Monthly water situation report

England

Summary – October 2021

Monthly rainfall totals across England were well above average at 162% of the October long term average. Soil moisture deficits continued to reduce with soils getting wetter during the month across much of England. River flows increased at the majority of reported sites and all indicator sites were classed as normal or higher for the time of year. The end of October groundwater levels were classed as normal or higher for the time of year at all indicator sites. Reservoir stocks increased during October at over two-thirds of the reservoirs and reservoir groups we report on.

Rainfall

The October rainfall total for England was 125mm, which represents 162% of the 1961-1990 long term average LTA (136% of the 1981-2010 LTA). The highest monthly rainfall totals were generally in western and southern areas, with lower totals in central and eastern England (Figure 1.1)

Monthly rainfall totals were classed as above normal or higher for the time of year in majority of the catchments across England with the LTA being exceeded in all catchments. Exceptionally high rainfall totals were recorded in parts of north west England and southern coastal catchments. The lowest rainfall total as a proportion of the LTA was over Mersey and Irwell in Greater Manchester, with 117mm of rainfall representing 113% of the October LTA. The highest rainfall total as a proportion of the LTA was over the Otter Sid Axe and Lim catchment in south-west England, with 214mm of rainfall representing 229% of the LTA. The 12 month cumulative rainfall totals are classed as normal or higher in all catchments across England except for the River Esk catchment (Dumfries) on the Scottish border. Here the 12 month cumulative rainfall totals were classed as below normal (Figure 1.2).

At a regional scale, October rainfall totals ranged from 139% of the LTA in east England to 176% of the LTA in south eastern and south western England. All regional rainfall totals for October, with the exception of east England were above normal or notably high for the time of year (Figure 1.3).

Soil moisture deficit

During October soil moisture deficits reduced across England as the majority of soils got wetter during the month. End of October soil moisture deficit (SMD) values were close to or smaller than the LTA for the time of year (soils were wetter than average) across England. (Figure 2.1)

At a regional scale, the end of October SMD values show that soils were wetter than average for the time of year across England. (Figure 2.2)

River flows

October monthly mean river flows increased at all but three of the indicator sites we report on, compared to September. Flows at the almost all reported sites in north-east, eastern and central England were classed as normal for the time of year. In contrast, monthly mean flows at over three quarters of the indicator sites we report on in south-east, south-west and north-west England were classed as above normal or higher. Flows recorded at Iping Mill on the River western Rother (in west Sussex) and Ouse Bridge on the River Derwent (in Cumbria) were classed as exceptionally high for the time of year (Figure 3.1)

At the regional index sites monthly mean flows were classed as normal on the River Dove at Marton-On Dove (central England), the Belford Ouse at Offord (east England) and Great Stour at Horton (south east England). The remaining regional index sites were all classed as above normal for the time of year (Figure 3.2)

Groundwater levels

Groundwater levels were in recession at more than half of the reported indicator sites during October however all the end of month groundwater levels were classed as normal or higher for the time of year (Figure 4.1).

At Priors Heyes (West Cheshire sandstone) and Weir Farm (Bridgnorth sandstone) the highest end of October levels on record were recorded (records go back to 1972 and 1983 respectively). Levels at Priors Heyes remain high compared to historic levels because the aquifer is recovering from the effects of historic abstraction. (Figure 4.1)

October groundwater levels at the major aquifer index sites ranged from being classed as exceptionally high at Weir Farm (central England) to normal in the Jurassic limestone at Jackaments Bottom. The chalk index sites at Stonor Park, Chilgrove, Dalton Holme and Redlands Hall were also classed as normal (Figure 4.2).

Reservoir storage

End of October reservoir stocks increased at almost two-thirds of the reservoirs and reservoir groups we report on. Stock increases of over 10% of total capacity were recorded at several reservoirs or groups, with the biggest increase seen at the Haweswater and Thirlmere Group in north-west England (an gain of 41%). End of month reservoir stocks were classed as normal or above for the time of year at the majority of reported reservoir sites however three groups, although recovering, remain classed as notably low for the time of year. (Figure 5.1).

At a regional scale, total reservoir stocks ranged from 71% in central and south-west England to 81% in east and south-east England. Total reservoir stocks for north-east, north-west, and central England were below the LTA for the time of year. Total reservoir stocks for England were 77% of total capacity at the end of October (Figure 5.2).

Forward look

The beginning of November was relatively dry in eastern and south-east England, with wetter weather seen across the south-west and north of the country. Moving in to the second week of the month, mixed conditions are expected with drier weather in south-east England, rain across central parts and a mix of showers and brighter spells likely in north-east and north-west England. The middle of November is expected to see changeable conditions, especially in west and north-west England with spells of rain, some of it persistent. South-east England is likely to be drier and brighter during this period. The end of November is likely to be more settled as high pressure dominates, although north and north-west England may see some further unsettled conditions.

For the 3 month period November to January, there is a slightly higher than normal chance that the period will be wet, and there is more than twice the normal chance it will be mild[1].

Projections for river flows at key sites[2]

By the end of March and end of September 2022, more than three quarters of the modelled sites have a greater than expected chance of cumulative river flows being normal or higher for the time of year. Less than one fifth 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 March and September 2022.

For scenario based projections of cumulative river flows at key sites by March 2022 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by September 2022 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by March 2022 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by September 2022 see Figure 6.4

Projections for groundwater levels in key aquifers[2]

By the end of March 2022, three-quarters 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 2022, more than three quarters of the modelled sites have a greater than expected chance of groundwater levels being normal or higher for the time of year.

For scenario based projections of groundwater levels in key aquifers in March 2022 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in September 2022 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2022 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2022 see Figure 6.8

Authors: National Water Resources Hydrology Team

1 Source: Met Office
2 Information produced by the Hydrological Outlook a partnership between UK Centre for Ecology and Hydrology, British Geological Survey, Met Office, Environment Agency and other devolved agencies.

Rainfall

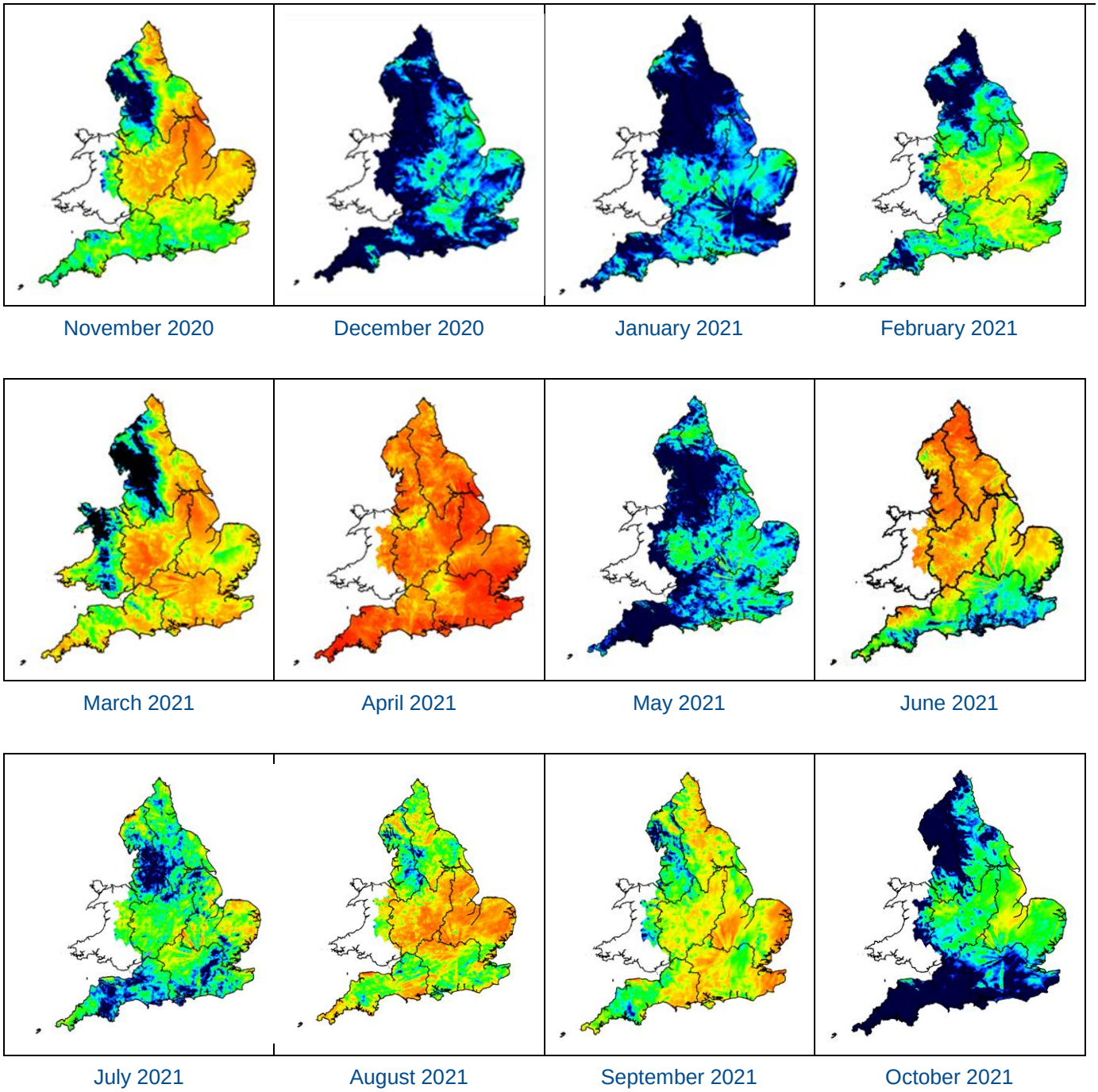


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2021). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

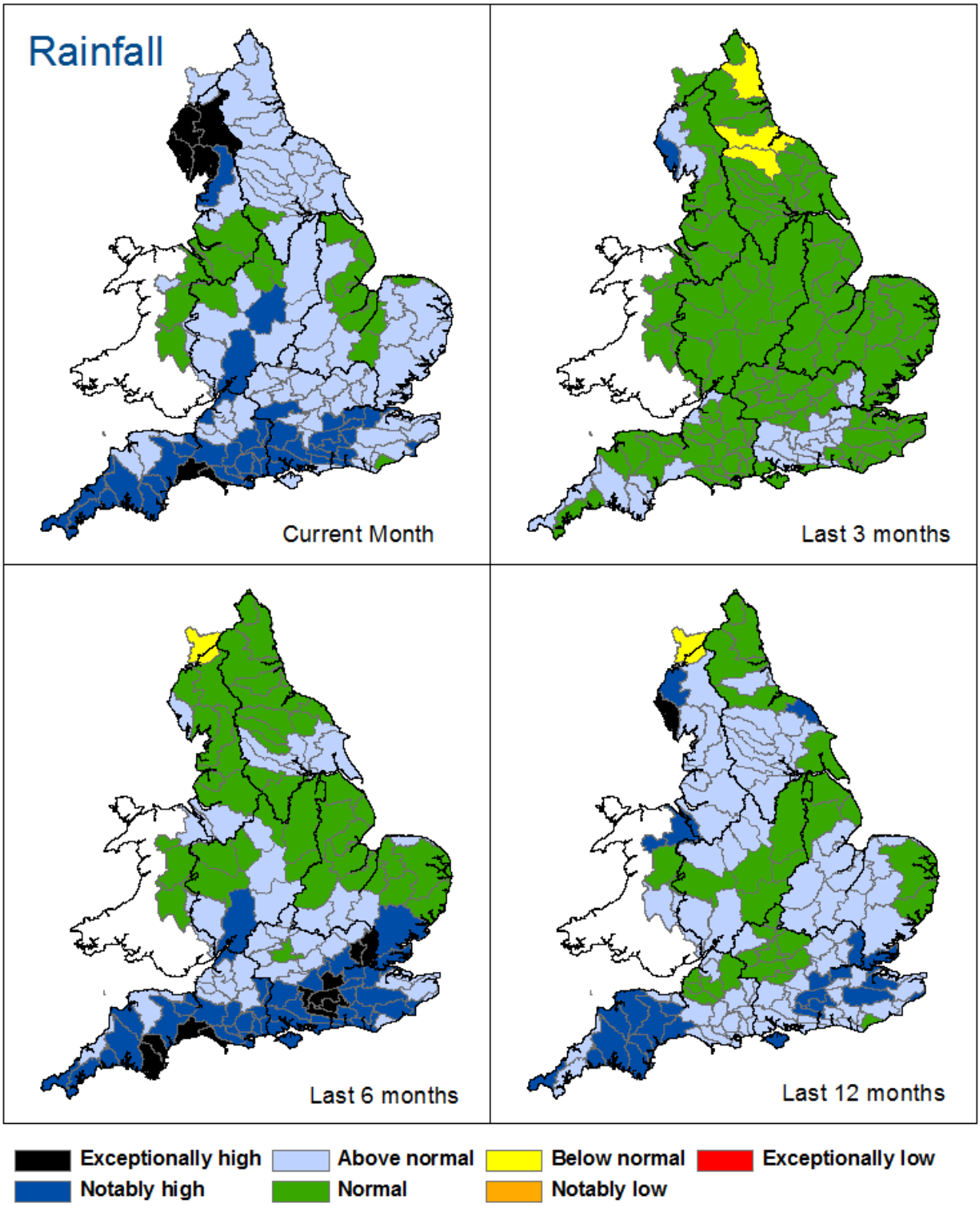


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 October), the last 3 months, the last 6months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived 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. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

Rainfall charts

Above average rainfall

Below average rainfall

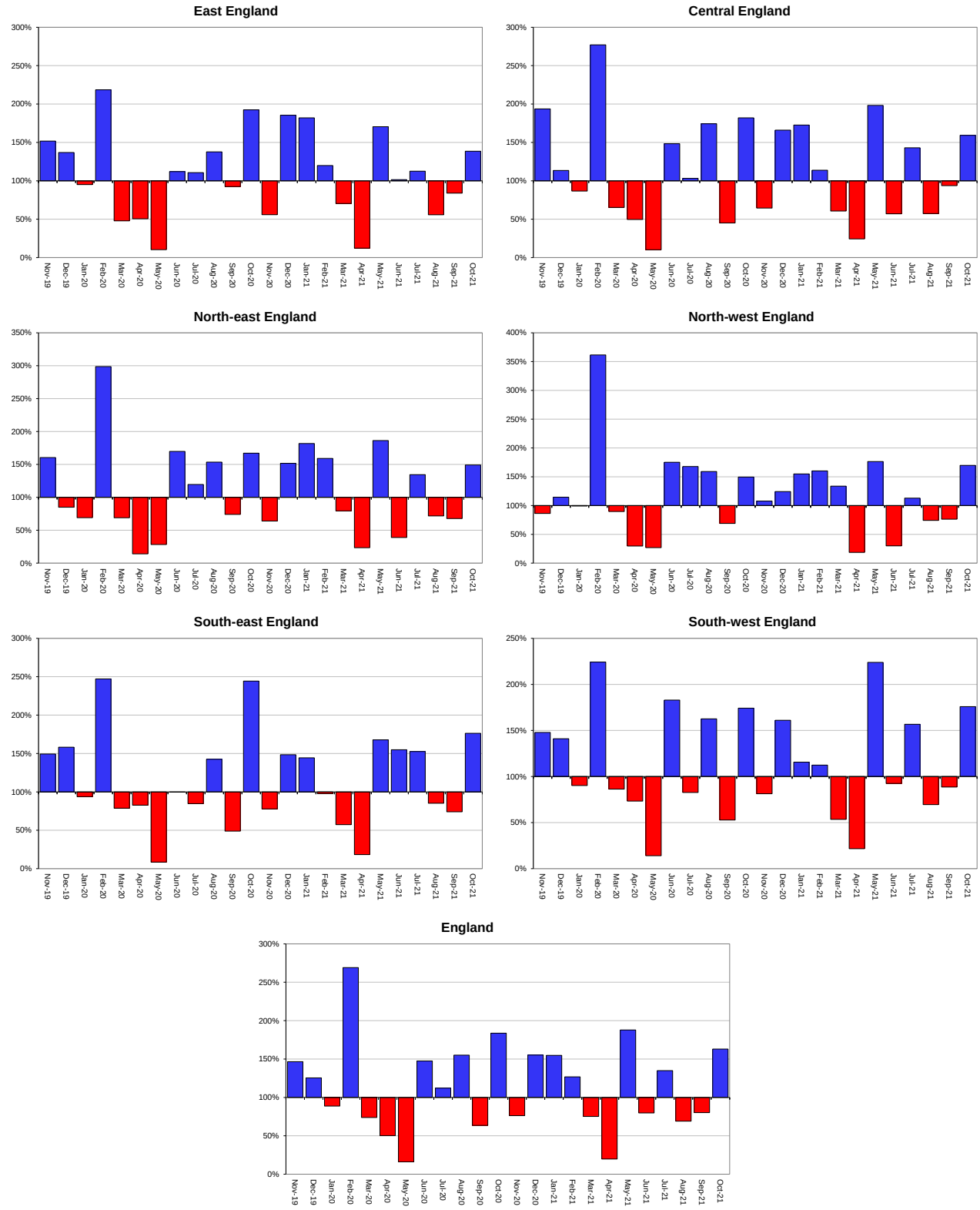


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2021).

Soil moisture deficit

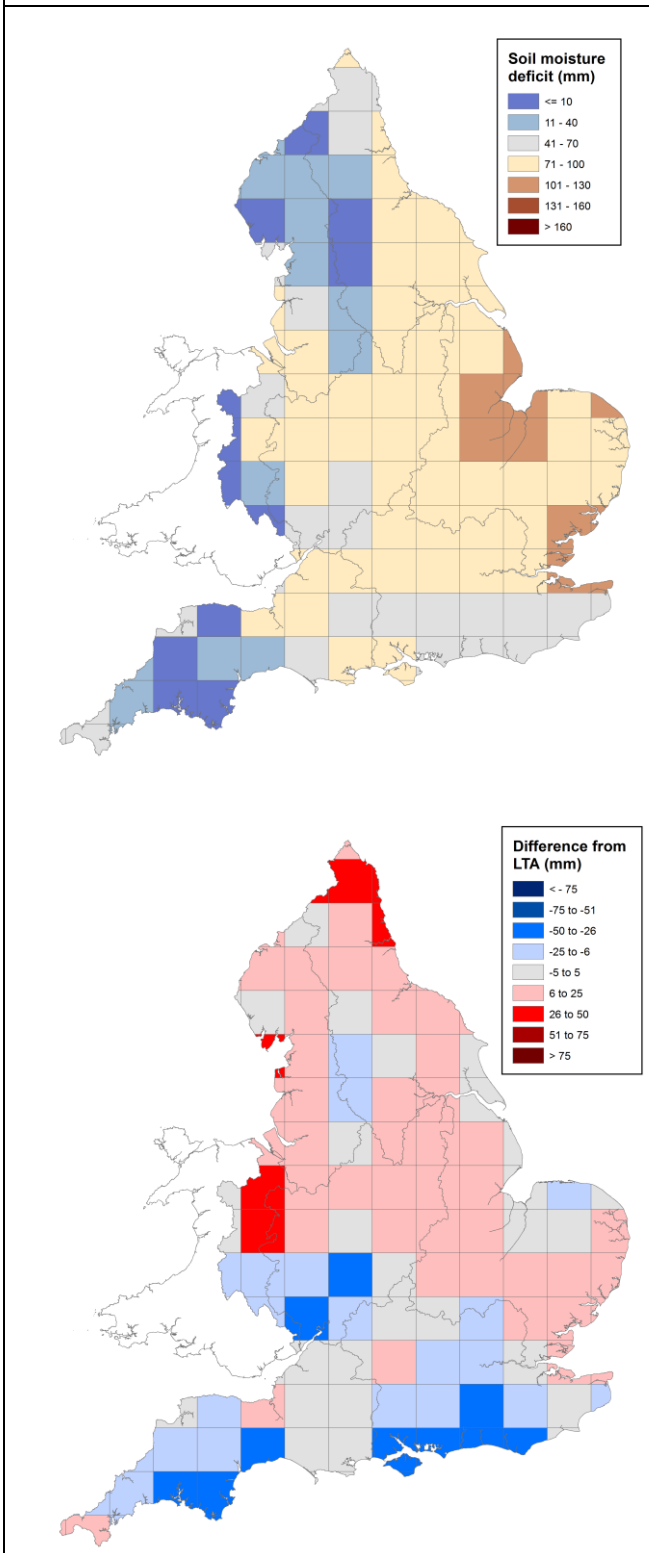
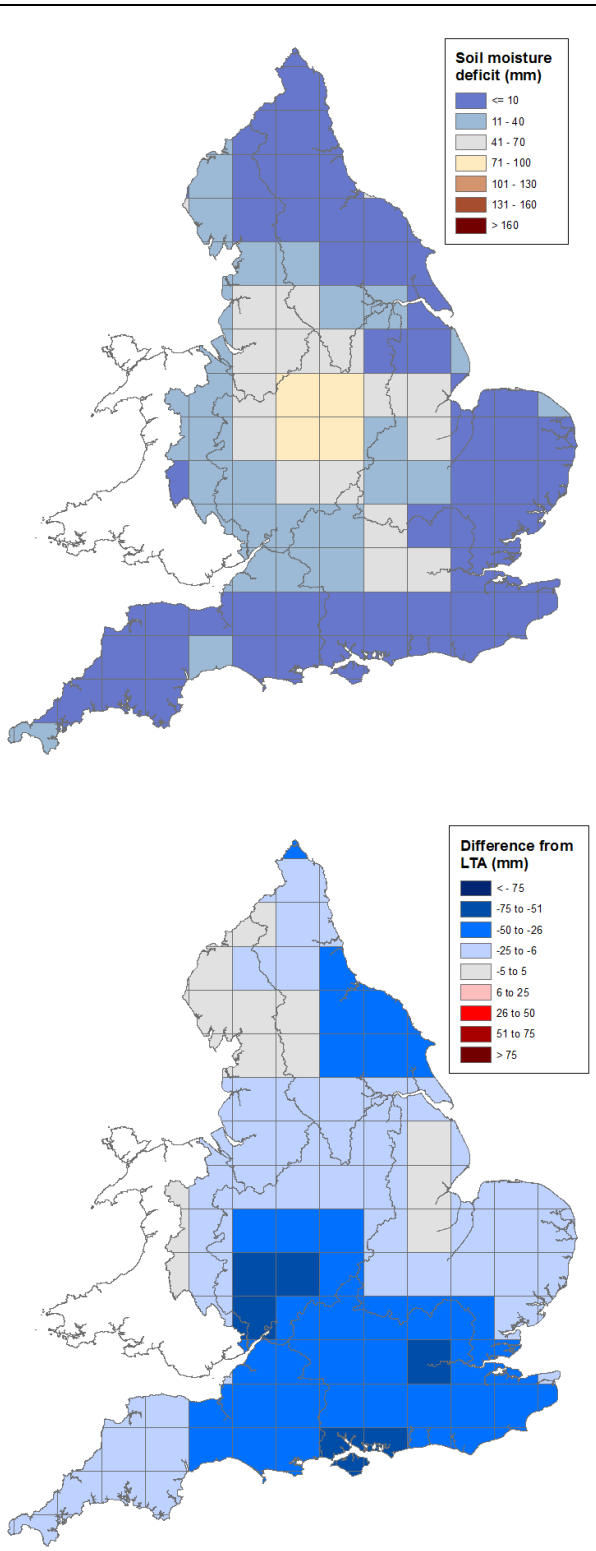
End of September 2021[1]	End of October 2021[2]
	

Figure 2.1: Soil moisture deficits for weeks ending 28 September 2021[1] (left panel) and 2 November 2021[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

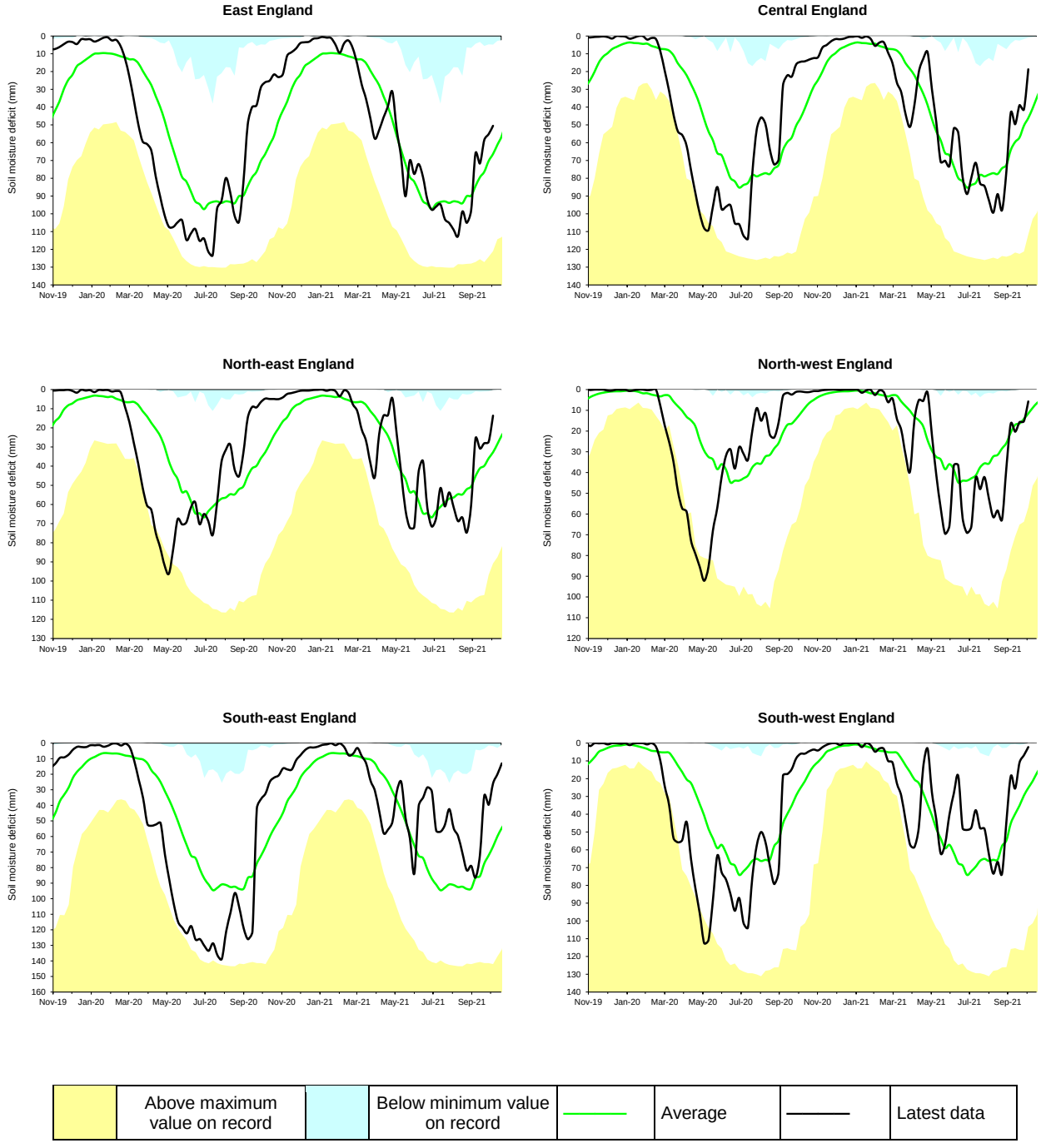
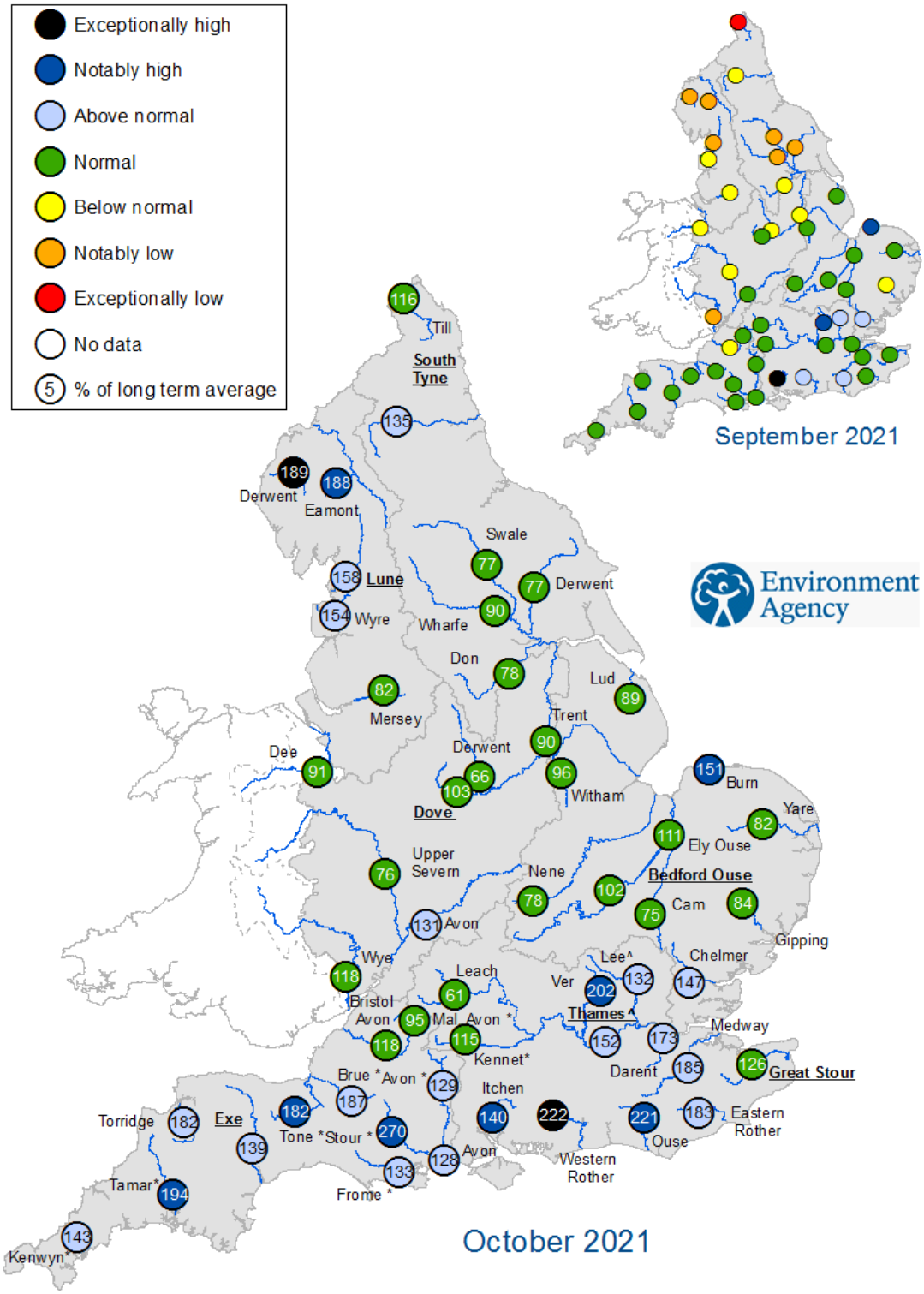


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961 to 90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2021).

River flows



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

* Flows may be overestimated at these sites – the data should be treated with caution

Underlined sites are regional index sites and are shown on the hydrographs in Figure 3.2

Figure 3.1: Monthly mean river flow for indicator sites for September 2021 and October 2021, expressed as a percentage of the respective long term average and classed relative to an analysis of historic September and October monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

River flow charts

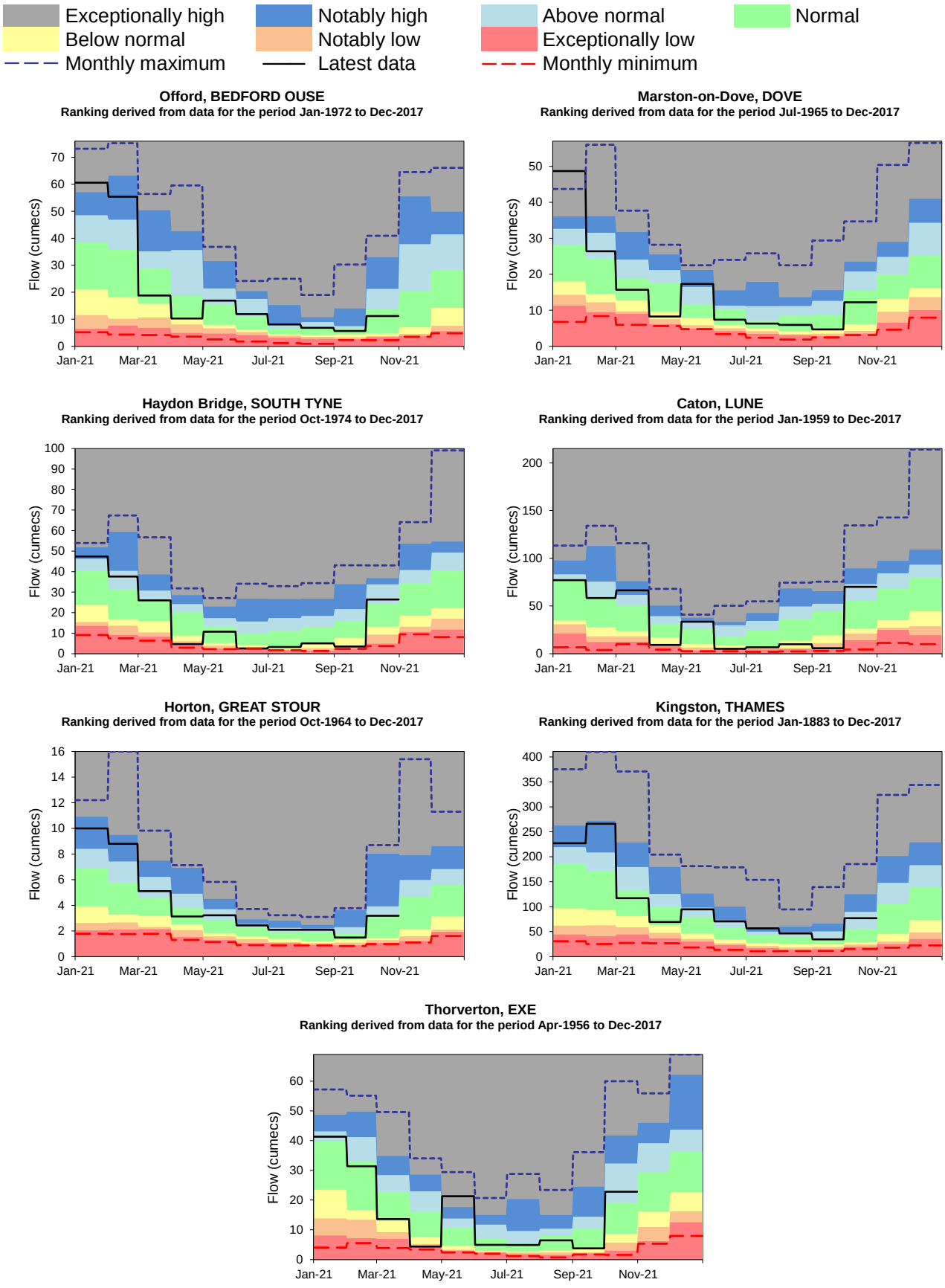
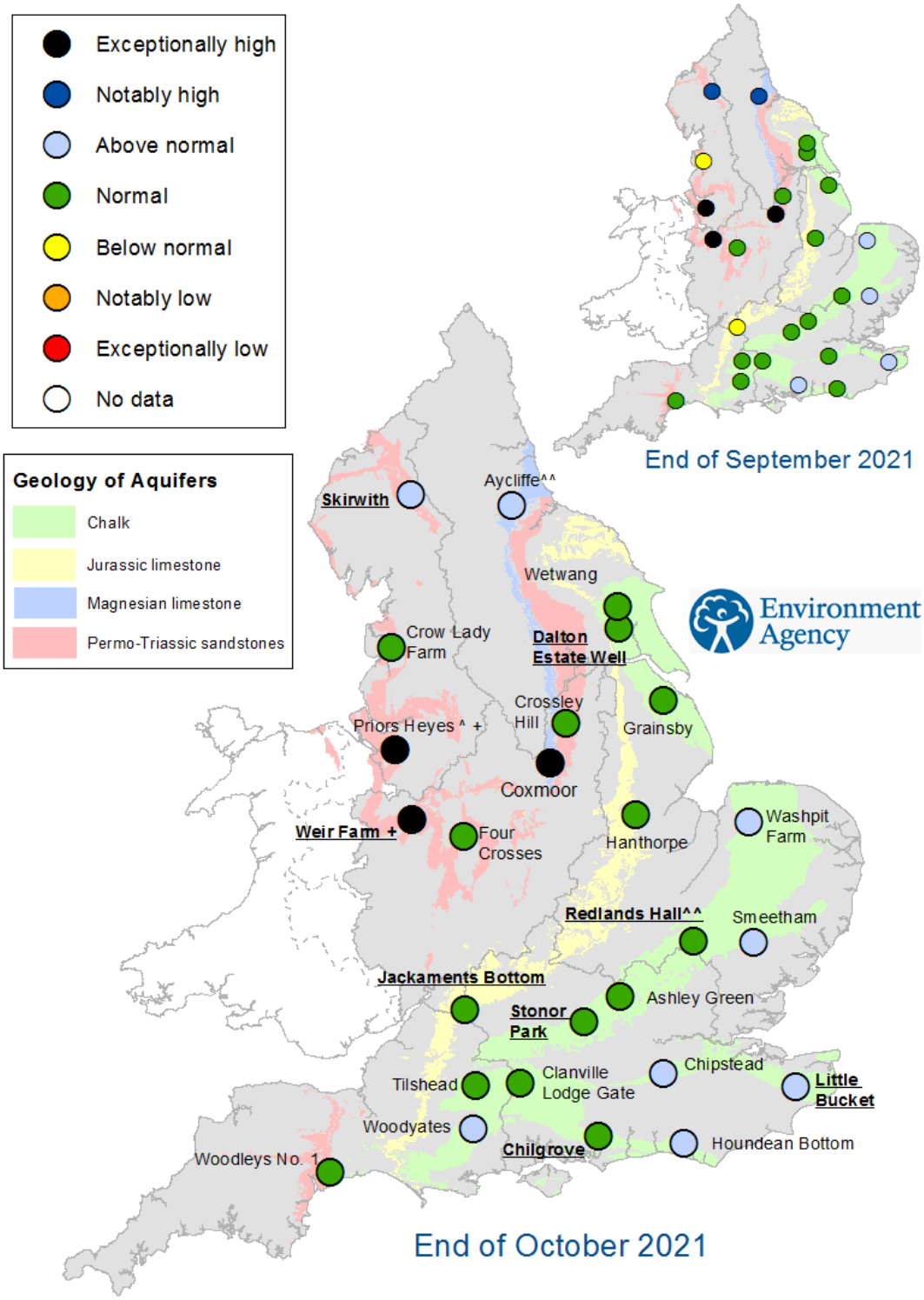


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 September 2021 and October 2021, classed relative to an analysis of respective historic September and October levels (Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

Groundwater level charts

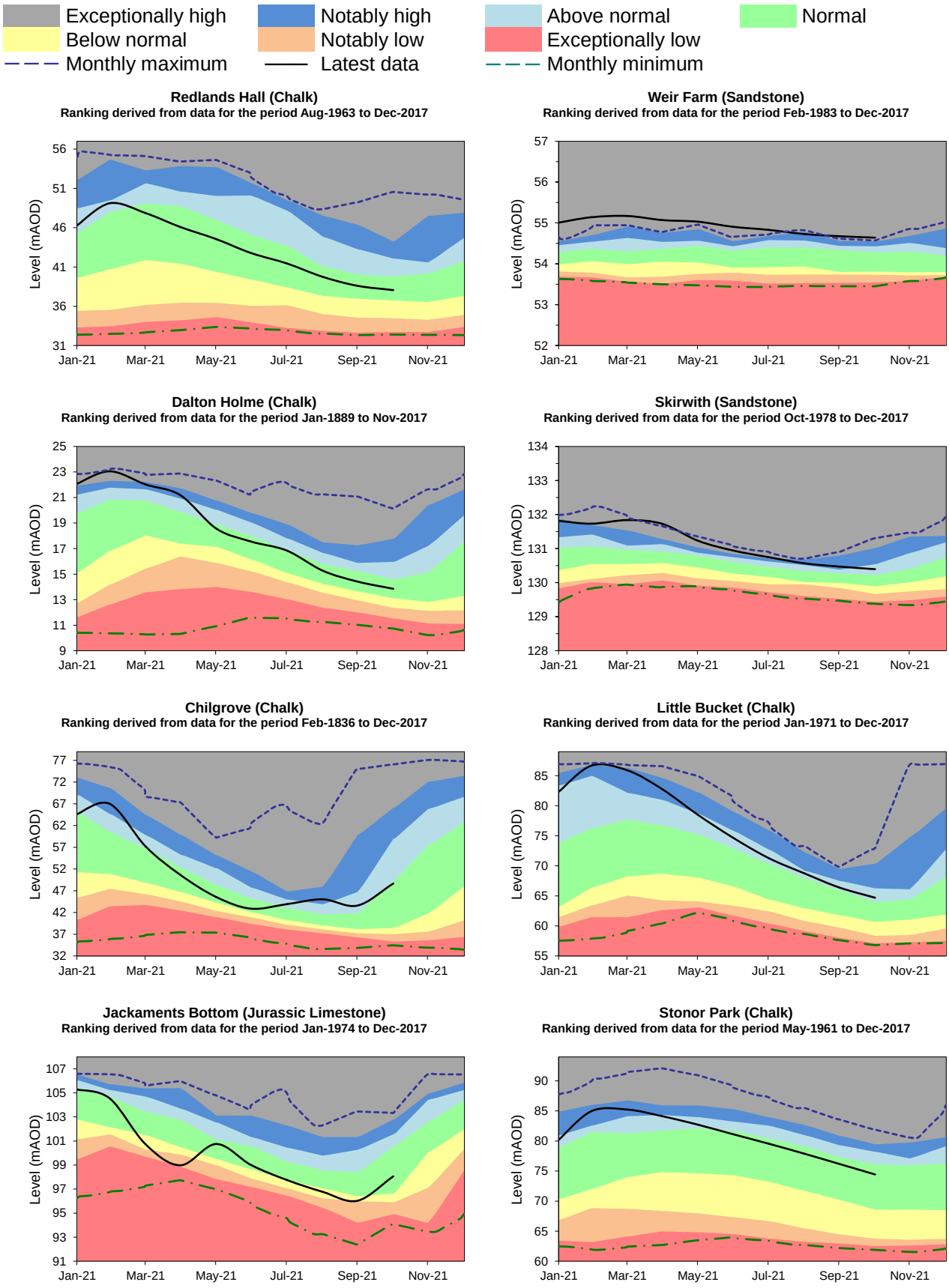
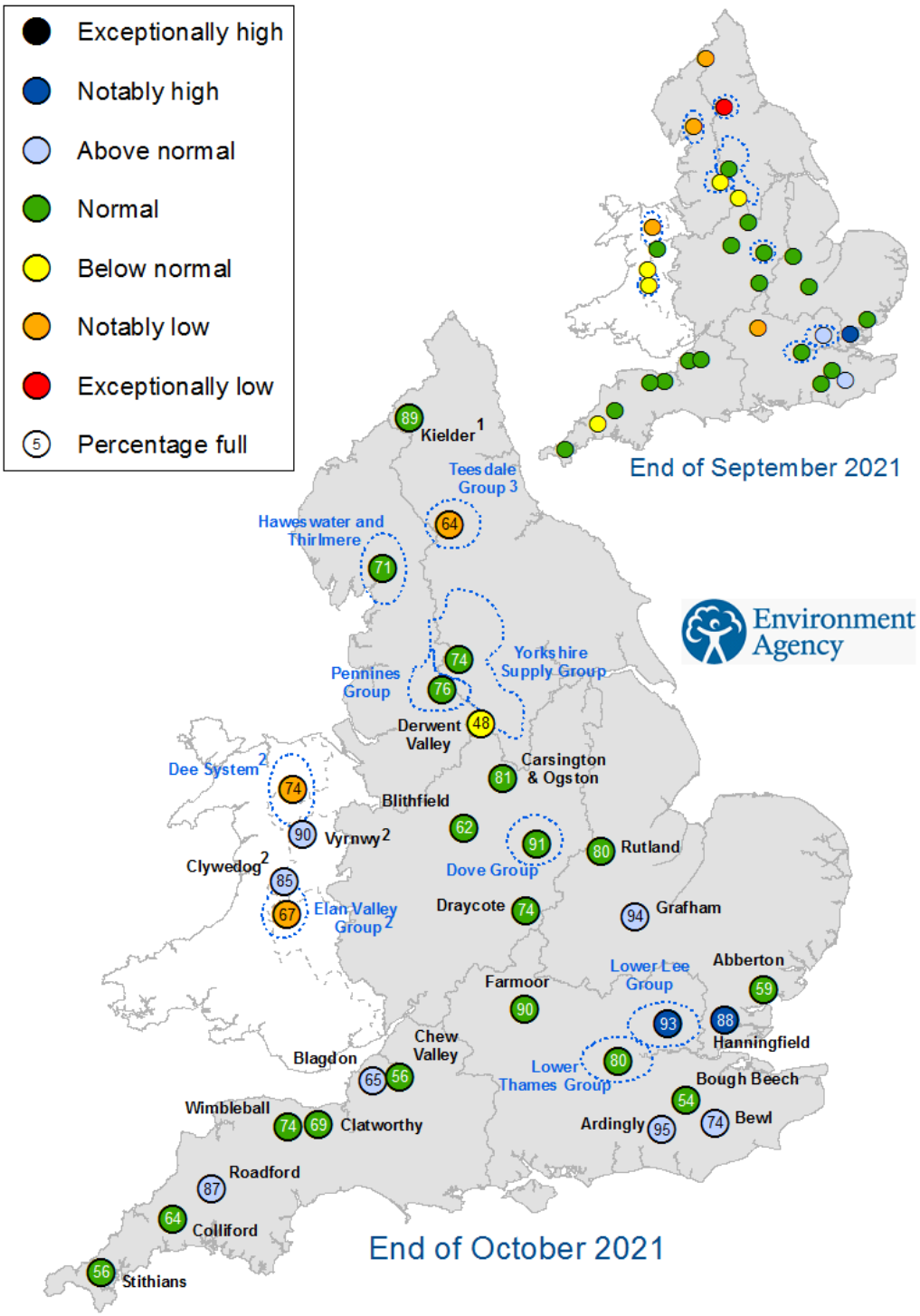


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2021).

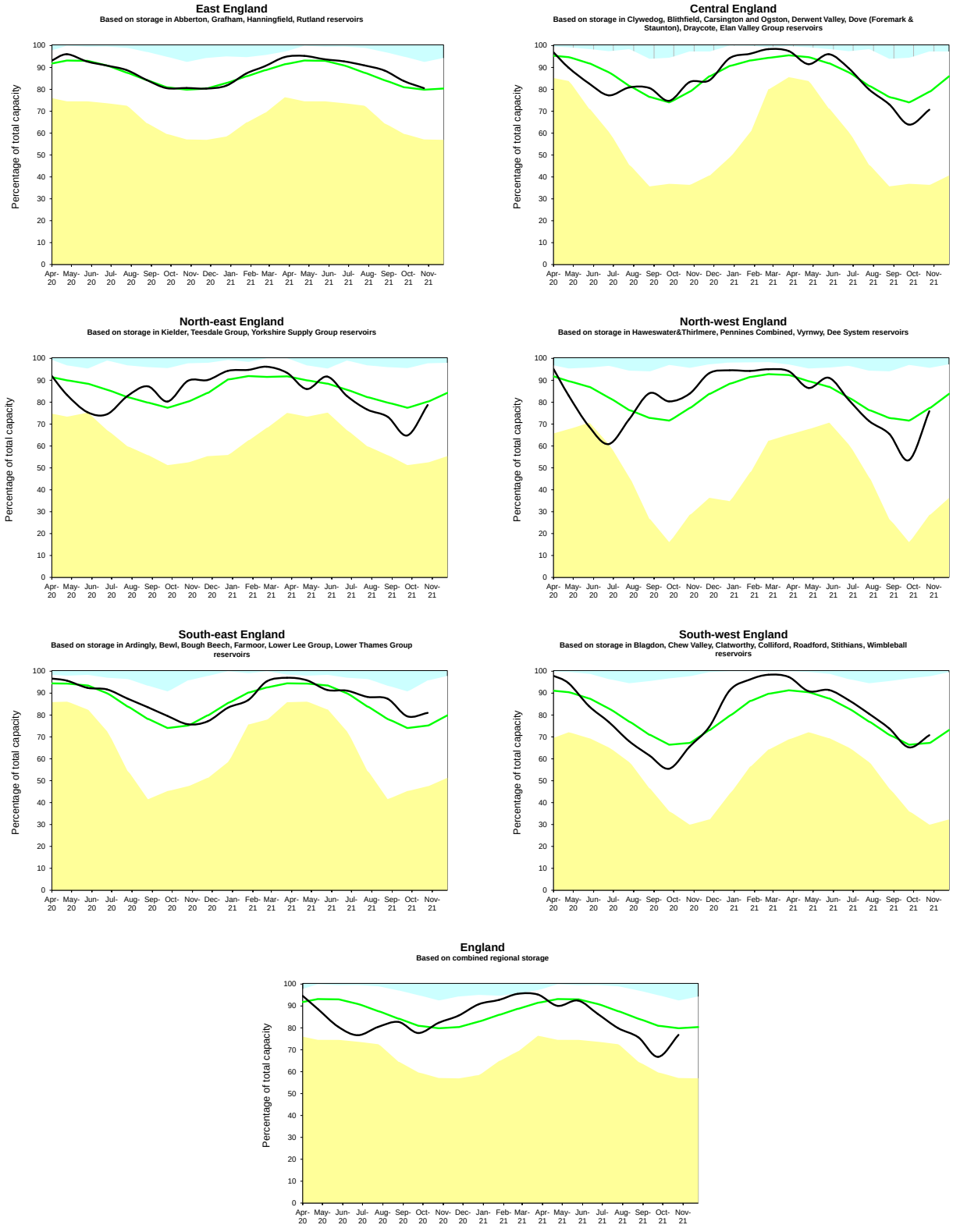
Reservoir storage



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
3. Current levels in the Teesdale Group have been drawn down for maintenance and safety inspections

Figure 5.1: Reservoir stocks at key individual and groups of reservoirs at the end of September 2021 and October 2021 as a percentage of total capacity and classed relative to an analysis of historic September and October values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate to control curves or triggers for drought actions. As well as for public water supply, some reservoirs are drawn down to provide flood storage, river compensation flows or for reservoir safety inspections. In some cases current reservoir operating rules may differ from historic ones. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

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

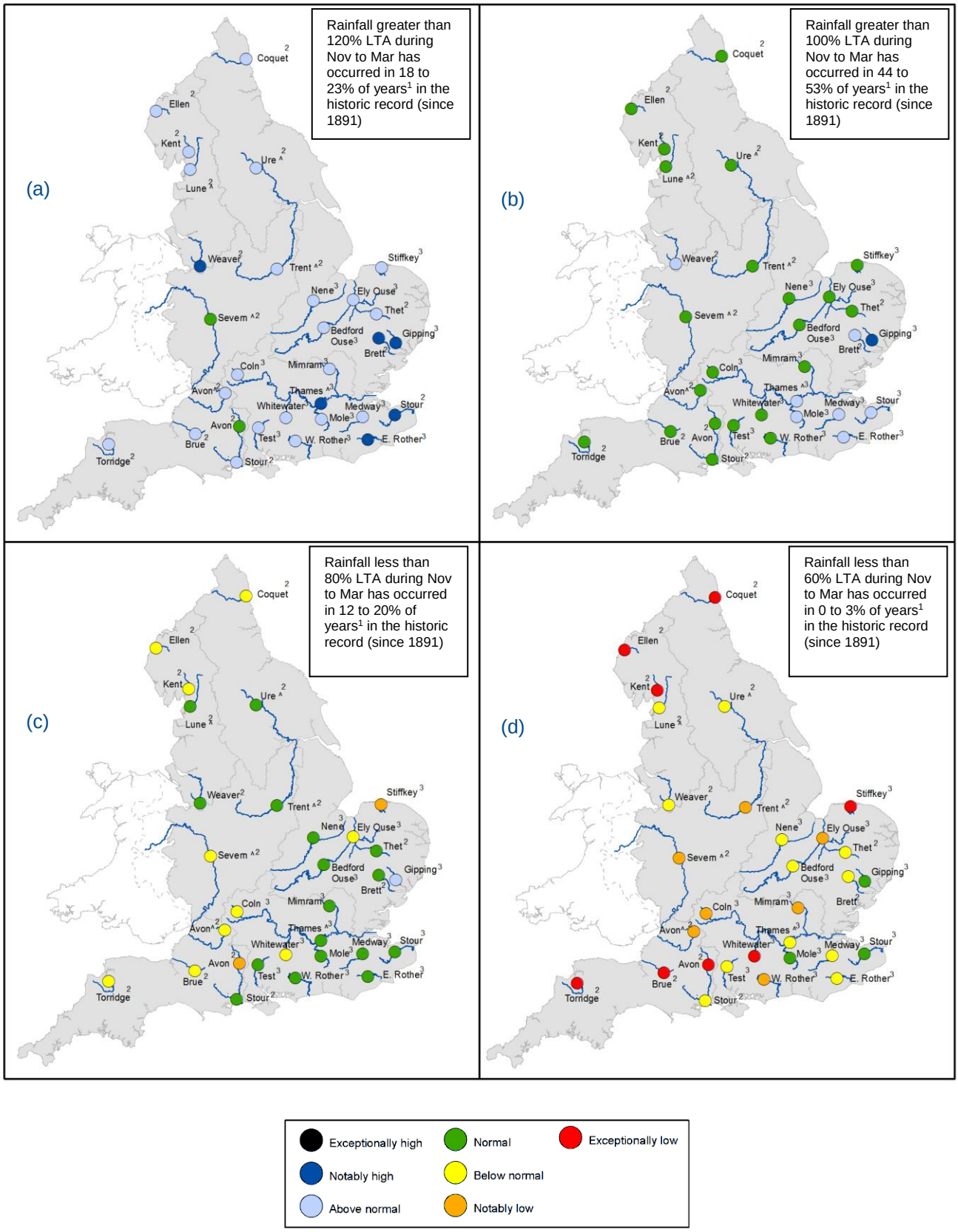
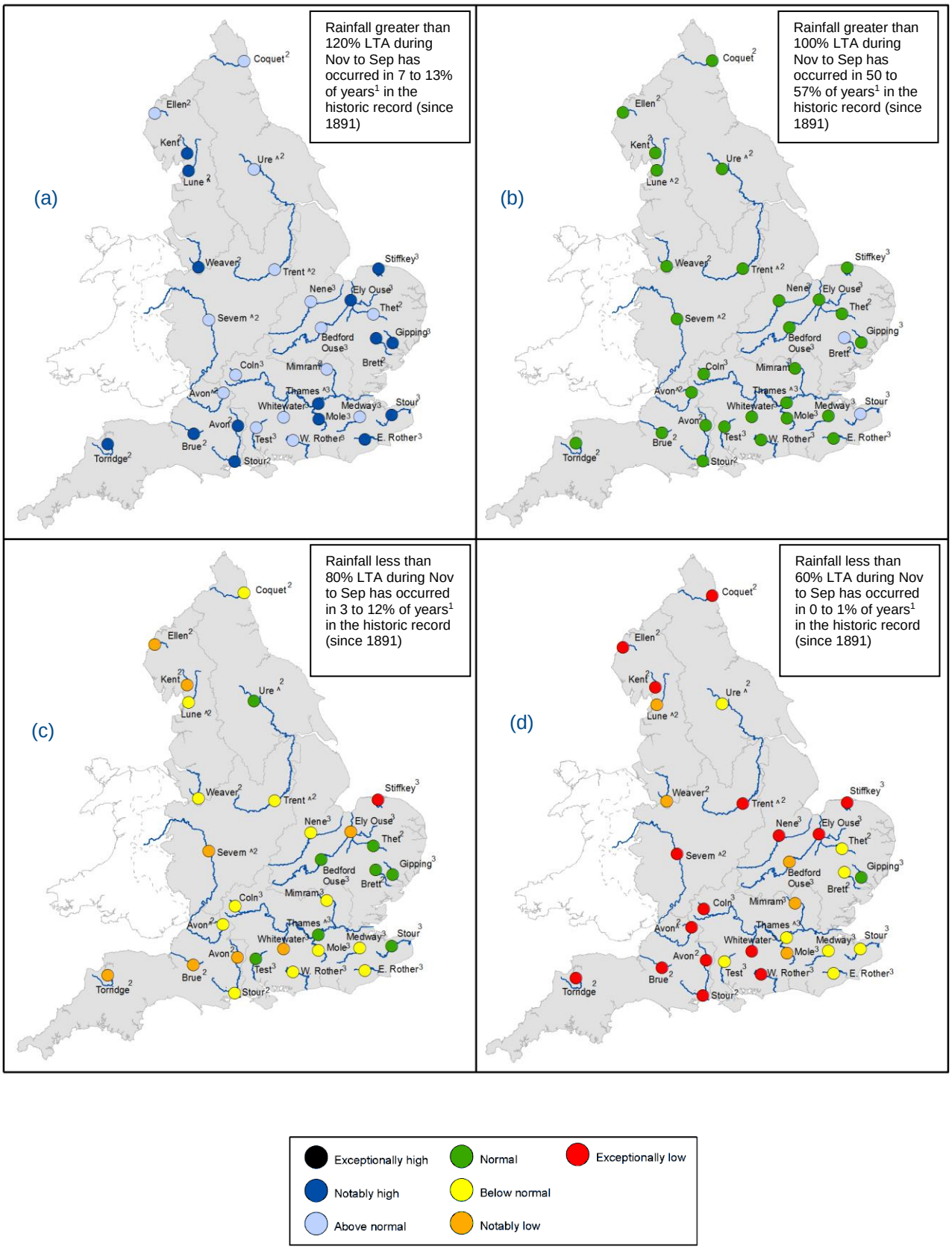


Figure 6.1: Projected river flows at key indicator sites up until the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2021 and March 2022 (Source: UK Centre for Ecology and Hydrology, Environment Agency)

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



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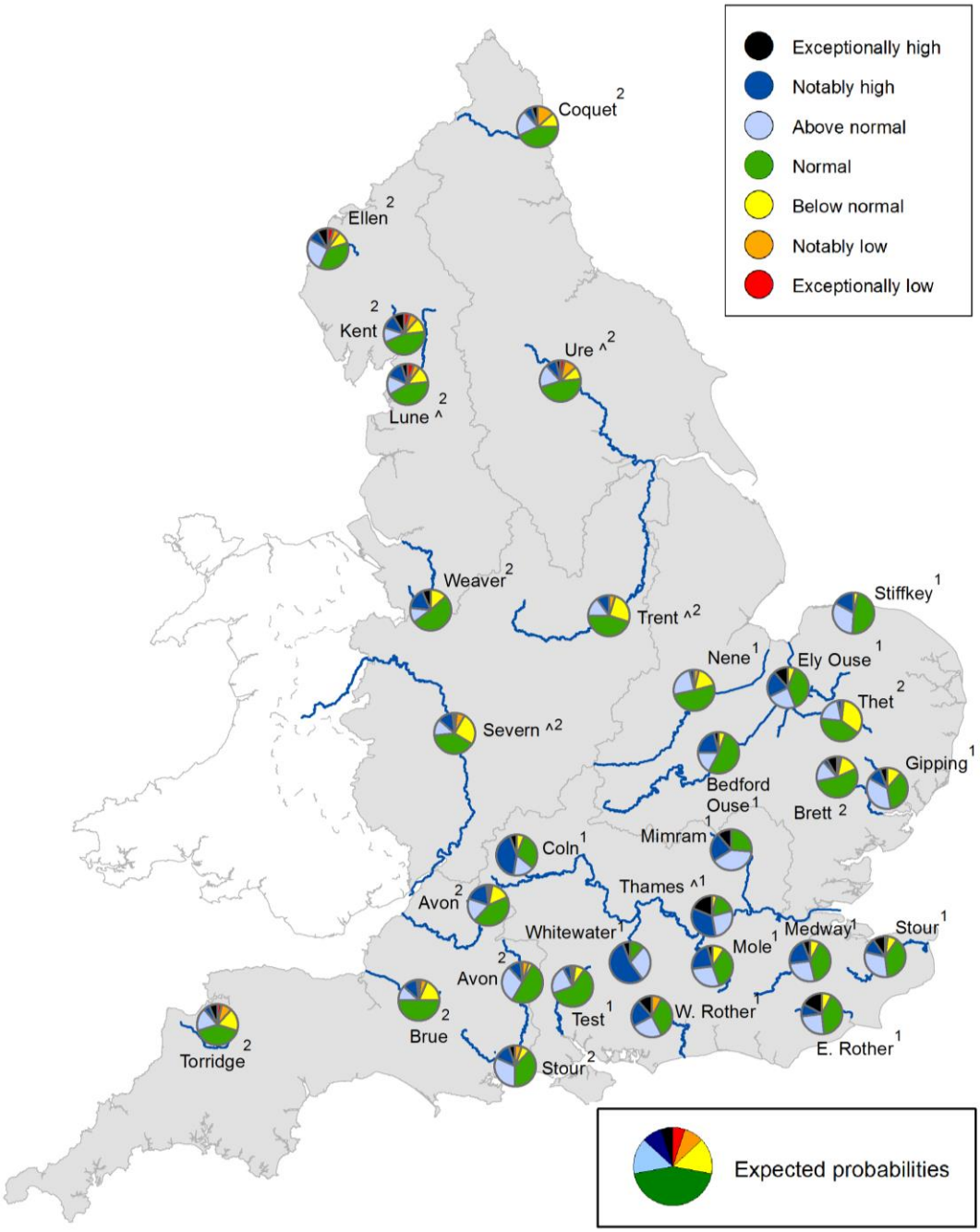

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2022. 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: UK Centre for Ecology and Hydrology, Environment Agency).

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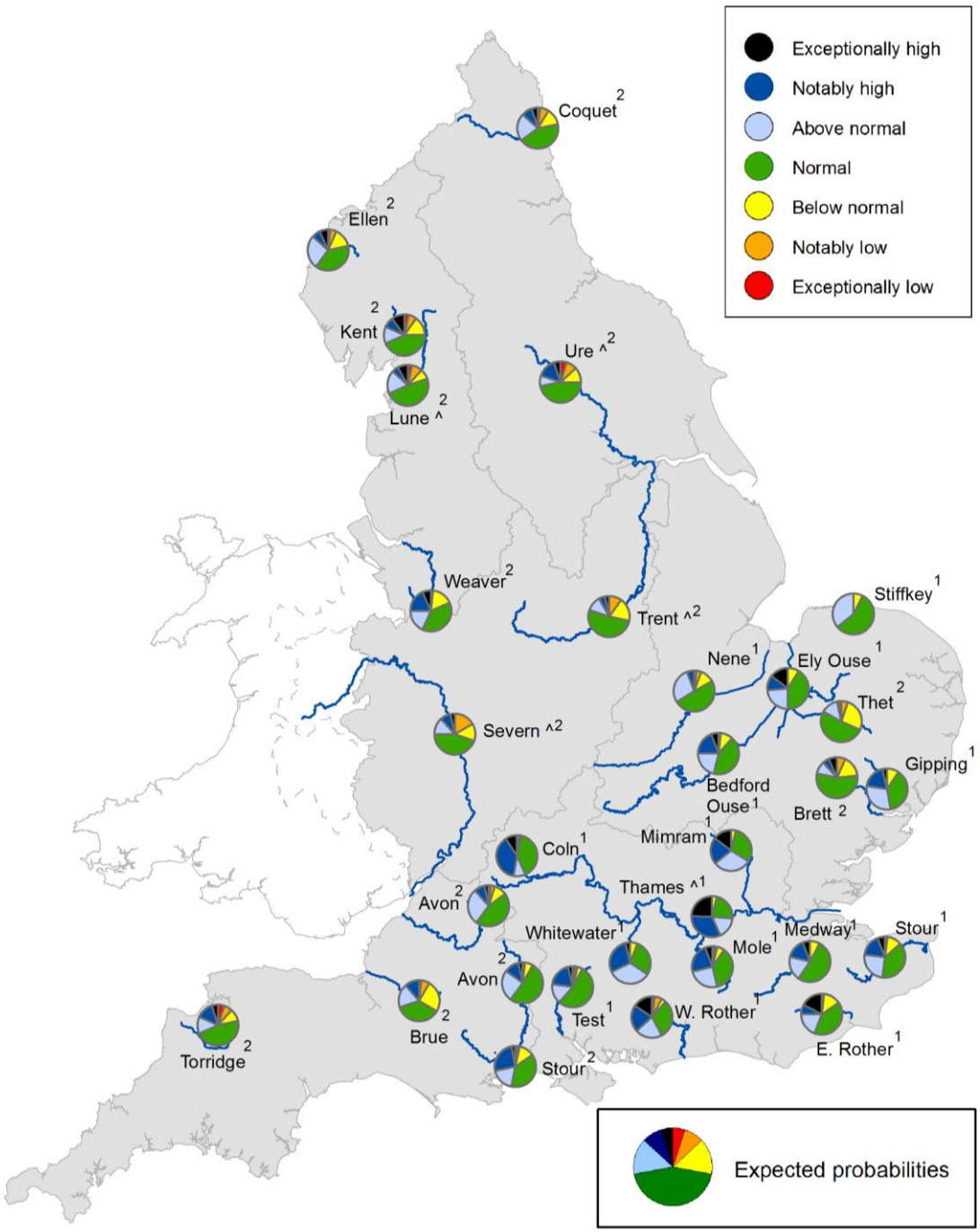

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of September 2022. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: UK 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 UK CEH
^"Naturalised" flows are projected for these sites

Forward look: groundwater

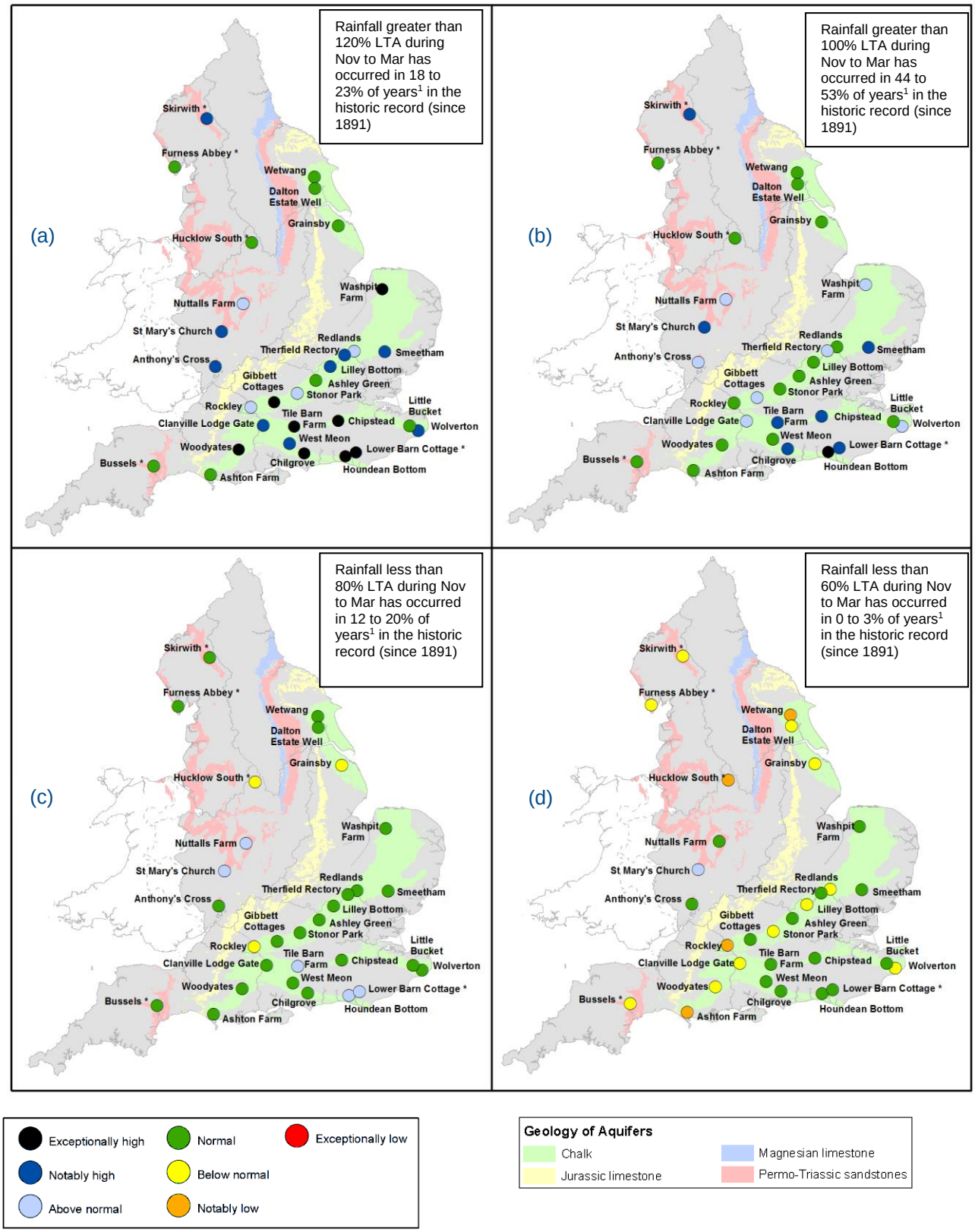

Figure 6.5: Projected groundwater levels at key indicator sites at the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2021 and March 2022 (Source: Environment Agency) Geological map reproduced with kind permission 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

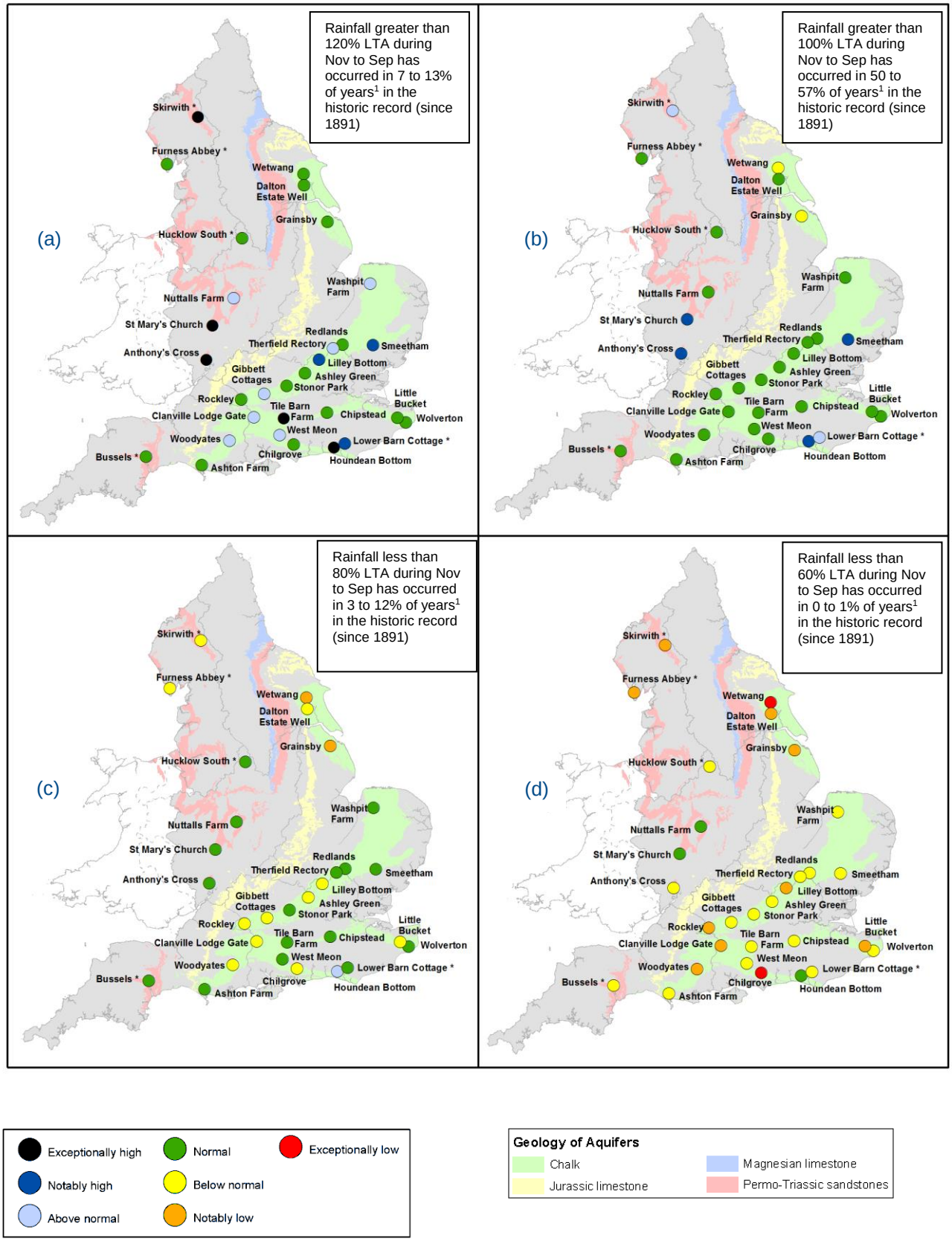

Figure 6.6: Projected groundwater levels at key indicator sites at the end of September 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between November 2021 and September 2022 (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum BGS © NERC Crown copyright. All rights reserved. Environment Agency 100024198 2021.

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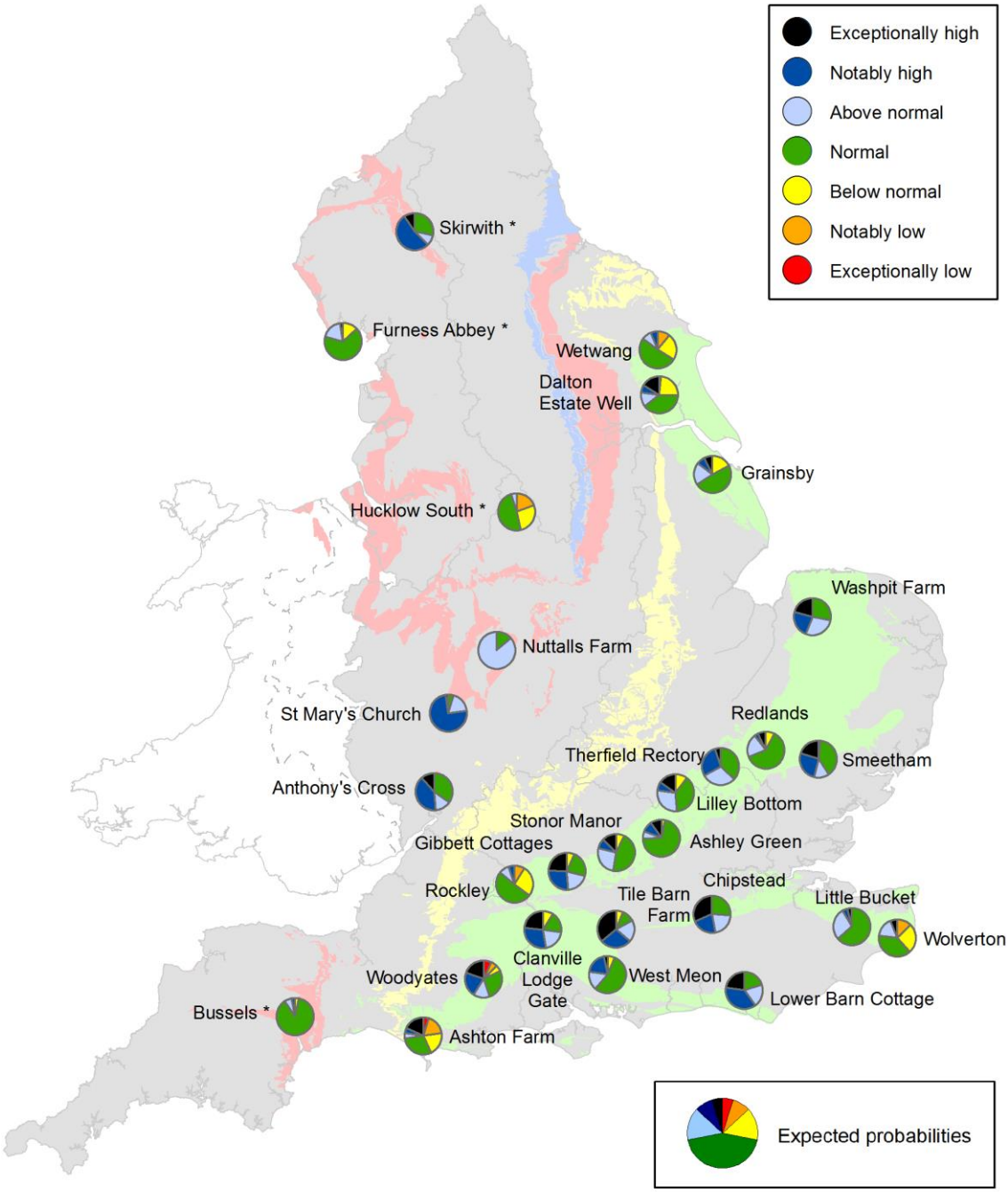
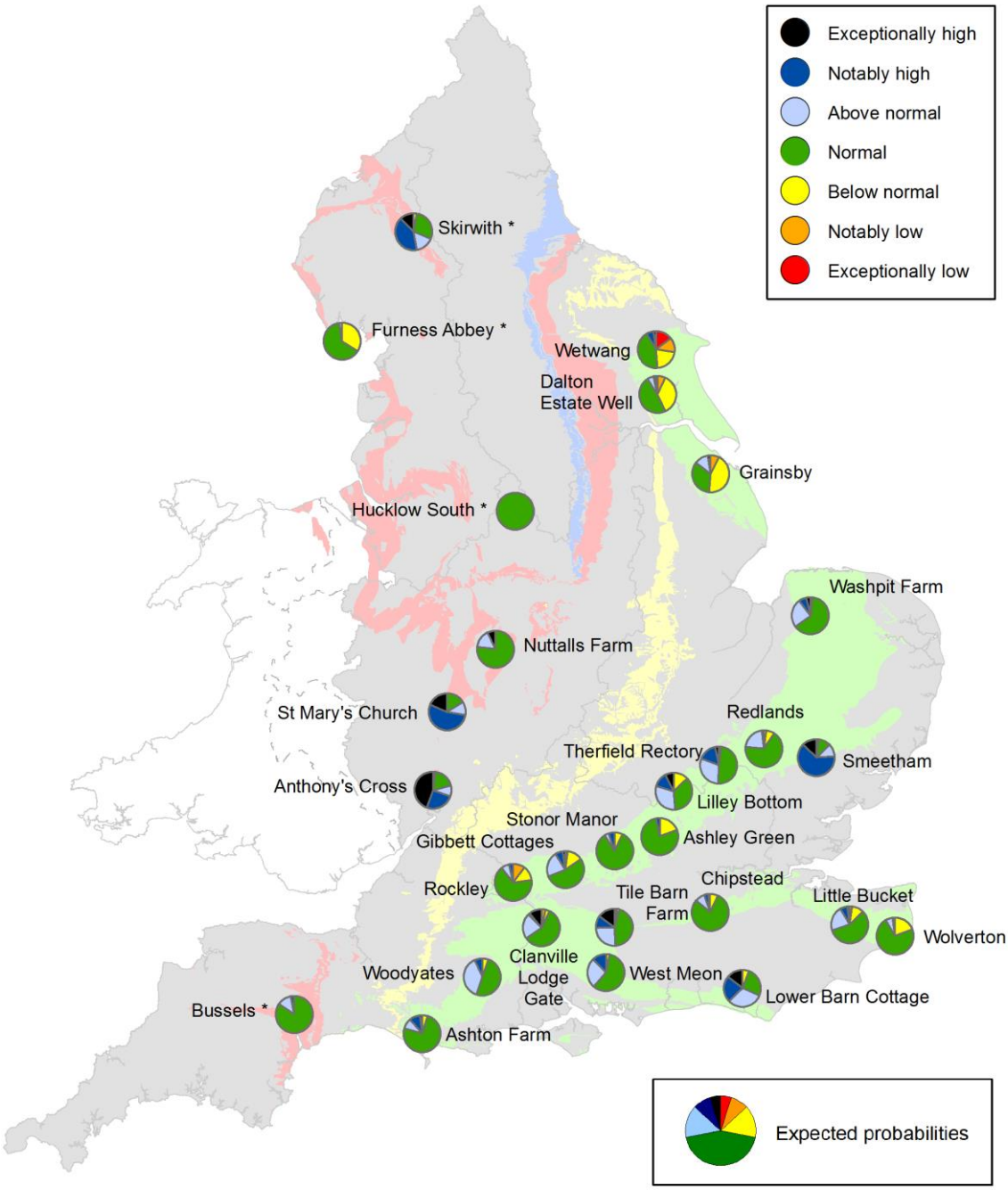


Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2022. 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 2022. 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