Monthly water situation report

England

Summary – July 2021

Monthly rainfall totals in all catchments were classed as normal or higher for the time of year, except for three catchments in north-west England. Three month cumulative rainfall totals ending in July were classed as exceptionally high across much of south-east and south-west England. At the end of July soils were wetter than the long-term average across much of southern England but drier than the long-term average across much of north-west England. River flows also reflected the rainfall distribution across the country, with flows at almost all indicator sites in south-east England classed as above normal or higher with exceptionally high flows recorded on the Rivers Itchen, Ver and western Rother. In north-west England monthly mean flows on the River Derwent and River Eamont (both in Cumbria) were classed as exceptionally low for the time of year. At all indicator sites the end of July groundwater levels were classed as normal or higher for the time of year. End of month reservoir stocks were classed as normal or higher at over four-fifths of reported reservoirs and reservoir groups. At a regional scale total reservoir stocks for north-east, north-west and central England were below the long-term average for the time of year.

Rainfall

The July rainfall total for England was 78mm, which represents 133% of the 1961-1990 long term average LTA (125% of the 1981-2010 LTA). July has seen higher rainfall totals in most places than the preceding month of June. The highest rainfall totals were across western and southern England, while parts of central and eastern England recorded the lowest totals (Figure 1.1).

Monthly rainfall totals were classed as higher than normal for the time of year in nearly half of all catchments. The rest were classed as normal for the time of year, except 3 catchments in north-west England where monthly rainfall totals were classed as below normal and notably low for the time of year (Figure 1.2).

The highest rainfall total as a proportion of the LTA was over Poole Harbour and Purbeck on the south coast, with 107mm of rainfall representing 260% of the LTA for July. On the Isle of Wight the July rainfall total of 106mm, representing 241% of the LTA for July, combined with the preceding 2 wet months making it the 2nd wettest May-June-July 3 months on record (records since 1891) surpassed only by 2007. The three month cumulative rainfall totals ending in July were classed as exceptionally high across much of south-east and south-west England.

By contrast the lowest rainfall total as a proportion of the LTA was over the Dumfries Esk catchment, with 59mm of rainfall representing 61% of the LTA for July. Following the dry June this made it the driest combined June-July on record in this catchment (records since 1891) (Figure 1.2).

At a regional scale, July rainfall totals ranged from 107% of the LTA in north-west England to 156% of the LTA in south-west England (Figure 1.3). The rainfall totals were classed as normal for the time of year in all but one region of England. South-west England was the only region where rainfall was classed as above normal for the time of year. The rainfall totals for south-east and south-west England represent the fifth wettest 3 month combined May-June-July rainfall totals on record (records since 1891).

Soil moisture deficit

Across much of England soils were drier at the end of July than they were at the end of June (soil moisture deficit increased). End of July soil moisture deficit (SMD) values were less than the LTA for the time of year across much of southern England (soils were wetter than the LTA) but higher than the LTA across much of north-west England. Along the south coast of England some soils had a SMD of less than 40mm, meaning they are much wetter than average (by over 75mm in places) for the time of year (Figure 2.1).

At a regional scale, the end of July SMD values meant that soils were wetter than average for the time of year in south-west and south-east England, and drier than average in north-west England. For all regions, soils were wetter at the end of July than at the end of June (Figure 2.2)

River flows

July monthly mean river flows decreased at three-quarters of the indicator sites we report on, compared to June. Despite this, flows were classed as normal or higher for the time of year at nine-tenths of indicator sites. River flows reflected the rainfall distribution across the country, with flows at almost all indicator sites in south-east England classed as above normal or higher and exceptionally high flows recorded on the Rivers Itchen, Ver and the western Rother. In north-west England, in Cumbria, monthly mean flows on the River Derwent and River Eamont were classed as exceptionally low for the time of year, at 25% and 32% of LTA respectively (Figure 3.1).

At the regional index sites monthly mean flows ranged from being classed as below normal on the River Lune at Caton (north-west England) to notably high (naturalised flows) on the Thames at Kingston (south-east England) (Figure 3.2).

Groundwater levels

Groundwater levels were in recession at most of the reported indicator sites during July, as is usual for this time of year. At all sites, the end of July groundwater levels were classed as normal or higher for the time of year. Groundwater levels at a fifth of sites were classed as either notably high or exceptionally high for the time of year (Figure 4.1).

Priors Heyes (West Cheshire sandstone), Coxmoor (Idle and Torne Permotriassic sandstone) and Weir Farm (Bridgnorth sandstone) all recorded the highest end of July levels on record (records go back to 1972, 1969 and 1983 respectively). Levels at Priors Heyes remain high compared to historic levels because the aquifer is recovering from the effects of historic abstraction. For Weir Farm it was the seventh consecutive month with the highest levels on record for the time of year, and the fourth consecutive month for Coxmoor (Figure 4.1).

End of July groundwater levels at the major aquifer index sites were exceptionally high in the sandstone aquifers at Weir Farm (central England) and at Skirwith (north-west England), above normal in the Chalk aquifers at Little Bucket and Chilgrove (south-east England) and normal everywhere else (Figure 4.2).

Reservoir storage

Reservoir stocks decreased compared with the end of June at over four-fifths of the reservoirs and reservoir groups we report upon. Reductions of over 10% of total capacity were recorded at Derwent Valley (-14%) and Elan Valley (-13%) reservoirs in central England, and at Blagdon, Clatworthy and Wimbleball reservoirs (all -11%) in south-west England. Despite this reductions, end of month reservoir stocks were classed as normal or higher at over four-fifth of reported reservoirs and reservoir groups (Figure 5.1).

At Haweswater and Thirlmere reservoir, stocks fell from 71% of capacity at the end of June to a below normal 56% at the end of July. The Teesdale group of reservoirs, in north-east England, were at 57% of capacity at the end of July, which was classed as exceptionally low for the time of year (Figure 5.1).

At a regional scale, total reservoir stocks ranged from 71% in north-west England to 91% in 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 at 80% of total capacity at the end of July (Figure 5.2)

Forward look

The beginning of August was characterised by unsettled conditions, with many parts of England experiencing heavy rain, most notably south-west England. The unsettled conditions are expected to continue at least for the first half of August, with showers and longer spells of rain affecting many parts of England, with a chance of heavy, thundery downpours. Into the second half of August, continued, changeable conditions are most likely with a mix of sunny spells and showers, although more settled conditions may develop. There is the potential for hotter weather towards the end of August, with below average rainfall amounts.

For the 3 month period August to October, there is a slightly higher than normal chance of dry conditions, with higher than average chances of this period being warmer than normal[1].

Projections for river flows at key sites[2]

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

By the end of September 2021, four-fifths of the modelled sites have a greater than expected chance of cumulative river flows being normal or higher for the time of year. By the end of March 2022, two-thirds of the modelled sites have a greater than expected chance of cumulative river flows being above normal or higher for the time of year.

For scenario based projections of cumulative river flows at key sites by September 2021 see Figure 6.1
For scenario based projections of cumulative river flows at key sites by March 2022 see Figure 6.2
For probabilistic ensemble projections of cumulative river flows at key sites by September 2021 see Figure 6.3
For probabilistic ensemble projections of cumulative river flows at key sites by March 2022 see Figure 6.4

Projections for groundwater levels in key aquifers[2]
By the end of September 2021, all of the modelled sites have a greater than expected chance of groundwater levels being normal or higher for the time of year. By the end of March 2022, half of the modelled sites have a greater than expected chance of groundwater levels being above normal or higher for the time of year.

For scenario based projections of groundwater levels in key aquifers in September 2021 see Figure 6.5
For scenario based projections of groundwater levels in key aquifers in March 2022 see Figure 6.6
For probabilistic ensemble projections of groundwater levels in key aquifers in September 2021 see Figure 6.7
For probabilistic ensemble projections of groundwater levels in key aquifers in March 2022 see Figure 6.8

Authors: National Water Resources Hydrology Team

Rainfall

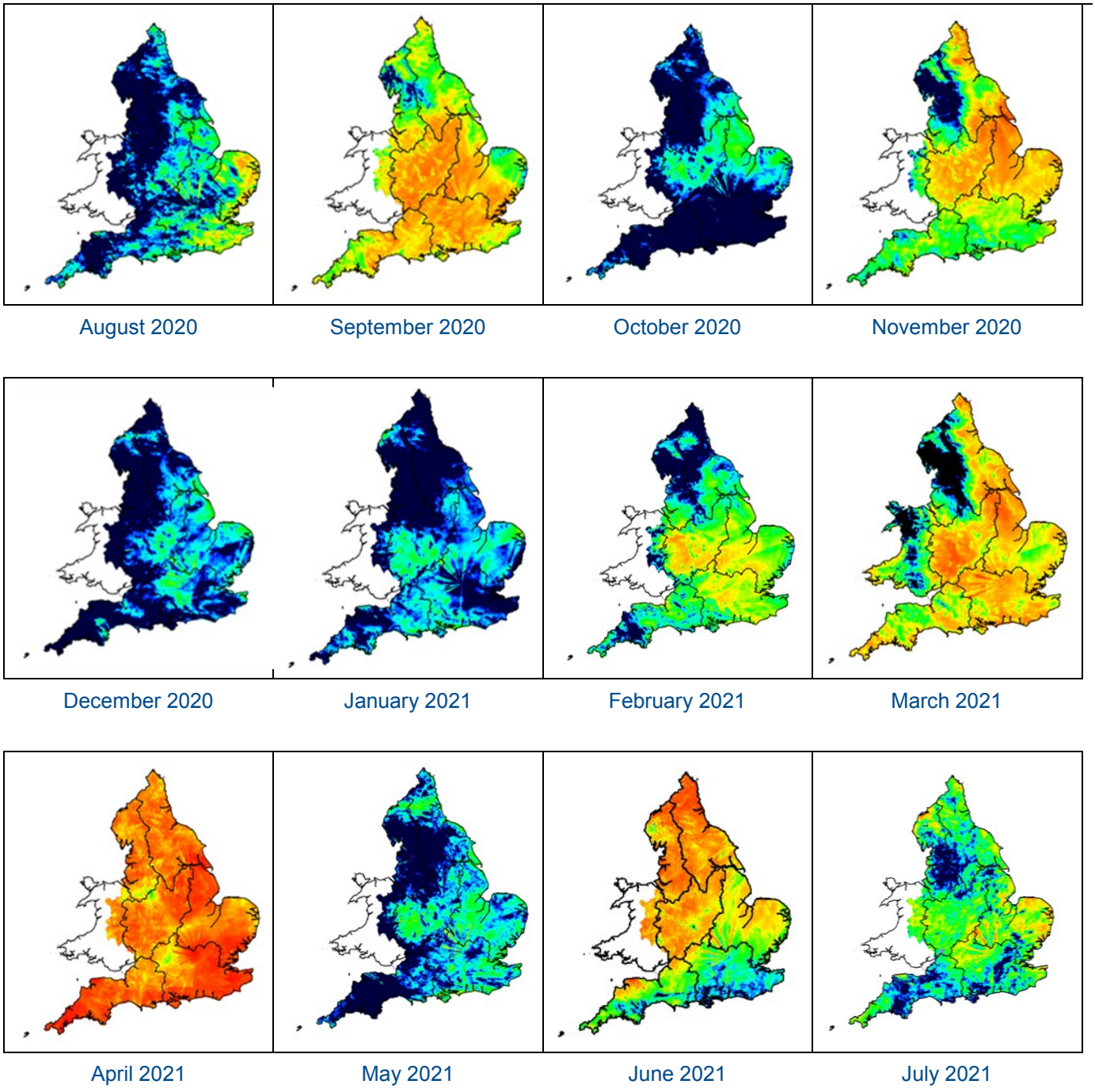
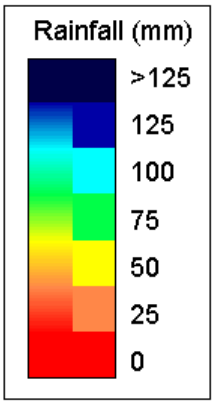


Figure 1.1: Monthly rainfall across England and Wales for the past 12 months. UKPP radar data (Source: Met Office © Crown Copyright, 2021). Note: Radar beam blockages in some regions may give anomalous totals in some areas. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.



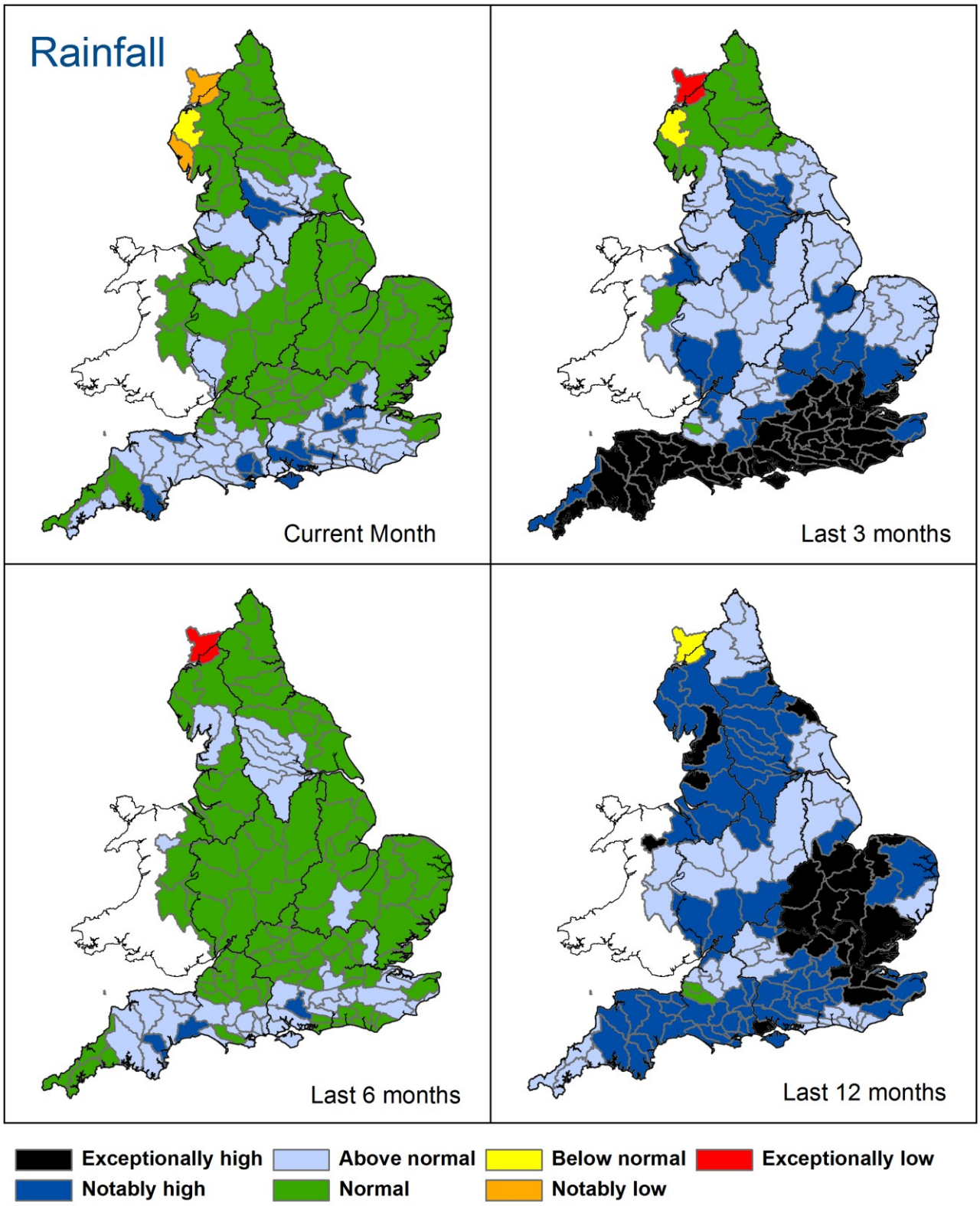


Figure 1.2: Total rainfall for hydrological areas across England for the current month (up to 31 July), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. HadUK data based on the Met Office 1km gridded rainfall dataset derived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

Rainfall charts

Above average rainfall

Below average rainfall

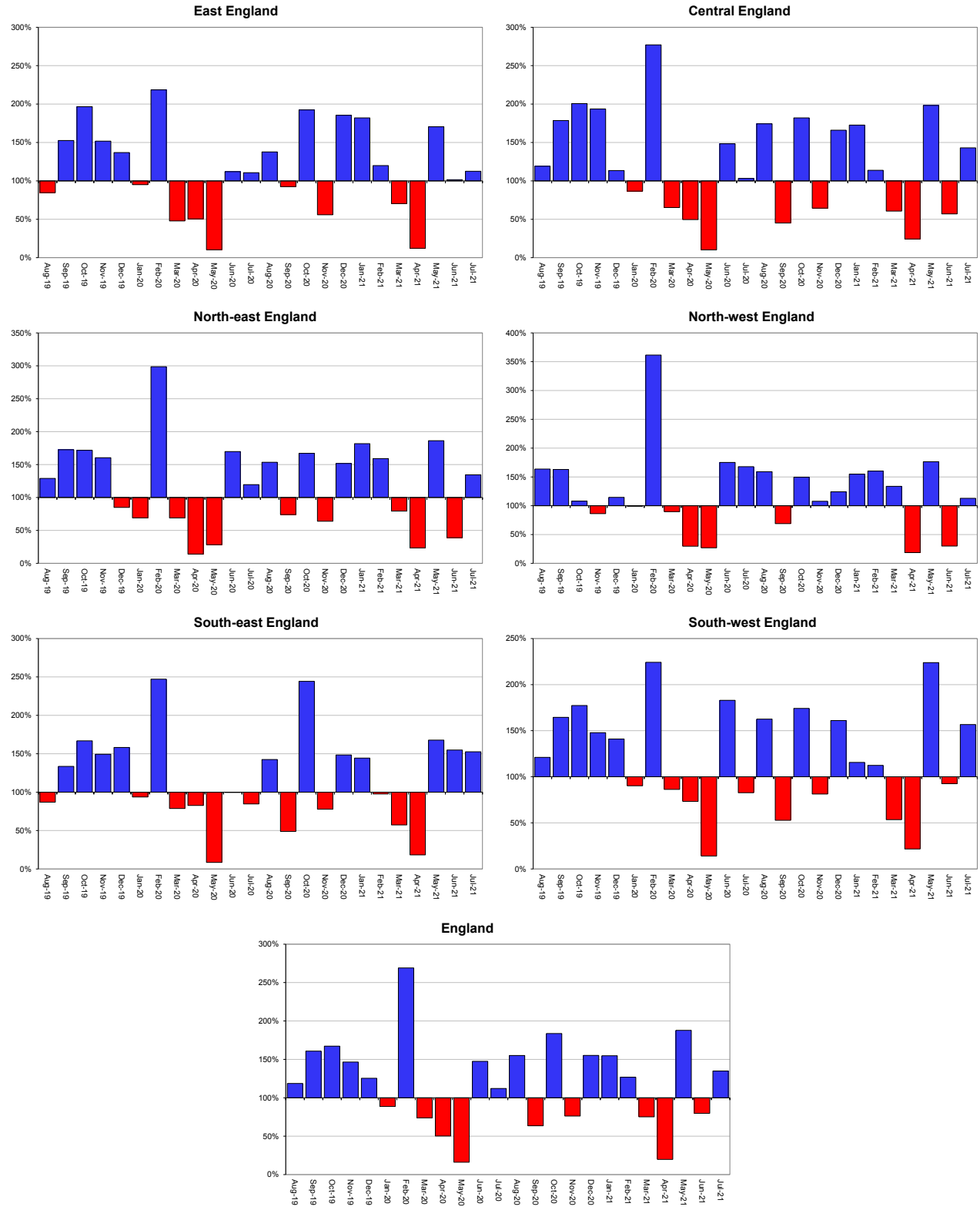


Figure 1.3: Monthly rainfall totals for the past 24 months as a percentage of the 1961 to 1990 long term average for each region and for England. HadUK rainfall data. (Source: Met Office © Crown Copyright, 2021).

Soil moisture deficit

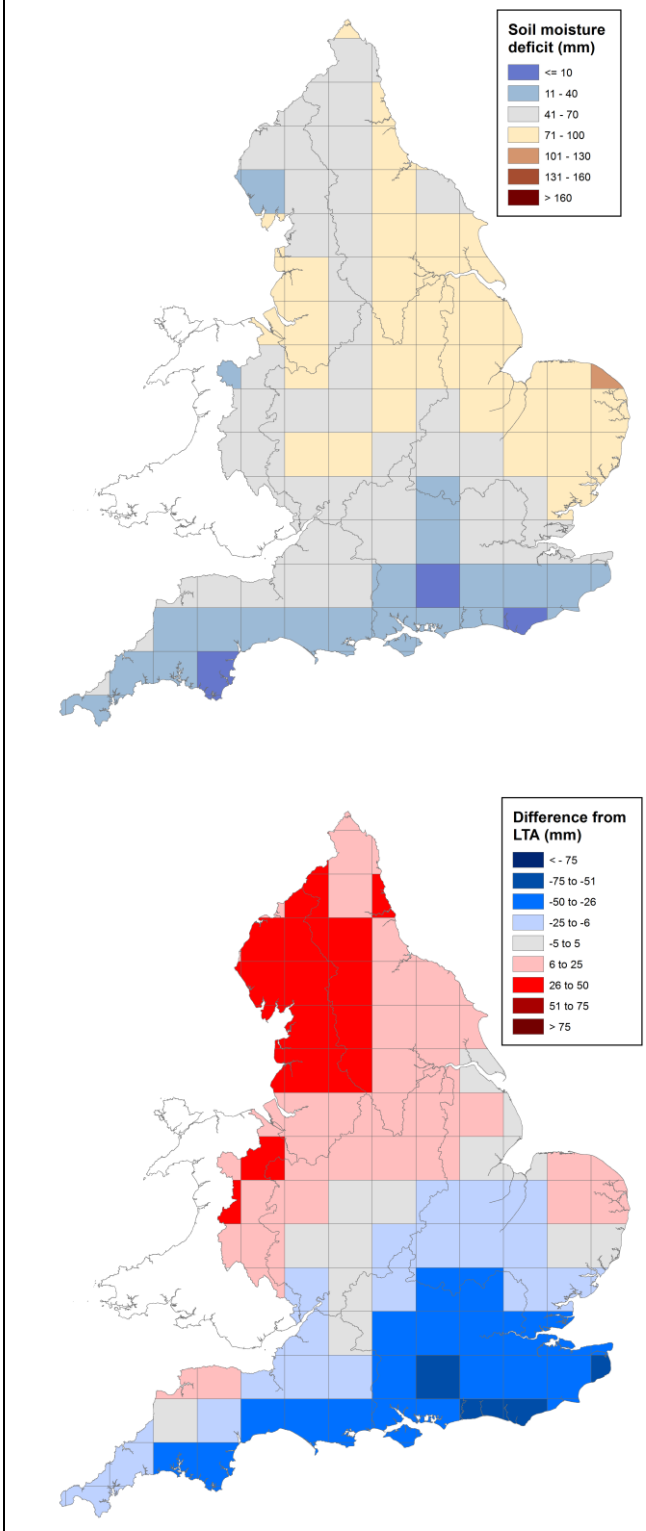
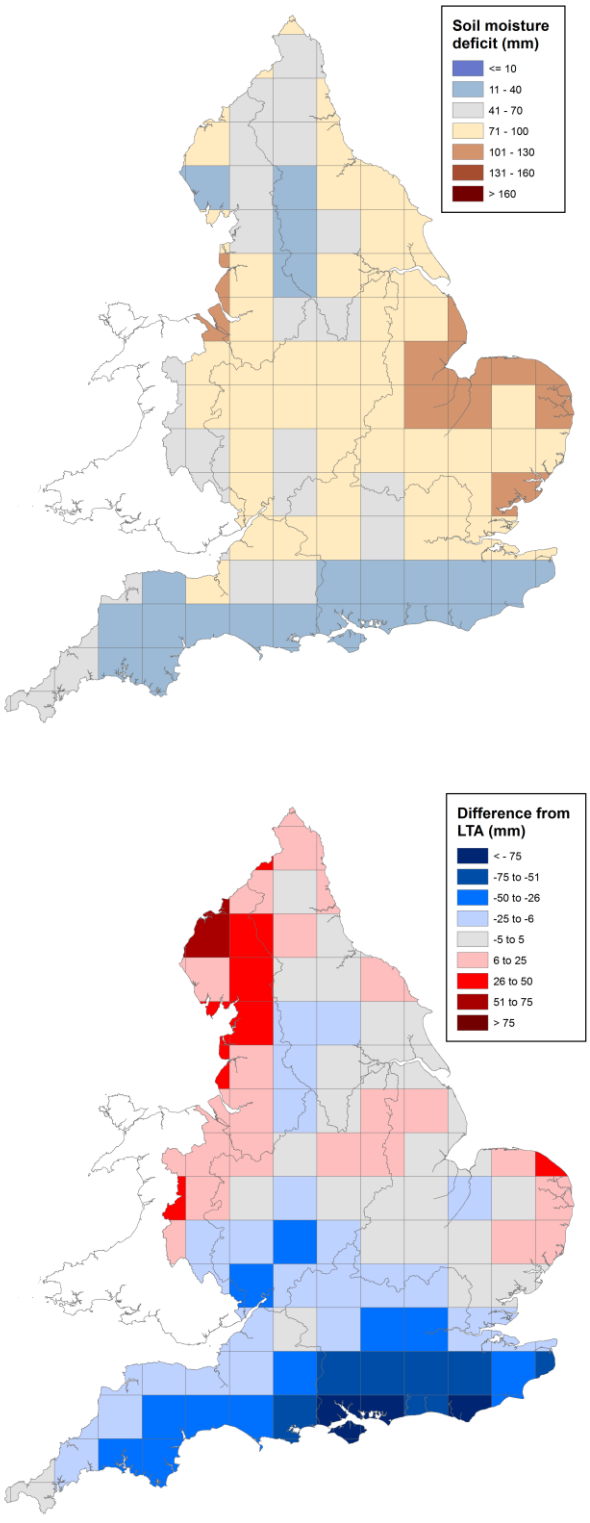
End of June 2021[1]	End of July 2021[2]
	

Figure 2.1: Soil moisture deficits for weeks ending 29 June 2021[1] (left panel) and 03 August 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

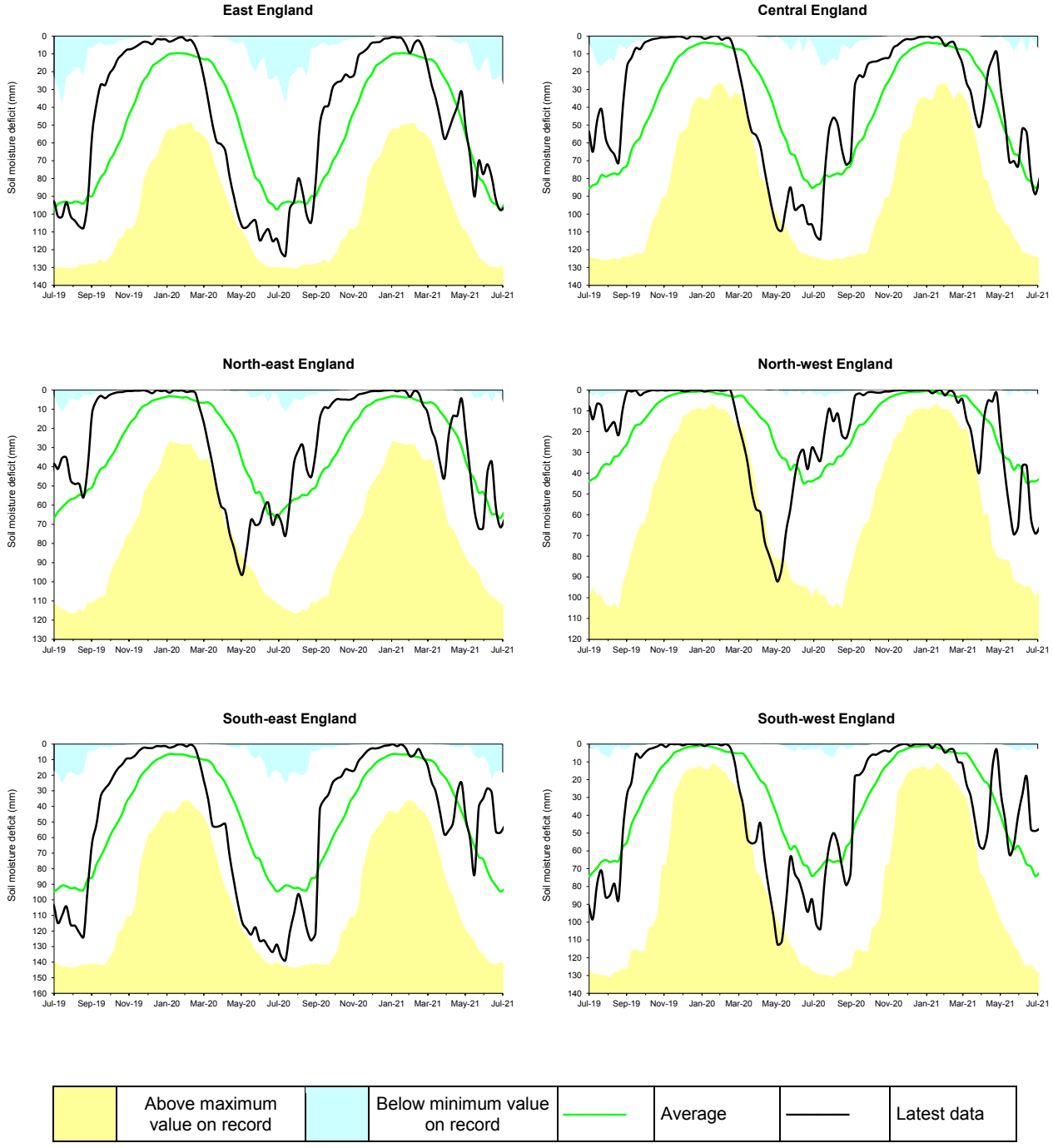
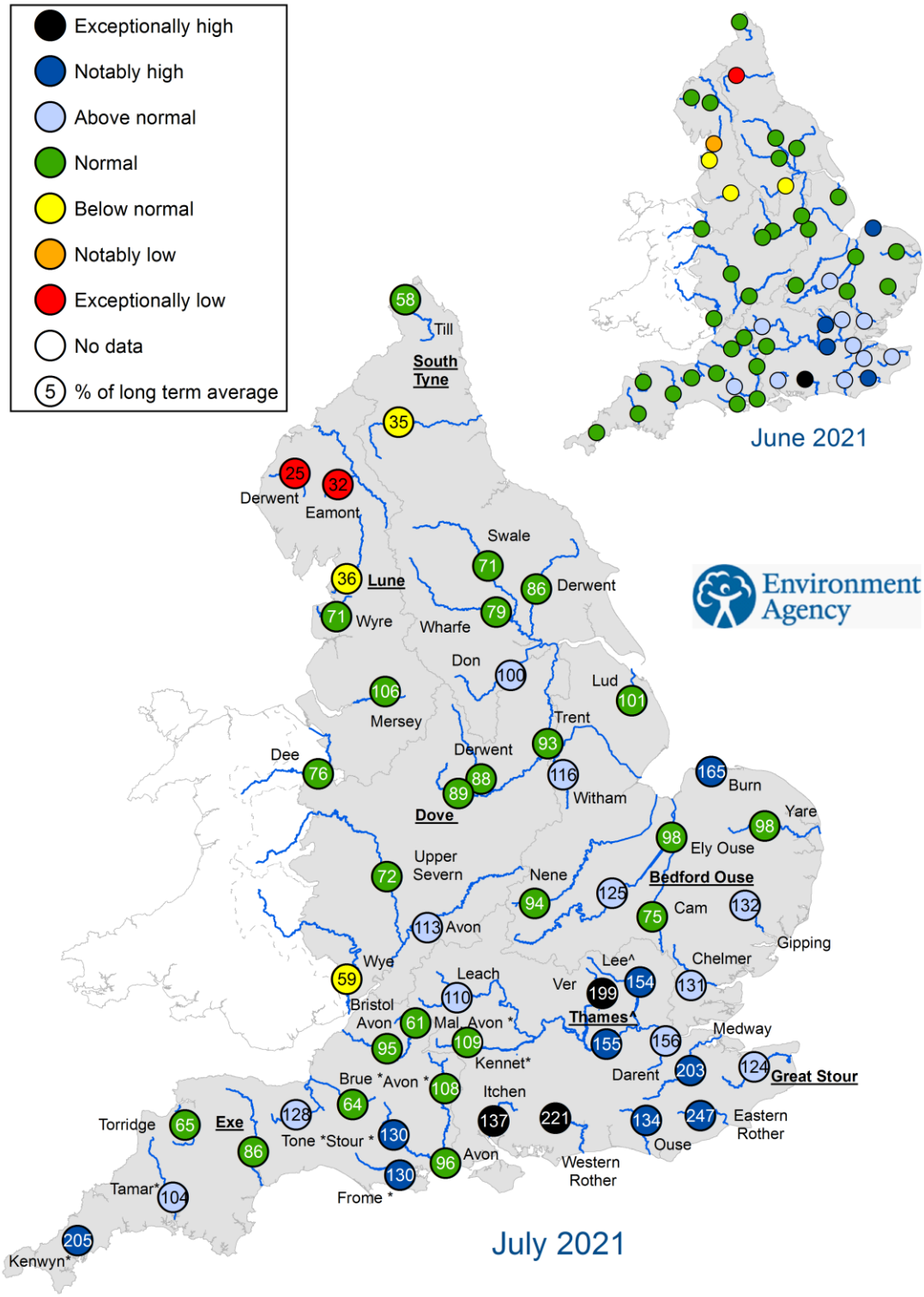


Figure 2.2: Latest soil moisture deficits for all geographic regions compared to maximum, minimum and 1961 to 90 long term average. Weekly MORECS data for real land use. (Source: Met Office © Crown Copyright, 2021).

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 June 2021 and July 2021, expressed as a percentage of the respective long term average and classed relative to an analysis of historic June and July monthly means (Source: Environment Agency). Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

River flow charts

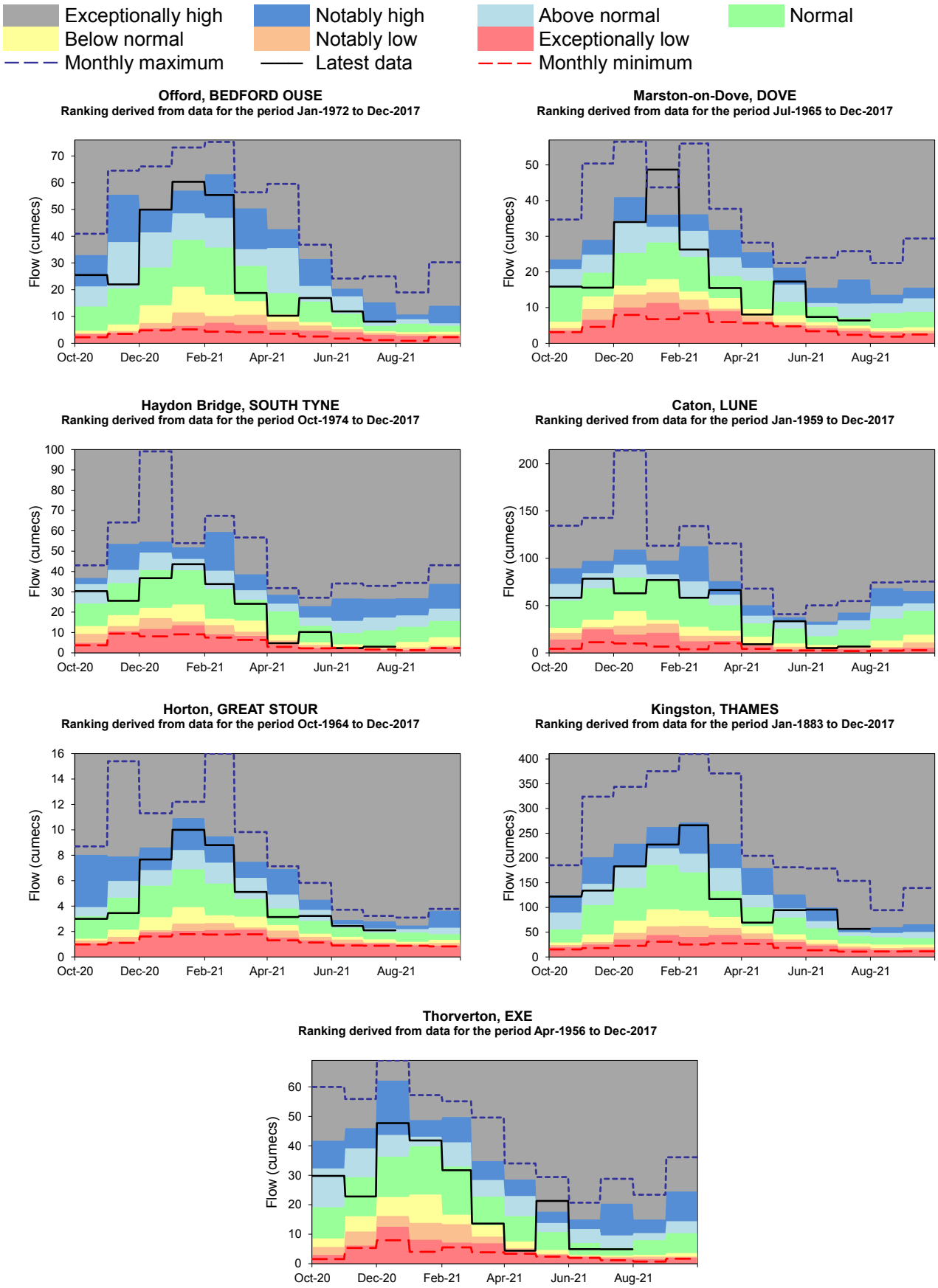
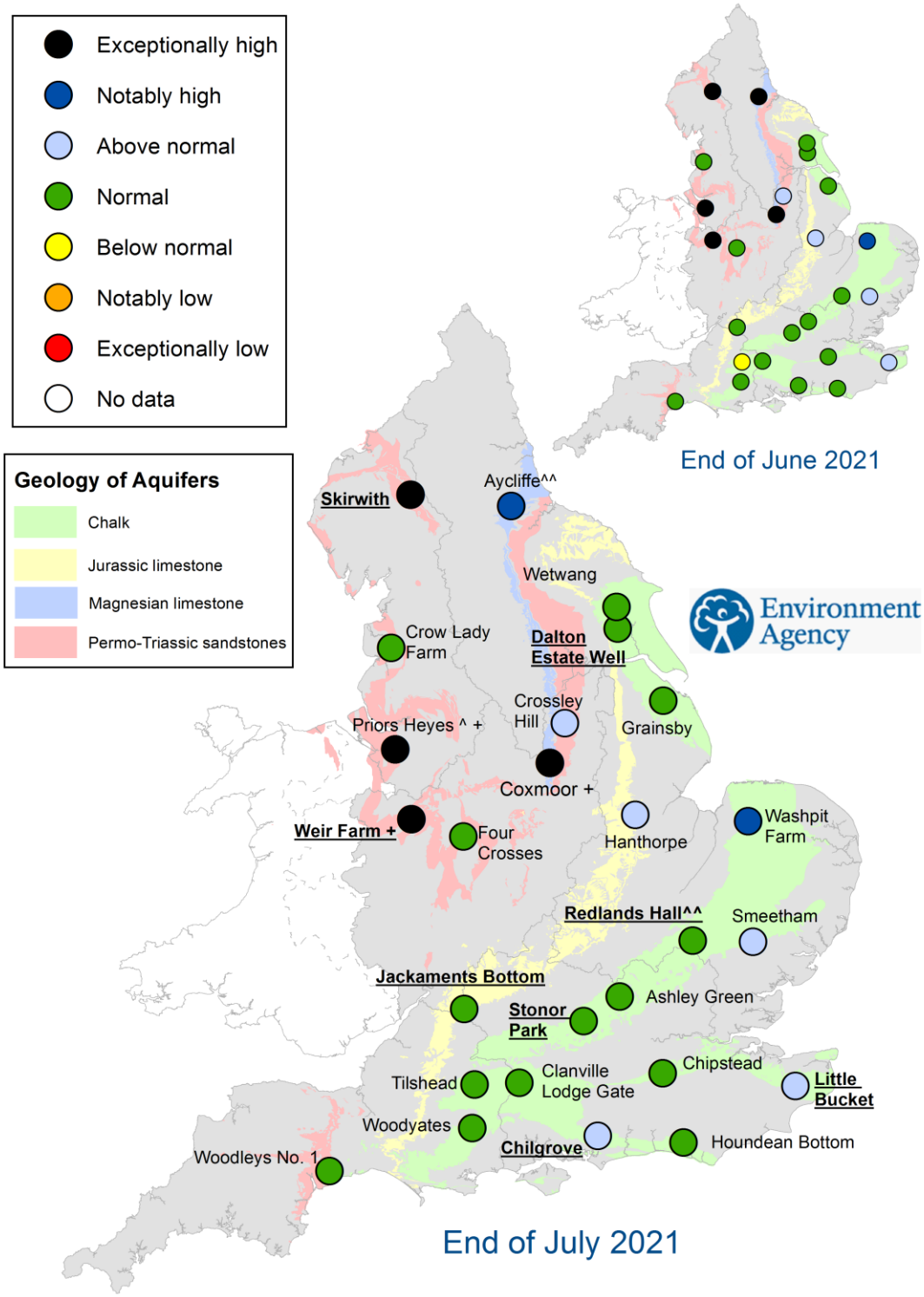


Figure 3.2: Index river flow sites for each geographic region. Monthly mean flow compared to an analysis of historic monthly mean flows, long term maximum and minimum flows. (Source: Environment Agency).

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 June 2021 and July 2021, classed relative to an analysis of respective historic June and July 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

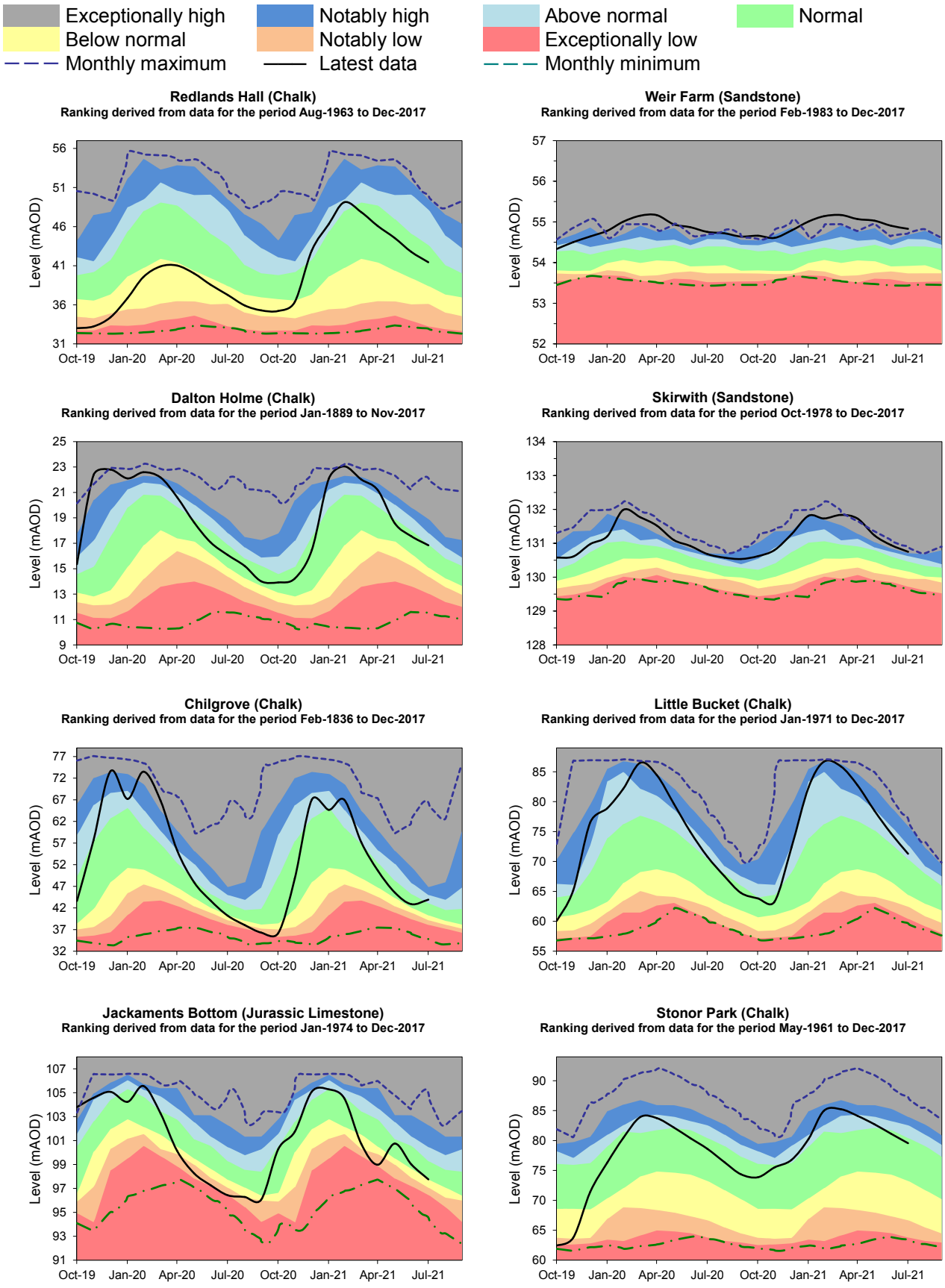
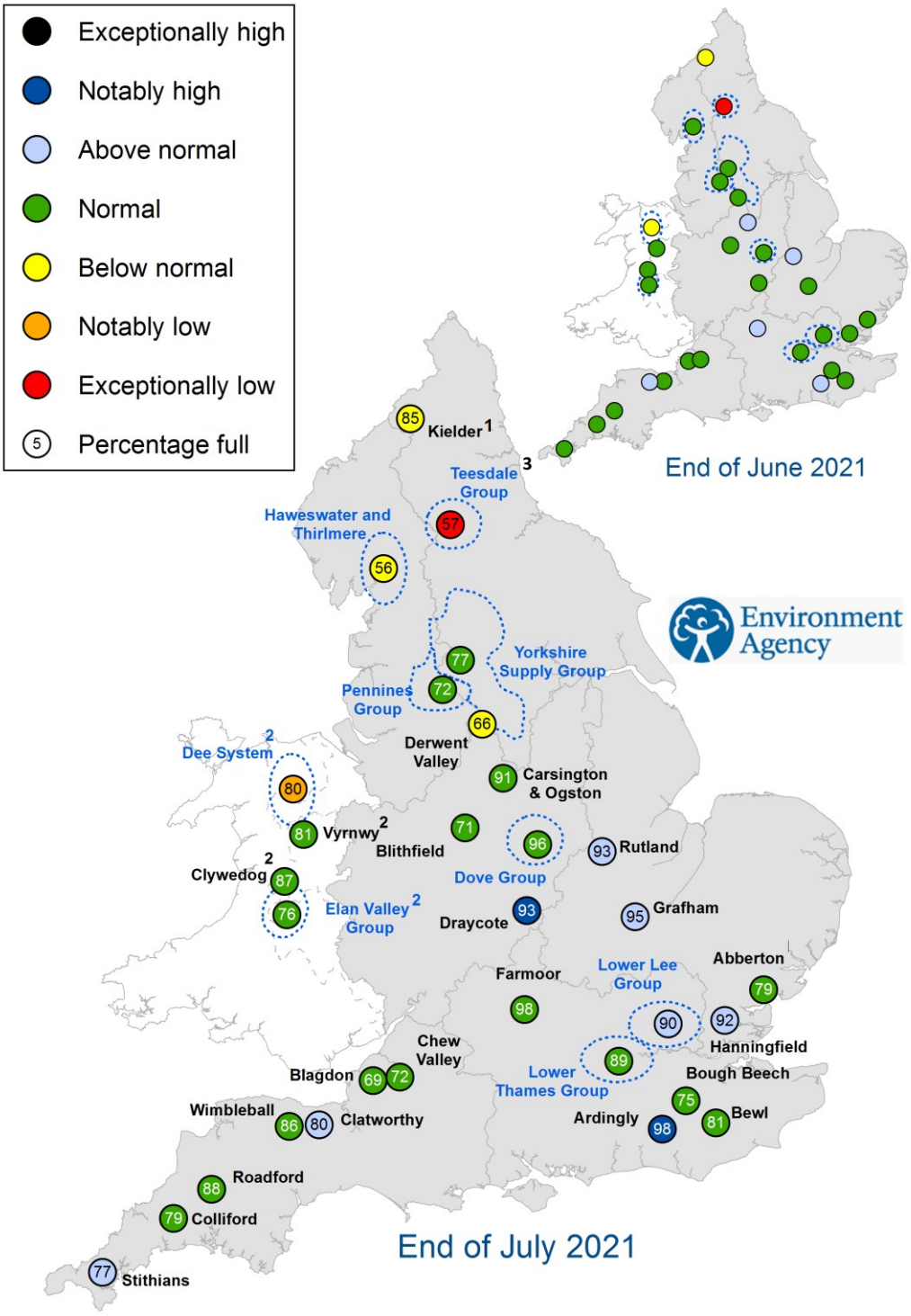


Figure 4.2: Index groundwater level sites for major aquifers. End of month groundwater levels months compared to an analysis of historic end of month levels and long term maximum and minimum levels. (Source: Environment Agency, 2021).

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 June 2021 and July 2021 as a percentage of total capacity and classed relative to an analysis of historic June and July values respectively (Source: Water Companies). Note: Classes shown may not necessarily relate to control curves or triggers for drought actions. As well as for public water supply, some reservoirs are drawn down to provide flood storage, river compensation flows or for reservoir safety inspections. In some cases current reservoir operating rules may differ from historic ones.

Reservoir storage charts

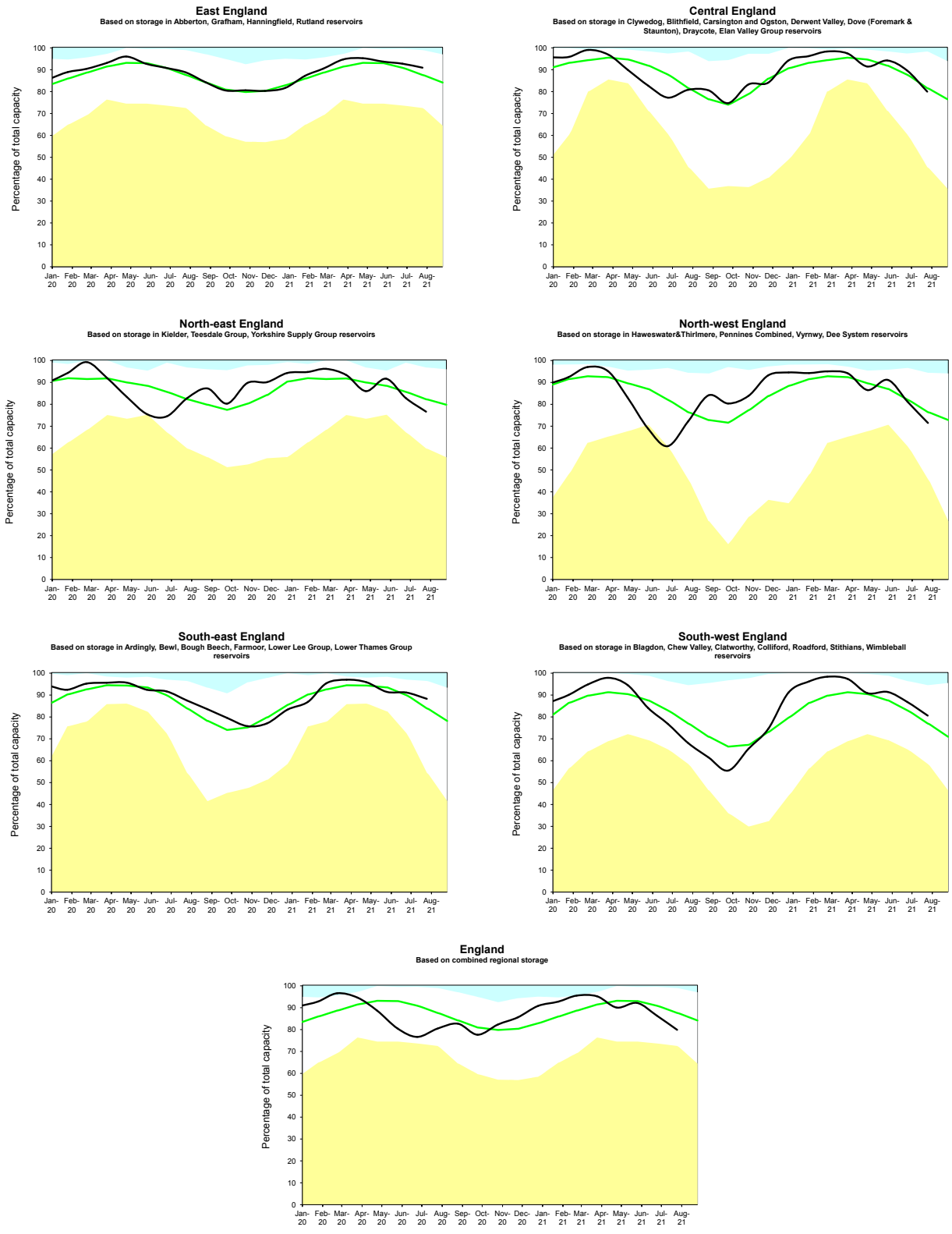


Figure 5.2: Regional reservoir stocks. End of month reservoir stocks compared to long term maximum, minimum and average stocks (Source: Water Companies). Note: Historic records of individual reservoirs/reservoir groups making up the regional values vary in length.

Forward look: river flow

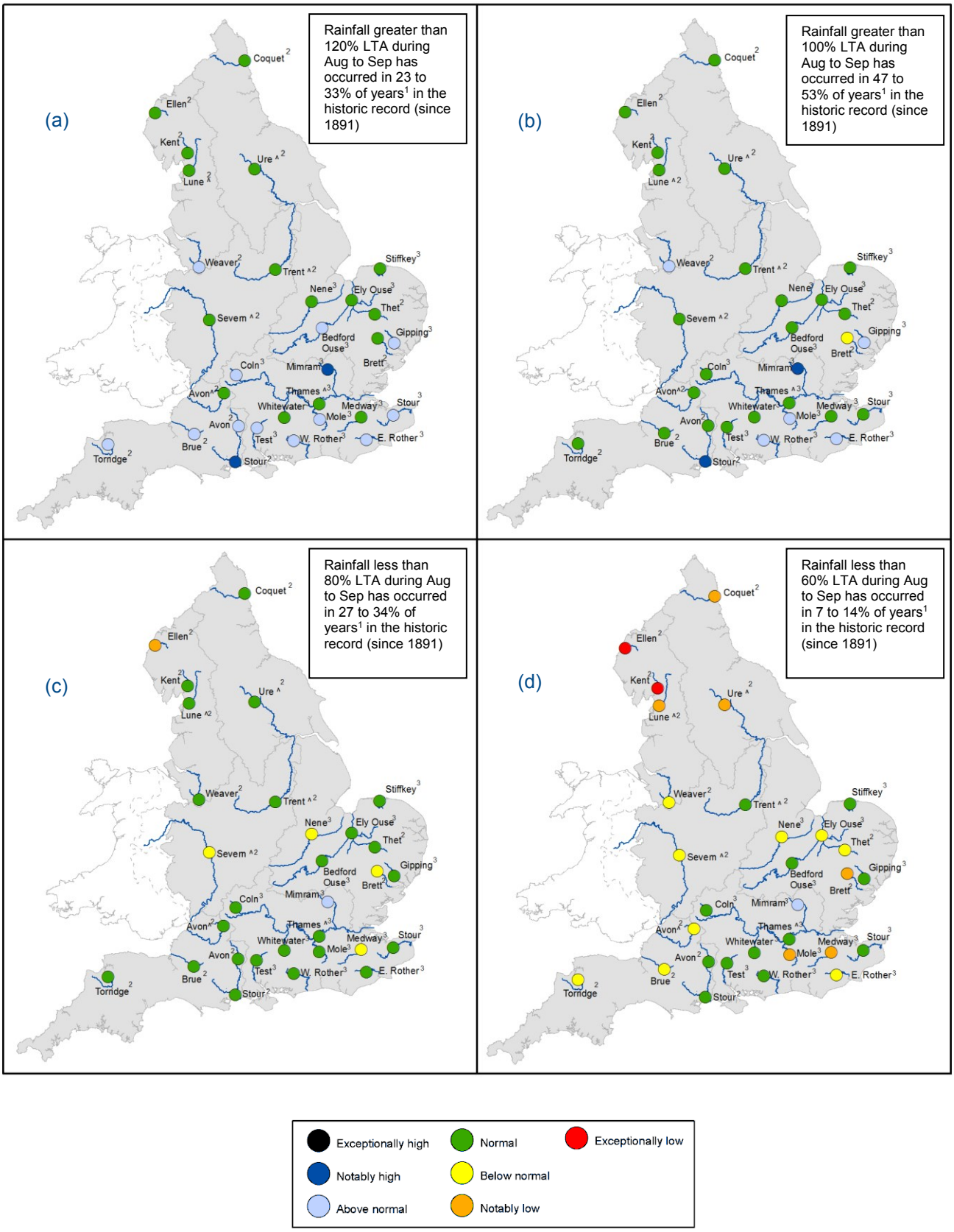


Figure 6.1: Projected river flows at key indicator sites up until the end of September 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2021 and September 2021 (Source: Centre for Ecology and Hydrology, Environment Agency)

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

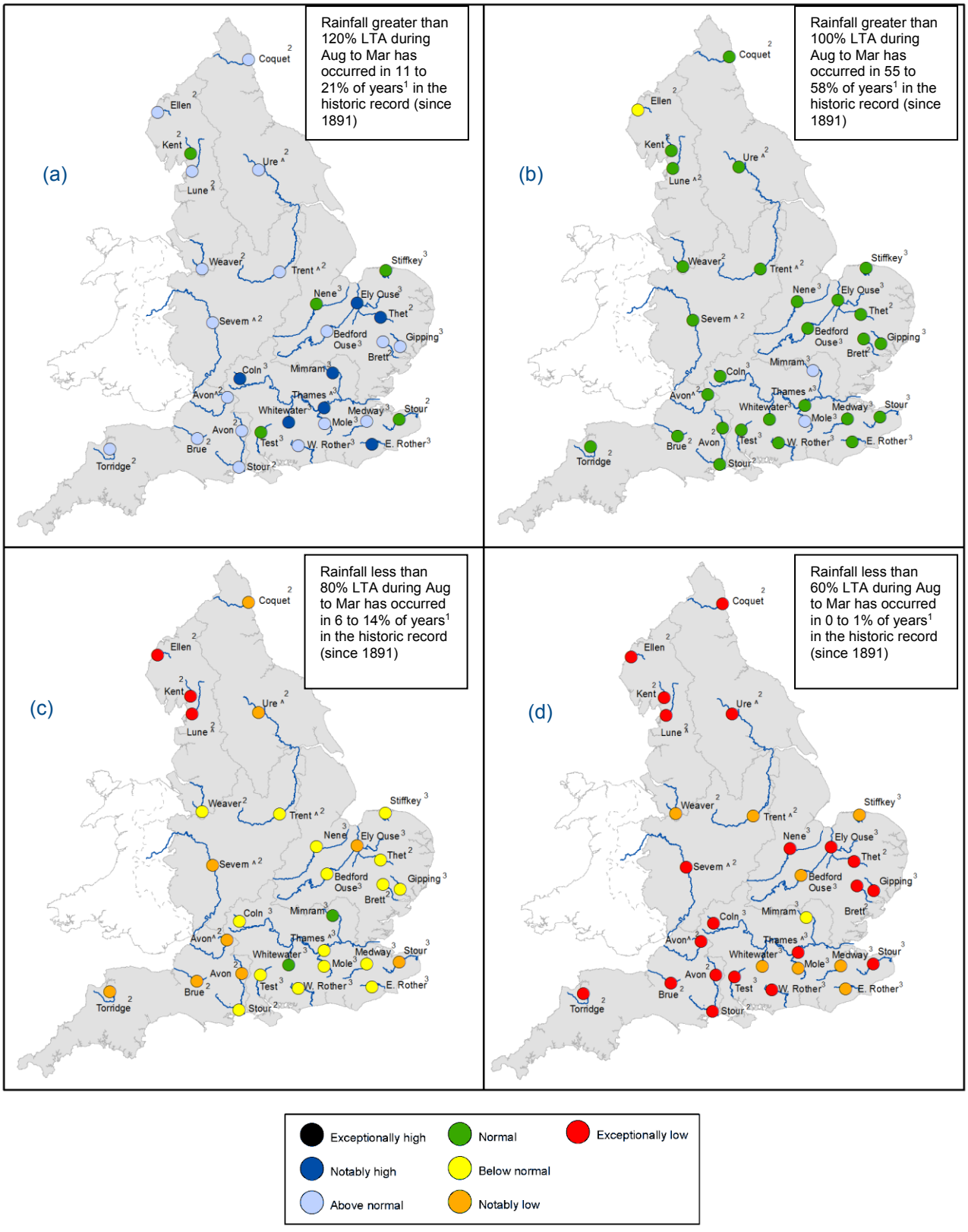


Figure 6.2: Projected river flows at key indicator sites up until the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2021 and March 2022 (Source: Centre for Ecology and Hydrology, Environment Agency)

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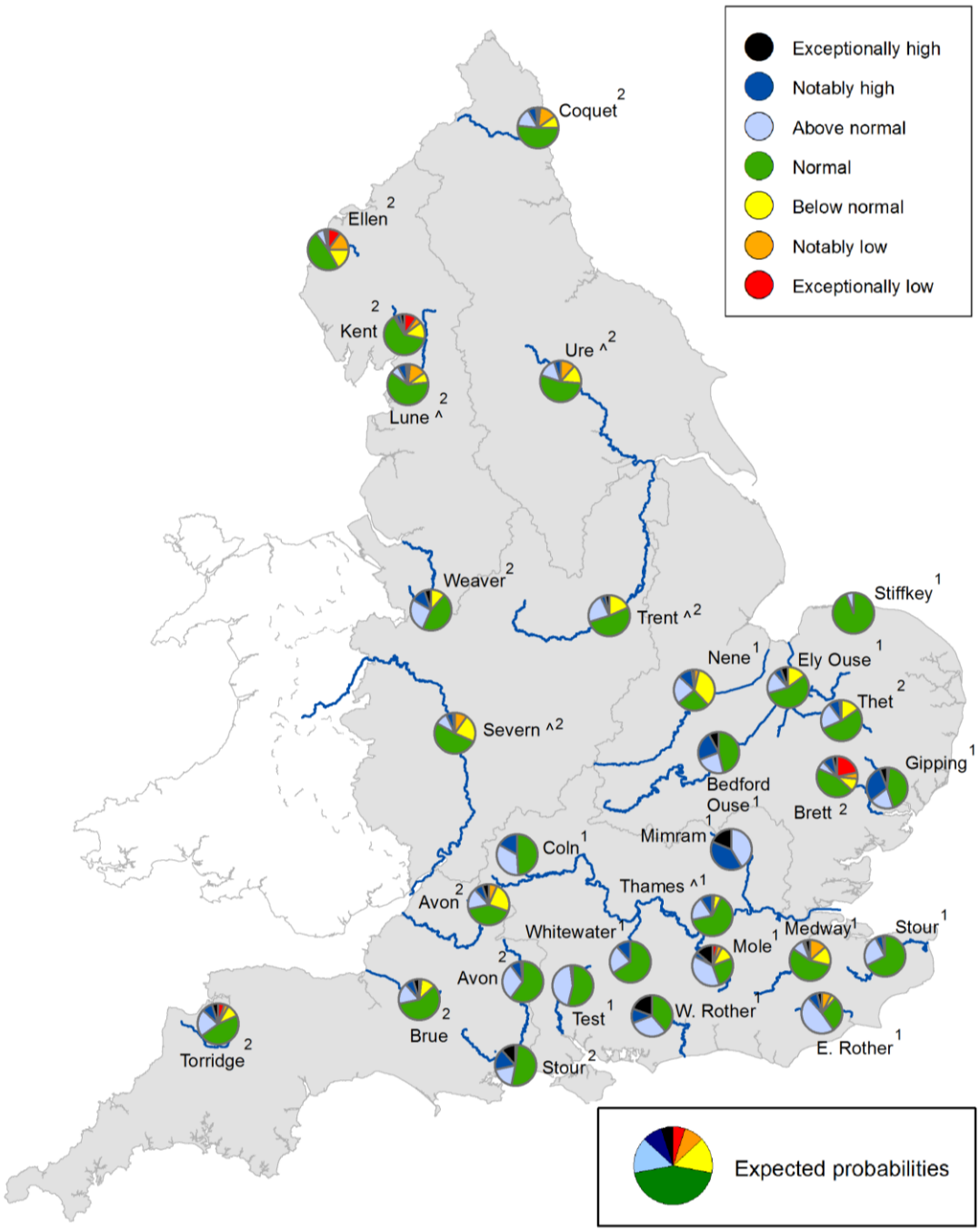

Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 2021. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the time of year. (Source: Centre for Ecology and Hydrology, Environment Agency).

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

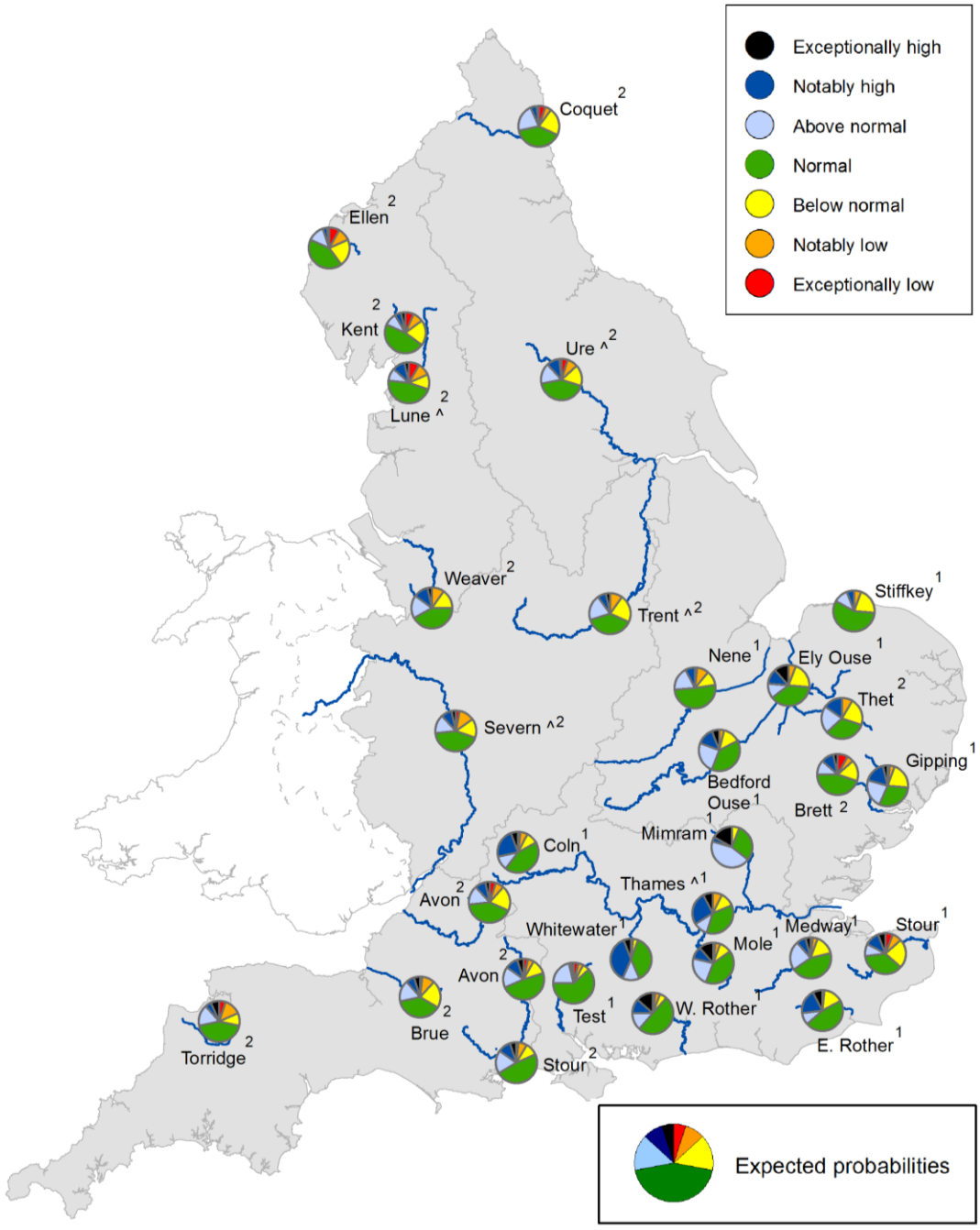

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Figure 6.4: Probabilistic ensemble projections of river flows at key indicator sites up until the end of March 2022. Pie charts indicate probability, based on climatology, of the surface water flow at each site being e.g. exceptionally low for the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

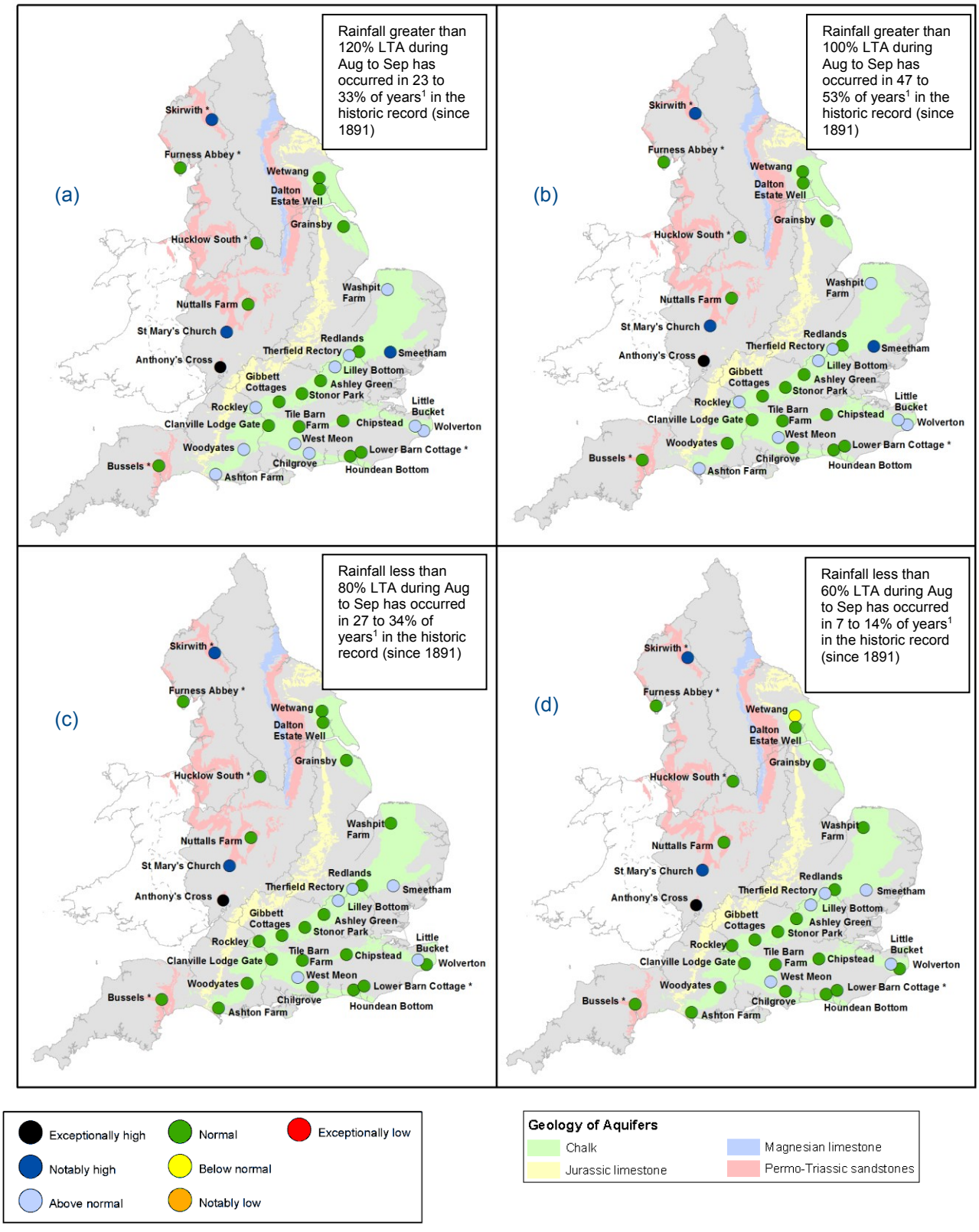


Figure 6.5: Projected groundwater levels at key indicator sites at the end of September 2021. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2021 and September 2021 (Source: Environment Agency) Geological map reproduced with kind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

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

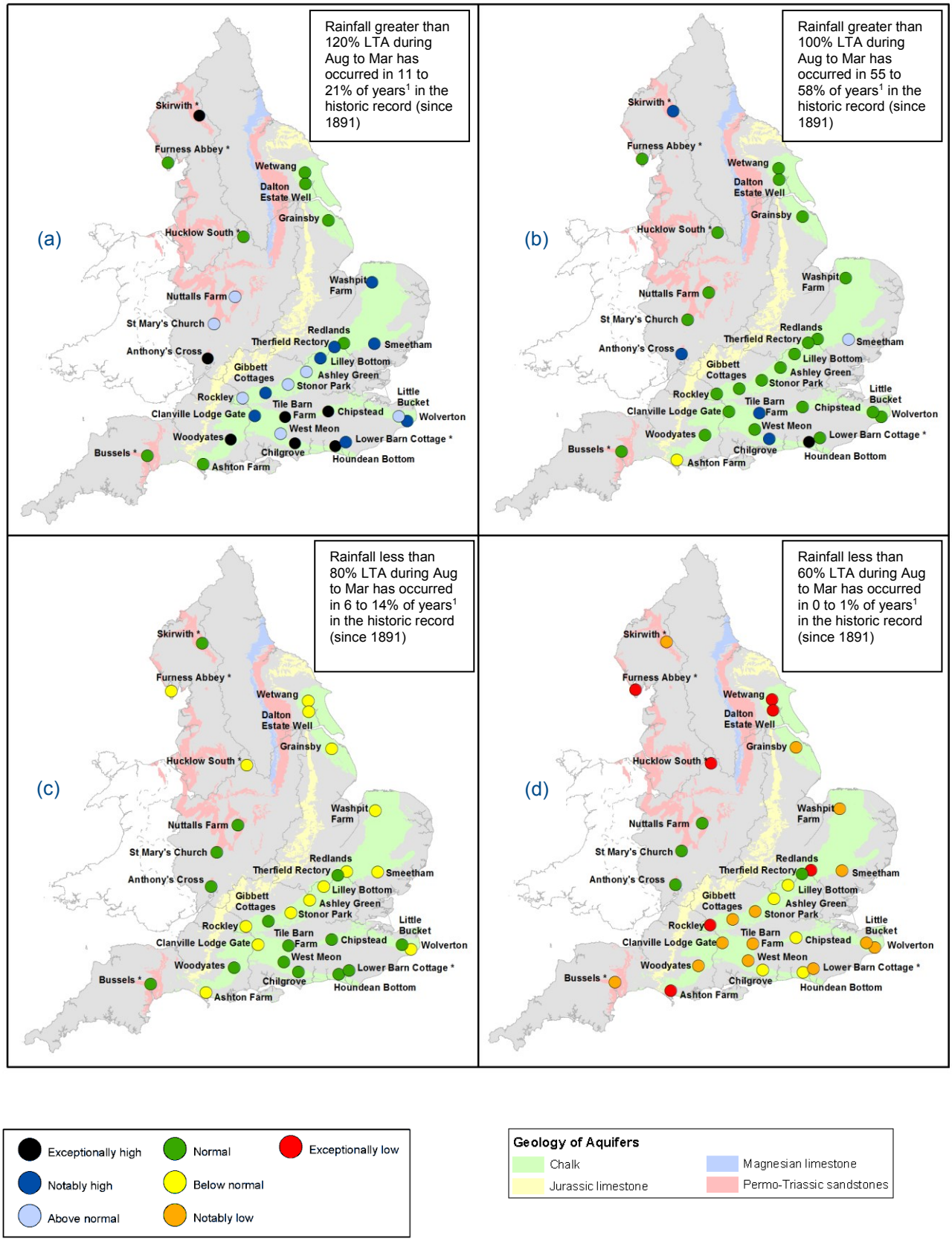
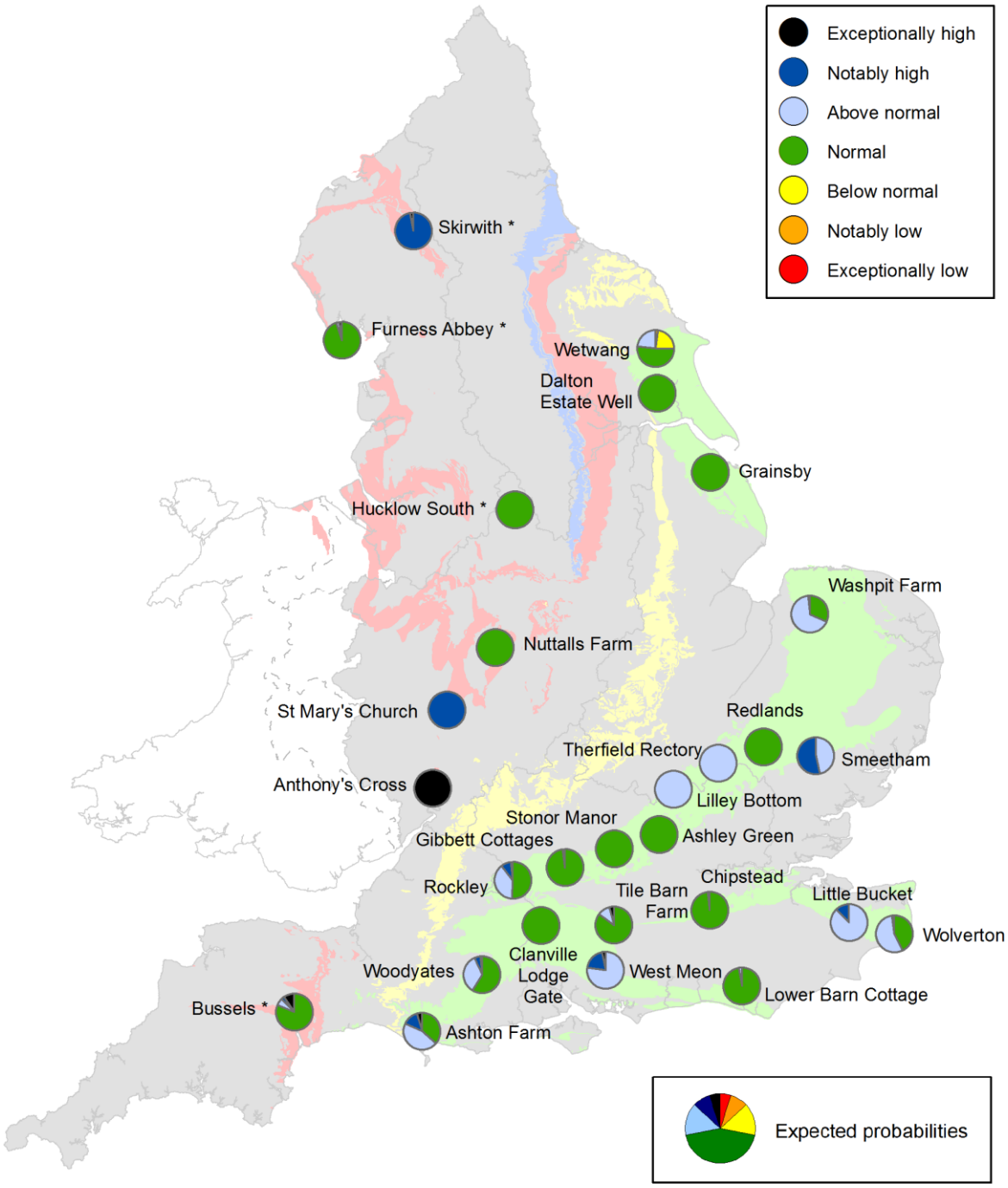


Figure 6.6: Projected groundwater levels at key indicator sites at the end of March 2022. Projections based on four scenarios: 120% (a), 100% (b), 80% (c) and 60% (d) of long term average rainfall between August 2021 and March 2022 (Source: Environment Agency) Geological map reproduced with kind permission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

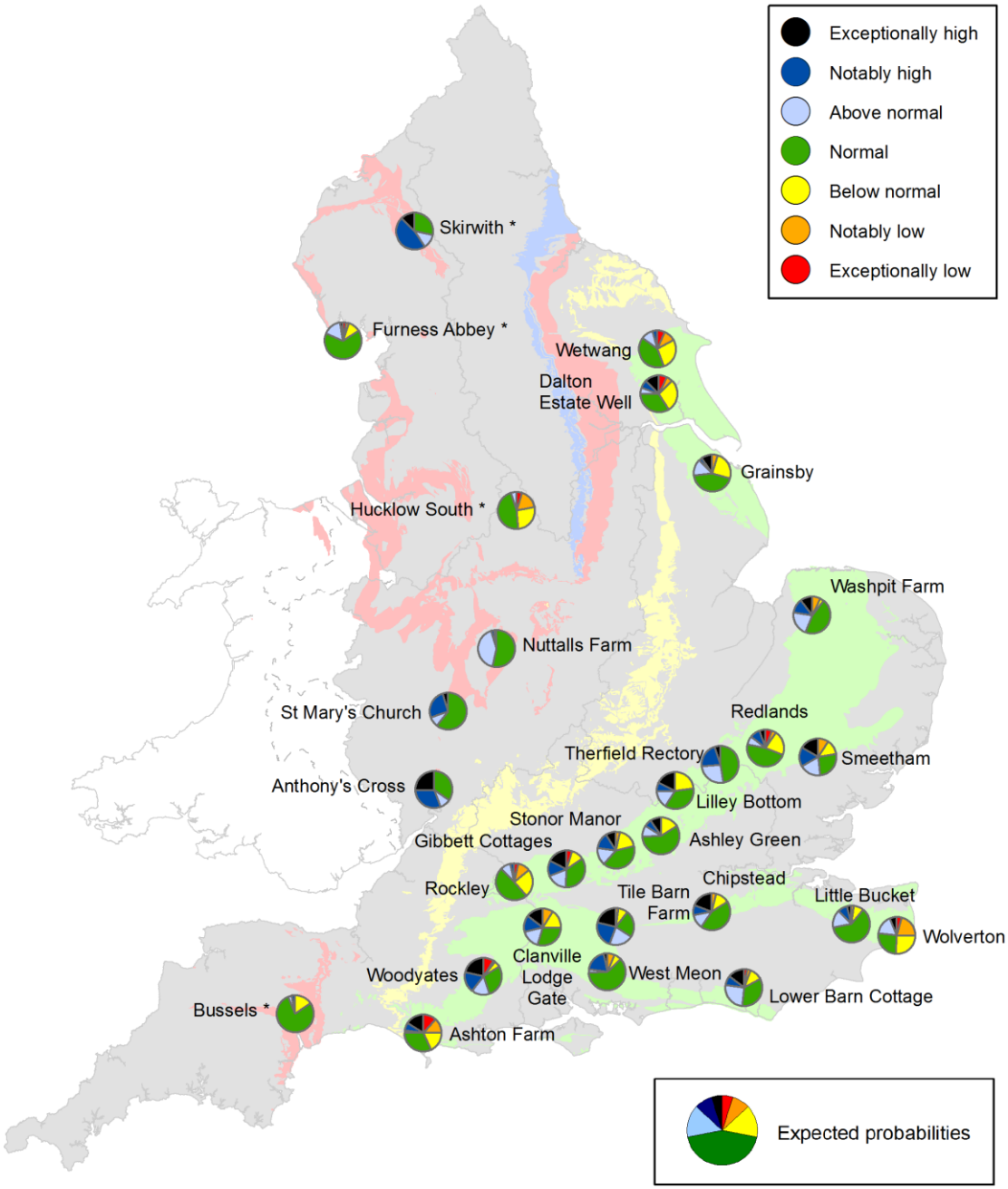
* Projections for these sites are produced by BGS
[1] This range of probabilities is a regional analysis



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 2021. Pie charts indicate probability, based on climatology, of the groundwater level at each site being e.g. exceptionally low for the time of year. (Source: Environment Agency) Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100024198, 2021.

** Projections for these sites are produced by BGS*



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

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

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