Environment Agency

Monthly water situation report

England

Summary – November 2019

Nearly all of England received above average rainfall during November, with some catchments receiving over double the average monthly total. In some catchments it was the wettest November on record. This is the third consecutive month with widespread wet conditions, the wettest autumn across England since 2000, and the fifth wettest on record. By the end of November, soils were wetter than average for the time of year across nearly all of the country. Monthly mean flows for November were classed as higher than normal at almost three-quarters of indicator sites. Groundwater levels at all reported sites are now showing signs of recovery from low levels as a result of recent rainfall following the cumulative impact of successive years of drier than average recharge. The total reservoir stocks across England increased during November and were at 89% of capacity at the end of the month.

Rainfall

The November rainfall total for England was 116 mm representing 141% of the 1961-90 long-term average LTA (132% of the 1981-2010 LTA). High rainfall totals were recorded in parts of central and north-east England. (Figure 1.1)

Nearly all catchments across England received above average rainfall during November. The highest rainfall totals as a percentage of LTA were recorded in the Don catchment in north-east England (253% of LTA) – the third consecutive month of exceptionally high rainfall here. It was the wettest November on record (using records from 1891) in 5 hydrological areas catchments including the Don, Lower Trent, Louth, Witham, Steeping/Great and Long Eau (Lincolnshire). The lowest November rainfall totals as a percentage of LTA were recorded in a group of 7 catchments in north-west England (totals ranged from 64-76% of LTA); for most of these catchments these were classed as below normal rainfall totals for November.

Over the past 3 and 6 months cumulative rainfall totals have been exceptionally high for much of central and north-east England. It has been the wettest autumn on record in 8 hydrological areas including the 5 where it was the wettest November. It has been the wettest summer and autumn (6 month) period across 15 hydrological areas. Over the past 12 months the Lee Chalk catchment in Hertfordshire remains the only catchment with cumulative rainfall classed as below normal. (Figure 1.2)

At a regional scale, November rainfall totals were above average in all regions apart from north-west England and were classed as notably high in central and north-east England. (Figure 1.3)

Soil moisture deficit

Soils got wetter across most of England during November. By the end of the month, soils moisture deficits across nearly all of England were smaller than average (soils were wetter than average). (Figure 2.1)

At the regional scale, soils at the end of November were wetter than average in all regions. All regions now have soil moisture deficits which are less than 10 mm. (Figure 2.2)

River flows

Monthly mean river flows increased at over three-quarters of indicator sites, relative to October (a wet month itself). Most of the sites where flows decreased were in north-west England reflecting the lower rainfall in this part of the country during November. The River Derwent at Ouse Bridge and the River Eamont at Pooley Bridge both saw lower monthly mean flows and at both indicator sites the flow class changed from normal to below normal. (Figure 3.1)

November monthly mean flows were classed as higher than normal at almost three-quarters of indicator sites. Flows on the River Don at Doncaster (record since 1959) and the River Lud at Louth Weir (record since 1968) both recorded their highest monthly mean flows on record for any month. Flows on the Upper Witham at Claypole (record since 1959), the River Avon at Evesham (record since 1936), the River Till at Heaton Mill (record since 2002) and the River Kenwyn at Truro (record since 1968) all recorded monthly mean flows which were the highest on record for November. Flows on the River Cam (Cambridgeshire) were classed as exceptionally low for November; flows here have been classed as either notably low or exceptionally low since September 2018 and this reflects lower than normal groundwater levels in the area. (Figure 3.1), (Figure 3.2)

Groundwater levels

Groundwater levels increased at all but one indicator site during November. By the end of November, groundwater levels at just over three-quarters of indicator sites were classed as normal or higher for the time of year; this contrasts with just under two-thirds of sites at the end of October (Figures 4.1 and 4.2).

For the first time this year all groundwater level indicator sites have started to show signs of recovery from low levels from the cumulative impact of successive years of drier than average recharge. The very wet autumn has seen groundwater levels rise slightly earlier than in typical years. In the Cam and Ely Ouse chalk aquifer at Redlands Hall and the East Chilterns chalk aquifer at Ashley Green, groundwater levels started to rise during November and while the former was still classed as notably low the latter had changed to below normal for the time of year at the end of the month. In the South West Chilterns Chalk aquifer at Stonor Park groundwater levels rose significantly and changed from exceptionally low to below normal. Groundwater levels in the Otter Sandstone aquifer (Devon) at Woodleys No.1 have started to rise and the class has changed from notably low to normal. (Figures 4.1 and 4.2)

Near the east coast the Northern Chalk at Grainsby, the Witham Jurassic Limestone at Hanthorpe and the Hull & East Riding Chalk at the Dalton Estate Well all recorded their highest groundwater levels on record for November.

Reservoir storage

Reservoir stocks increased at over half of reported reservoirs and reservoir groups during November. The end of month reservoir stocks were classed as lower than normal at only four of the reported reservoirs and reservoir groups. Of these, Roadford in south-west England and Hanningfield in east England ended the month at 64% and 59% of total storage capacity respectively. The biggest increase in reservoir stocks, as a proportion of total capacity, were seen in the Bough Beech and Ardingly reservoirs in south-east England – both with a 31% increase (Figure 5.1).

At the end of November one fifth of reported reservoirs and reservoir groups had stocks classed as exceptionally high for the time of year.

The total reservoir stocks across England were at 89% of capacity at the end of November. This is a slight increase from the end of October. At a regional scale, total reservoir stocks were at or above the long-term average in all regions; they ranged from 82% of total capacity in south-west England to 96% of total capacity in central England, at the end of October (Figure 5.2).

Forward look

December is forecast to start with widespread showers. From the middle of the month it is likely to become colder – although remaining wet. The chance of heavy rain will be greatest in south-east England at first but becoming wetter in north-west England by the end of the month. Temperatures are likely to be warmer by the start of January and south-east England will be more likely to experience drier conditions than the rest of England.

For the three month period December to February, above average precipitation is more likely than below average. Above average temperatures are also more likely than below average[1].

Projections for river flows at key sites[2]

Over two-thirds of 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 2020. By the end of September 2020, over two-thirds of modelled sites have a greater than expected chance of flows being normal or higher for the time of year.

For scenario based projections of cumulative river flows at key sites by March 2020 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2020 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2020 see Figure 6.3

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 September 2020 see Figure 6.4

Projections for groundwater levels in key aquifers[2]
Around twenty percent of modelled sites have a greater than expected chance of groundwater levels being below normal or lower for the time of year by the end of March 2020. By the end of September 2020, around one quarter of modelled sites have a greater than expected chance of groundwater levels being below normal or lower for the time of year.

For scenario based projections of groundwater levels in key aquifers in March 2020 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2020 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2020 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2020 see Figure 6.8

Authors: National Water Resources Hydrology Team

Rainfall

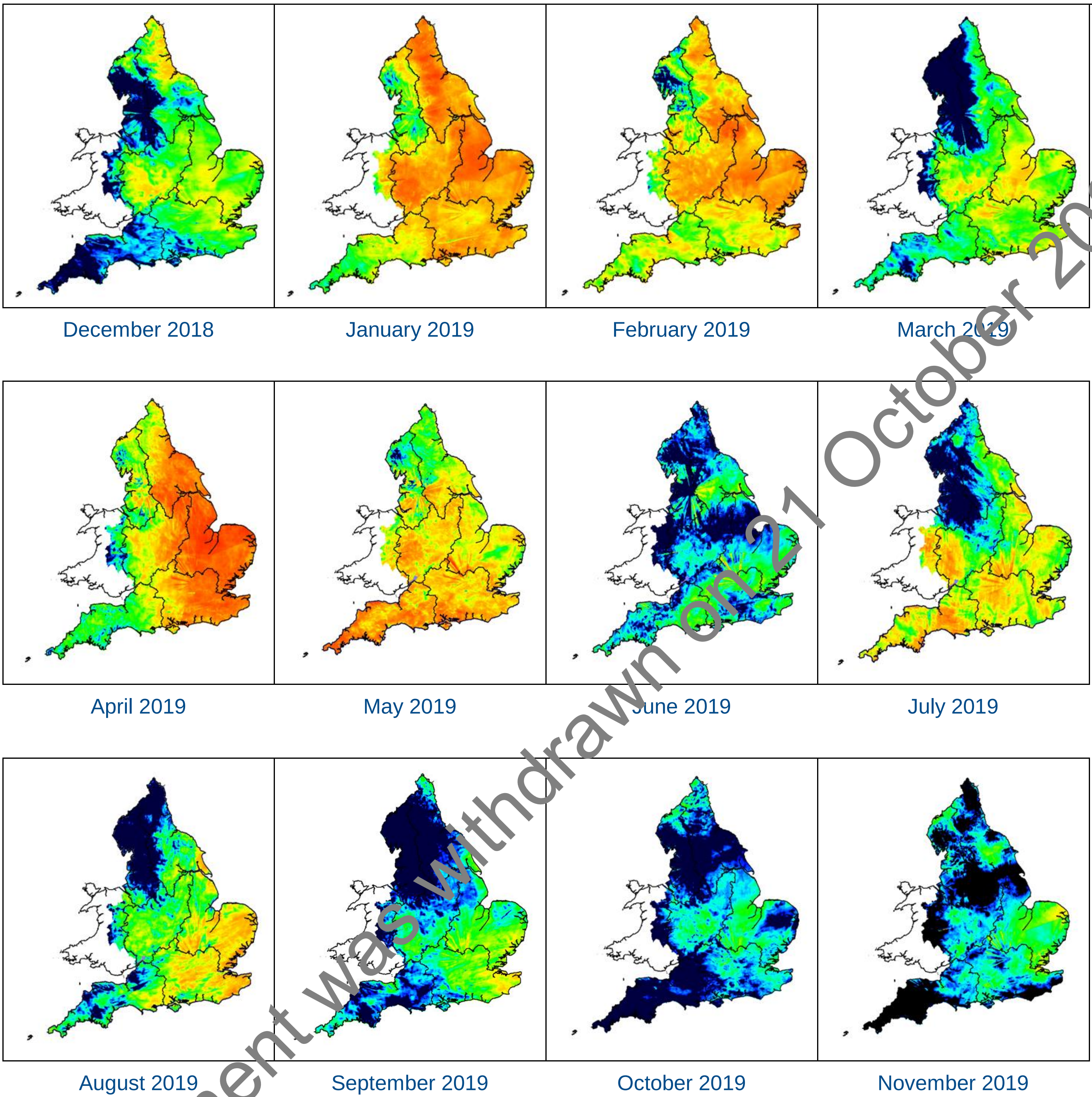
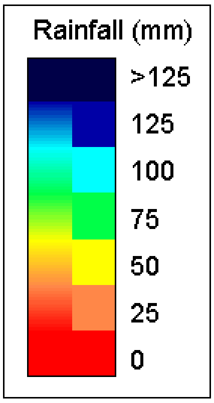


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2019). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.



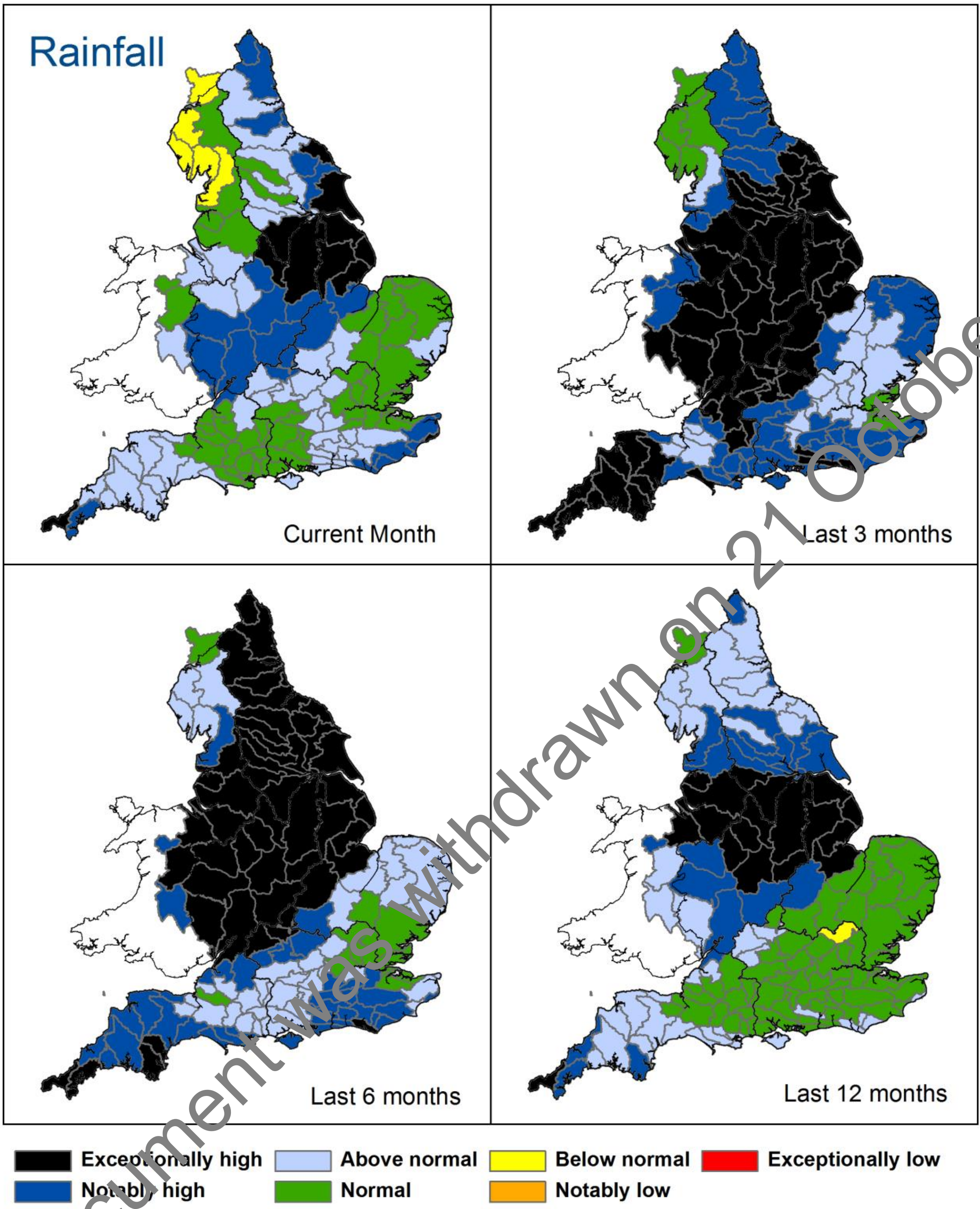


Figure 1.2: Total rainfall for hydrological areas across England for the current month, the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 2019).* 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, 2019.

Rainfall charts

Above average rainfall | Below average rainfall

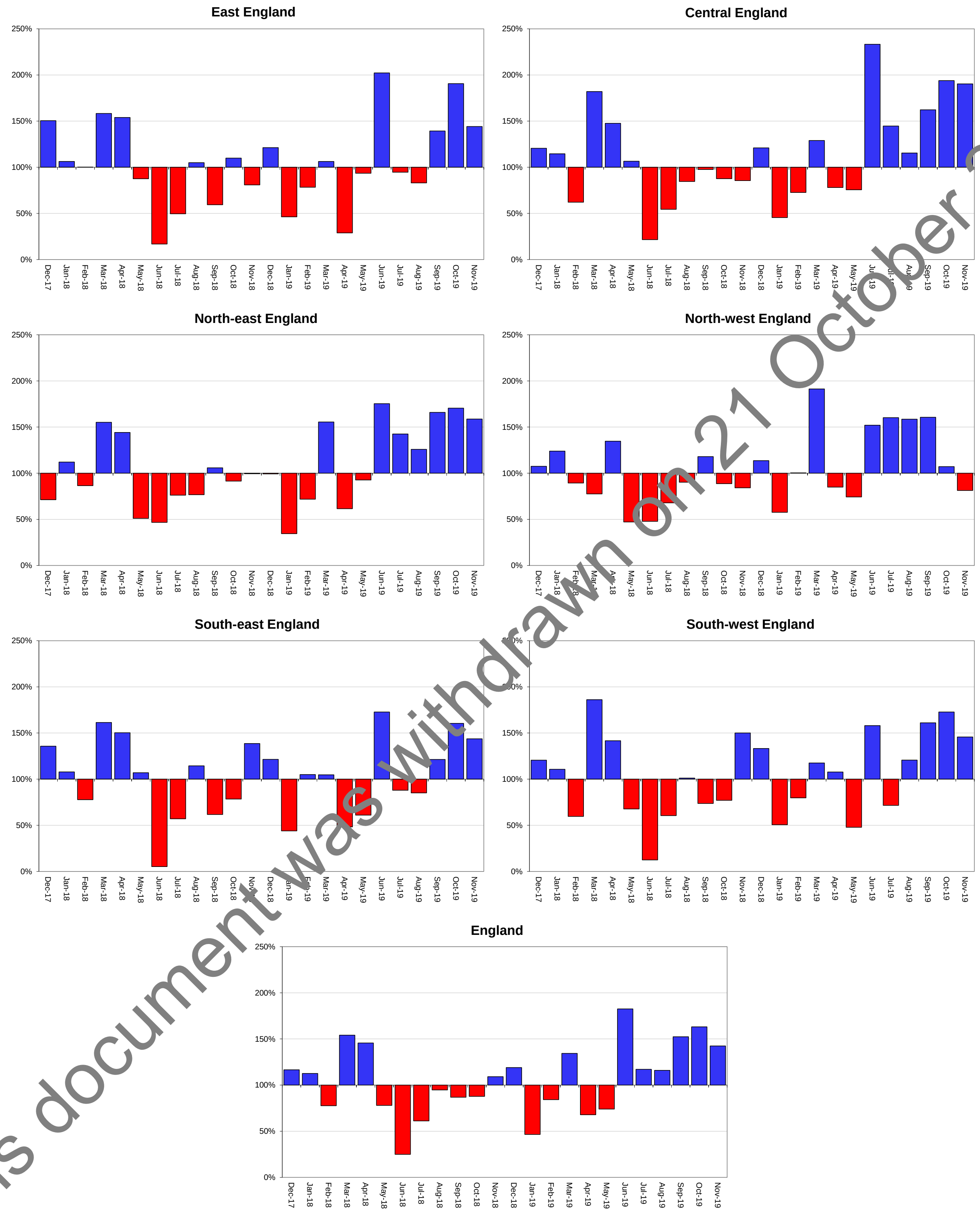


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2019).

Soil moisture deficit

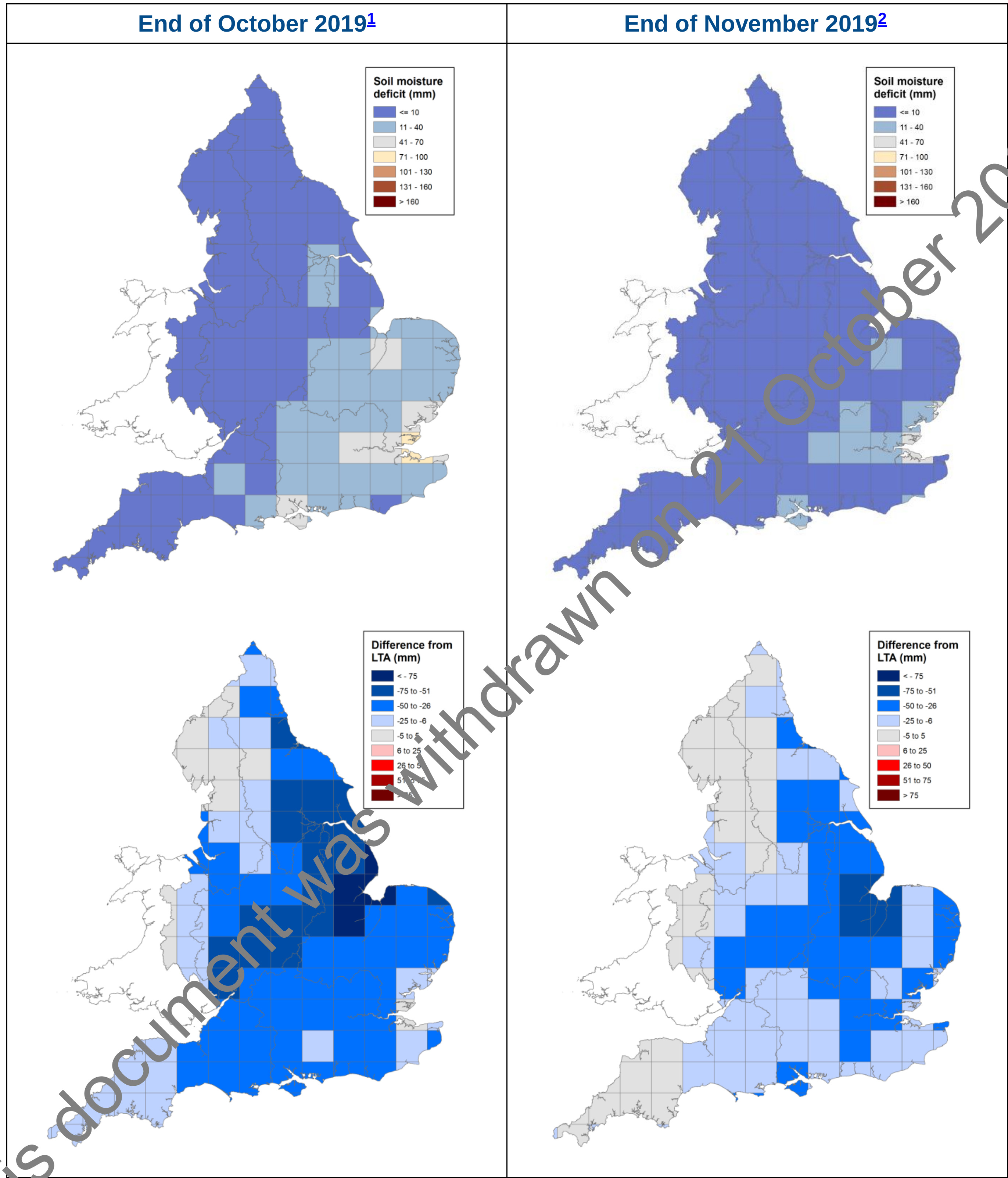


Figure 2.1: Soil moisture deficits for weeks ending 29 October 2019 [1] (left panel) and 29 November 2019 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2019). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019

Soil moisture deficit charts

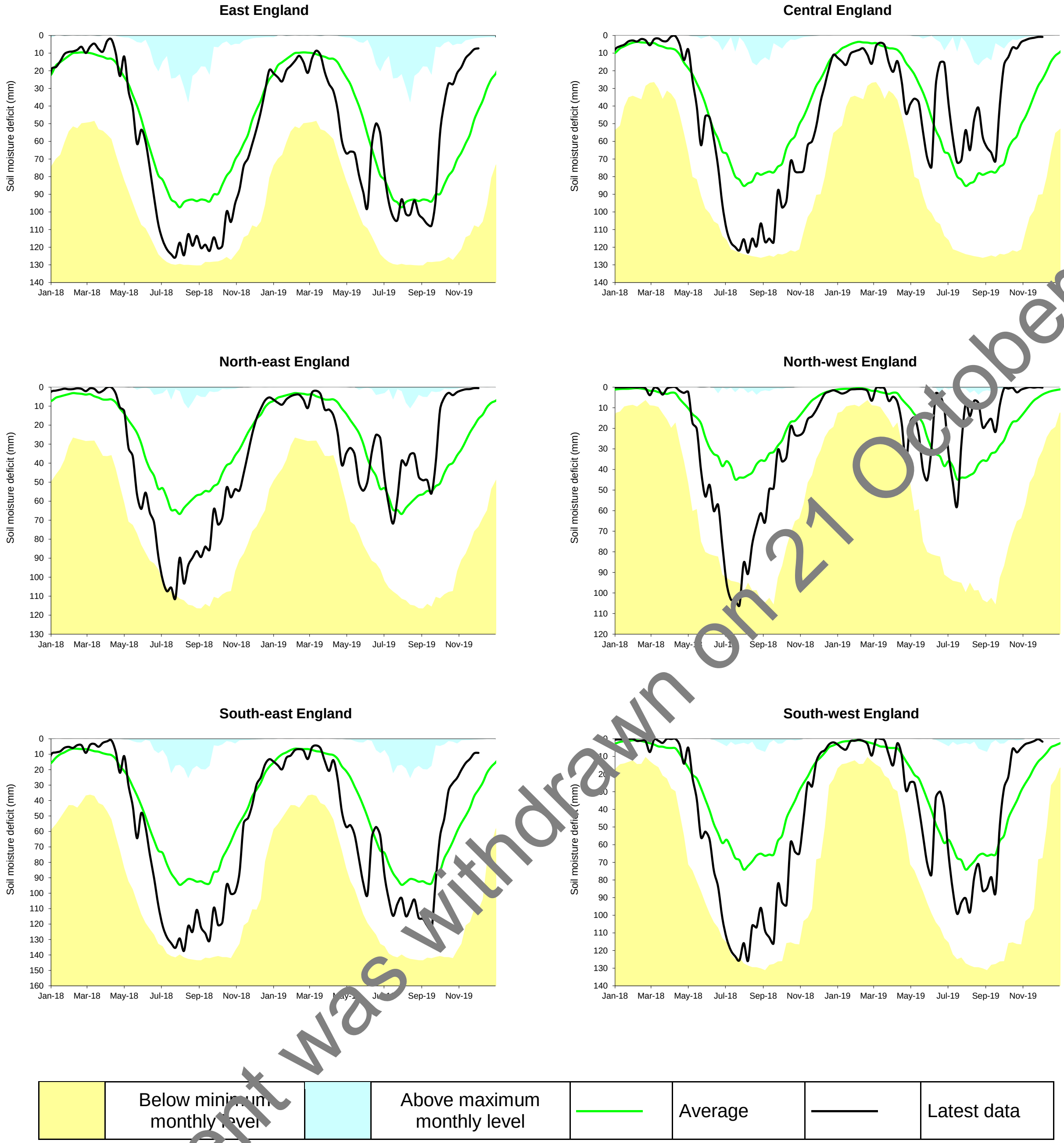
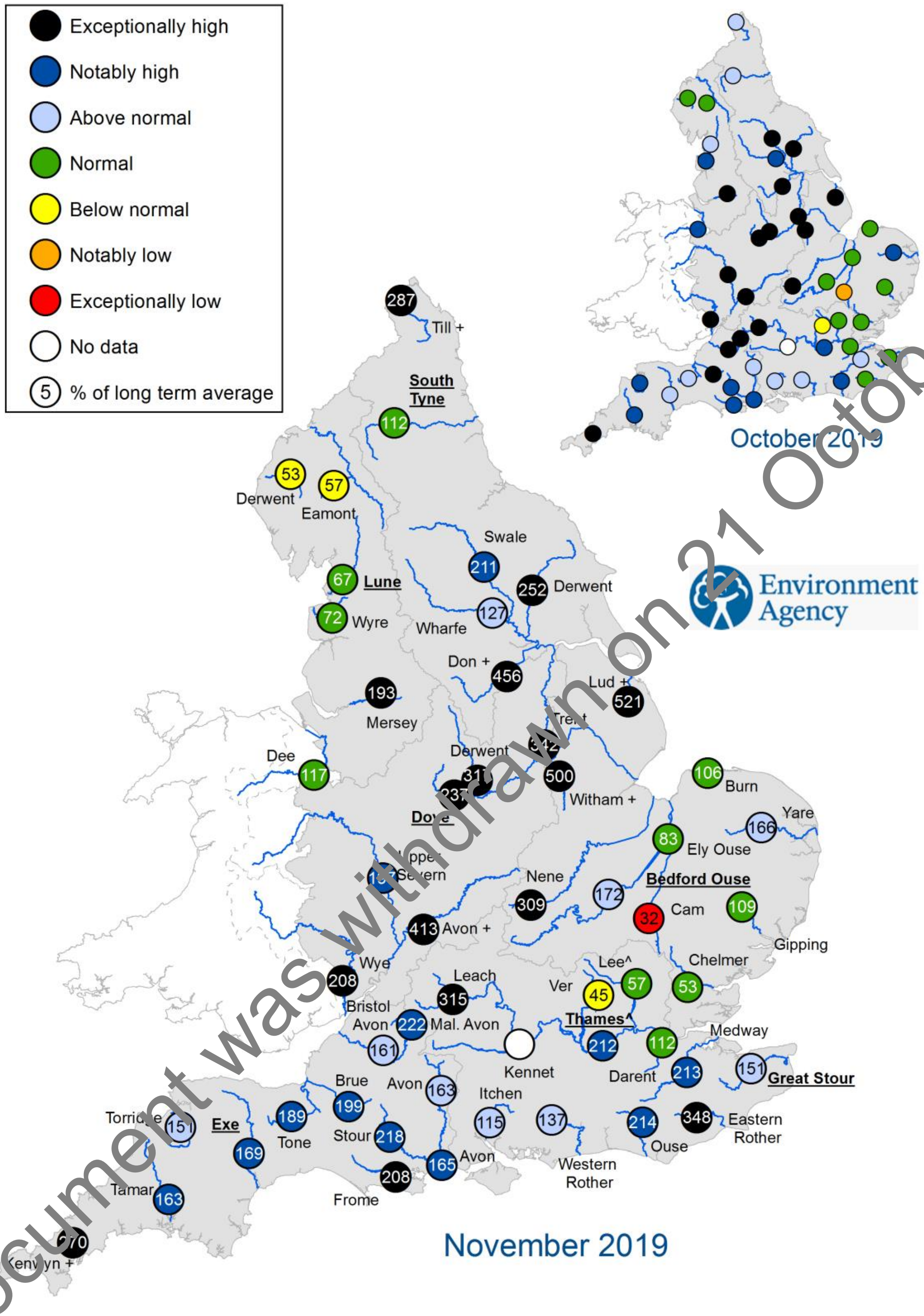


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2019).

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 October 2019 and November 2019, expressed as a percentage of the respective long term average and classed relative to an analysis of historic October and November monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.

River flow charts

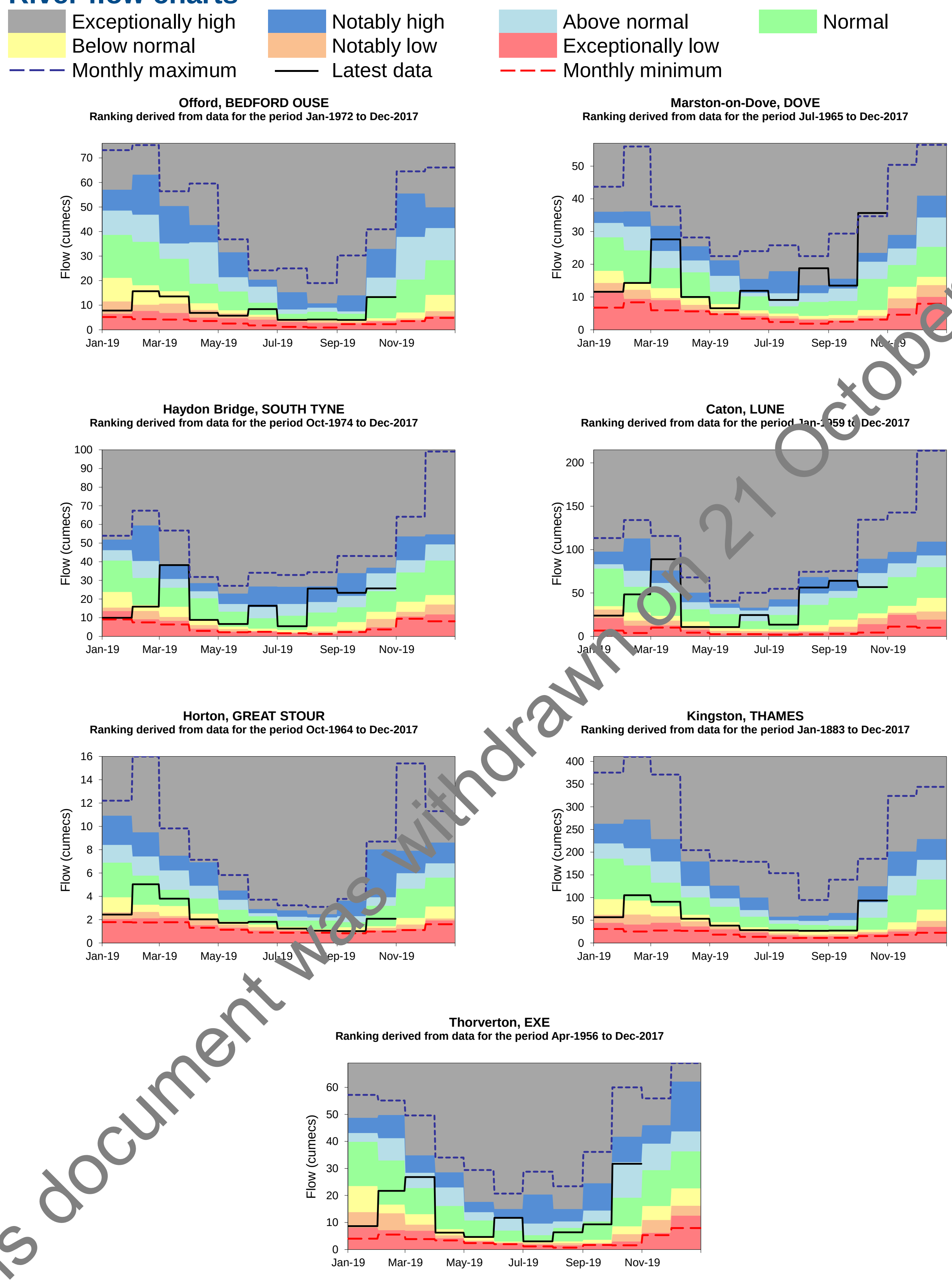
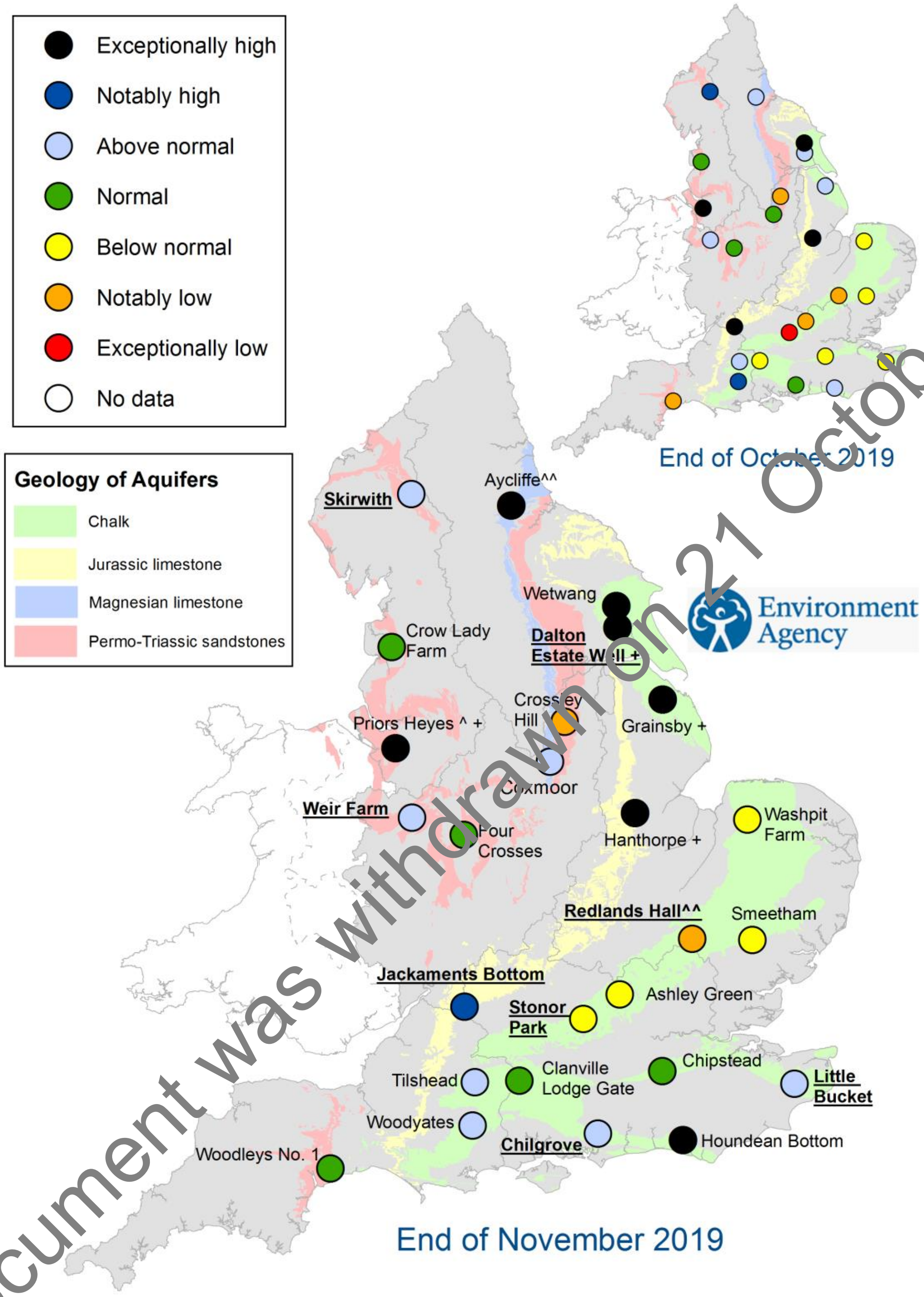


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 October 2019 and November 2019, classed relative to an analysis of respective historic October and November levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.

Groundwater level charts

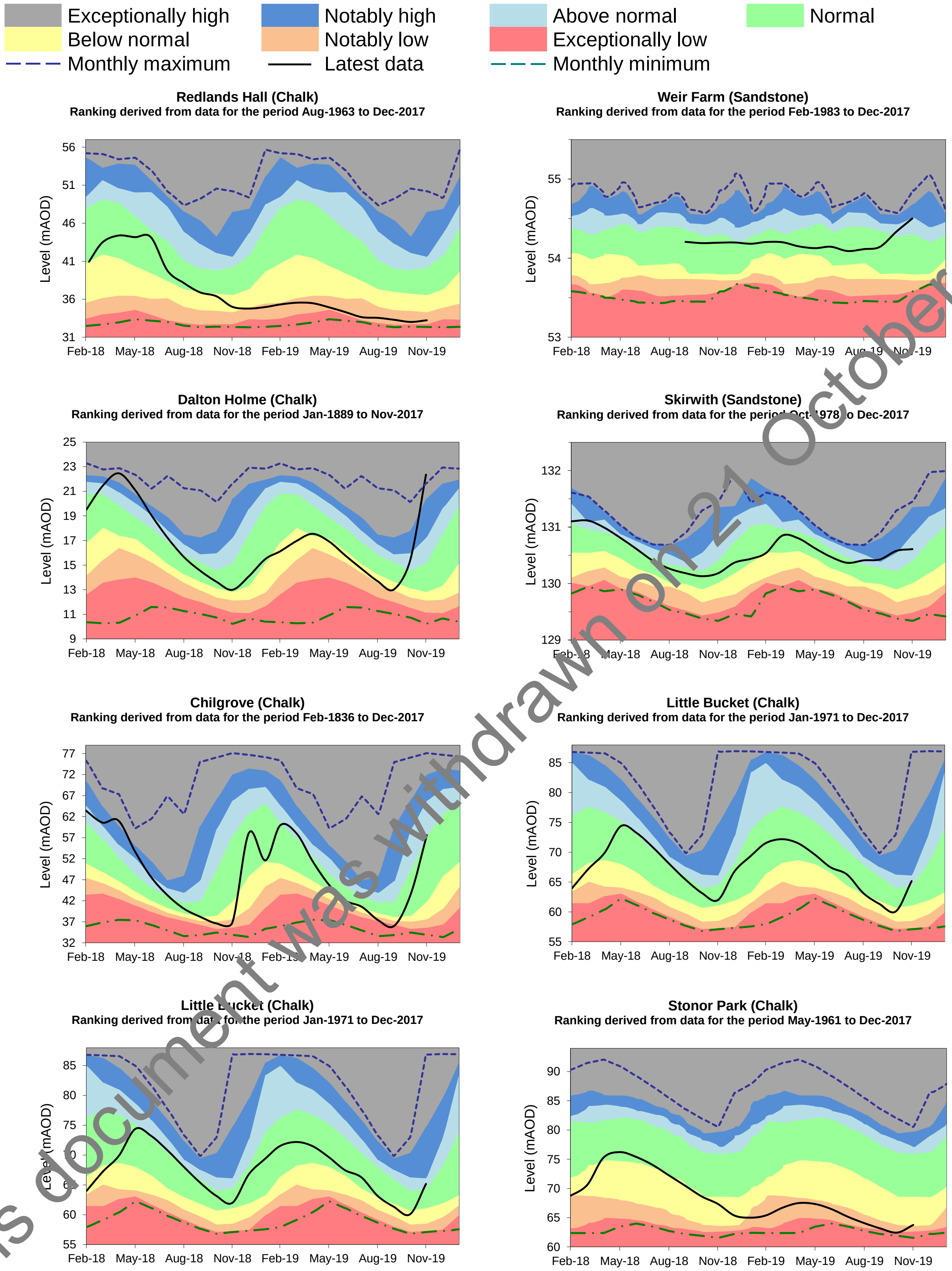
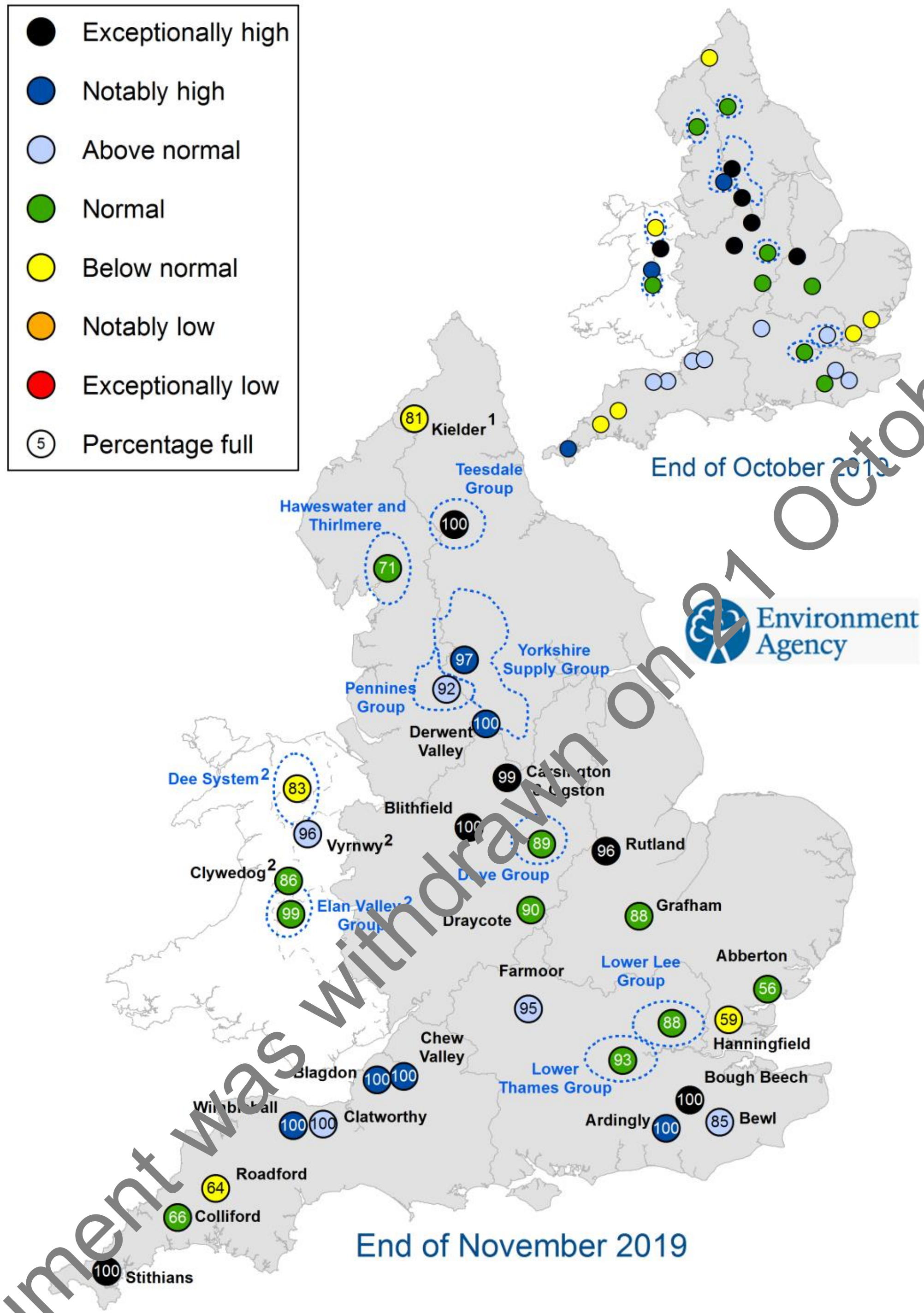


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2019).

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 October 2019 and November 2019 as a percentage of total capacity and classed relative to an analysis of historic October and November 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, 2019.

Reservoir storage charts

	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

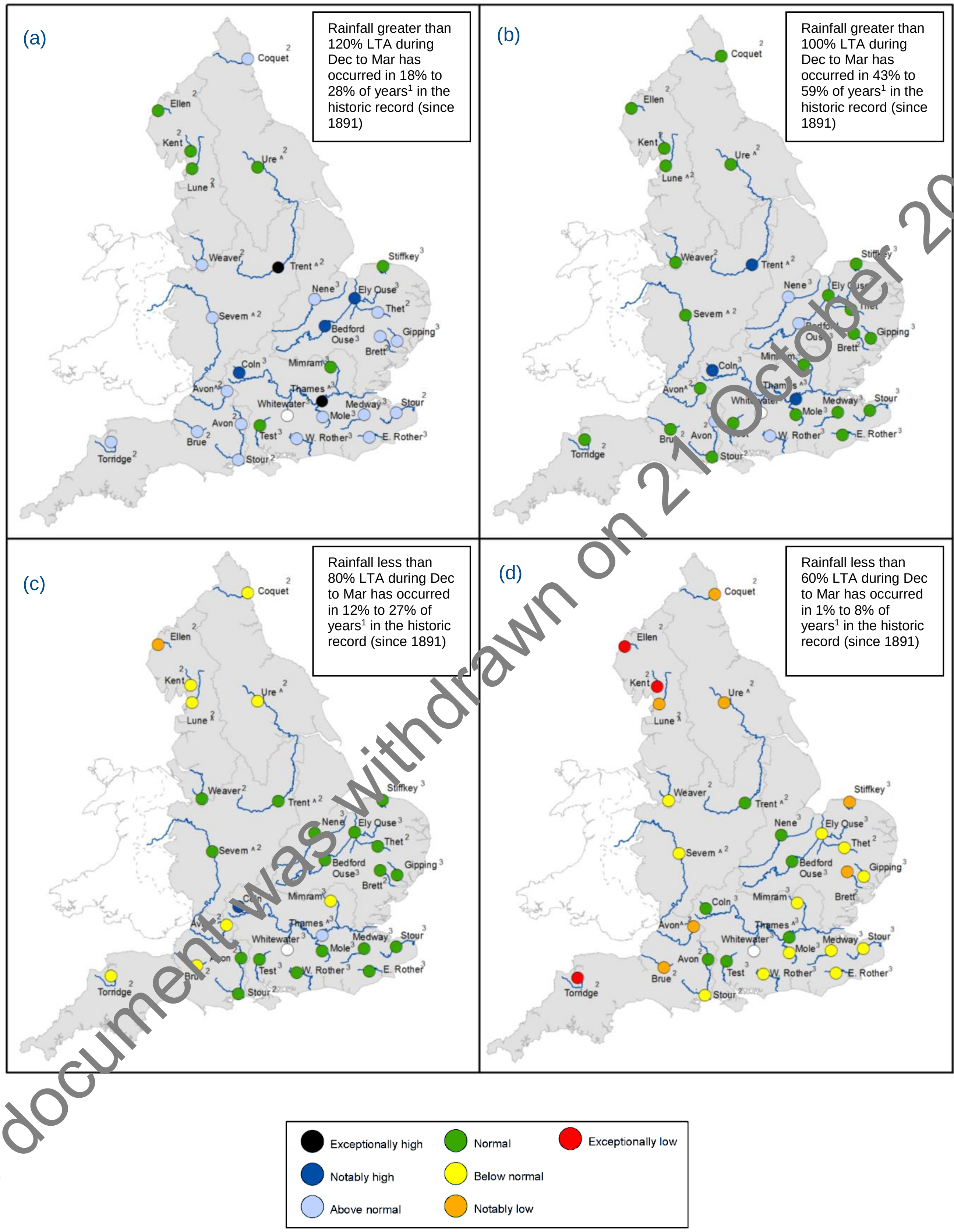
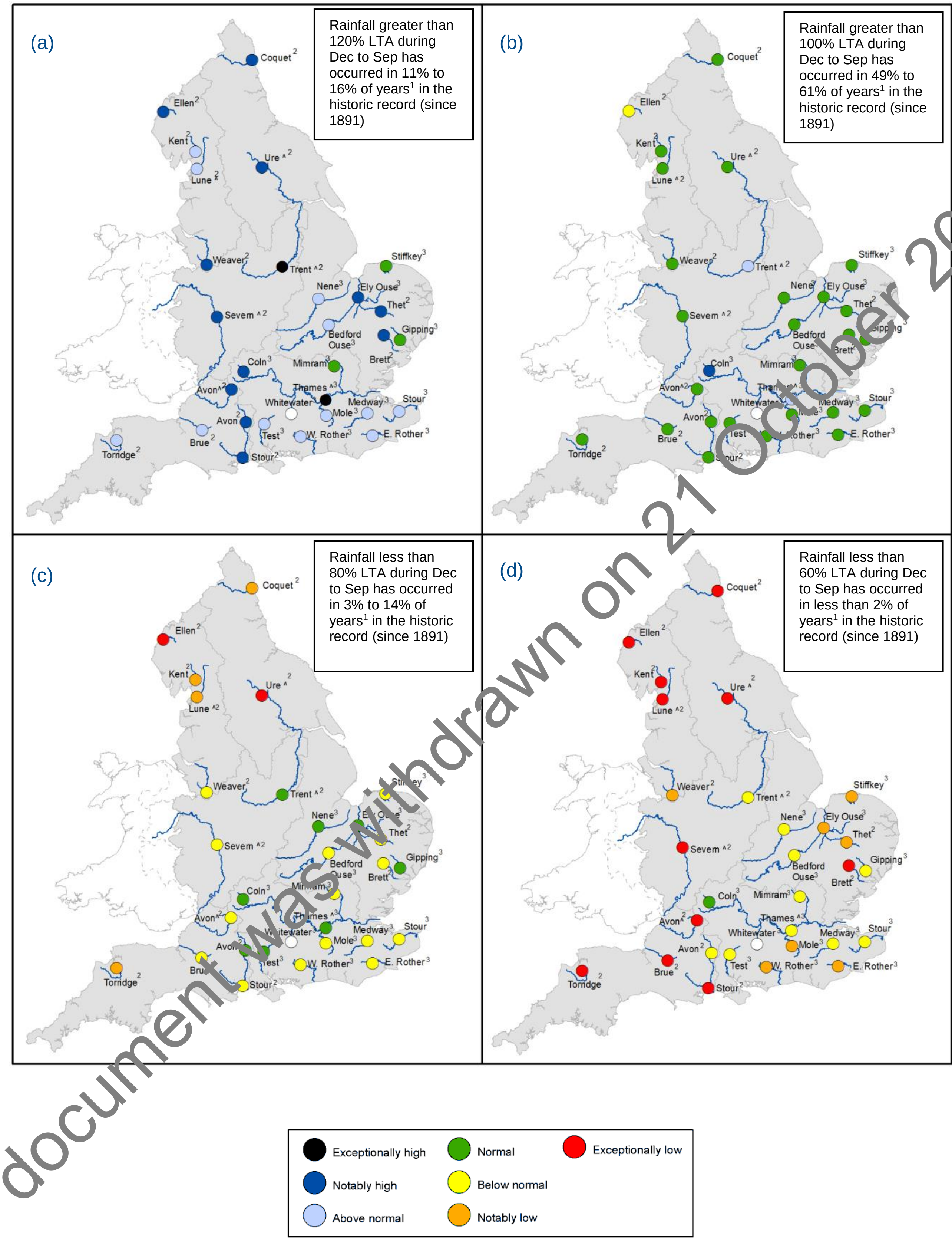


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2019 and March 2020 (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*



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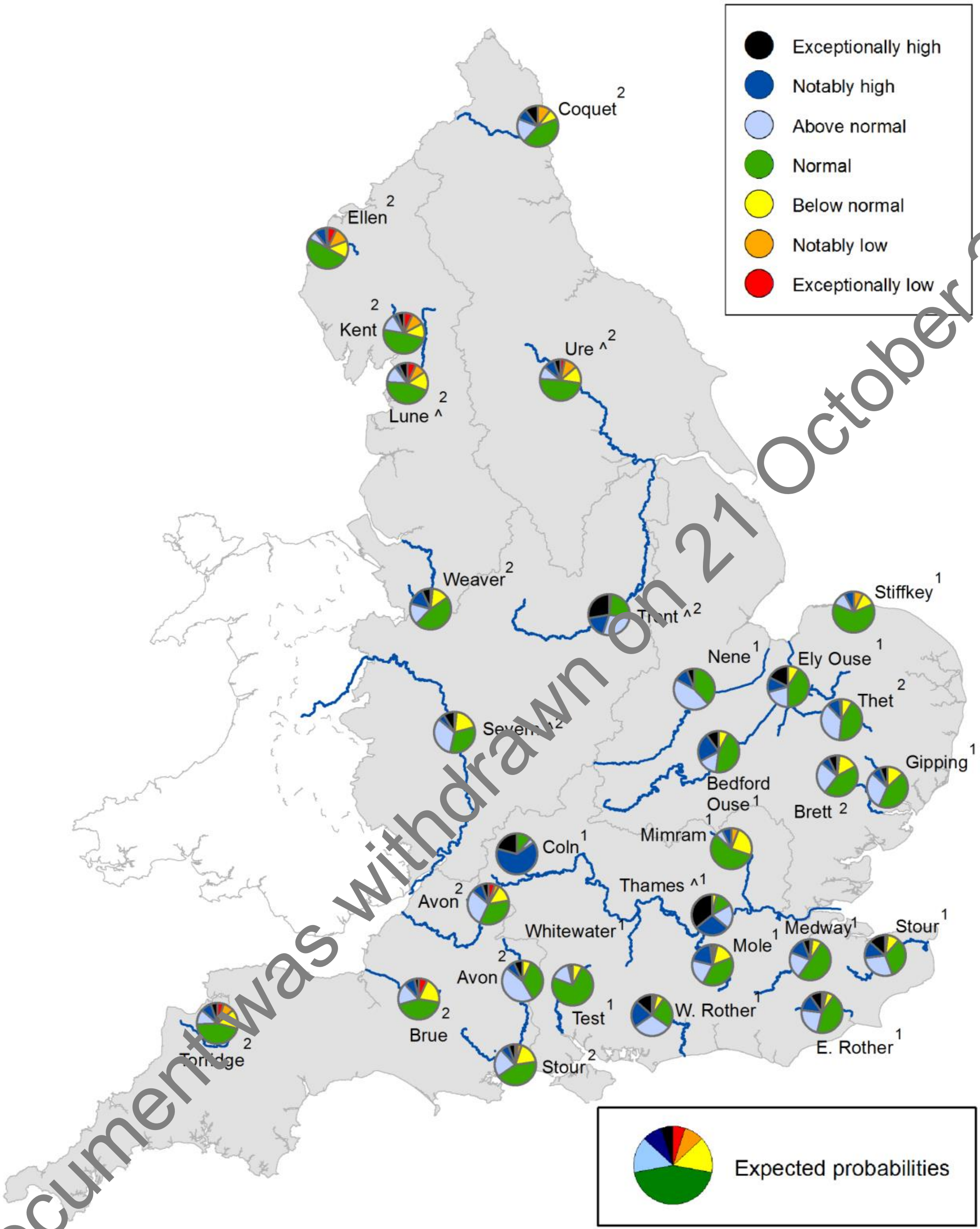

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2020. 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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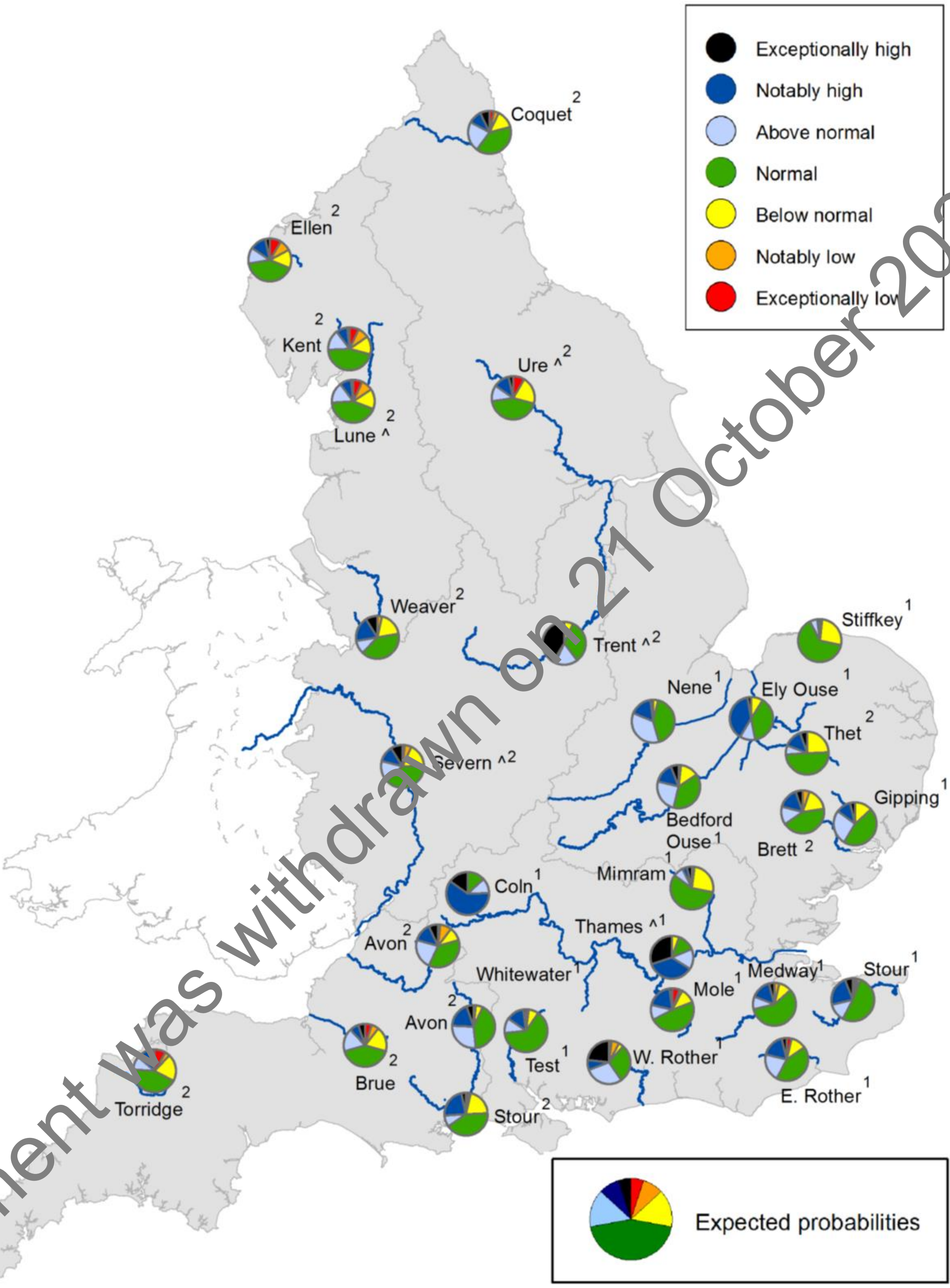

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2020. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

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

Forward look - groundwater

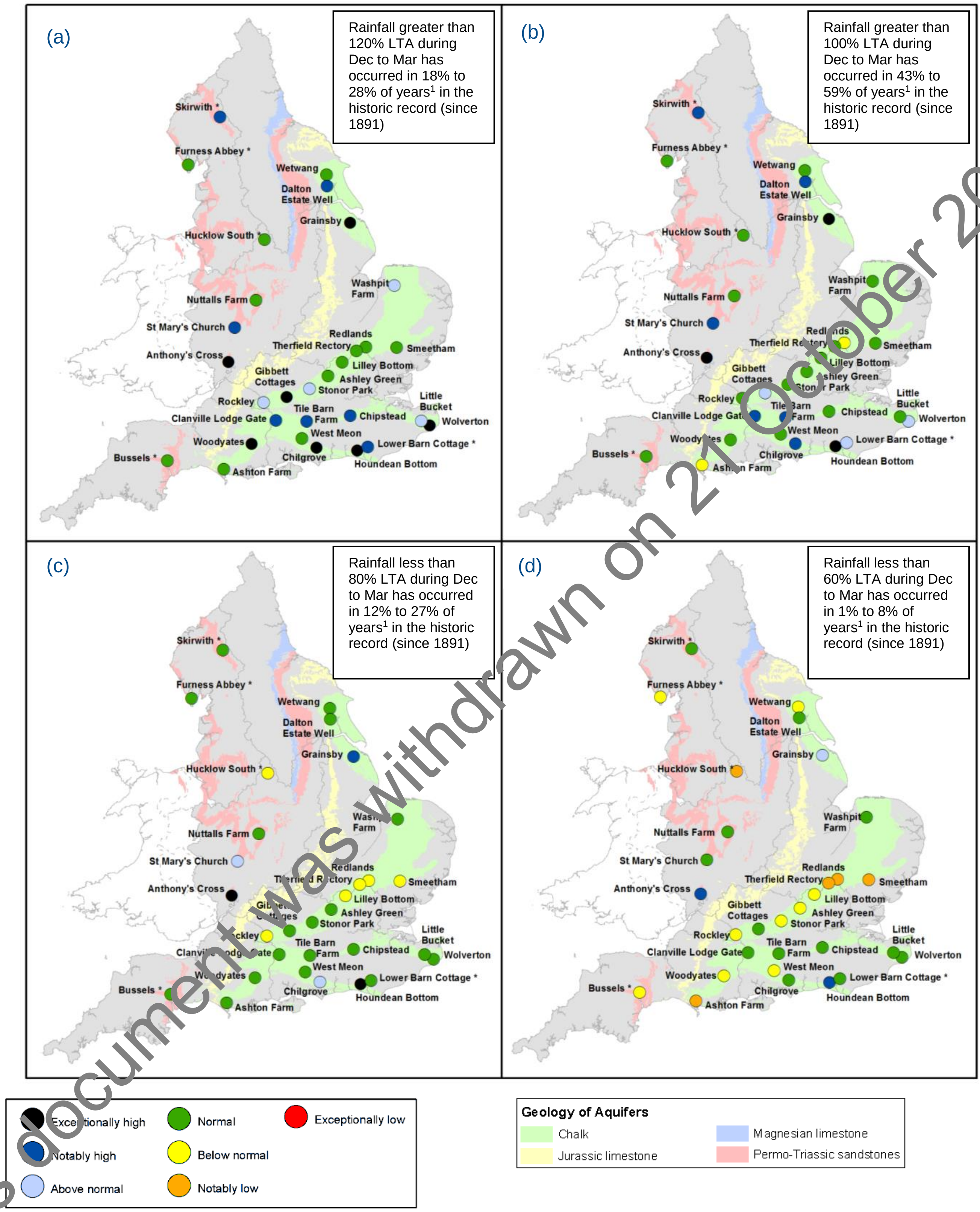

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2019 and March 2020 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC. Crown copyright all rights reserved. Environment Agency 100026380, 2019.

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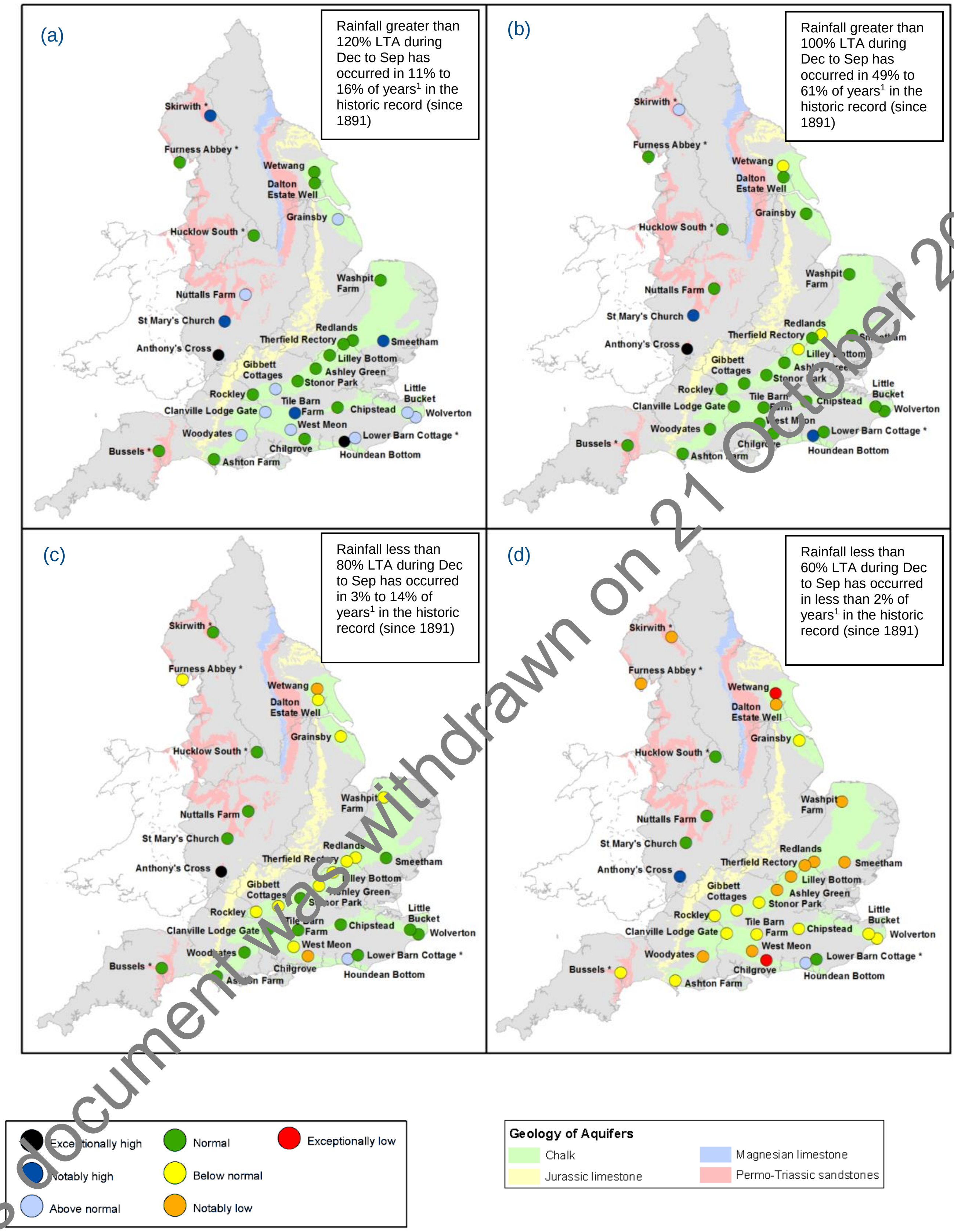

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between December 2019 and September 2020 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100026380 2019.

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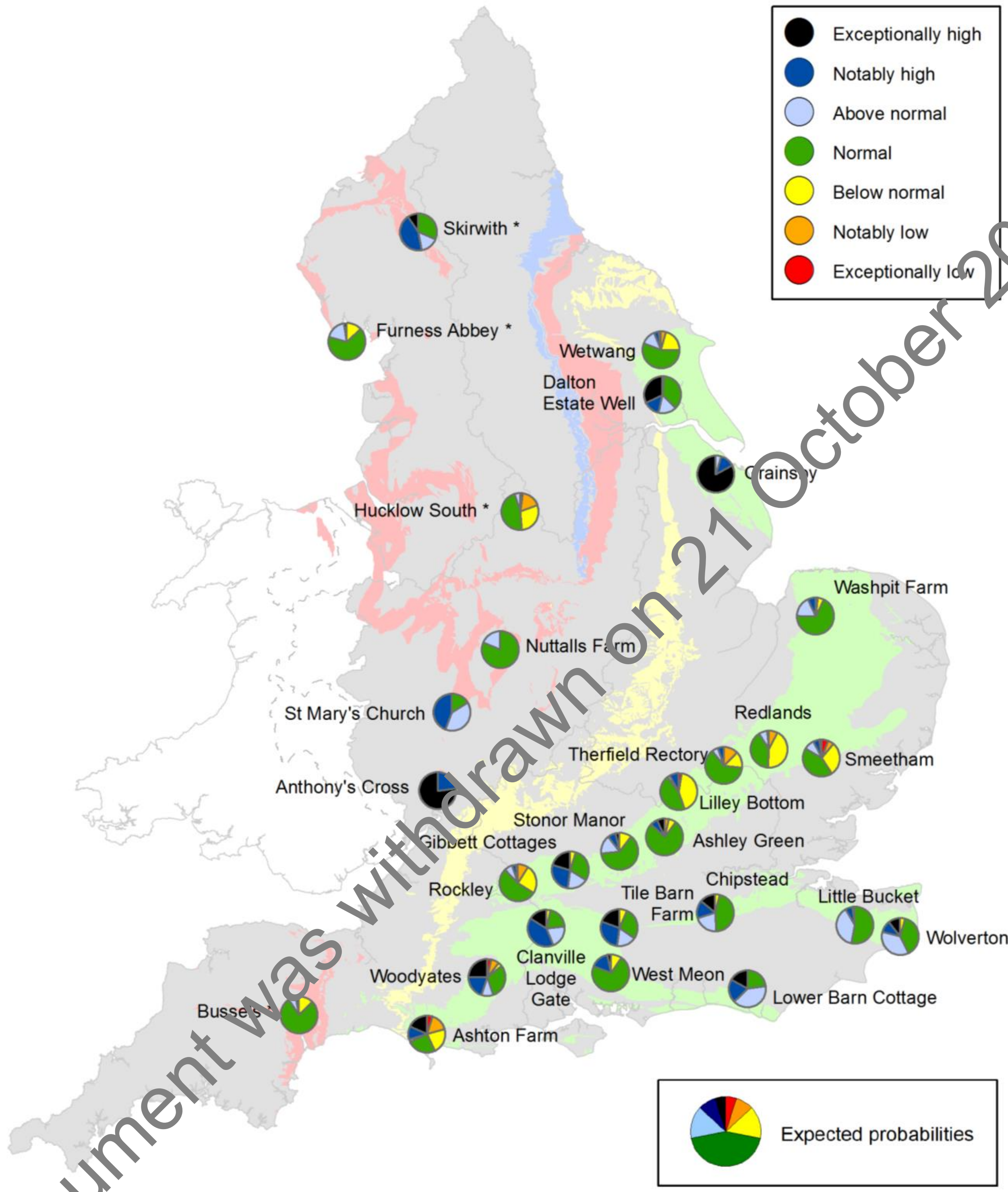

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

Figure 6.7: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2020. 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, 2019.

** Projections for these sites are produced by BGS*

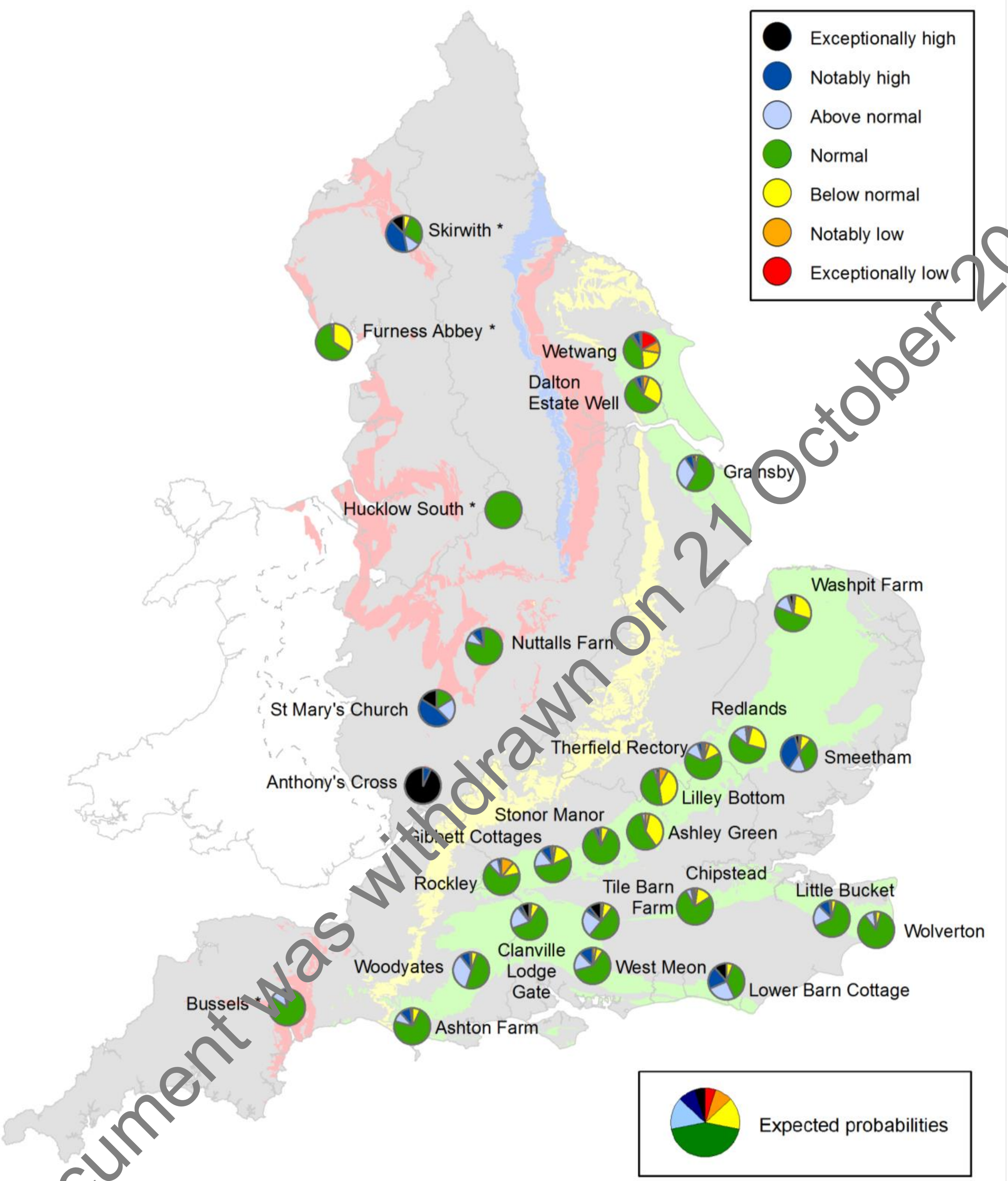

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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of September 2020. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for 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, 2019.

* Projections for these sites are produced by BGS

Figure 7.1: Geographic regions

Glossary

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

Categories

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