

# Monthly water situation report: East Anglia

## 1 Summary - December 2022

December began dry, with cold, settled conditions dominating for the first half of the month. The second half of the month saw a return to wetter conditions with a succession of frontal systems and associated rainfall moving in from the Atlantic. By the end of the month rainfall totals were close to average across the Area.

### 1.1 Rainfall

December rainfall was in the normal range across East Anglia. Following on from a generally wet autumn, the three-month rainfall is now above normal or notably high, apart from in north and west Norfolk, where it was in the normal range. The twelve-month totals are still showing the effects of the exceptionally dry spring and summer.

### 1.2 Soil moisture deficit and recharge

Soil moisture deficits have continued to decline through December. Much of the Area now has saturated soils and recharge is well-established. The exception is in west Norfolk, where the soil moisture deficit has perpetuated longer into the winter than elsewhere.

### 1.3 River flows

Rivers receded to baseflows during the dry weather of the first half of the month, but most have responded to the subsequent rainfall. At this time of year, the category that most river flow records occupy is a reflection of recent rainfall, or its absence, rather than an indicator of long-term status.

### 1.4 Groundwater levels

Groundwater levels are recovering at most boreholes in this report, where December dips or telemetered measurements are available. Some sites in Norfolk are yet to see sustained recovery in groundwater levels, reflecting the lower rainfall and the persistence of a soil moisture deficit.

### 1.5 Reservoir stocks

All reservoirs showed at least some recovery in storage during December. Levels in all reservoirs are currently lower than they are in most years on this date, reflecting the higher demands during summer and the reduced abstraction at intakes then. However, flows at all intakes ended December in the normal range or higher.

## 1.6 Environmental impact

Flows are not currently expected to be a cause of environmental issues.

## 1.7 Forward Look

### .1.7.1 Probabilistic ensemble projections for river flows at key sites

There is no clear and unambiguous signal for either drier or wetter conditions than normal in the ensemble projections for river flows. There is perhaps a signal though that flows in March and June are less likely to be either exceptionally high or exceptionally low than in the long-term record.

### .1.7.2 Probabilistic ensemble projections for groundwater levels in key aquifers

The groundwater projections show an increased probability of normal groundwater levels in the coming months at most boreholes. Kenninghall and Bircham Newton are exceptions, and at these sites the probability of below normal or notably low levels is elevated to a surprisingly high likelihood.

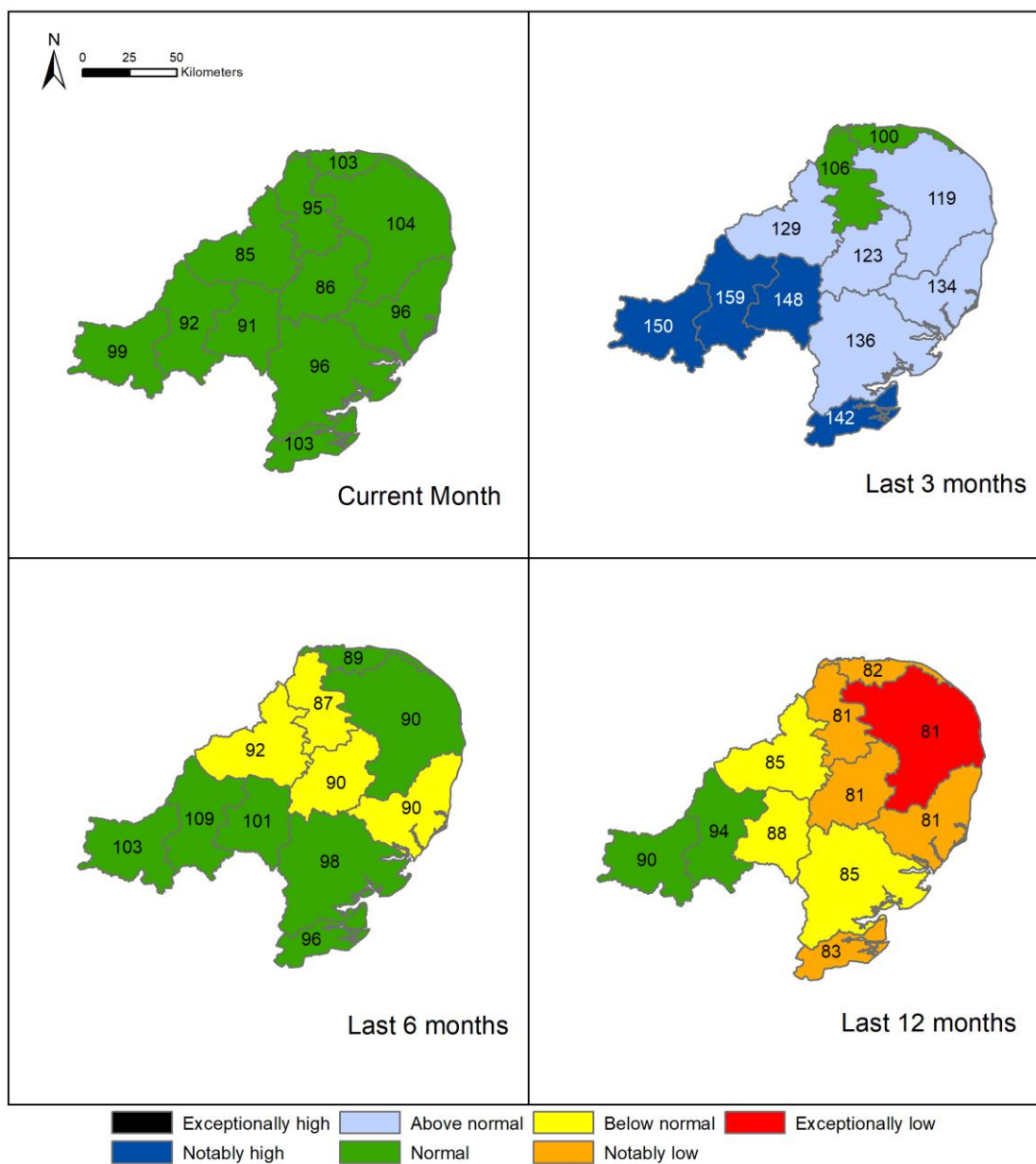
Author: Hydrology & Operations, [ANG-Hydrology@environment-agency.gov.uk](mailto:ANG-Hydrology@environment-agency.gov.uk)

Contact Details: 03708 506 506

## 2 Rainfall

### 2.1 Rainfall map

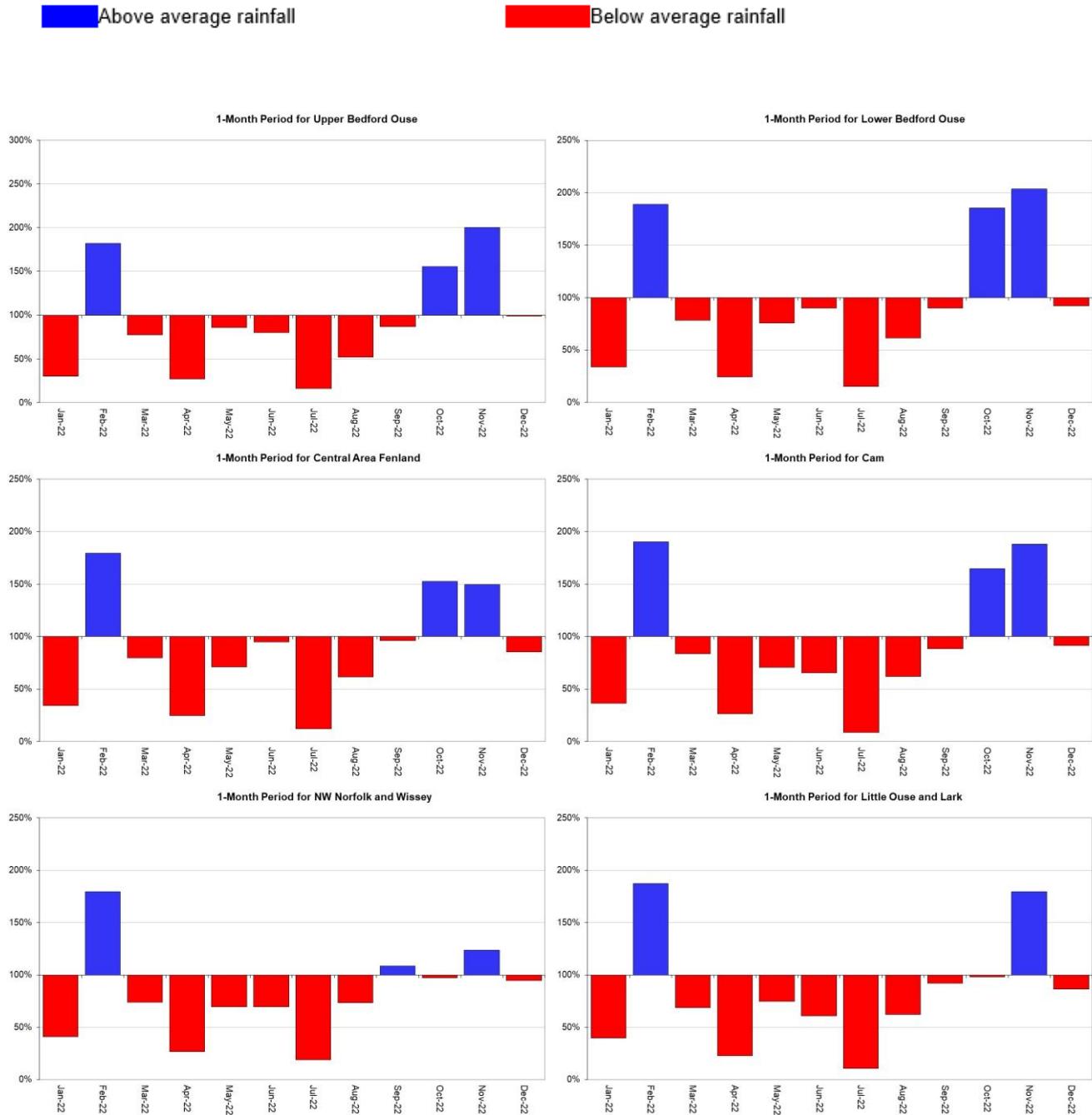
Figure 2.1: Total rainfall for hydrological areas for the current month (up to 31 December 2022), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Table available in the appendices with detailed information.

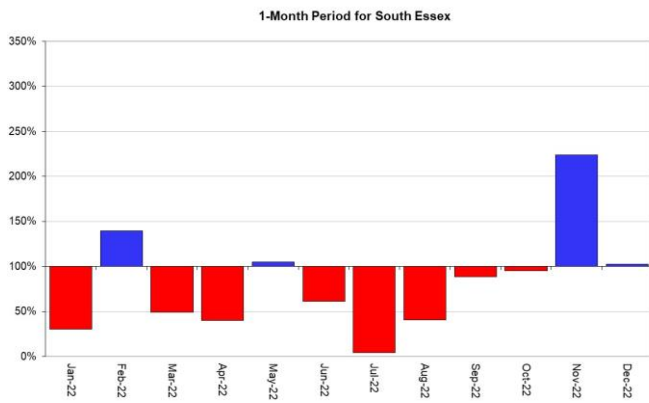
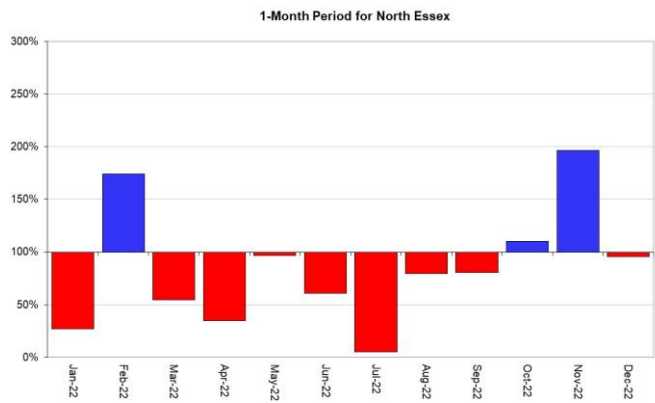
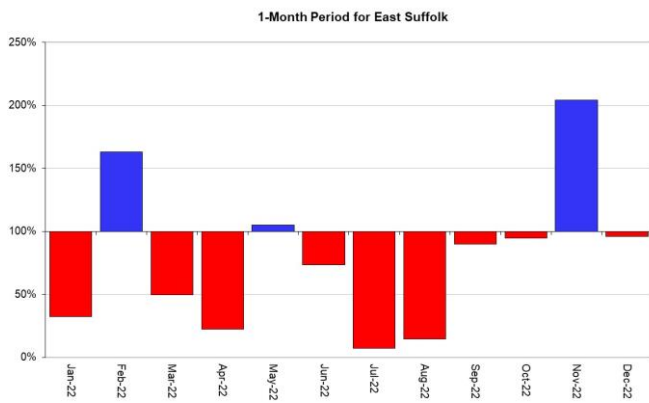
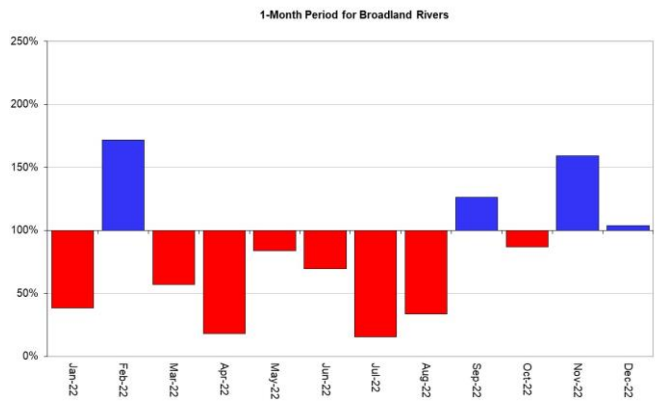
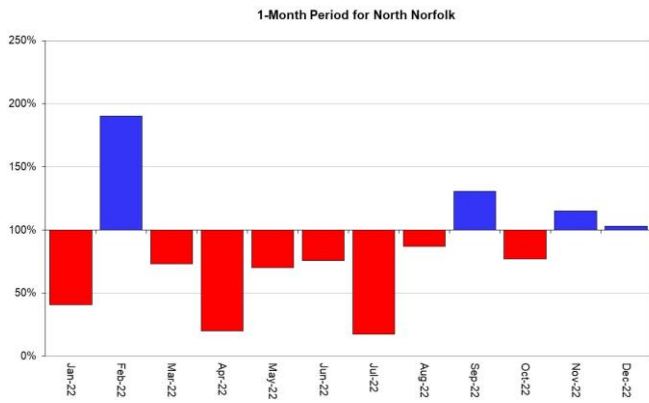


HadUK data based on the Met Office 1km gridded rainfall dataset derived from rain gauges (Source: Met Office. Crown copyright, 2023). Provisional data based on Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. Crown copyright. All rights reserved. Environment Agency, 100024198, 2023.

## 2.2 Rainfall charts

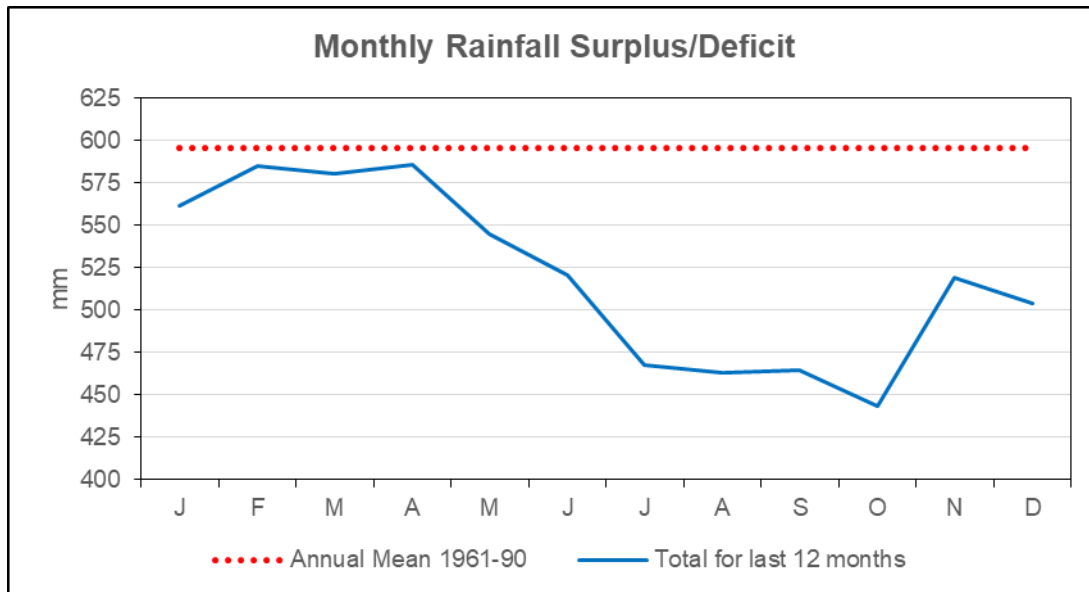
Figure 2.2: Monthly rainfall totals for the past 12 months as a percentage of the 1961 to 1990 long term average for each region and for England.





HadUK rainfall data. (Source: Met Office. Crown copyright, 2023).

### 2.3 Monthly Rainfall Surplus Deficit Chart

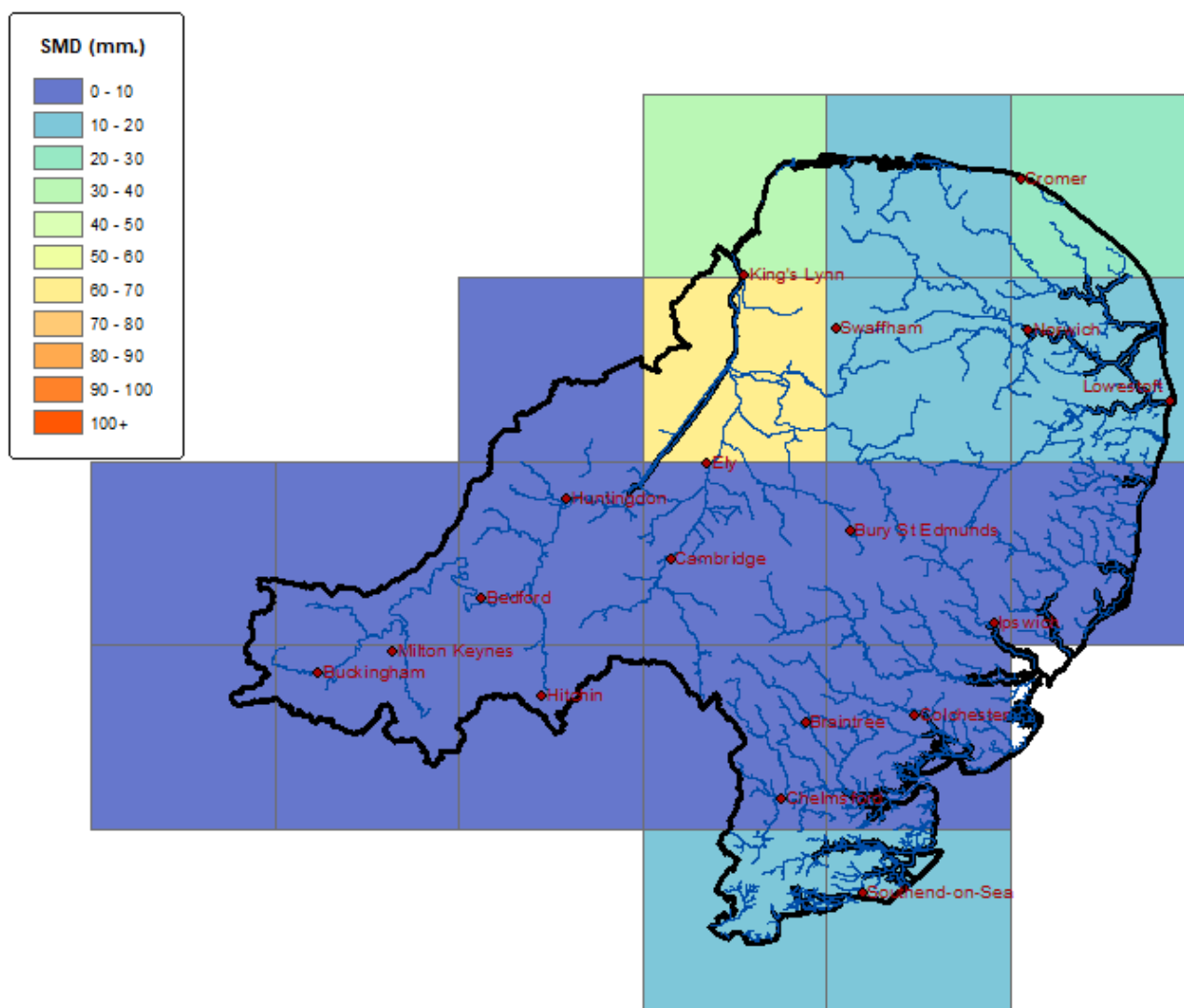


HadUK rainfall data. (Source: Met Office. Crown copyright, 2023).

### 3 Soil moisture deficit

#### 3.1 Soil moisture deficit map

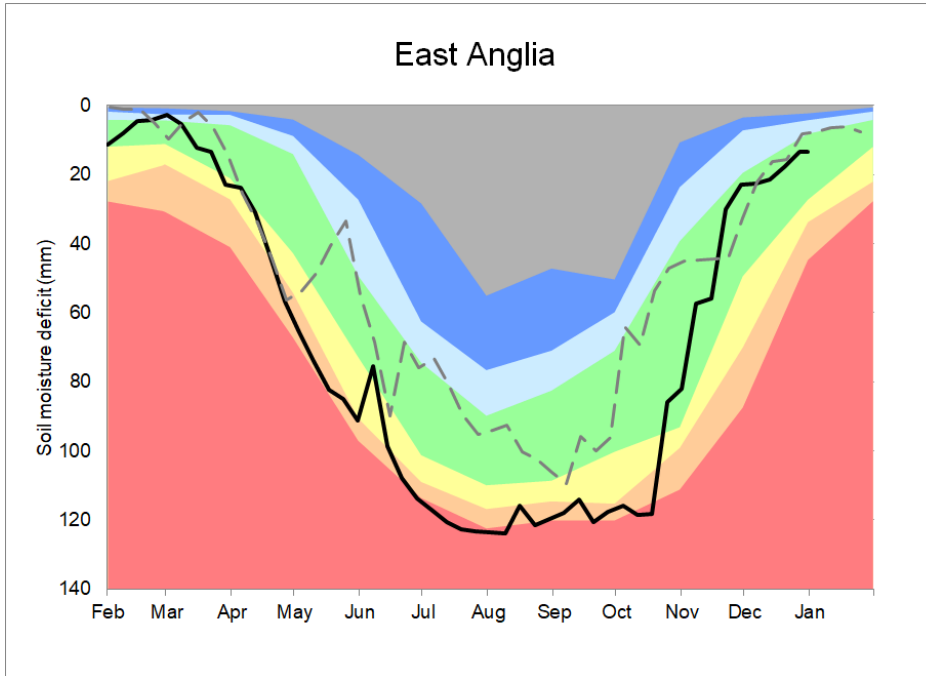
Figure 3.1: Soil moisture deficits for the 31 December 2022. Data based on the MORECS data for real land use.



(Source: Met Office. Crown copyright, 2023). All rights reserved. Environment Agency, 100024198, 2023.

### 3.2 Soil moisture deficit charts

Figure 3.2: Latest soil moisture deficit compared to an analysis of historic 1961 to 1990 long term data set. Weekly MORECS data for real land use.

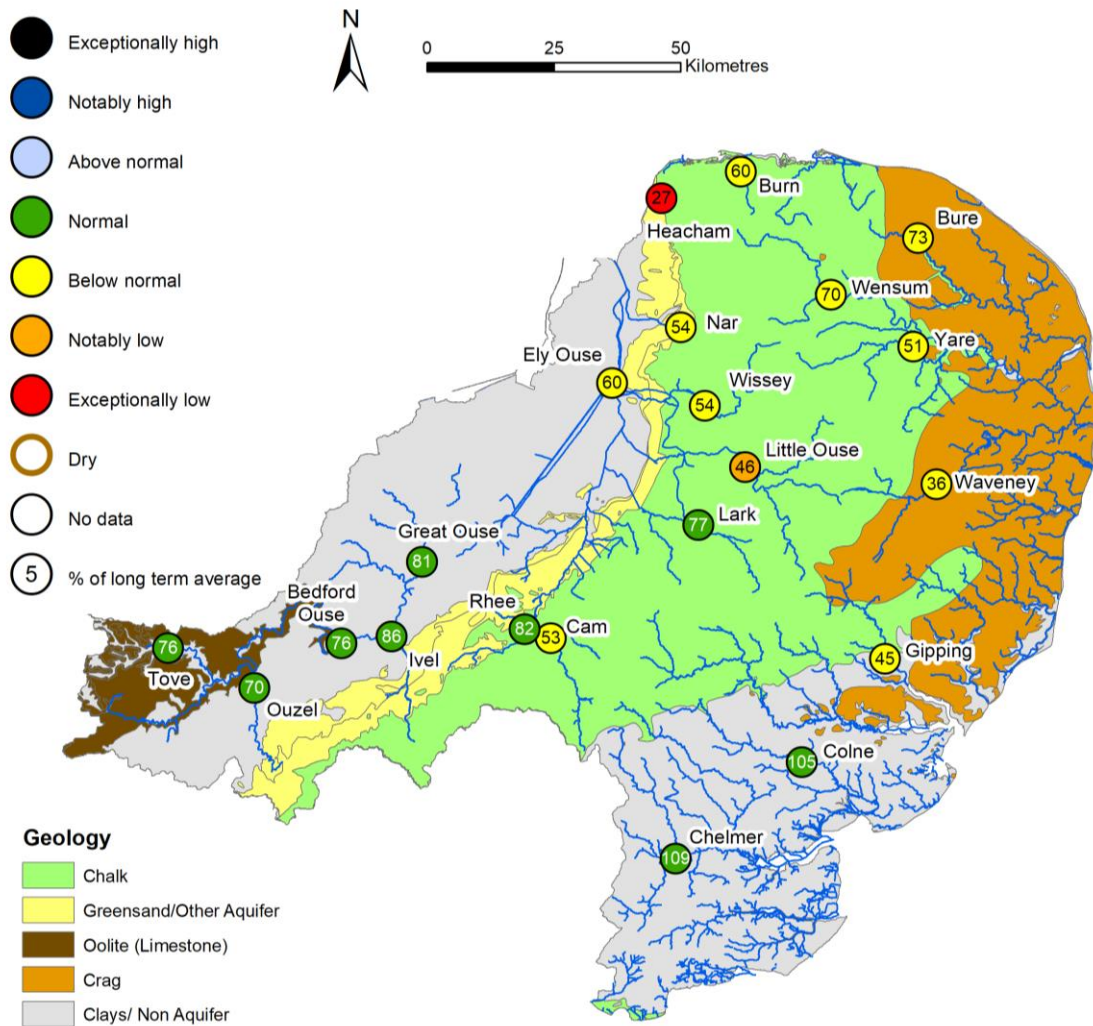


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## 4 River flows

### 4.1 River flows map

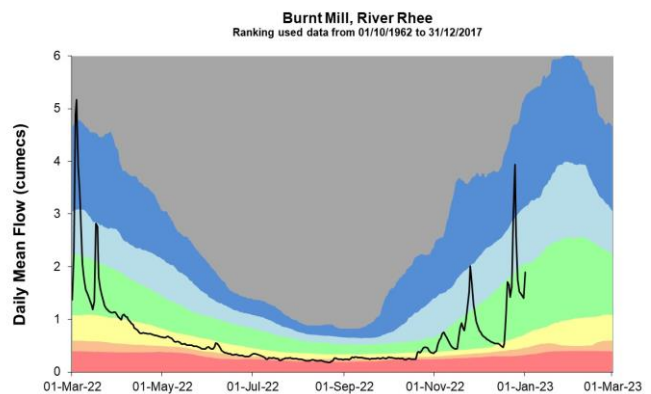
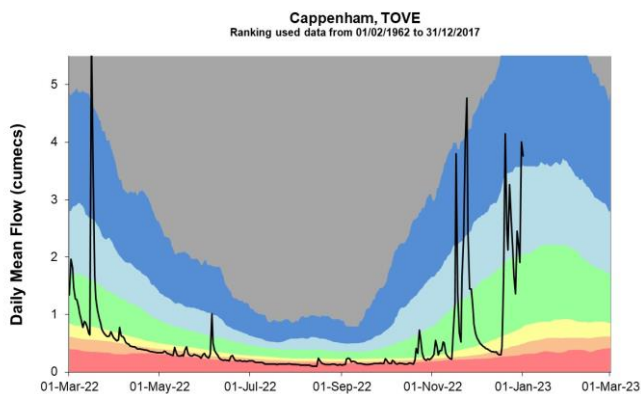
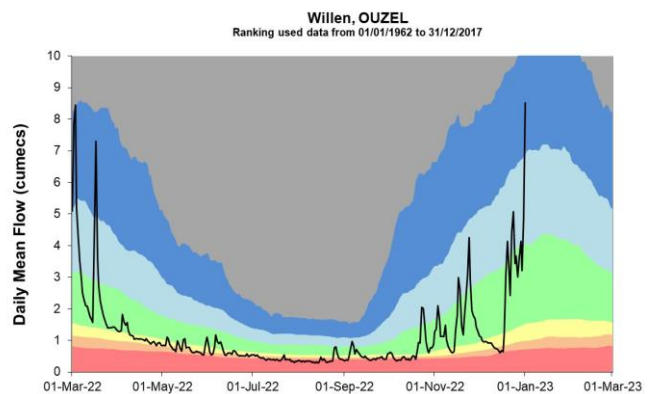
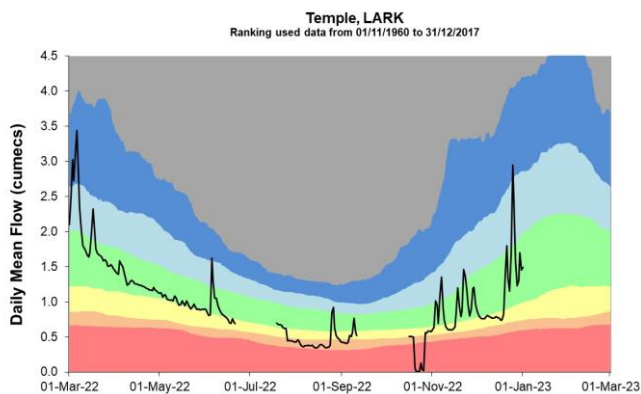
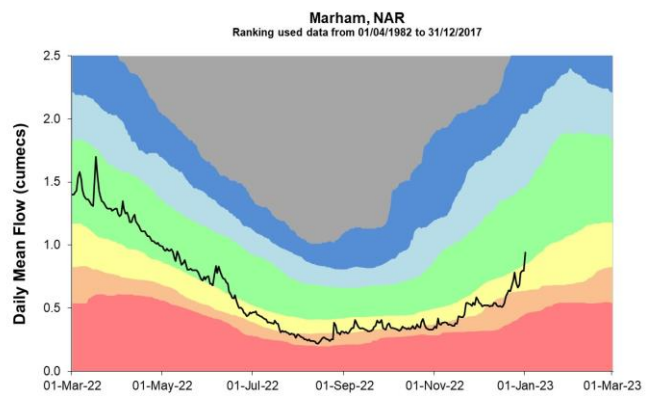
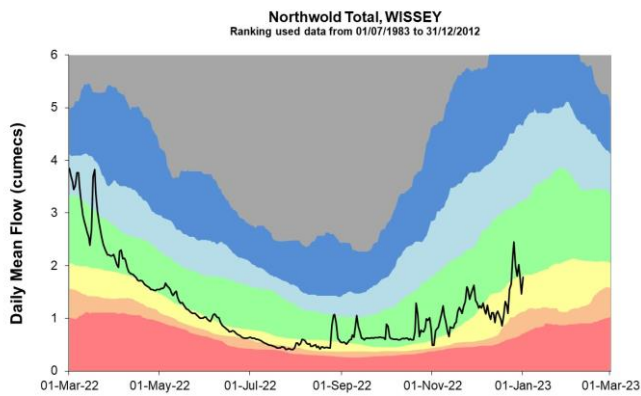
Figure 4.1: Monthly mean river flow for indicator sites for December 2022, expressed as a percentage of the respective long term average and classed relative to an analysis of historic December monthly means Table available in the appendices with detailed information.

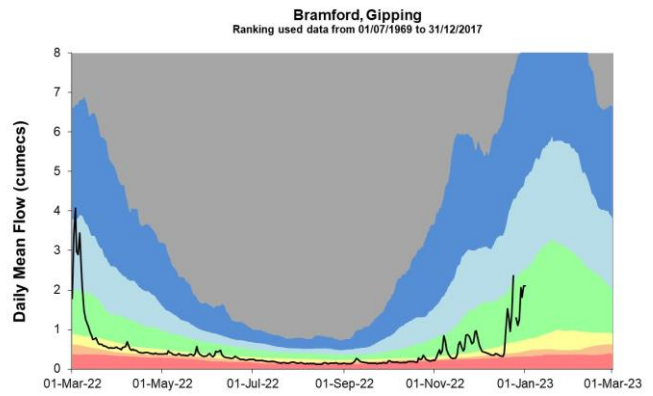
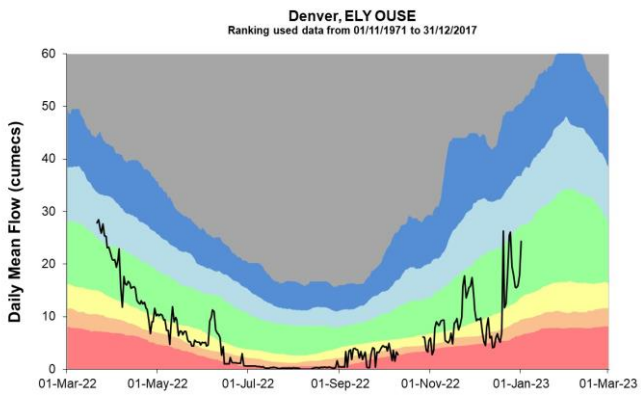
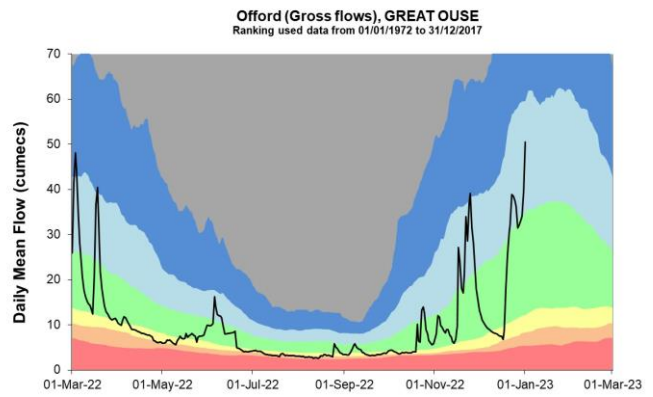
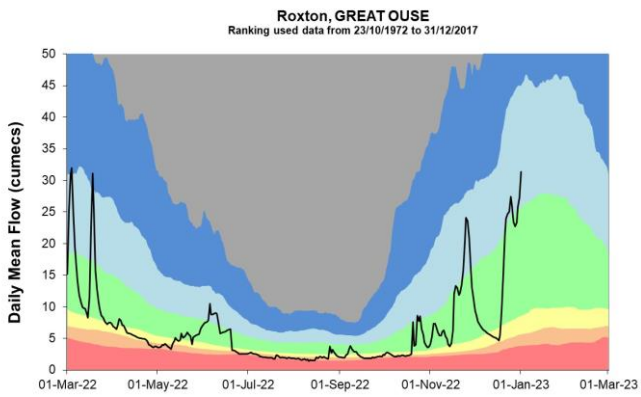
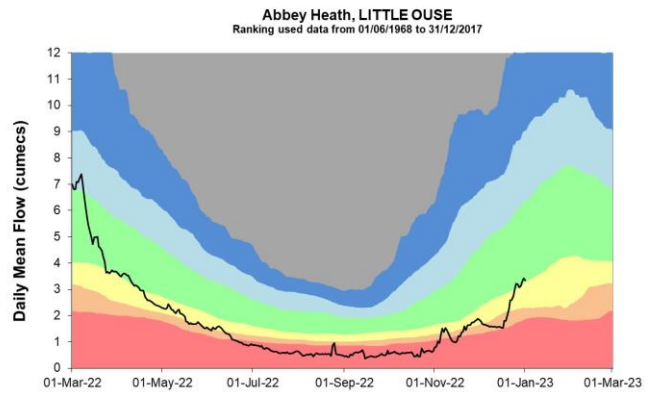
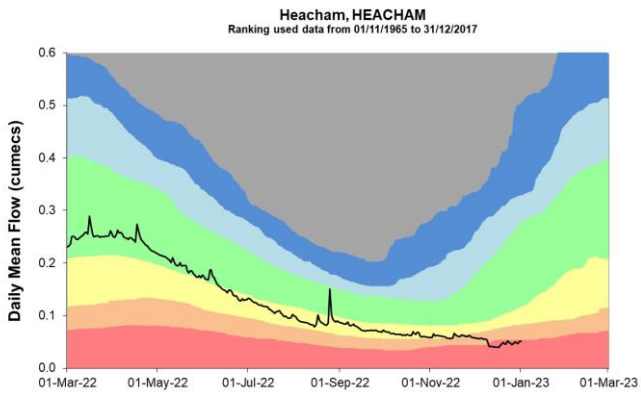
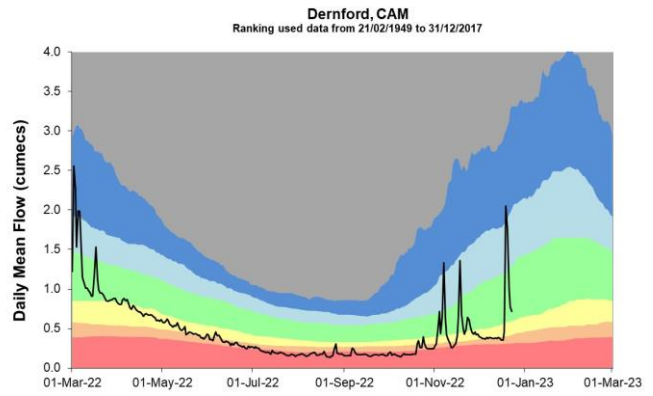
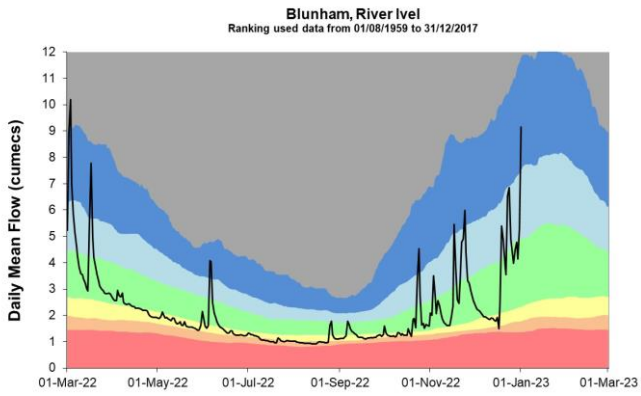


(Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS copyright NERC. Crown copyright. All rights reserved. Environment Agency, 100024198, 2023.

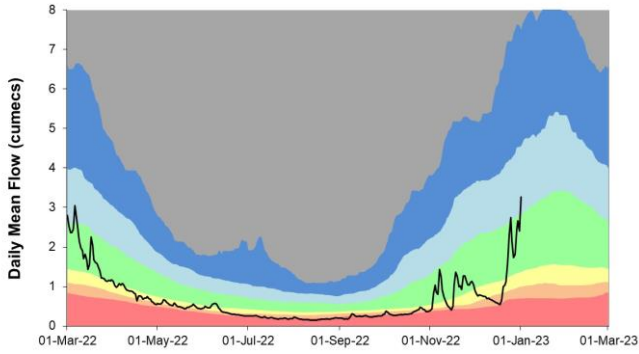
## 4.2 River flow charts

Figure 4.2: Daily mean river flow for index sites over the past year, compared to an analysis of historic daily mean flows, and long term maximum and minimum flows.

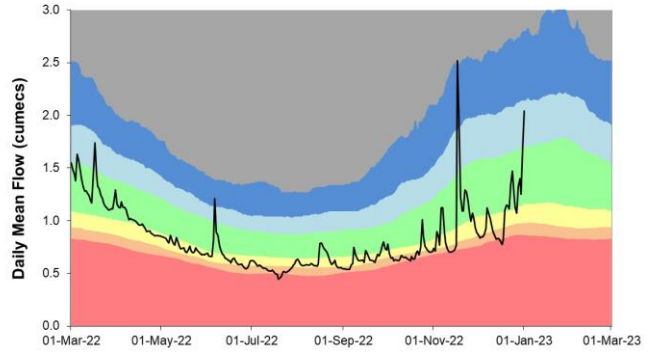




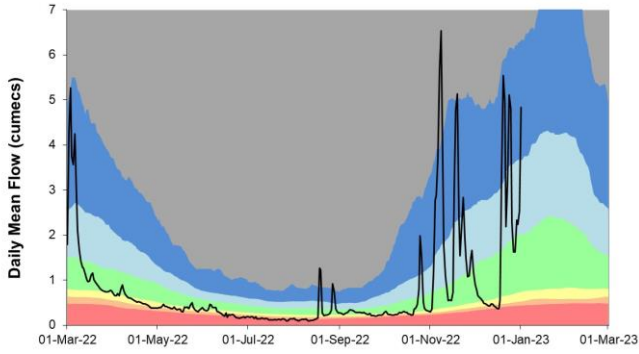
**COLNEY, River Yare**  
Ranking used data from 01/01/1970 to 31/12/2017



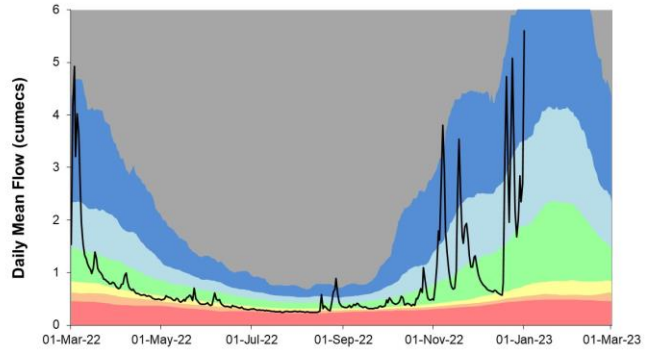
**Ingworth, Bure**  
Ranking used data from 01/06/1959 to 31/12/2017



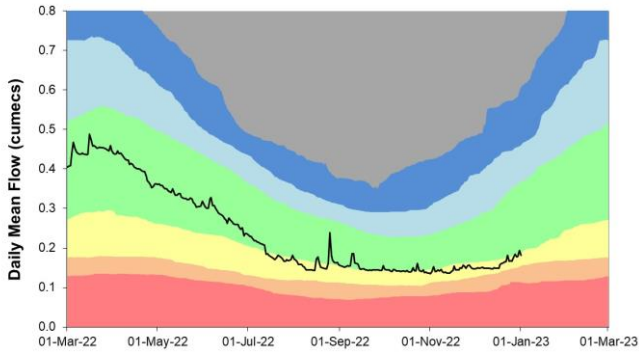
**Lexden, Colne**  
Ranking used data from 01/10/1959 to 31/12/2017



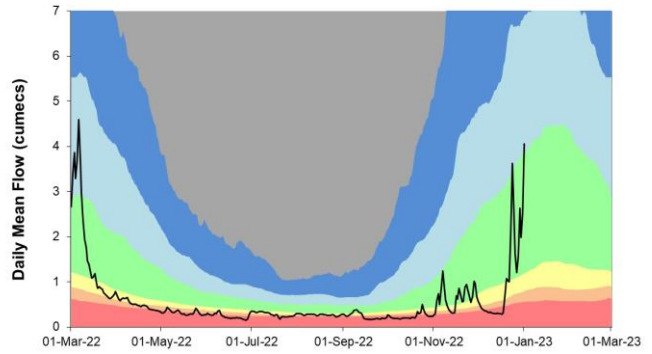
**SPRINGFIELD, River Chelmer**  
Ranking used data from 01/01/1970 to 31/12/2017



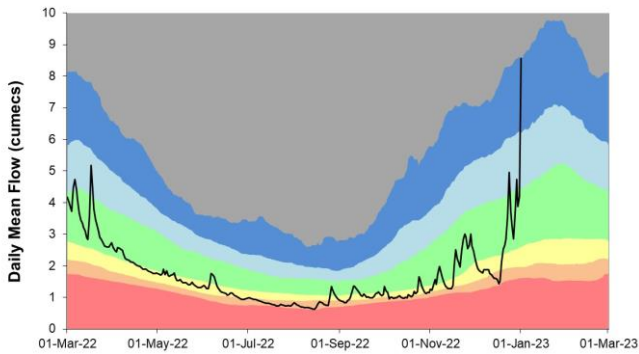
**BURNHAM OVERY TOWN, River Burn**  
Ranking used data from 01/01/1970 to 31/12/2017



**Needham Weir Total, Waveney**  
Ranking used data from 01/12/1963 to 31/12/2017



**Swanton Morley Total Flow, Wensum**  
Ranking used data from 01/10/1969 to 31/12/2017

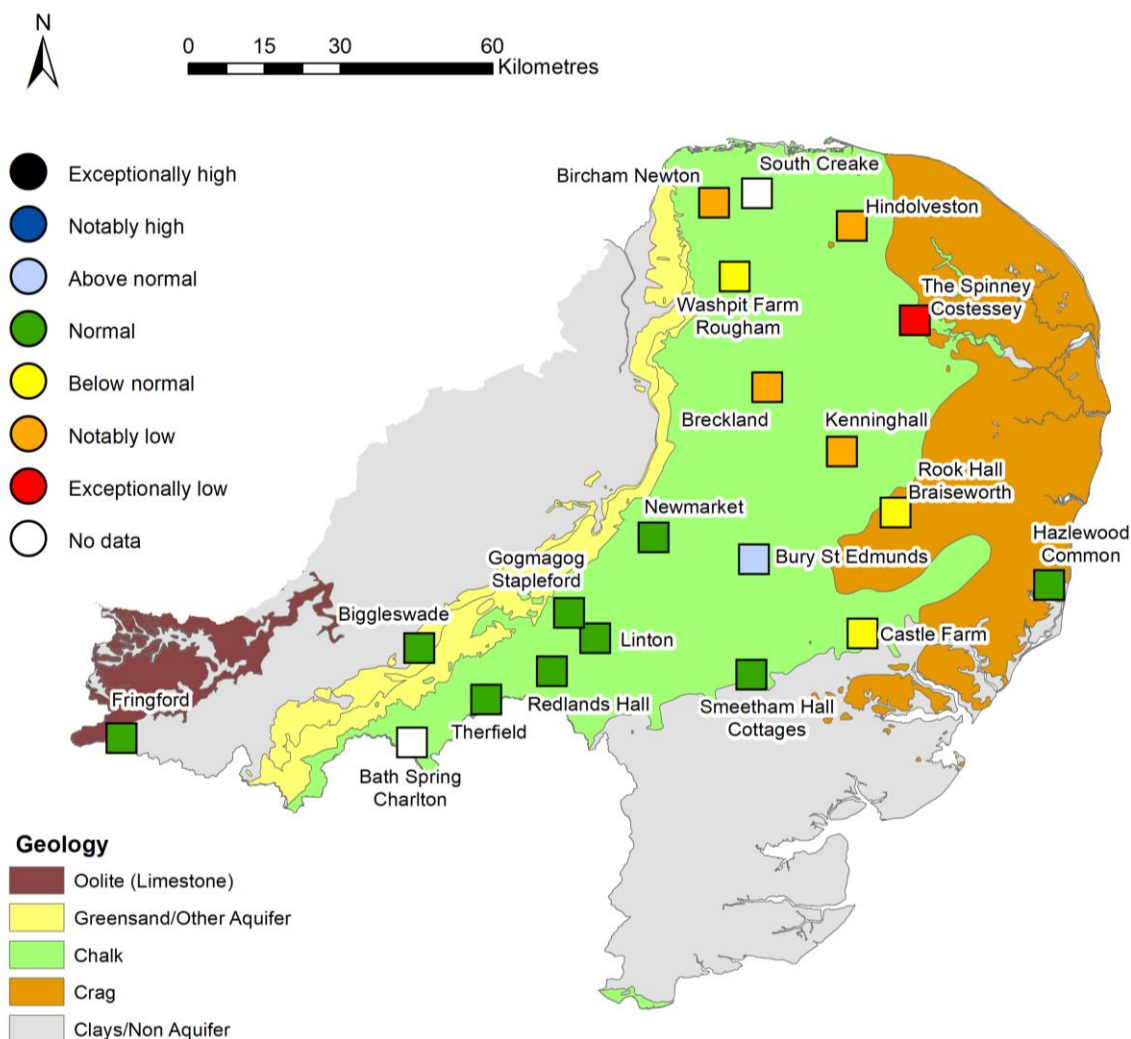


Source: Environment Agency.

## 5 Groundwater levels

### 5.1 Groundwater levels map

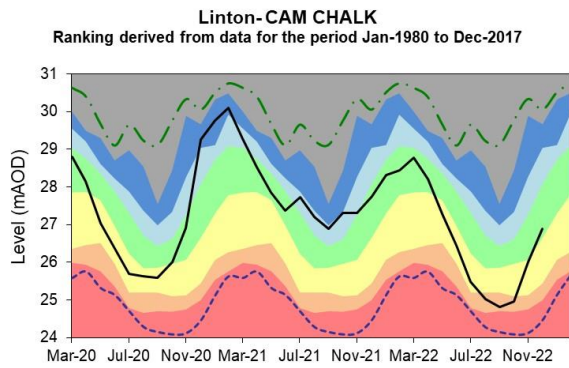
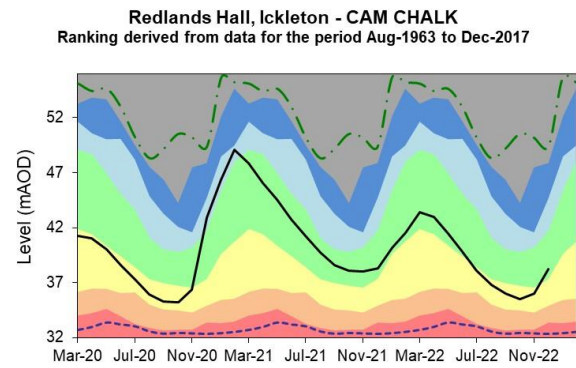
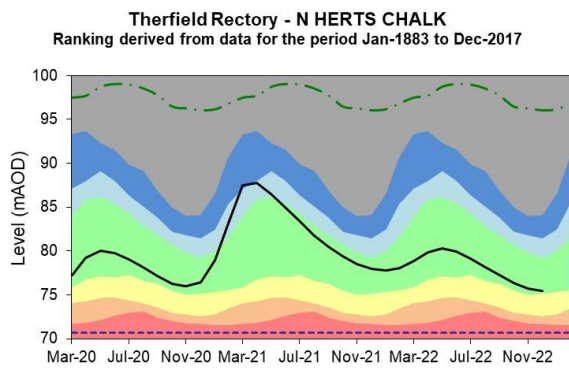
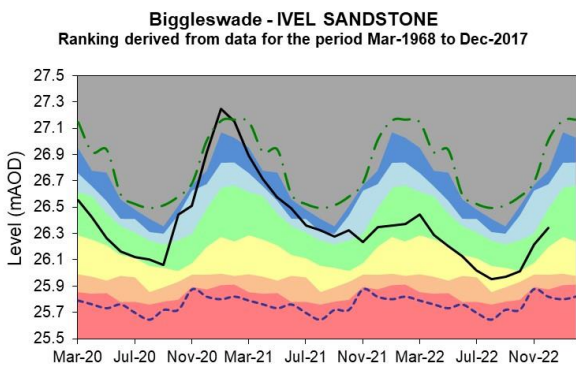
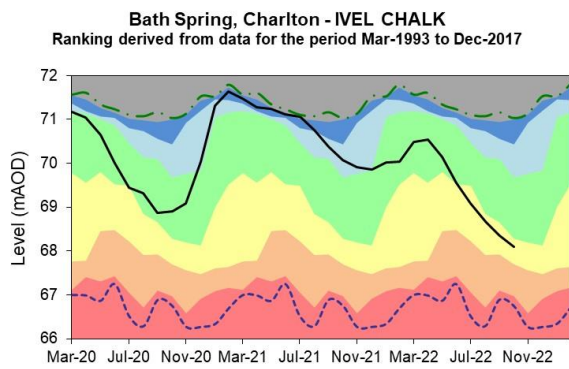
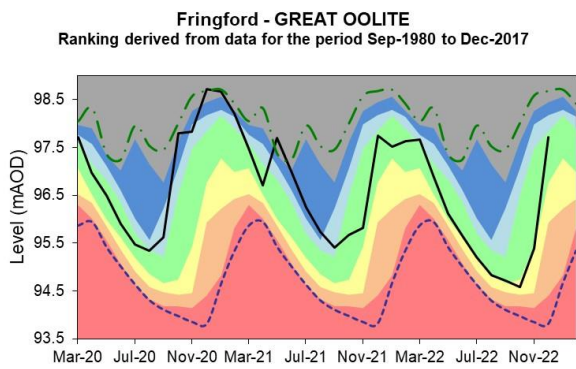
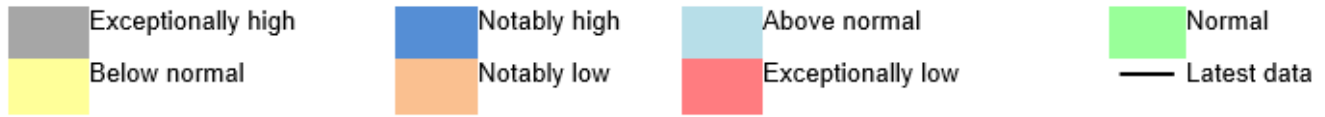
Figure 5.1: Groundwater levels for indicator sites at the end of December 2022, classed relative to an analysis of respective historic December levels. Table available in the appendices with detailed information.



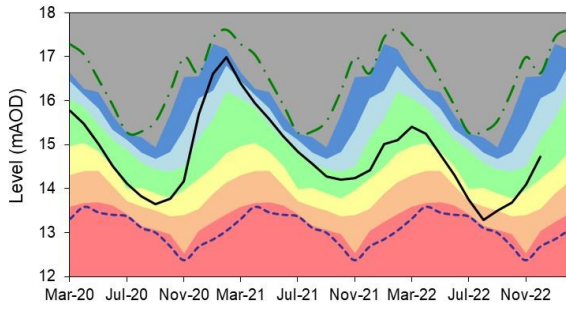
(Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS copyright NERC. Crown copyright. All rights reserved. Environment Agency, 100024198, 2023.

## 5.2 Groundwater level charts

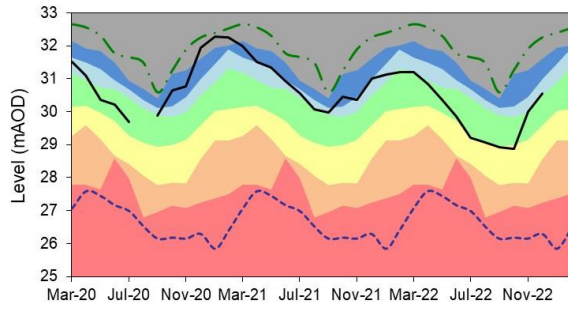
Figure 5.2: End of month groundwater levels at index groundwater level sites for major aquifers. 22 months compared to an analysis of historic end of month levels and long term maximum and minimum levels.



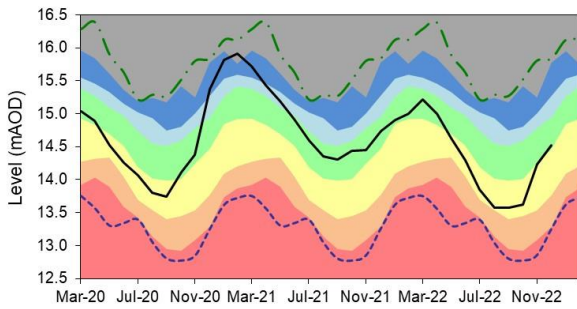
**Gog Magog, Stapleford - CAM CHALK**  
Ranking derived from data for the period Jan-1980 to Dec-2017



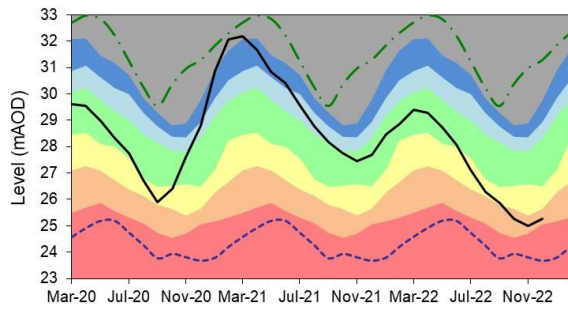
**Bury St Edmunds - UPPER LARK CHALK**  
Ranking derived from data for the period May-1983 to Dec-2017



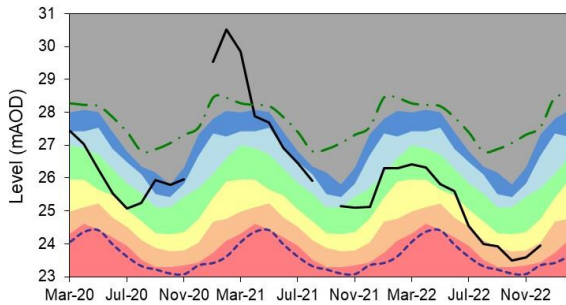
**Newmarket - SNAIL CHALK**  
Ranking derived from data for the period Feb-1983 to Dec-2017



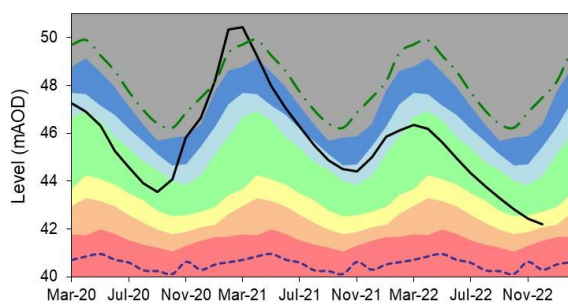
**Kenninghall - LITTLE OUSE CHALK**  
Ranking derived from data for the period Aug-1973 to Dec-2017



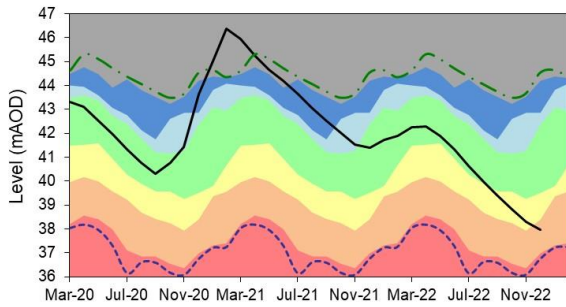
**Breckland - WISSEY CHALK**  
Ranking derived from data for the period Jan-1971 to Nov-2017



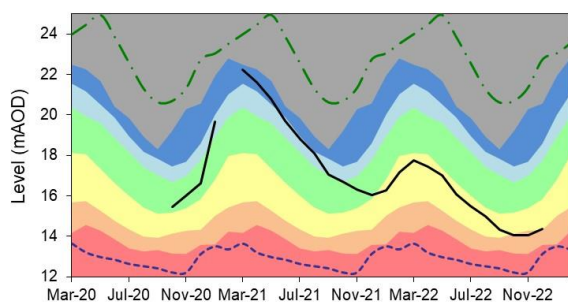
**Washpit Farm, Rougham - NW NORFOLK CHALK**  
Ranking derived from data for the period May-1950 to Dec-2017



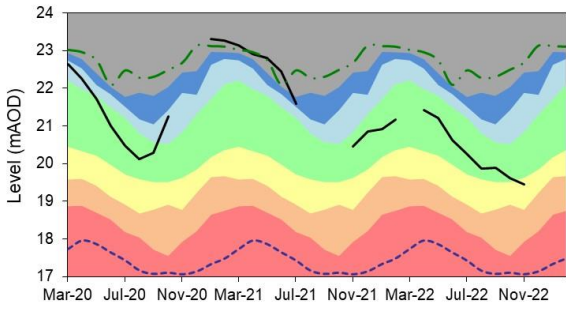
**Bircham Newton - NW NORFOLK CHALK**  
Ranking derived from data for the period Mar-1995 to Sep-2017



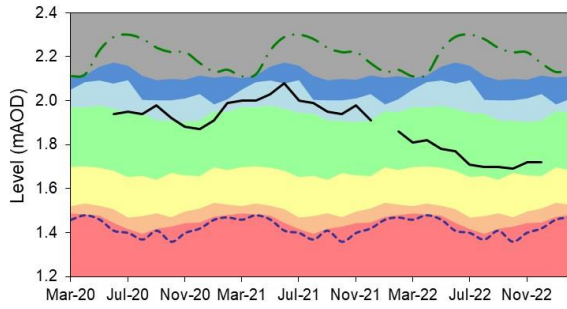
**Castle Farm, Offton - MID SUFFOLK CHALK**  
Ranking derived from data for the period Mar-1967 to Dec-2017



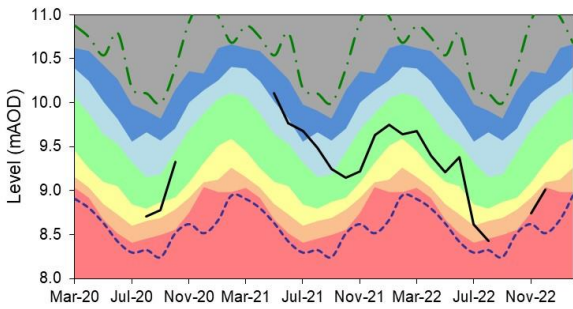
**Old Primary School, South Creake, NORFOLK CHALK**  
 Ranking derived from data for the period Oct-1971 to Dec-2017



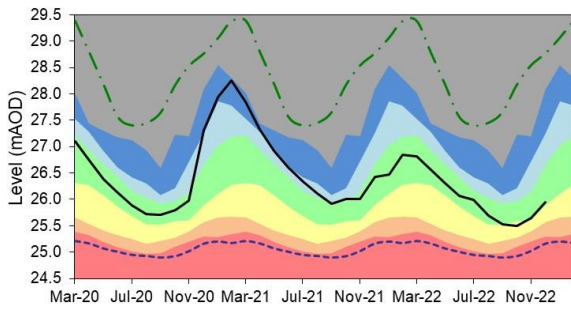
**Hazlewood Common - SUFFOLK CRAG**  
 Ranking derived from data for the period Oct-1988 to Feb-2020



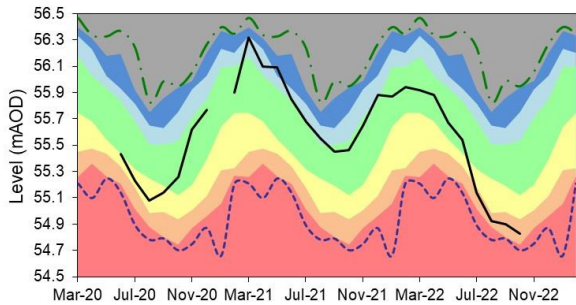
**The Spinney, Costessey- WENSUM CHALK**  
 Ranking derived from data for the period Oct-1971 to Dec-2017



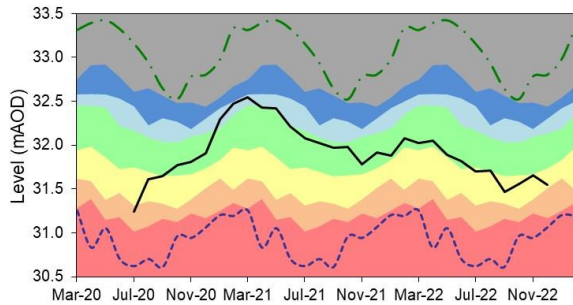
**Smeetham Hall Cottages, Bulmer - ESSEX CHALK**  
 Ranking derived from data for the period Jan-1964 to Dec-2017



**Hindolveston - NORFOLK CHALK**  
 Ranking derived from data for the period Sep-1984 to Nov-2017



**Rook Hall, Braiseworth- SUFFOLK CHALK**  
 Ranking derived from data for the period Jan-1980 to Dec-2017

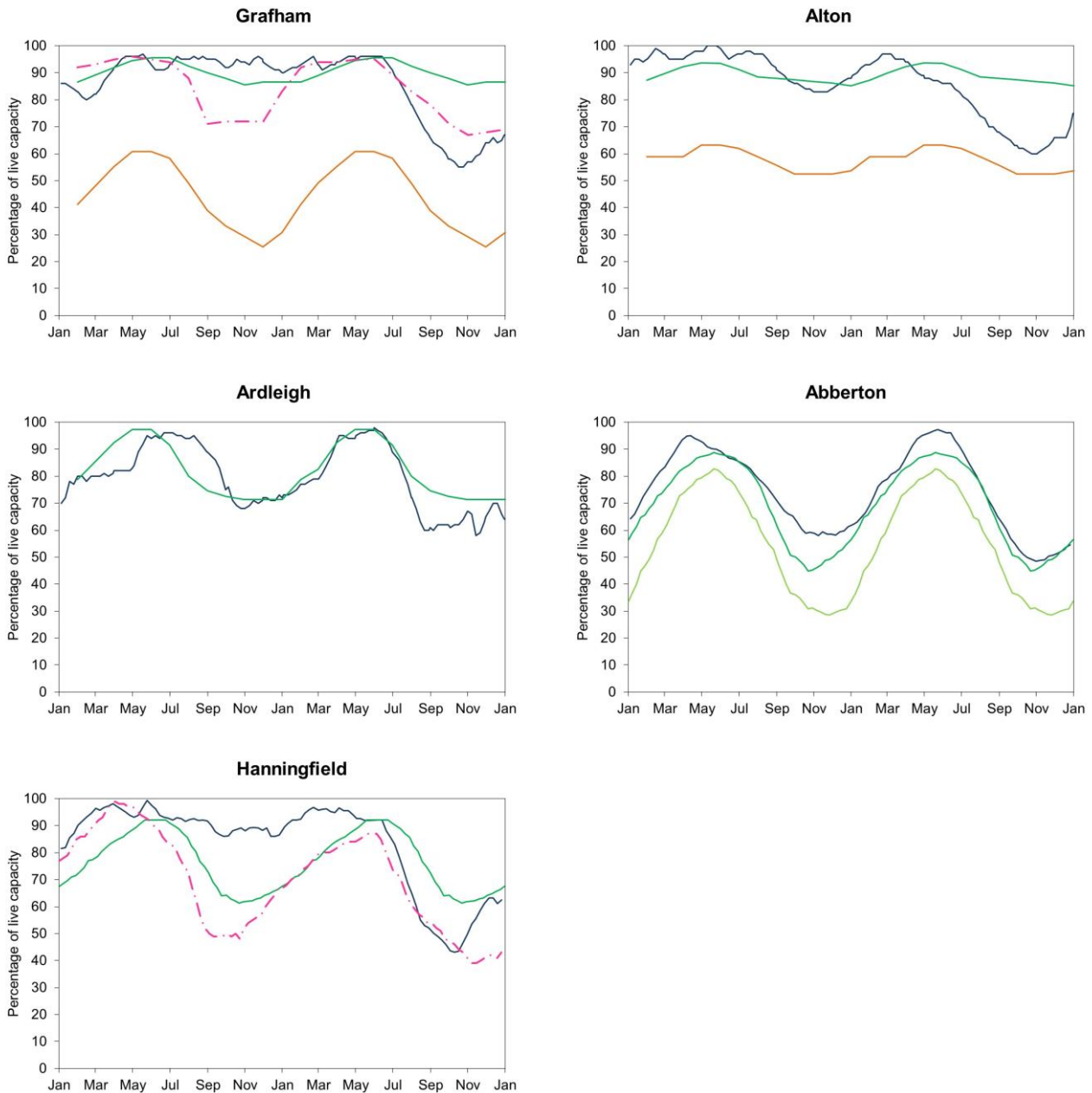


Source: Environment Agency, 2023.

## 6 Reservoir stocks

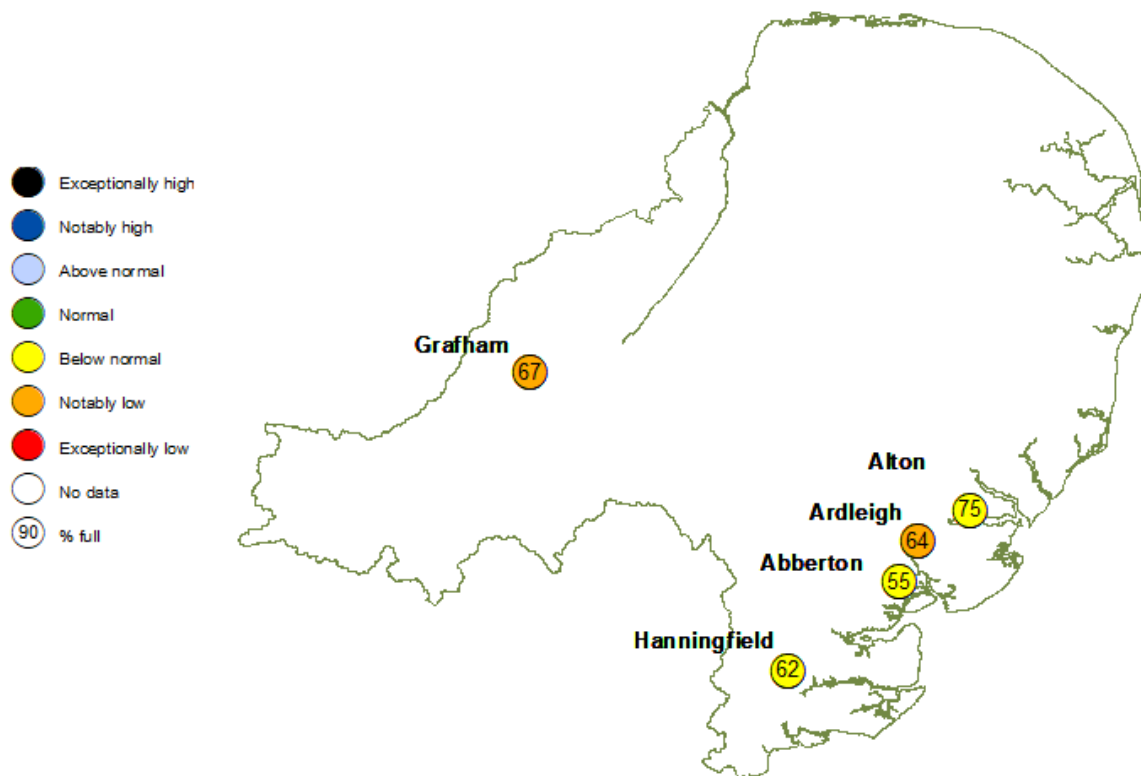
Figure 6.1: End of month regional reservoir stocks compared to the normal operating curve, drought curve and dry 1995-1996 stocks. Note: Historic records of individual reservoirs and reservoir groups making up the regional values vary in length.

— 2021-2022 — Normal Operating Curve — Drought Alert Curve - - 1995-1996



(Source: water companies).

## 6.1 Reservoir Stocks Map

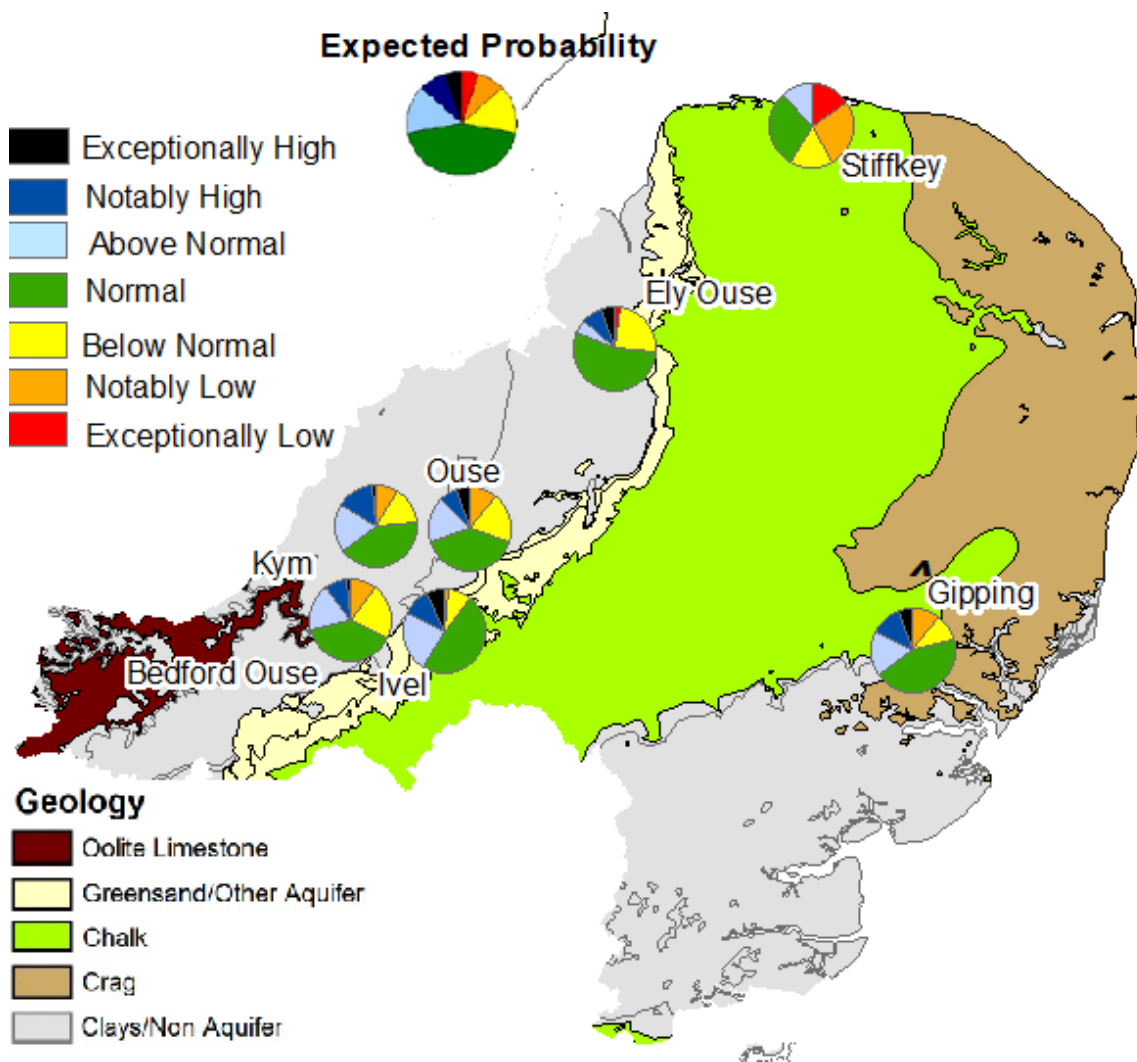


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## 7 Forward Look

### 7.1 Forward Look – Probabilistic ensemble projection of river flows at key sites in March 2023

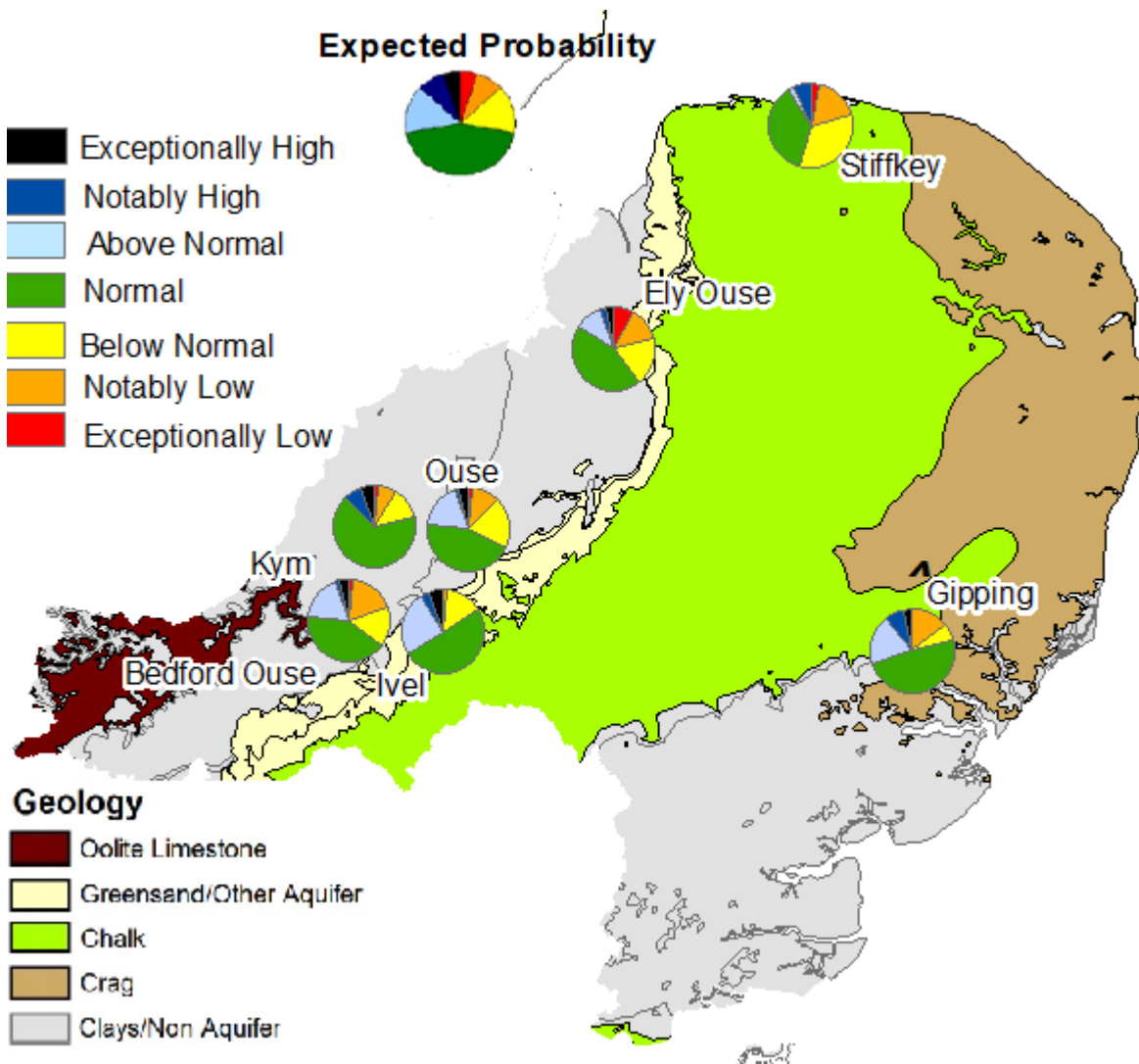
Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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



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) Geological map reproduced with kind permission from UK Groundwater Forum, BGS © NERC. Crown copyright. All rights reserved. Environment Agency, 100026380, 2023.

## 7.2 Forward Look – Probabilistic ensemble projection of river flows at key sites in June 2023

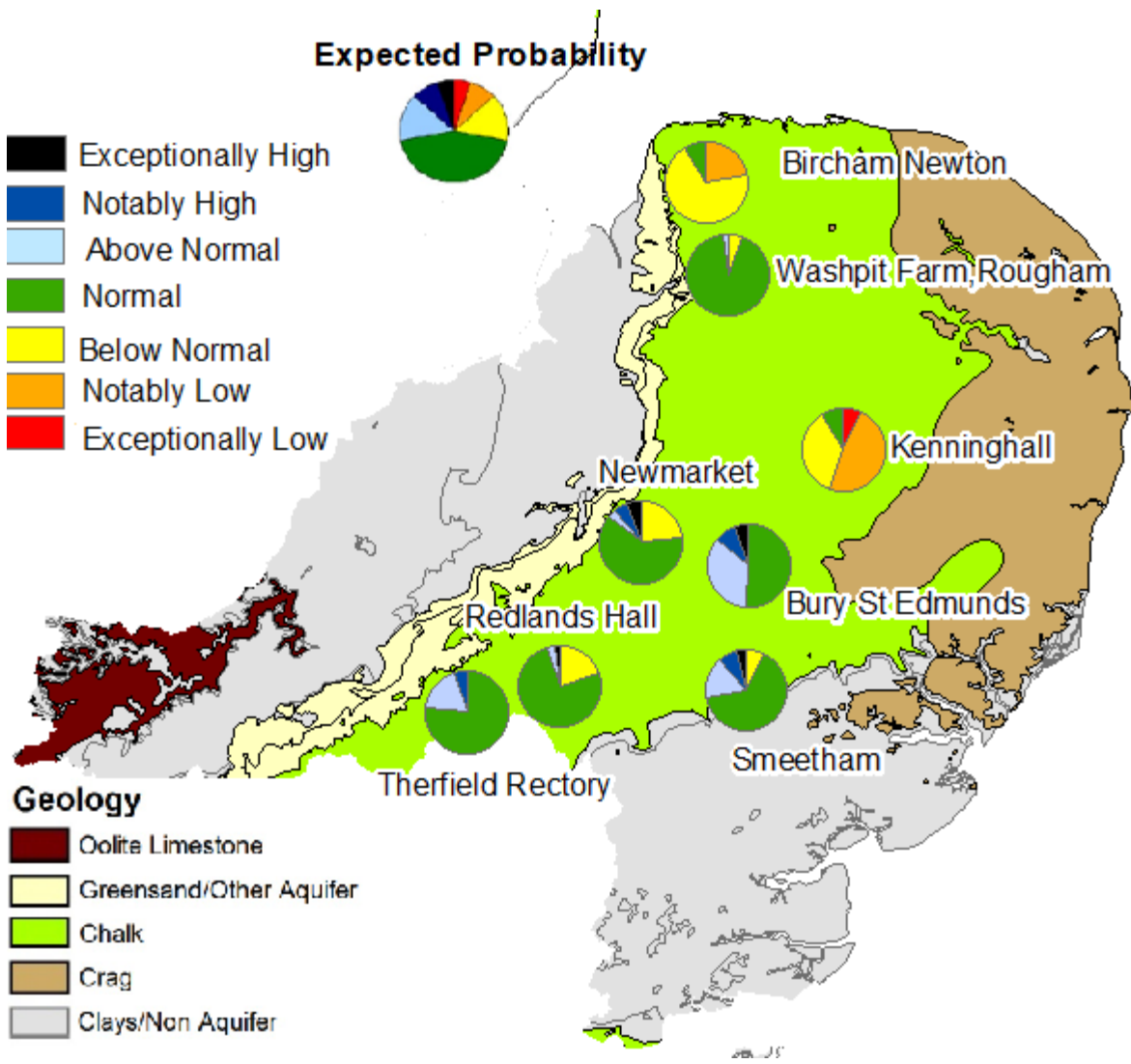
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### 7.3 Forward Look – Probabilistic ensemble projection of groundwater levels at key sites in March 2023

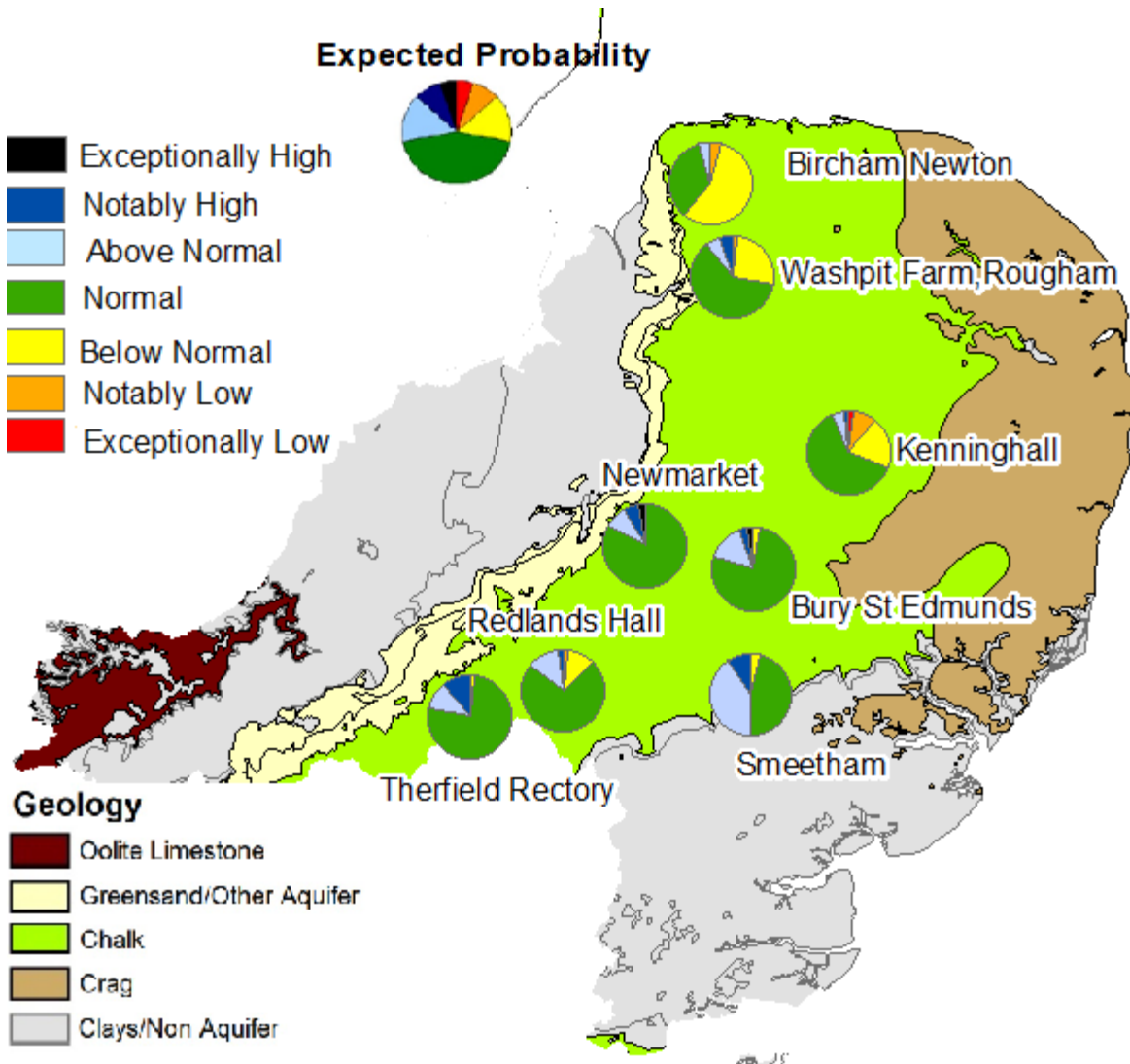
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## 7.4 Forward Look – Probabilistic ensemble projection of groundwater levels at key sites in September 2023

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.



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, 2023

## 8 Glossary

### 8.1 Terminology

#### **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 ( $\text{m}^3\text{s}^{-1}$ ).

#### **Effective rainfall**

The rainfall available to percolate into the soil or produce river flow. Expressed in depth of water (mm).

#### **Flood alert and 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, usually based on the period 1961 to 1990. However, the period used may vary by parameter being reported on (see figure captions for details).

### **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 by 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 (for example, 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).

## 8.2 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.

## 9 Appendices

### 9.1 Rainfall table

Hydrological area	Dec 2022 rainfall % of long term average 1961 to 1990	Dec 2022 band	Oct 2022 to December cumulative band	Jul 2022 to December cumulative band	Jan 2022 to December cumulative band
Broadland Rivers	104	Normal	Above normal	Normal	Exceptionally low
Cam	91	Normal	Notably high	Normal	Below normal
Central Area Fenland	85	Normal	Above normal	Below normal	Below normal
East Suffolk	96	Normal	Above normal	Below normal	Notably low
Little Ouse And Lark	86	Normal	Above normal	Below normal	Notably low
Lower Bedford Ouse	92	Normal	Notably high	Normal	Normal
North Essex	96	Normal	Above normal	Normal	Below normal
North Norfolk	103	Normal	Normal	Normal	Notably low
Nw Norfolk And Wissey	95	Normal	Normal	Below normal	Notably low
South Essex	103	Normal	Notably high	Normal	Notably low

Upper Bedford Ouse	99	Normal	Notably high	Normal	Normal
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## 9.2 River flows table

Site name	River	Catchment	Dec 2022 band	Nov 2022 band
Abbey Heath	Little Ouse	Little Ouse	Notably low	Notably low
Blunham	Ivel	Ivel	Normal	Normal
Bramford	Gipping	Gipping	Below normal	Normal
Burnham Overy	Burn	Burn	Below normal	Below normal
Burnt Mill	Rhee	Rhee	Normal	Normal
Cappenhams	Tove	Tove	Normal	Normal
Colney	Yare	Yare	Below normal	Normal
Denver	Ely Ouse	Cutoff and Renew Channel	Below normal	Normal
Dernford	Cam	Cam	Below normal	Normal
Heacham	Heacham	Heacham	Exceptionally low	Below normal
Ingworth	Bure	Bure	Below normal	Below normal
Lexden	Colne	Colne Essex	Normal	Above normal
Marham	Nar	Nar	Below normal	Below normal
Needham Weir Total	Waveney (lower)	Waveney	Below normal	Below normal

Northwold Total	Wissey	Wissey	Below normal	Normal
Offord (gross Flows)	Great Ouse	Ouse Beds	Normal	Normal
Roxton	Great Ouse	Ivel	Normal	Normal
Springfield	Chelmer	Chelmer Upper	Normal	Above normal
Swanton Morley Total	Wensum	Wensum	Below normal	Normal
Temple	Lark	Lark	Normal	Normal
Willen	Ouzel	Ouzel	Normal	Normal

### 9.3 Groundwater table

Site name	Aquifer	End of Dec 2022 band	End of Nov 2022 band
Bath Spring, Charlton	Upper Ivel Chalk	No Data	No Data
Biggleswade	Ivel Woburn Sands	Normal	Normal
Bircham Newton	North West Norfolk Chalk	Notably low	Below normal
Breckland	Wissey Chalk	Notably low	Notably low
Bury St Edmunds	Upper Lark Chalk	Above normal	Above normal
Castle Farm, Offton	East Suffolk Chalk	Below normal	Notably low
Gog Magog, Stapleford	Cam Chalk	Normal	Normal
Hazlewood Common	East Suffolk Crag	Normal	Normal
Hindolveston	Norfolk Chalk	Notably low	No Data
Kenninghall	Little Ouse Chalk	Notably low	Notably low
Linton	Cam Chalk	Normal	Below normal
Newmarket	Snail Chalk	Normal	Below normal

Old Primary School, South Creake	North Norfolk Chalk	No Data	Below normal
Redlands Hall, Ickleton	Cam Chalk	Normal	Below normal
Rook Hall, Braiseworth	East Suffolk Chalk	Below normal	Below normal
Smeetham Hall Cottages, Bulmer	North Essex Chalk	Normal	Normal
The Spinney, Costessey	Wensum Chalk	Exceptionally low	Exceptionally low
Washpit Farm, Rougham	North West Norfolk Chalk	Below normal	Below normal
Therfield Rectory	Upper Lee Chalk	Normal	Normal
Fringford P.s.	Upper Bedford Ouse Oolitic Limestone (great)	Normal	Below normal

## 9.4 Ensemble Projections Tables

### 9.4.1 Probabilistic ensemble projection of river flows at key sites in March 2023

Percentage of pie chart for each band

Site	Bedford Ouse	Kym	Ivel	Ouse	Ely Ouse	Stiffkey	Gipping
Exceptionally Low	0.0	0.0	0.0	0.0	2.6	15.8	0.0
Notably Low	10.7	8.9	1.8	10.7	0.0	26.3	10.5
Below Normal	21.4	14.3	8.9	19.6	23.7	15.8	10.5
Normal	39.3	41.1	48.2	39.3	55.3	29.8	43.9
Above Normal	17.9	19.6	23.2	17.9	5.3	12.3	17.5
Notably High	8.9	14.3	10.7	7.1	7.9	0.0	12.3
Exceptionally High	1.8	1.8	7.1	5.4	5.3	0.0	5.3

### .9.4.2 Probabilistic ensemble projection of river flows at key sites in June 2023

Percentage of pie chart for each band

Site	Bedford Ouse	Kym	Ivel	Ouse	Ely Ouse	Stiffkey	Gipping
Exceptionally Low	1.8	1.8	0.0	1.8	7.9	3.5	0.0
Notably Low	17.9	7.1	1.8	10.7	13.2	17.5	14.0
Below Normal	16.1	12.5	14.3	19.6	18.4	33.3	7.0
Normal	41.1	66.1	50.0	44.6	44.7	36.8	49.1
Above Normal	17.9	0.0	25.0	17.9	10.5	1.8	19.3
Notably High	1.8	7.1	3.6	1.8	2.6	7.0	7.0
Exceptionally High	3.6	5.4	5.4	3.6	2.6	0.0	3.5

### .9.4.3 Probabilistic ensemble projection of river flows at key sites in March 2023

Percentage of pie chart for each band

Site	Therfie Id Rector y	Redlan ds Hall	Newmar ket	Wash pit Farm	Bircha m Newto n	Kenning hall	Bury St Edmun ds	Smeeth am
Exceptionally low	0.0	0.0	0.0	0.0	0.0	6.7	0.0	0.0
Notably low	0.0	0.0	0.0	0.0	21.7	48.9	0.0	0.0
Below normal	0.0	20.0	22.9	5.3	69.6	35.6	0.0	7.4
Normal	76.8	74.5	62.9	93.0	8.7	8.9	51.4	64.8
Above normal	17.9	3.6	2.9	1.8	0.0	0.0	34.3	16.7
Notably high	5.4	0.0	5.7	0.0	0.0	0.0	8.6	7.4
Exceptionally high	0.0	1.8	5.7	0.0	0.0	0.0	5.7	3.7

#### .9.4.4 Probabilistic ensemble projection of river flows at key sites in September 2023

Percentage of pie chart for each band

Site	Therfie Id Rector y	Redlan ds Hall	Newmar ket	Wash pit Farm	Bircha m Newto n	Kenning hall	Bury St Edmun ds	Smeeth am
Exceptionally low	0.0	0.0	0.0	0.0	0.0	2.2	0.0	0.0
Notably low	0.0	1.8	0.0	1.8	4.3	8.9	0.0	0.0
Below normal	1.8	10.9	0.0	26.3	56.5	20.0	2.9	3.7
Normal	76.8	72.7	83.3	61.4	34.8	62.2	77.1	46.3
Above normal	10.7	12.7	8.3	5.3	4.3	4.4	14.3	40.7
Notably high	10.7	1.8	5.6	5.3	0.0	2.2	2.9	9.3
Exceptionally high	0.0	0.0	2.8	0.0	0.0	0.0	2.9	0.0