Monthly water situation report

England

Summary – October 2015

For the second consecutive month, rainfall totals for October were below average across England at 82% of the long term average. Despite the below average rainfall, soil moisture deficits decreased by up to 65mm across all areas during the month. Monthly mean river flows decreased compared to September at just over half of the indicator sites; flows were classed as normal or higher for the time of year at just over half of sites, with the rest ranging from below normal to exceptionally low for the time of year. Groundwater levels decreased during the month at all but 5 indicator sites, with the majority ranging from normal to below normal for the time of year. Reservoir stocks decreased at all but one of the reported reservoirs and reservoir groups during October. Stocks remain normal or higher for the time of year at all sites in the south and east of England but are now below normal or lower at more than two-thirds of the sites supplying or located in central and northern England. Overall stocks for England decreased to 71% of total capacity.

Rainfall

Rainfall totals during October ranged from around 100mm across parts of south Devon, west Cumbria and West and South Yorkshire to around 30mm across parts of Suffolk and Essex. Monthly rainfall totals were below the October long term average (LTA) in just over three quarters of hydrological areas, with those covering parts of west Cumbria, west Somerset and the Welsh Marches receiving less than 50% of the LTA. In contrast, rainfall totals were above the LTA across most of north-east England and part of Lincolnshire at 120 to 140% of the October LTA (Figure 1.1).

October rainfall totals were normal for the time of year across much of England. However, totals were below normal across parts of south-west, north-west England and central England and notably low across parts of the catchments for the rivers Severn, Wye and Dee. Over the 3 month period ending in October, cumulative rainfall totals were normal across most of central, southern and eastern England; however, rainfall totals were below normal or notably low for the time of year across the north-west and the far north-east of England. Over the 6 and 12 month periods ending in October, rainfall totals were generally normal to below normal across England (Figure 1.2).

At the regional scale, October rainfall totals were below normal in all but the north-east of England, ranging from 61% of the LTA in north-west England to 110% in north-east England. Totals were below normal for the time of year in north-west, central and south-west England and normal elsewhere. Rainfall totals across England as a whole were below normal for the time of year at 82% of the October LTA (Figure 1.3).

Soil moisture deficit

Despite the below average rainfall across most of England, soil moisture deficits (SMDs) decreased by up to 65mm during October across all areas. The largest decreases occurred across parts of Yorkshire where rainfall totals were above average. At the end of October, SMDs were at, or close to, zero across much of north-west and south-west England; in contrast, soils were much drier along the Humber estuary, and in Lincolnshire, Nottinghamshire and Norfolk, with SMDs of between 70 and 120mm (Figure 2.1).

End of month SMDs were close to, or smaller than, the LTA particularly across most of southern and northern England; soils were notably wetter than average along the south coast and across parts of North Yorkshire, Greater London and the east Kent coast. By contrast, soils were drier than average across parts of central and east England, particularly in Lincolnshire (Figure 2.1).

At a regional scale, SMDs decreased during October across all regions and at the end of month, ranged from 10mm in south-west England to 67mm in east England. At the end of October, soils were drier than average across north-west, central and east England and wetter than average across north-east, south-east and south-west England (Figure 2.2).

River flows

Monthly mean river flows for October decreased compared to September at just over half of the indicator sites across England, most of which were in east and south-east England. Monthly mean flows were classed as normal for the time of year at just over half of the indicator sites, with the groundwater-fed River Itchen in south-east England remaining above normal. Flows at the remaining sites were classed as below normal or notably low, with flows at the indicator sites on the rivers Tyne, Derwent (in north-west England), Dee and Upper Severn being classed as exceptionally low for the time of year (Figure 3.1).

Monthly mean river flows were classed as normal for the time of year at 3 of the 7 regional index sites (all in east and south-east England). The River Dove in central England was classed as below normal for the fourth consecutive month**,** whilst the rivers Exe and Lune in south-west and north-west England respectively were classed as notably low. The South Tyne in north-east England was classed as exceptionally low for the time of year (Figure 3.2).

Groundwater levels

Groundwater levels continued to decline during October at all but 5 indicator sites. At the end of October, groundwater levels were classed as normal or higher for the time of year at just over half of the sites, with a further third of sites classed as below normal. The levels at Dalton Holme (in the Hull & East Riding chalk aquifer) and Tilshead (in the upper Hampshire Avon chalk aquifer) were classed as 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 Jackaments Bottom (in the Burford Jurassic limestone aquifer) being below normal for the time of year. Dalton Holme (in the Hull and East Riding chalk aquifer) was notably low (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks decreased at all but one of the reported reservoirs and reservoir groups during October, with the largest decreases occurring in the NCZ Regional group (-11%) in north-west England, Clywedog reservoir (-10%) and the Elan Valley group (-9%) which supply central England and Blagdon reservoir (-9%) in south-west England. End of month stocks were classed as normal or higher for the time of year at just over two-thirds of reported reservoirs and reservoir groups. The remaining sites, all located in or supplying central and northern England, were below normal or lower for the time of year (Figure 5.1).

Regional-scale reservoir stocks decreased across all regions during October by between 2 and 9%. At the end of October, regional stocks ranged from 57% of total capacity in north-west England to 81% in east England. Overall reservoir storage for England decreased by 4% to 71% of total capacity (Figure 5.2).

Forward look

November is likely to see unsettled, wet and windy weather through the month, but with some drier interludes; particularly in the south towards the end of the month. Further ahead, for the period November-December-January there is an increased probability of above average temperatures, with above average rainfall more probable than below average[1].

Projections for river flows at key sites[2]

More than two thirds of modelled sites have a greater than expected chance of below normal or lower cumulative flows between November 2015 and March 2016. Three quarters of modelled sites have a greater than expected chance of below normal or lower cumulative flows between November 2015 and September 2016.

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

Projections for groundwater levels in key aquifers[2]

Nearly two thirds of modelled sites have a greater than expected chance of normal groundwater levels at the end of March 2016. At the end of September 2016, four fifths of modelled sites have a greater than expected chance of normal groundwater levels.

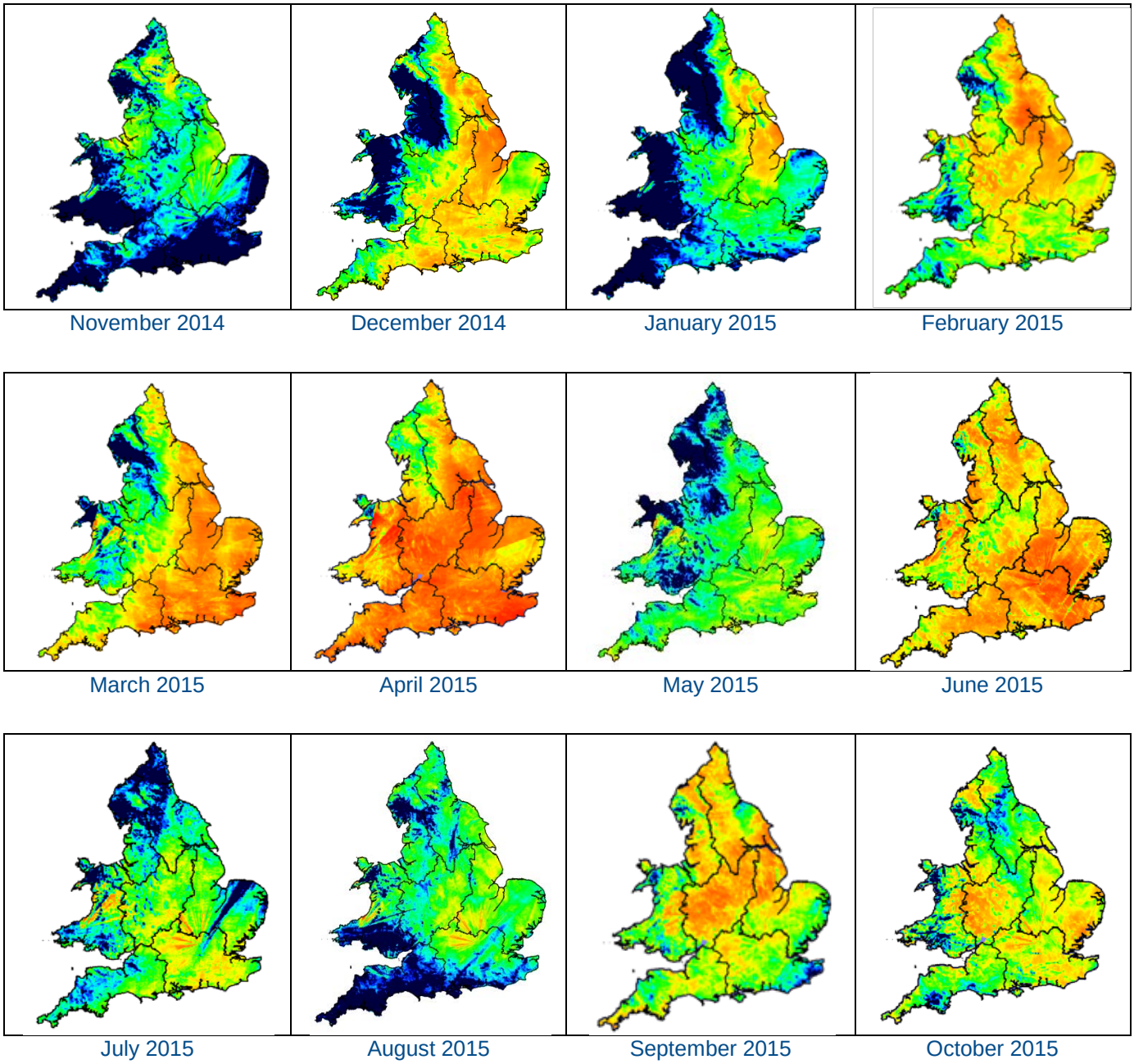
For scenario based projections of groundwater levels in key aquifers in March 2016 see Figure 6.5

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).

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

Authors: E&B Hydrology Team

Rainfall



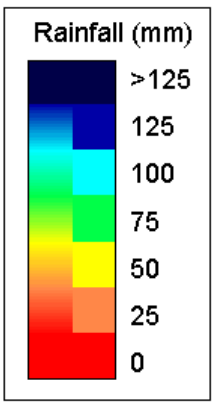


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2015). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

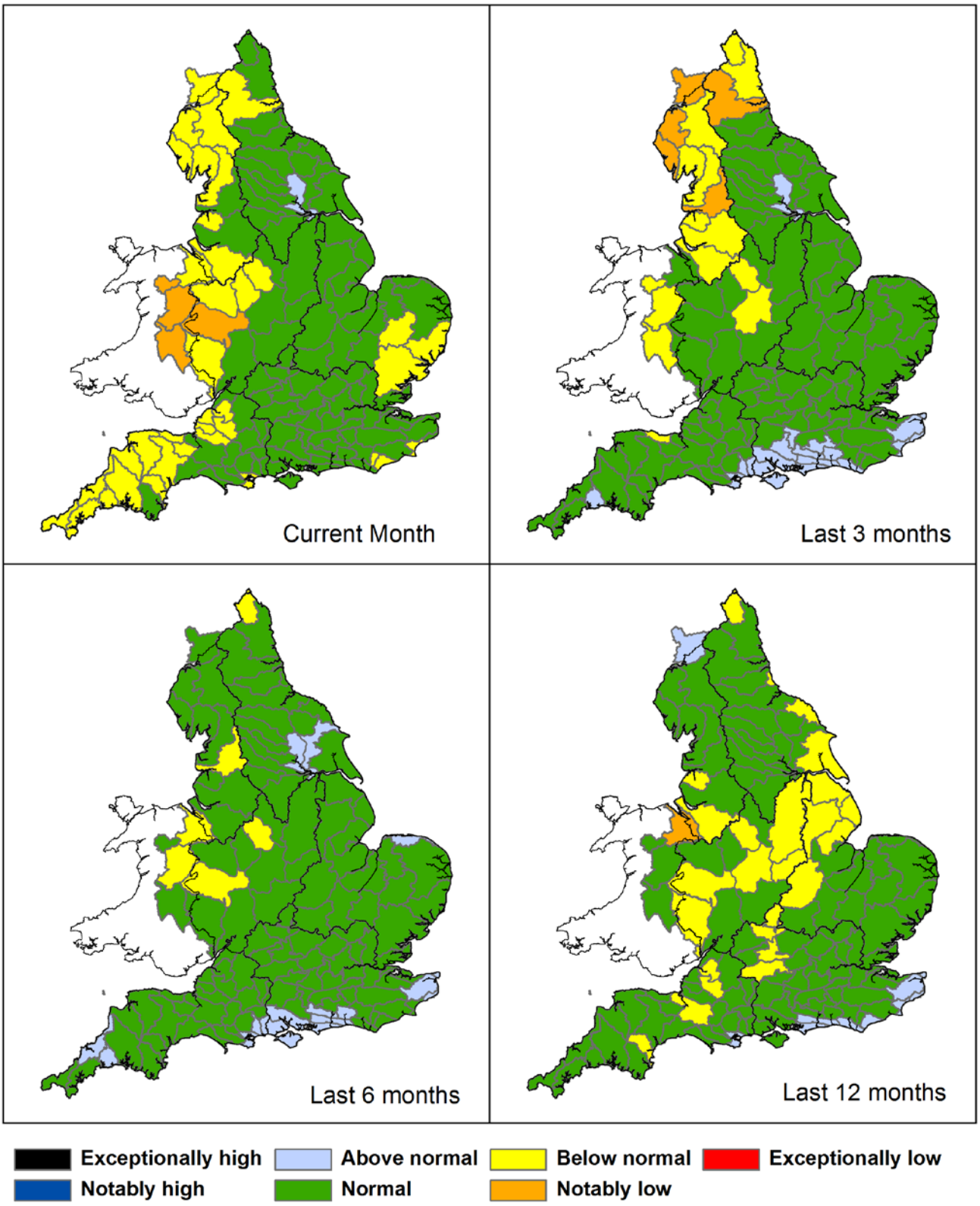


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 October 2015), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final and provisional NCIC (National Climate Information Centre) 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.

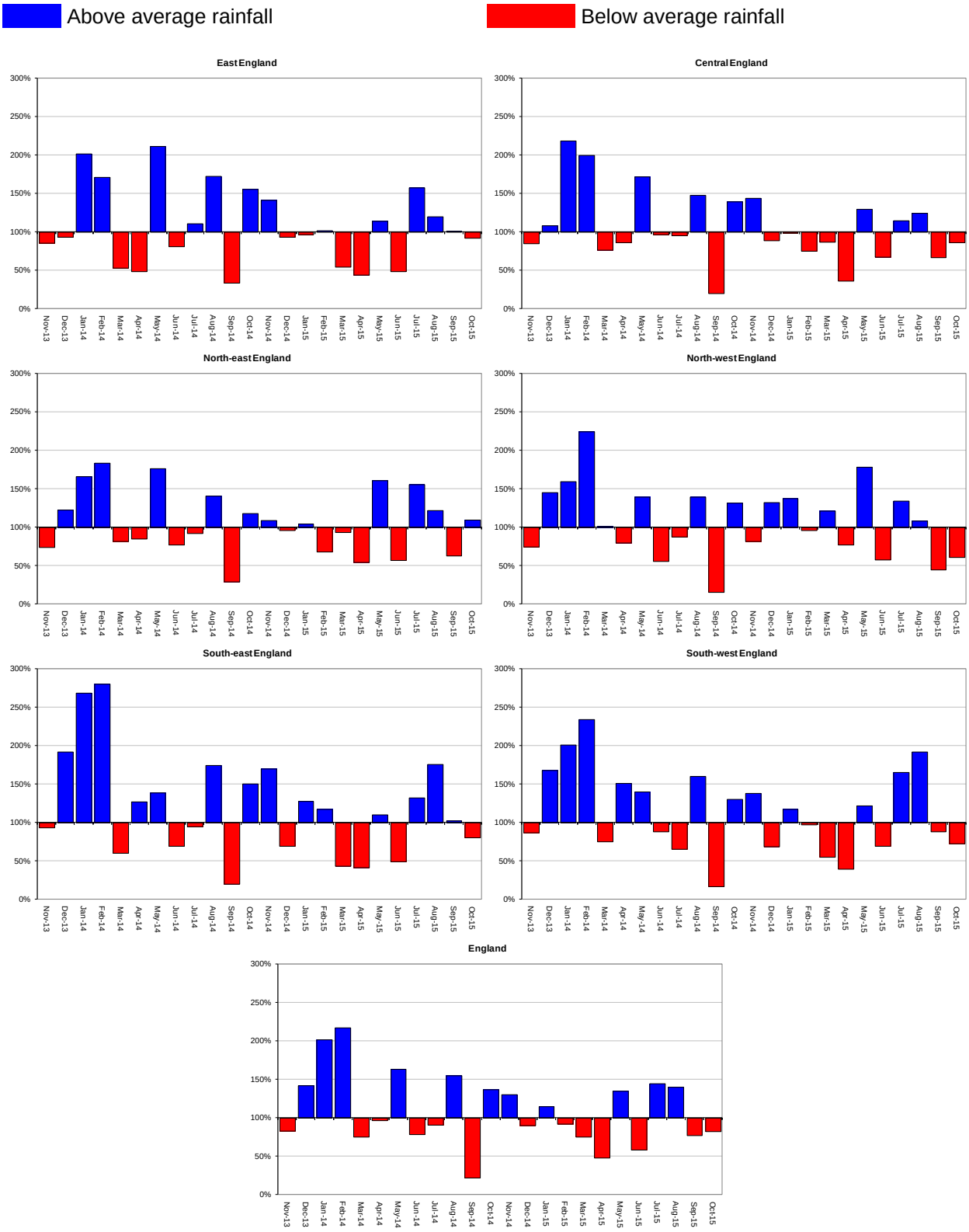


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2015).

Soil moisture deficit

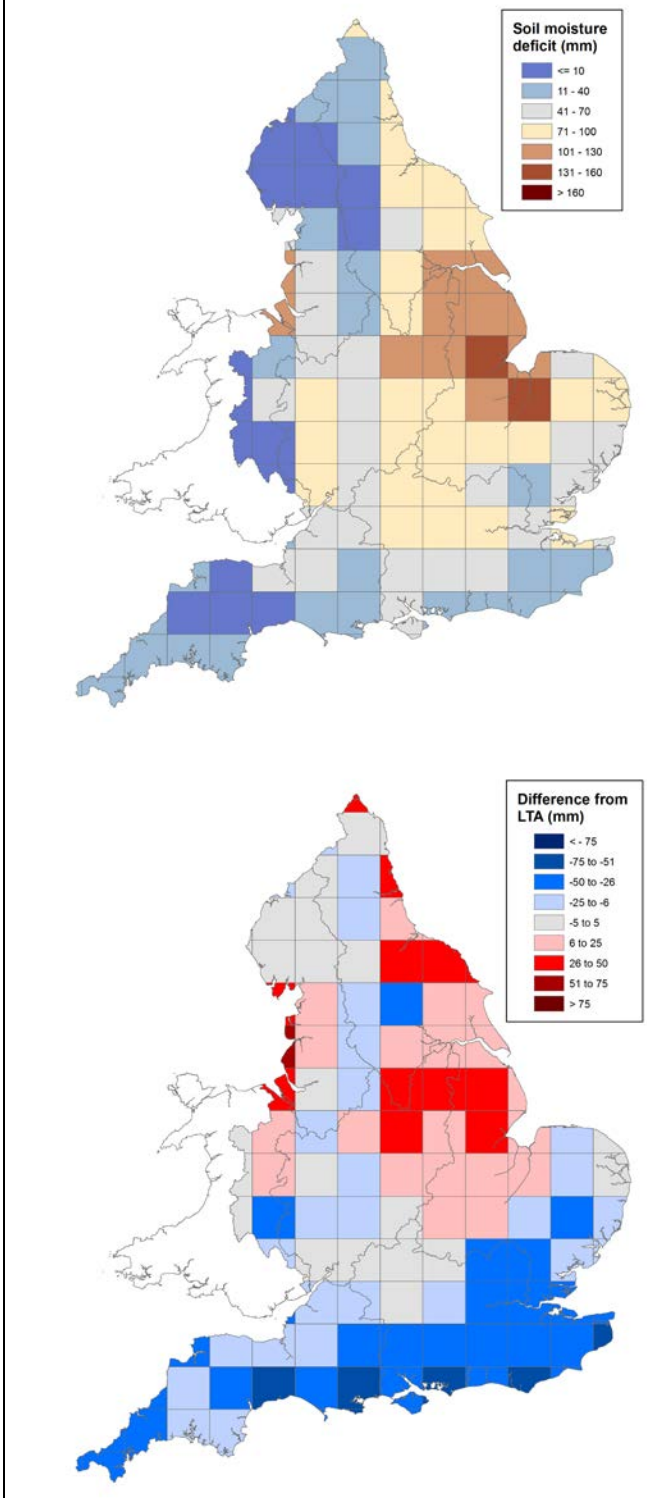
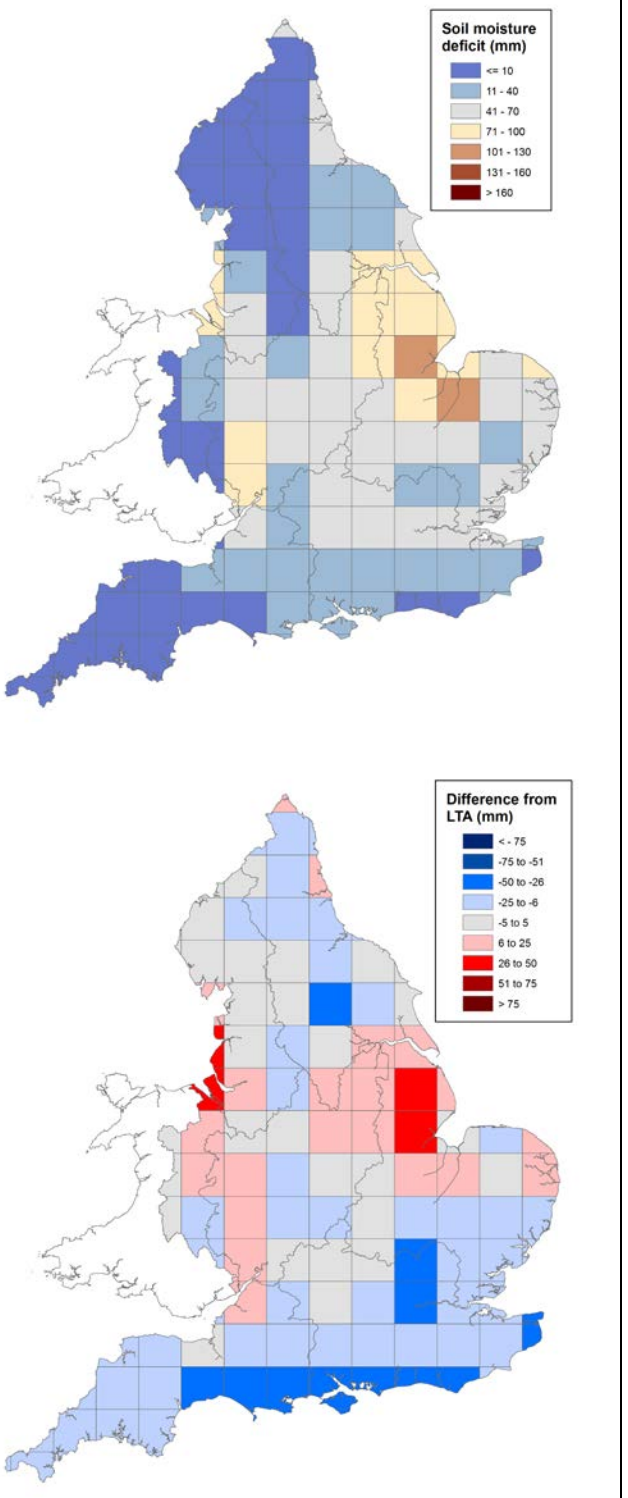
End of September 2015[1]	End of October 2015[2]
	

Figure 2.1: Soil moisture deficits for weeks ending 29 September 2015 [1] (left panel) and 03 November 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

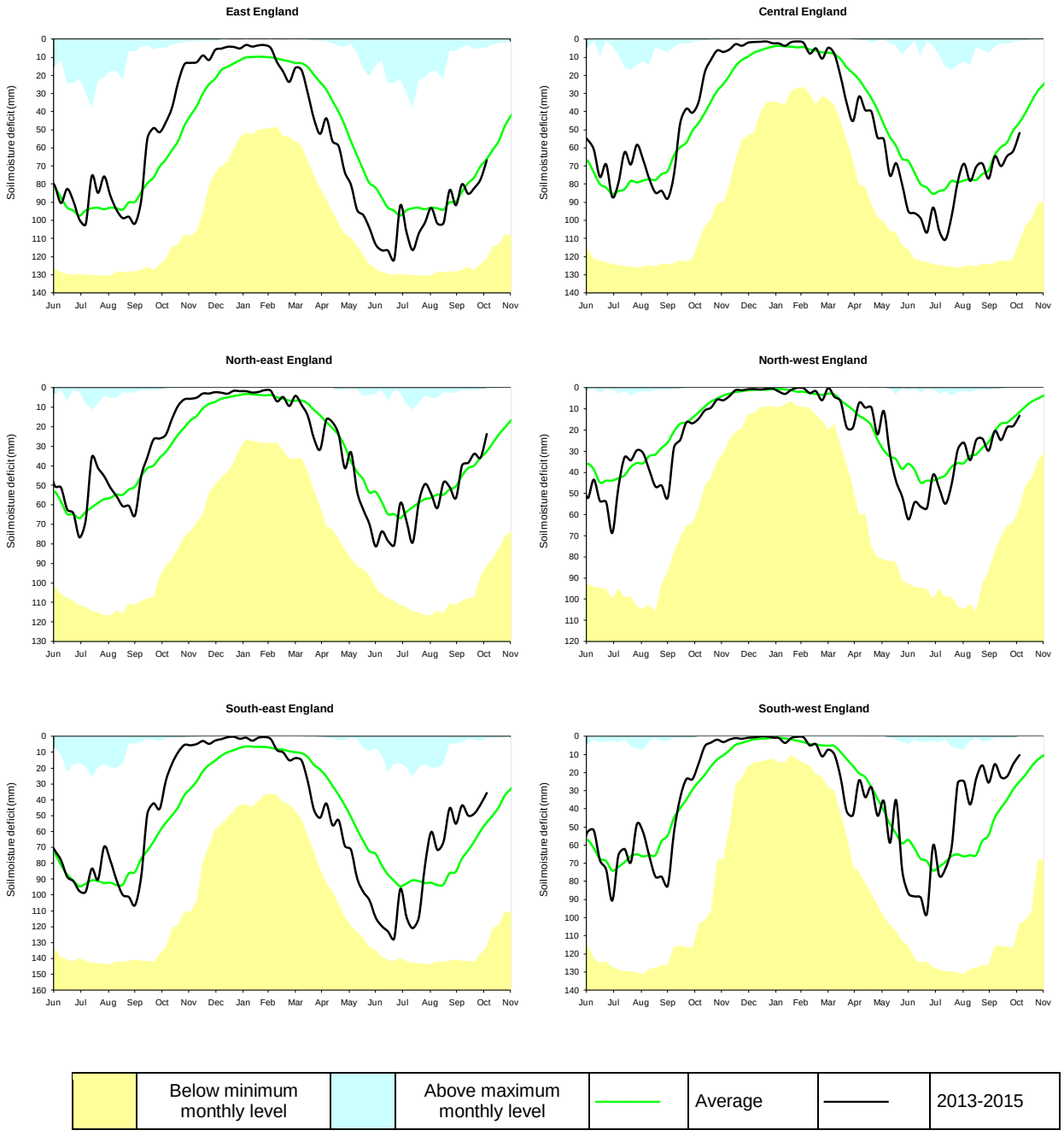
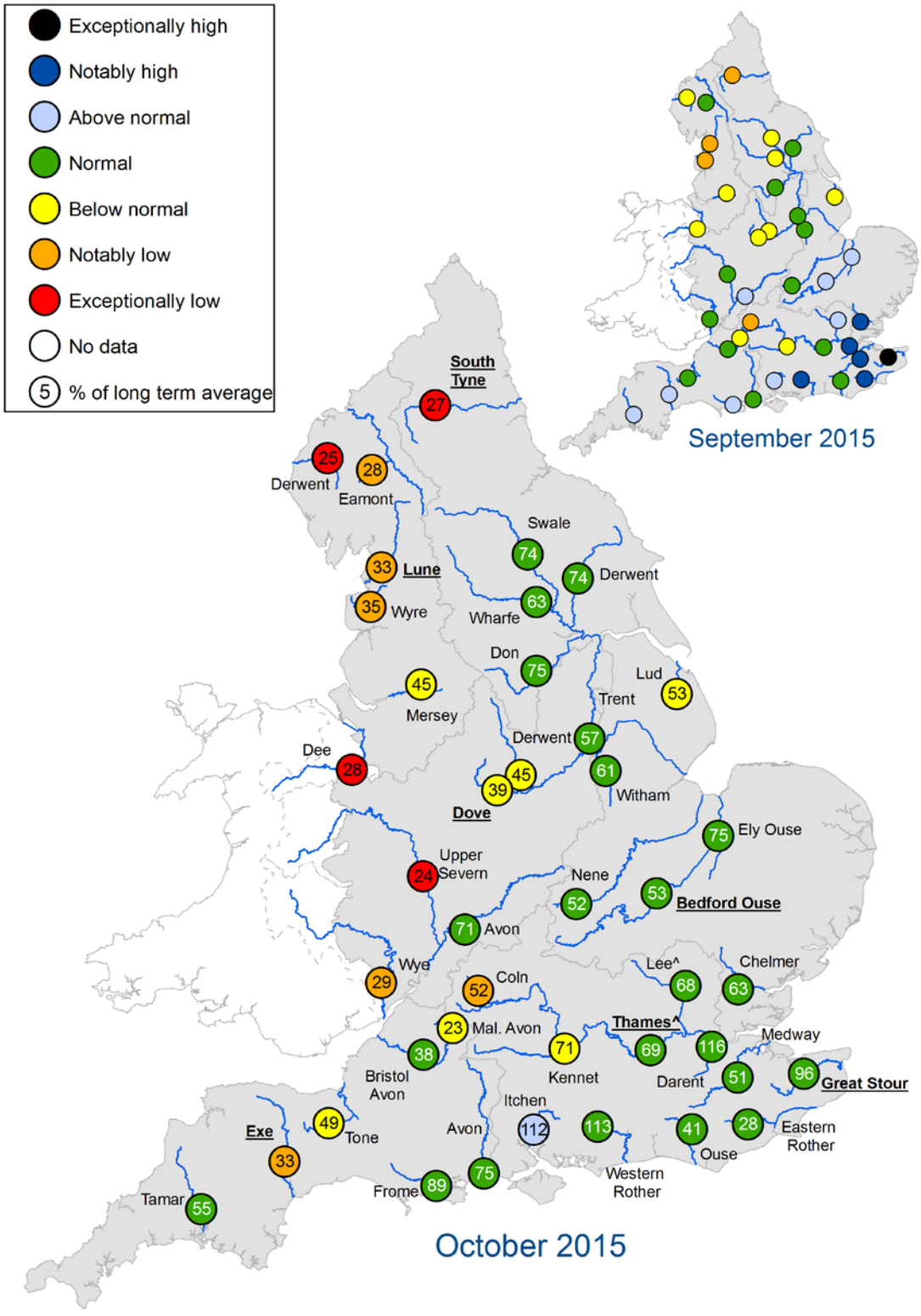


Figure 2.2: Latest soil moisture deficits for all regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2015).

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 September 2015 and October 2015, expressed as a percentage of the respective long term average and classed relative to an analysis of historic September and October monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2015.

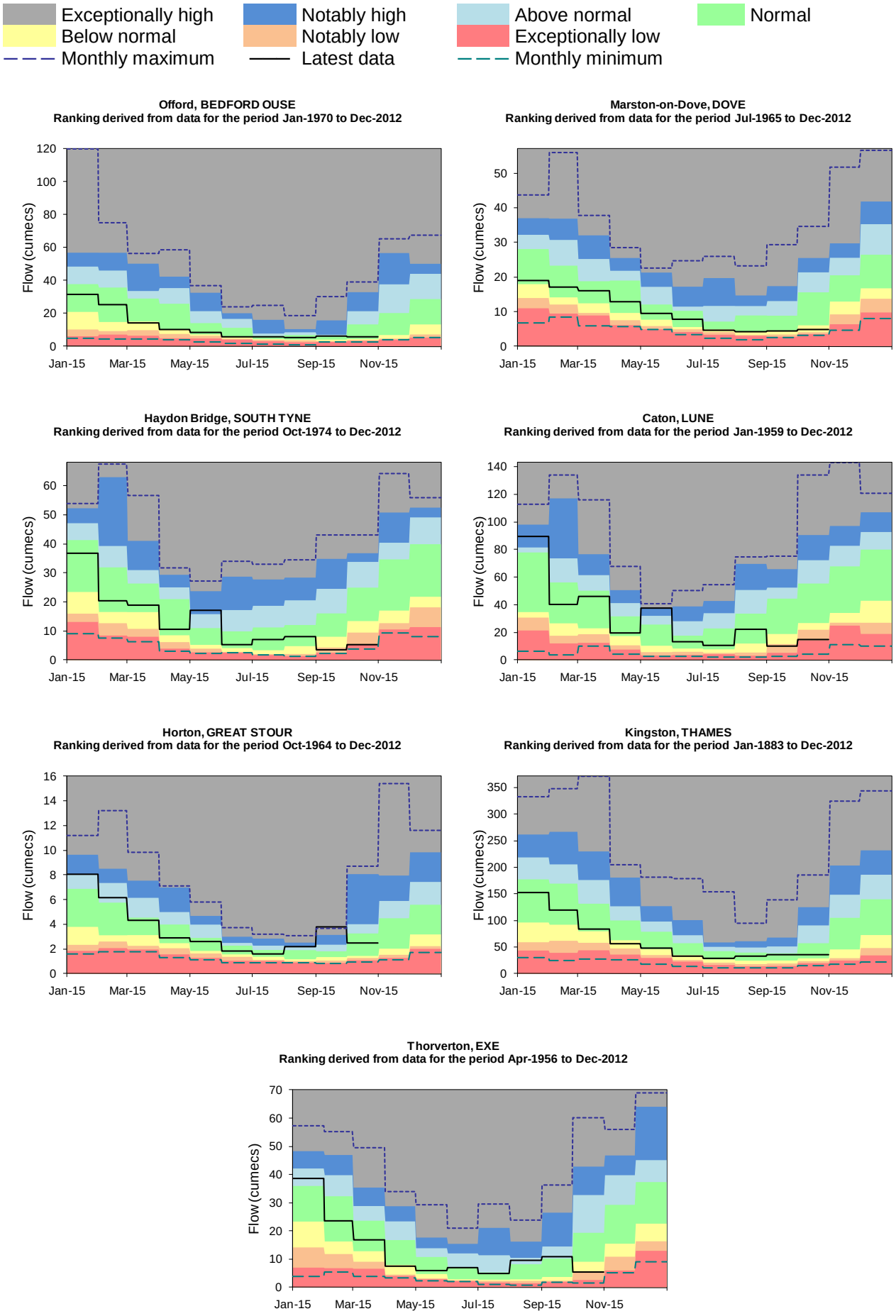
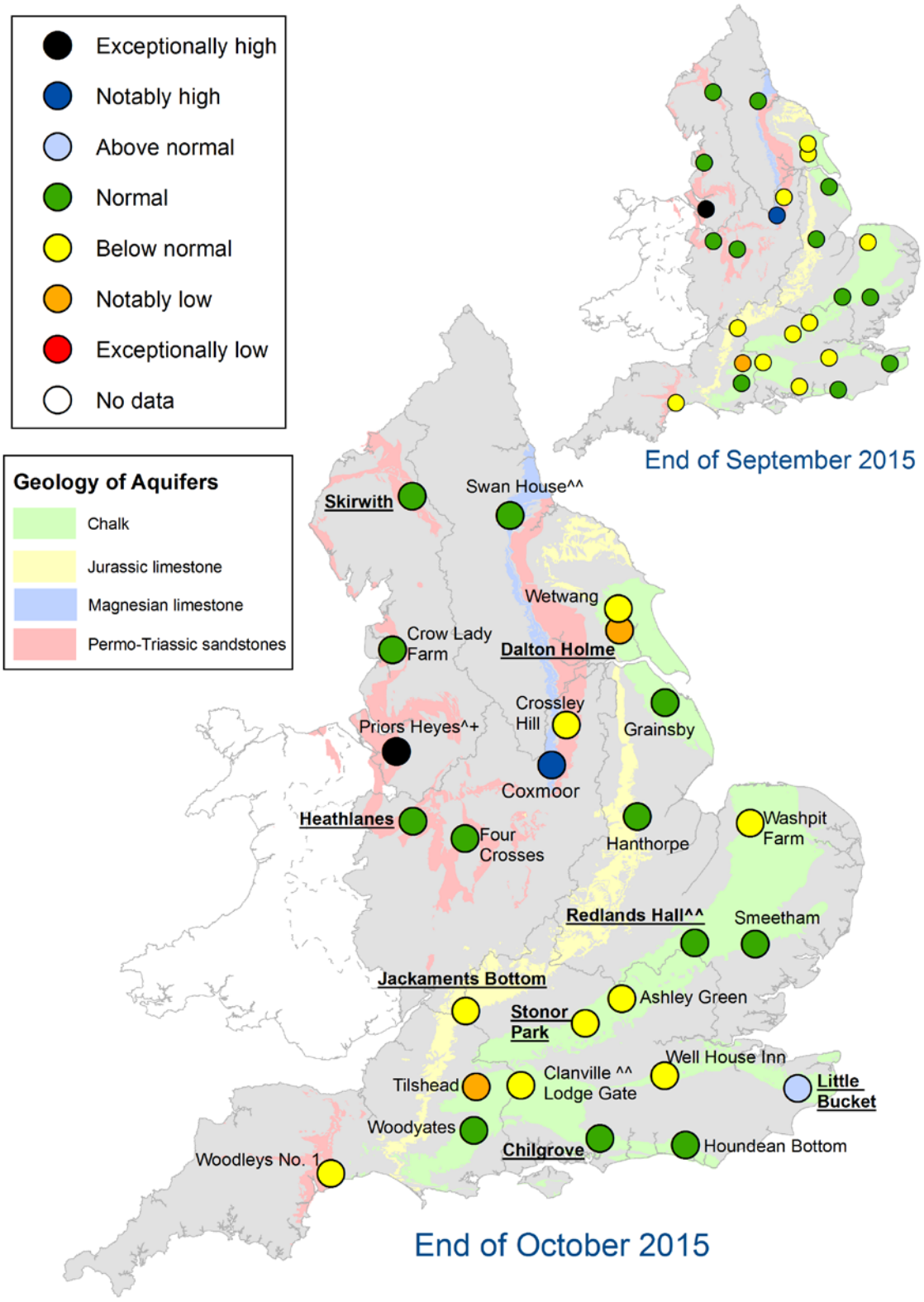


Figure 3.2: Index river flow sites for each Environment Agency Region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 September 2015 and October 2015, classed relative to an analysis of respective historic September and October 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.

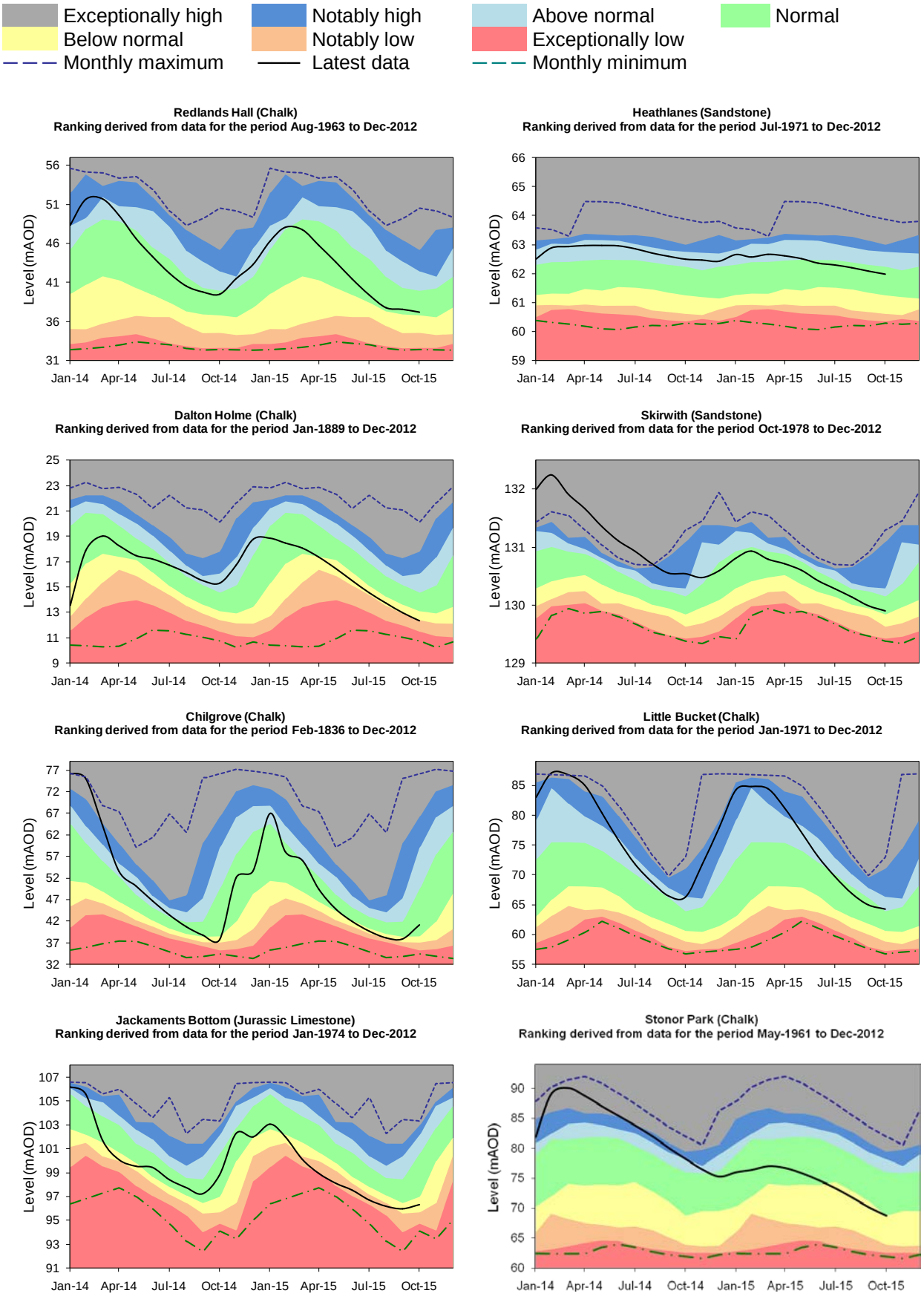
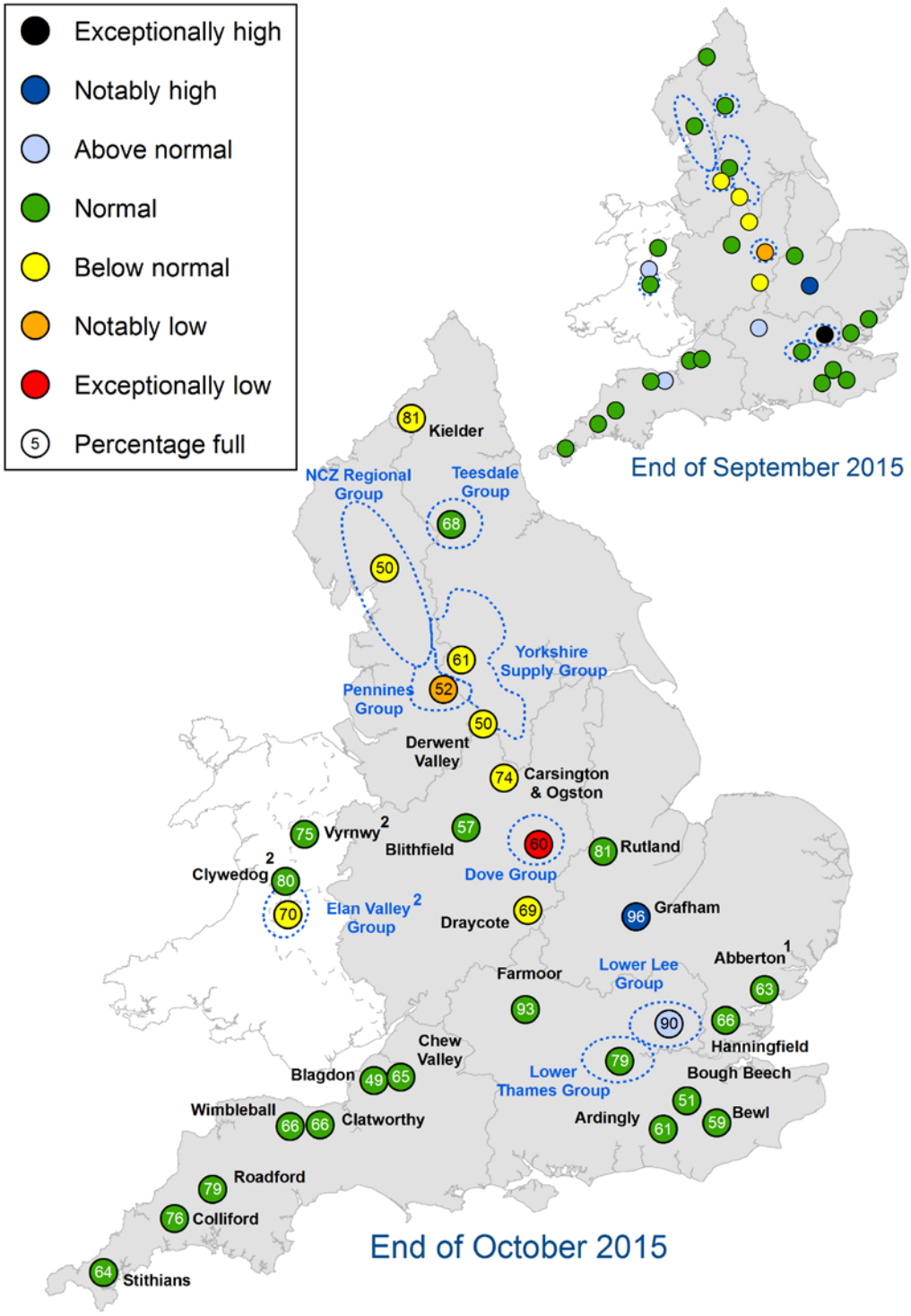


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2015).

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

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of September 2015 and October 2015 as a percentage of total capacity and classed relative to an analysis of historic September and October 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, 2015.

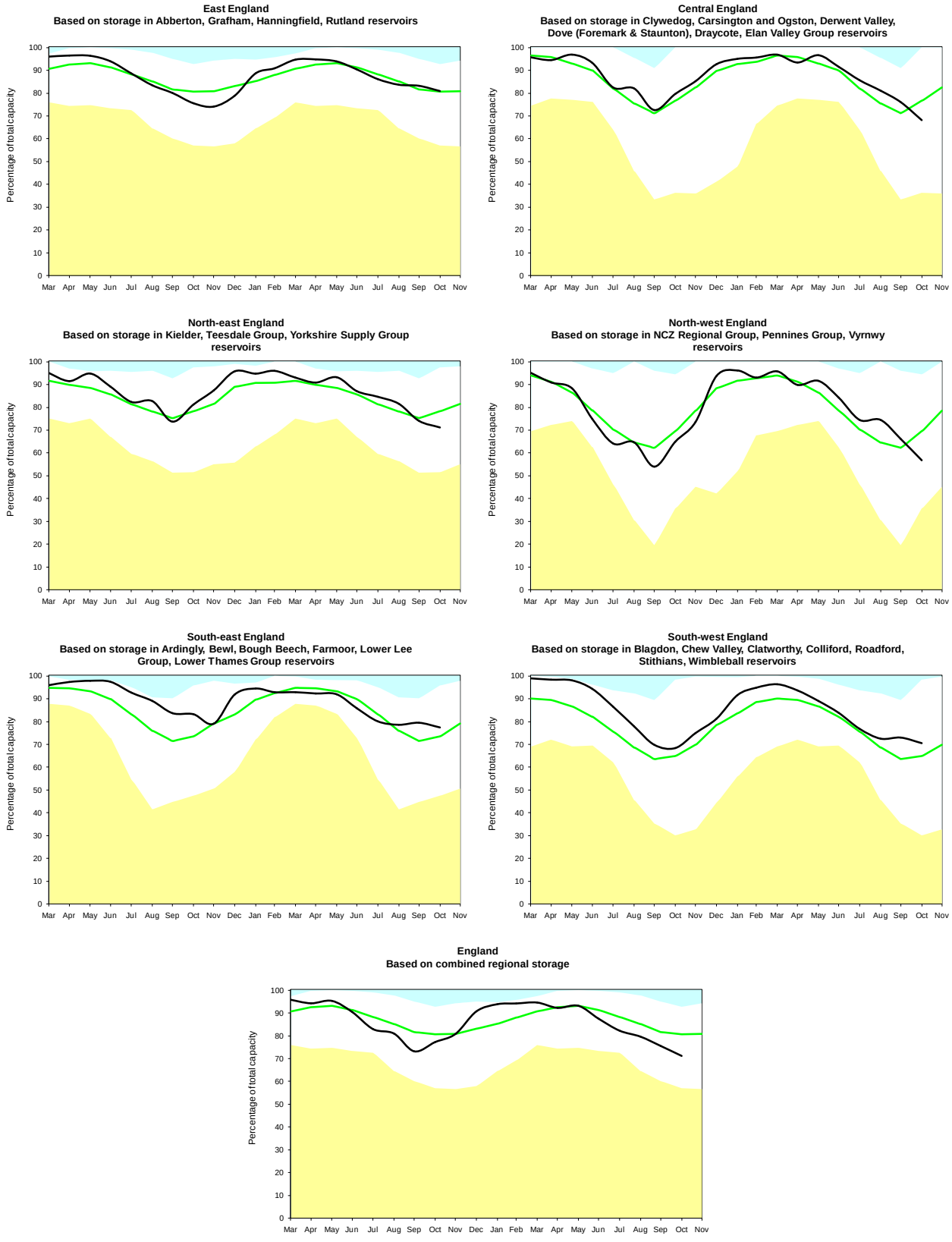


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

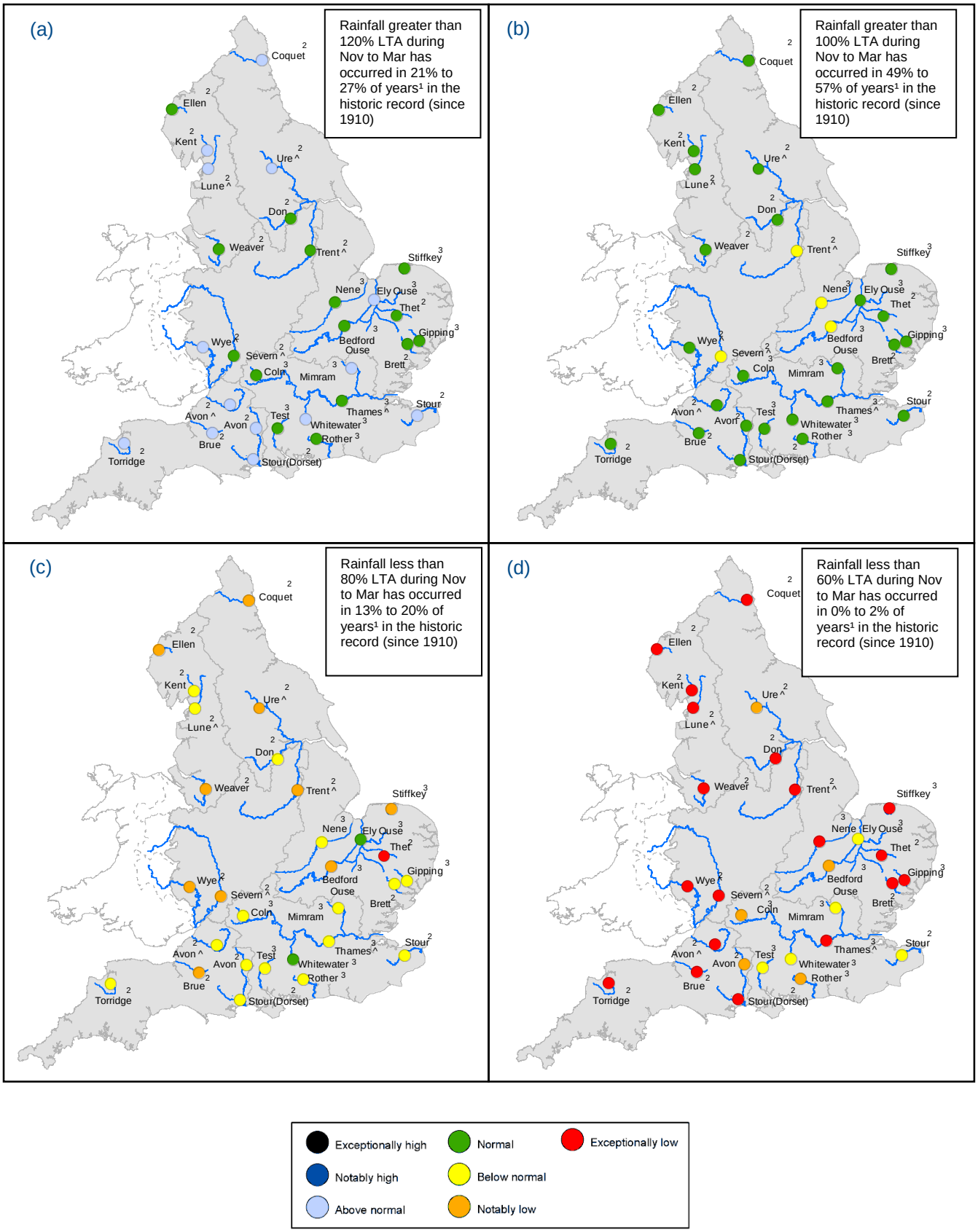
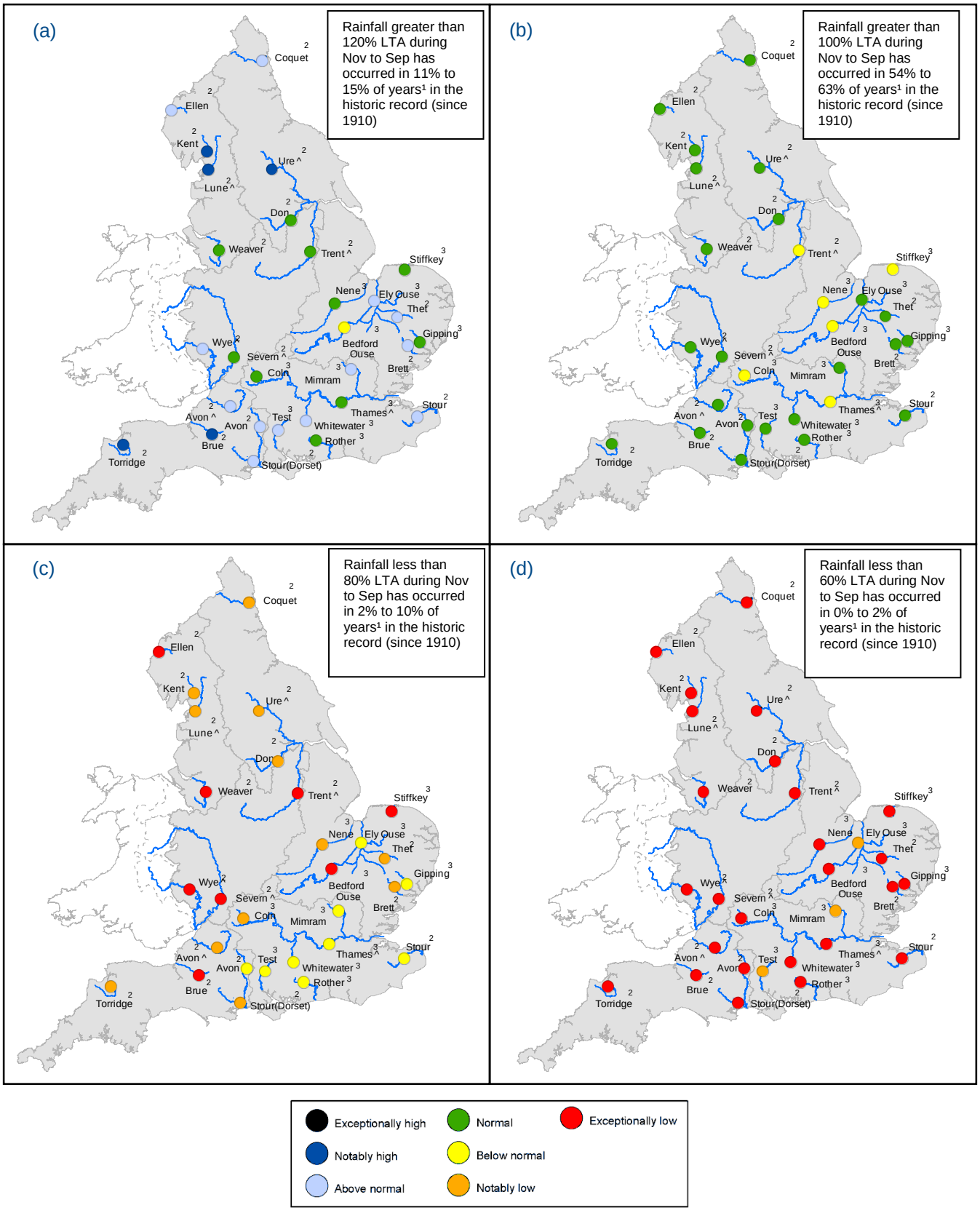


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2015 and March 2016 (Source: Centre for Ecology and Hydrology, Environment Agency).

[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*



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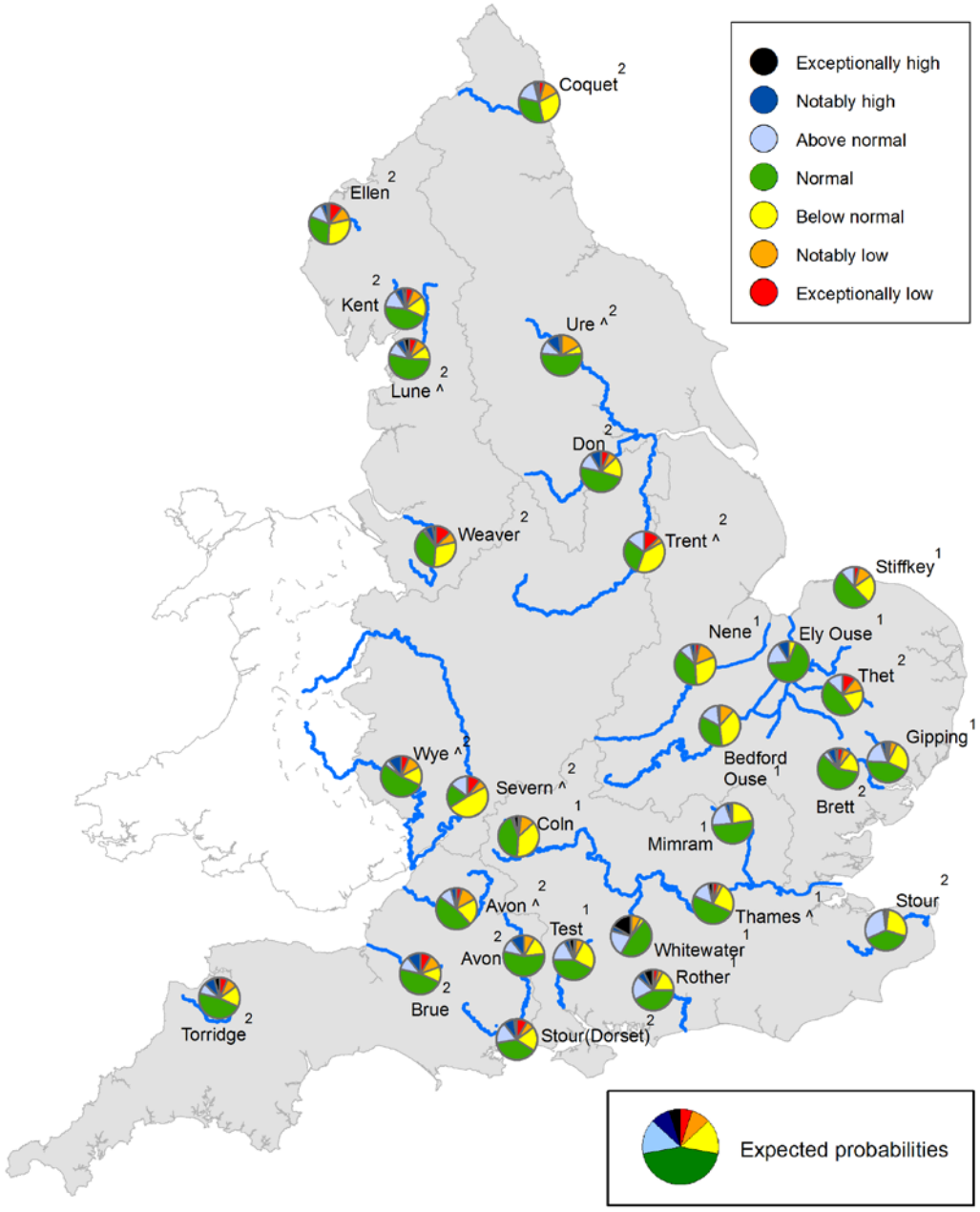

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

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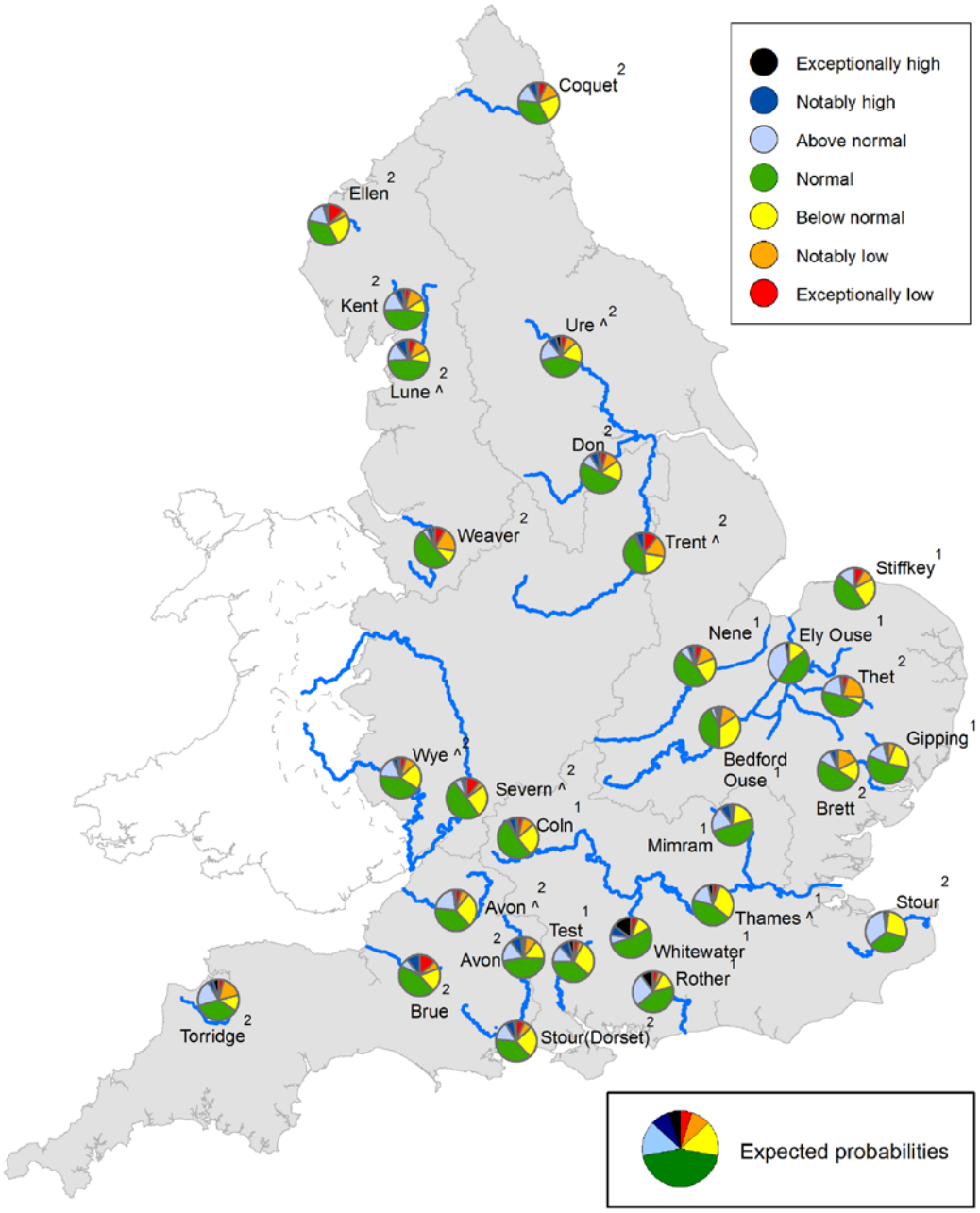

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2016. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

[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

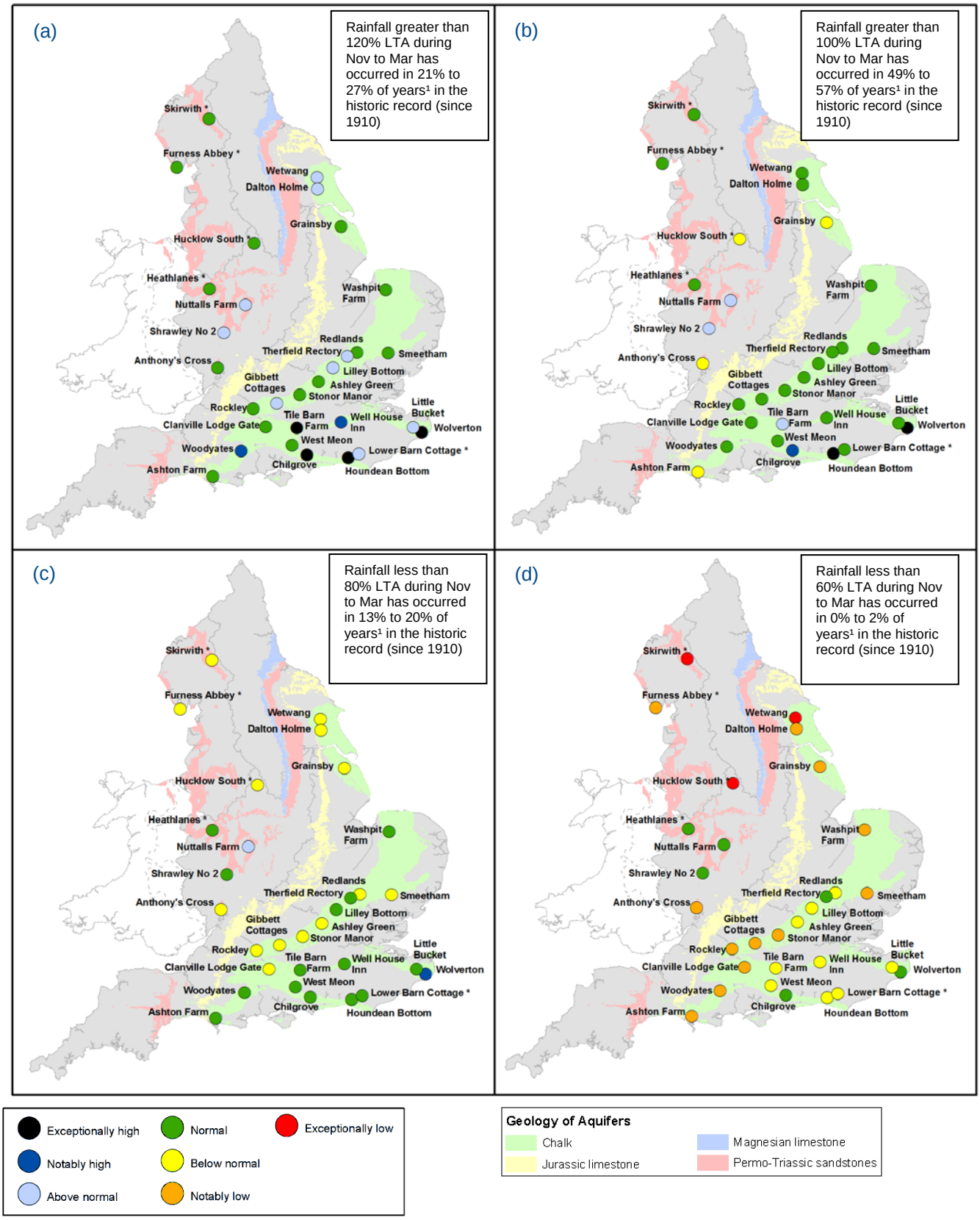

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2015 and March 2016 (Source: Environment Agency) Geological map reproduced with kind permission 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

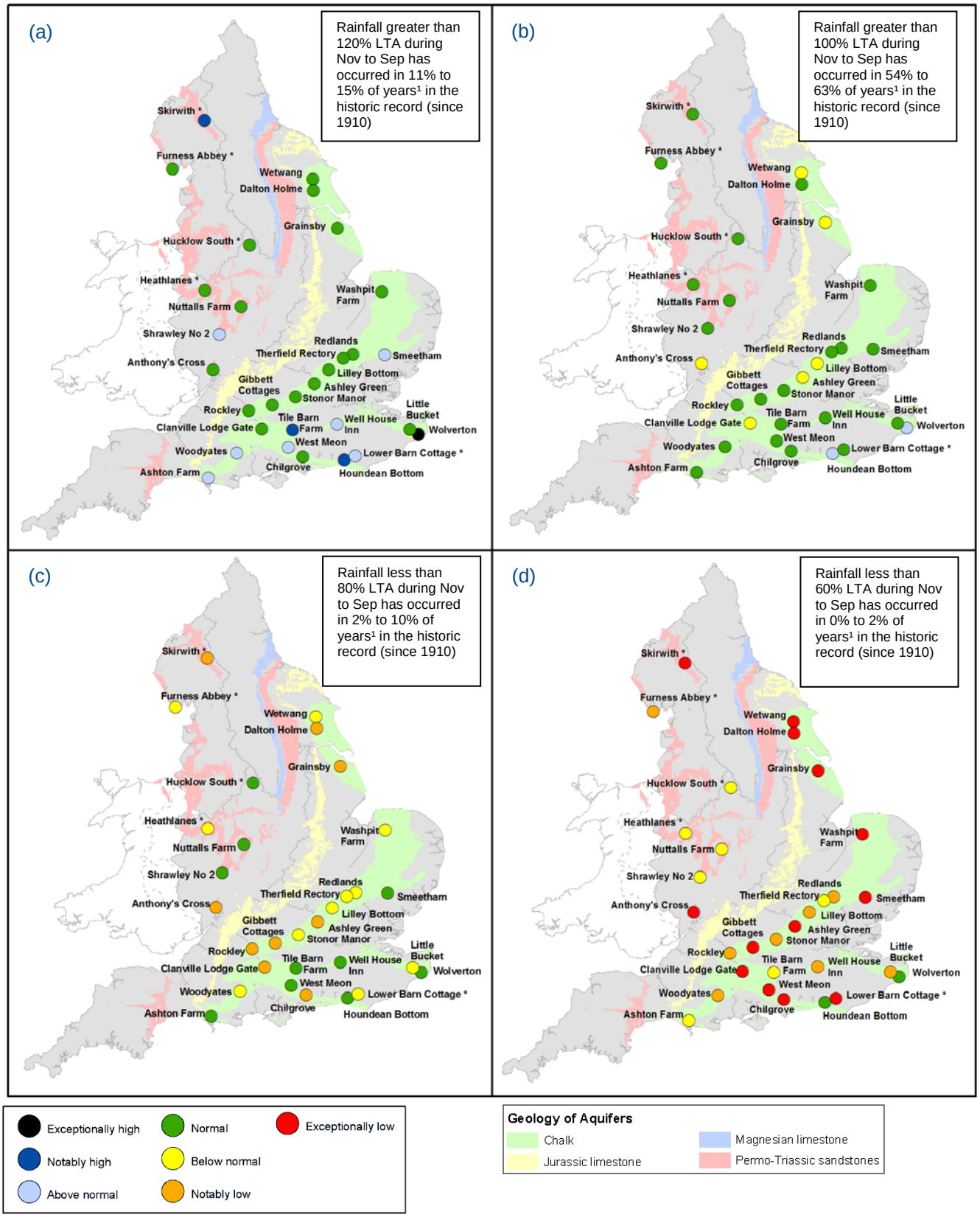

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2016. Forecasts based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2015 and September 2016 (Source: Environment Agency) Geological map reproduced with kind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

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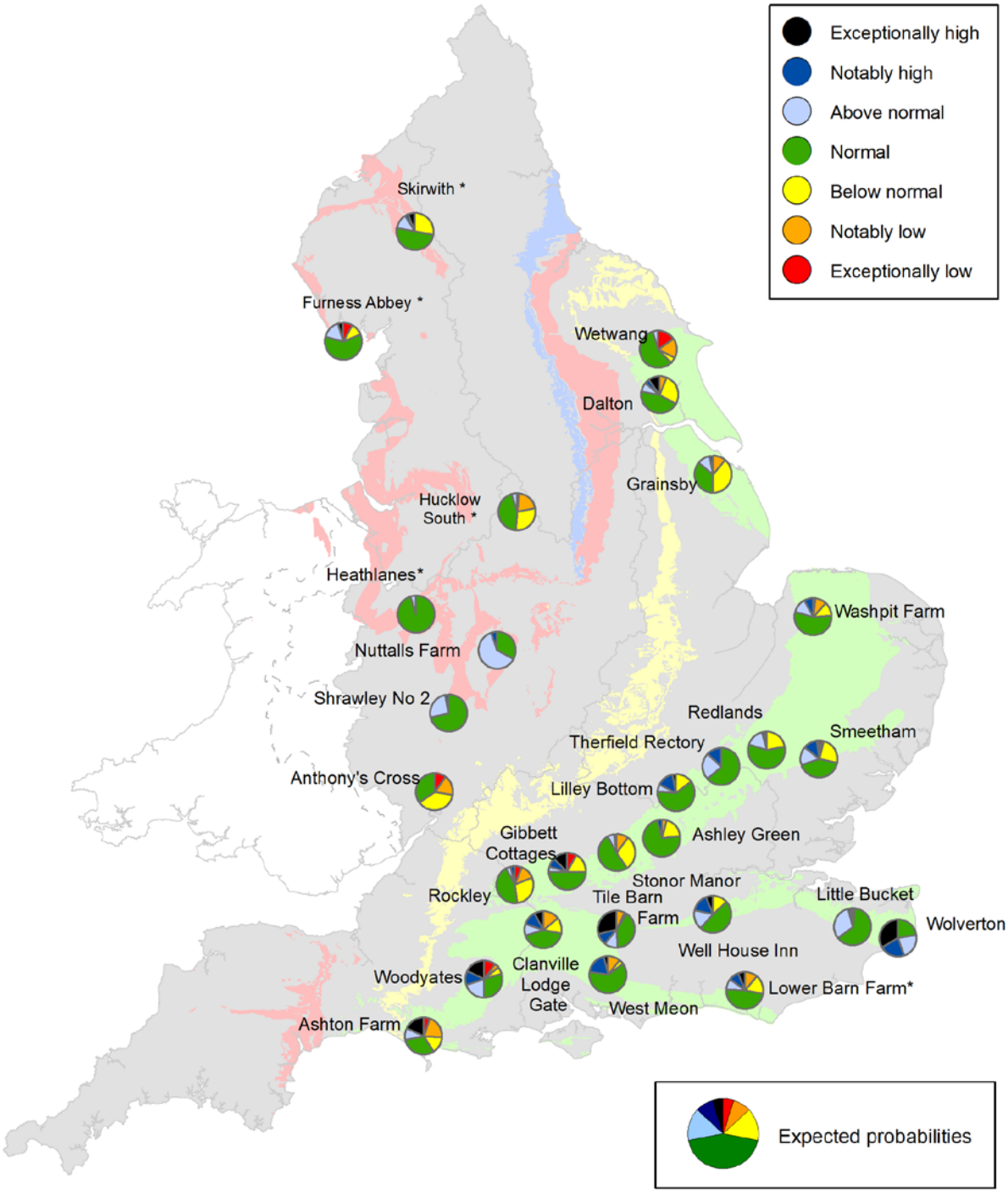
[1] This range of probabilities is a regional analysis



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

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

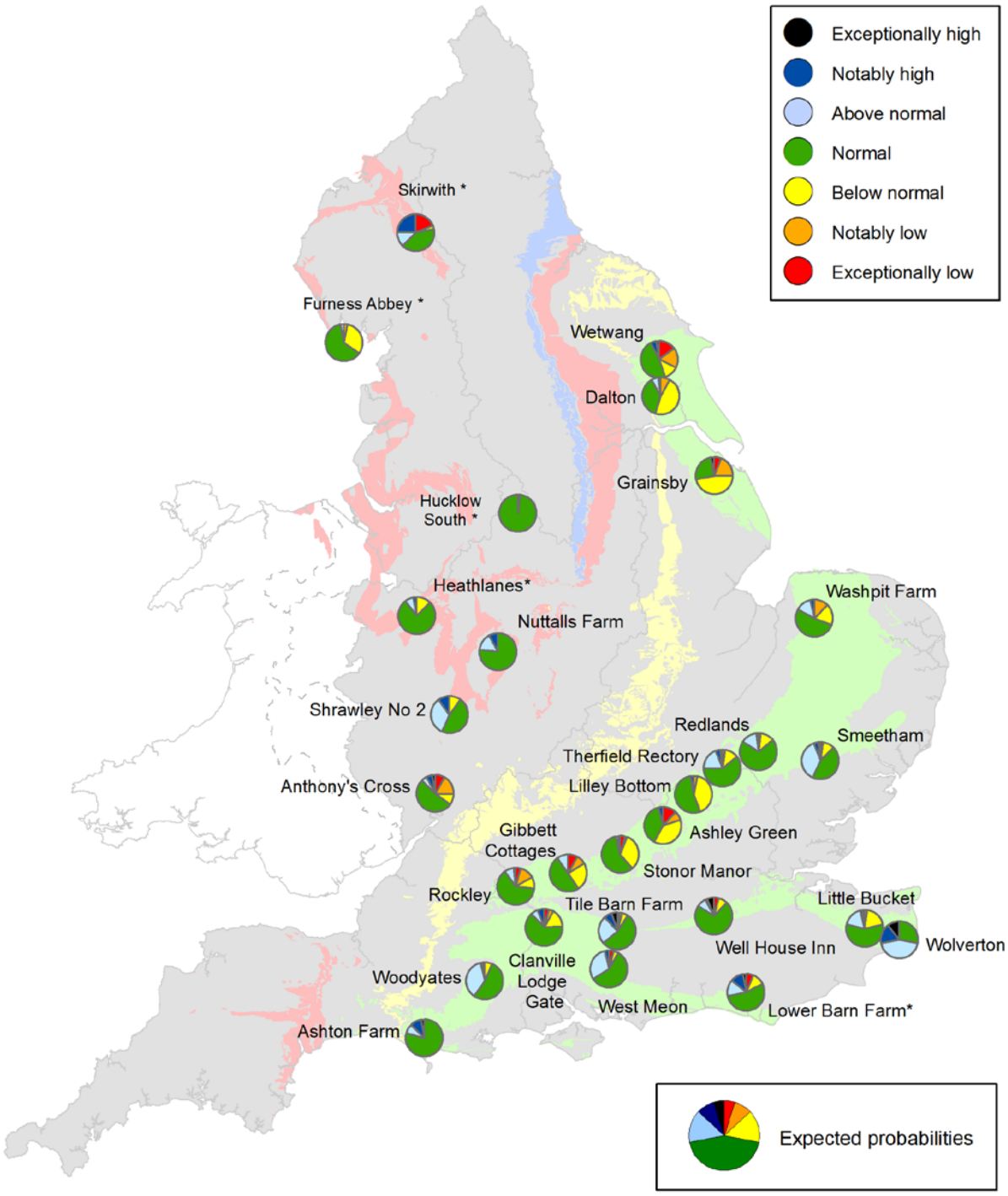


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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2016. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for 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, 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