Monthly water situation report

England

Summary – April 2019

The rainfall total for England was below average for the time of year with higher totals in western England and lower totals in the east. Monthly mean river flows were classed as below normal or lower for the time of year at almost two-thirds of the sites we report on. Soils got drier across much of England during April and by the end of the month soils were significantly drier than average across most of east and south-east England. Groundwater levels fell during April at over half of the sites we report on. Total reservoir stocks for England were at 90% of capacity at the end of April.

Rainfall

The April rainfall total for England was 38mm, representing 67% of the 1961 to 1990 long-term average (64% of the 1981-2010 long term average (LTA)). This is less than half of the rainfall total for March, which was higher than average for the time of year at 89mm. There was a clear east-west pattern in the distribution of rainfall during April, with higher totals in western England and lower totals in eastern England (Figure 1.1). The lowest rainfall totals, relative to the April LTA, were in the South Essex catchments, which received only 21% of the LTA. The highest rainfall totals were in the West Cornwall and the Lower Wye (Herefordshire) catchments with both receiving 133% of the LTA.

In a quarter of the catchments across England the April rainfall total was classed as notably low. In less than half of the catchments totals were classed as either normal or above normal for the time of year. Across much of England the 12 month cumulative rainfall totals are classed as either notably low or exceptionally low. The 12 month cumulative rainfall total for the Welland and Nene catchments is the second lowest on record (records go back to 1910). Only the 12 months ending in April 1976 were drier (Figure 1.2).

At a regional scale, April rainfall totals ranged from 29% of the LTA in east England to 110% in south-west England. In both central and east England, rainfall totals in four of the last six months were below average (Figure 1.3).

Soil moisture deficit

Soil moisture deficits (SMDs) increased during April across much of England, as soils got drier. Soils were drier than average across much of England with SMD values reflecting the distribution of rainfall during April. By the end of the month significant SMDs of between 41 and 100mm had developed in parts of east and south-east England (Figure 2.1).

At a regional scale, SMDs increased during April in all geographic regions. Rainfall in the last week of the month caused SMD to decrease slightly in central, northern and south-west England but it still ended the month larger than at the end of March. Soils were drier than average for the time of year in all regions (Figure 2.2).

River flows

Monthly mean river flows for April were lower than March flows at all indicator sites across England. March monthly mean flows were classed as exceptionally high on the River Eamont (north-west) and Rivers Swale, Wharfe and Don (north-east), but had these changed to be classed as notably low flows in April (Figure 3.1).

At almost two-thirds of indicator sites monthly mean flows were classed as either below normal, or notably low for the time of year. Flows were particularly low in east, south-east and north-east England. Monthly mean flows on the River Ely Ouse on the River Cam were classed as exceptionally low for the time of year. The monthly mean flow on the River Cam was the lowest April flow on record (records start in 1949) (Figure 3.1).

At the regional indicator sites, April flows were normal for the time at year on the River Dove (central England) and South Tyne (north-east England). At all other regional indicator sites monthly mean flows were below normal or lower for April (Figure 3.2).

Groundwater levels

At the end of April groundwater levels were lower than they had been at the end of March at over half of the indicator sites across England. At almost two-thirds of indicator sites, these end of month groundwater levels were classed as below normal or lower (Figures 4.1).

At the major aquifer index sites, the end of month groundwater levels were classed as notably low in the chalk aquifers at Redlands Hall and at Stonor Park. Groundwater levels at Jackaments Bottom (Burford Jurassic Limestone aquifer) were below normal for the time of year. At all other major aquifer index sites the end of month groundwater level was classed as normal (Figures 4.1 and 4.2).

Reservoir storage

Reservoir stocks decreased during April at half of the reported reservoirs and reservoir groups in England. The biggest reductions as a proportion of total storage capacity were seen in north-west England in the NCZ Regional group of reservoirs (-18%) and the Pennines group of reservoirs (-14%). Despite these reductions reservoir stocks at the end of April were classed as normal or higher at almost two-thirds of reported reservoirs and reservoir groups. Maintenance of the Thames Lee Tunnel since mid-January has resulted in the Lower Lee Group of reservoirs being drawn down (Figure 5.1).

At a regional scale, total reservoir stocks increased slightly (+1%) in east England and remained the same in south-east and south-west England during April. Total regional reservoir stocks reduced in all other regions. Total reservoir stocks for England were at 90% of capacity at the end of April. This is just below average for the time of year (Figure 5.2).

Forward look

High pressure is expected to remain dominant during May with widespread settled weather and warm temperatures. However this will be interspersed with frontal systems arriving from the Atlantic, bringing rain and cooler temperatures at times to most places. For both May, and the three month period May to July, there's a slightly increased chance of below average precipitation whilst temperatures are likely to be above average[1].

Projections for river flows at key sites[2]

By the end of September 2019, nearly two-thirds of the modelled sites have a greater than expected chance of cumulative river flows being notably low or lower for the time of year, increasing to all but four of the modelled sites by the end of March 2020.

For scenario based projections of cumulative river flows at key sites by September 2019 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2020 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2019 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2020 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

Nearly two-thirds of the 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 both September 2019 and March 2020.

For scenario based projections of groundwater levels in key aquifers in September 2019 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2020 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2019 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2020 see Figure 6.8

Authors: National Water Resources Hydrology Team

1 Source: Met Office
2 Information produced by the Water Situation Forward Look group led by Environment Agency in partnership with the Centre for Ecology and Hydrology, British Geological Survey, Met Office (www.hydoutuk.net).

Rainfall

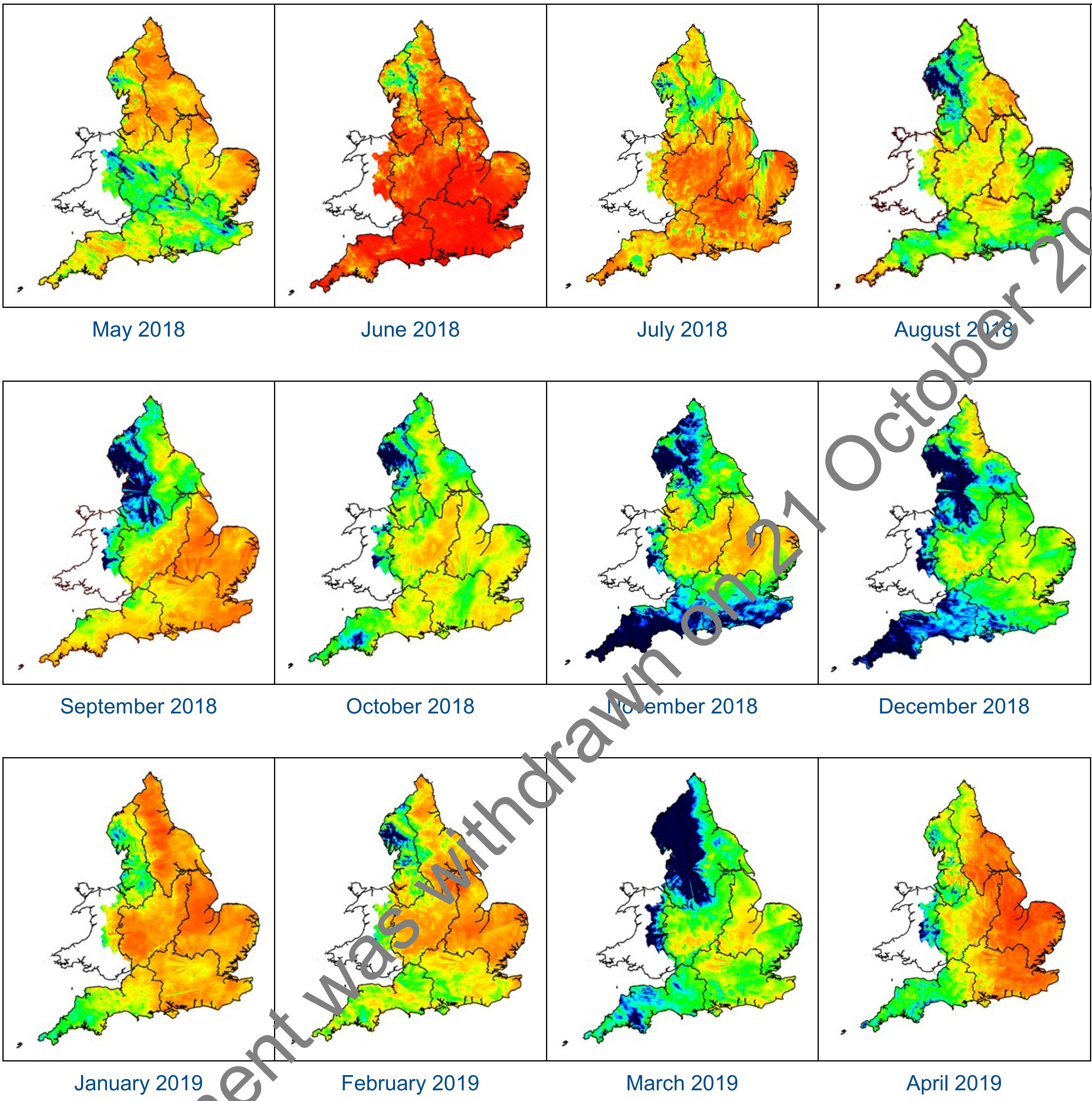
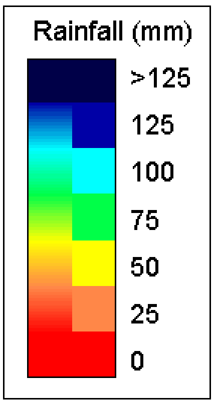


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2019). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.



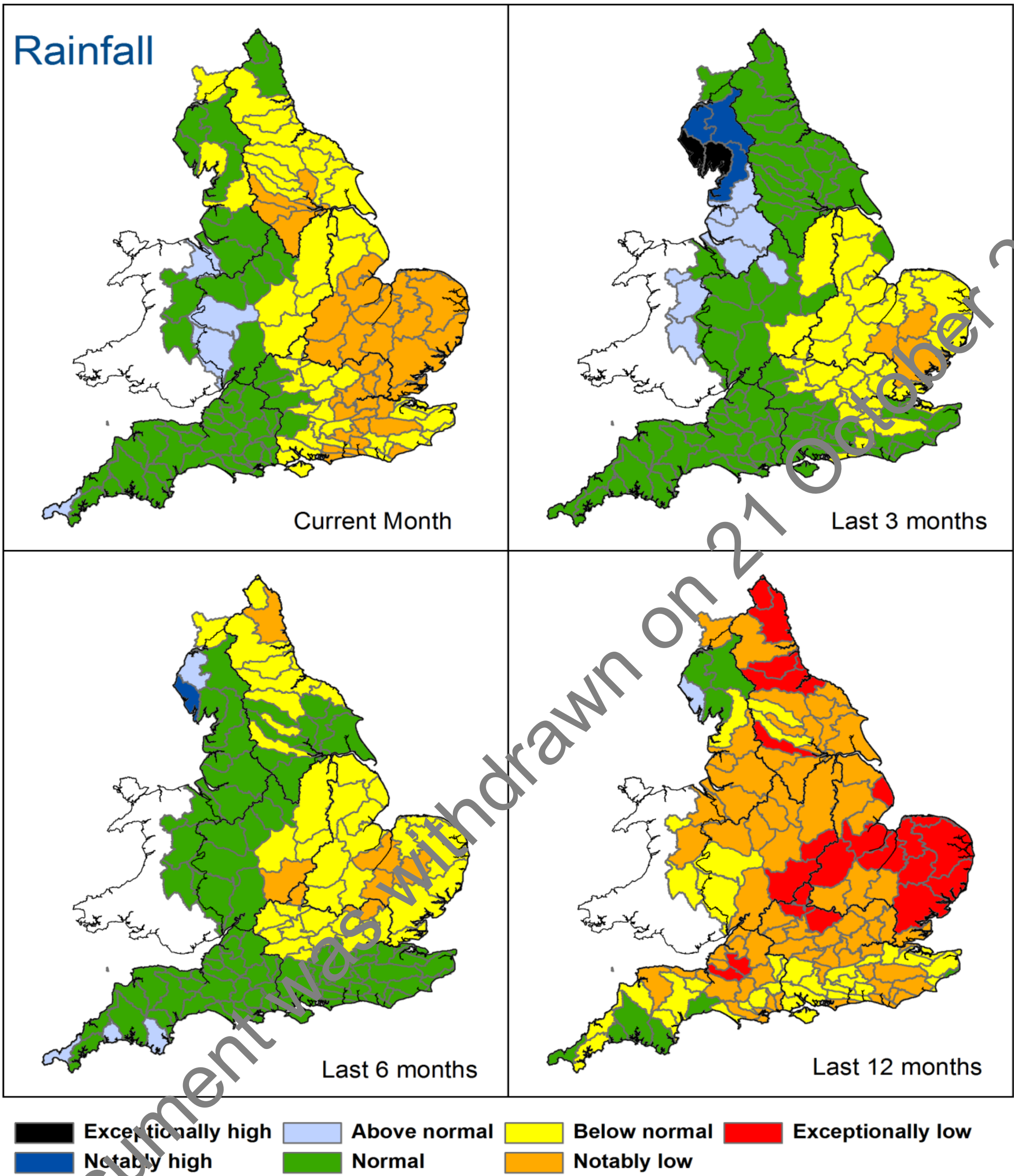


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 30 April 2019), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Final NCIC (National Climate Information Centre) data based on the Met Office 5km gridded rainfall dataset derived from rain gauges *(Source: Met Office © Crown Copyright, 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

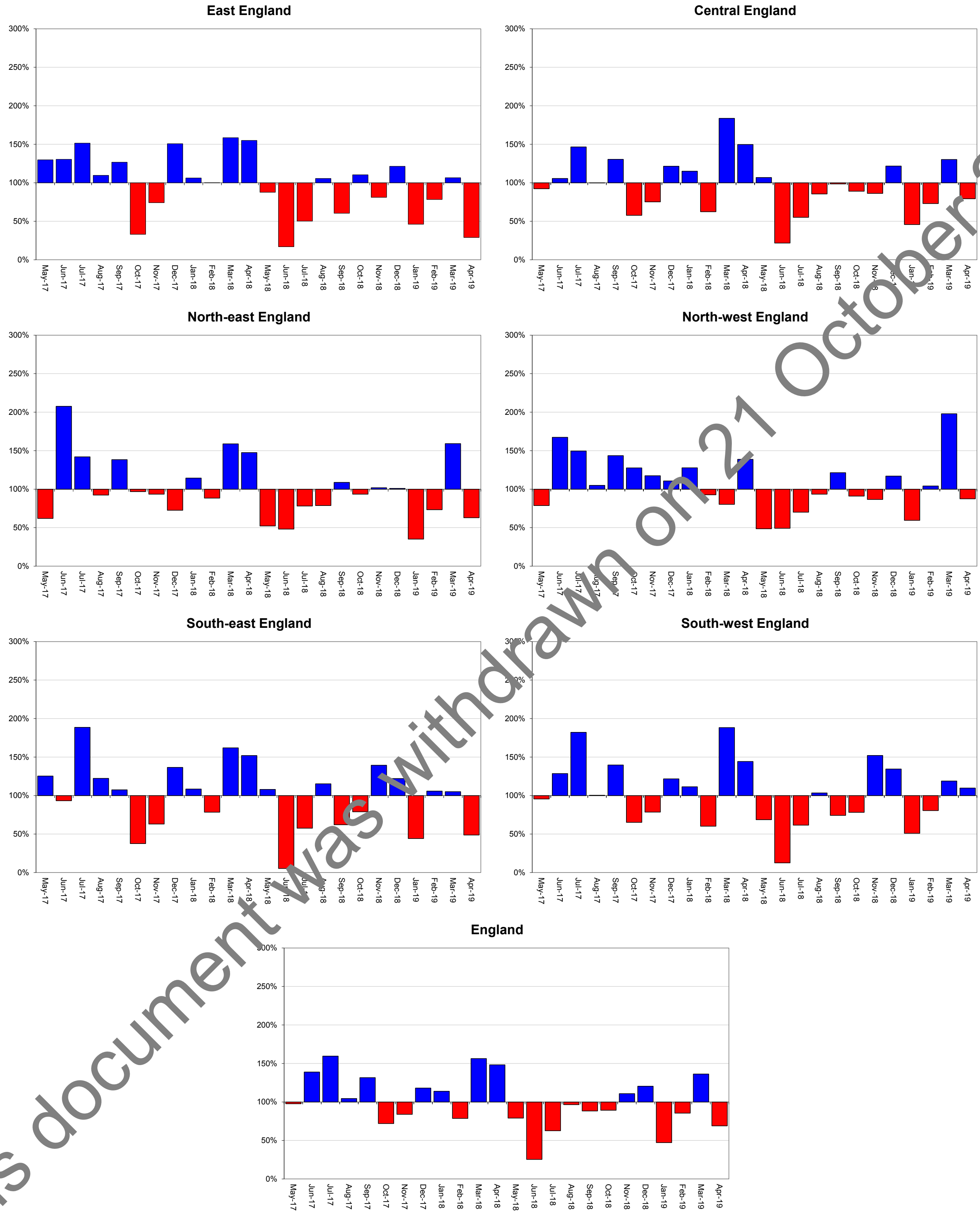


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. NCIC (National Climate Information Centre) data. (Source: Met Office © Crown Copyright, 2019).

Soil moisture deficit

End of March 2019[1]	End of April 2019[2]

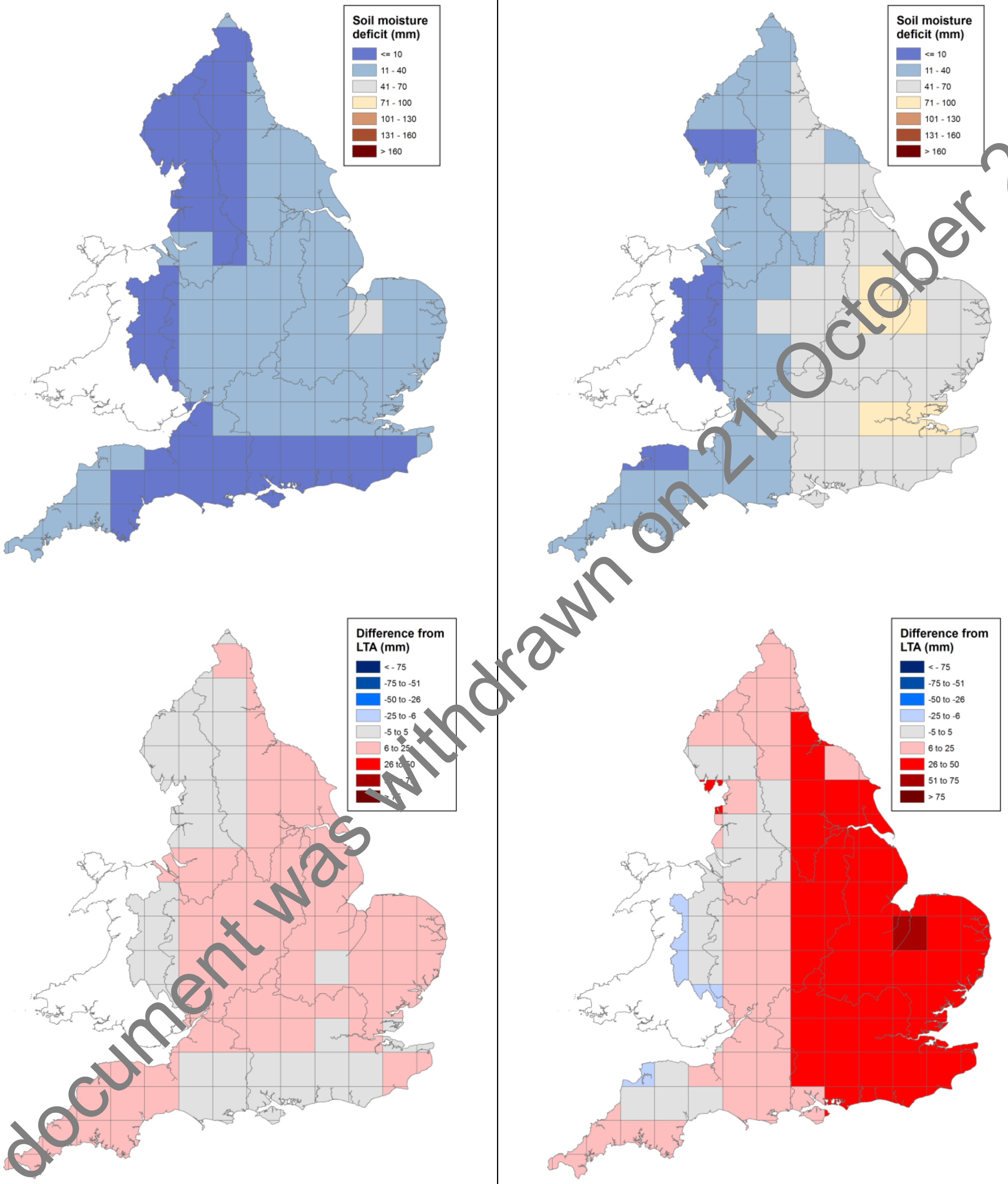


Figure 2.1: Soil moisture deficits for weeks ending 2 April 2019 [1] (left panel) and 30 April 2019 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2019). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019

Soil moisture deficit charts

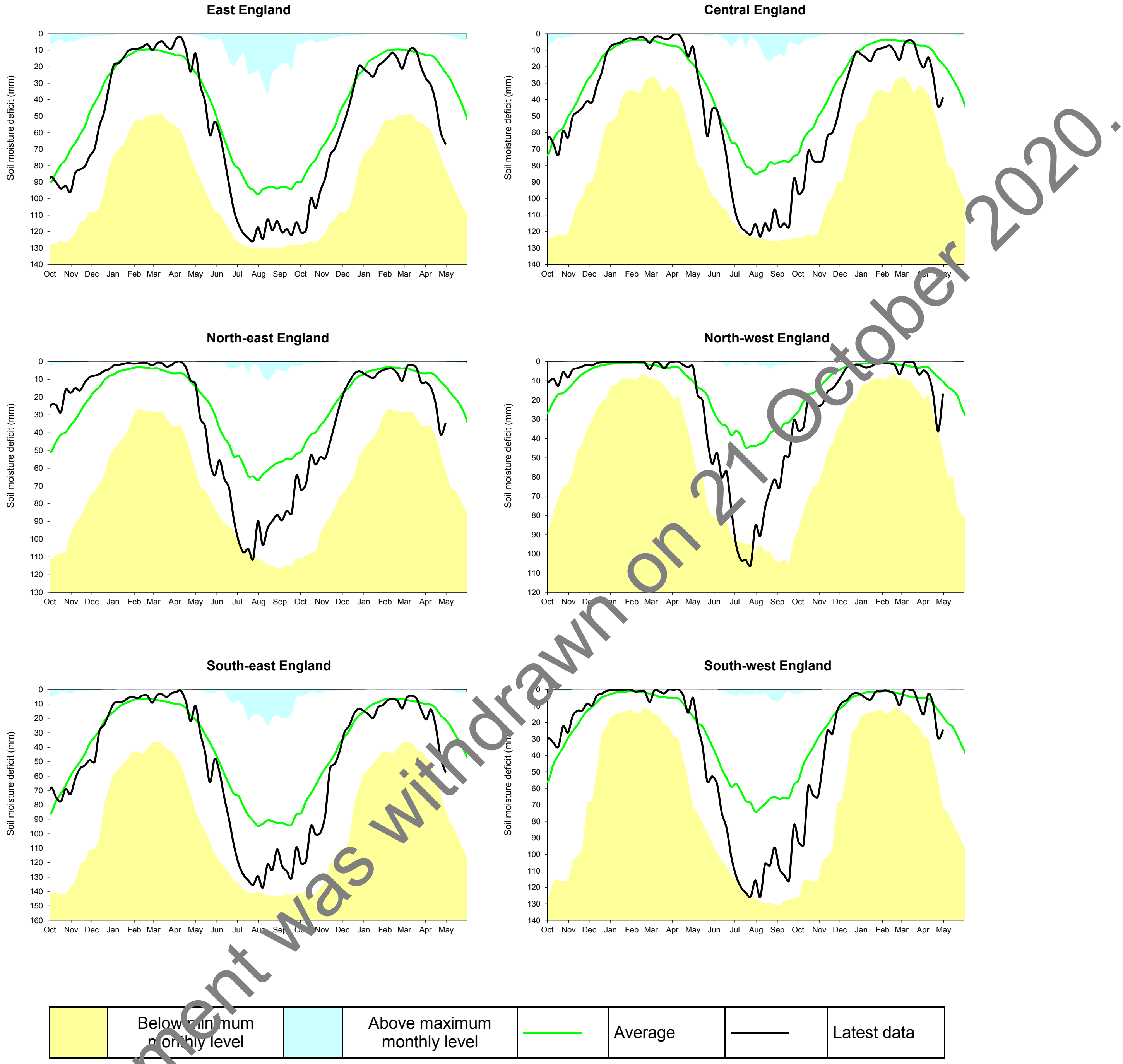
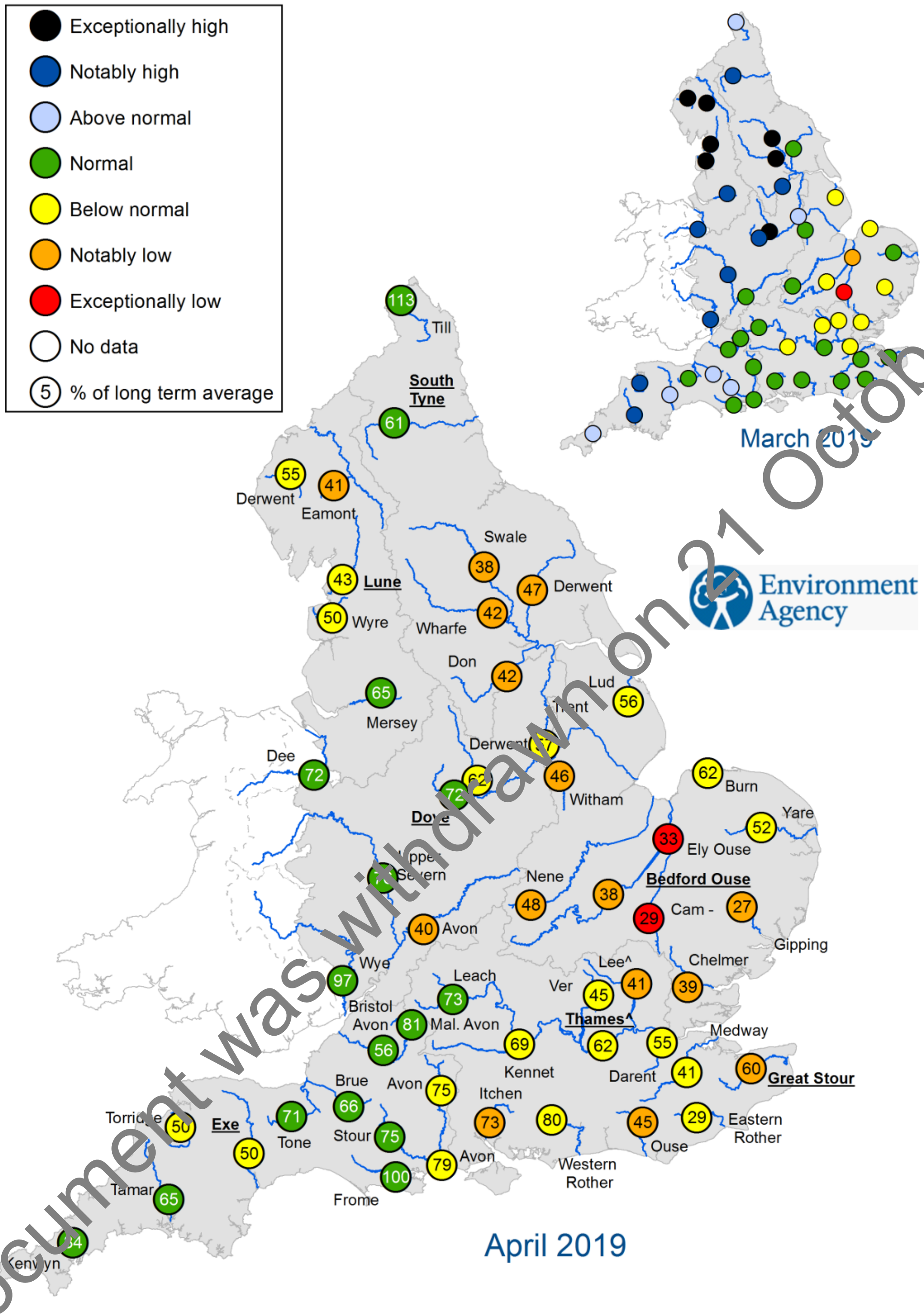


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2019).

River flows



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

- Monthly mean flow is the lowest 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 March and April 2019, expressed as a percentage of the respective long term average and classed relative to an analysis of historic March and April monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019. The flow sites in this report are indicator sites providing a National overview and are a subset of a wider flow monitoring network.

River flow charts

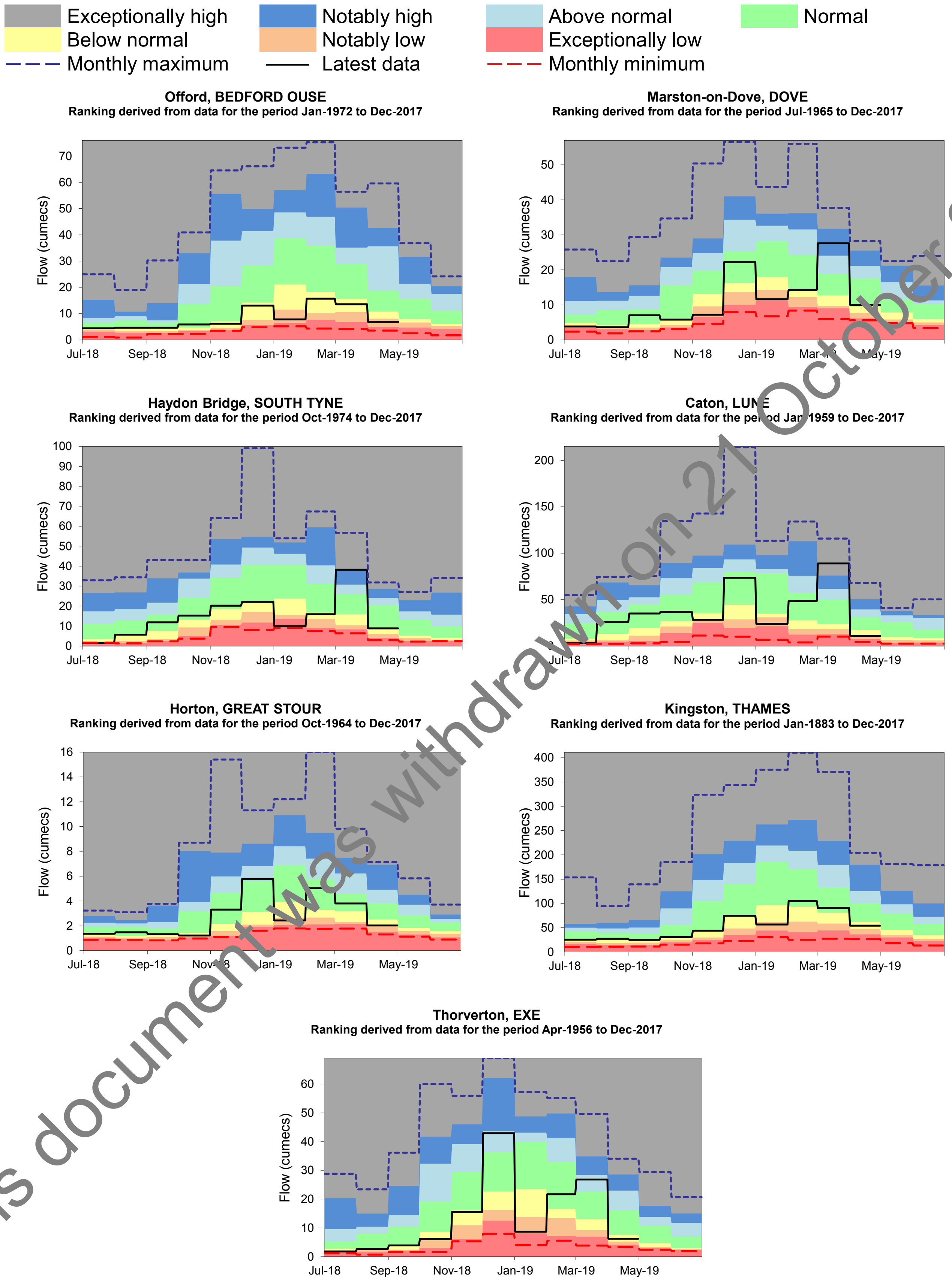
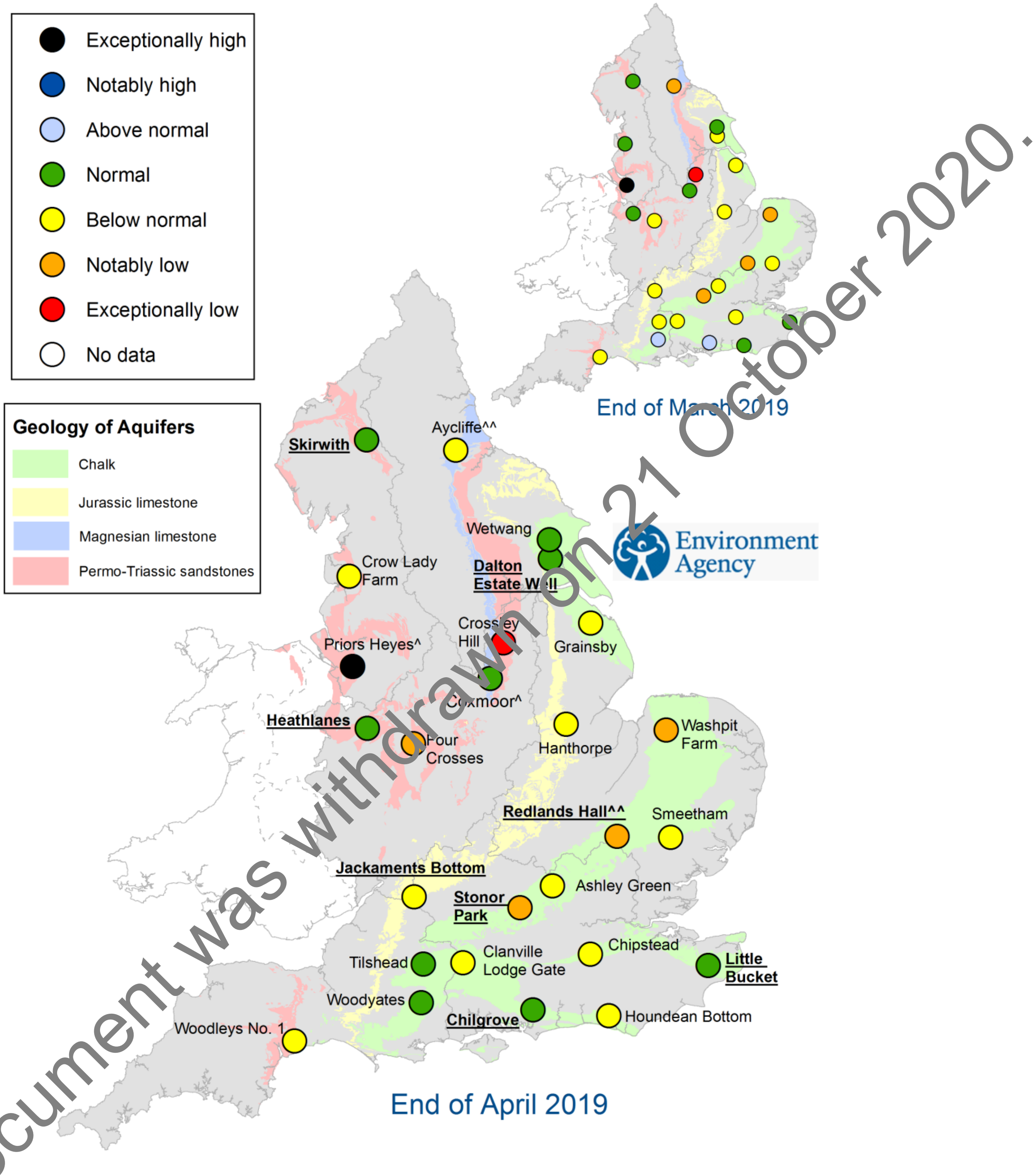


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
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 March and April 2019, classed relative to an analysis of respective historic March and April 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. The groundwater level sites in this report are indicator sites providing a National overview and are a subset of a wider groundwater level monitoring network.

Groundwater level charts

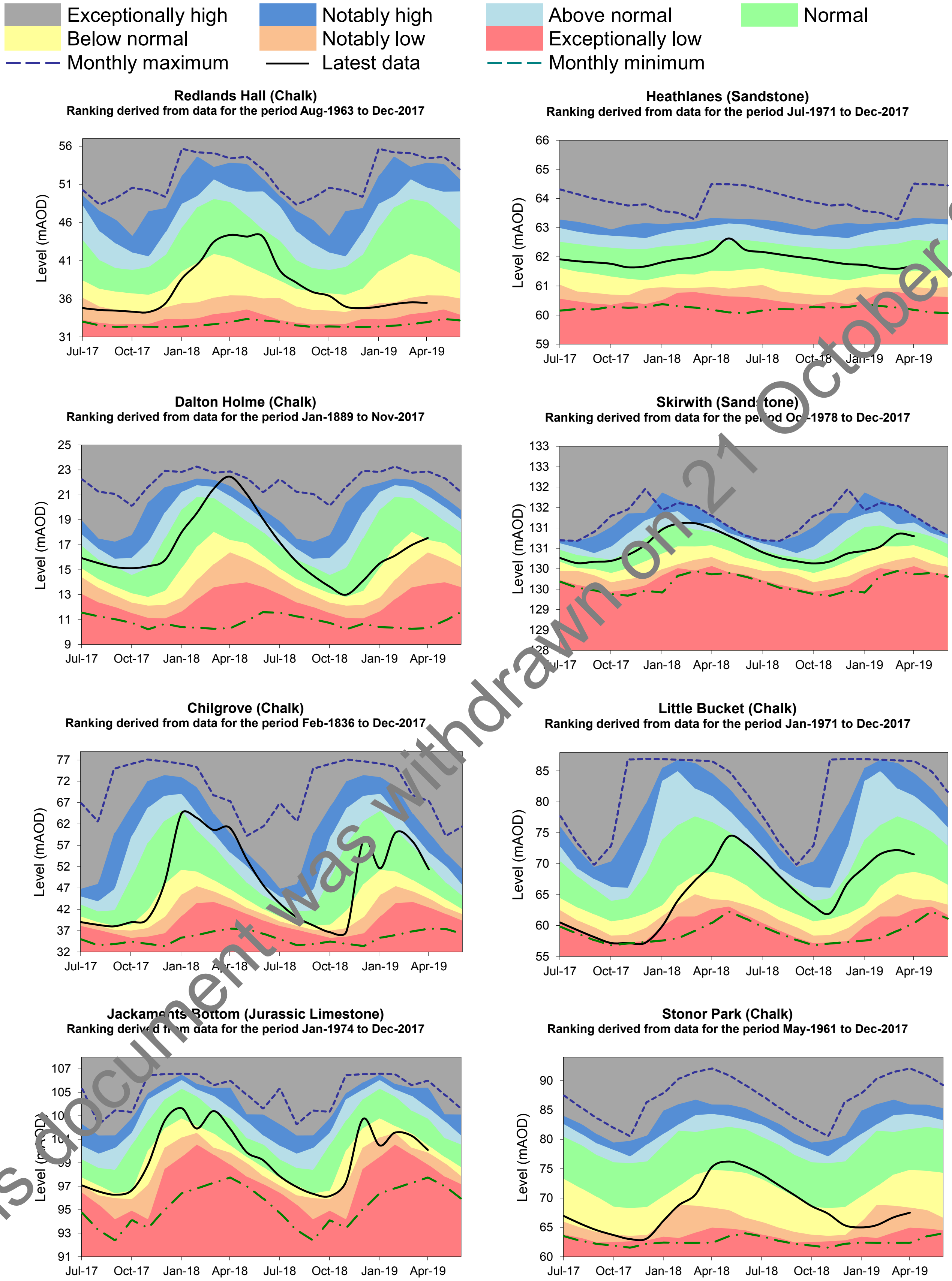
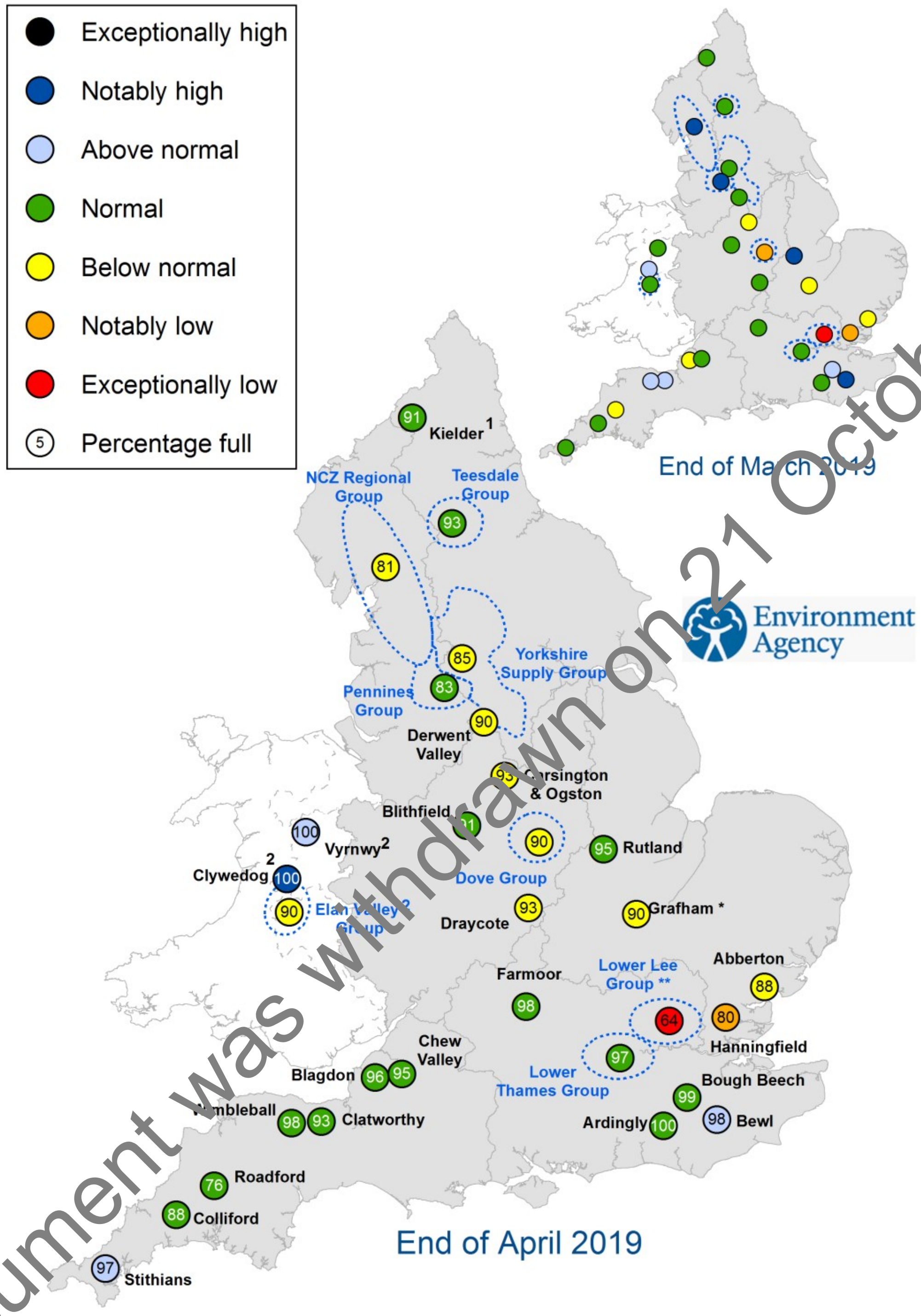


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2019).

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
* Levels at Grafham affected by engineering works in late 2018
** Maintenance of the Thames Lee Tunnel since mid-January has resulted in the reservoirs being drawn down

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of March and April 2019 as a percentage of total capacity and classed relative to an analysis of historic March and April 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

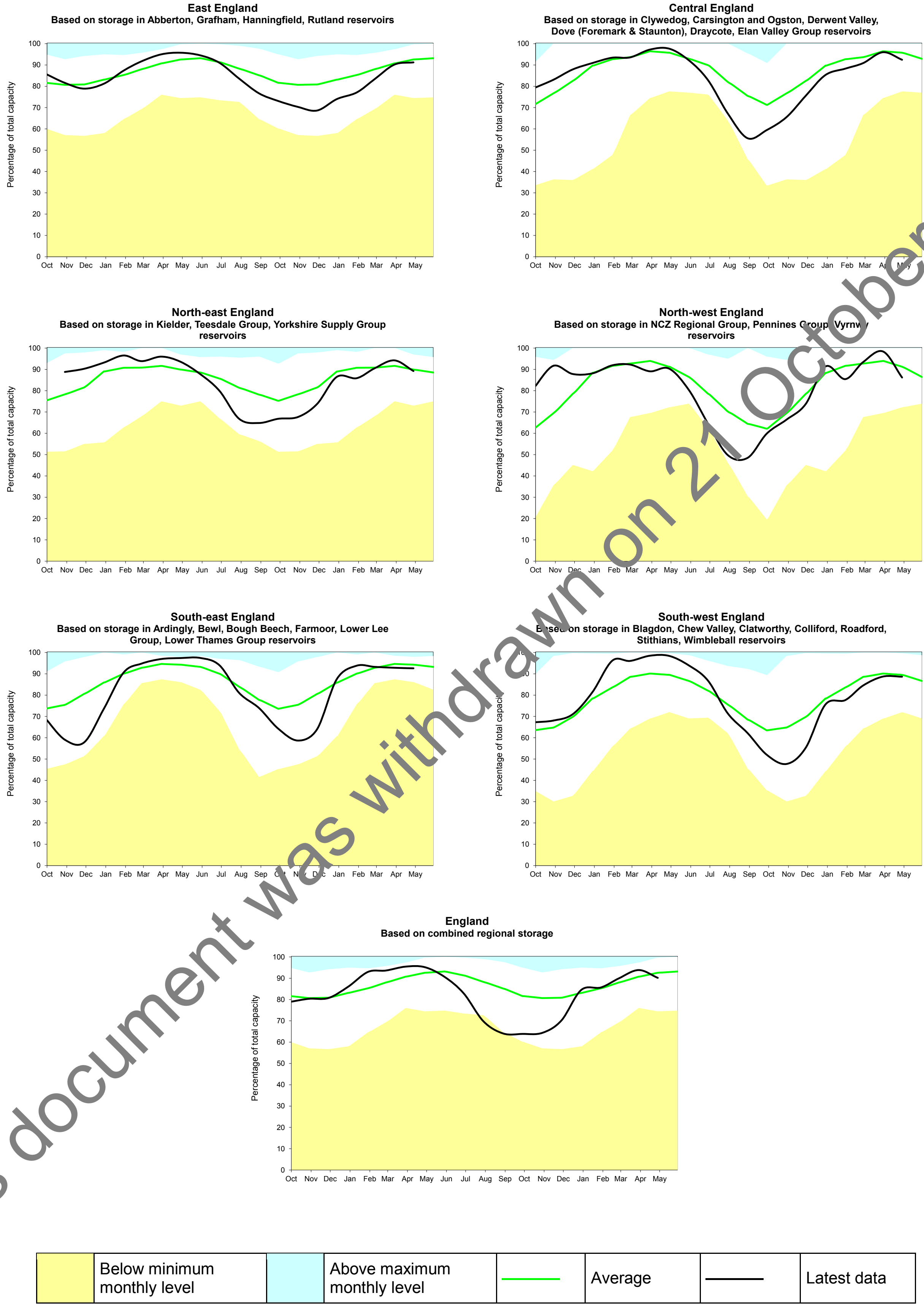


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look – river flow

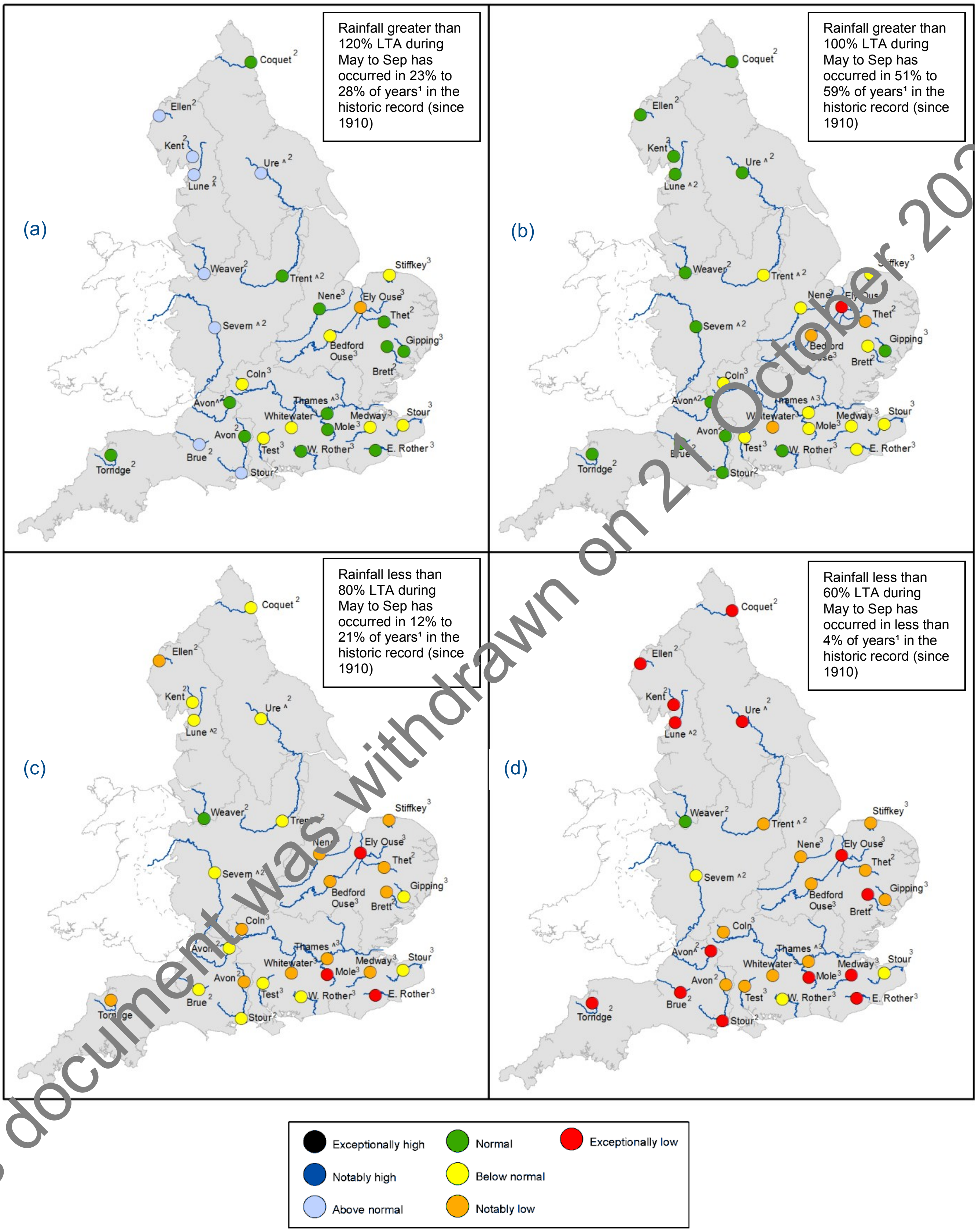


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May and September 2019 (Source: Centre for Ecology and Hydrology, Environment Agency).

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

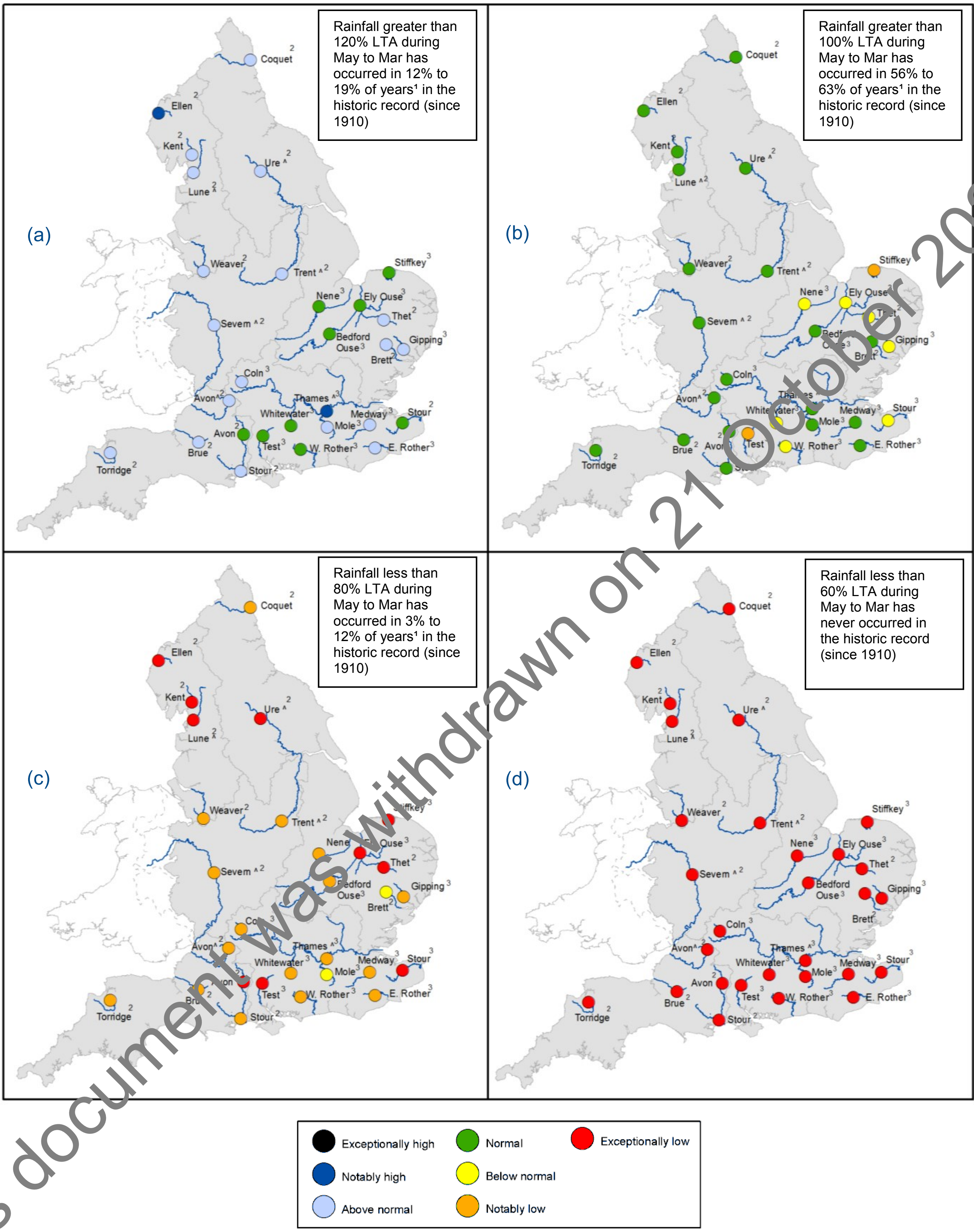


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2019 and March 2020 (Source: Centre for Ecology and Hydrology, Environment Agency).

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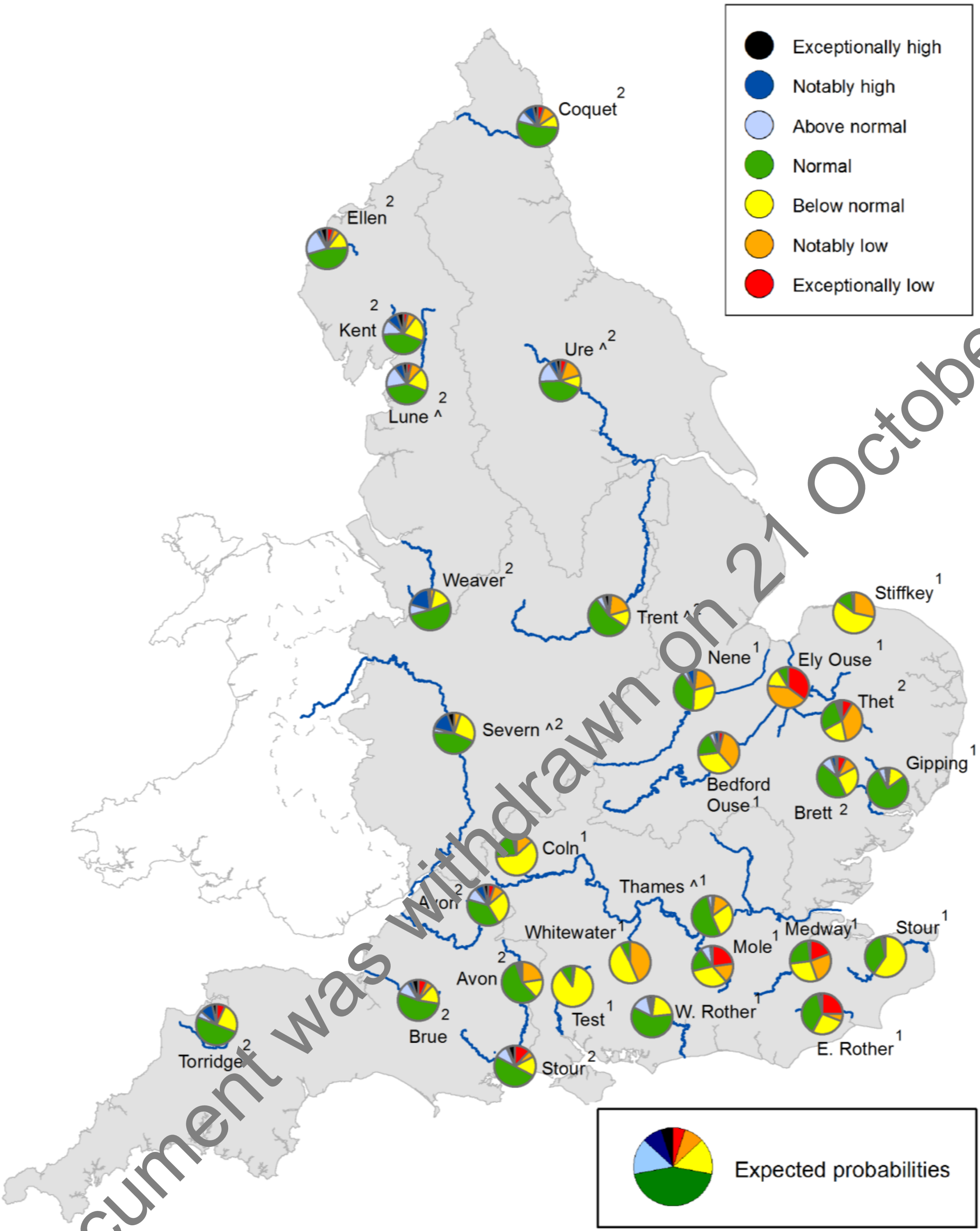

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2019. 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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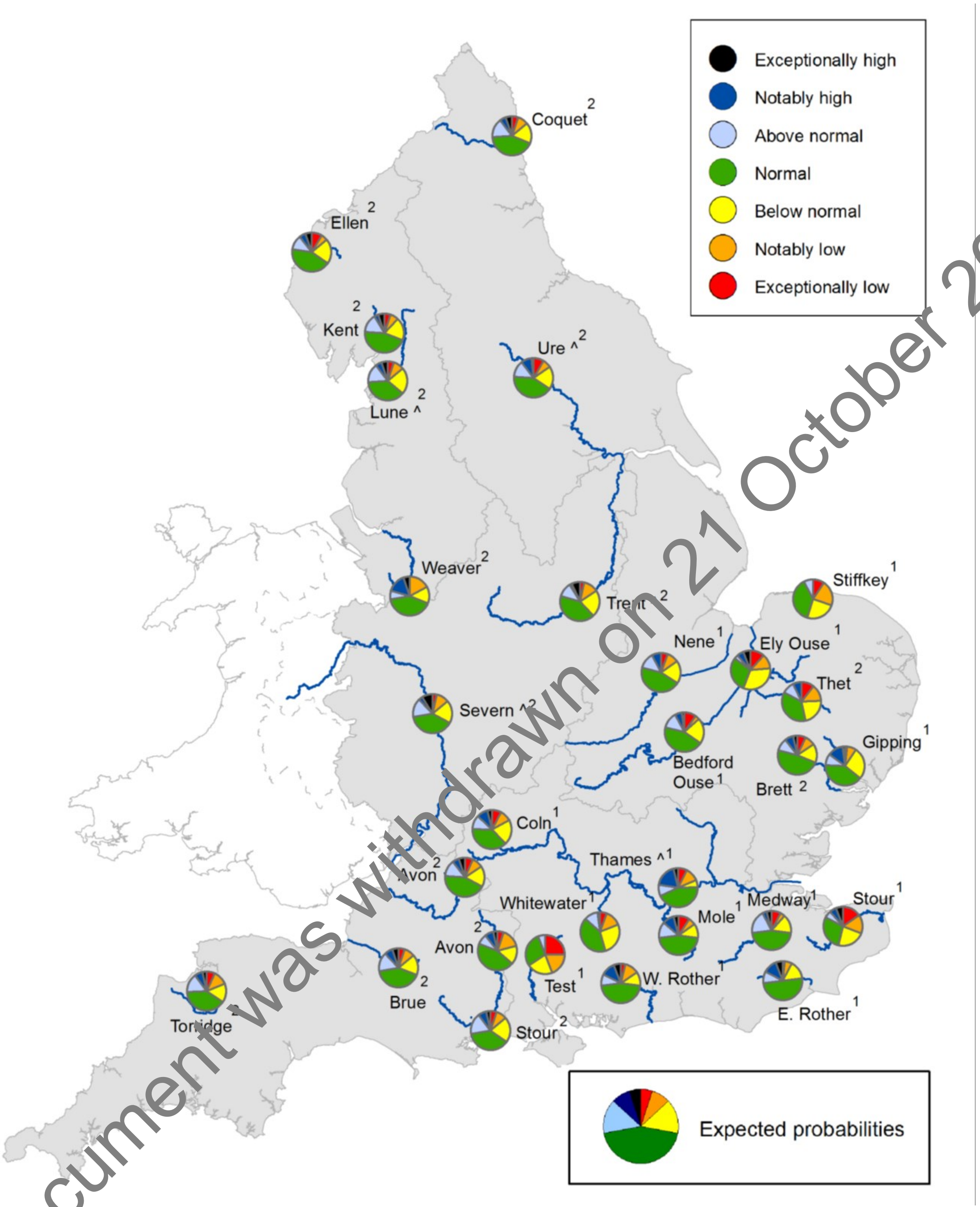


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 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
[2] Projections for these sites are produced by CEH
^"Naturalised" flows are projected for these sites

Forward look - groundwater

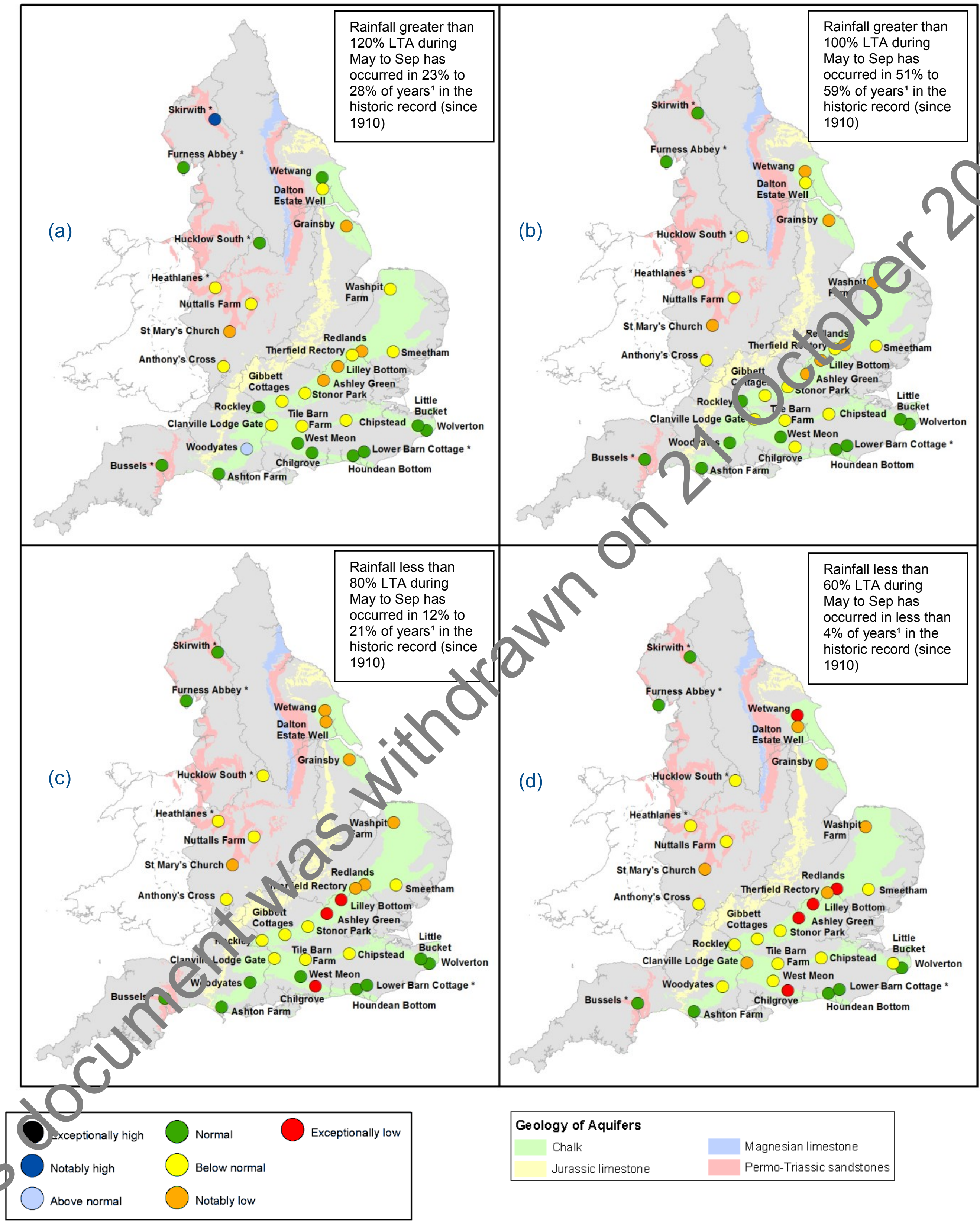


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May and September 2019 (Source: Environment Agency). Geological map reproduced with kind permission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

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

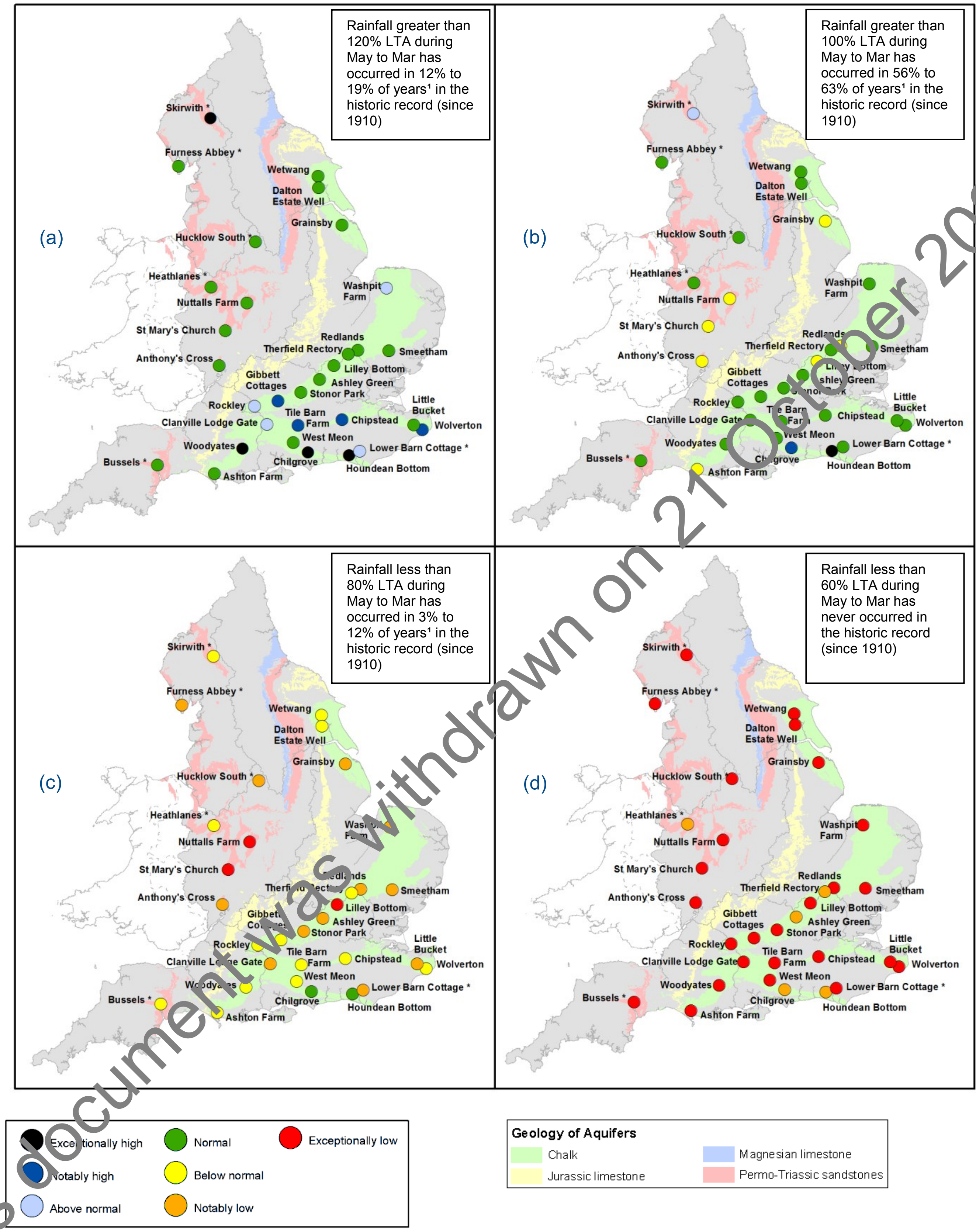
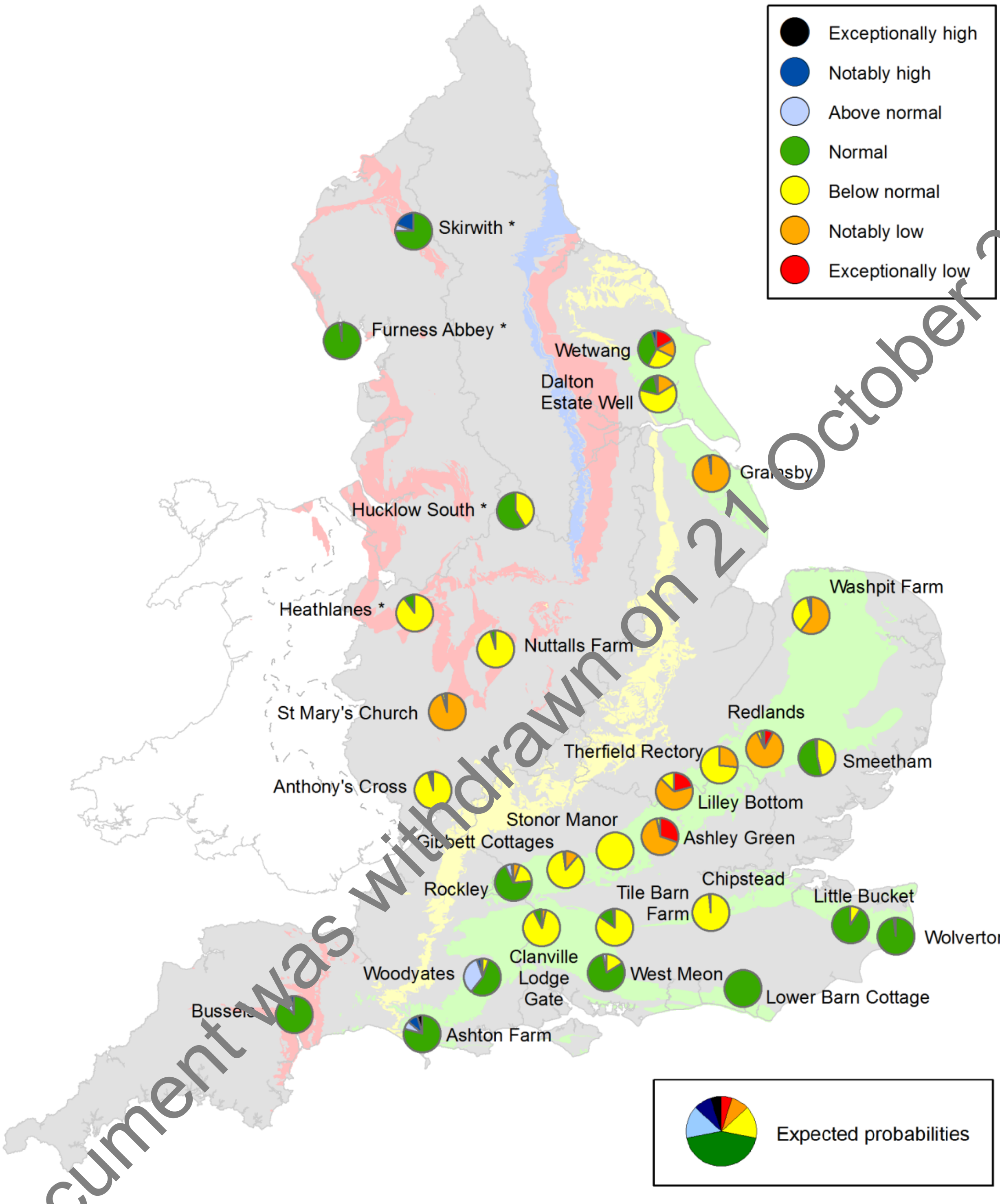


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between May 2019 and March 2020 (Source: Environment Agency). Geological map reproduced with kind permission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

* 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 2019. 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

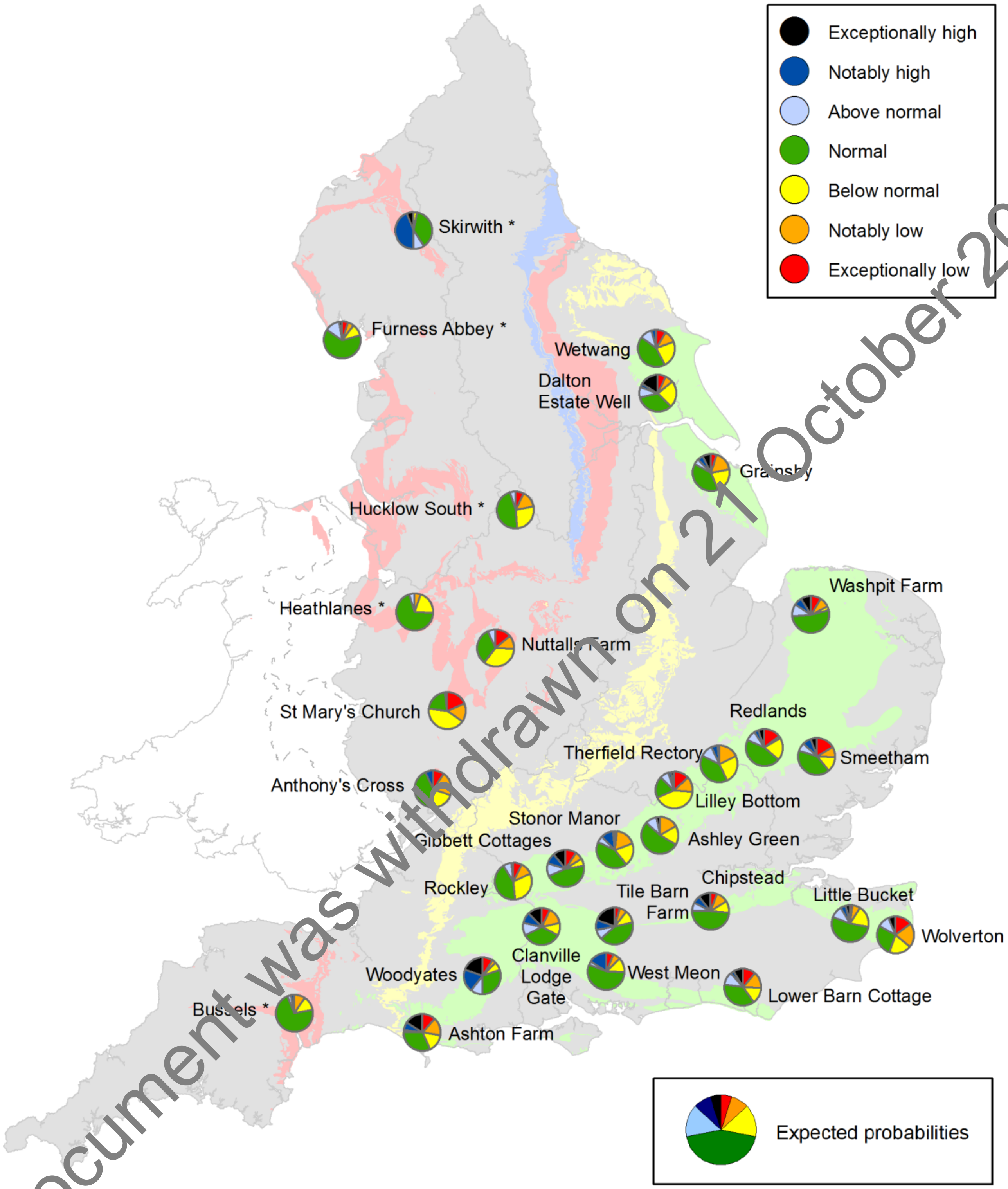


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Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 2020. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the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

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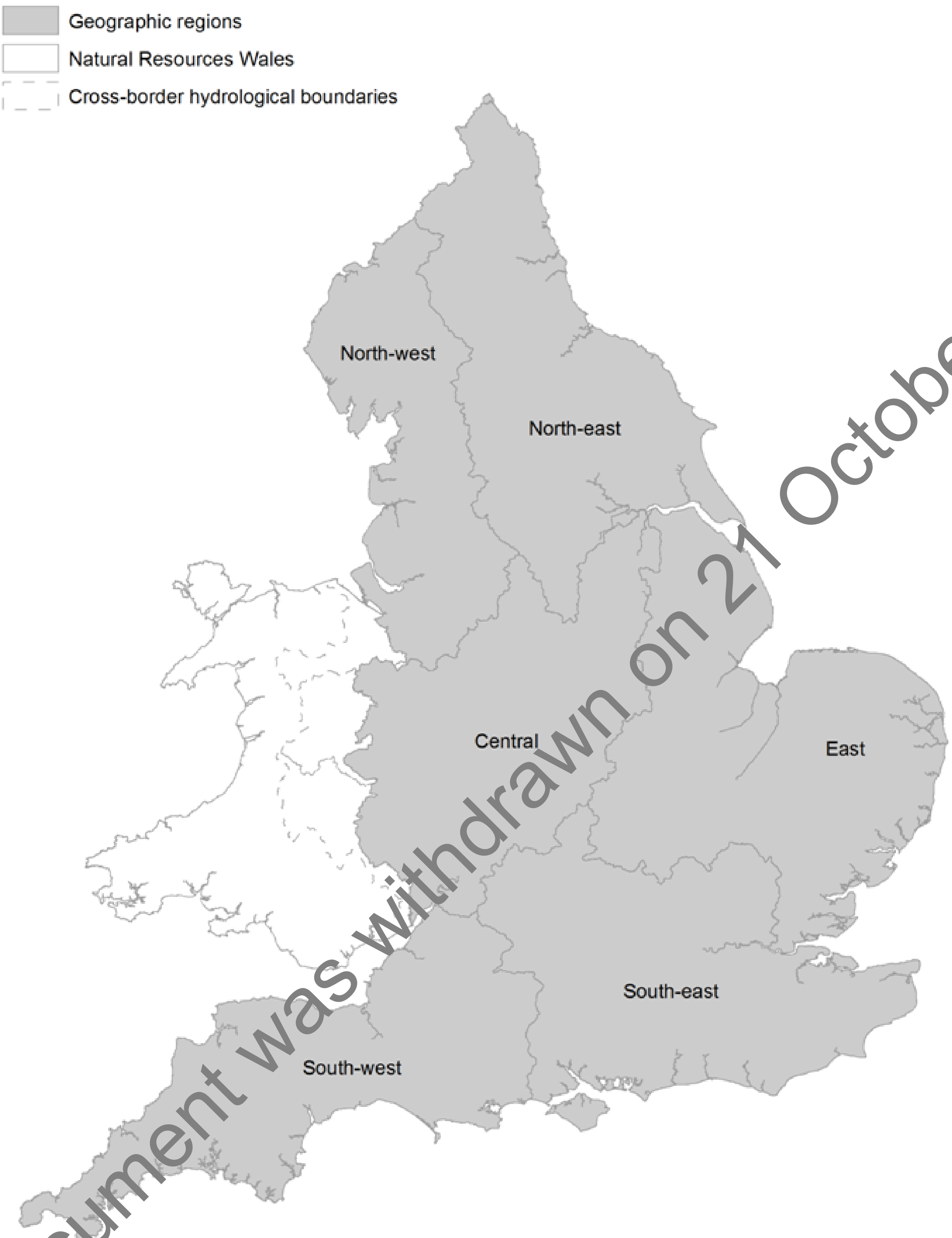

Figure 7.1: Geographic regions

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