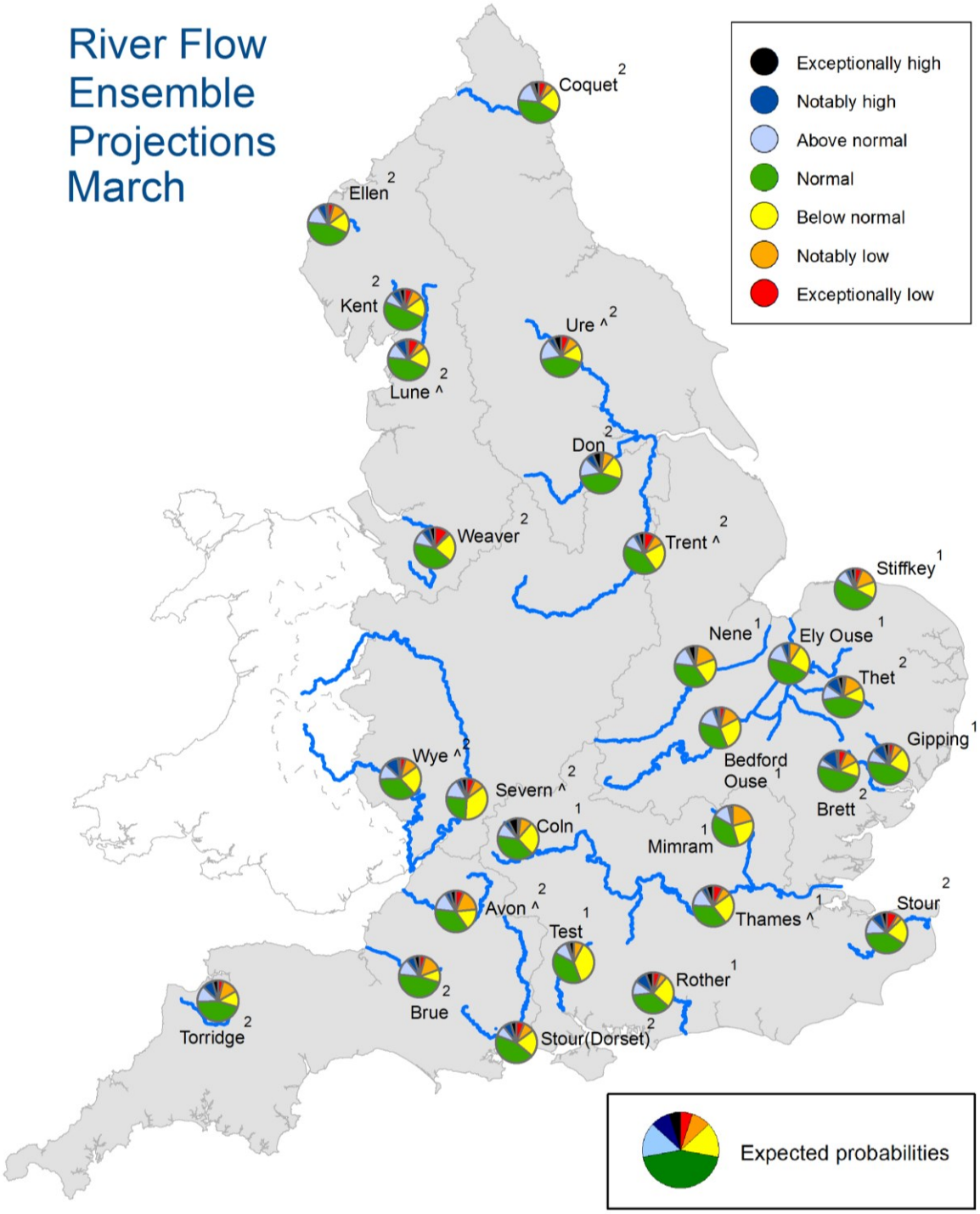

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

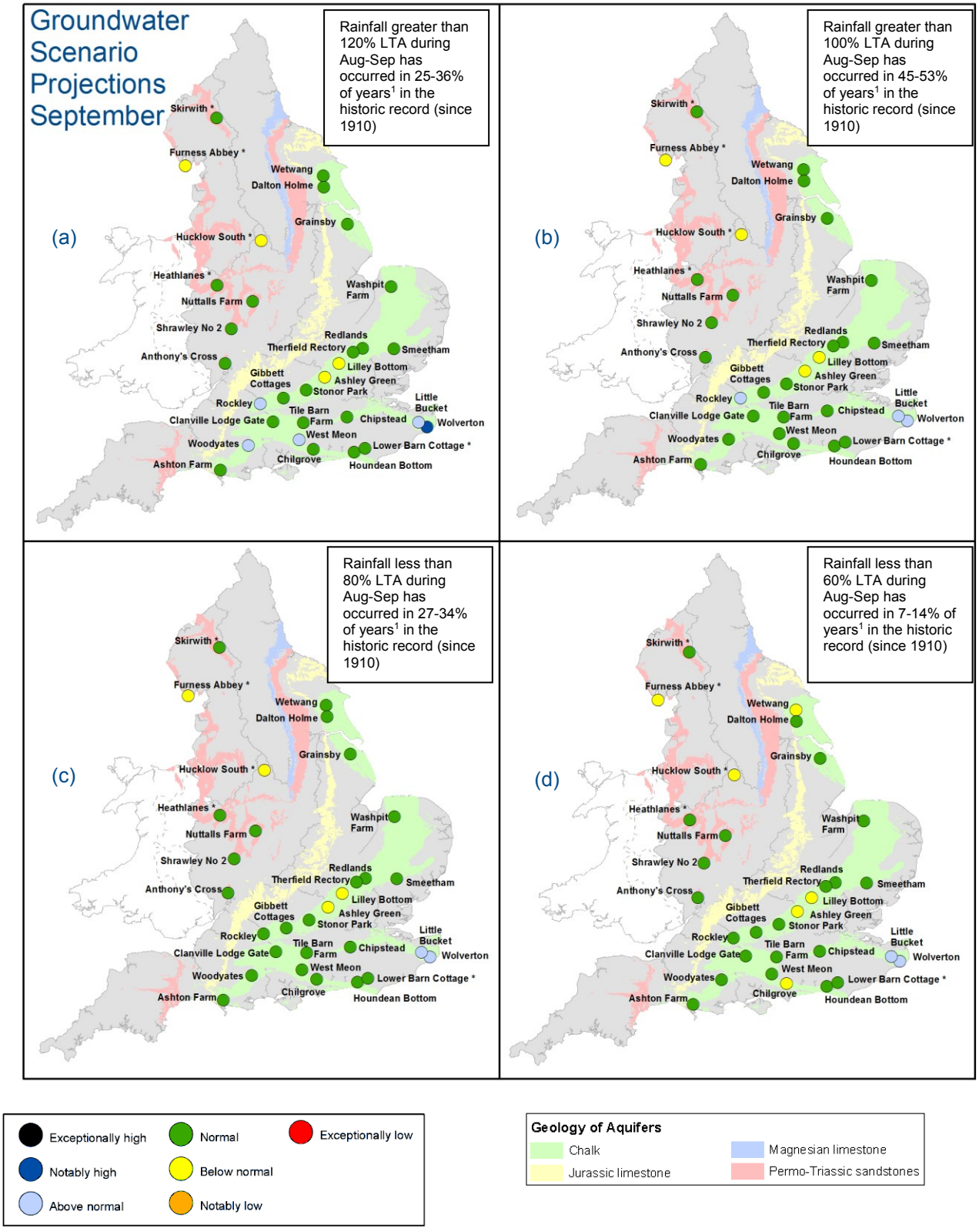

Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2018. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2018 and September 2018 (Source: Environment Agency) Geological map reproduced with kind 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

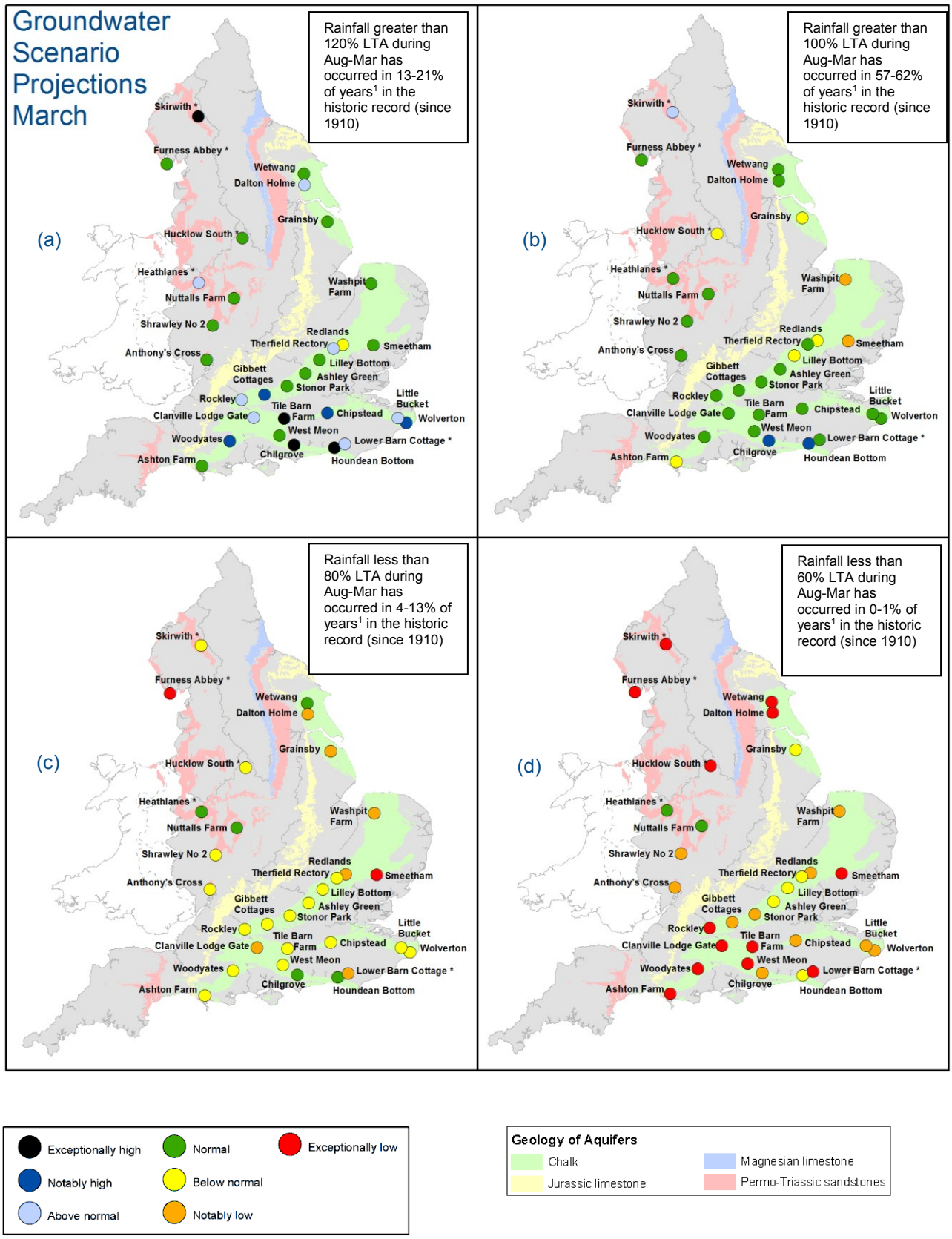

Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2018 and March 2019 (Source: Environment Agency) Geological map reproduced with kind permission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

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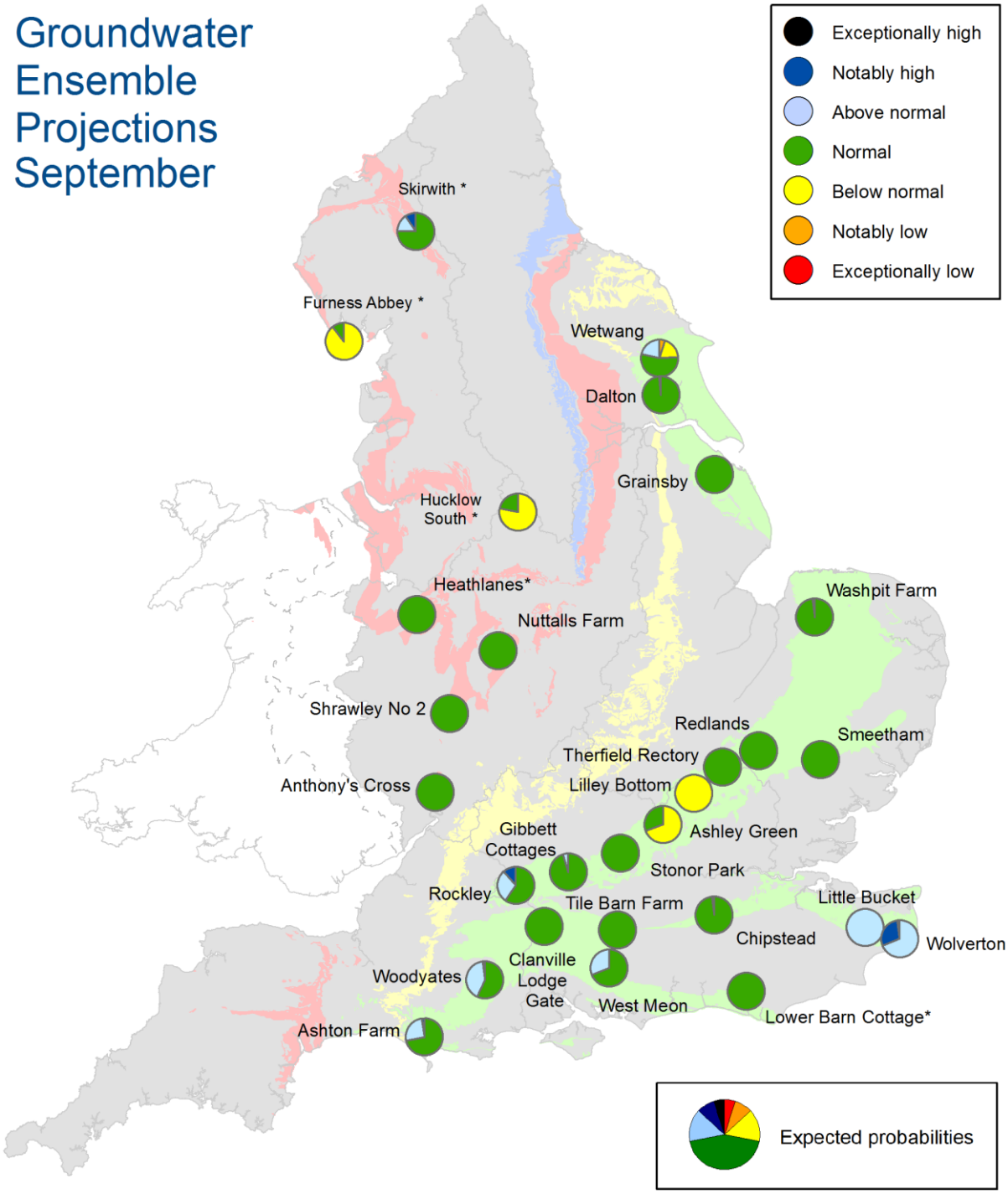
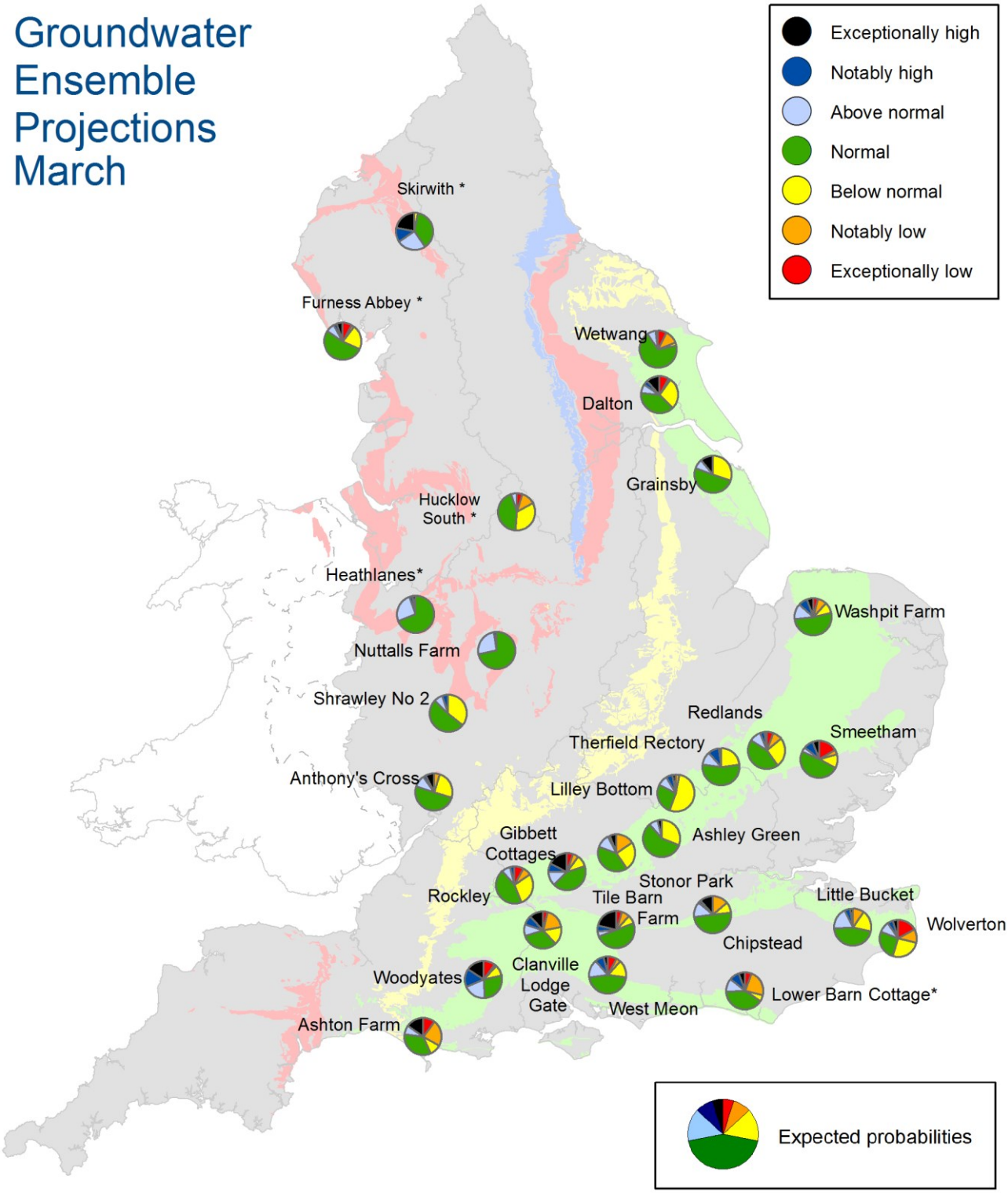


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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