Monthly water situation report

England

Summary – August 2019

The August rainfall total for England represented 115% of long-term average, with highest rainfall totals in parts of north-west England. By the end of the month, soils were drier than average across much of eastern and southern England, but generally wetter than average across central and northern England. Monthly mean river flows for August decreased compared to July at almost all indicator stations in east and south-east England but mainly increased across the rest of England. End of month groundwater levels were classed as below normal or lower at over half of the sites we report on. Total reservoir stocks across England were at 84% of capacity at the end of August, in line with the long term average.

Rainfall

The August rainfall total for England was 71 mm, representing 115% of the 1961-90 long-term average LTA (118% of 1981-2010 LTA). The highest August rainfall totals were in parts of north-west England, with the lowest totals in parts of Essex and Kent (Figure 1.1).

August rainfall totals in the Derwent catchment were the 5th highest on record (records from 1891) and were classed as exceptionally high for the time of year. Across most of the country rainfall totals were normal for the time of year. In South Essex the rainfall total was just over half of the August LTA and was classed as below normal. Across a significant part of southeast England where chalk is the primary aquifer, the cumulative rainfall totals for the last 12 months are notably low (Figure 1.2).

At a regional scale, August rainfall totals were below average for the month in east and south-east England (83% and 85% of LTA respectively). Higher than average rainfall totals were recorded in all other regions, ranging from 116% of LTA in central England to 159% of LTA in north-west England (Figure 1.3).

Soil moisture deficit

Soils became slightly drier during August for most of the country except for some parts of south-west England. By the end of August, soil moisture deficits (SMDs) remained larger than average (soils were drier than average) for the time of year across much of eastern and southern England. In contrast to last month however, soils around the Humber changed from wetter than average to drier than average for the time of year. Soils across the rest of central and northern England remained wetter than average for the time of year (Figure 2.1).

At a regional scale SMDs decreased in the middle of the month in response to rainfall across all regions before increasing again towards the end of the month. By the end of August, soils were wetter than average in north-west, north-east and central England and drier than average for the time of year in east, south-east and southwest England (Figure 2.2).

River flows

Monthly mean river flows for August decreased at most indicator sites in east and south-east England but mainly increased across the rest of England compared to July. This reflects both the distribution of rainfall as well as the seasonal recession from groundwater dominated chalk catchments (Figure 3.1).

August monthly mean river flows were classed as normal at over a third of indicator sites and a similar proportion were classed as higher than normal; just under a quarter of indicator sites were lower than normal. For the sixth month in a row monthly mean flows on the River Cam (Cambridgeshire) were classed as exceptionally low – for the last twelve months flows here have been classed as either exceptionally low or notably low. By contrast five sites in central and north-west England had monthly mean flows that were classed as exceptionally high for the time of year (Figure 3.1).

At the regional index sites monthly mean flows were classed as below normal for August on the Great Stour at Horton in south-east England. Flows at the rest of the index sites in east, south-east and south-west England were classed as normal. In the north of England flows at the index sites were notably high and in central England they were exceptionally high for the time of year. (Figure 3.2).

Groundwater levels

Groundwater levels were in recession during August at over two thirds of indicator sites – falling groundwater levels were mainly in chalk aquifers while rising levels were mainly in sandstone aquifers. End of month groundwater levels were classed as lower than normal at over half the indicator sites – a similar proportion as at the end of July. All five sites where groundwater levels were classed as notably low were in chalk aquifers: Redlands Hall (Cam and Ely Ouse Chalk), Washpit Farm (North West Norfolk Chalk), Chilgrove, Ashley Green (East Chilterns Chalk) and Stonor Park (South West Chilterns Chalk) (Figure 4.1).

At the major aquifer index sites, the end of month groundwater levels were classed as notably low in the chalk aquifers of east and south-east England – apart from Little Bucket (east Kent Chalk) which was classed as normal. Dalton Estate Well (Hull & East Riding Chalk) was classed as below normal. The remaining sandstone and limestone aquifer index sites had groundwater levels classed as normal or higher for the time of year (Figure 4.2).

Reservoir storage

Reservoir stocks decreased at nearly two thirds of reported reservoirs and reservoir groups during August. The largest decreases in reservoir stocks, as a proportion of total storage capacity, were in south-west, south-east and east England, with a 15% decrease at Ardingly reservoir (West Sussex) and 13% decreases at Abberton reservoir (Essex) and Clatworthy reservoir (Somerset). Despite this, reservoir stocks at the end of August were classed as normal or higher at over three-quarters of reservoirs and reservoir groups (Figure 5.1).

Total reservoir stocks across England were at 84% of capacity at the end of August. At a regional scale, total reservoir stocks ranged from 65% of capacity in south-west England to 90% of capacity it north-east England (Figure 5.2)

Forward look

The weather forecast for September is for generally unsettled conditions across England, with spells of bright and sunny weather giving way to showers and periods of heavier rainfall. For the three month period September to November, above average precipitation is slightly more likely than below average precipitation[1].

Projections for river flows at key sites[1]

Three-fifths of the modelled sites have a greater than expected chance of cumulative river flows being below normal or lower for the time of year by the end of September 2019. By the end of March 2020, half of the modelled sites have a greater than expected chance of flows being above normal or higher for the time of year.

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]

Three-quarters 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 September 2019. At just over three-fifths of the modelled sites, there is a greater than expected chance of groundwater levels being notably low or lower for the time of year, by the end of 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 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

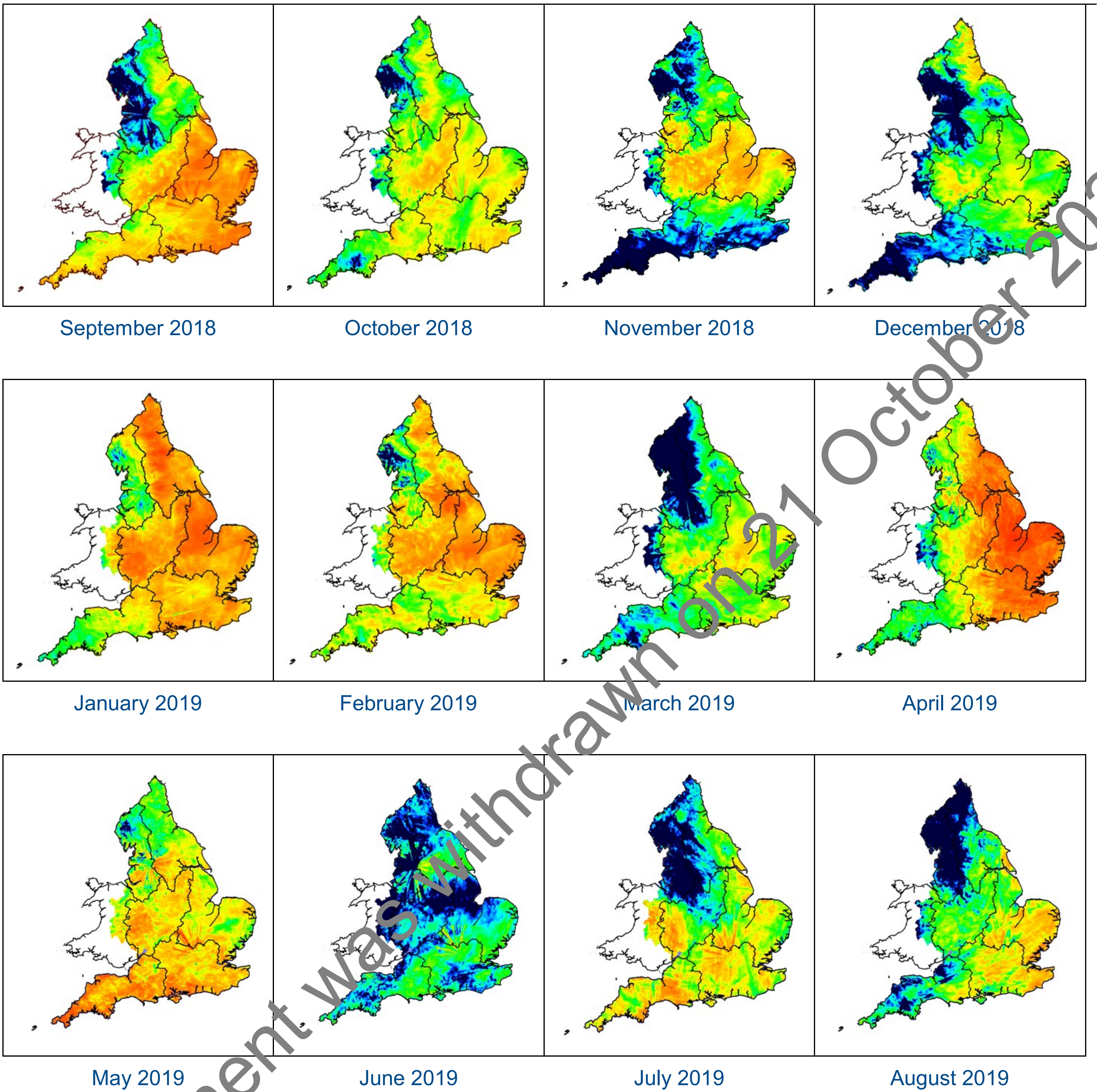
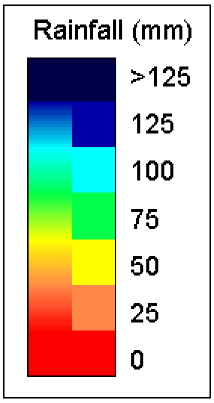


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2019). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100026380, 2019.



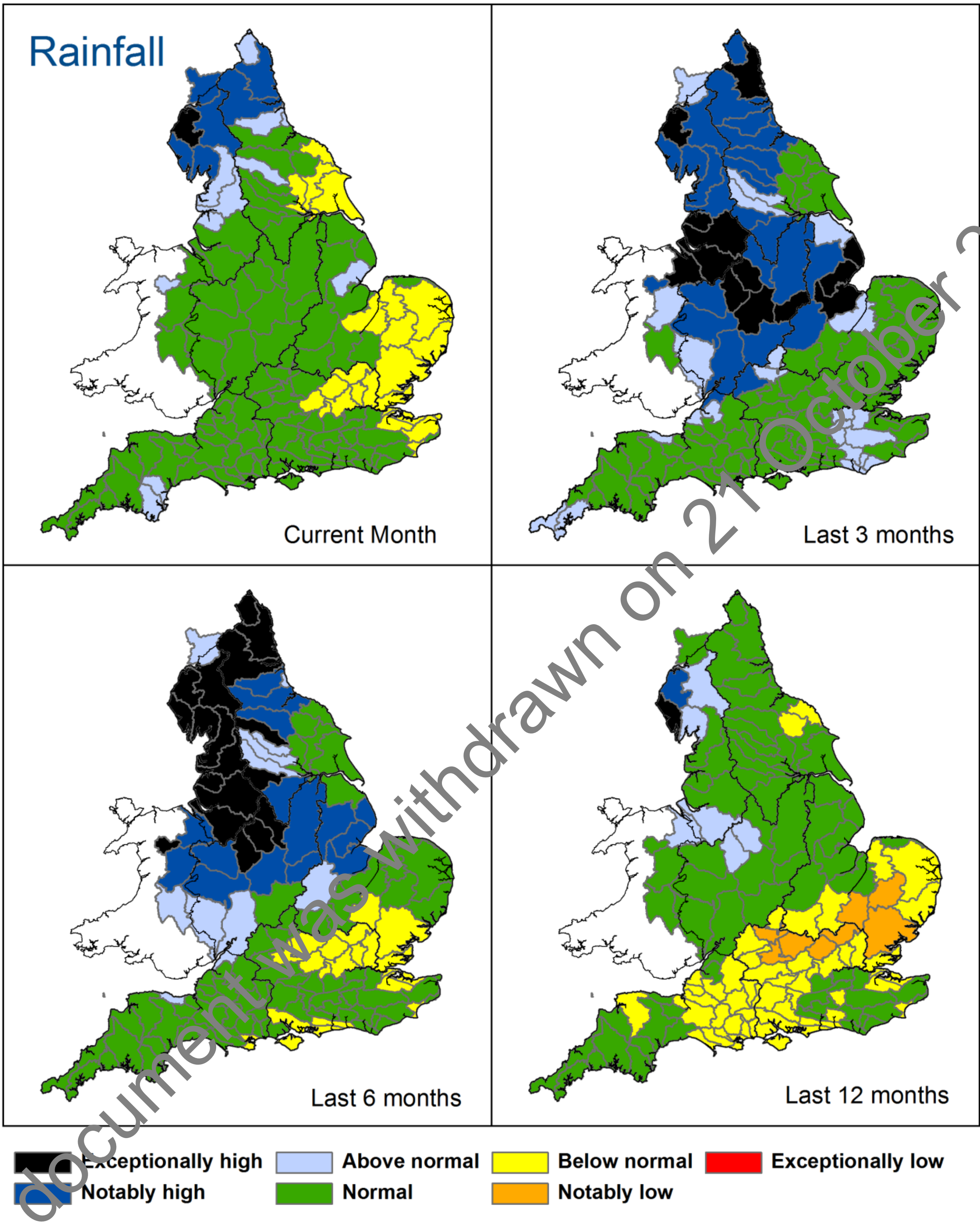


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 August 2019), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived 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

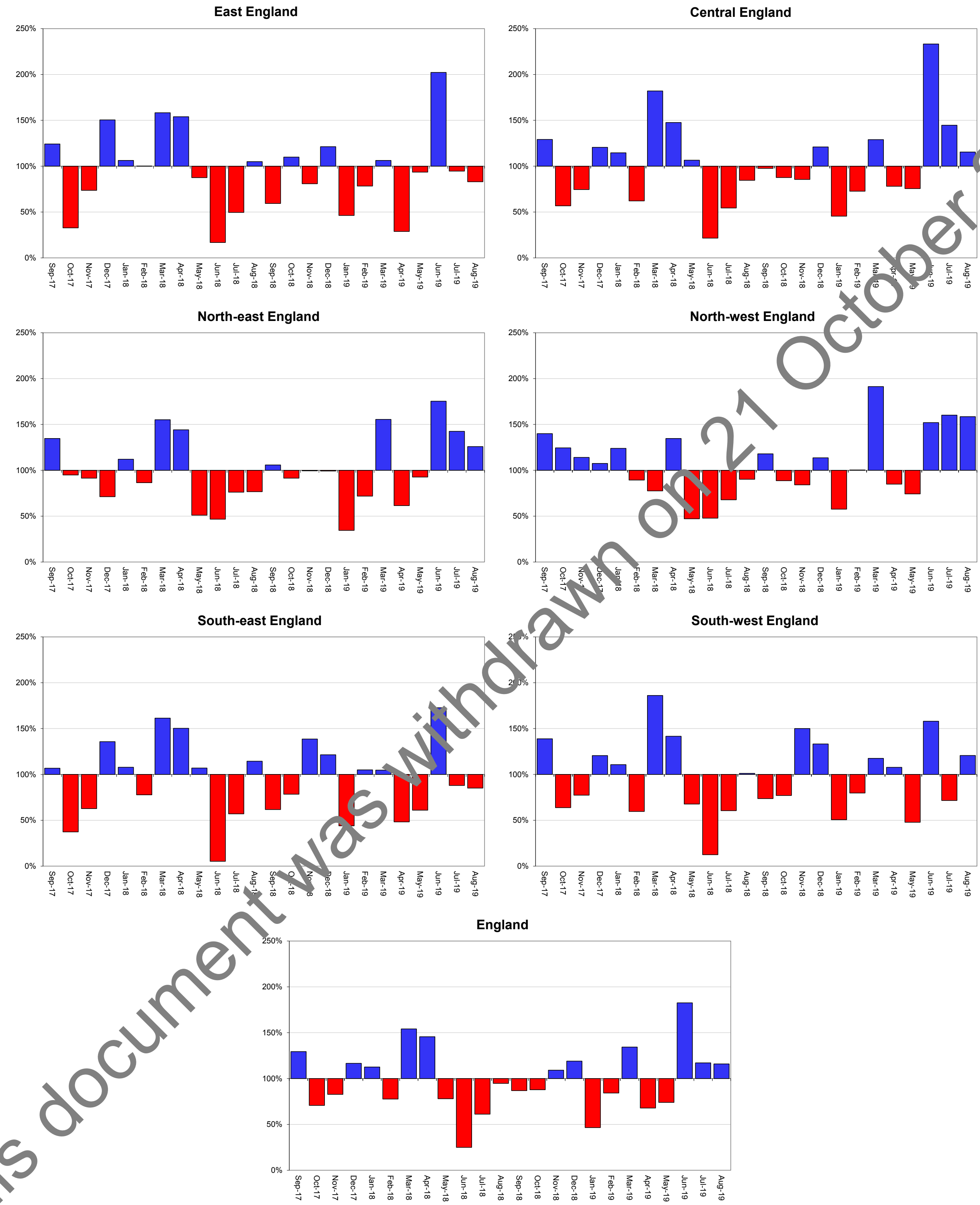


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 – 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2019).

Soil moisture deficit

End of July 2019[1]	End of August 2019[2]

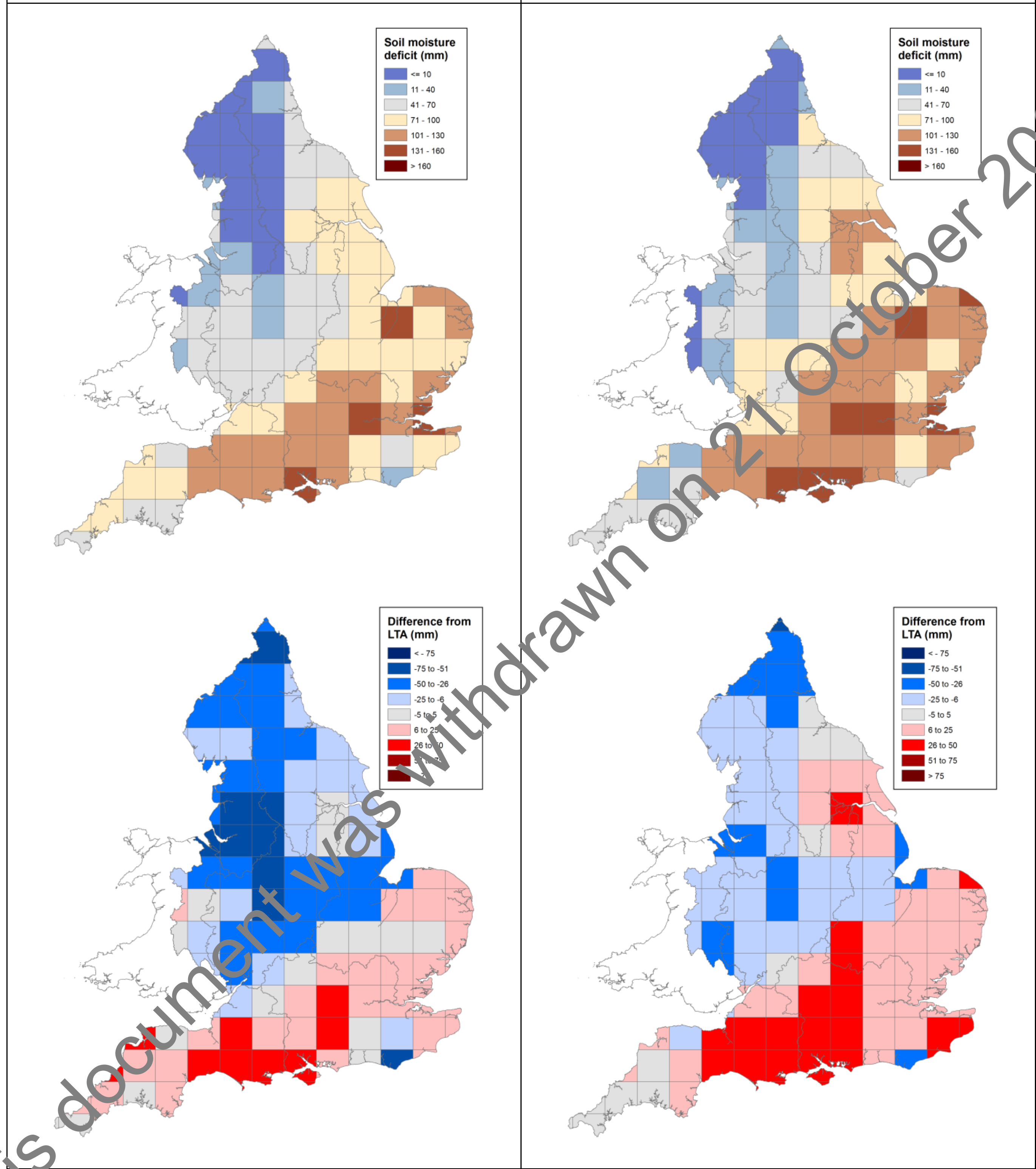


Figure 2.1: Soil moisture deficits for weeks ending 30 July 2019 [1] (left panel) and 3 September 2019 [2] (right panel). Top row shows actual soil moisture deficits (mm) and bottom row shows the difference (mm) of the actual from the 1961-90 long term average soil moisture deficits. MORECS data for real land use (Source: Met Office © Crown Copyright, 2019). Crown copyright. All rights reserved. Environment Agency, 100026380, 2019

Soil moisture deficit charts

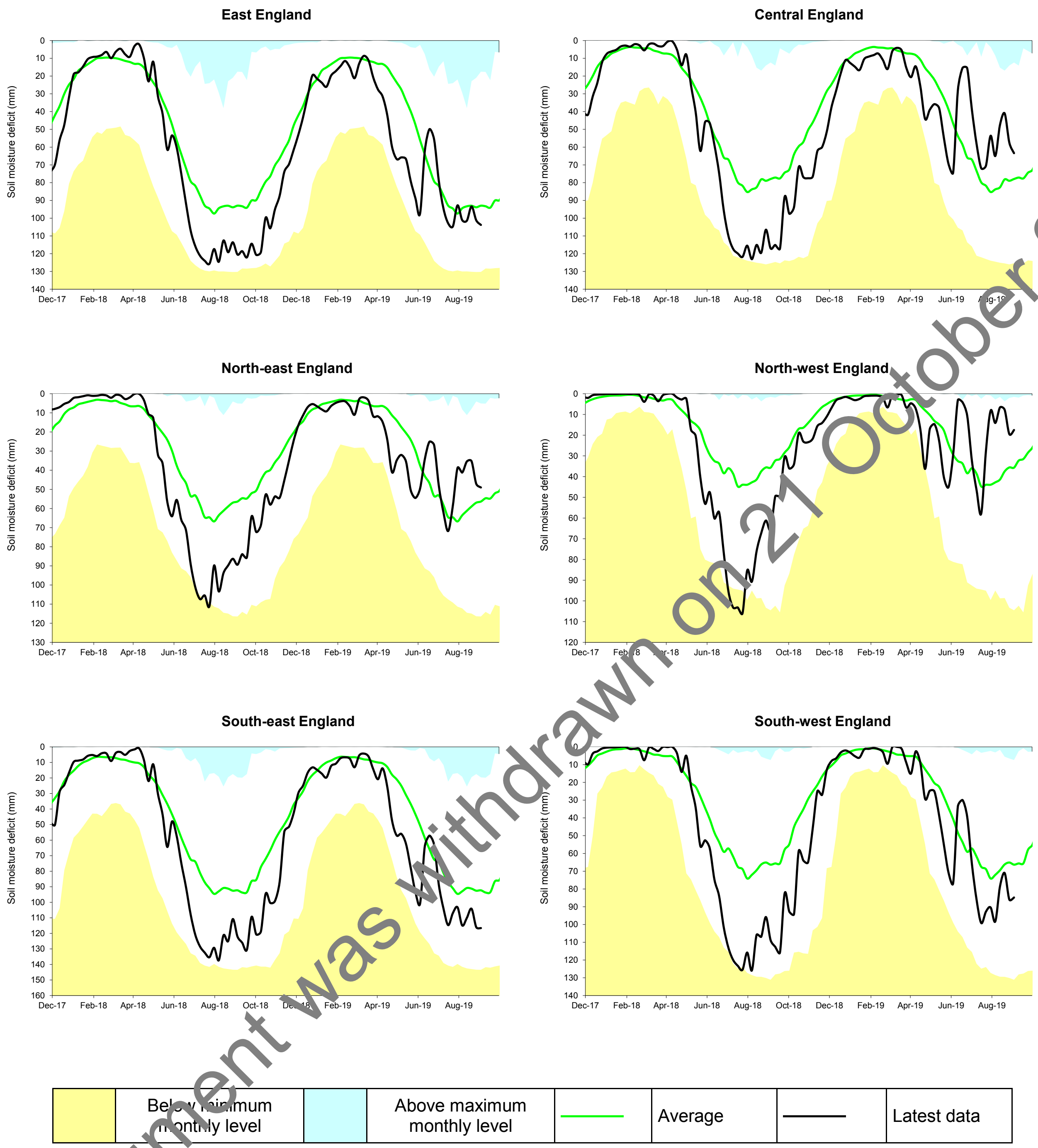
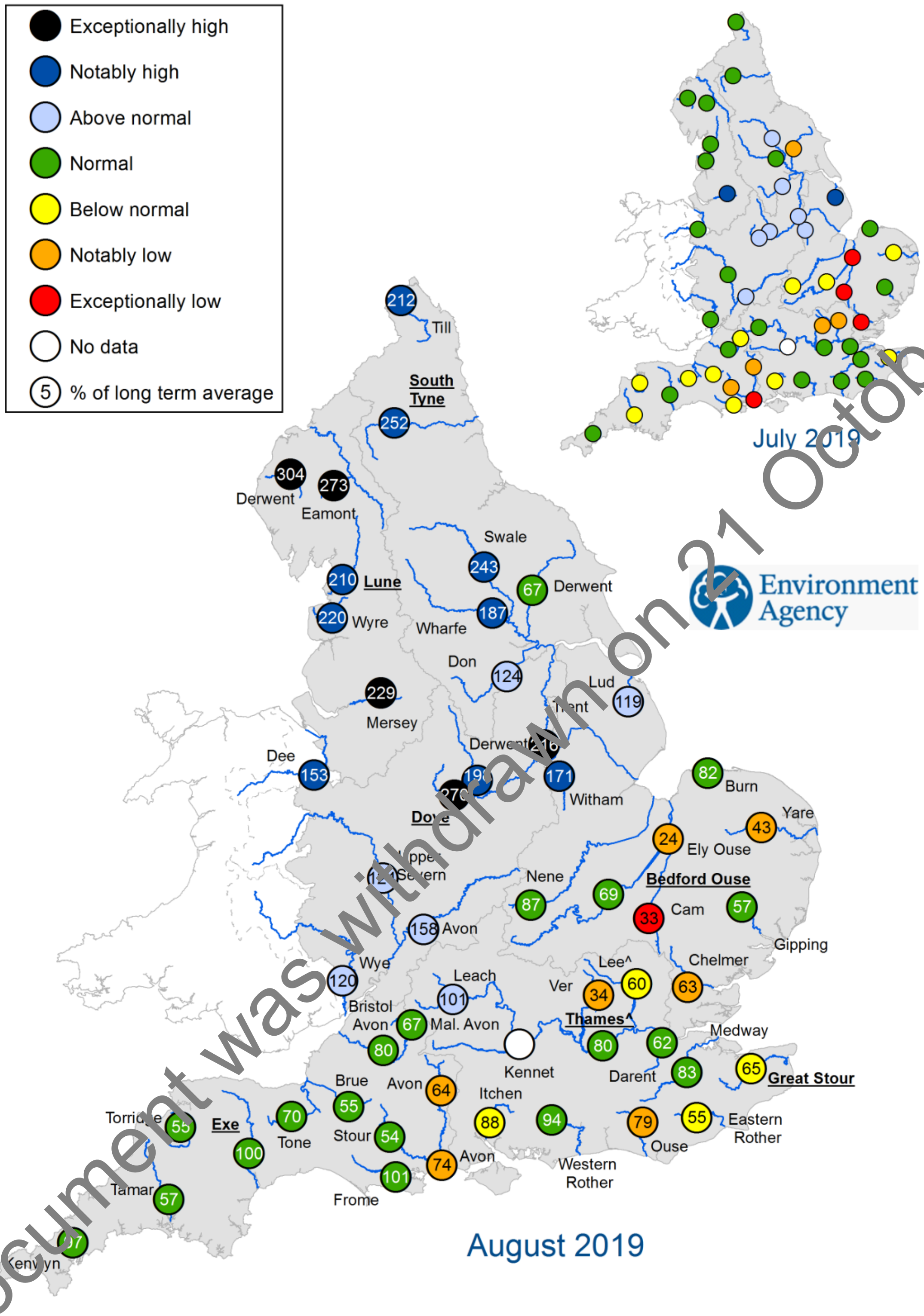


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961-90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2019).

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

River flow charts

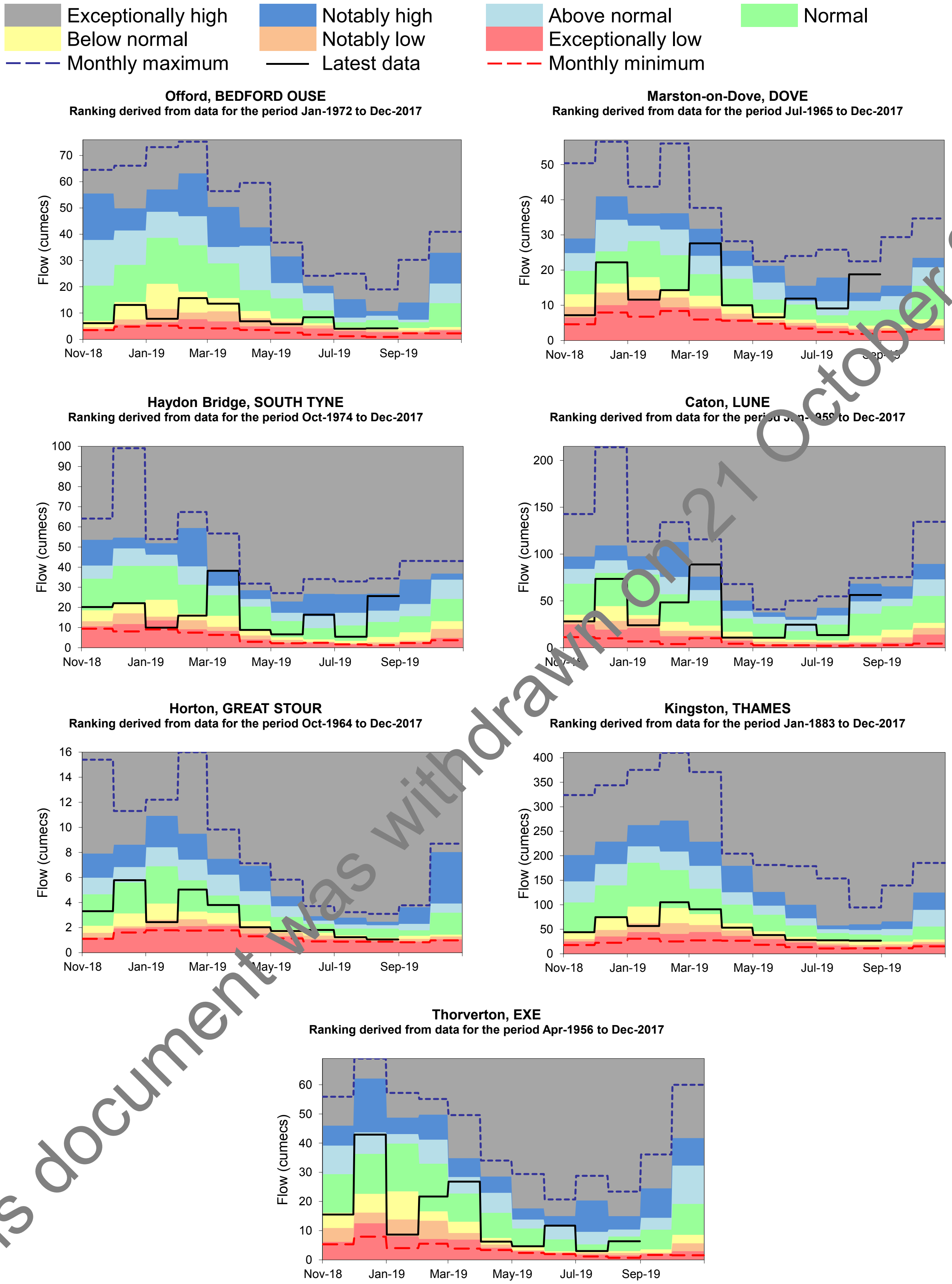
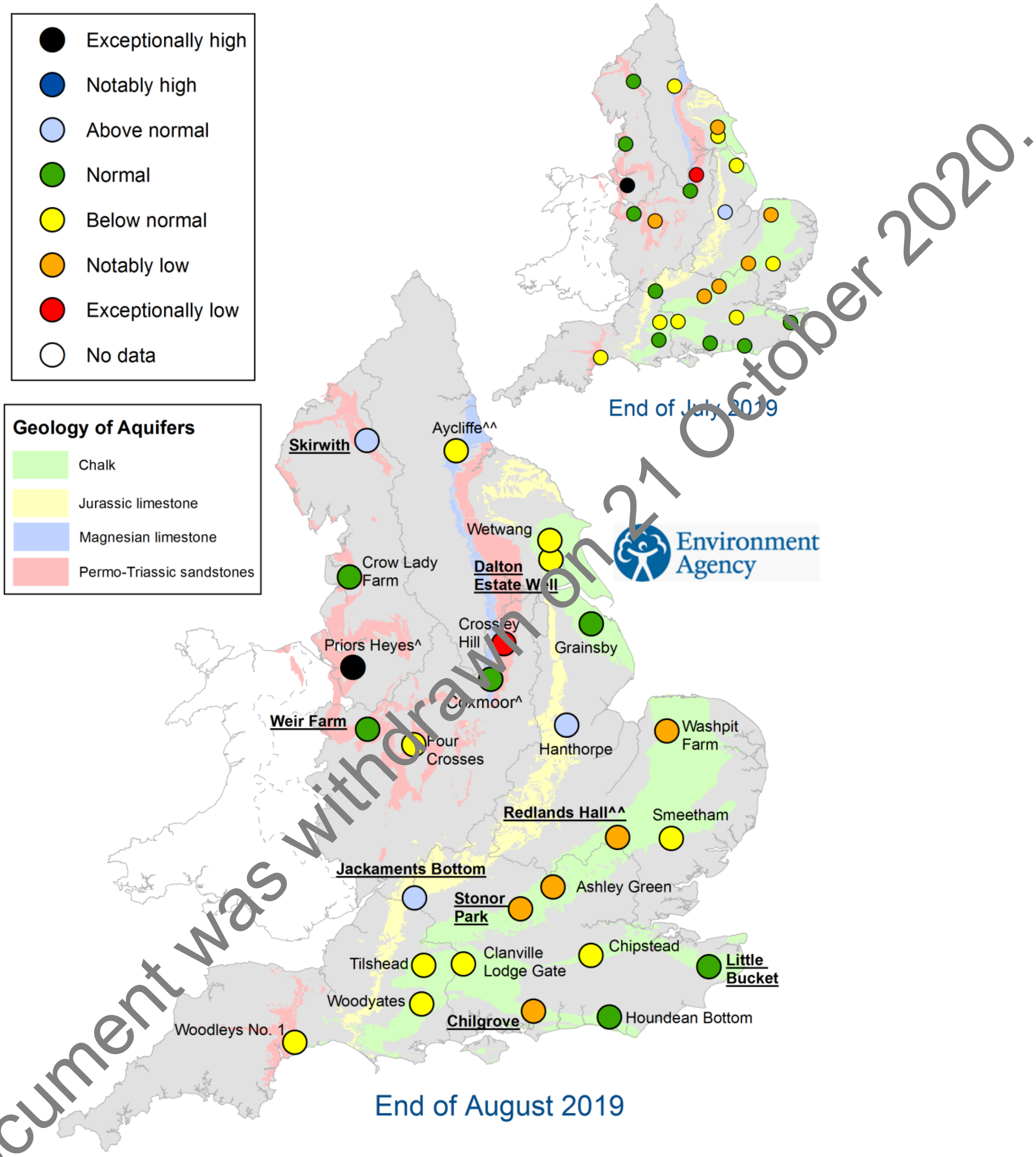


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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
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 July and August 2019, classed relative to an analysis of respective historic July and August levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC.

Groundwater level charts

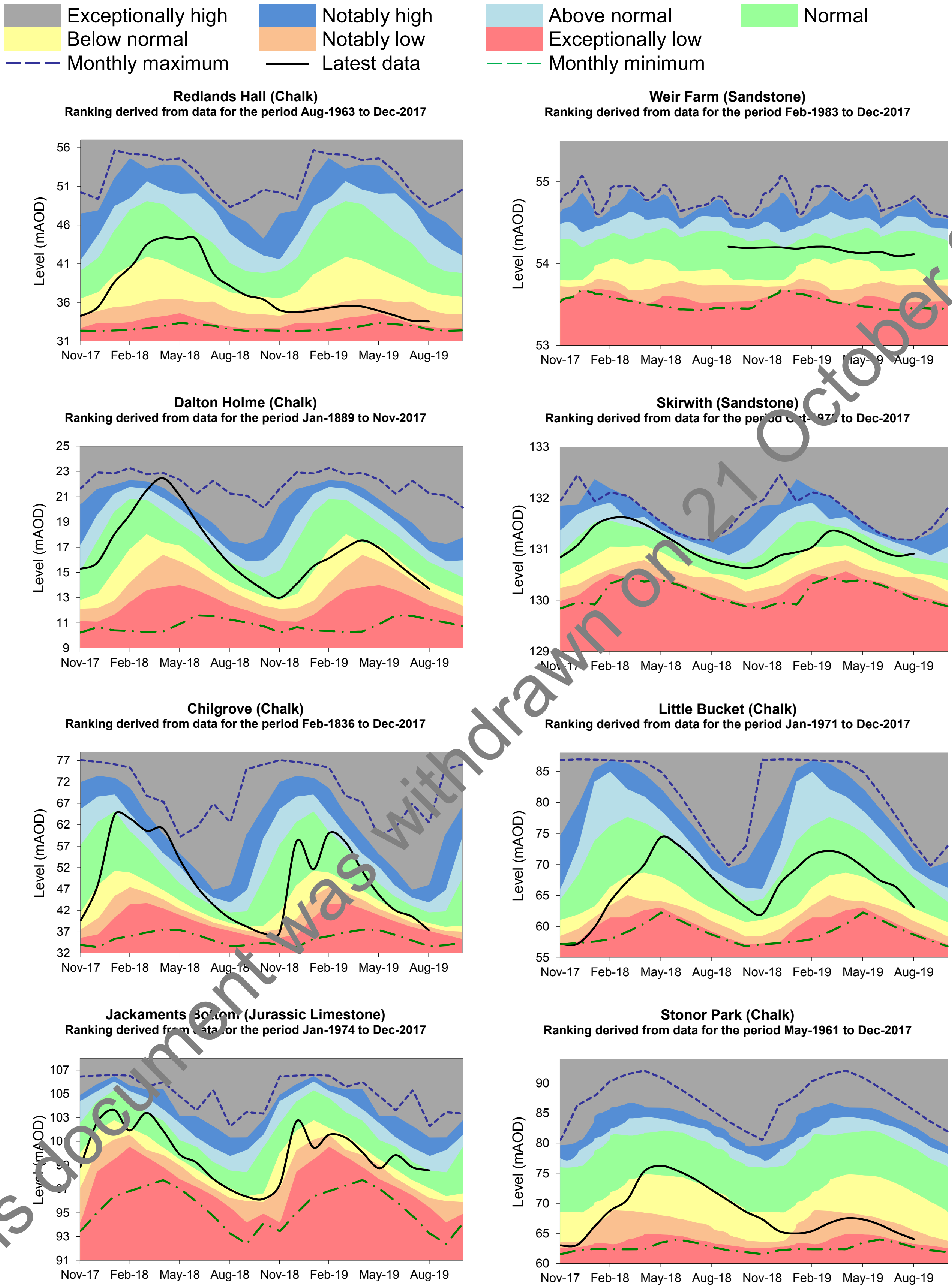
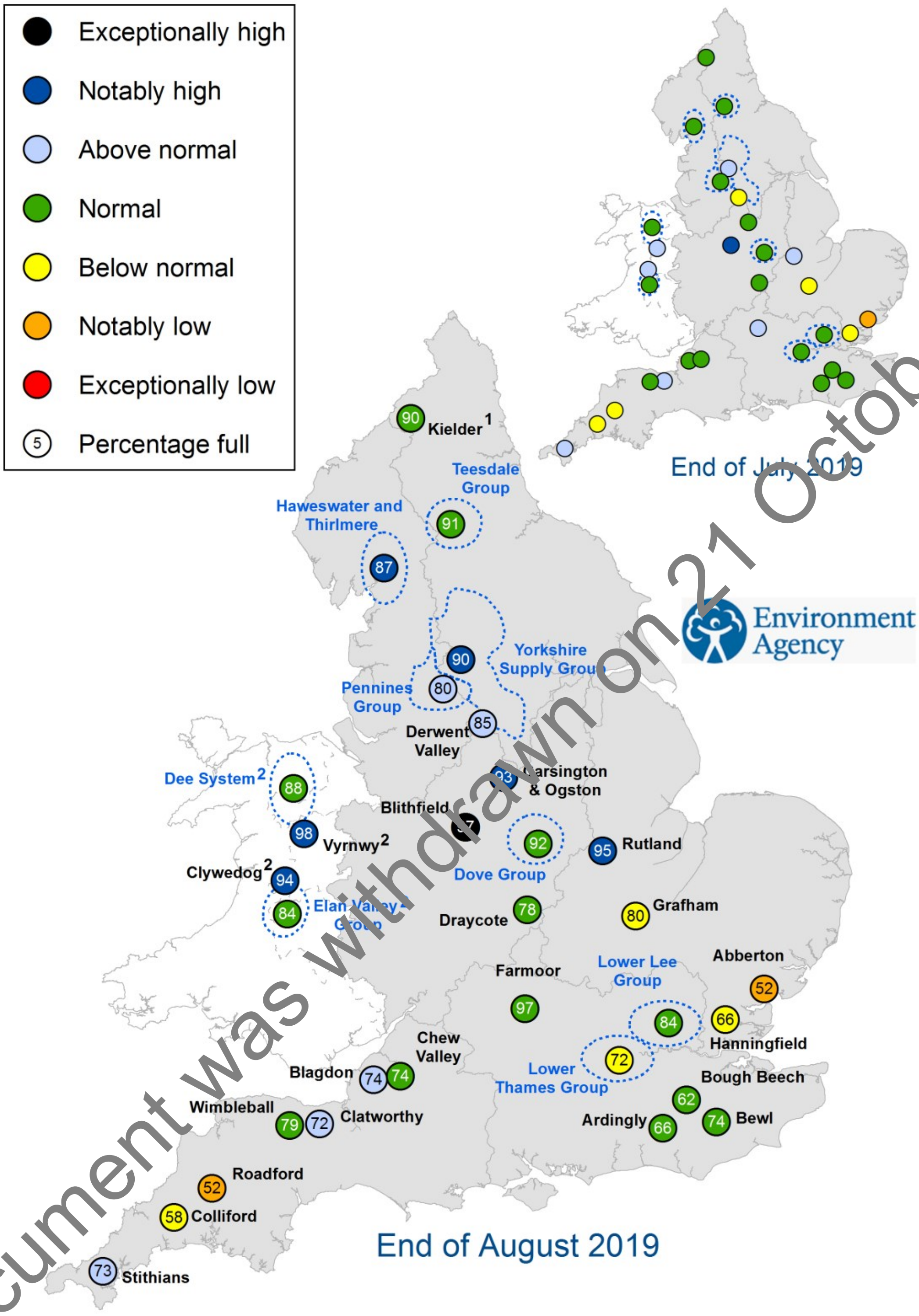


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2019).

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 July and August 2019 as a percentage of total capacity and classed relative to an analysis of historic July and August values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate to control curves or triggers for drought actions. As well as for public water supply, some reservoirs are drawn down to provide flood storage, river compensation flows or for reservoir safety inspections. In some cases current reservoir operating rules may differ from historic ones. 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

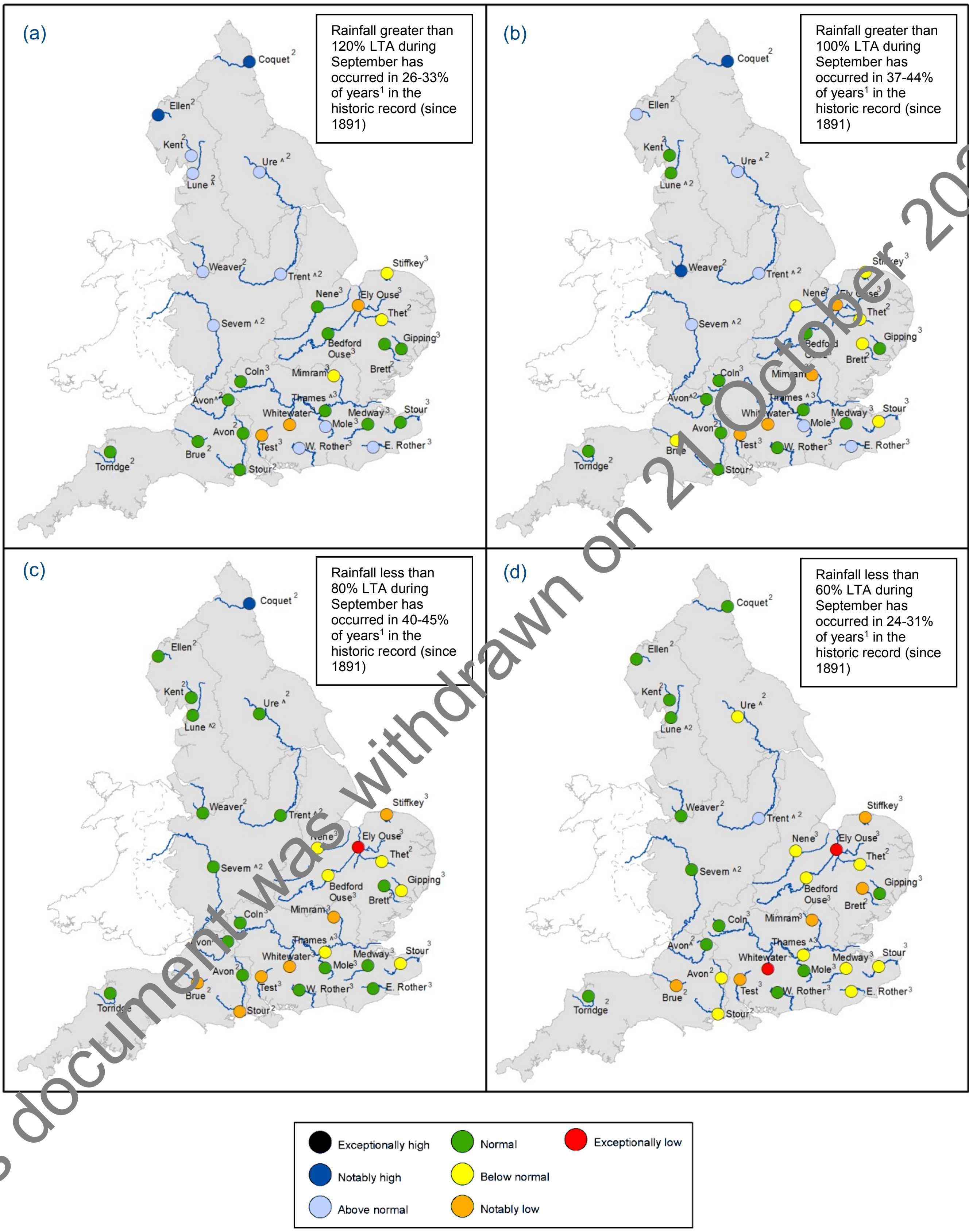


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between during September (Source: Centre for Ecology and Hydrology, Environment Agency)

[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*

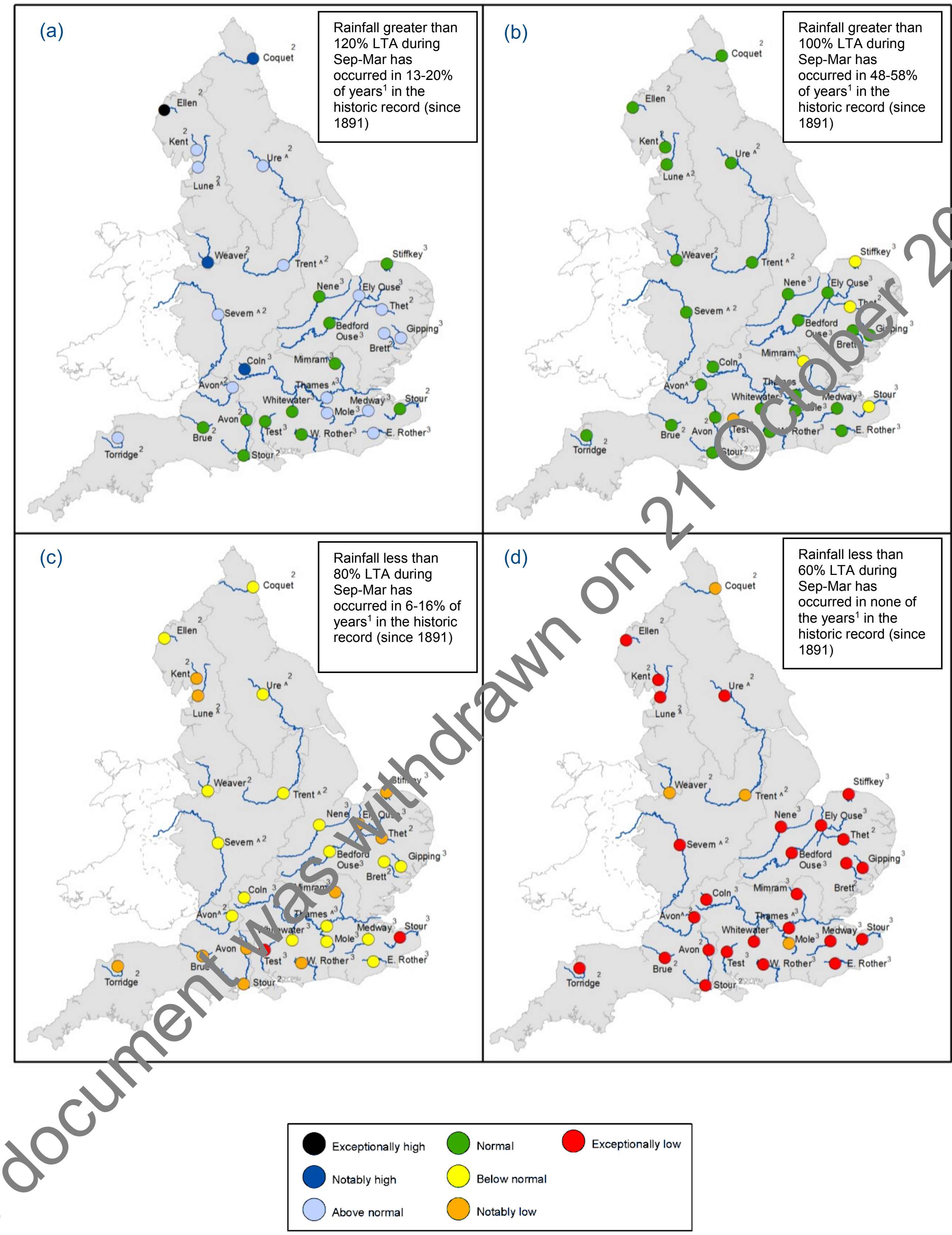
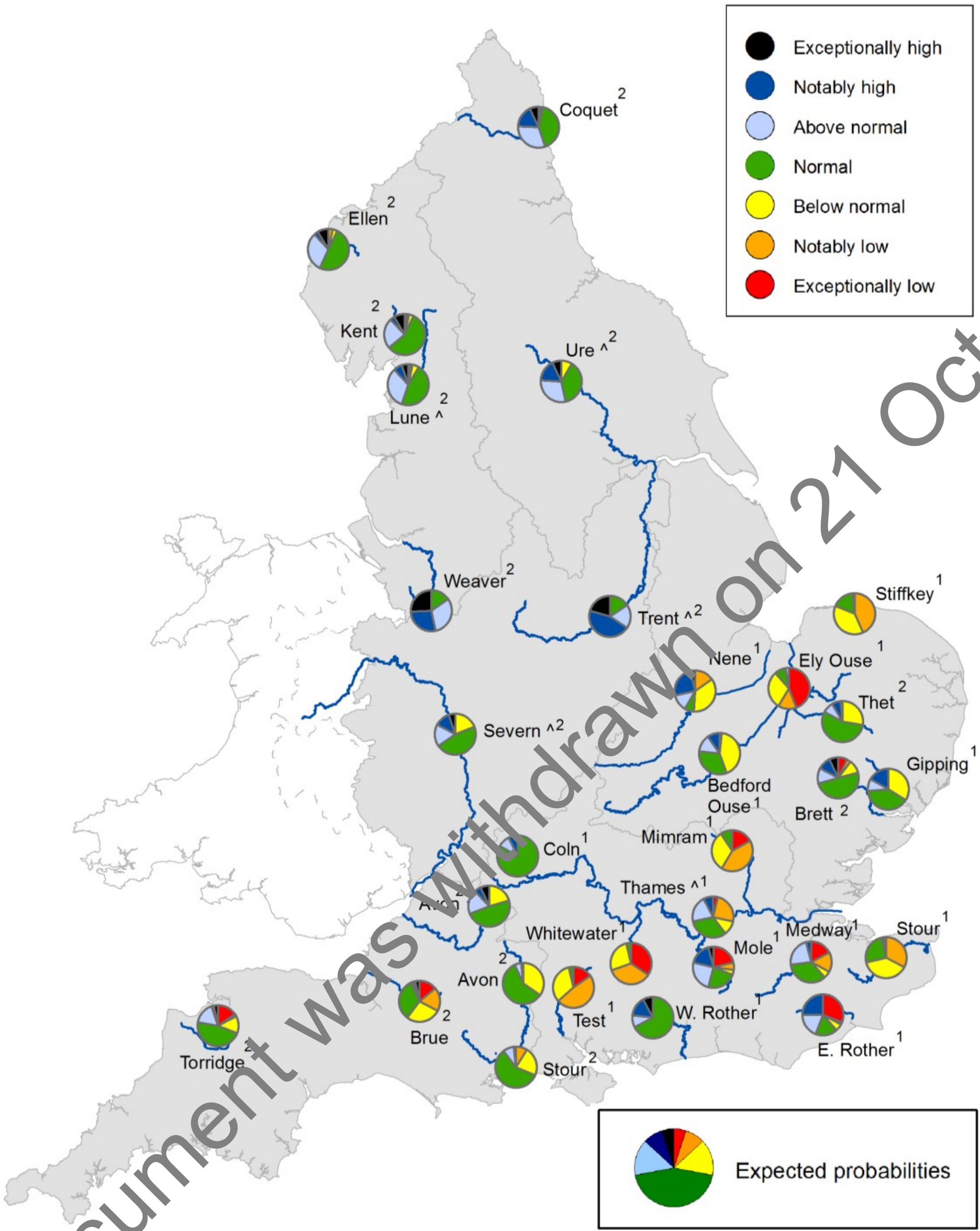


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between September and March (Source: Centre for Ecology and Hydrology, Environment Agency)

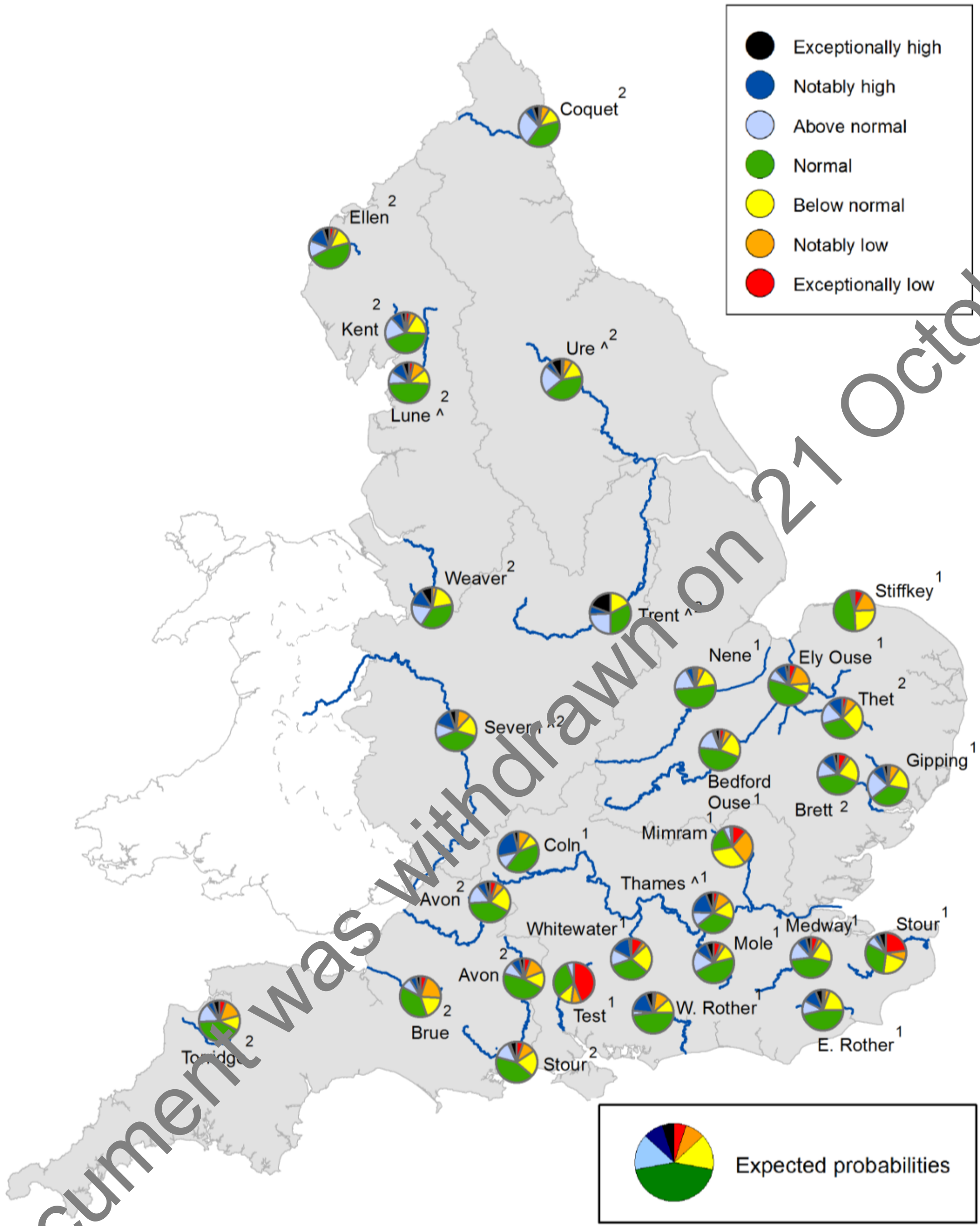
[1] This range of probabilities is a regional analysis
[2] Projections for these sites are produced by CEH
[3] Projections for these sites are produced by the Environment Agency
^ *"Naturalised" flows are projected for these sites*



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).

[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



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

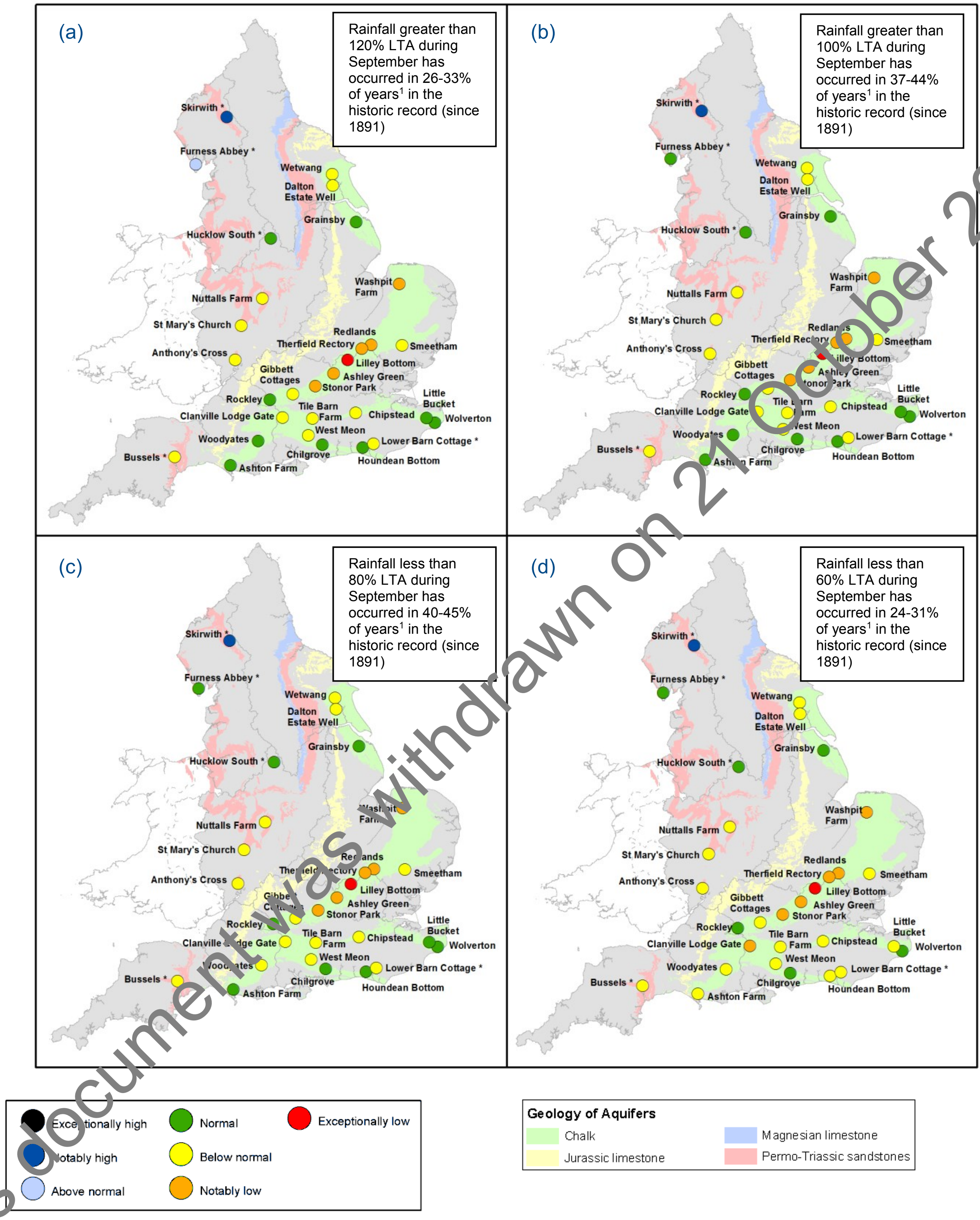


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2019. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall during September (Source: Environment Agency) Geological map reproduced with kind permission from UK 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

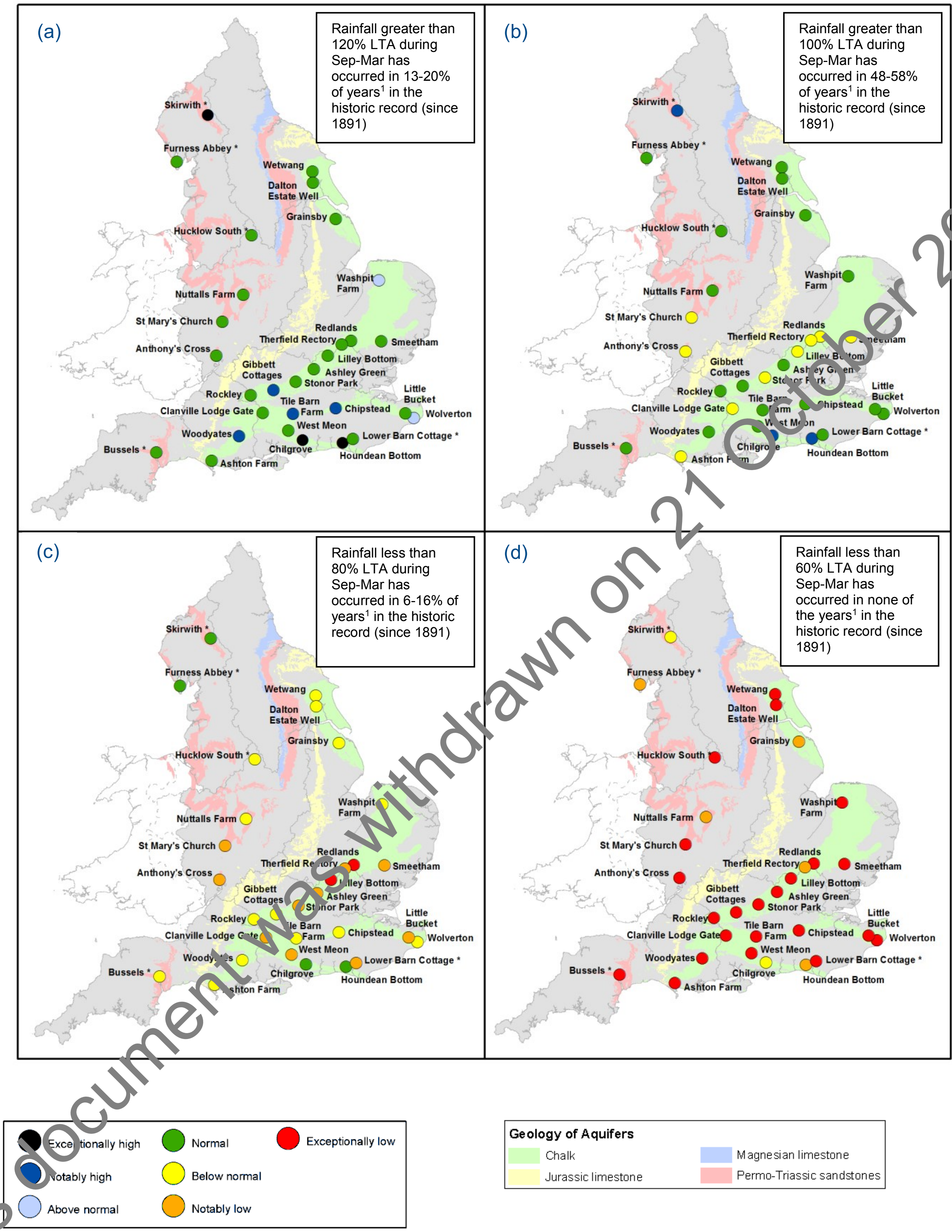
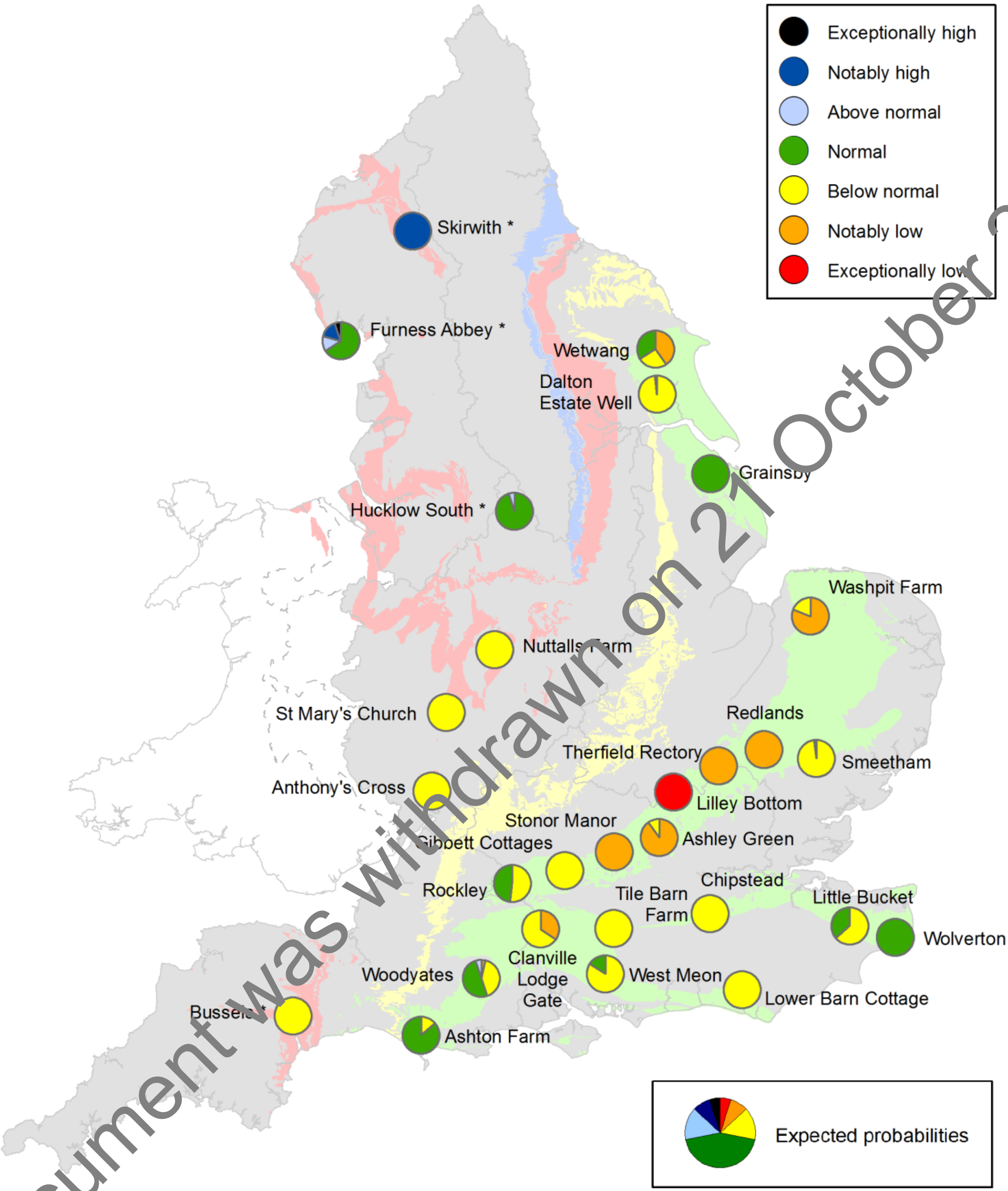


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2020. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between September and March (Source: Environment Agency) Geological map reproduced with kind permission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

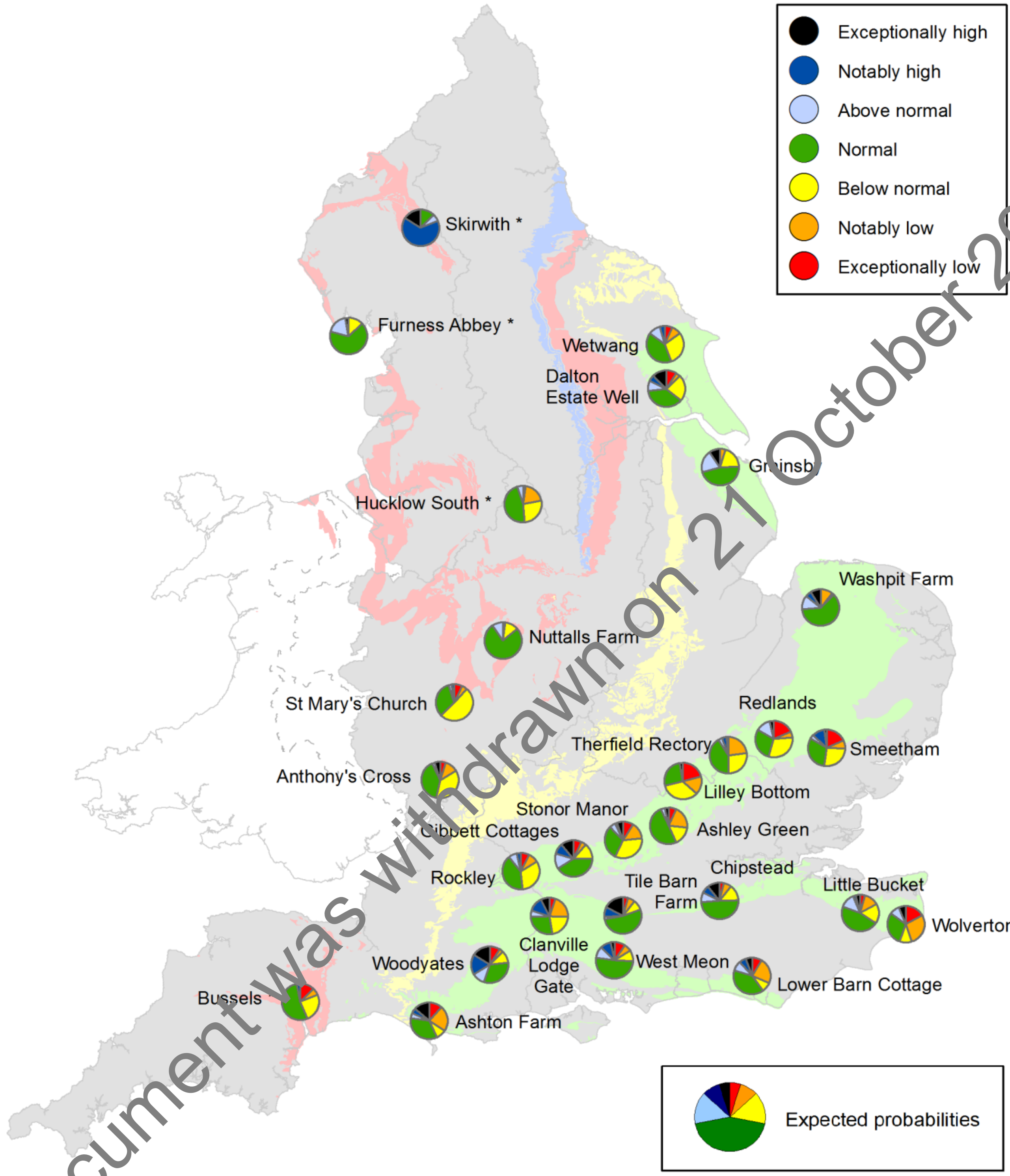
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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*



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

Figure 6.8: Probabilistic ensemble projections of groundwater levels at key indicator sites at the end of March 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

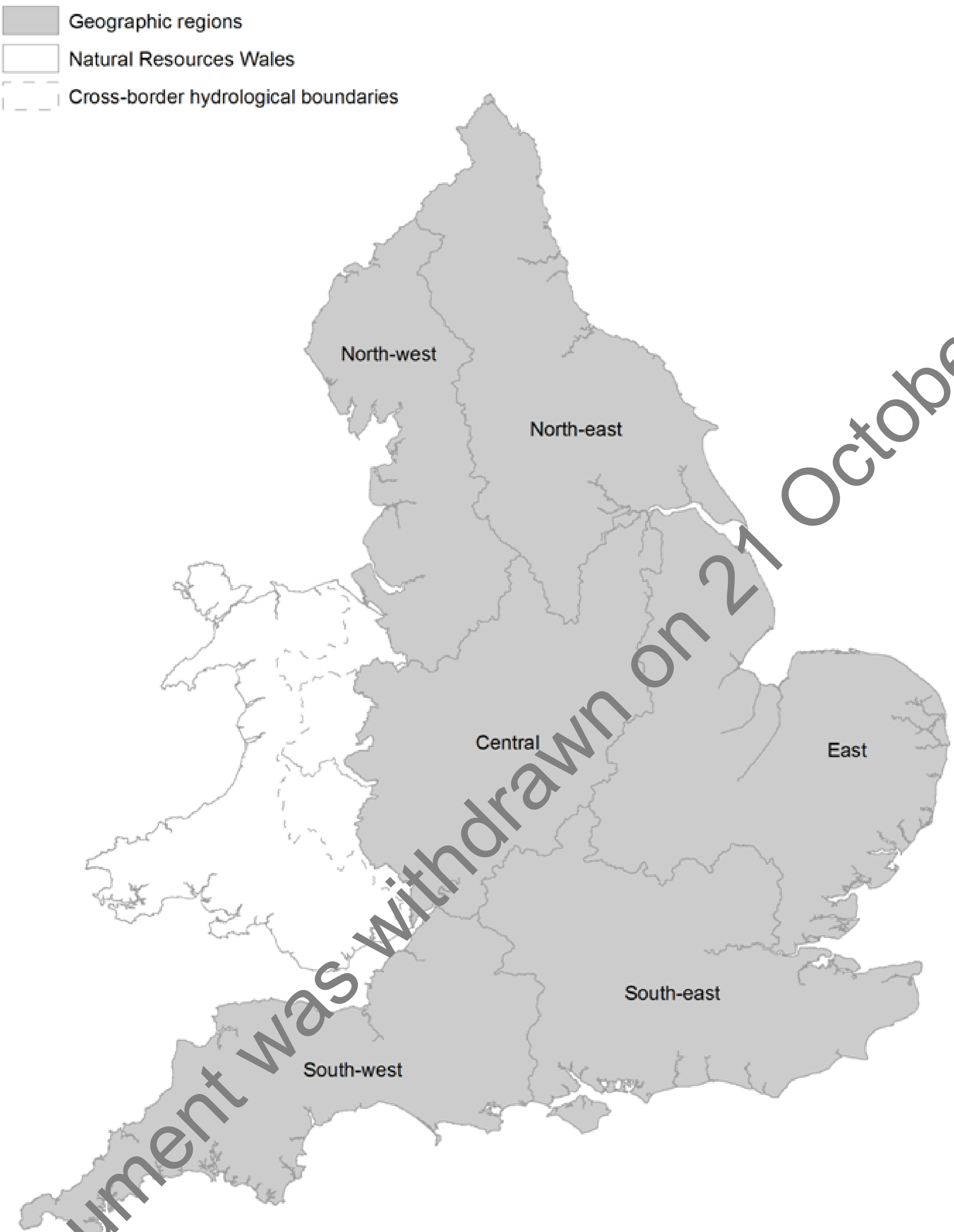


Figure 7.1: Geographic regions

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