Monthly water situation report

England

Summary – August 2016

Rainfall totals for August were higher than the previous month across much of England and close to the long term average. Soils were drier than average across much of England. River flows and groundwater decreased at most indicator sites across England, but remain normal or higher for the time of year at almost all sites. Reservoir stocks decreased at the majority of sites, with overall storage for England being 85% of total capacity – this is typical for the time of year.

Rainfall

Rainfall totals for August ranged from less than 25mm across much of East Anglia, Greater London, Kent and parts of East and West Sussex to more than 100mm in parts of Cumbria and Lancashire. Monthly rainfall totals were above the long term average (LTA) for August across north-east and north-west England. For much of the rest of England rainfall was between 60 and 100% of the August LTA, although parts of south-east England received less than 50% of the August LTA. South Essex received only 25% of the August LTA (Figure 1.1).

For the majority of hydrological areas in England rainfall totals for August were normal for the time of year. Parts of Cumbria had above normal rainfall for the time of year, while parts of east, south-east and south-west England had below normal or lower rainfall during August. Over the three month period to the end of August, rainfall totals were normal or higher for many parts of England, although parts of south-west England were below normal or lower for the time of year (Figure 1.2).

At the regional scale August rainfall totals ranged from 64% of the LTA in south-east England to 133% in north-west England. Rainfall totals across England as a whole were close to average at 98% of the August LTA (Figure 1.3).

Soil moisture deficit

Soil Moisture Deficits (SMDs) at the end of August increased compared to July across much of England, with the largest increases in east and south-east England. At the end of August deficits were as small as zero in parts of north-west England but as large as 140mm in parts of east England (Figure 2.1).

End of month SMDs were larger than the long term average (LTA) for the end of August across much of east and south-east England (ie soils were drier than the LTA here). Soils were wetter than average in parts of north-east, north-west and central England (Figure 2.1).

At a regional scale, SMDs decreased during the month in central, north-west and north-east England. Values at the end of August ranged from 30mm in north-west England to 102mm in south-east England (Figure 2.2).

River flows

Monthly mean river flows for August decreased at nearly three quarters of indicator sites across England compared with July. However, the majority of sites were classed as normal or higher for the time of year. Three sites across south-east and north-west England were notably high for the time of year, whilst the River Wyre in Lancashire was exceptionally high (Figure 3.1).

Monthly mean river flows were classed as above normal for the time of year at two of the regional index sites covering north-east and north-west England. Monthly mean flows were normal for the time of year at the remaining regional index sites (Figure 3.2).

Groundwater levels

At the end of August, groundwater levels decreased or remained static at all but 2 indicator sites compared to the end of July.

Groundwater levels were normal at just under two thirds of the indicator sites, and were above normal or higher at all but two of the remaining sites. Groundwater levels at Crossley Hill (Nottinghamshire and Doncaster Permo-Triassic sandstone) and at Ashley Green (Chilterns East Chalk) were below normal for the time of year (Figure 4.1).

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

Reservoir storage

Reservoir stocks decreased at two thirds of reported reservoirs and reservoir groups during August. The largest decreases in storage were at Hanningfield, Blagdon, Ardingly and Clatworthy, where stocks reduced by between 10 and 20%. The largest increase in storage was in the Teesdale Group of reservoirs (11%). More than two thirds of reservoirs and reservoir groups were above 75% of full capacity End of month stocks were classed as normal or higher for the time of year at the majority of reservoirs and reservoir groups, with just over a third being above normal or higher (Figure 5.1).

At the regional scale reservoir stocks at the end of August increased in north-east and north-west England, but decreased elsewhere. The largest decrease of 8% was in south-west England. Month-end regional stocks for the end of August ranged from 70% of total capacity in south-west England to 91% in central England. Reservoir storage at the end of August for England overall was at 85% of total capacity, a slight decrease compared to last month but typical for the time of year (Figure 5.2).

Forward look

Weather conditions are expected to be changeable throughout the remainder of September and early October, with the wettest weather likely in northern and western areas. For the period September-October-November there is a slightly higher chance of above average rainfall[1].

Projections for river flows at key sites[2]

By the end of September 2016 nearly three quarters of modelled sites have a greater than expected chance of normal or lower cumulative flows. By the end of March 2017, nearly two thirds of modelled sites have a greater than expected chance of lower than normal cumulative flows

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

Projections for groundwater levels in key aquifers[2]

At the end of September 2016, all but one modelled site have a greater than expected chance of normal or higher groundwater levels for the time of year. At the end of March 2017 three quarters of modelled sites have a greater than expected chance of normal or higher groundwater levels for the time of year.

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

Authors: E&B Hydrology Team

1 Source: Met Office
2 Information produced 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

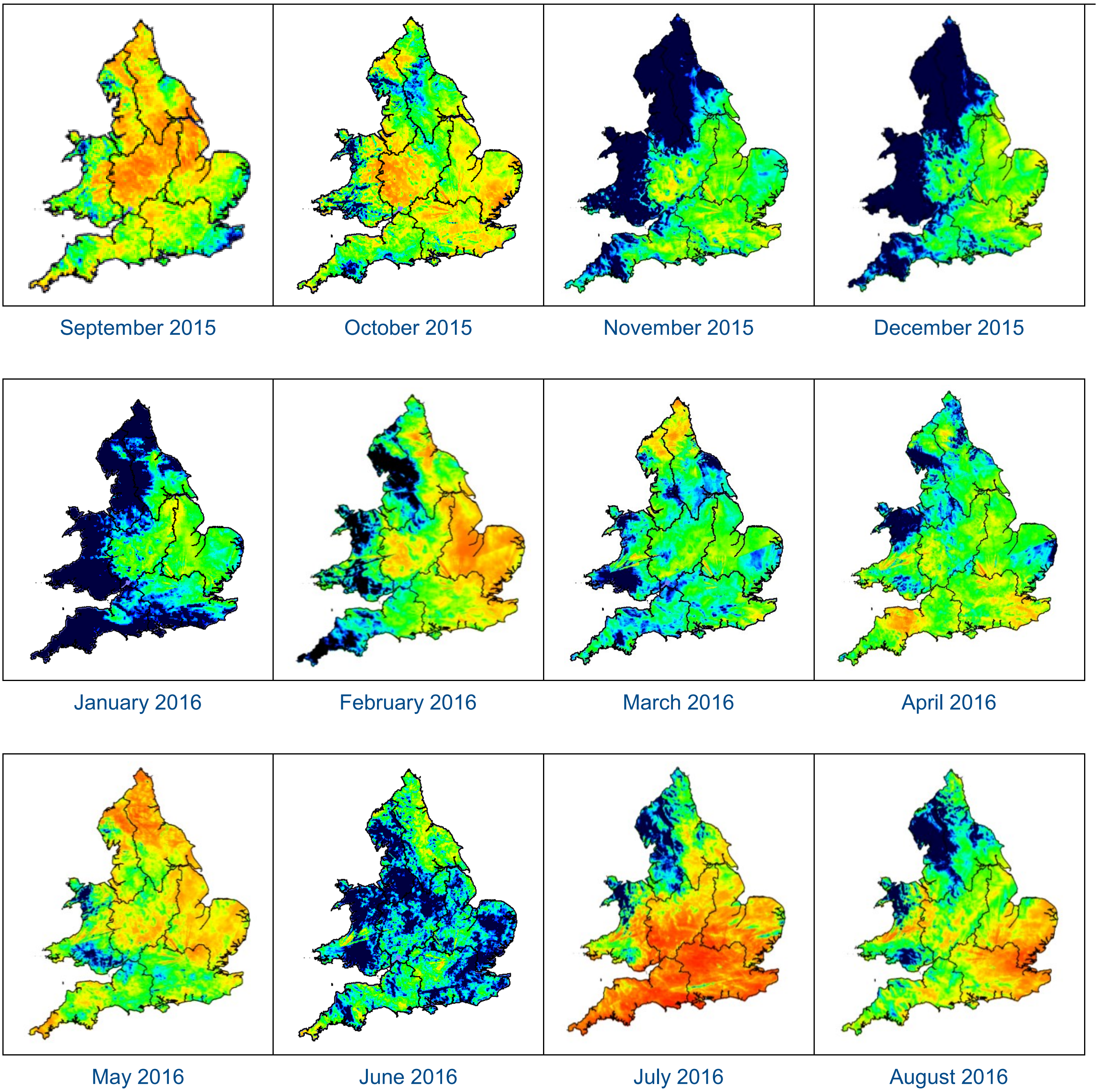
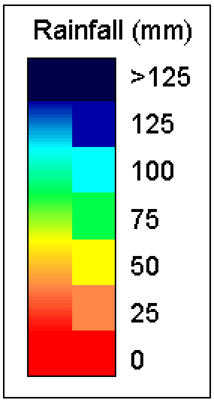


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2016). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.



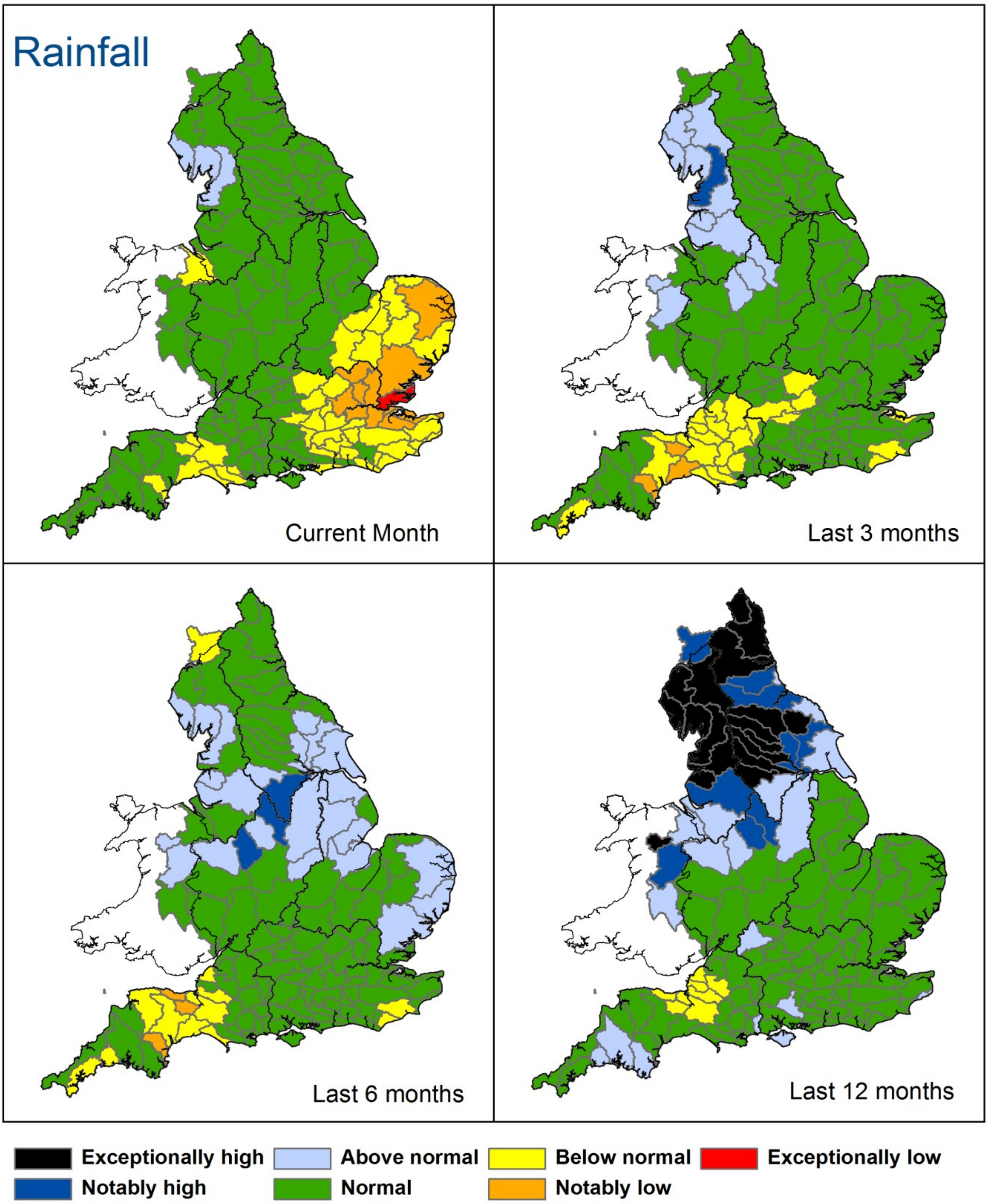


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 August), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met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

Rainfall charts

Above average rainfall   Below average rainfall

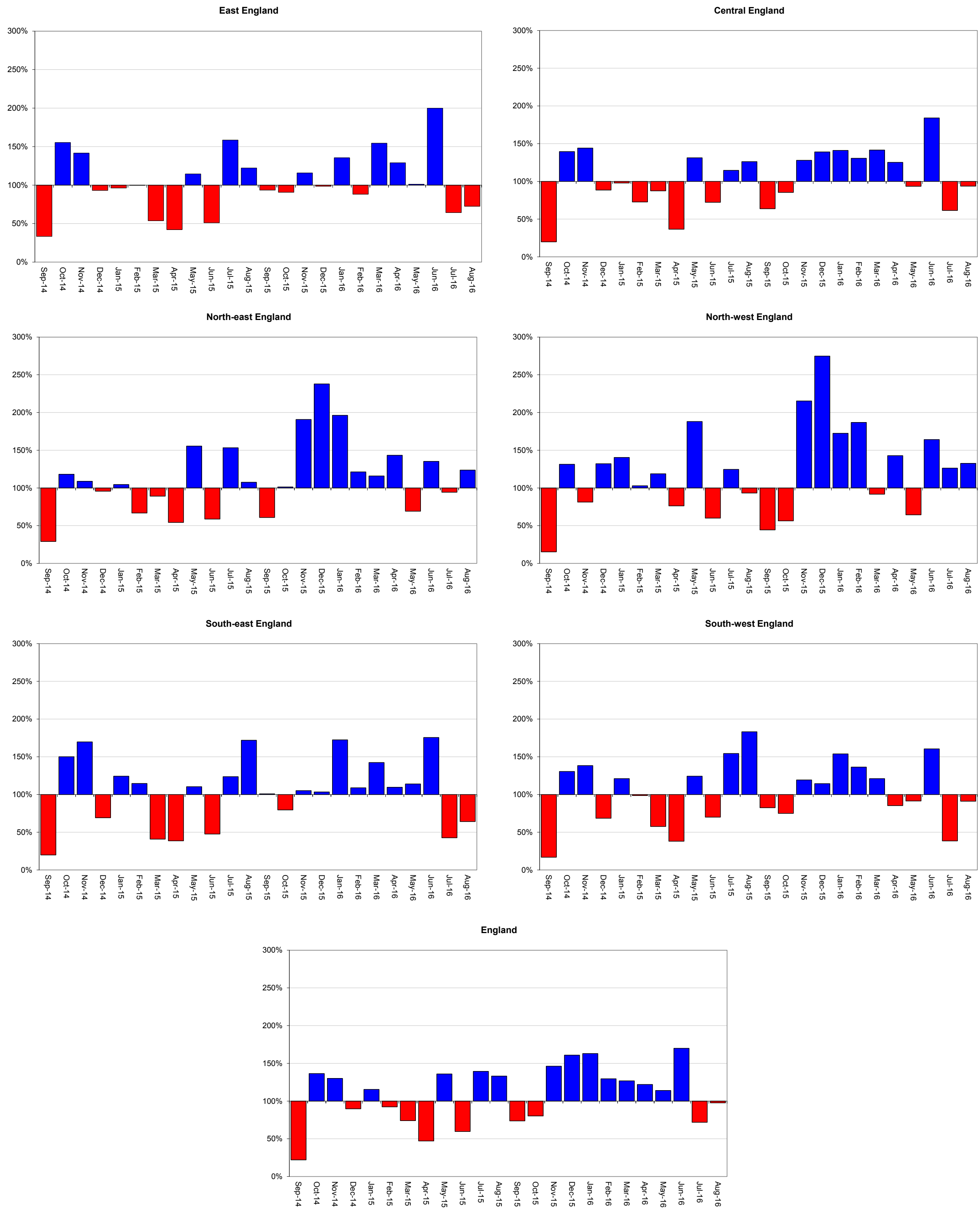


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2016).

Soil moisture deficit

End of July 2016[1]	End of August 2016[2]

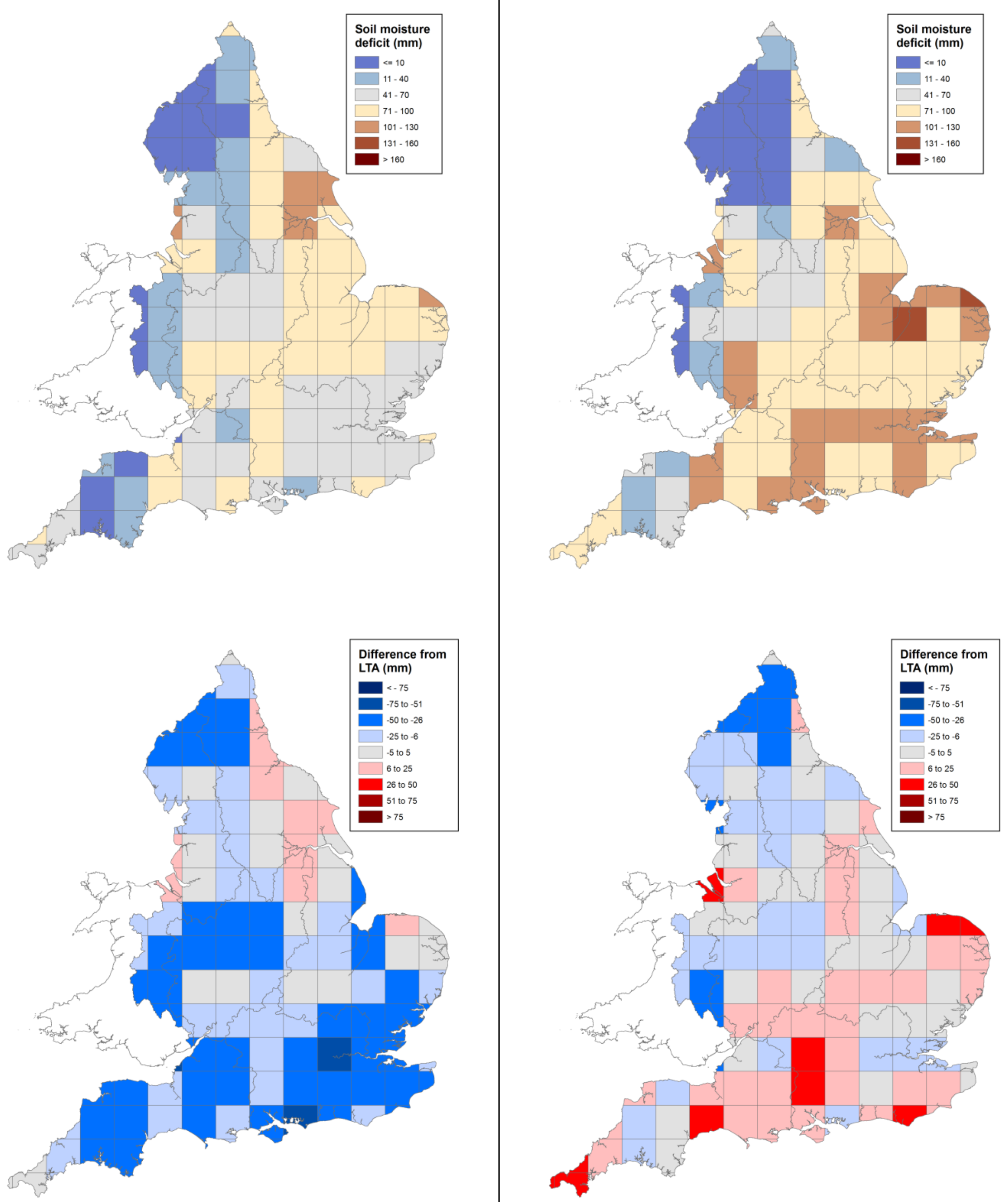


Figure 2.1: Soil moisture deficits for weeks ending 2 August 2016 [1] (left panel) and 30 August 2016 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2016). Crown copyright. All rights reserved. Environment Agency, 100026380, 2016

Soil moisture deficit charts

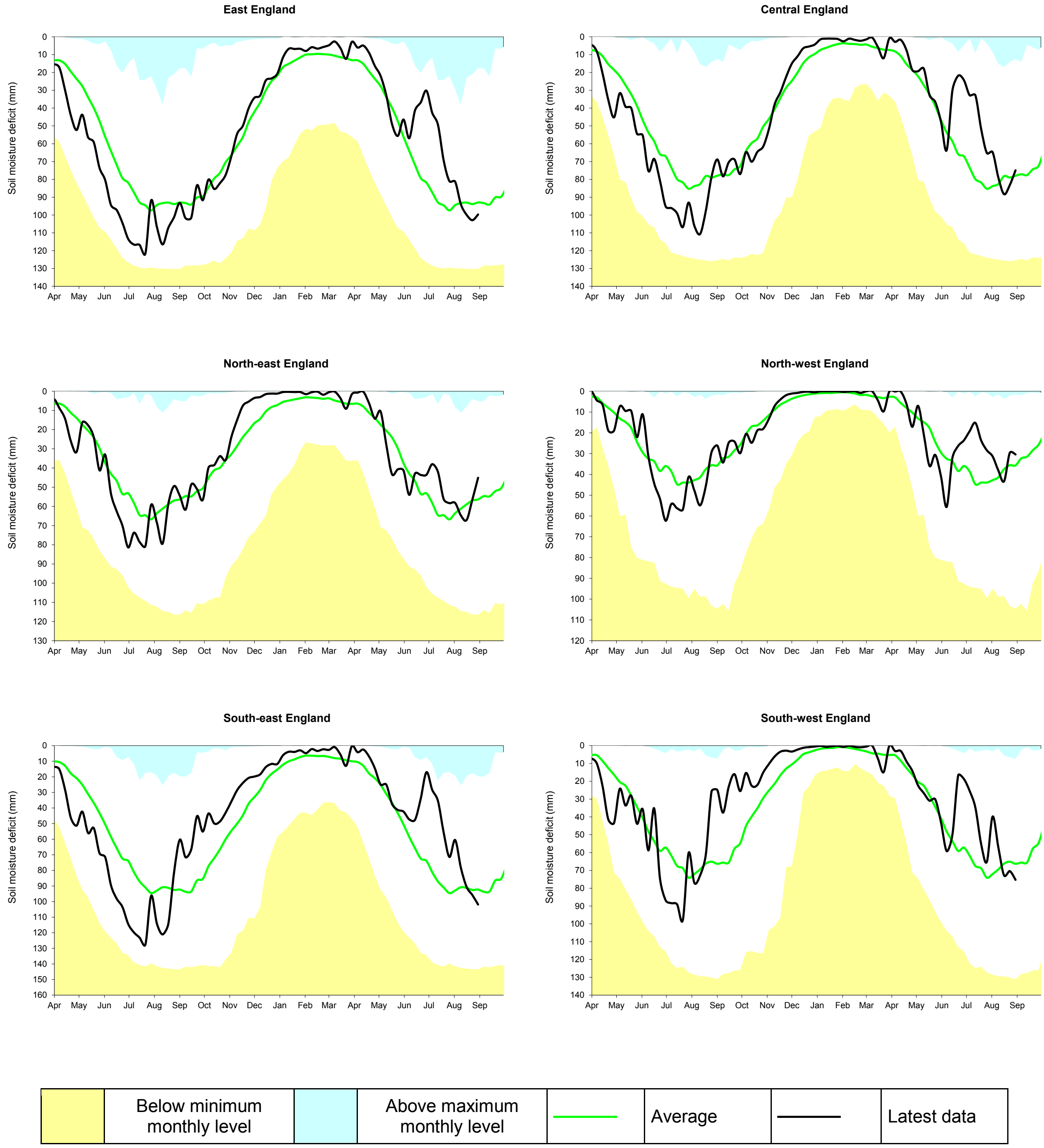
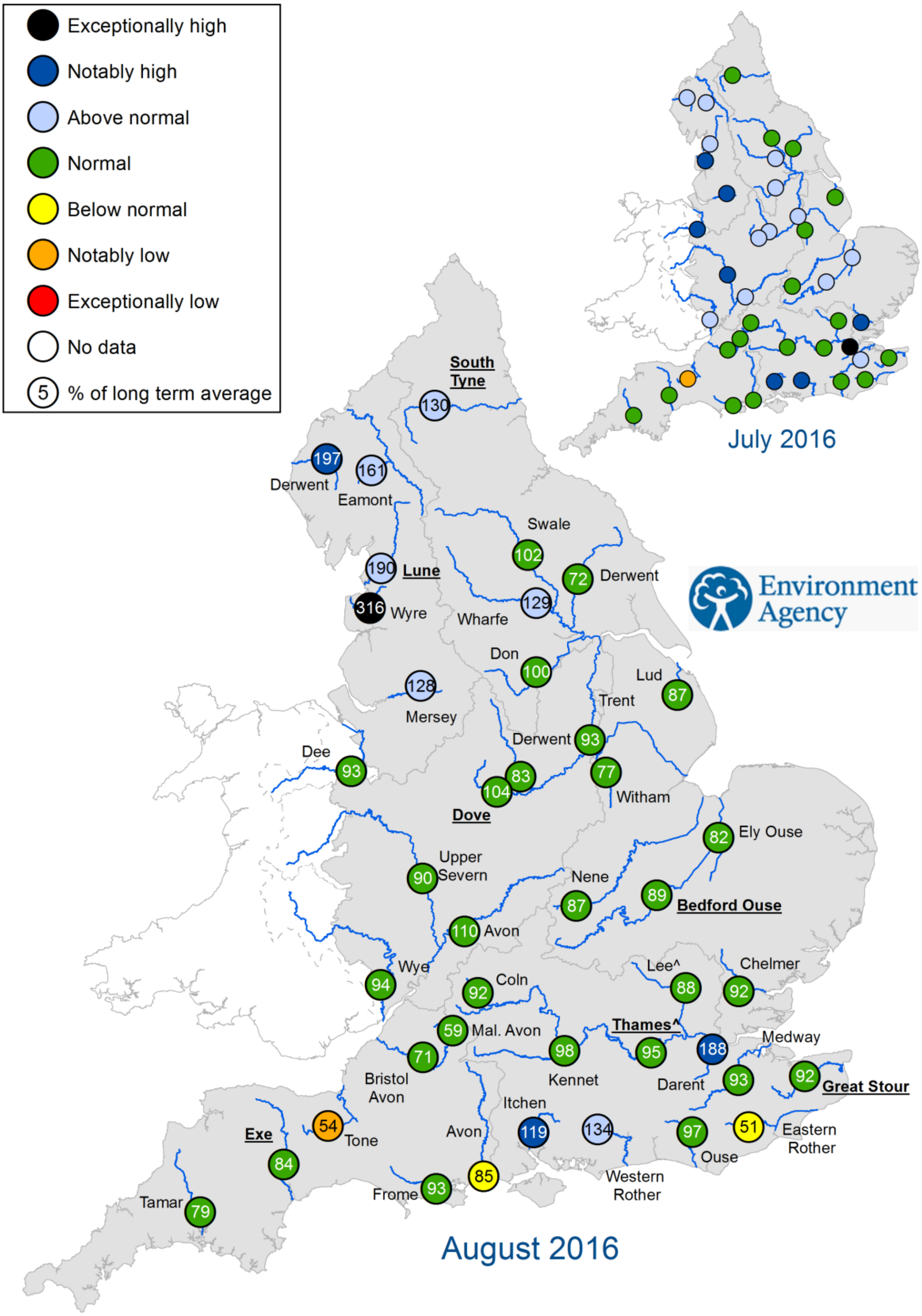


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2016).

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 July 2016 and August 2016, expressed as a percentage of the respective long term average and classed relative to an analysis of historic July and August monthly means (Source: Environment Agency).

River flow charts

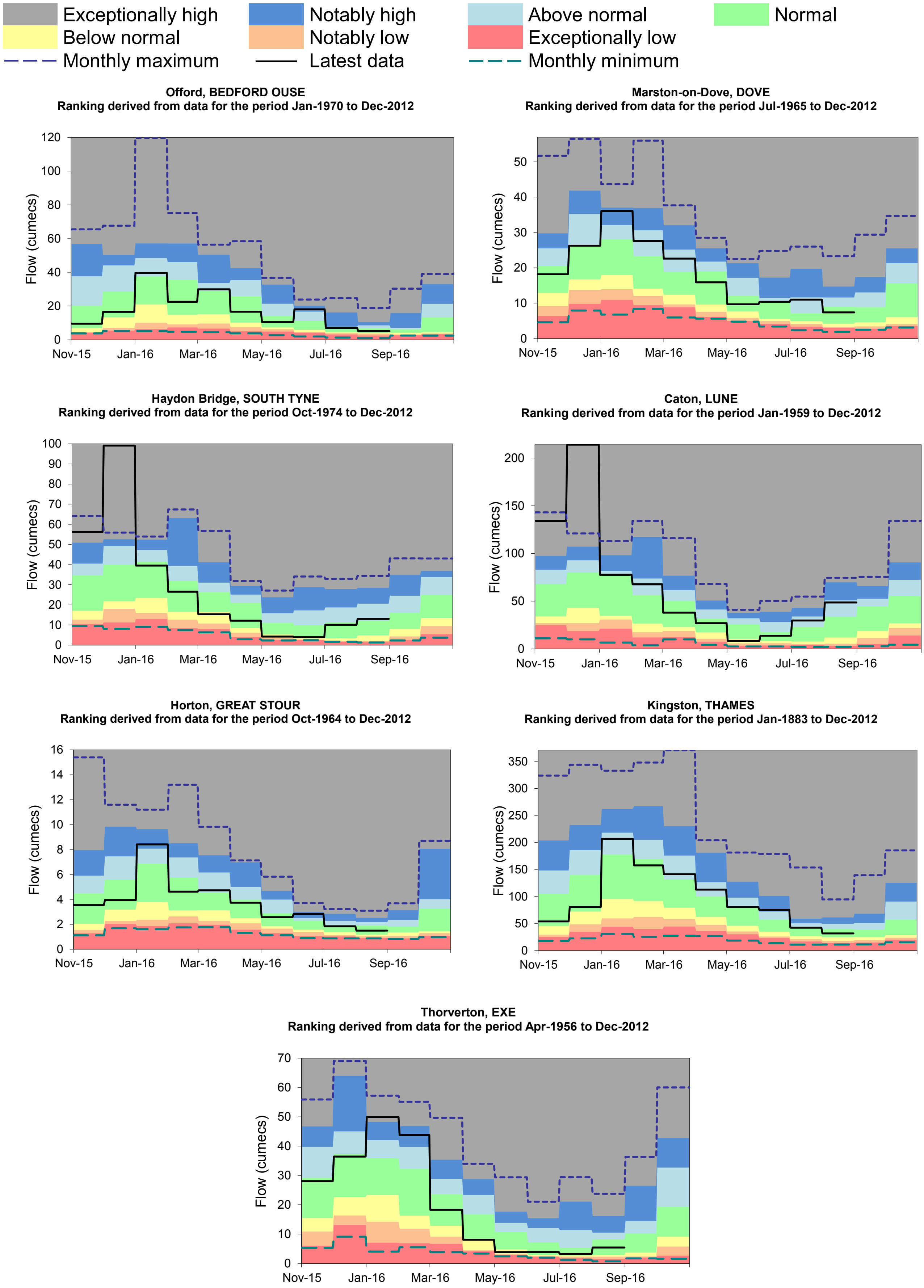
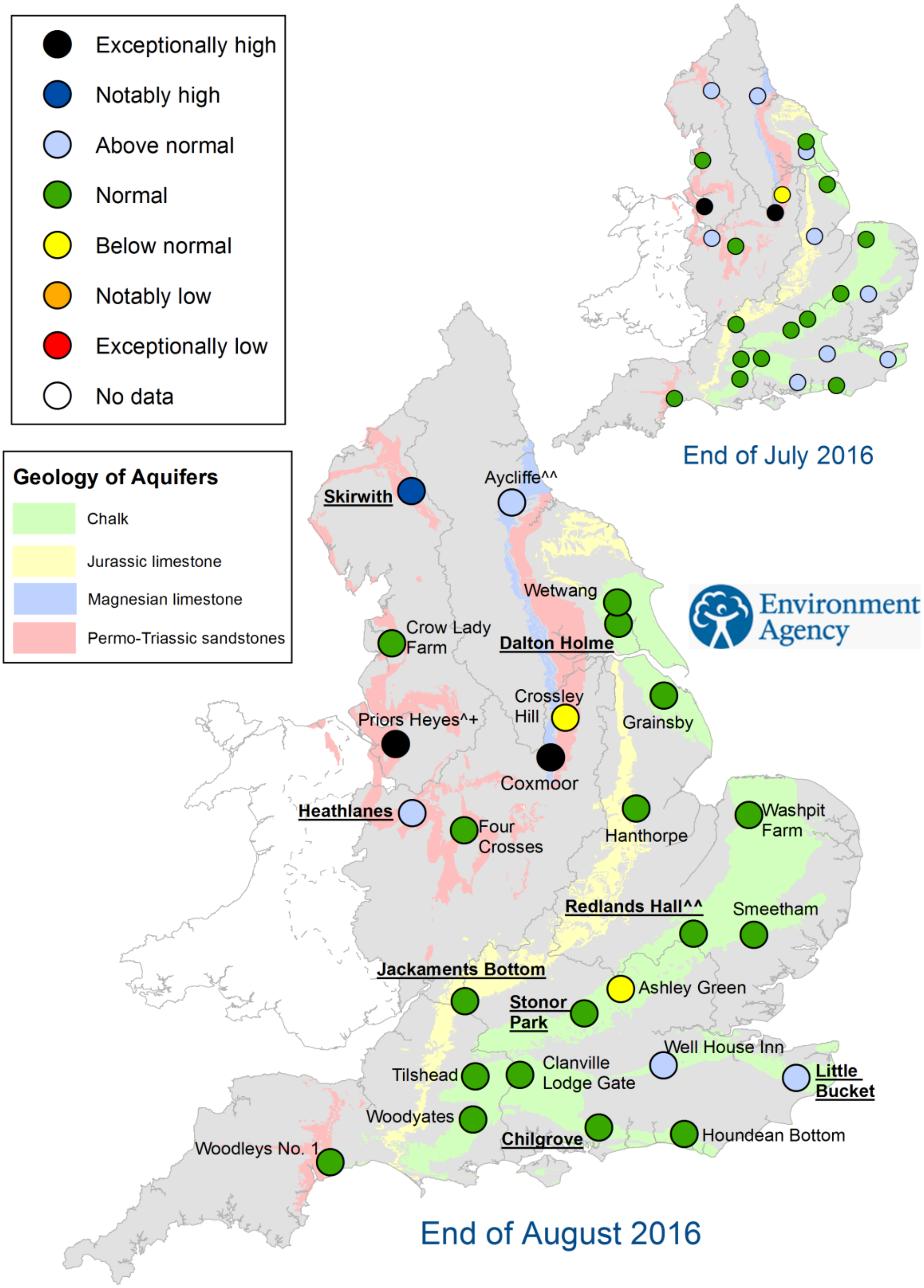


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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

+/- Highlighted sites are major aquifer index sites and are shown in the groundwater level charts in Figure 4.2

Figure 4.1: Groundwater levels for indicator sites at the end of July 2016 and August 2016, classed relative to an analysis of respective historic July and August levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

Groundwater level charts

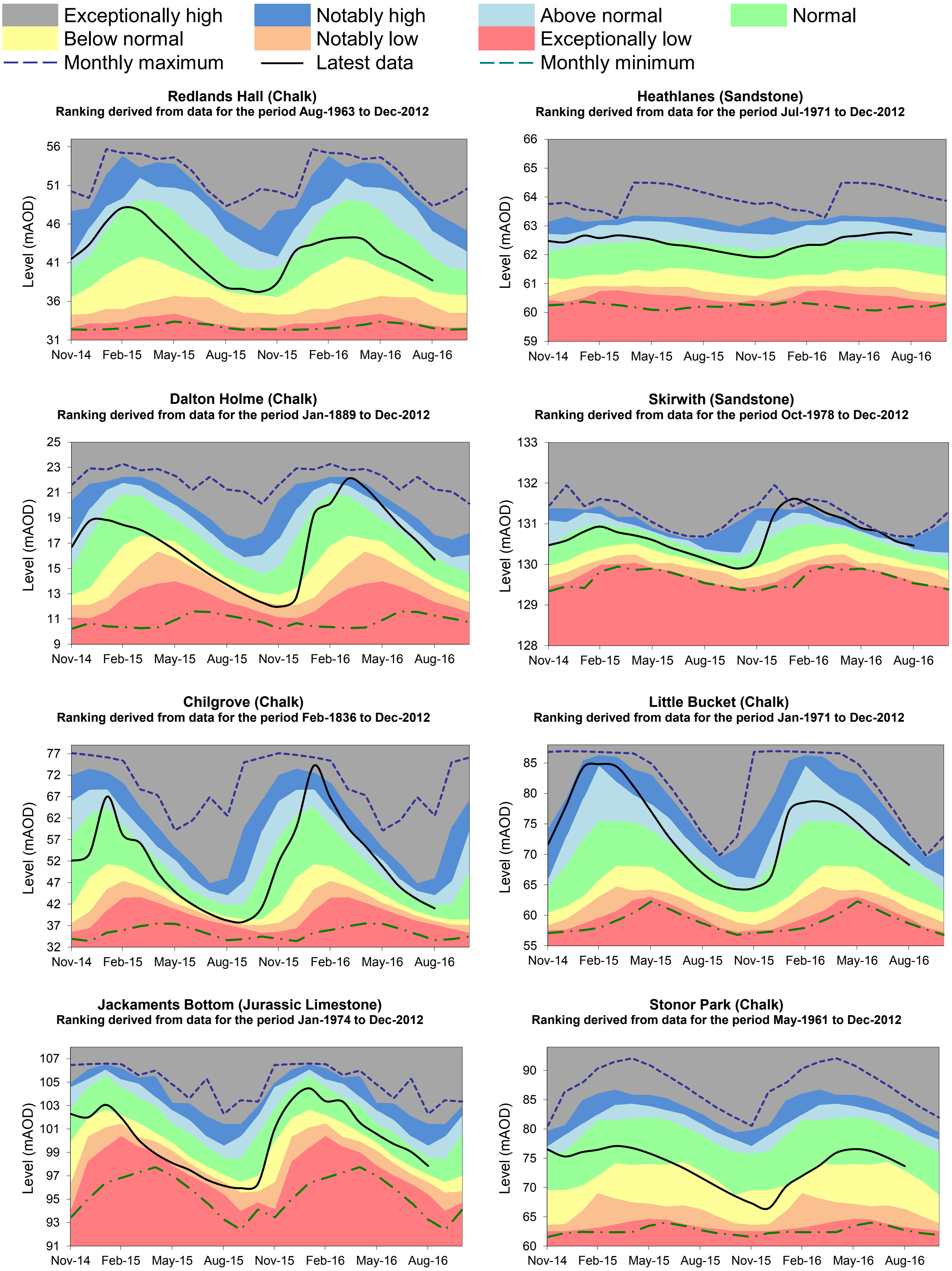
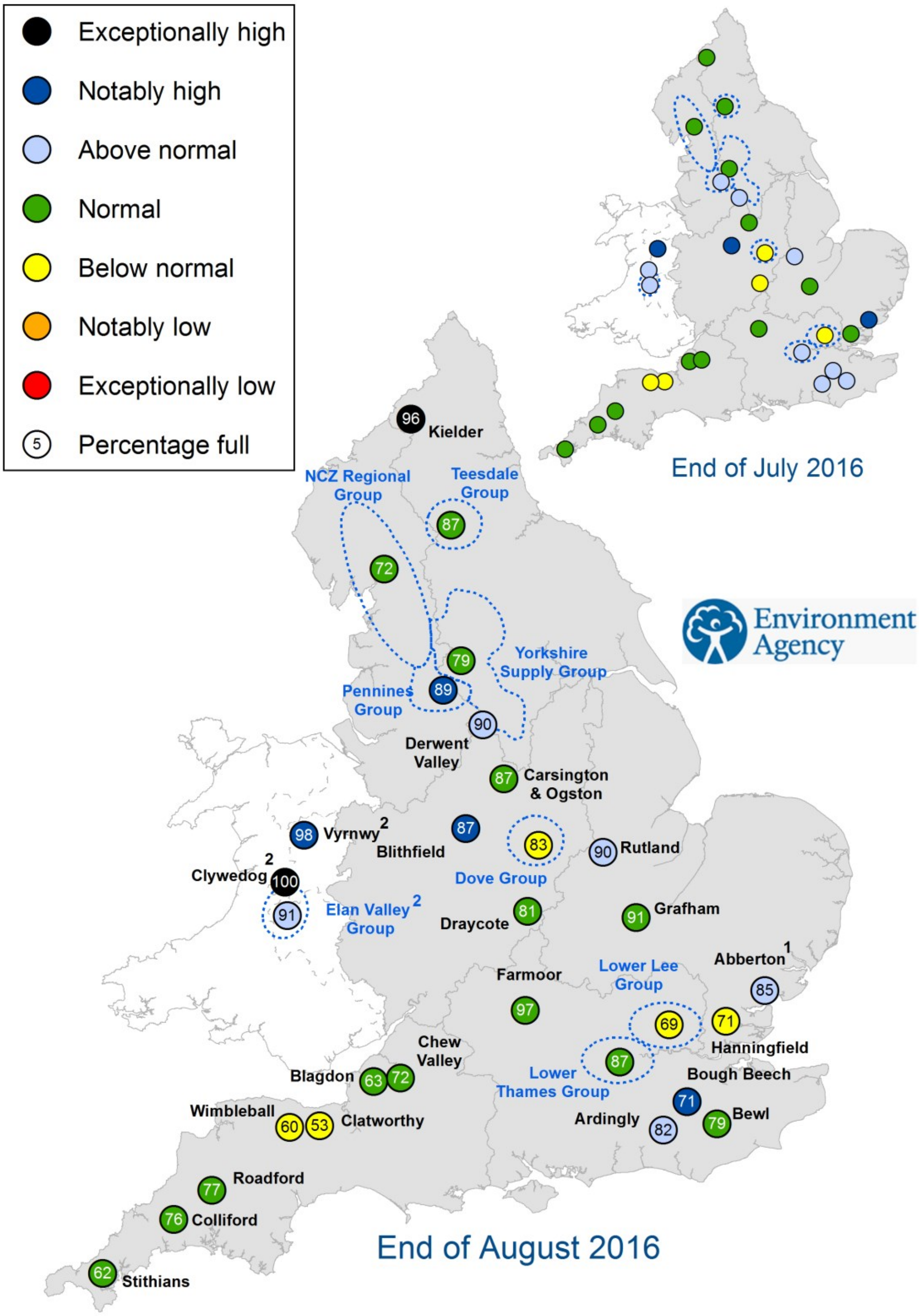


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2016).

Reservoir storage

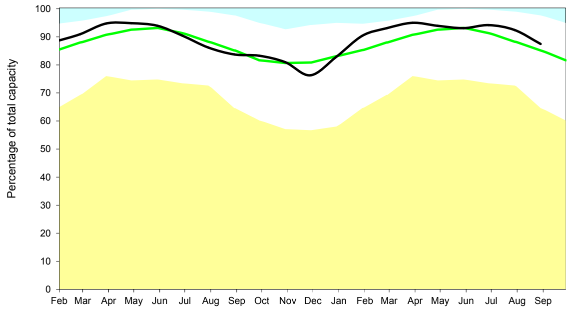


1. Engineering work at Abberton Reservoir in east England to increase capacity has been completed
2. Vyrnwy, Clywedog and Elan Valley reservoirs are located in Wales but provide a water resource to Central and north-west England

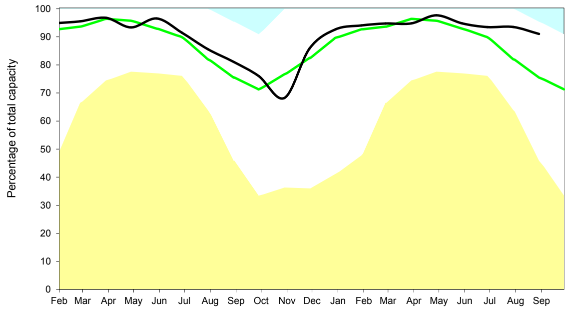
Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of July 2016 and August 2016 as a percentage of total capacity and classed relative to an analysis of historic July and August values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate 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, 2016.

Reservoir storage charts

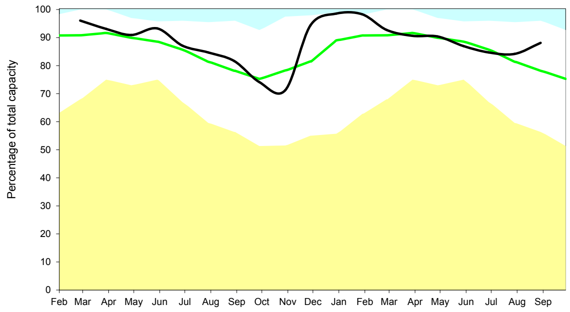
East England
Based on storage in Abberton, Grafham, Hanningfield, Rutland reservoirs



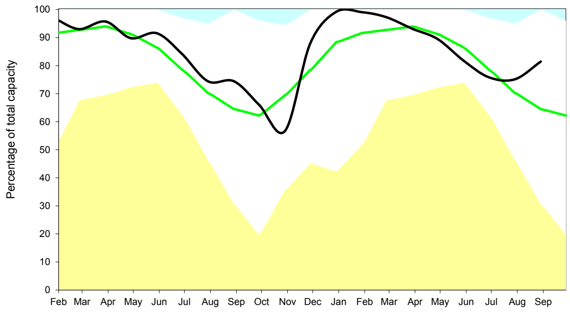
Central England
Based on storage in Clywedog, Carsington and Ogston, Derwent Valley, Dove (Foremark & Staunton), Draycote, Elan Valley Group reservoirs



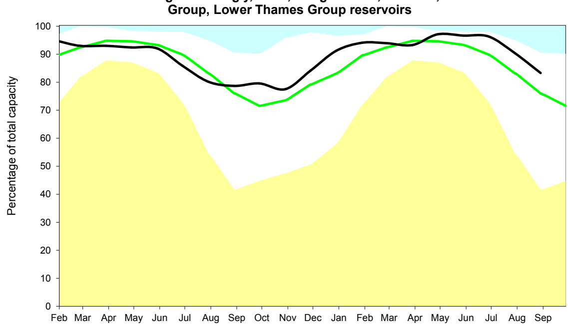
North-east England
Based on storage in Kielder, Teesdale Group, Yorkshire Supply Group reservoirs



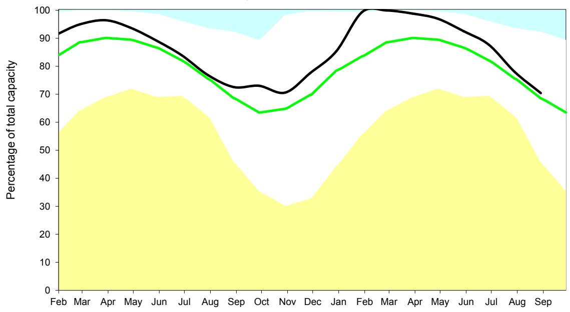
North-west England
Based on storage in NCZ Regional Group, Pennines Group, Vyrnwy reservoirs



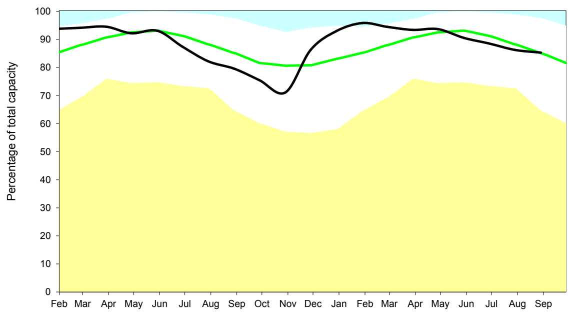
South-east England
Based on storage in Ardingly, Bewl, Bough Beech, Farmoor, Lower Lee Group, Lower Thames Group reservoirs



South-west England
Based on storage in Blagdon, Chew Valley, Clatworthy, Colliford, Roadford, Stithians, Wimbleball reservoirs



England
Based on combined regional storage



	Below minimum monthly level		Above maximum monthly level		Average		Latest data

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

Forward look – river flow

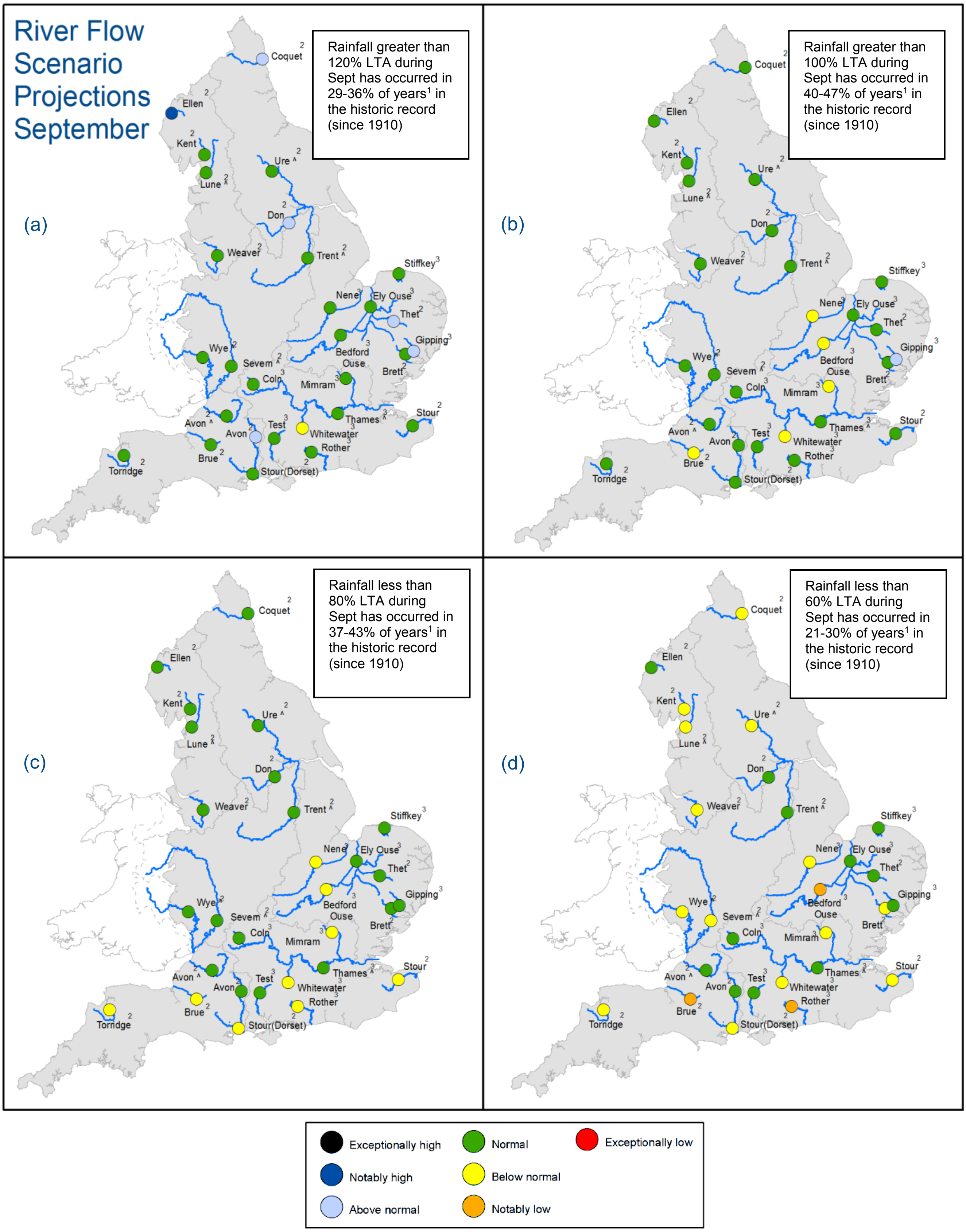


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall during September 2016 (Source: Centre for Ecology and Hydrology, Environment Agency)

[1] This range of probabilities is a regional analysis
[2] Projections for these sites are produced by CEH
[3] Projections for these sites are produced by the Environment Agency
^ *"Naturalised" flows are projected for these sites*

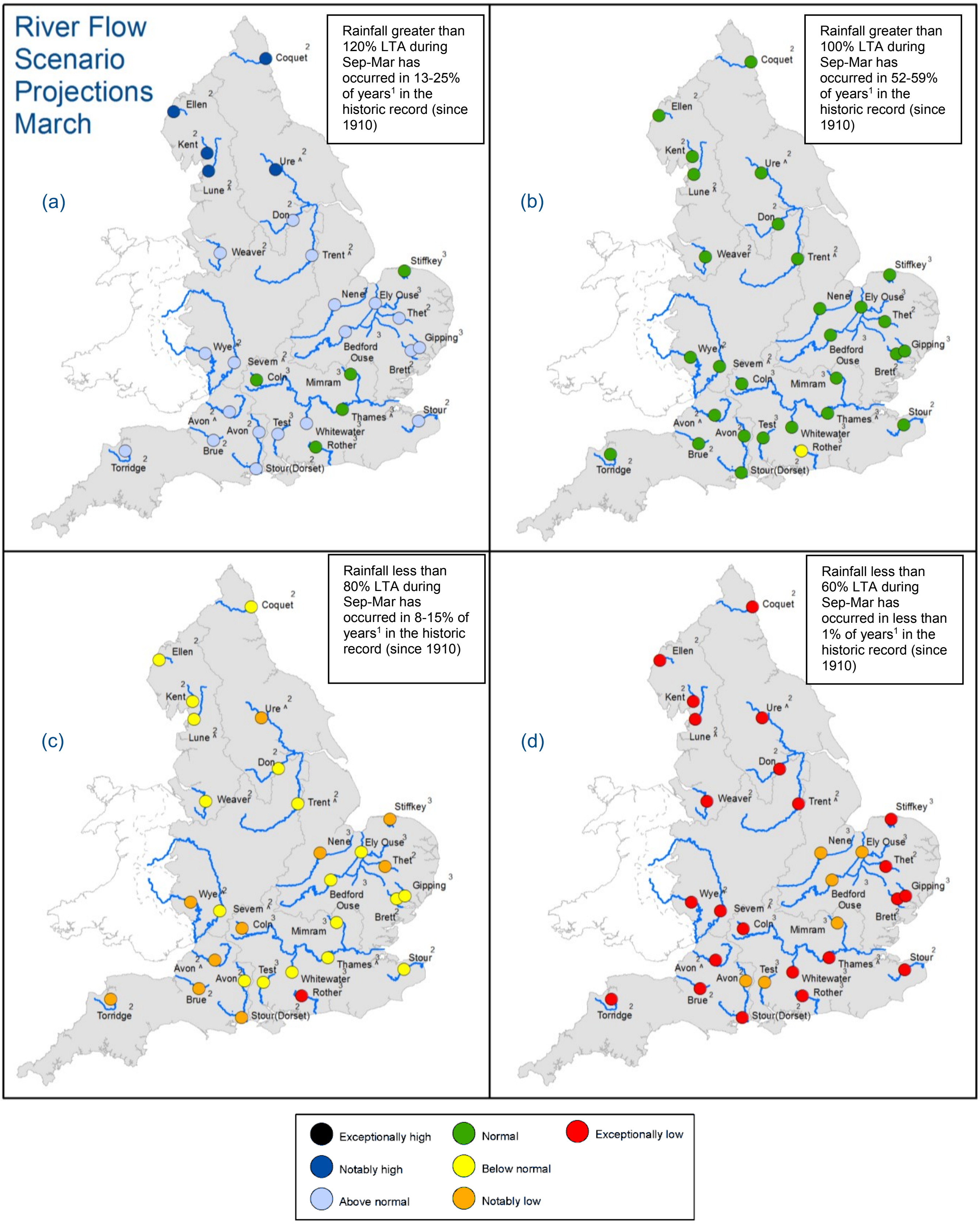


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between September 2016 and March 2017 (Source: Centre for Ecology and Hydrology, Environment Agency)

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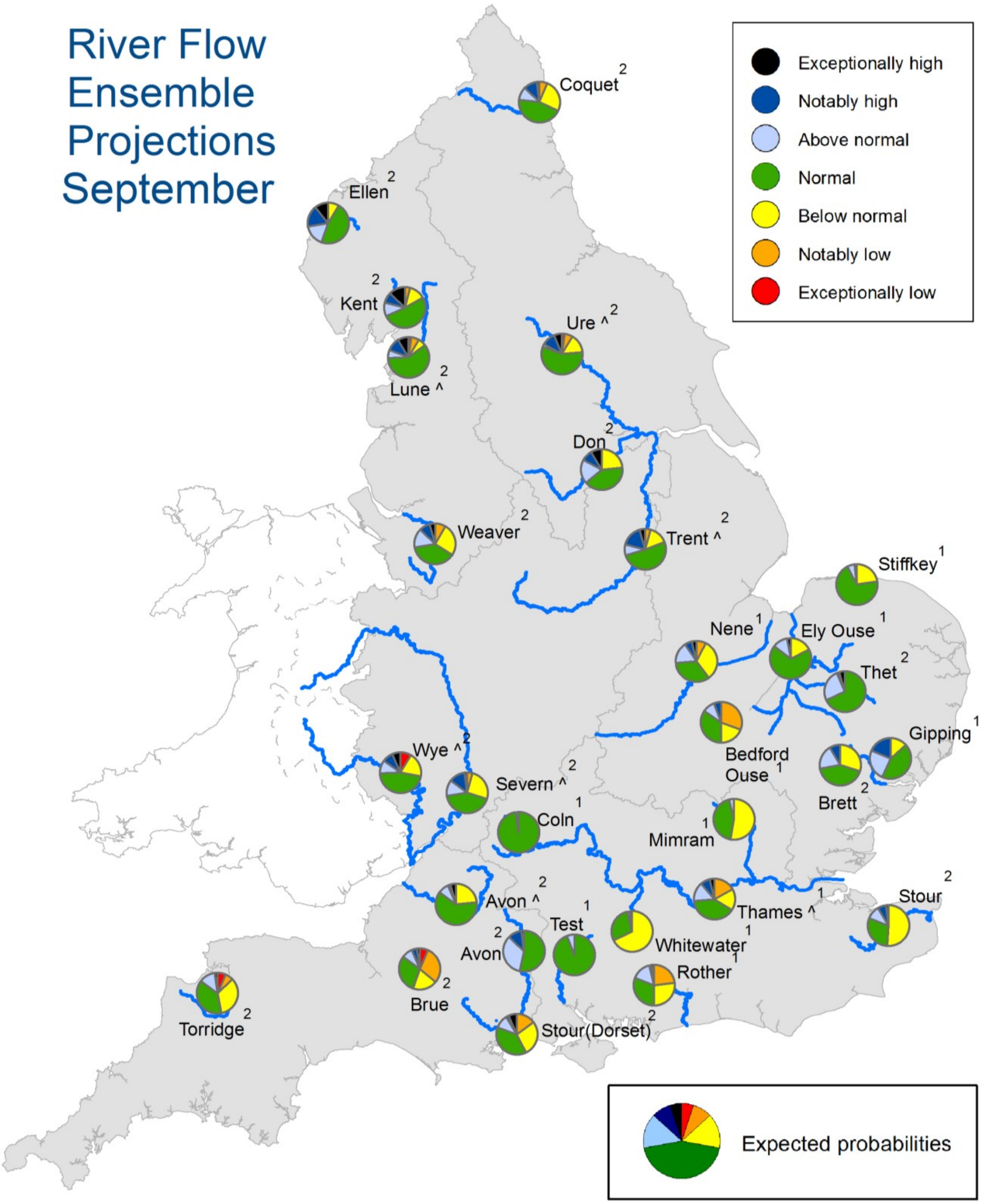

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2016. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

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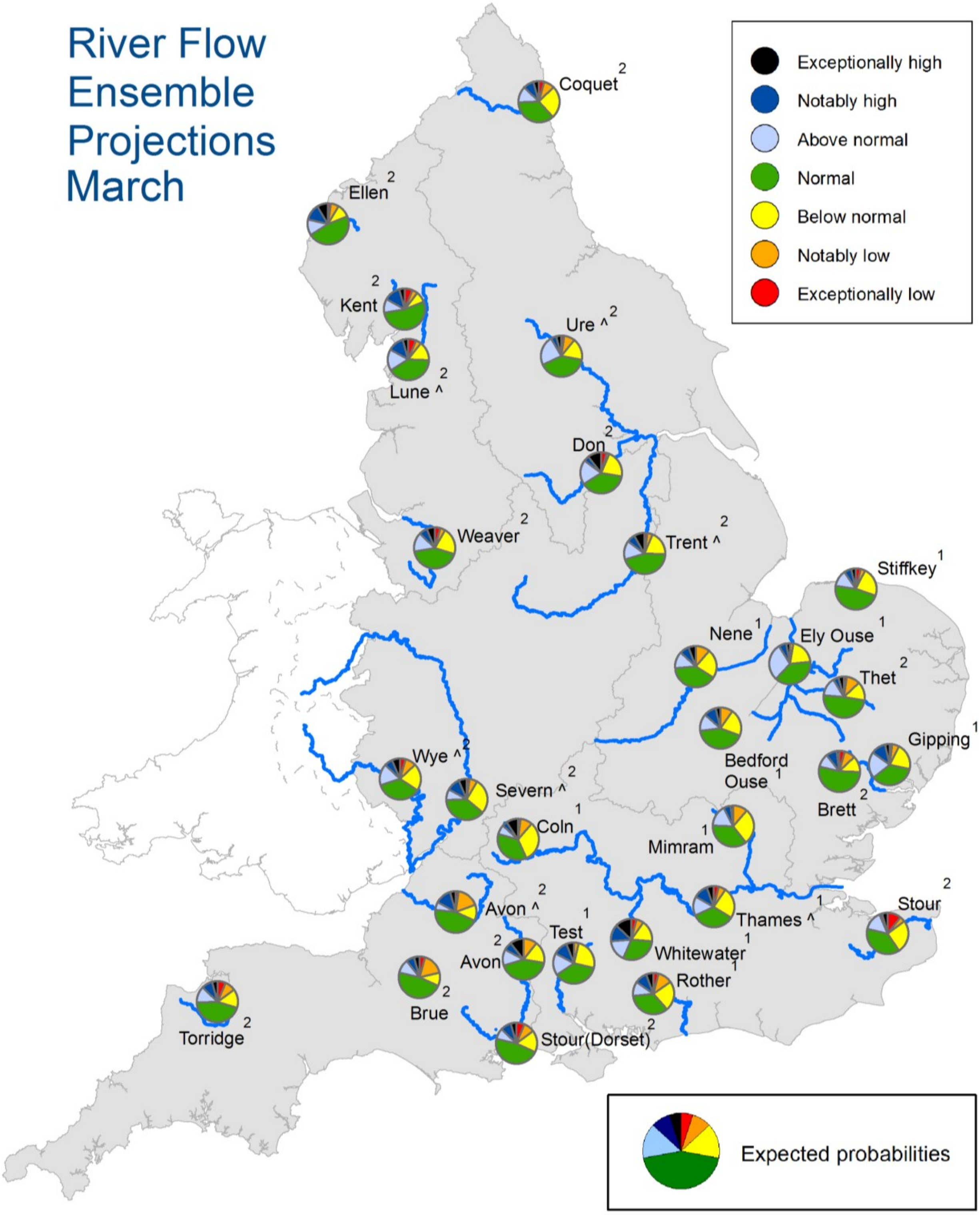


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2017. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

[1] Projections for these sites are produced by the Environment Agency
[2] Projections for these sites are produced by CEH
^"Naturalised" flows are projected for these sites

Forward look - groundwater

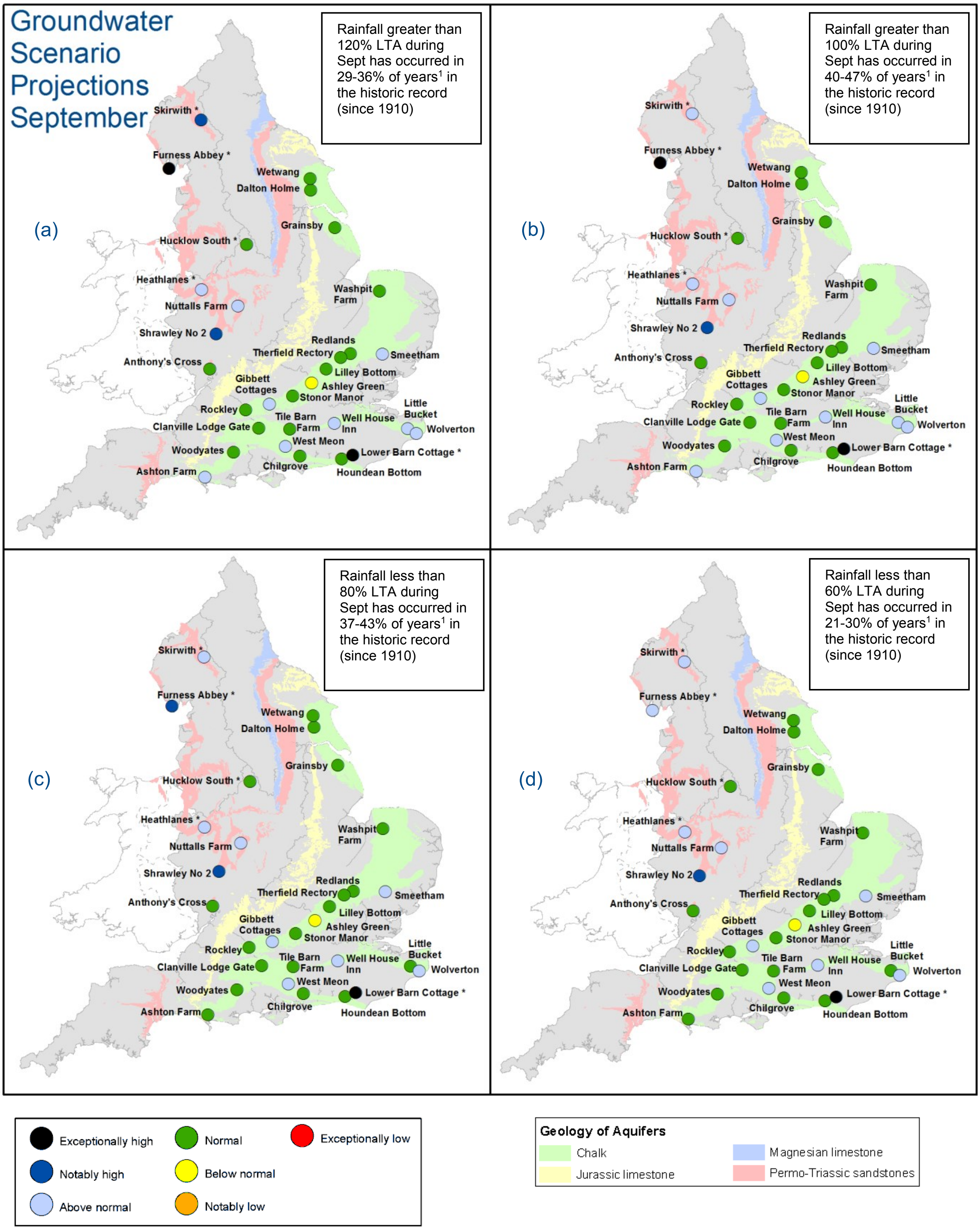


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall during September 2016 (Source: Environment Agency) Geological map reproduced with kind permission from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

* Projections for these sites are produced by BGS

[1] This range of probabilities is a regional analysis

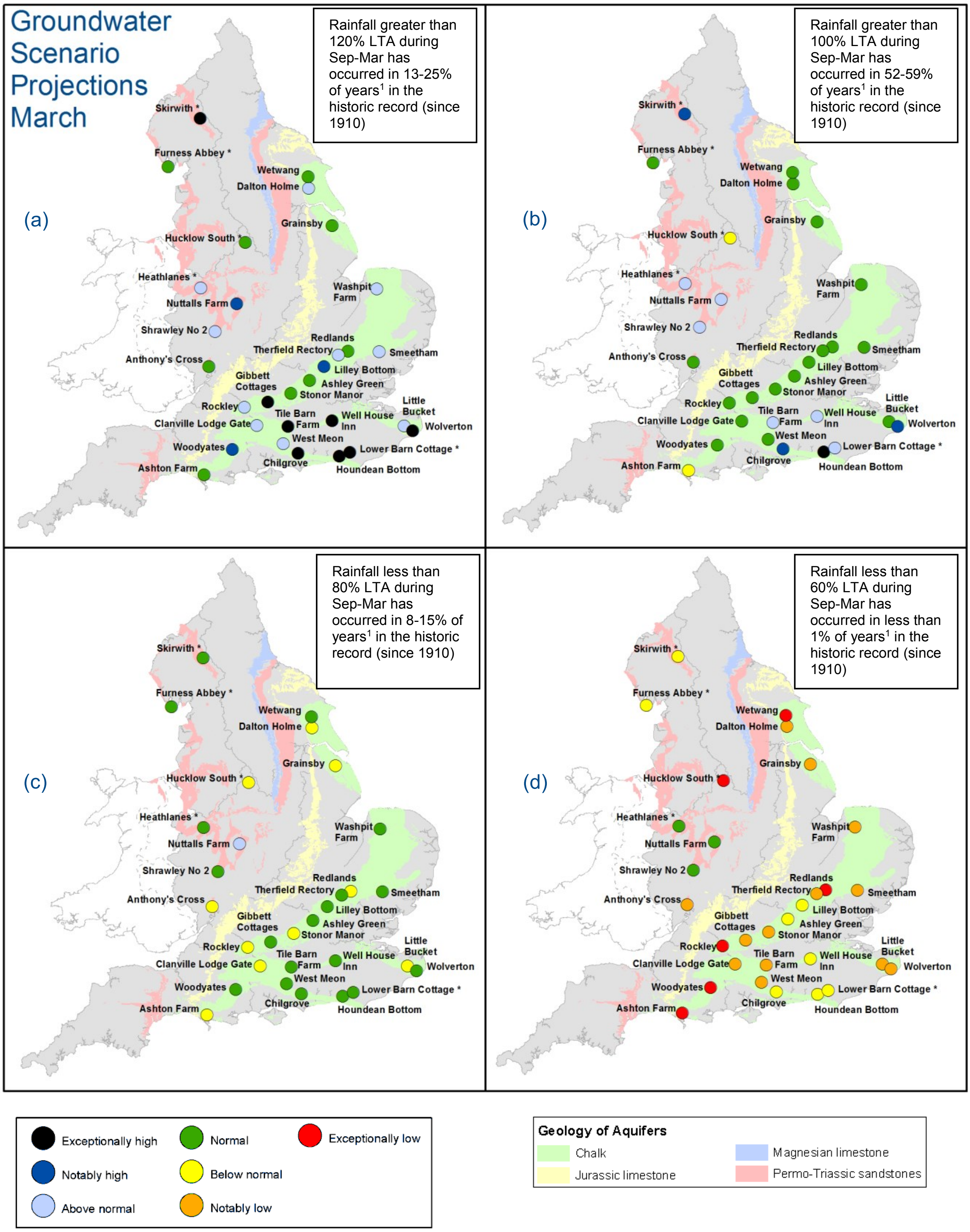
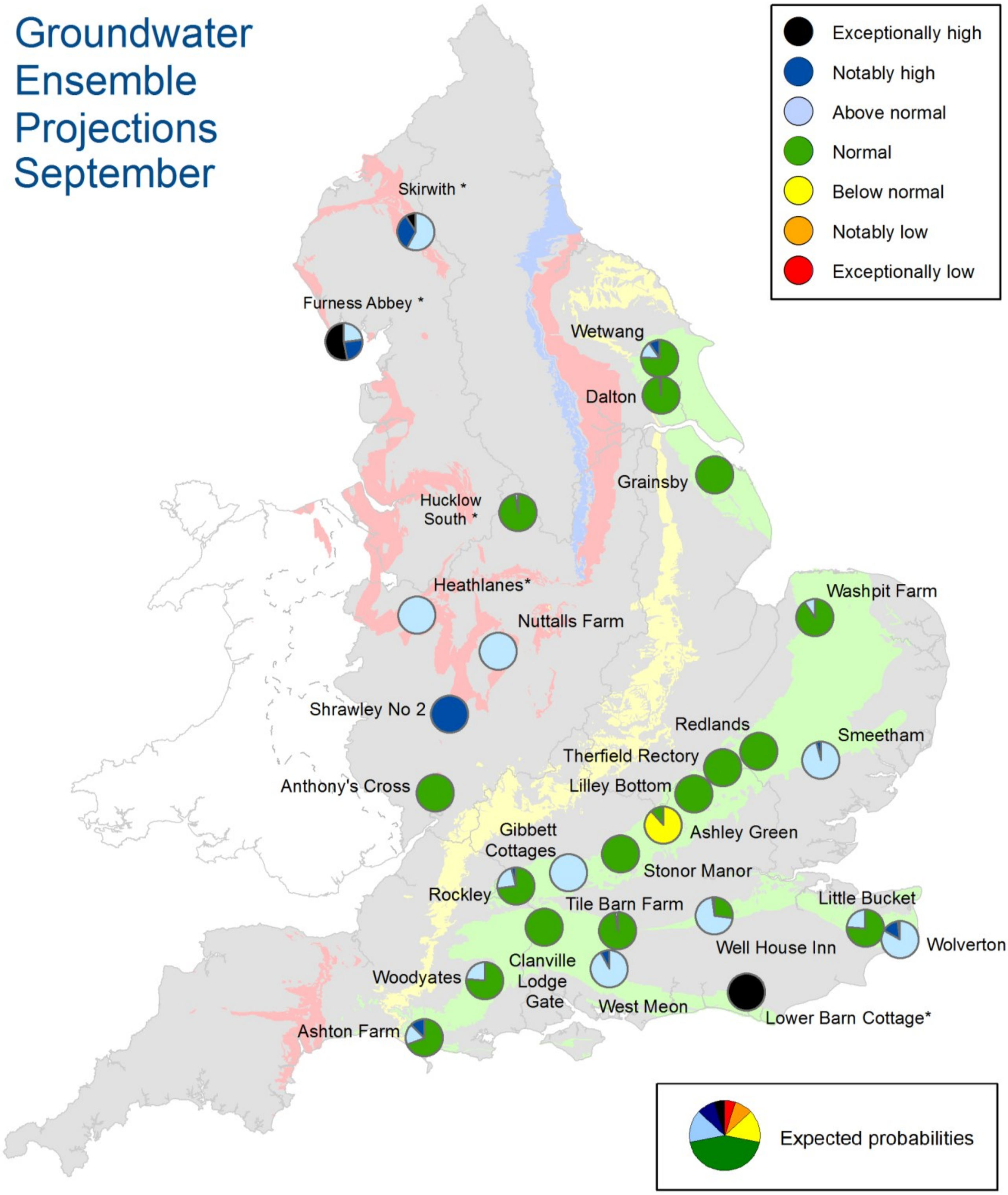


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2017. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between September 2016 and March 2017 (Source: Environment Agency) Geological map reproduced with kind permission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

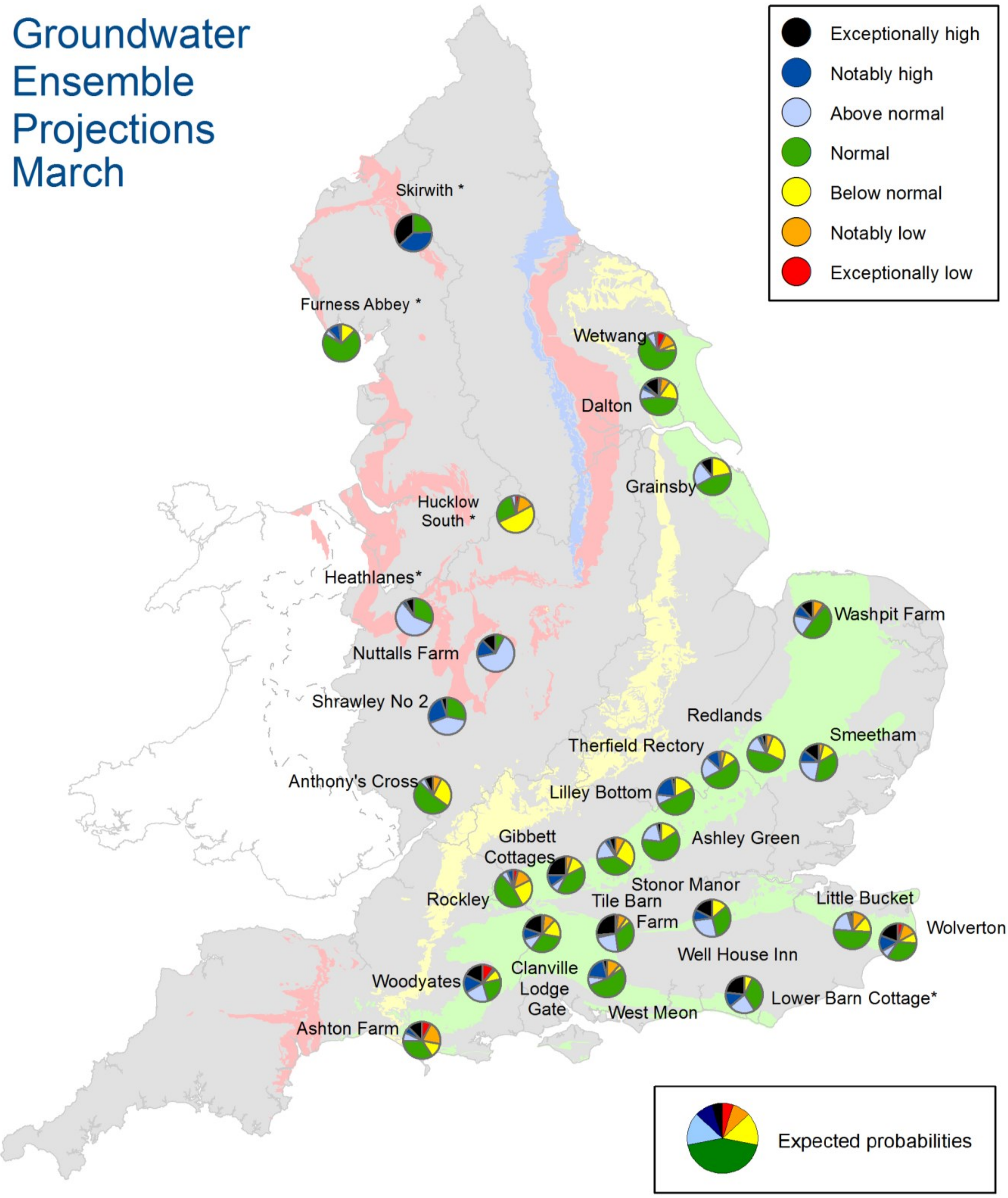
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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

Figure 6.7: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2016. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the time of year. (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

** Projections for these sites are produced by BGS*



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

Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2017. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the time of year. (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2016.

* Projections for these sites are produced by BGS

Figure 7.1: Geographic regions

Glossary

Term	Definition
Aquifer	A geological formation able to store and transmit water.
Areal average rainfall	The estimated average depth of rainfall over a defined area. Expressed in depth of water (mm).
Artesian	The condition where the groundwater level is above ground surface but is prevented from rising to this level by an overlying continuous low permeability layer, such as clay.
Artesian borehole	Borehole where the level of groundwater is above the top of the borehole and groundwater flows out of the borehole when unsealed.
Cumecs	Cubic metres per second (m^3s^{-1})
Effective rainfall	The rainfall available to percolate into the soil or produce river flow. Expressed in depth of water (mm).
Flood Alert/Flood Warning	Three levels of warnings may be issued by the Environment Agency. Flood Alerts indicate flooding is possible. Flood Warnings indicate flooding is expected. Severe Flood Warnings indicate severe flooding.
Groundwater	The water found in an aquifer.
Long term average (LTA)	The arithmetic mean calculated from the historic record, usually based on the period 1961-1990. However, the period used may vary by parameter being reported on (see figure captions for details).
mAOD	Metres Above Ordnance Datum (mean sea level at Newlyn Cornwall).
MORECS	Met Office Rainfall and Evaporation Calculation System. Met Office service providing real time calculation of evapotranspiration, soil moisture deficit and effective rainfall on a 40 x 40 km grid.
Naturalised flow	River flow with the impacts of artificial influences removed. Artificial influences may include abstractions, discharges, transfers, augmentation and impoundments.
NCIC	National Climate Information Centre. NCIC area monthly rainfall totals are derived using the Met Office 5 km gridded dataset, which uses rain gauge observations.
Recharge	The process of increasing the water stored in the saturated zone of an aquifer. Expressed in depth of water (mm).
Reservoir gross capacity	The total capacity of a reservoir.
Reservoir live capacity	The capacity of the reservoir that is normally usable for storage to meet established reservoir operating requirements. This excludes any capacity not available for use (e.g. storage held back for emergency services, operating agreements or physical restrictions). May also be referred to as ‘net’ or ‘deployable’ capacity.
Soil moisture deficit (SMD)	The difference between the amount of water actually in the soil and the amount of water the soil can hold. Expressed in depth of water (mm).

Categories

Exceptionally high	Value likely to fall within this band 5% of the time
Notably high	Value likely to fall within this band 8% of the time
Above normal	Value likely to fall within this band 15% of the time
Normal	Value likely to fall within this band 44% of the time
Below normal	Value likely to fall within this band 15% of the time
Notably low	Value likely to fall within this band 8% of the time
Exceptionally low	Value likely to fall within this band 5% of the time