Monthly water situation report

England

Summary – August 2015

August rainfall totals were well above average across England for a second consecutive month at 140% of the long term average (LTA). Soil moisture deficits decreased by up to 75mm across most of England during the month, particularly across parts of north Devon and the south coast between Dorset and East Sussex. Monthly mean river flows increased compared to July at three quarters of indicator sites and remained **normal** or higher for the time of year at the majority of sites. Groundwater levels continued to decrease during the month at all but one indicator site. End of month groundwater levels remain **normal** or higher at half of the indicator sites. Reservoir stocks decreased at all but five reported reservoirs and reservoir groups during August, but remain **normal** or higher for the time of year at most sites. Overall stocks for England decreased to 80% of total capacity.

Rainfall

August rainfall totals ranged from 180 to 220mm across parts of Devon and Cornwall to around 50 to 55mm across parts of Lincolnshire, Bedfordshire and Oxfordshire. August rainfall totals were above the long term average (LTA) in almost all hydrological areas, with many of those covering south-east and south-west England receiving more than 200% of the LTA. Parts of the south coast between Dorset and East Sussex and the far west of Cornwall received between 250 and 280% of the August LTA (Figure 1.1).

August rainfall totals were **normal** or **above normal** for the time of year across the majority of England. Totals across southern and south-west England were **notably high** or **exceptionally high**. Over the 3, 6 and 12 month periods ending in August, cumulative rainfall totals were broadly **normal** for the time of year across most of England (Figure 1.2).

At a regional scale, August rainfall totals ranged from 108% of the LTA in north-west England to 192% in south-west England. Totals were classed as **notably high** for the time of year in south-west England, **above normal** in south-east England and **normal** elsewhere. Across England as a whole, rainfall was **above normal** for the time of year at 140% of the August LTA (Figure 1.3).

August rainfall totals were the 2nd or 3rd wettest on record in the hydrological areas covering west Cornwall, south Devon and the south coast area between Purbeck and West Sussex; in most of these hydrological areas, it was the wettest August since 1912 or 1917. In west Cornwall, the two month (July and August) rainfall total was the 2nd wettest on record with the wettest period occurring in 1912. In south-west England, the August rainfall total was the 7th wettest on record and the wettest since 1997; the two month (July and August) rainfall total was the 9th wettest on record and the wettest since 2012.

Soil moisture deficit

Soil moisture deficits (SMDs) decreased across most of England during August, in response to the above average rainfall. The largest decreases of 60 to 75mm occurred across parts of north Devon and the south coast between Dorset and East Sussex. SMDs increased by up to 20mm across parts of the far north-west, north-east and east of England. At the end of August, SMDs were smallest across south-west and much of north-west England at less than 10mm and largest across parts of Yorkshire, Lincolnshire, Norfolk and Cambridgeshire at 100 to 135mm. At the end of August, soils were much wetter than average across much of England, particularly south and south-west England. In contrast, soils were drier than average in parts of north-east and east England, particularly across North Yorkshire and Lincolnshire (Figure 2.1).

At a regional scale, SMDs increased slightly during August in east England, but decreased elsewhere by up to 35mm. At the end of August, regional SMDs were smaller than the LTA in all regions (Figure 2.2).

River flows

August monthly mean river flows increased compared to July at three quarters of indicator sites across England. However, August flows decreased compared to July at all but one indicator site in central England, half the sites in east England and three sites in the south-east. Monthly mean flows were classed as **normal** or **above normal**

for the time of year at most sites, with the Western Rother and Great Stour rivers in south-east England being **notably high**. Flows on the River Coln from the Jurassic limestone aquifer in the Cotswolds remained **notably low** for the time of year, with a further three sites being **below normal** (Figure 3.1). Monthly mean river flows were classed as **normal** or higher for the time of year at 6 of the 7 regional index sites; the River Dove in central England remained **below normal** for the time of year for a second consecutive month (Figure 3.2).

Groundwater levels

The above average rainfall in August (most of which fell in the latter half of the month) helped to slow the rate of decline in groundwater levels but has yet to reverse the seasonal trend at any indicator sites. At the end of August, the class of the groundwater level at each site remained unchanged from the previous month at all but one site, with just over half classed as **normal** or higher for the time of year. Levels at 10 sites across north-east, east, south-east and south-west England were **below normal** for the time of year, whilst the levels at Jackaments Bottom (in the Burford Jurassic limestone aquifer) and Tilshead (in the upper Hampshire Avon chalk aquifer) remained **notably low** for the time of year.

End of month groundwater levels at the major aquifer index sites remained **normal** for the time of year at 4 of the 8 sites, with Stonor Park (in the south west Chilterns chalk), Chilgrove (in the Chichester chalk aquifer) and Dalton Holme (in the Hull and East Riding chalk aquifer) remaining **below normal** for the time of year. Jackaments Bottom remained **notably low** for the time of year (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks decreased at all but five reported reservoirs and reservoir groups during August. The largest decreases occurred at Derwent Valley reservoir (-13%) in central England, Clatworthy reservoir (-11%) in south-west England and Ardingly reservoir (-10%) in south-east England. The largest increase in stocks of 6% occurred at the Lower Lee reservoir group in south-east England. End of month stocks were classed as **normal** or higher for the time of year at all but four reported reservoirs and reservoir groups. Draycote and Carsington & Ogston reservoirs and the Dove reservoir group in central England together with Hanningfield reservoir in east England were **below normal** or lower for the time of year (Figure 5.1).

Regional-scale reservoir stocks decreased by between 2 and 5% across all regions except the north-west which remained static. At the end of August, regional stocks ranged from 74% of total capacity in north-west England to 84% in east England. Overall reservoir storage for England decreased by 2% to 80% of total capacity (Figure 5.2).

Forward look

The remainder of September is expected to be unsettled with the heaviest and most persistent rain in west and south-west England. Longer term, for the period September-October-November as a whole, there is no strong signal for high or low precipitation, however there is a slightly increased chance of above average temperature[1].

Projections for river flows at key sites[2]

More than half of modelled sites have a greater than expected chance of **normal** or higher flows in September. By the end of March 2016, almost half of sites have a greater than expected chance of **normal** or higher cumulative flows.

For scenario based projections of cumulative river flows at key sites by September 2015 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2016 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2015 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2016 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

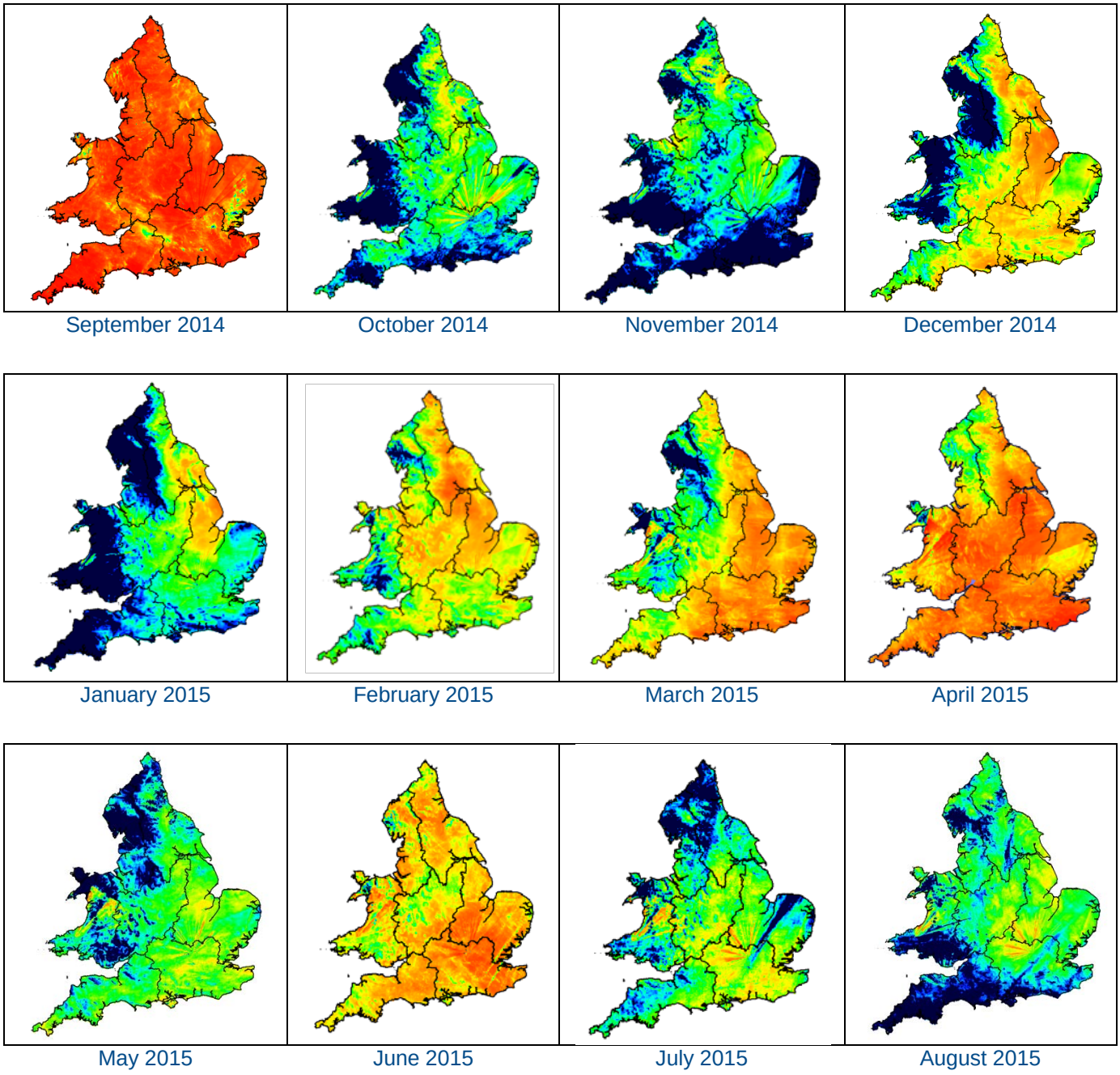
At the end of September, three quarters of modelled sites have a greater than expected chance of **normal** or higher groundwater levels for the time of year. By the end of March 2016 nearly two thirds of modelled sites have a greater than expected chance of **normal** or higher groundwater levels for the time of year.

For scenario based projections of groundwater levels in key aquifers in September 2015 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2016 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2015 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2016 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.

Rainfall



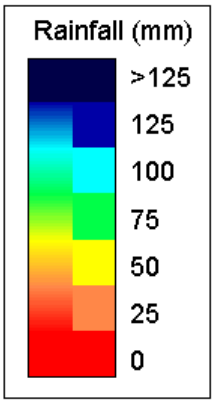


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2015). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

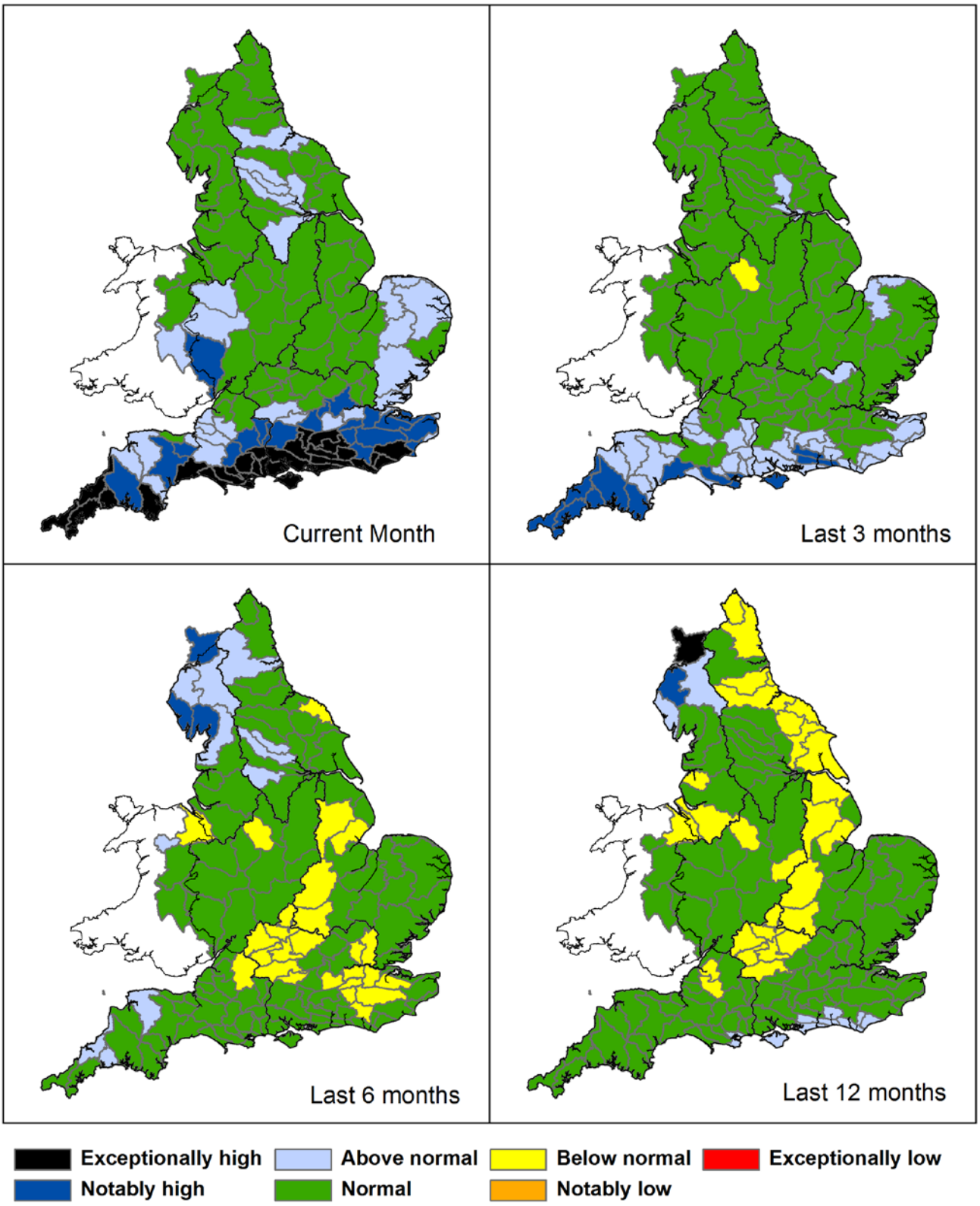


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 August), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2015).* Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

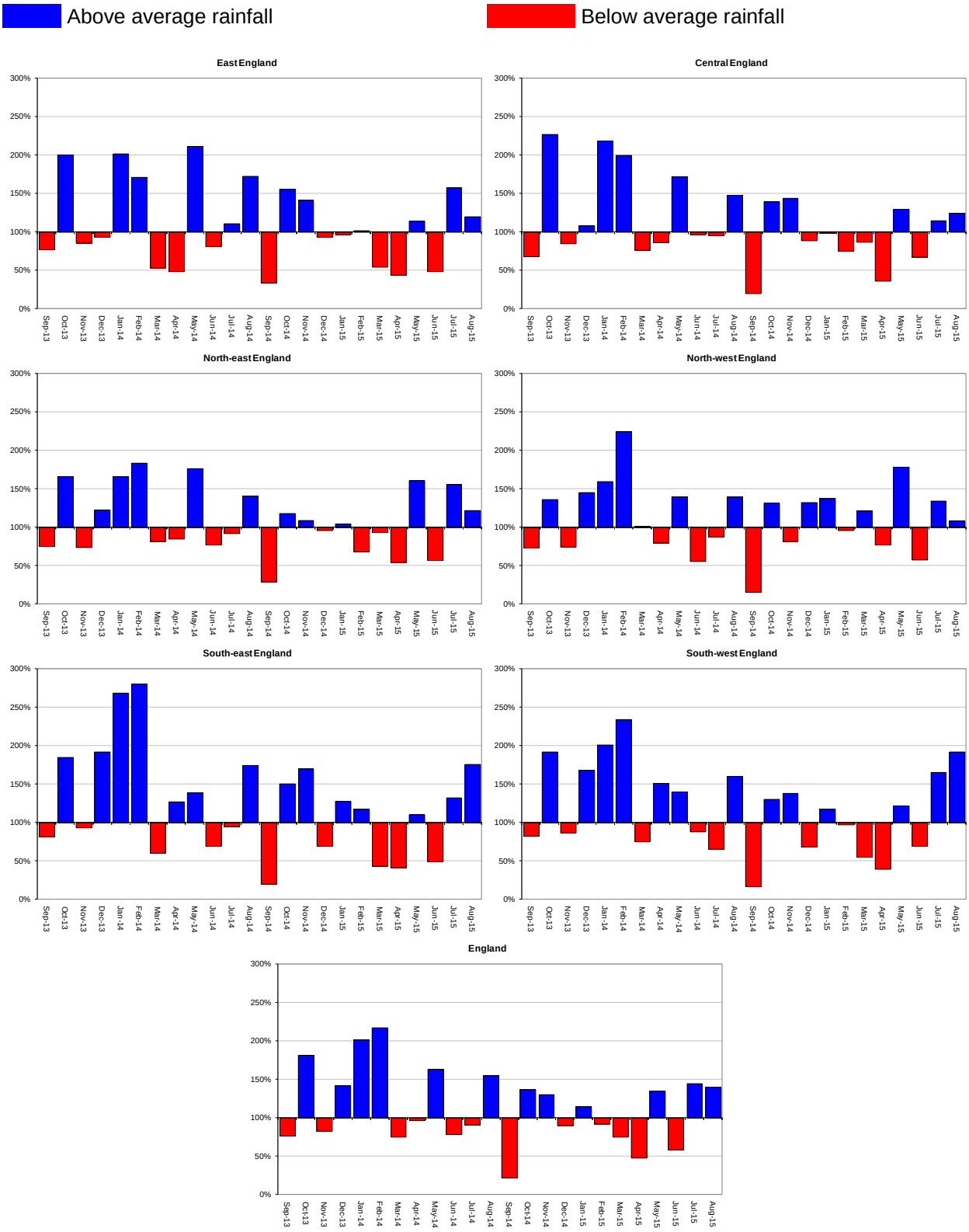


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2015).

Soil moisture deficit

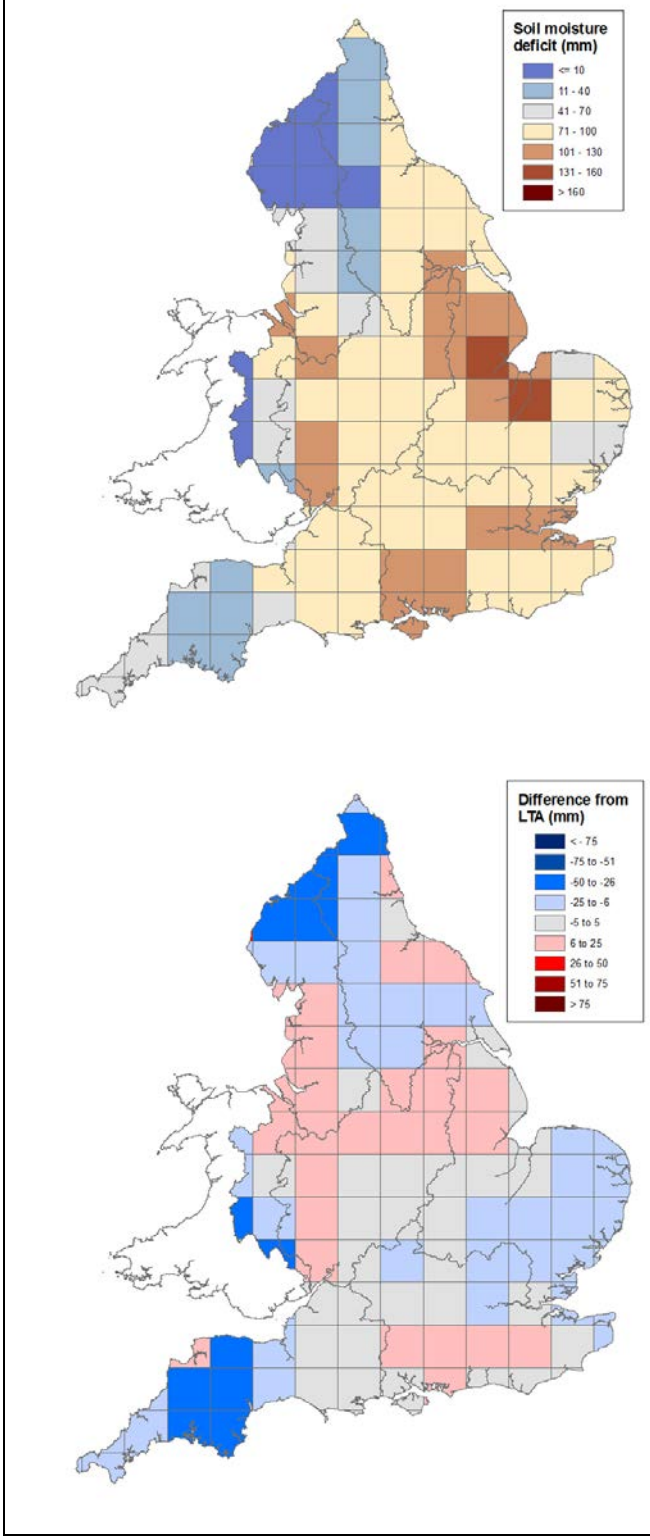
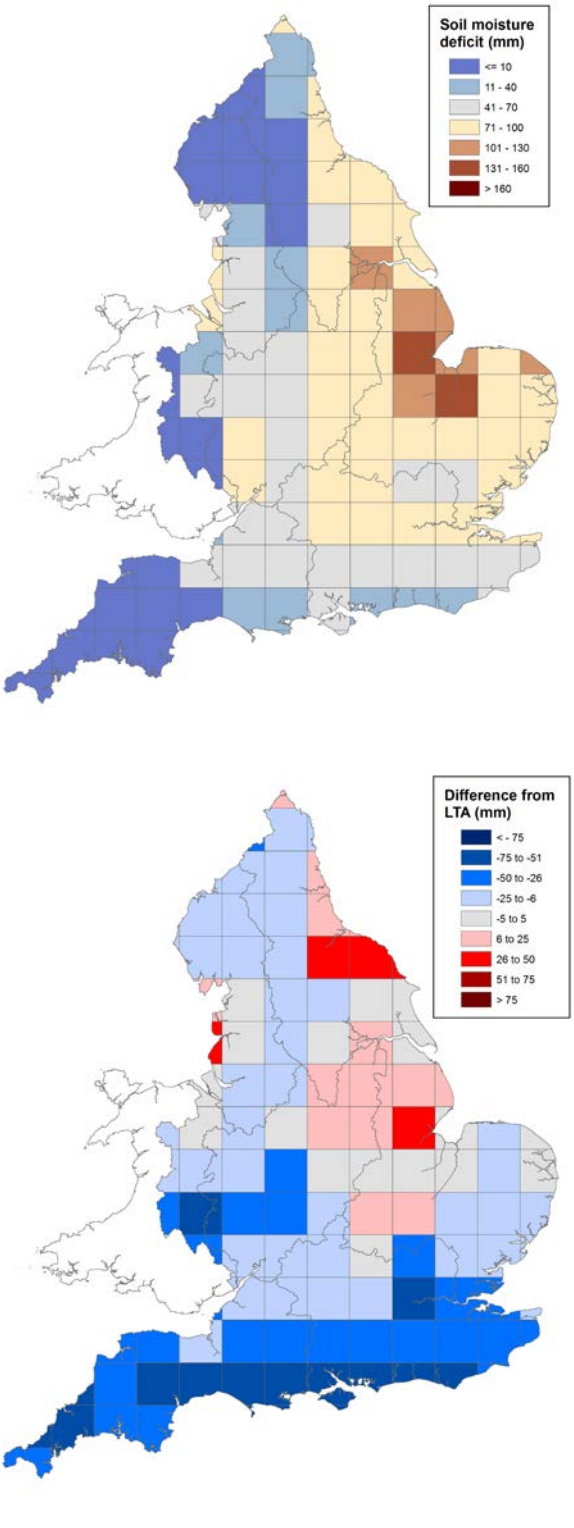
End of July 2015[1]	End of August 2015[2]
	

Figure 2.1: Soil moisture deficits for weeks ending 29 July 2015 [1] (left panel) and 1 September 2015 [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, 2014). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

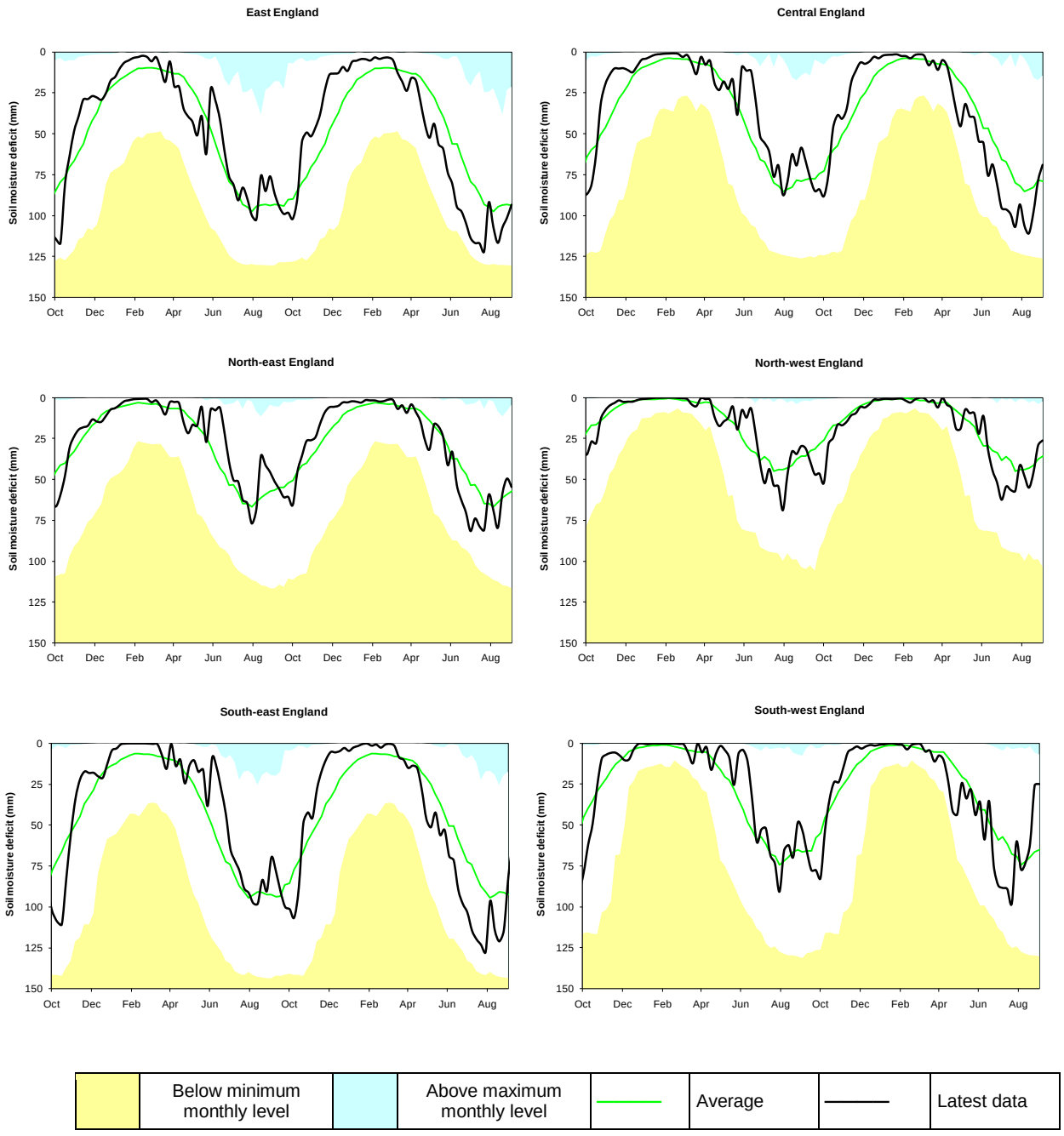
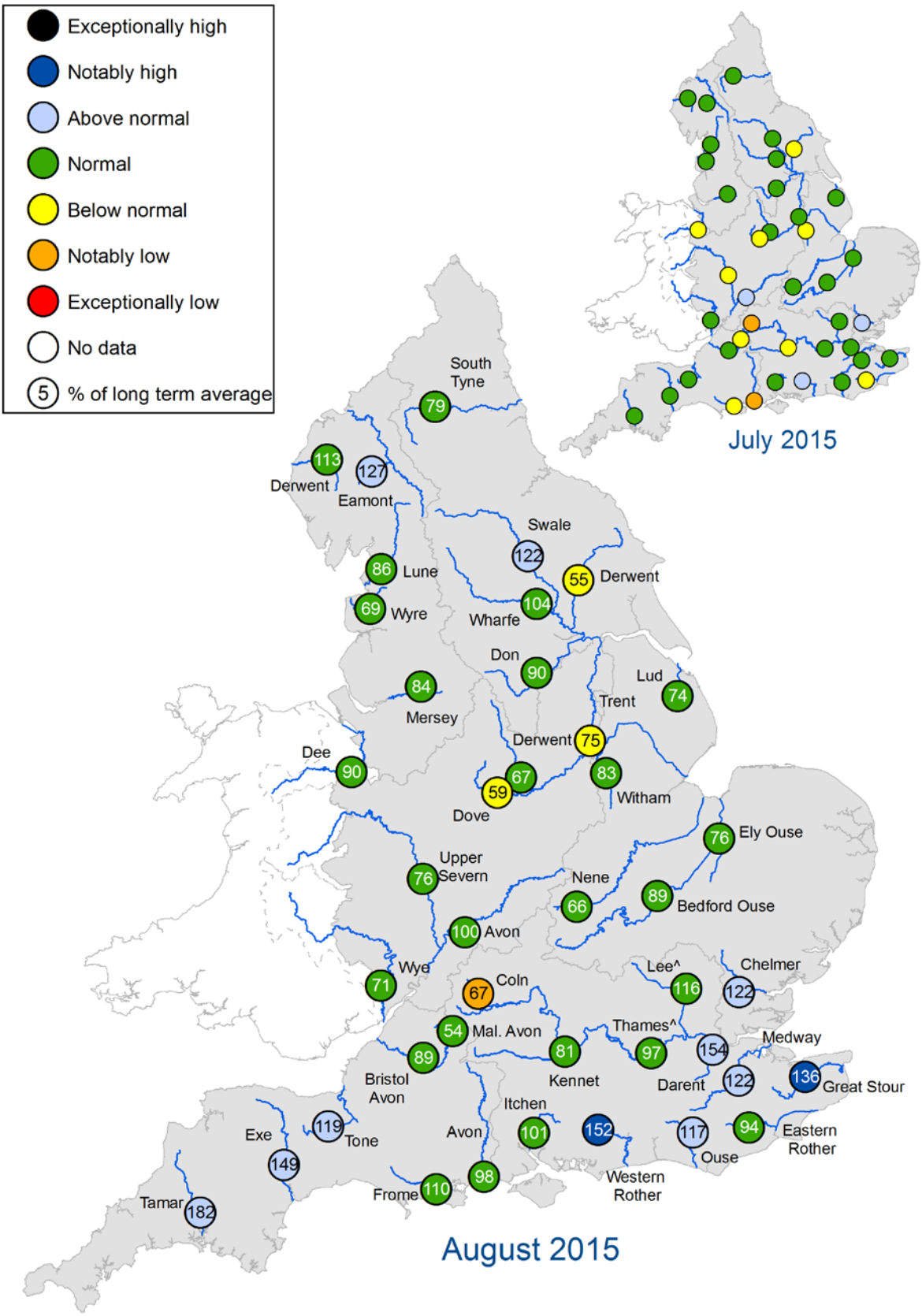


Figure 2.2: Latest soil moisture deficits for all regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2015).

River flows



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

\+ Monthly mean flow is the highest on record for the current month (note that record length varies between sites)

Underlined sites are regional index sites and are shown on the hydrographs in Figure 3.2

Figure 3.1: Monthly mean river flow for indicator sites for July 2015 and August 2015, 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). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

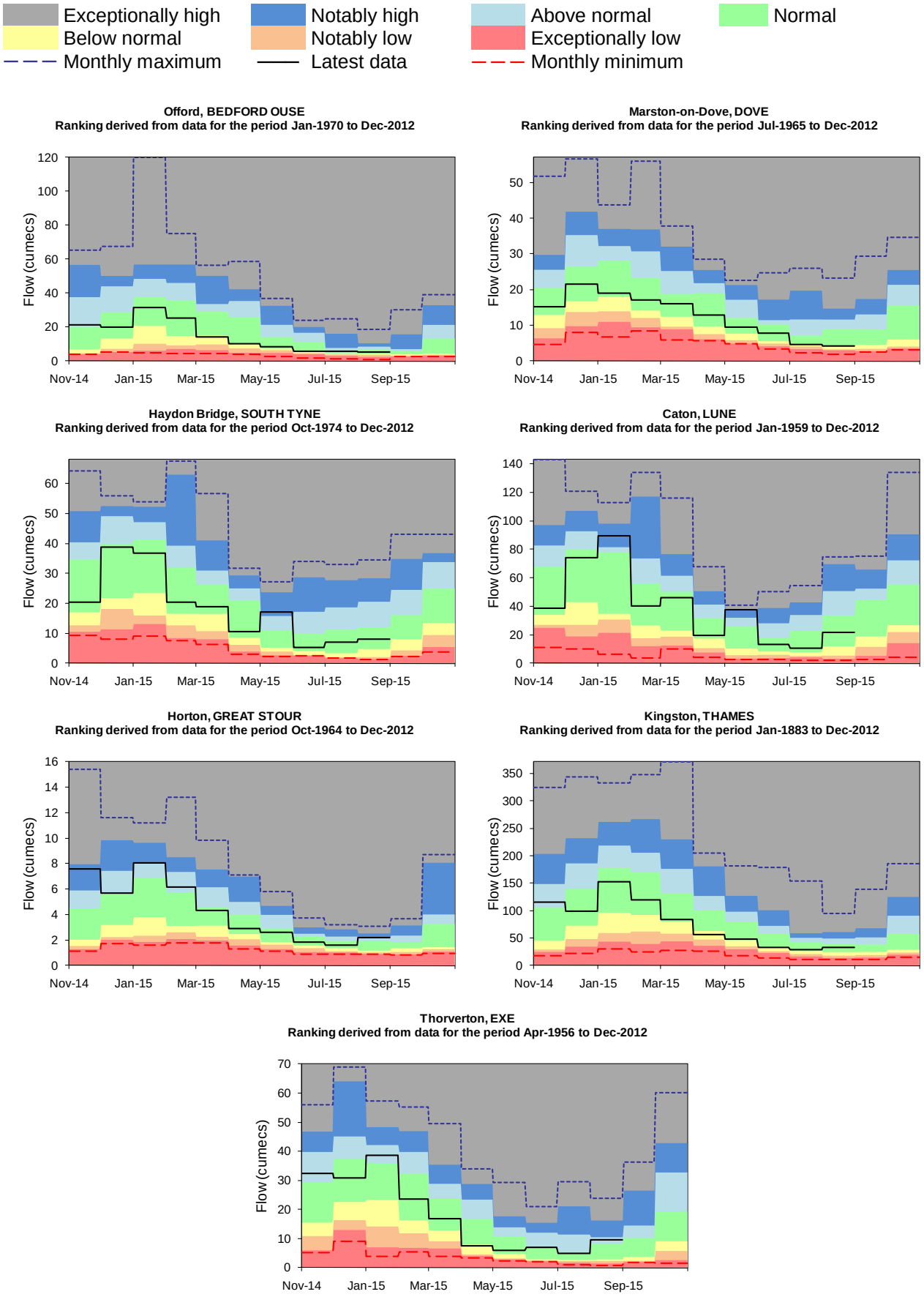
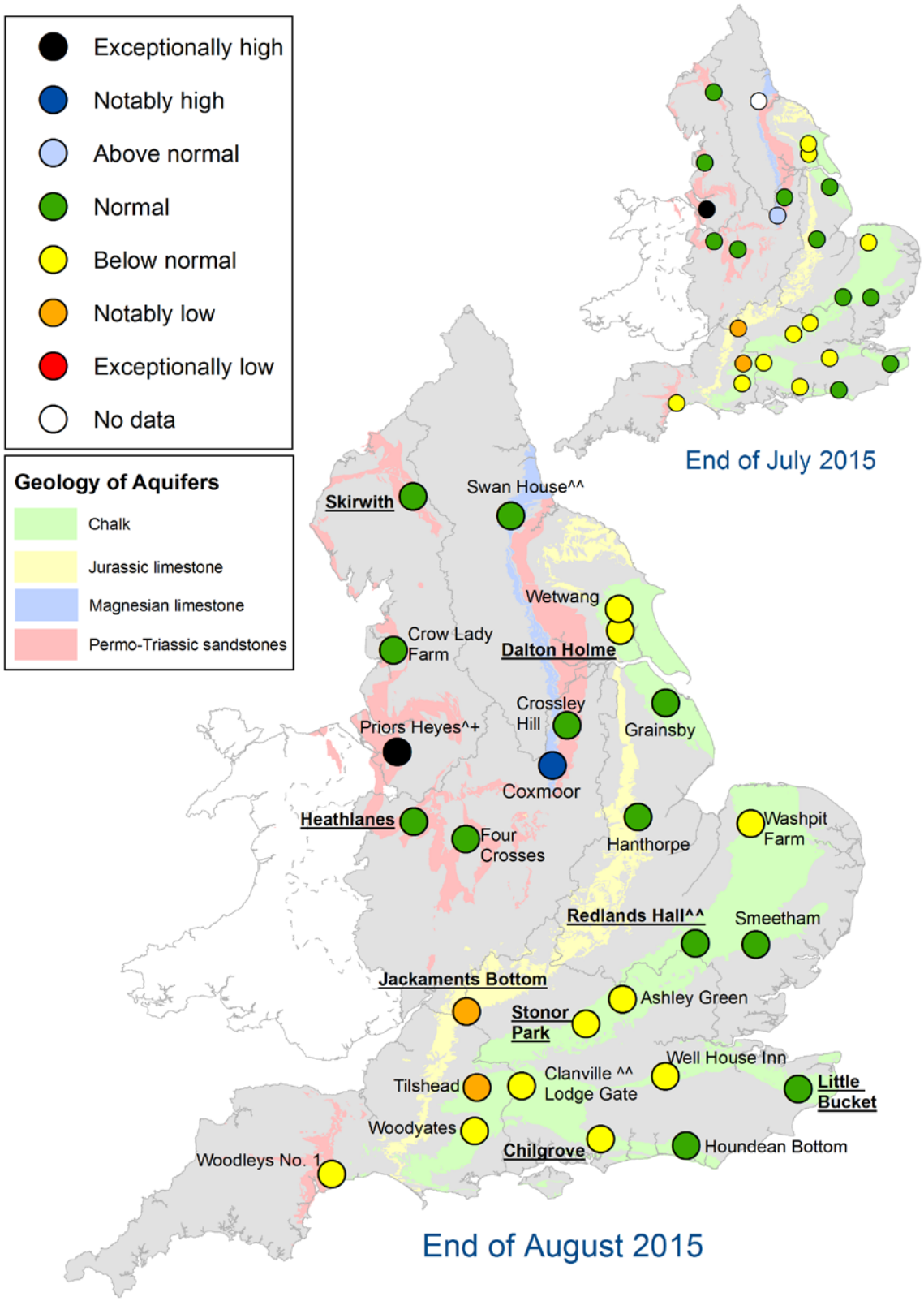


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
\+ End of month groundwater level is the highest on record for the current month (note that record length varies between sites).
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 2015 and August 2015, 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, 2015.

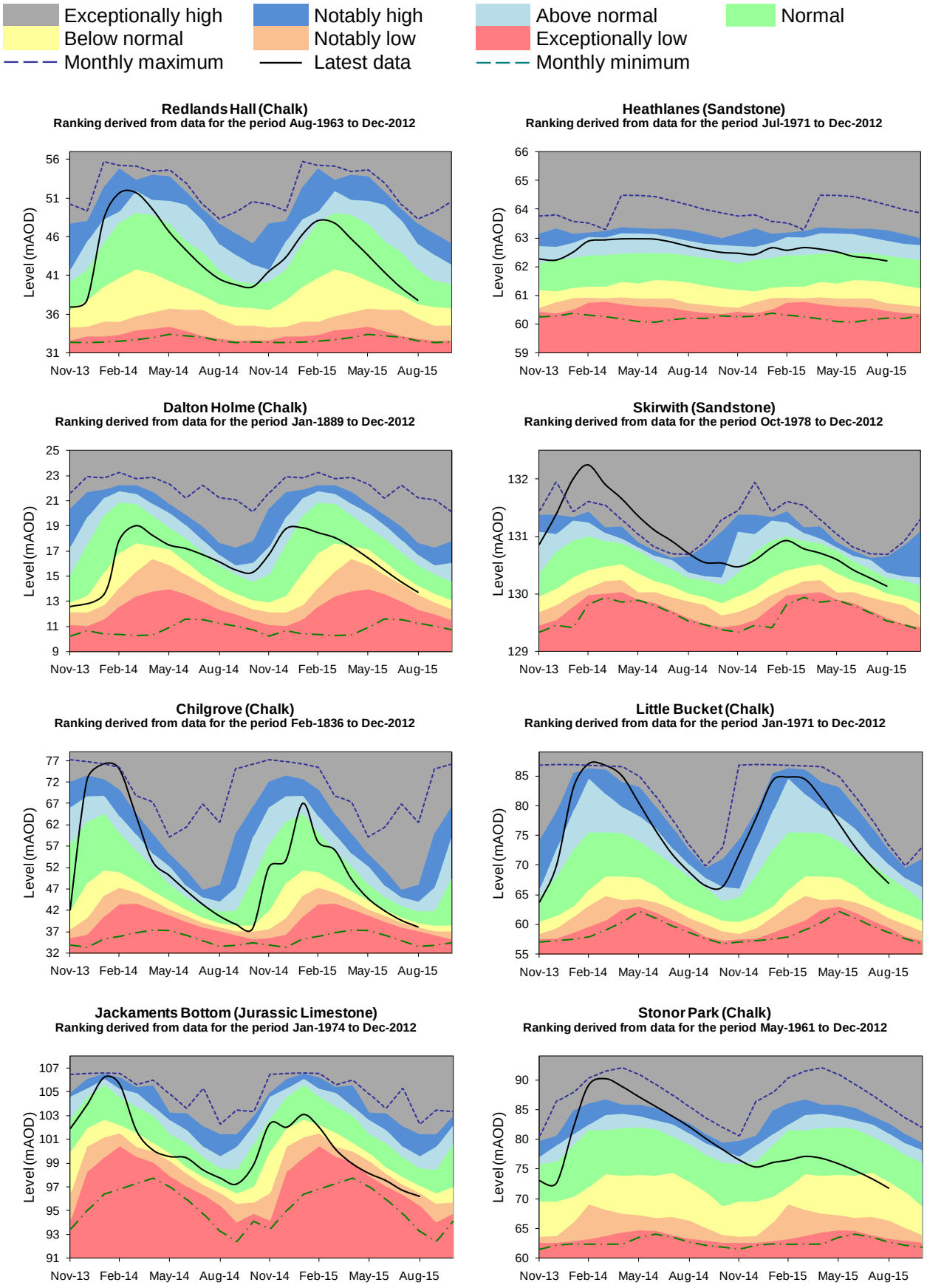
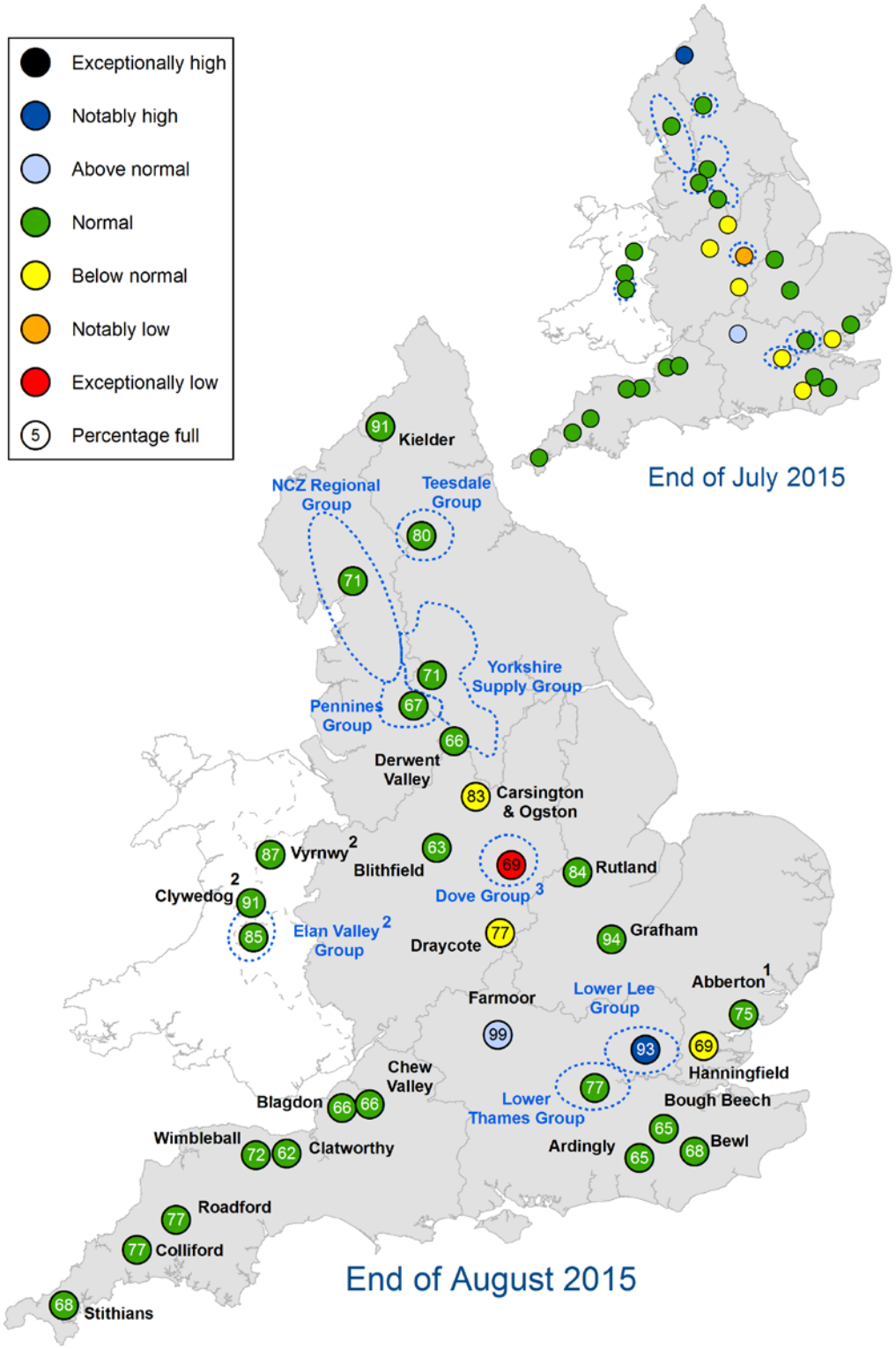


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2015).

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. Operational issues at the Dove reservoir group in central England have affected storage during August

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of July 2015 and August 2015 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.

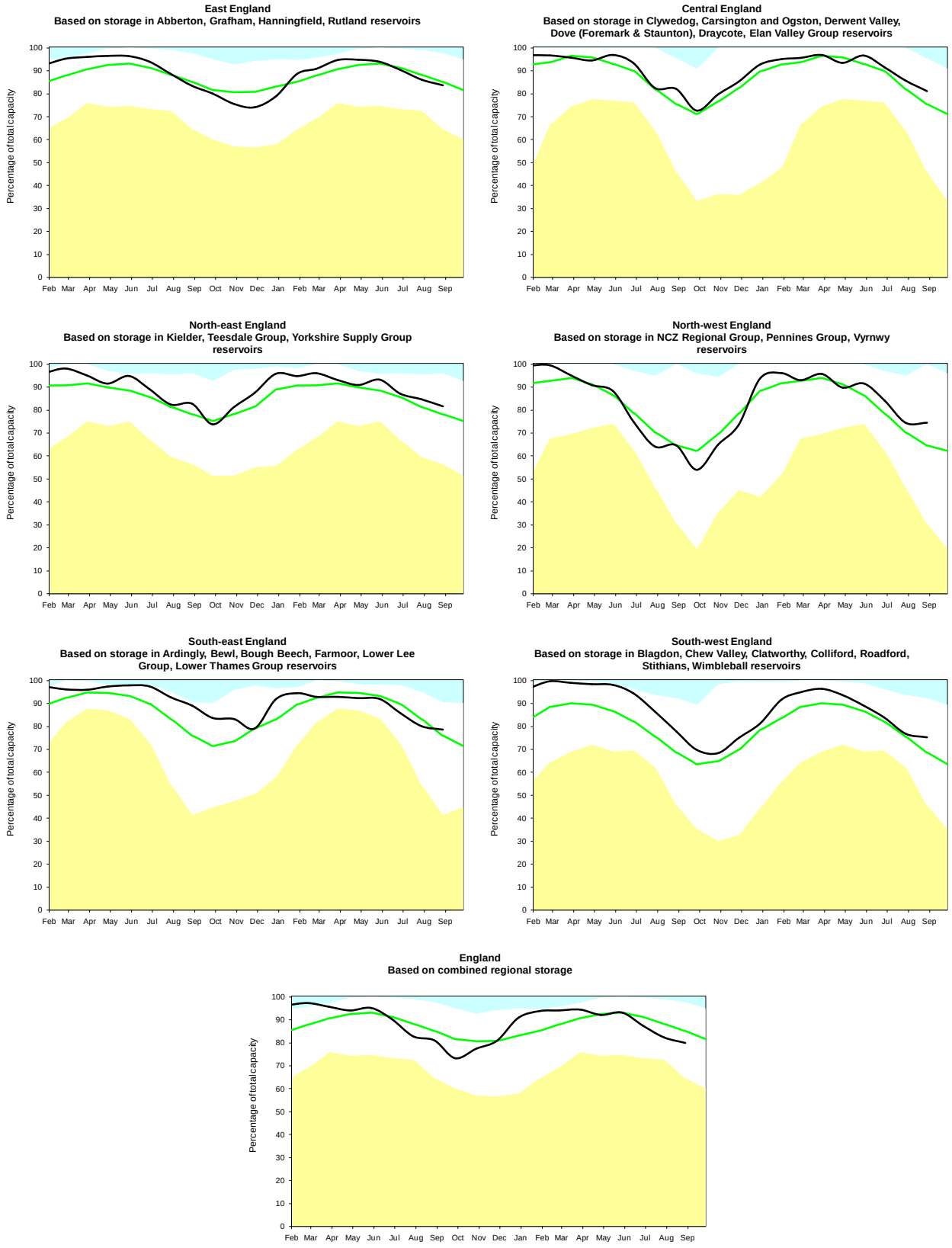


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

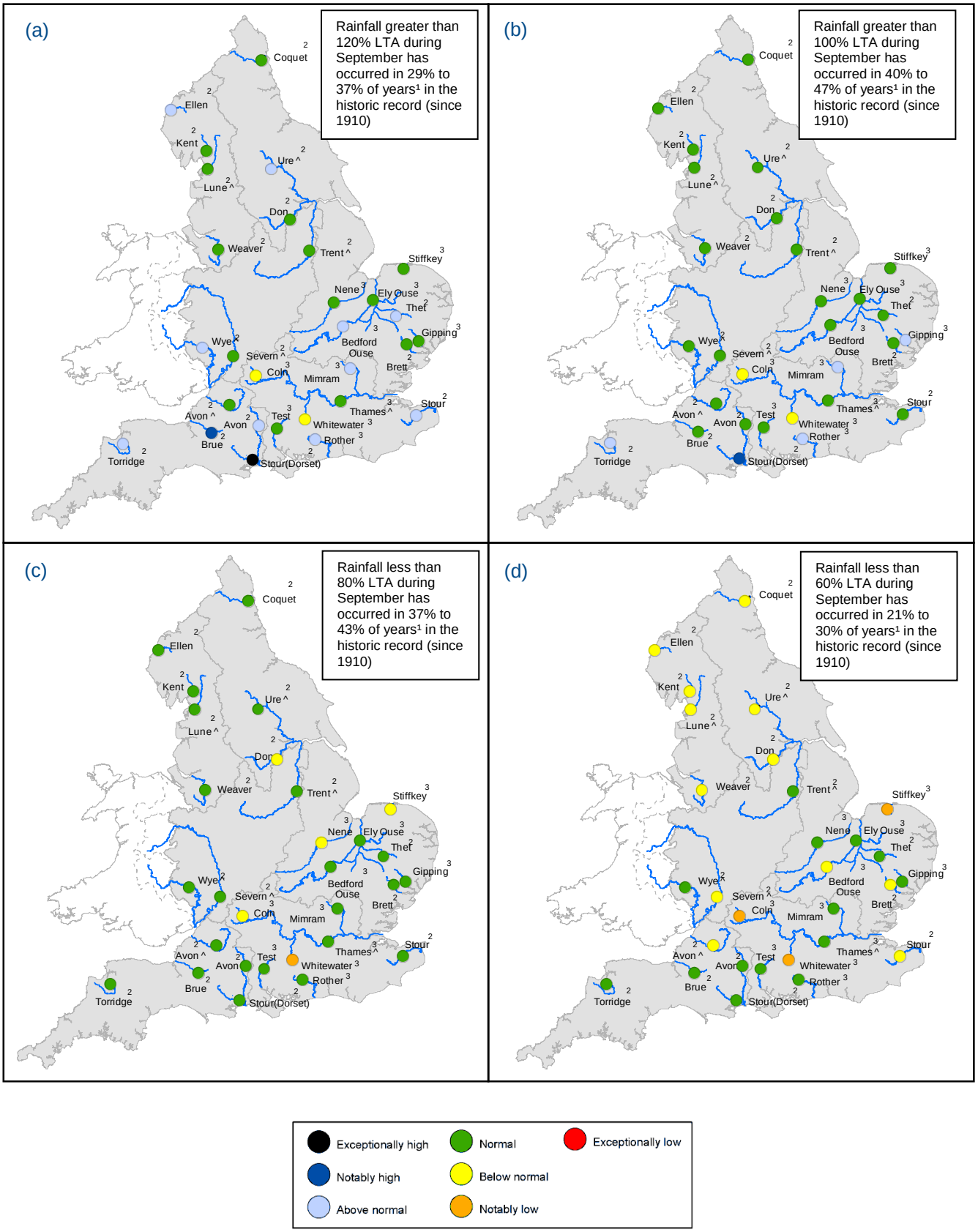


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall in September 2015 (Source: Centre for Ecology and Hydrology, Environment Agency)

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

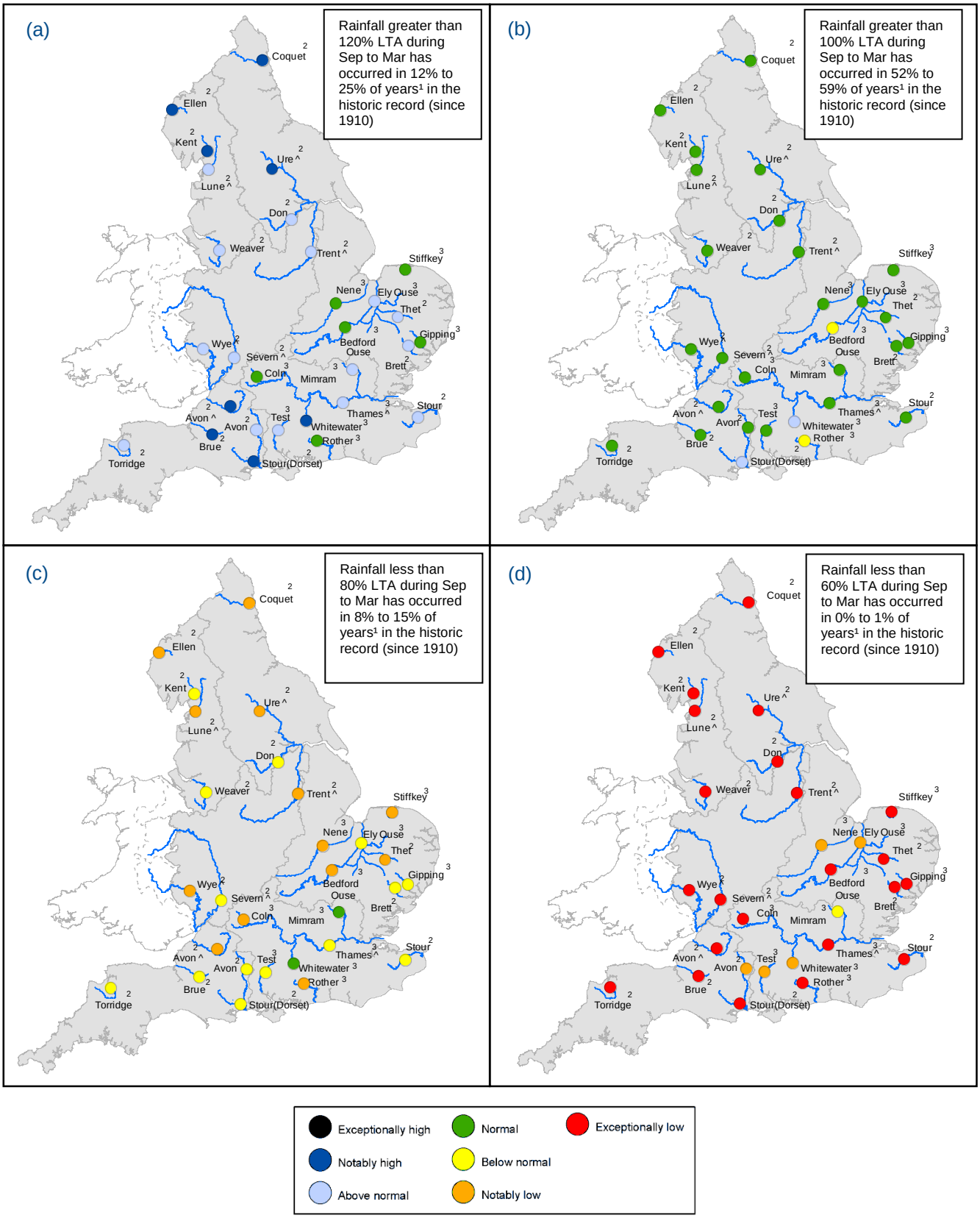


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between September 2015 and March 2016 (Source: Centre for Ecology and Hydrology, Environment Agency)

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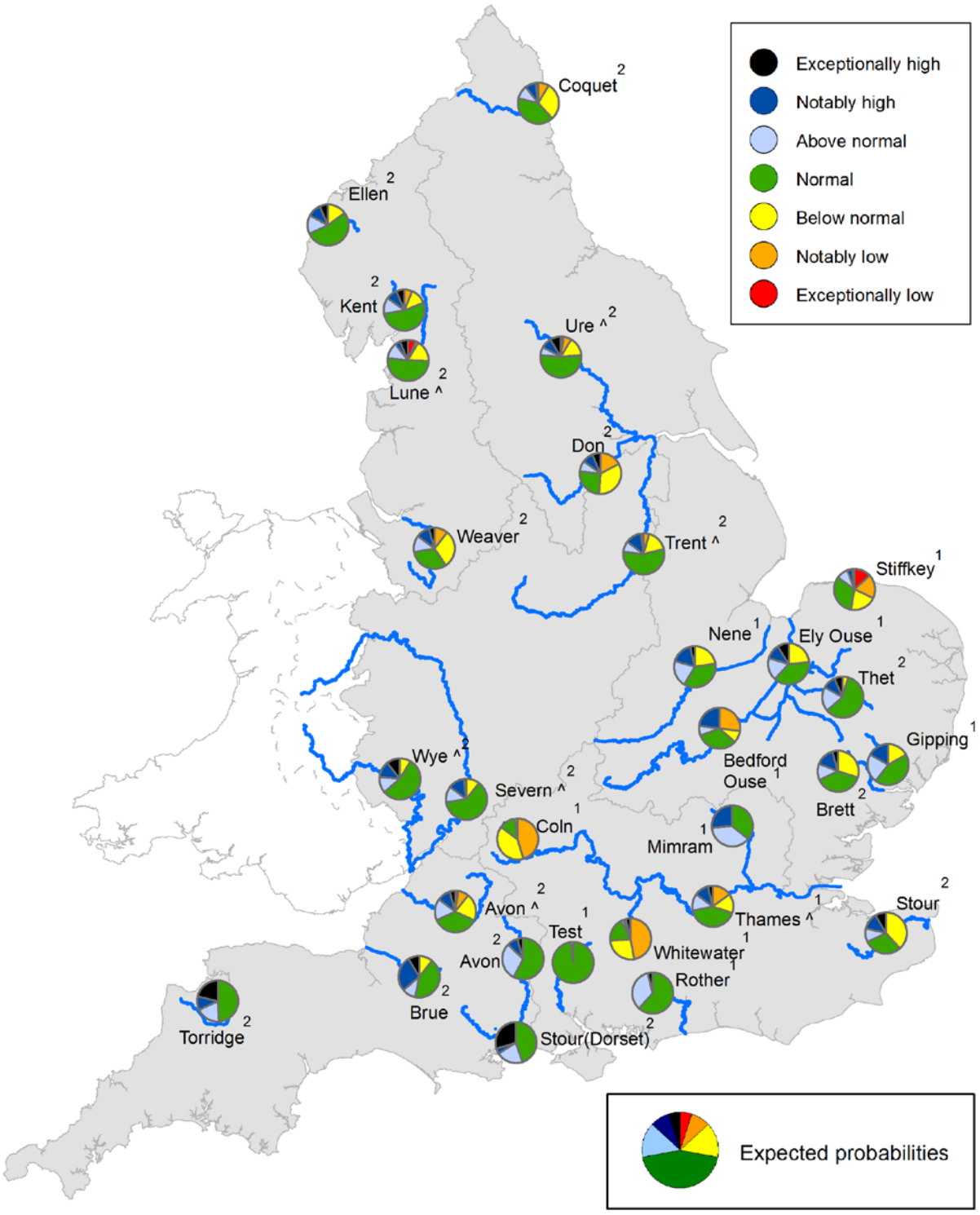

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2015. 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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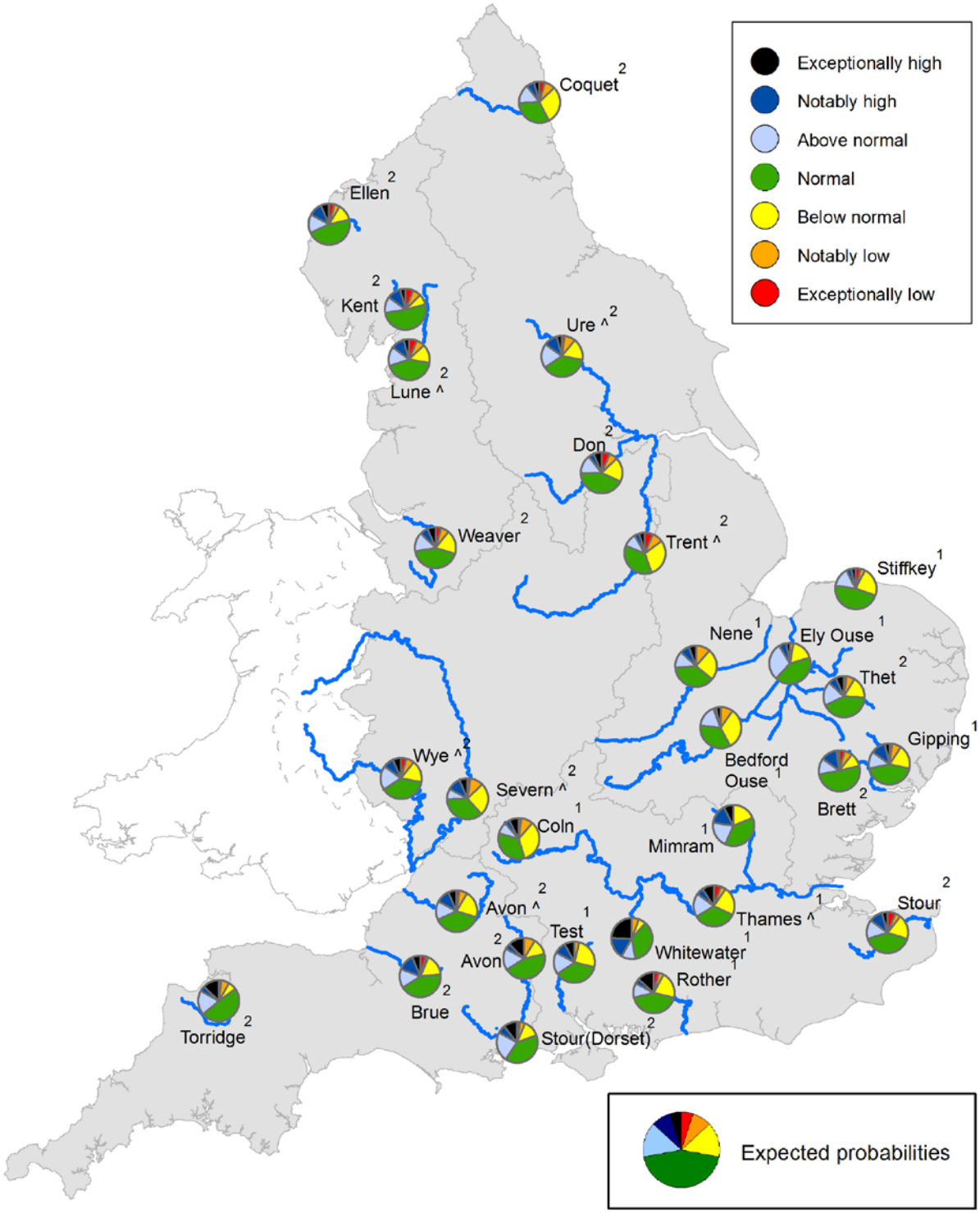


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

[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

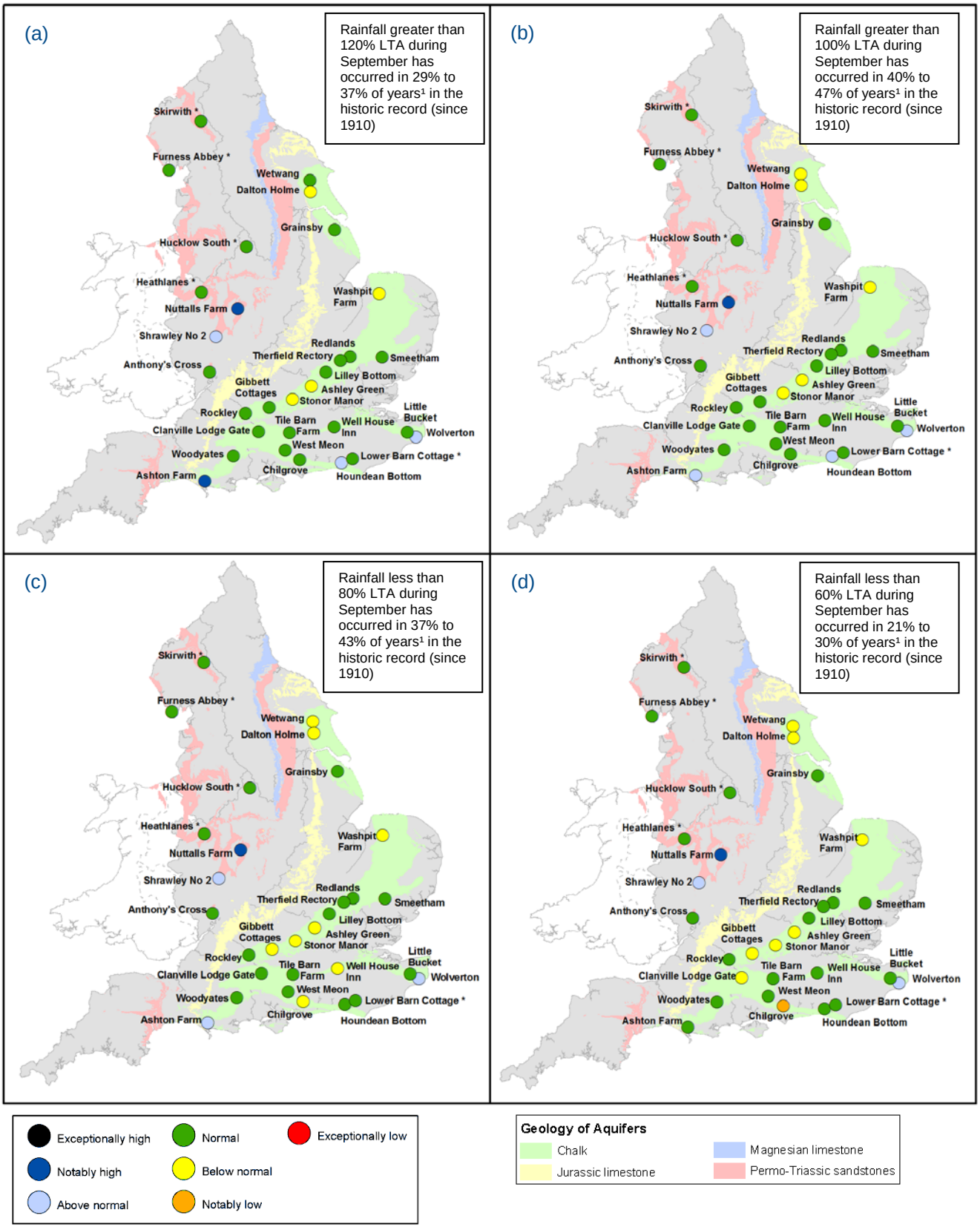


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2015. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall in September 2015 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2015.

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

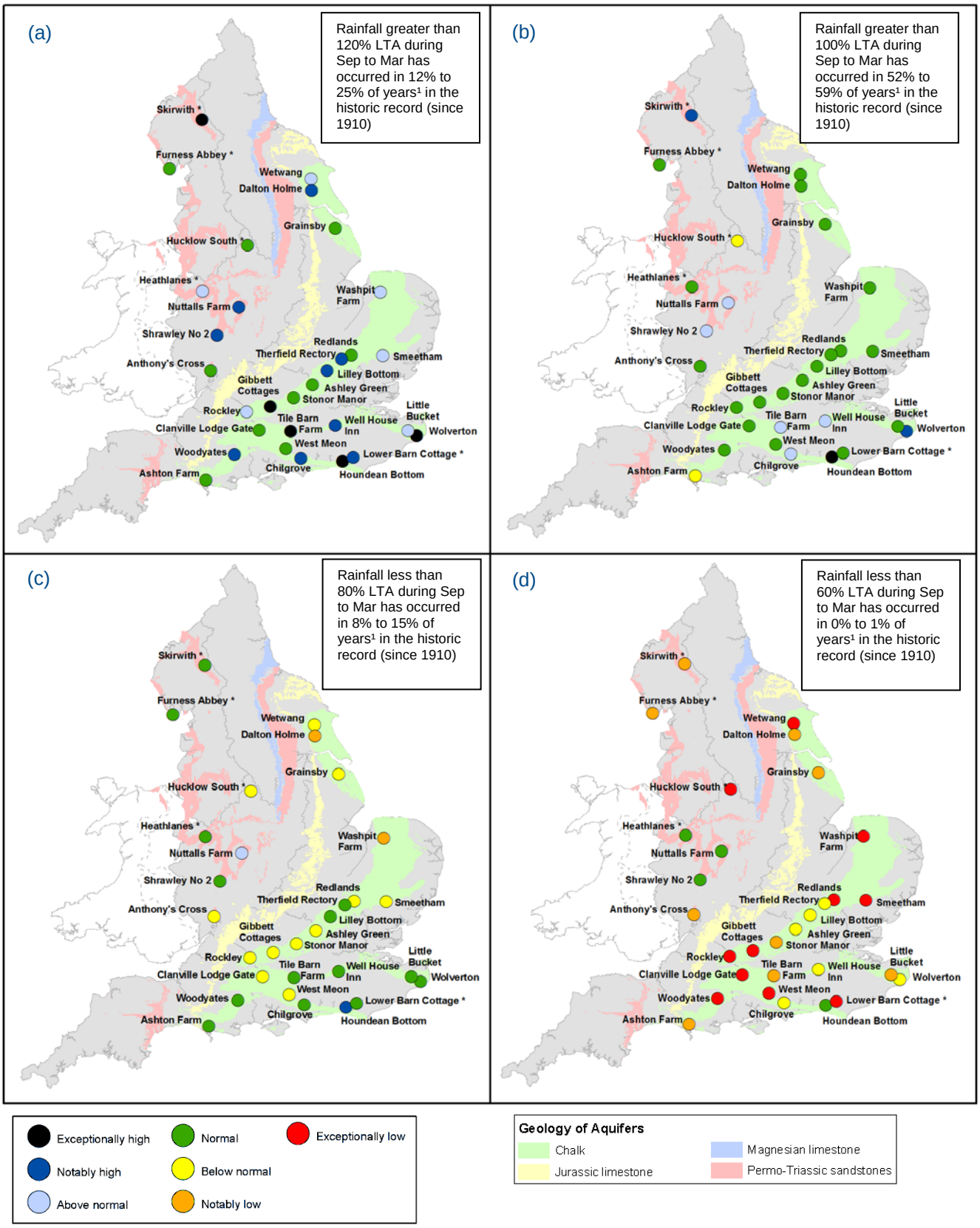
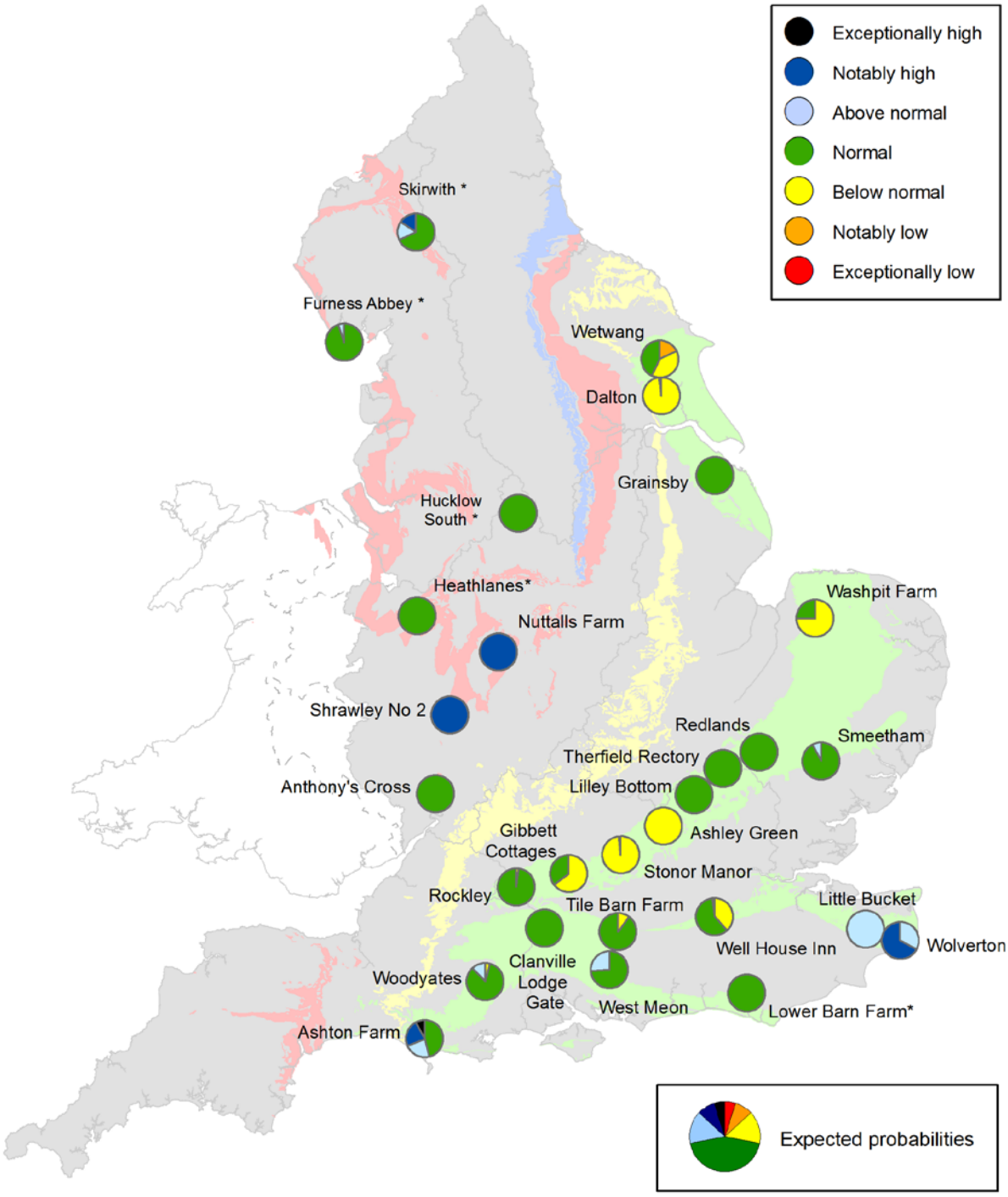


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between September 2015 and March 2016 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2015.

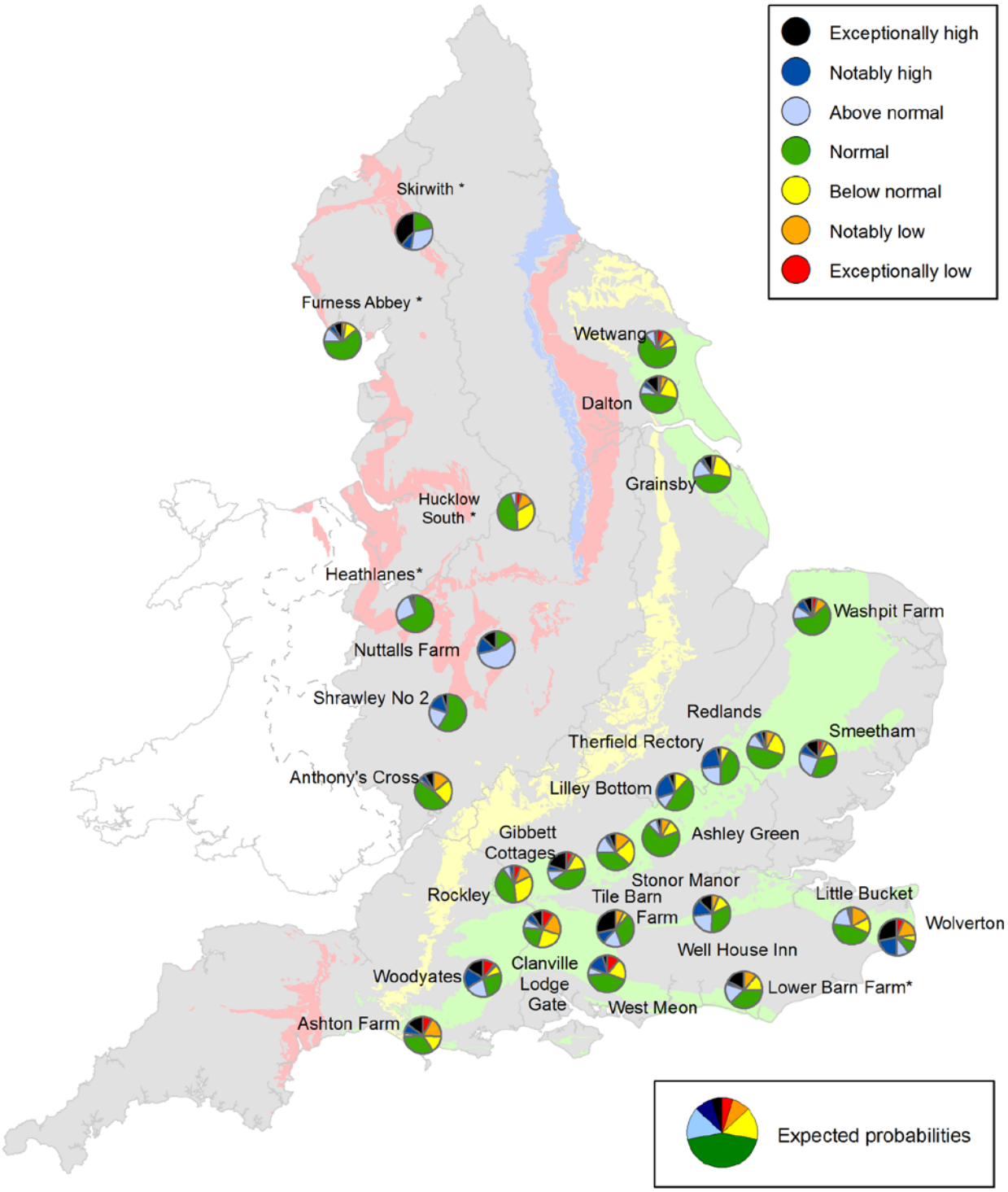
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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 2015. 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, 2015.

** 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 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, 2015.

* 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