Monthly water situation report

England

Summary – December 2020

Almost all of England received above average rainfall totals during December. Soils were at, or close to saturation, across almost all of the country at the end of the month. Exceptionally high rainfall totals for the time of year were recorded across much of Norfolk, Sussex, Cornwall, Worcestershire, Gloucestershire and parts of Essex, Cambridgeshire, north Yorkshire and Northumberland. As a result, river flows were classed as either exceptionally high or notably high at over half of these, with record high December monthly mean flows recorded on the River Yare and the River Gipping in east England. Groundwater levels were classed as normal or higher for the time of year at all sites, at the end of the month. Total reservoir stocks for England were at 91% of total capacity at the end of December.

Rainfall

The December rainfall total for England was 131mm, which represents 154% of the 1961 to 1990 long term average (LTA) (150% of the 1981 to 2010 LTA). This is more than double the rainfall total for England in November (62mm). Rainfall was widespread with the highest monthly rainfall totals recorded in south-west England (Figure 1.1).

Monthly rainfall totals were classed as normal or higher across all catchments. The lowest rainfall total, as a proportion of the LTA, was over the Esk catchment (Dumfries). Here, the rainfall total (124mm) which represented 97% of the December LTA. Exceptionally high rainfall totals for the time of year were recorded across much of Norfolk, Sussex, Cornwall, Worcestershire, Gloucestershire and parts of Essex, Cambridgeshire, north Yorkshire and Northumberland. The highest December rainfall total on record (records since 1891) for the Lower Welland and Nene catchments (Lincolnshire) was recorded, with 121mm of rainfall representing 246% of the December LTA. December rainfall totals were classed as either notably high or exceptionally high at in almost half the catchments across England.

The 3, 6 and 12 month cumulative rainfall totals, ending in December, are classed as normal or higher in every catchment across England. Much of south-east and east England has received a cumulative rainfall total over the last three months which is classed as either notably high or exceptionally high (Figure 1.2).

At a regional scale, December rainfall totals ranged from 124% of LTA in north-west England, to 186% of LTA in east England, where it was the wettest December since 1978 (Figure 1.3).

Soil moisture deficit

Across almost the whole of England soils were close to saturation at the end of December, with a soil moisture deficit (SMD) of less than 10mm. Across England SMDs were close to average (<10mm difference from LTA), or lower than average (indicating that soils are wetter than usual) for the time of year (Figure 2.1).

At a regional scale, the end of month SMD values were close to or lower than the end of December LTA in all regions (Figure 2.2).

River flows

Monthly mean flows for December were classed as normal or higher for the time of year at all of the reported gauging stations; flows were classed as either exceptionally high or notably high at over half of these. In east England flows at all but one of the indicator sites were classed as exceptionally high or notably high. The highest December monthly mean flows on record were recorded on the River Yare (356% LTA) and the River Gipping (320% of LTA) in east England (records from 1970 and 1966 respectively).

River flows increased at over four-fifths of sites, compared to November. For example, at Heaton Mill on the River Till (Northumberland) monthly mean flows had been classed as below normal in November (43% LTA) but

were over four-times higher in December and classed as above normal for the time of year (163% LTA), responding to the high rainfall totals in this part of the country (Figure 3.1).

At the regional index sites monthly mean flows ranged from being classed as normal on the River Lune (north-west England) and the South Tyne (north-east England) to being classed as exceptionally high on the Bedford Ouse (east England). On the Great Stour (south-east) and River Exe (south-west) December flows were classed as notably high (Figure 3.2).

Groundwater levels

Groundwater levels increased at over four-fifths of the indicator sites we report on during December. The end of month groundwater levels were classed as normal or higher for the time of year at all sites, with notably high or exceptionally high groundwater levels recorded at over a third of sites.

Groundwater levels at Washpit Farm (North West Norfolk Chalk aquifer) and Horndean Bottom (Brighton Chalk aquifer) were classed as exceptionally high at the end of December. Levels at Coxmoor (Idle and Torne sandstone) and Priors Hayes (West Cheshire sandstone) remained classed as exceptionally high for the time of year. These sites recorded the highest end of December levels on record (records go back to 1970 and 1973 respectively). Levels at Priors Heyes remains high compared to historic levels because the aquifer is recovering from the effects of historic abstraction.

End of month groundwater levels at the major aquifer index sites ranged from normal at Dalton Holme (Hull and East Riding Chalk) notably high at Weir Farm (Bridgnorth sandstone) and Skirwith (Carlisle Basin and Eden Valley sandstone). At Redlands Hall, in the Cam and Ely Ouse Chalk aquifer, end of November groundwater levels were classed as below normal for the time of year but had risen to an above normal level by the end of December (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks increased at four-fifths of the reservoirs and reservoir groups we report on during December. The biggest increase, as a proportion of total capacity, was in Ardingly reservoir (West Sussex), where stocks increased from 51% of capacity at the end of November to 88% at the end of December. Stocks decreased at only 3 of the reservoirs and reservoir groups we report on. Of these, the biggest decrease (12% of capacity) was seen at Farmoor reservoir (Oxfordshire), where stocks were at 78% of capacity by the end of December because abstraction into the reservoir was reduced because of high flows. In early January stocks are now recovering. Reservoir stocks in most of the reservoirs and reservoir groups we report on were classed as normal or higher for the time of year.

Total reservoir stocks for England were at 91% of total capacity at the end of December (an increase from 86% at the end of November), just above the LTA for the time of year. At a regional scale, total reservoir stocks ranged from 82% in east England to 95% in north-west England (Figure 5.2).

Forward look

The early part of January is expected to be cold, with outbreaks of rain, sleet and snow for many parts of England, with the driest weather likely in southern and south-east England. Moving through the middle part of the month, it is possible that the north and west of England will see the most changeable conditions, with outbreaks of rain likely, whereas southern and eastern of England may see drier, brighter weather with more settled conditions. Towards the end of January, there is a possibility that drier weather may be seen in northern parts of England, with more unsettled weather in the south.

For the 3 month period January to March, across the UK, above average precipitation is more likely than below average precipitation[1].

Projections for river flows at key sites[2]

More than two-thirds of the modelled sites have a greater than expected chance of cumulative river flows being notably high or higher for the time of year by the end of March 2021. By the end of September 2021, more than three-quarters of sites have a greater than expected chance of cumulative river flows being normal or higher for the time of year.

For scenario based projections of cumulative river flows at key sites by March 2021 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2021 see Figure 6.2

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 probabilistic ensemble projections of cumulative river flows at key sites by March 2021 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2021 see Figure 6.4

Projections for groundwater levels in key aquifers[2]
By the end of March 2021, four-fifths of the modelled sites have a greater than expected chance of groundwater levels being above normal or higher for the time of year. By the end of September 2021, half of the modelled sites have a greater than expected chance of groundwater levels being above normal or higher for the time of year.

For scenario based projections of groundwater levels in key aquifers in March 2021 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2021 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2021 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2021 see Figure 6.8

Authors: National Water Resources Hydrology Team

Rainfall

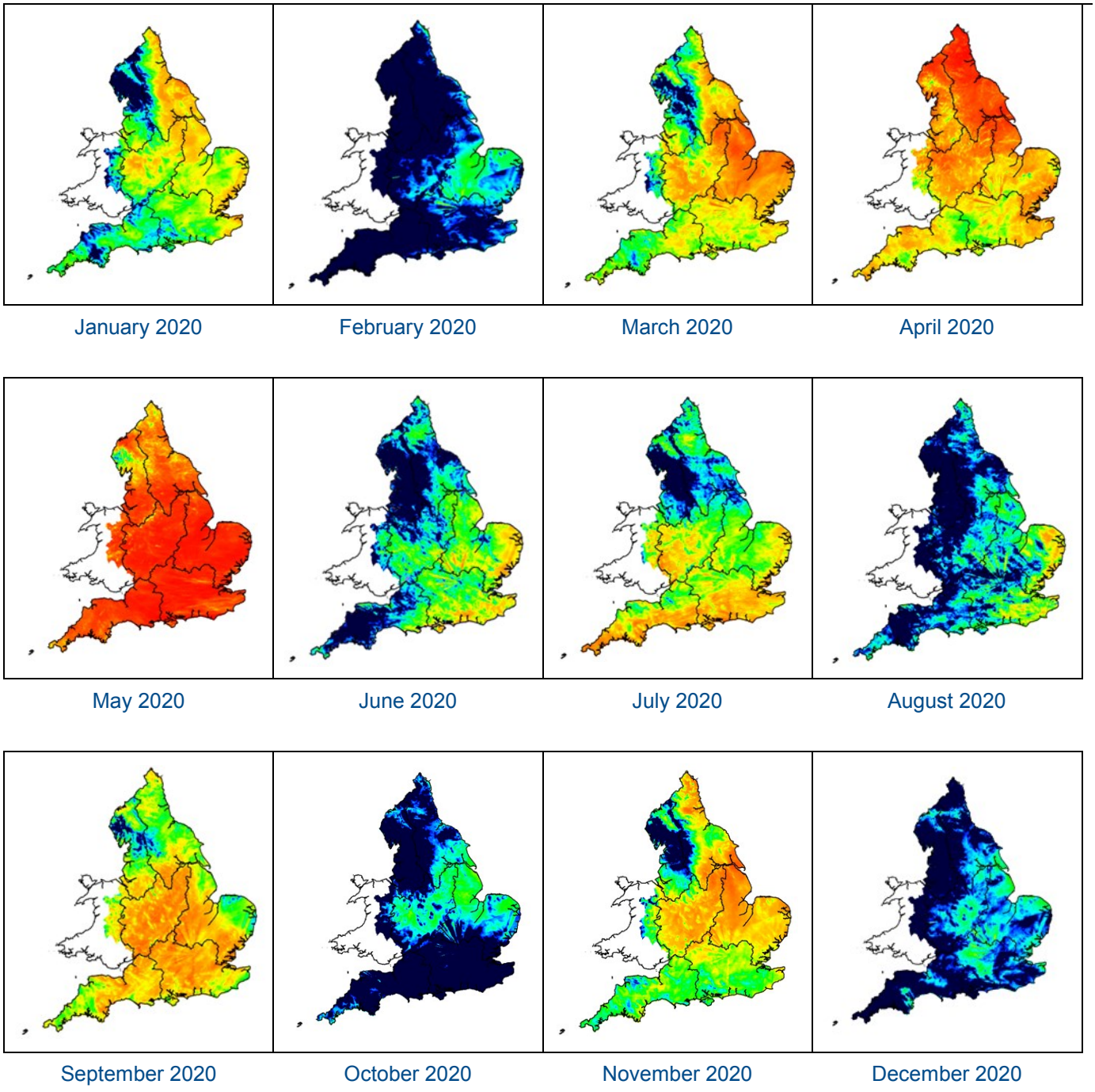


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2021). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

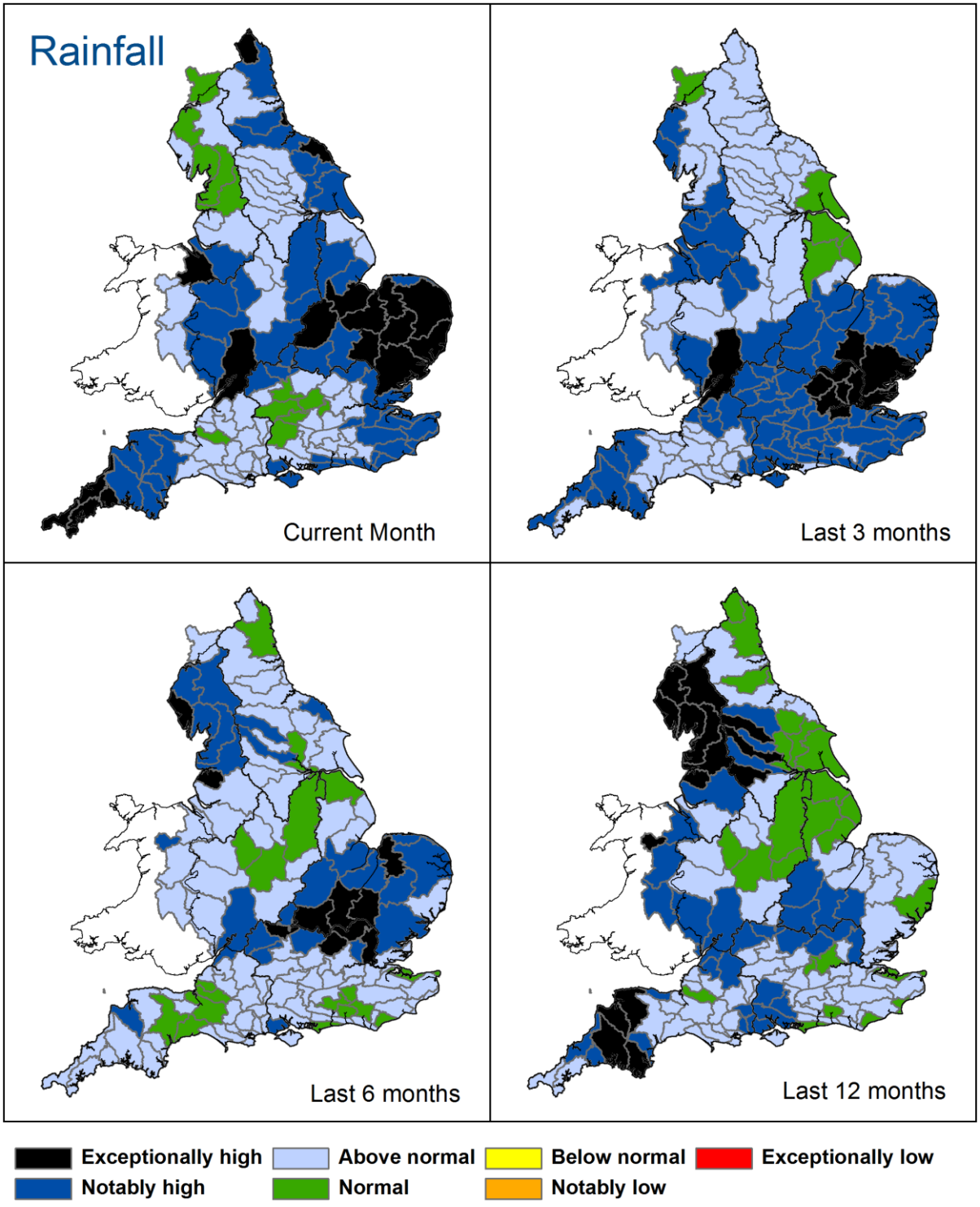


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 December), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2021).* Provisional data based on Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. Totals in some west Midlands Hydrological Areas may be underestimated due to recently identified outstation configuration. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

Rainfall charts

Above average rainfall

Below average rainfall

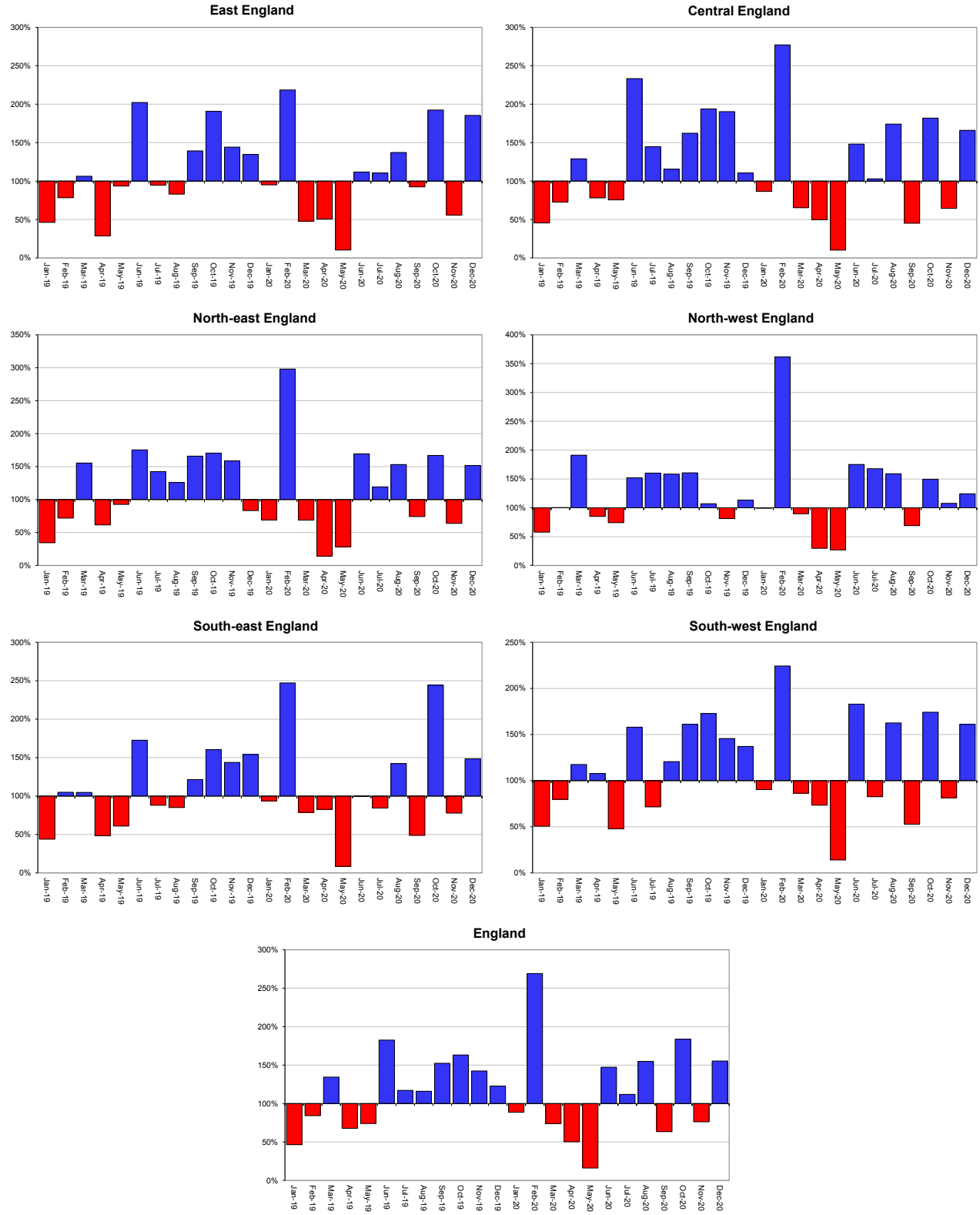


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2021).

Soil moisture deficit

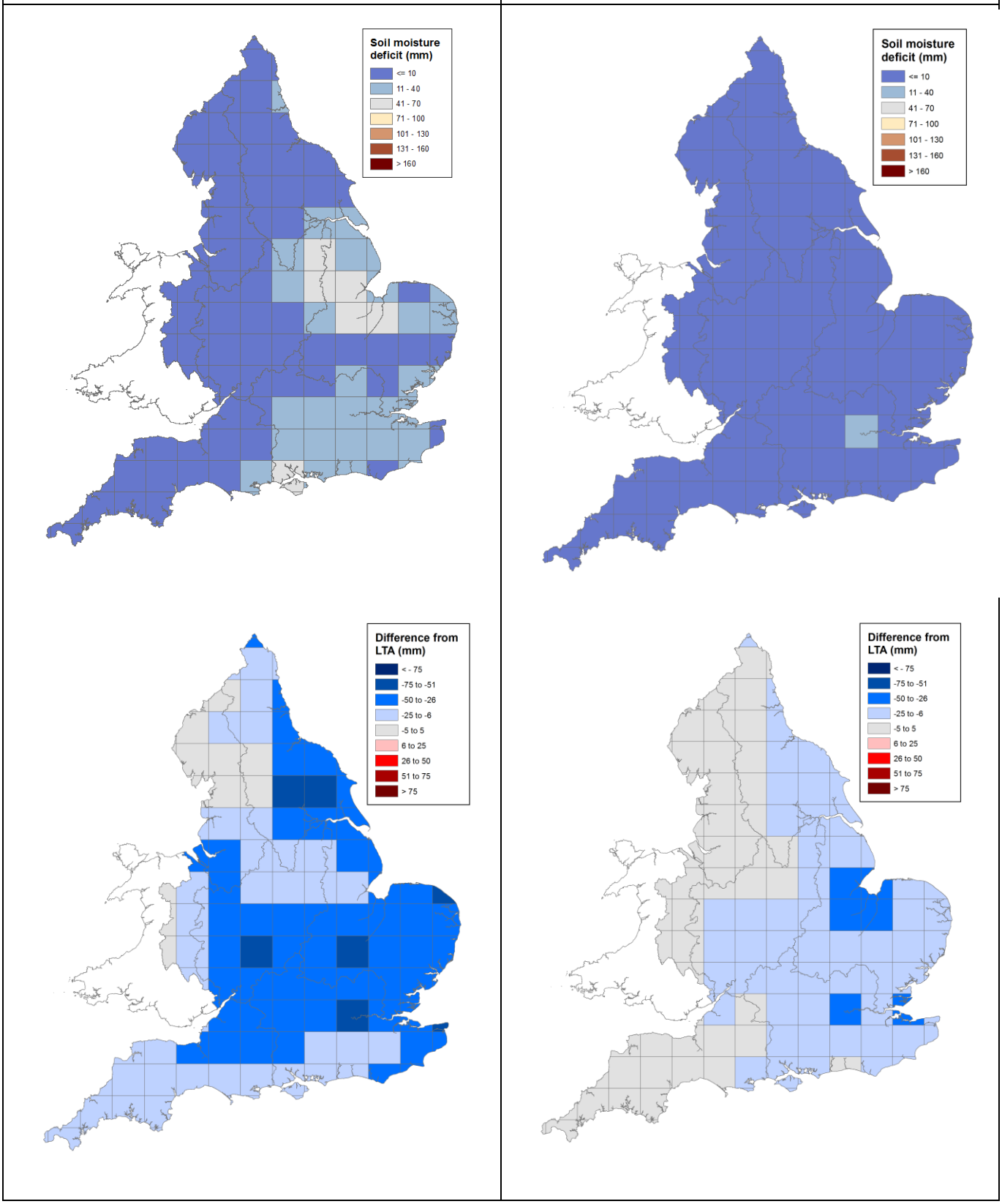
End of November 2020[1]	End of December 2020[2]
	

Figure 2.1: Soil moisture deficits for weeks ending 02 December 2020 [1] (left panel) and 29 December 2020 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961 to 90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2021). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021

Soil moisture deficit charts

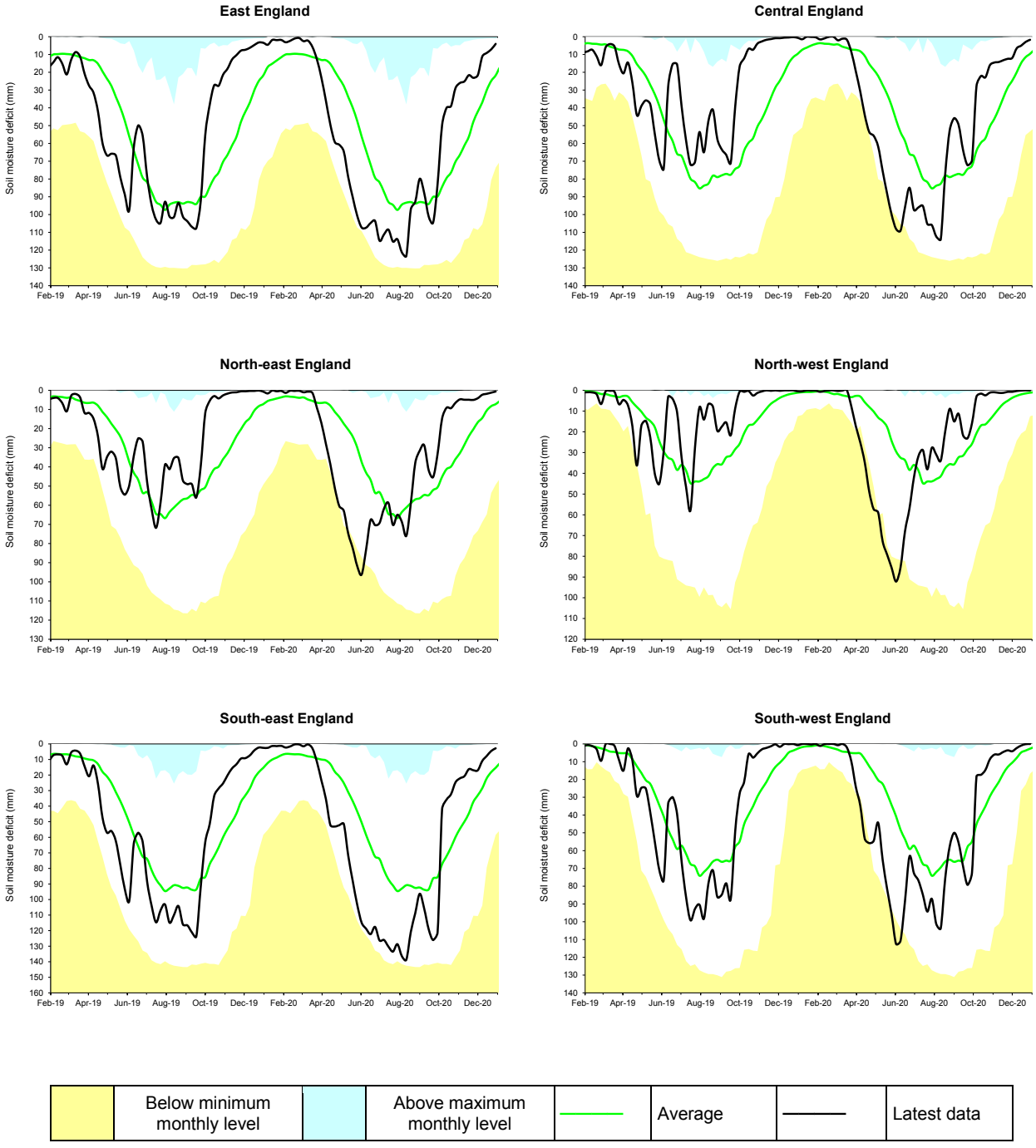
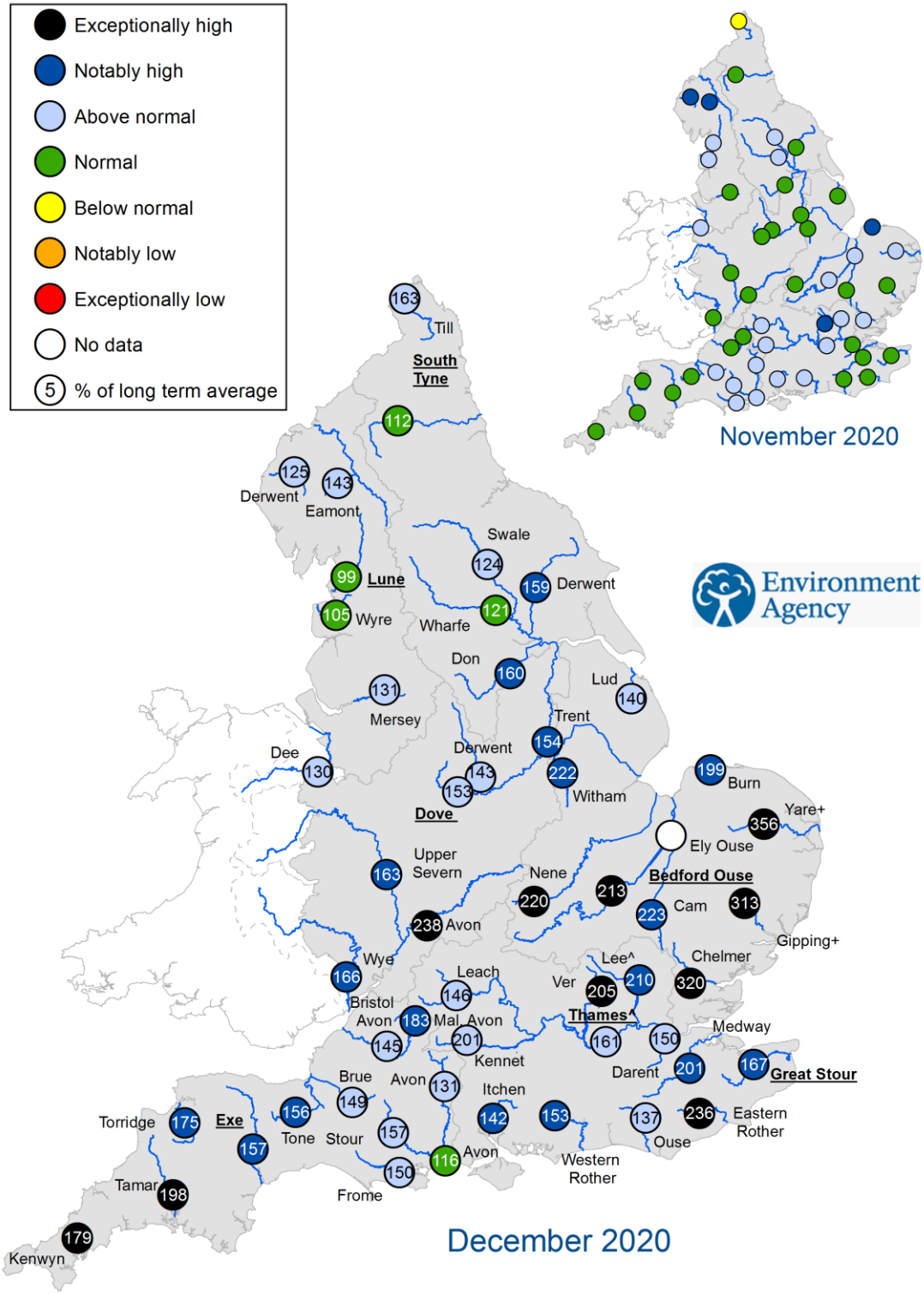


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961 to 90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2021).

River flows



^ "Naturalised" flows are provided for the River Thames at Kingston and the River 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 November 2020 and December 2020, expressed as a percentage of the respective long term average and classed relative to an analysis of historic November and December monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

River flow charts

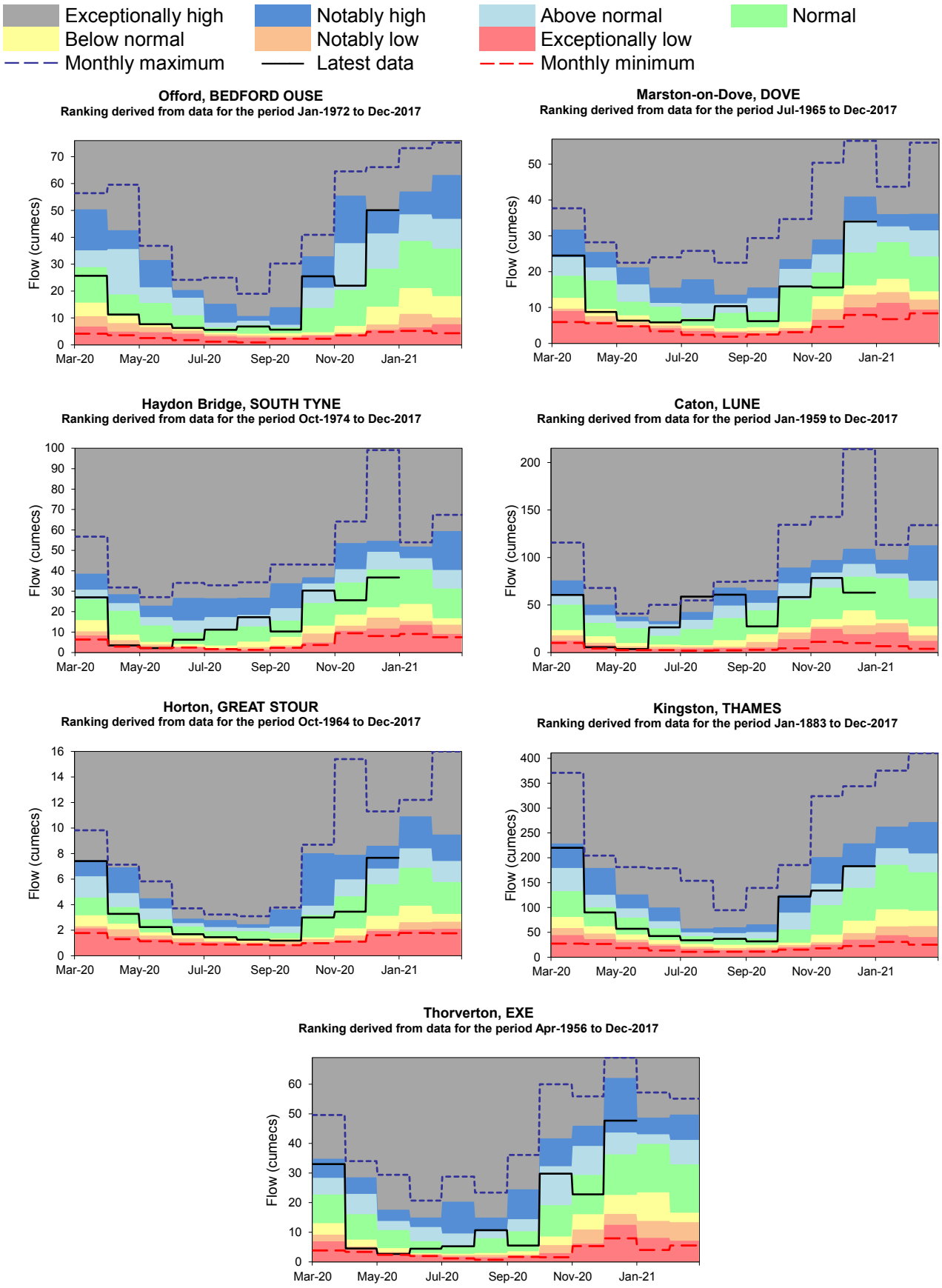
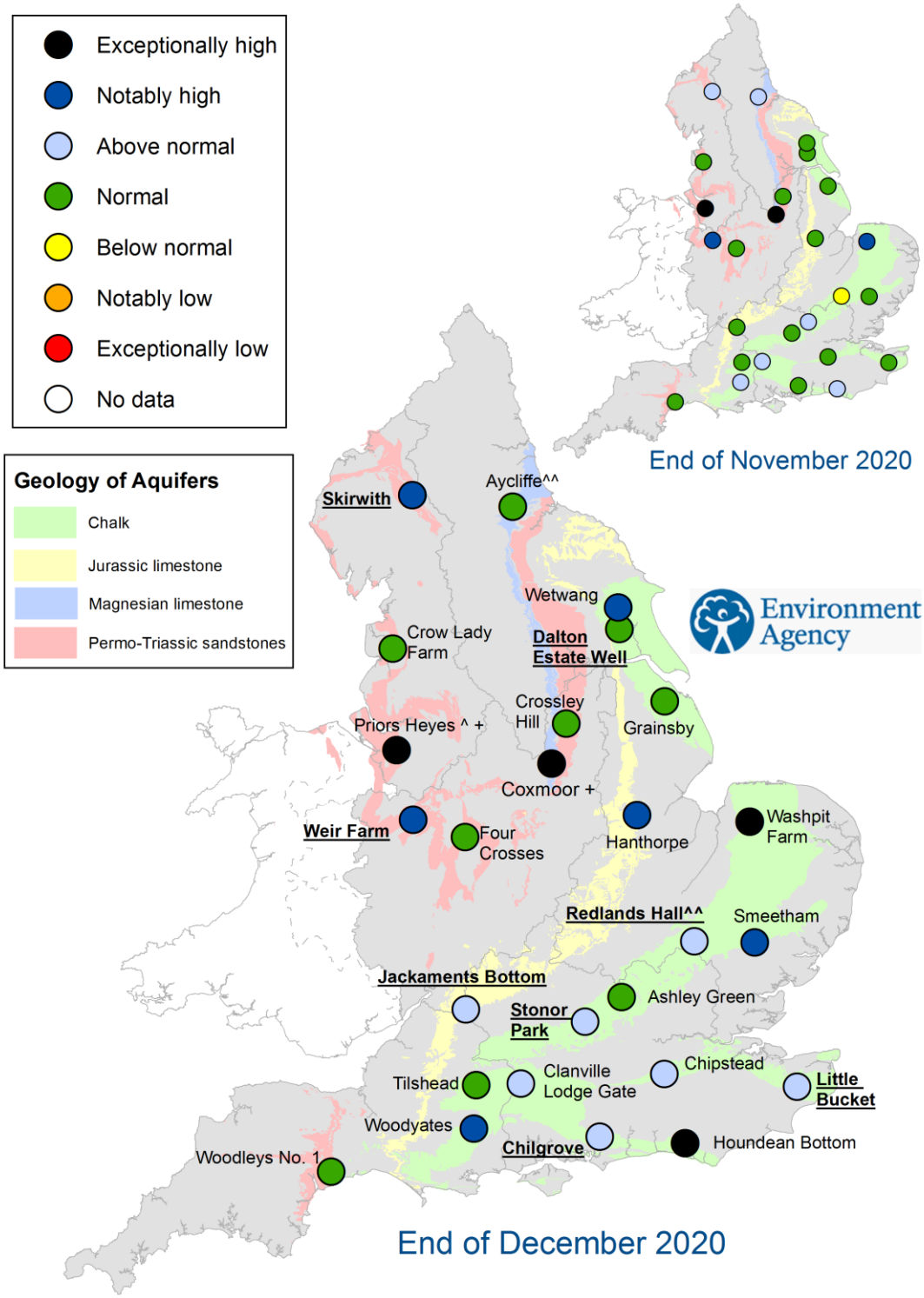


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
\+ End of month groundwater level is the highest on record for the current month (note that record length varies between sites).
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 November 2020 and December 2020, classed relative to an analysis of respective historic November and December levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

Groundwater level charts

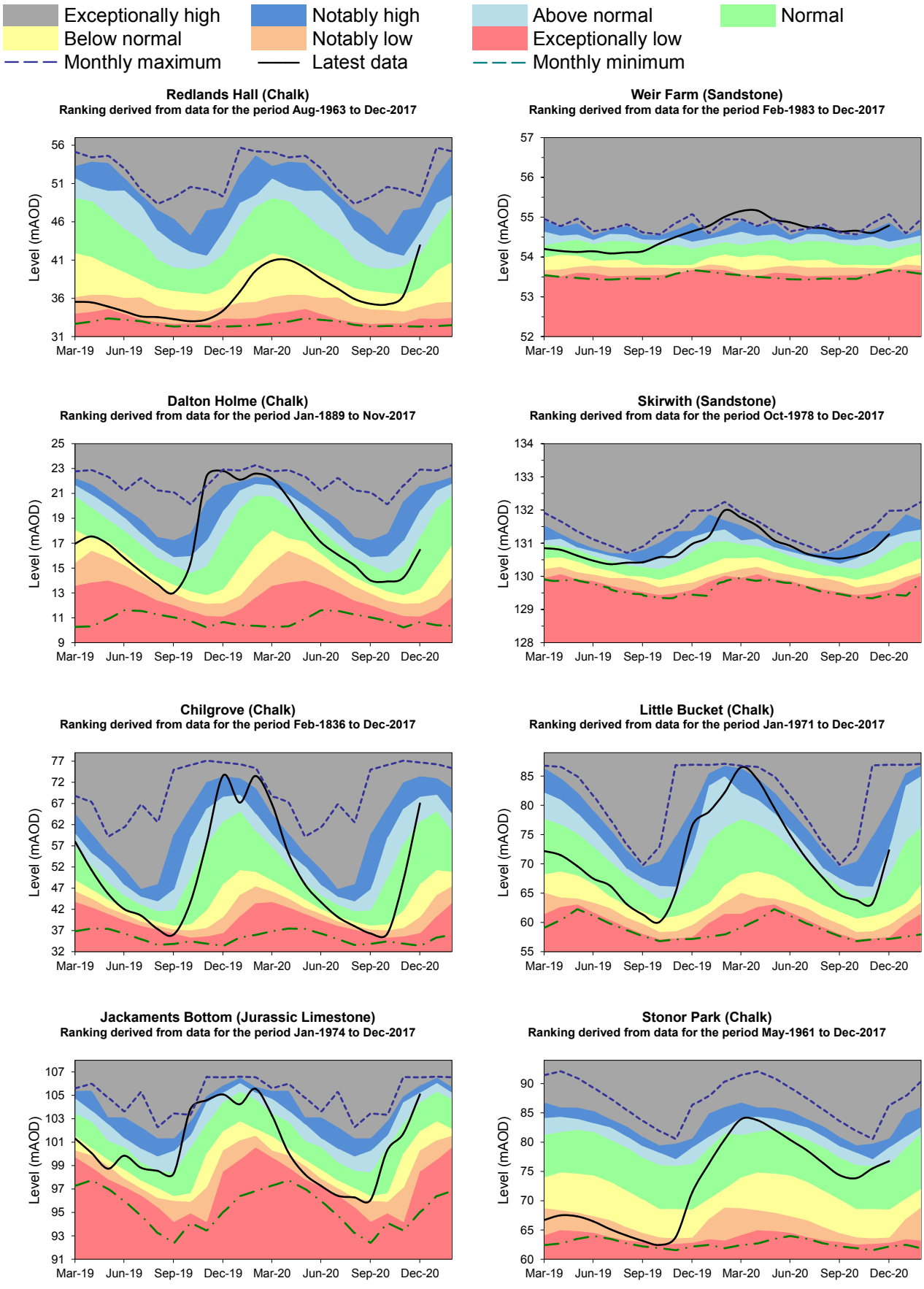
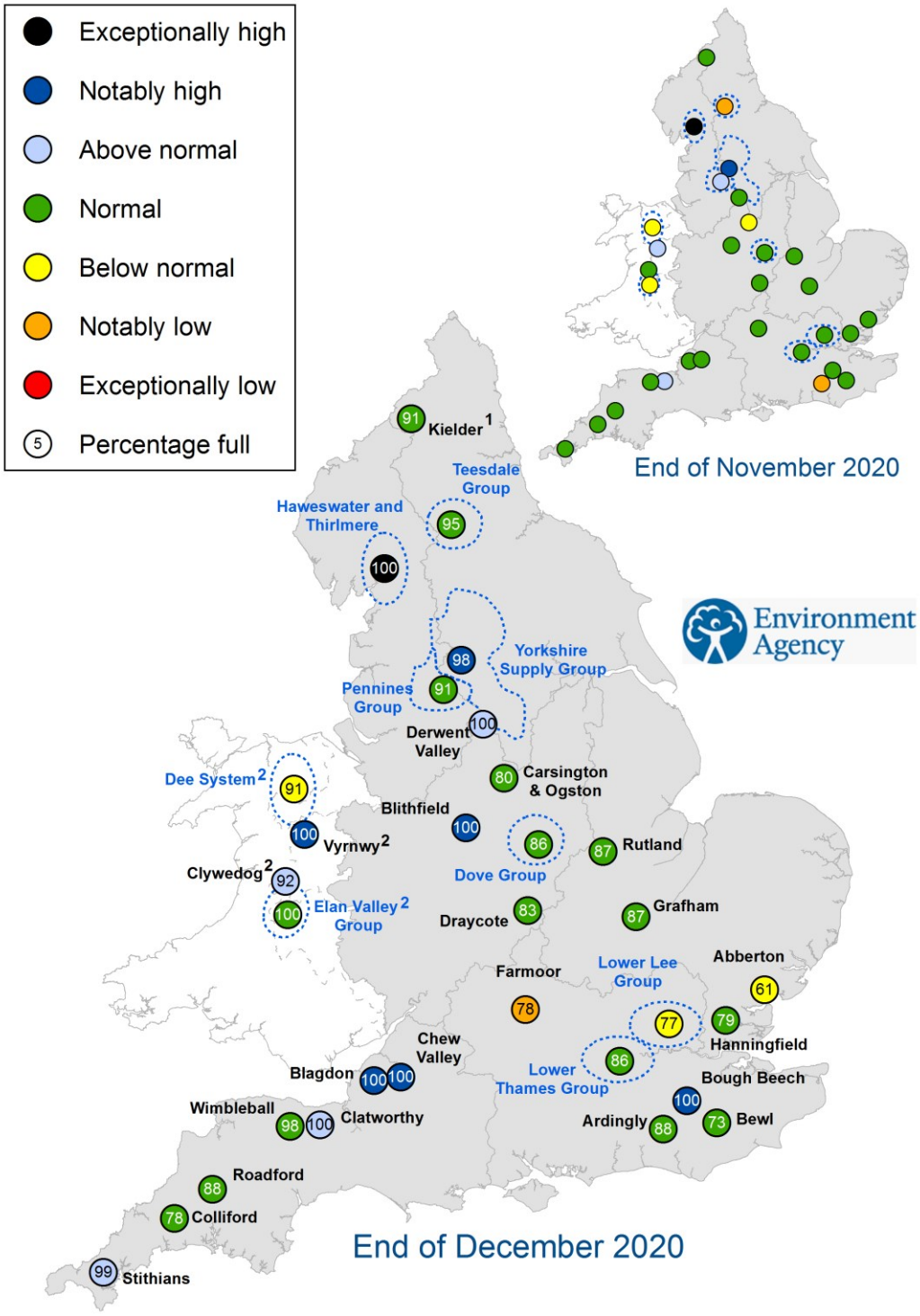


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2021).

Reservoir storage



1. Current levels at Kielder are lower than historical levels due to the implementation of a new flood alleviation control curve
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 November 2020 and December 2020 as a percentage of total capacity and classed relative to an analysis of historic November and December 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

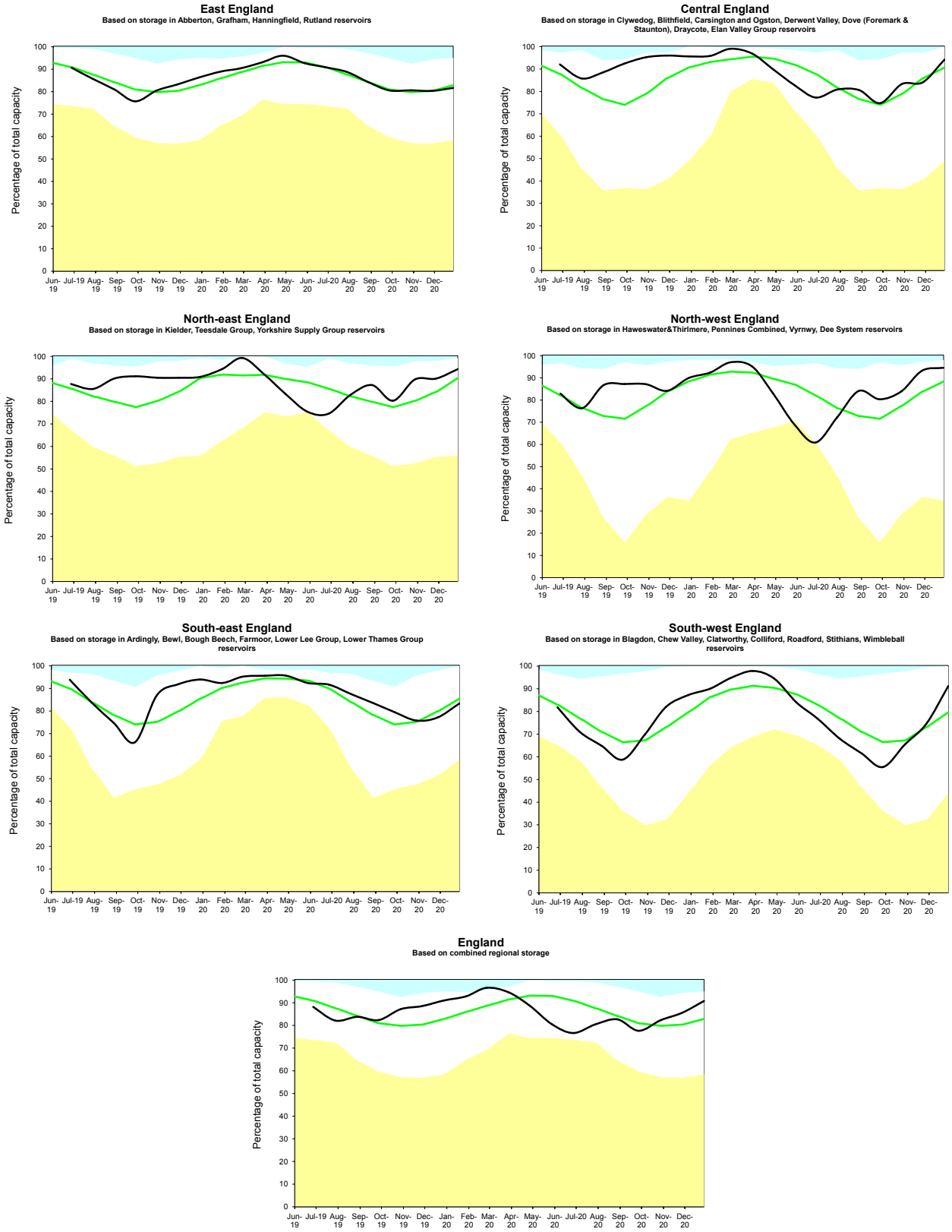


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look: river flow

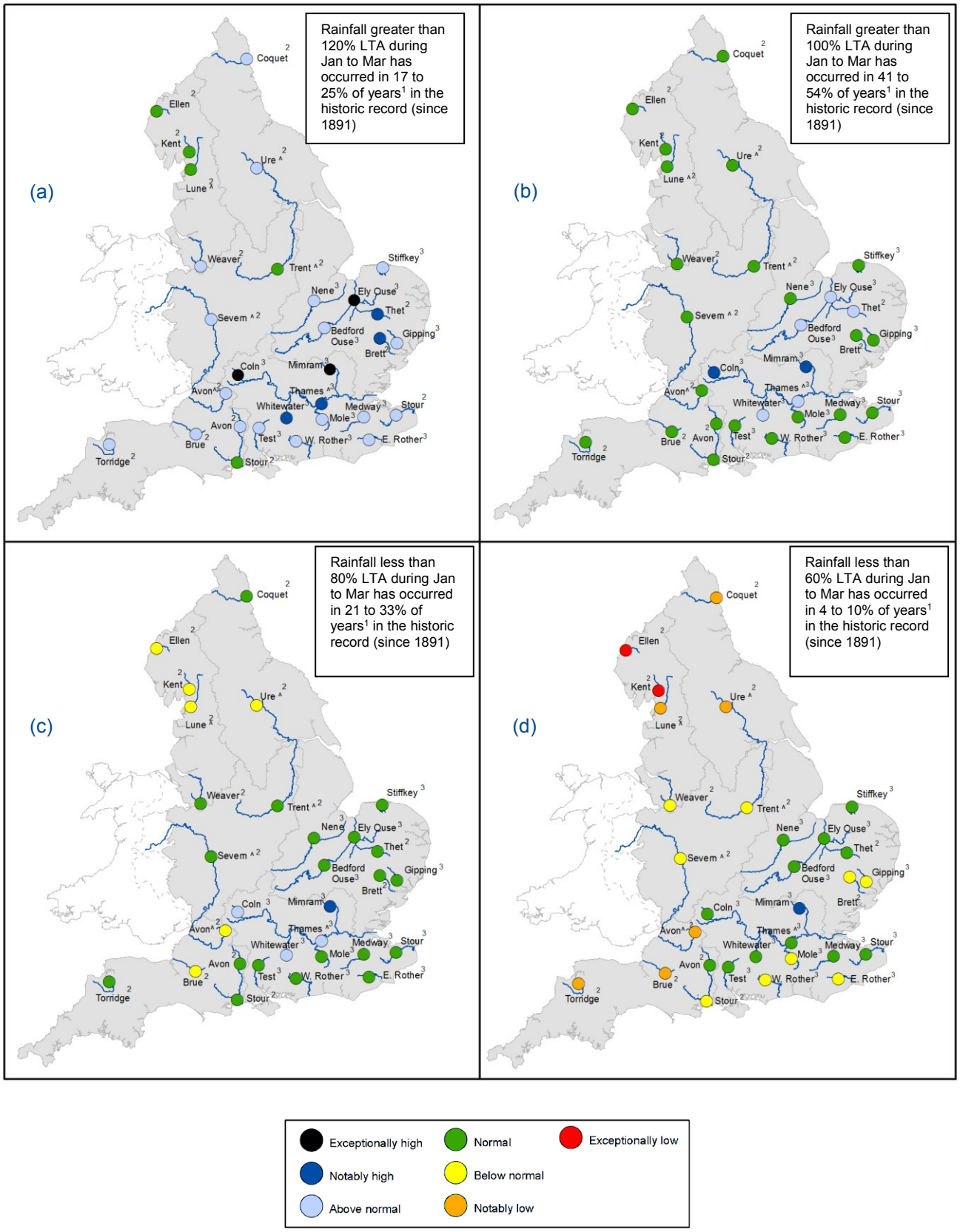


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between January 2021 and March 2021 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*

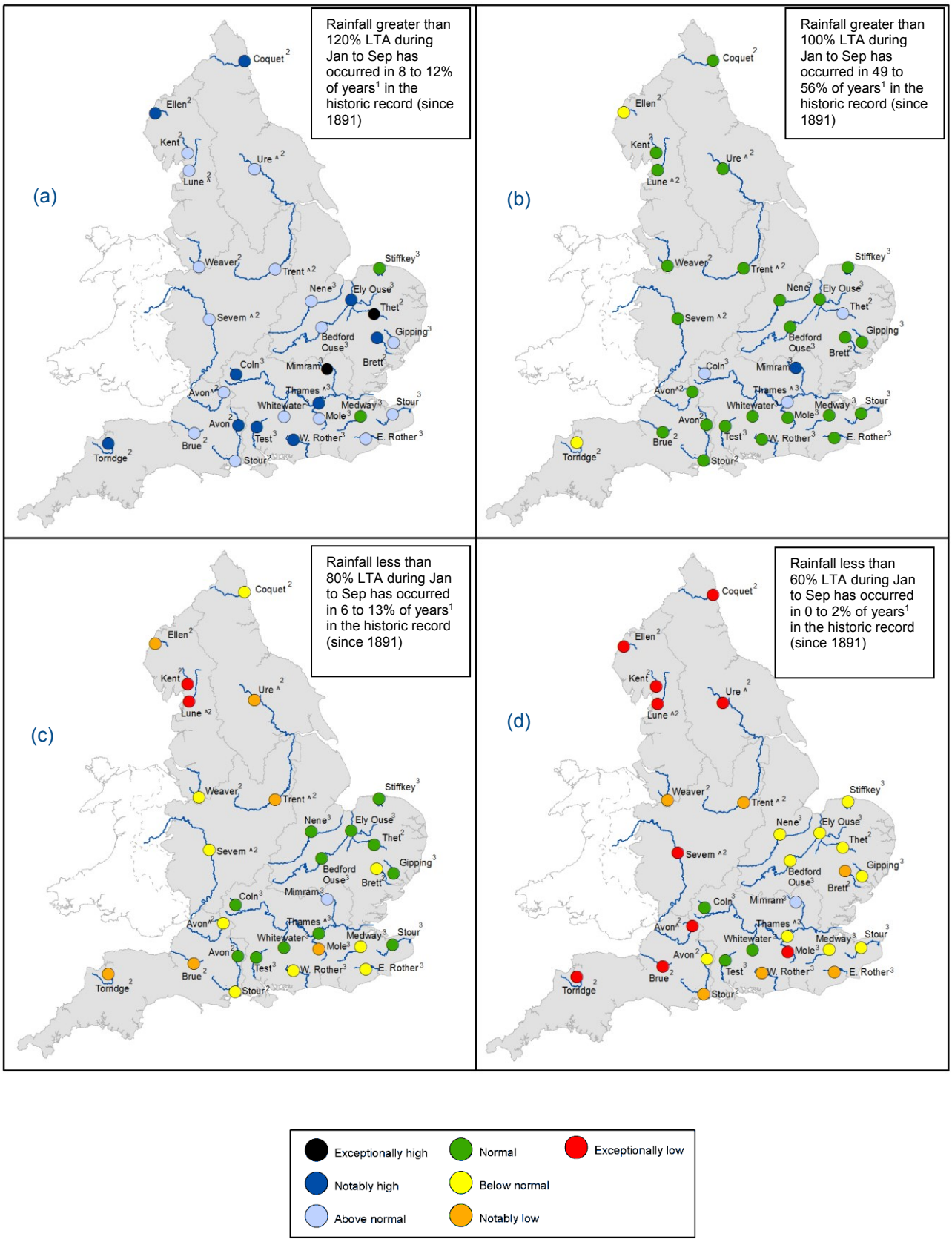


Figure 6.2: Projected river flows at key indicator sites up until the end of September 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between January 2021 and September 2021 (Source: Centre for Ecology and Hydrology, Environment Agency)

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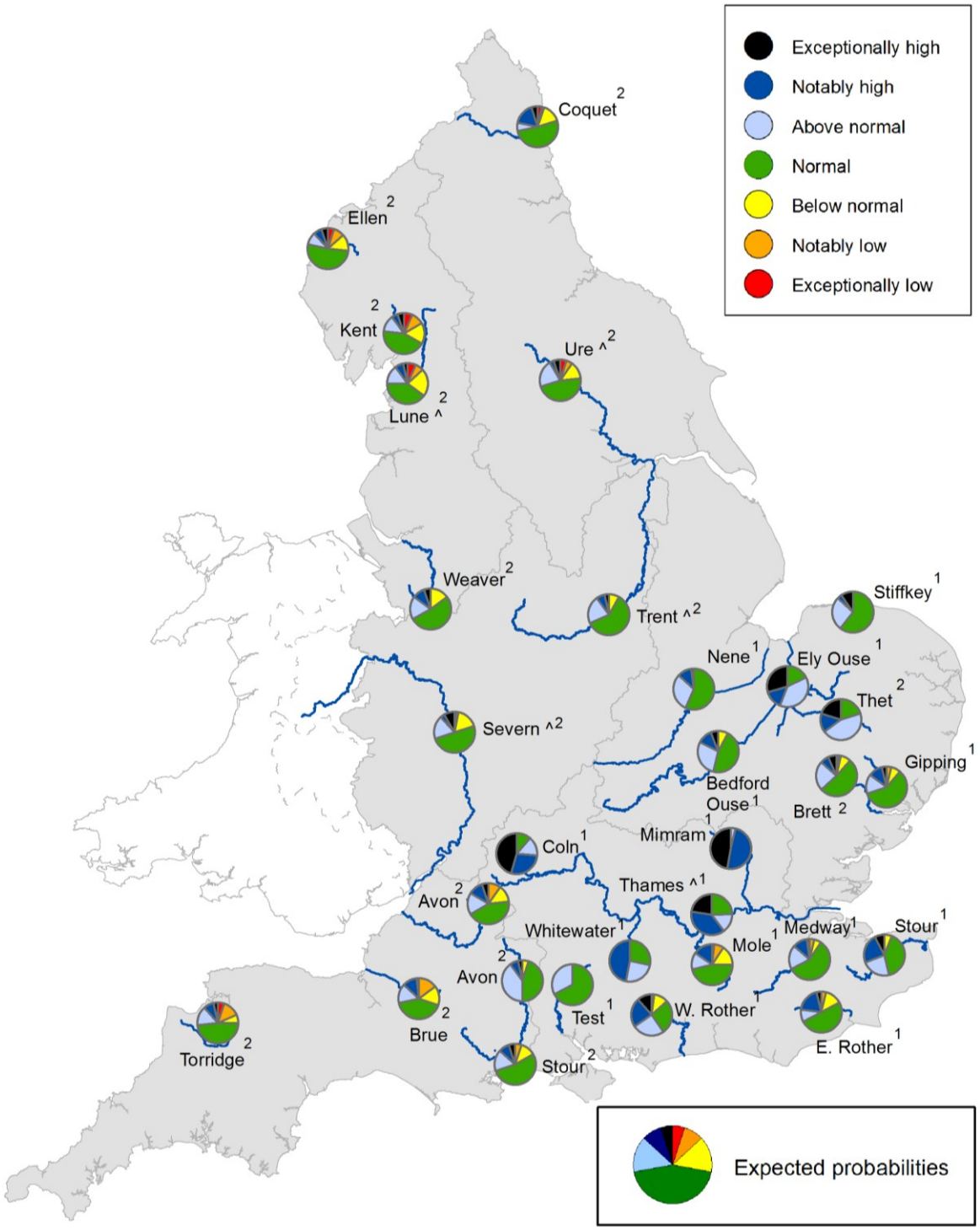

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 March 2021. 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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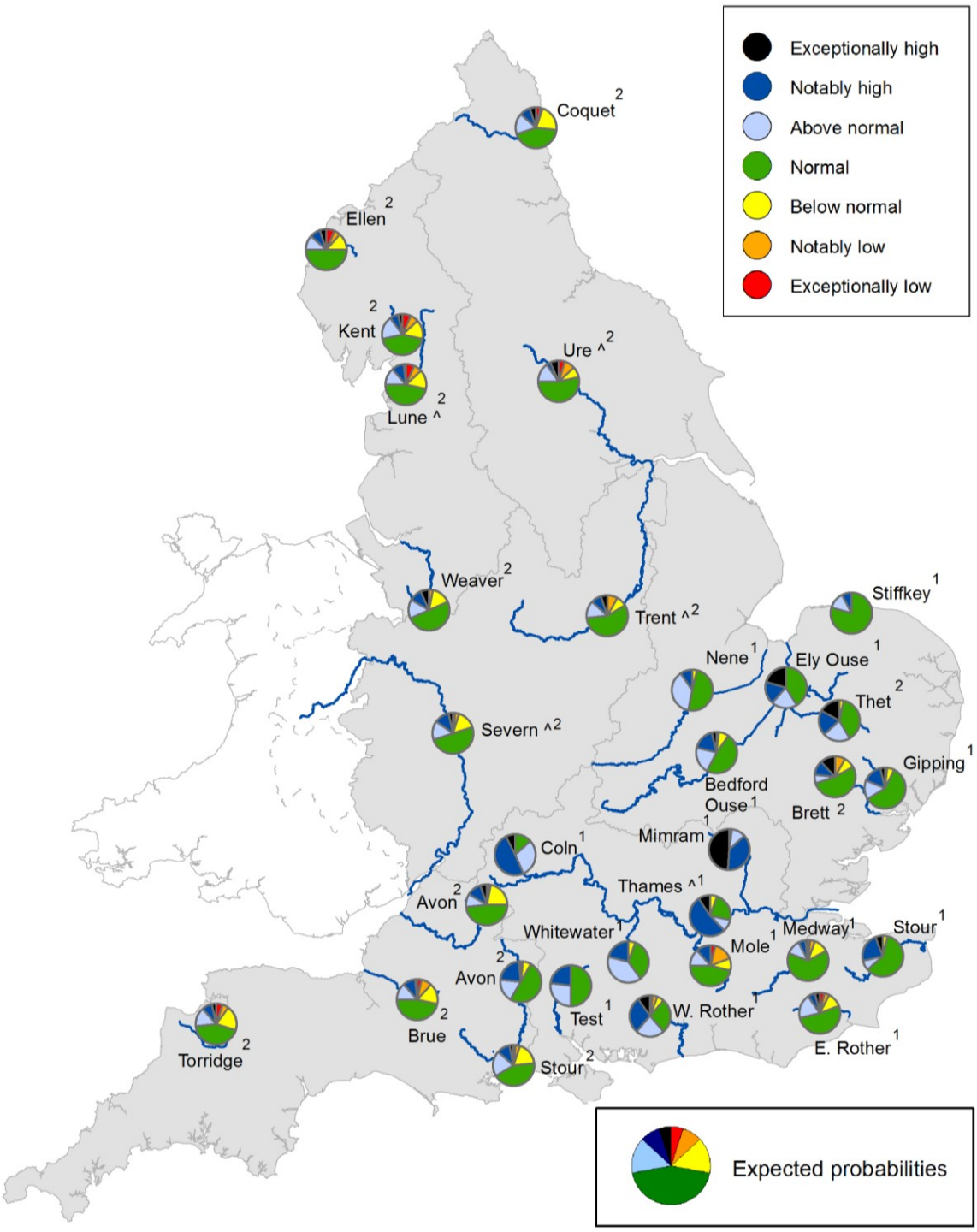

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2021. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for 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

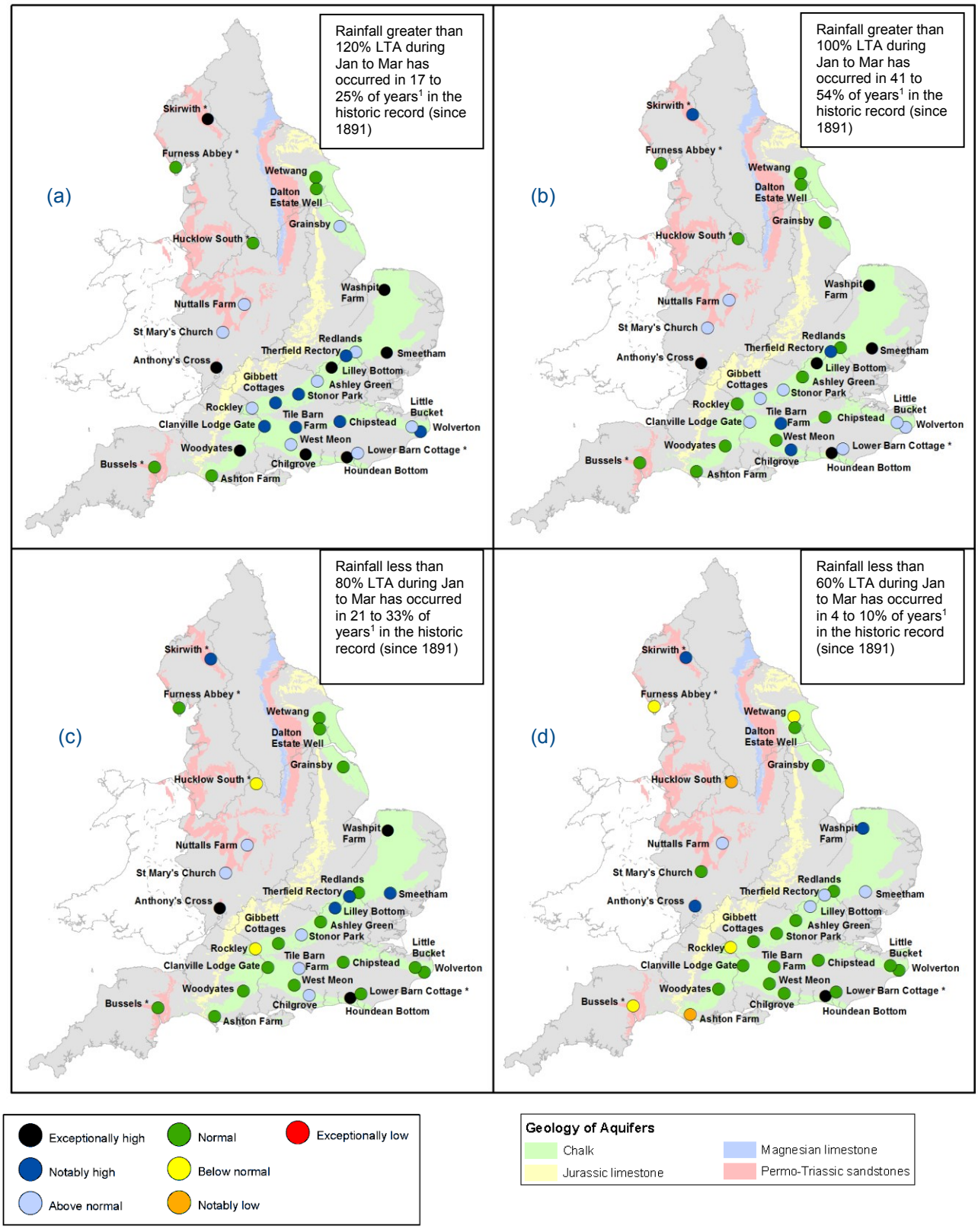

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between January 2021 and March 2021 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100024198, 2021.

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

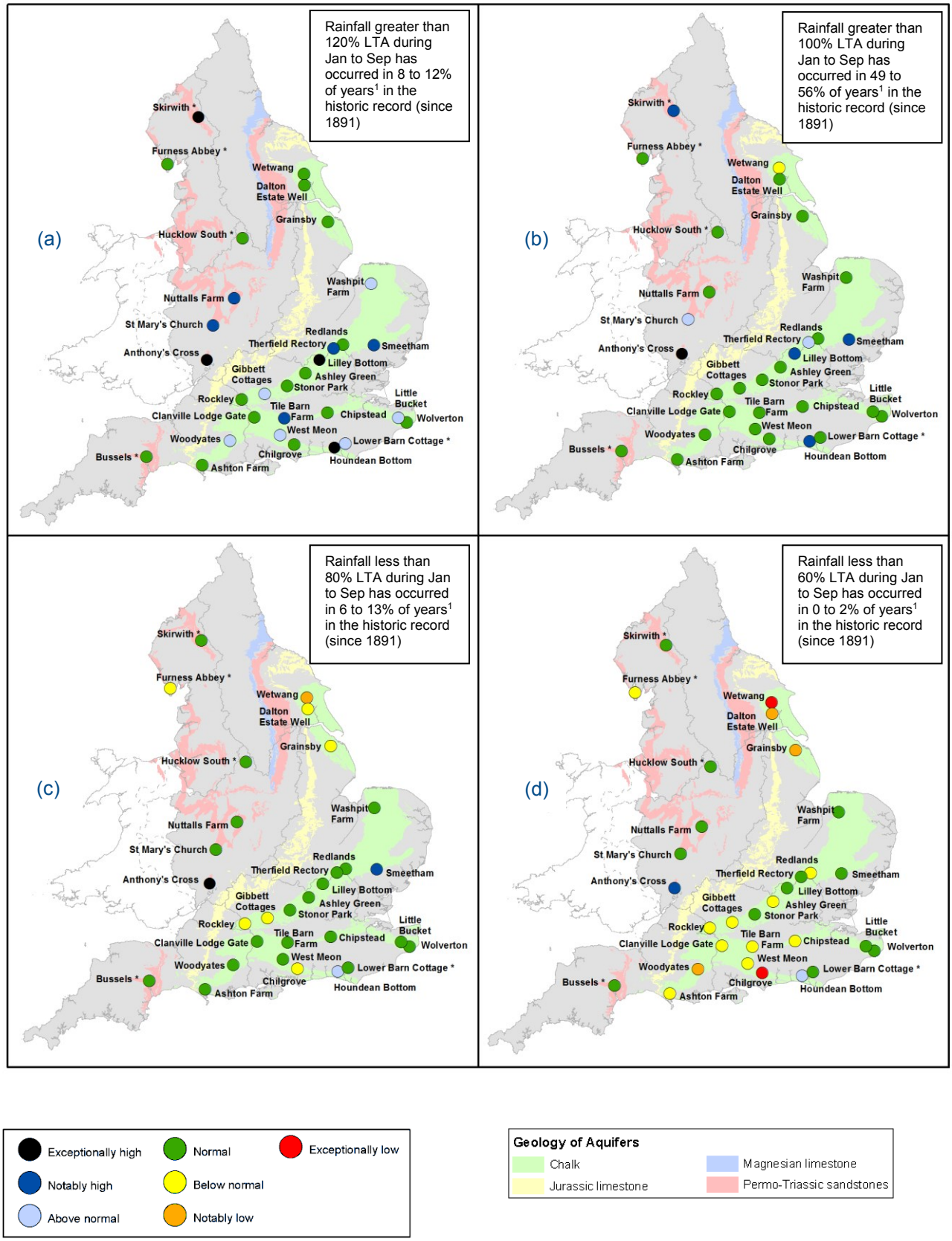

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between January 2021 and September 2021 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100024198 2021.

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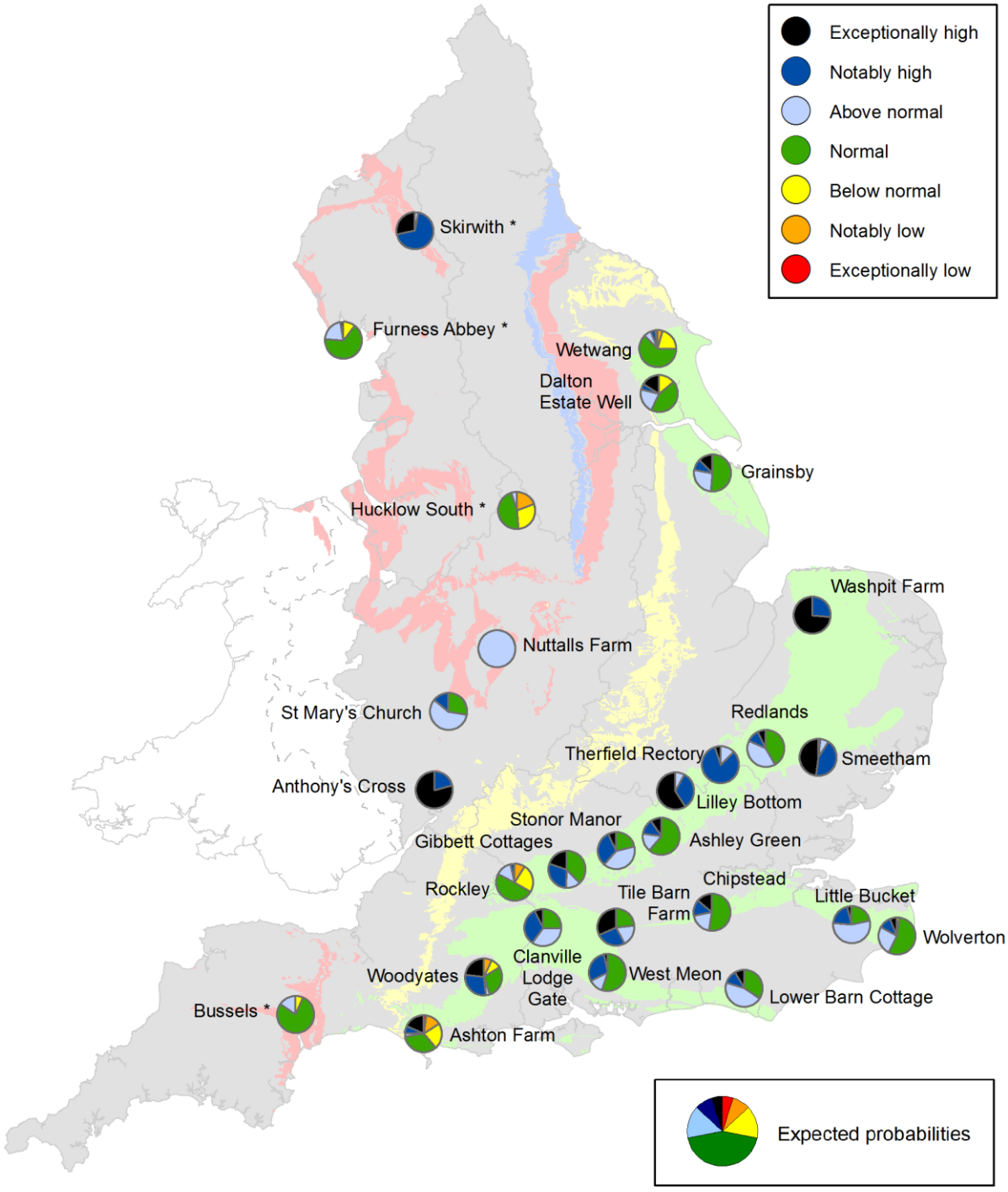
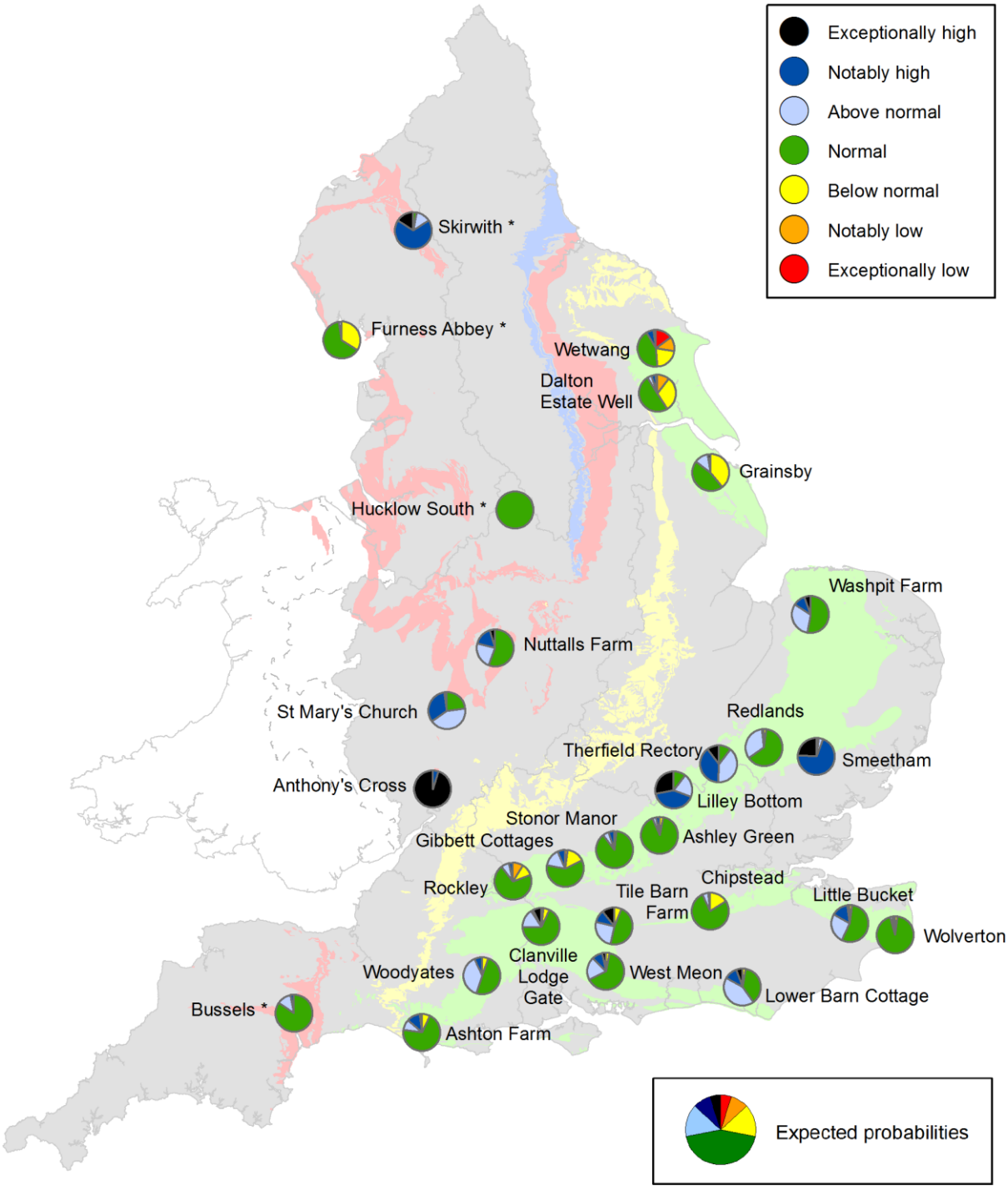
[1] This range of probabilities is a regional analysis



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 2021. 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, 100024198, 2021.

** 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 September 2021. 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, 100024198, 2021.

* 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 to 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