Monthly water situation report: East Anglia

1 Summary - March 2023

Overall, March was a very wet month which exceptionally high levels of rainfall across most hydrological areas. In most hydrological areas, March 2023 rainfall ranked in the top five wettest on record, with most getting more than double the amount of the LTA rainfall. Longer term rainfall continues to show a north/east to south/west split, with the south and west getting more than the north and east. As a result of this Heavy rainfall, SMD levels have decreased across the area and now back to normal levels for the time of year. Furthermore, river flows improved at all sites during March with the majority now being at normal levels or higher. There is a few indicator sites in the northeast of the area still at lower than normal levels, which are in line with the longer term rainfall patterns. The majority of groundwater indicator sites showed recharge during March (varying levels) and as a result most are now at normal levels or higher. Again, like river indicator sites, there is a few sites in the northeast of the area at less than normal levels, ranging from exceptionally low to below normal. Finally, reservoir levels improved at most sites, with most now being at or above their operational curve.

1.1 Rainfall

Overall, March was a very wet month, with rainfall varying between 163% to 256% of the LTA rainfall. This meant that rainfall was classified as exceptionally high in all hydrological areas except North Norfolk where rainfall was classified as notably high. On average, the area received 99mm of rain, over double the LTA of 46mm. Furthermore, the majority of hydrological areas ranked in the top five wettest March's on record, with a few areas in the northeast ranking just outside the top five. Following the wet March, the 3-month total is now showing normal to above normal levels, with a north/east to south/west split, with the above normal levels being in the south and west of the region. The 6-month total shows rainfall ranging from normal to exceptionally high levels, with the lowest rainfall being seen in the northeast of the region. Finally, the 12-month total shows notably low to normal levels, again with a north/east to south/west split, with the notably low and below normal levels being in the north and west of the region.

1.2 Soil moisture deficit and recharge

Following an exceptionally dry February, SMD levels had been increasing across the area and was at above normal to notably high levels for the year. As a result of the exceptionally wet March, SMD levels have been decreasing throughout March and have ended the month at normal levels for the time of year (very nearly at below normal levels). In most of the region, SMD is now between 0mm to 10mm, with a few areas having SMD between 10mm and 20mm.

1.3 River flows

Following and exceptionally wet March, river flows have increased at all monitoring sites across the area since the February water situation report. As of the end of March, river flows at the monitoring sites varies between 28% to 255% of the LTA; meaning classification range from notably low to exceptionally high for the time of year. There are three sites at notably low to below normal levels, these are all found in the northeast of the region where both March's rain and longer term rain has been less than the other areas of the region. For the remaining 18 sites, 7 are at normal levels, 6 at above normal levels, 4 at notably high levels and one at exceptional high levels. The majority of normal levels are seen in the north/east of the region with the higher flows mostly being found in the south and west of the region (following pattern of longer term rainfall.

1.4 Groundwater levels

Following the exceptionally wet March, the vast majority of groundwater sites have shown recharge during March, although at varying levels. There is a handful of sites that didn't show recharge during March, this is likely a delayed impact of the dry February and the impact of March's rainfall will be seen during April. The groundwater classifications show a real mixed bag with classifications ranging from exceptionally to exceptionally high for the time of year. As of the end of March, 1 site is exceptionally low levels, 1 is notably low levels, 4 are at below normal levels, 7 are at normal levels, 2 are at above normal levels, 1 at notably high levels and 1 at exceptionally high levels. The groundwater levels seen follow the long term rainfall patterns with lowest classification generally being seen in the north and east and the higher levels being seen in the south and west.

1.5 Reservoir stocks

As a result of the wet March and increasing river levels during the month, reservoir stocks have substantially improved at most sites, with most now being at or above their operational curve. The only exception is Grafham, where levels didn't really improve during March and the reservoir remains below the normal operational curve.

1.6 Environmental impact

During March, only 1 pump has been in operation in the area, this was at Dungate Farm on the Lodes Granta Support scheme. This pump was switch on in the latter half of the month, and remains in operation. All other pumps on the Lodes grant and all other schemes haven't been used during March. In March there was 42 flood alerts and 0 flood warnings in the East Anglia region.

1.7 Forward Look

.1.7.1 Probabilistic ensemble projections for river flows at key sites

June 2023: Most sites are showing an increased probability of normal flows. The Ivel is showing an increased probability of greater than normal flows whilst Stiffkey is showing a greatly increased probability of notably low flows.

September 2023: Bedford Ouse, Kym, Ouse and Ivel are all showing a reduced probability of lower than normal flows. Gipping is in line with the expected probability whilst both Ely Ouse and Stiffkey show an increased probability of lower than normal flows.

.1.7.2 Probabilistic ensemble projections for groundwater levels in key aquifers

September 2023: Most sites are showing an increased probability of normal levels. Smeetham is showing an increased probability of greater than normal levels whilst Bircham Newton is showing an increased probability of notably low levels.

March 2024: Most sites are in line with the expected probability. Therfield and Smeetham are both showing an increased probability of greater than normal levels whilst Bircham Newton is showing an increased probability of below normal levels.

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*[SMD]: soil moisture deficits

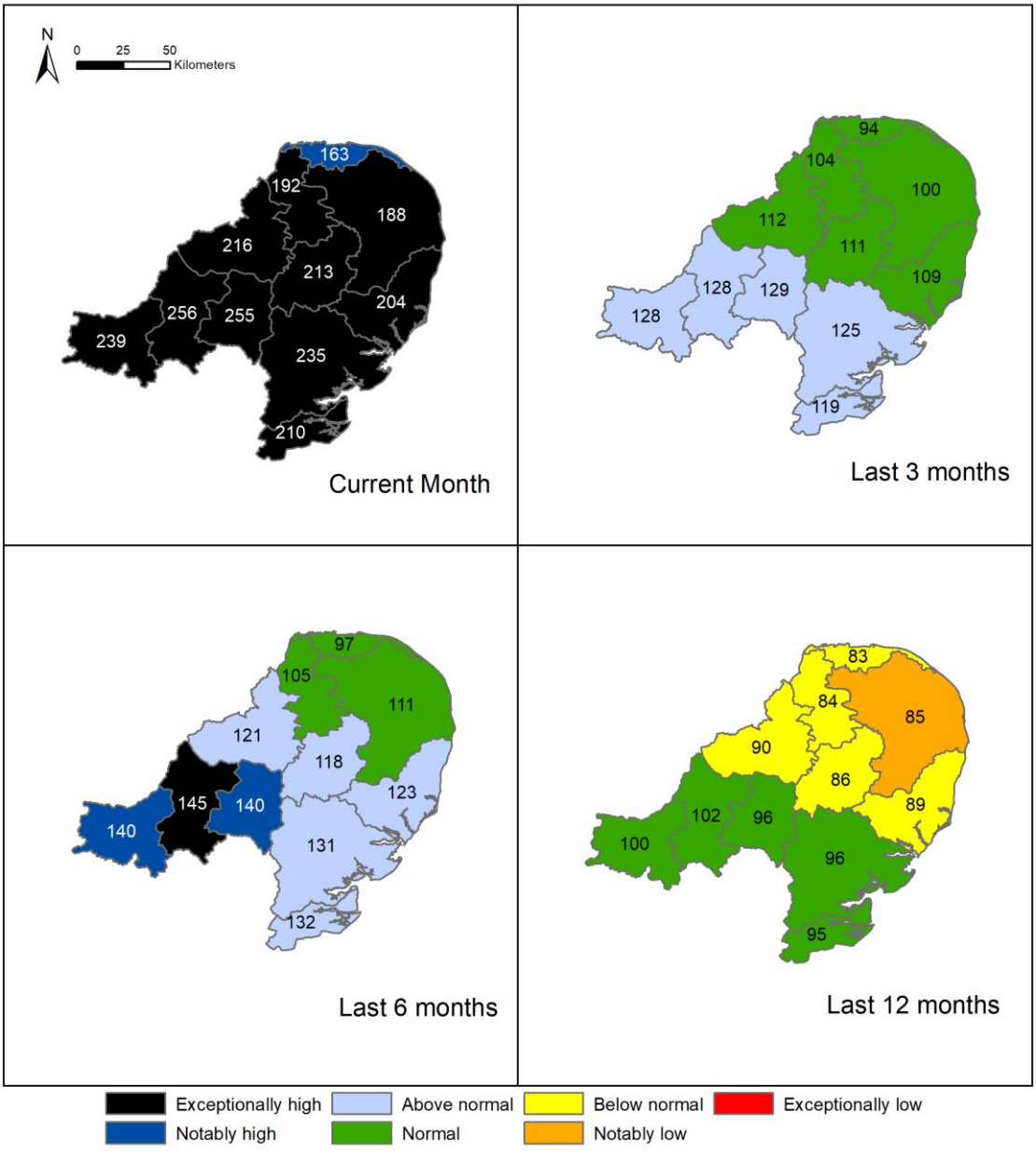
*[LTA]: long term average

Contact Details: 03708 506 506

2 Rainfall

2.1 Rainfall map

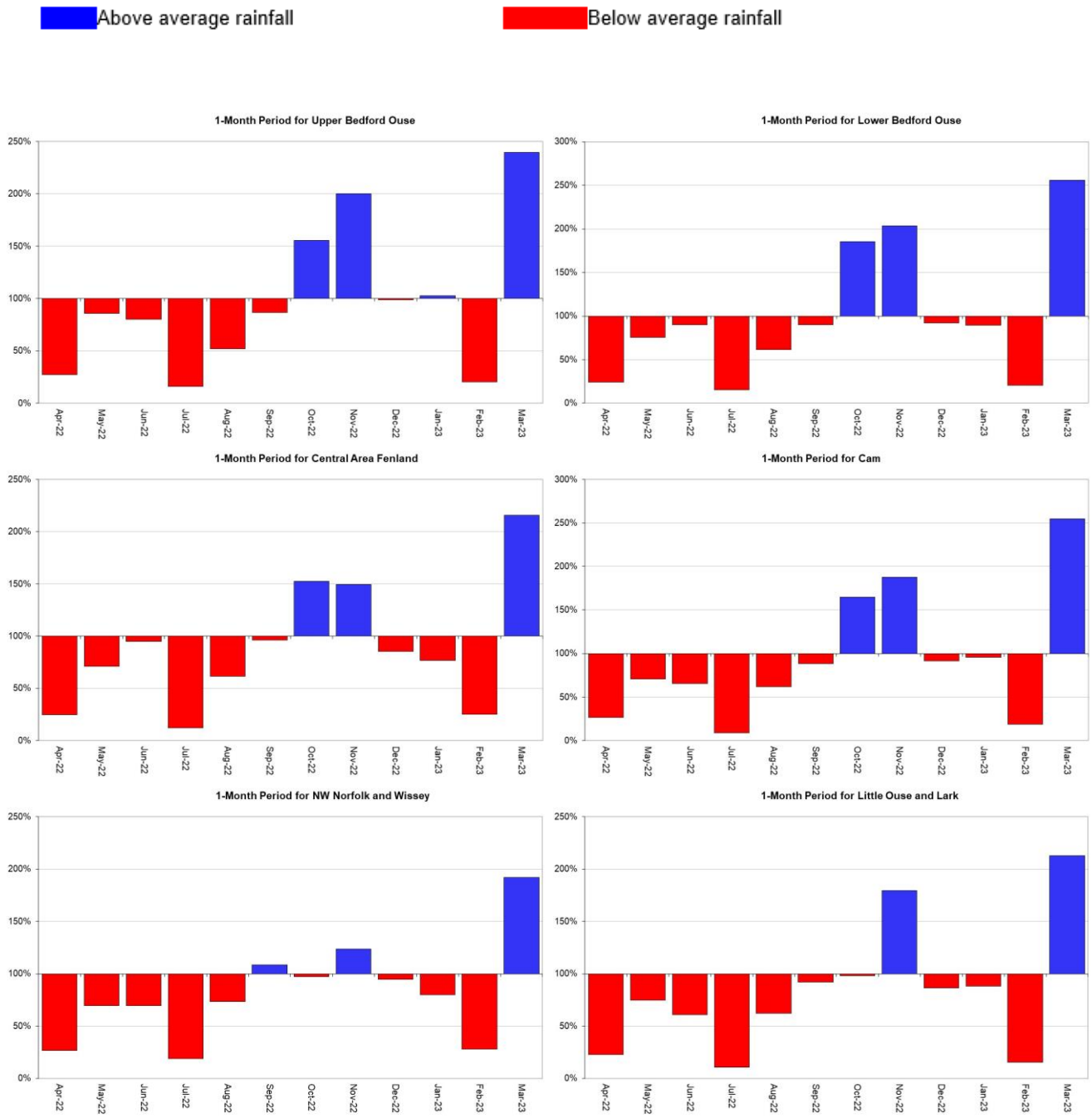
Figure 2.1: Total rainfall for hydrological areas across East Anglia, expressed as a percentage of long term average rainfall for the current month (up to 31 March 2023), the last 3 months, the last 6 months, and the last 12 months. Category classes are based on an analysis of respective historic totals. Table available in the appendices with detailed information.

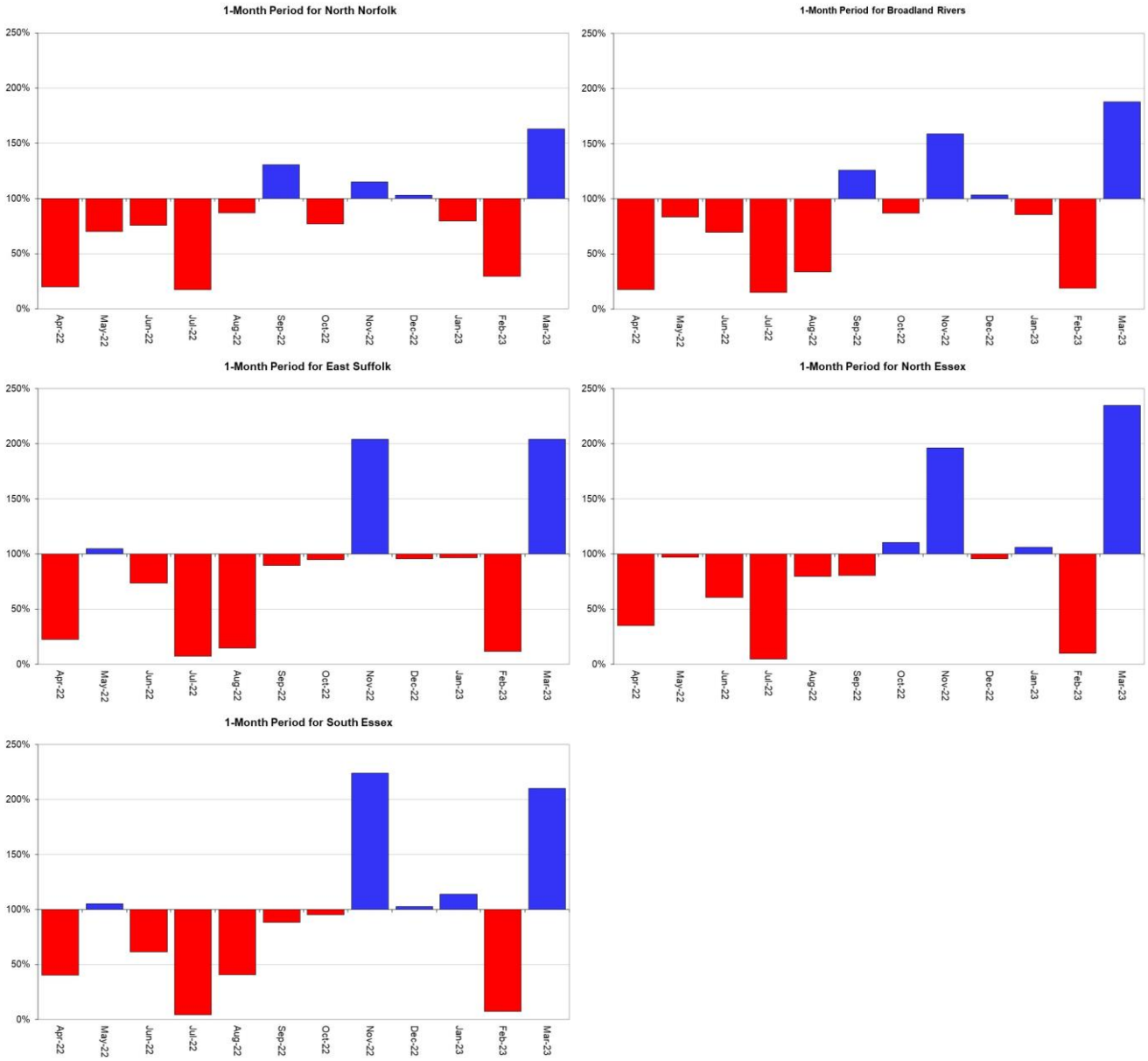


HadUK data based on the Met Office 1km gridded rainfall dataset derived from rain gauges (Source: Met Office. Crown copyright, 2023). Provisional data based on Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. Crown copyright. All rights reserved.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

2.2 Rainfall charts

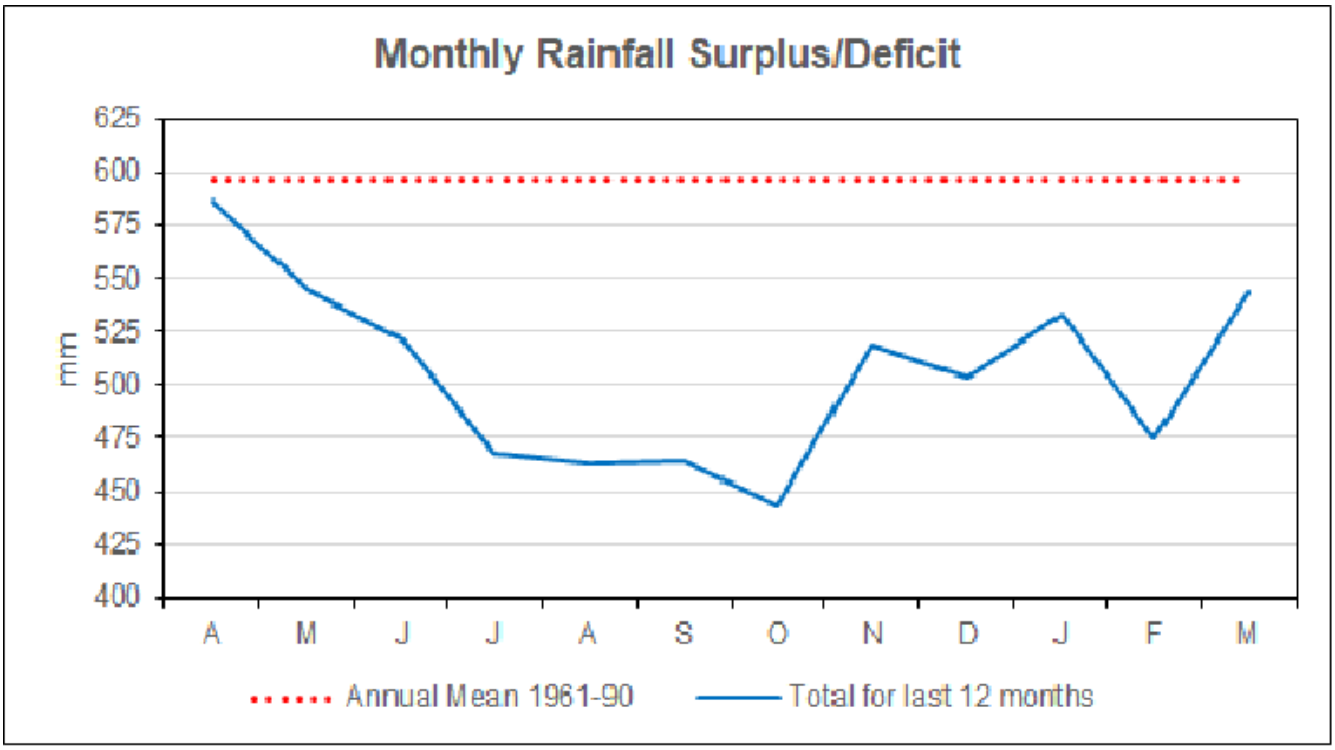
Figure 2.2: Monthly rainfall totals for the past 12 months as a percentage of the 1961 to 1990 long term average for each region and for England.





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

2.3 Monthly Rainfall Surplus Deficit Chart

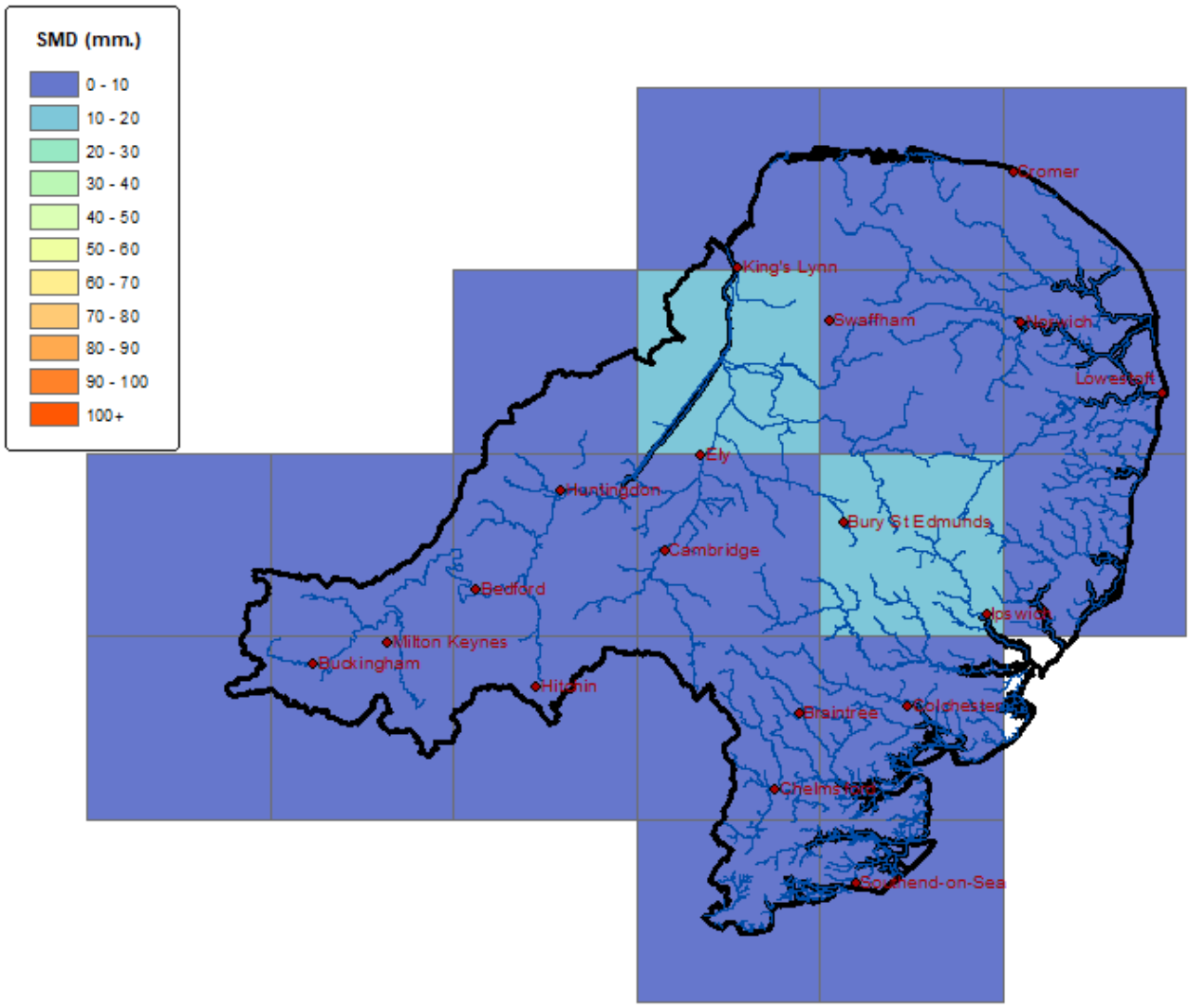


HadUK rainfall data. (Source: Met Office. Crown copyright, 2023).

3 Soil moisture deficit

3.1 Soil moisture deficit map

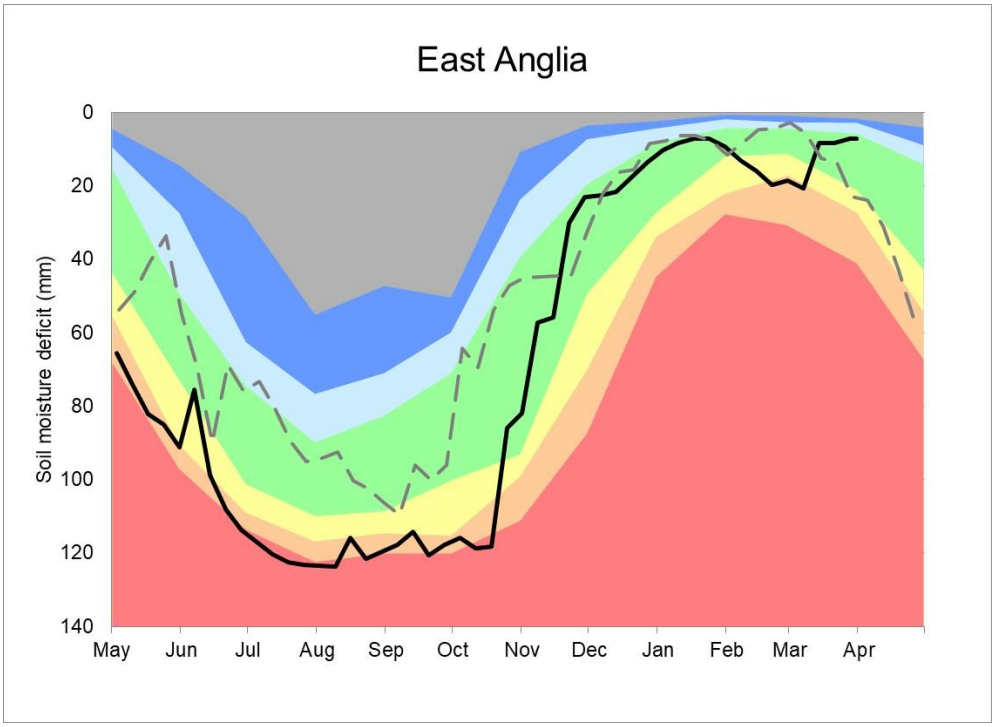
Figure 3.1: Soil moisture deficit values for 31 March 2023. Values based on the weekly MORECS data for real land use.



(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.

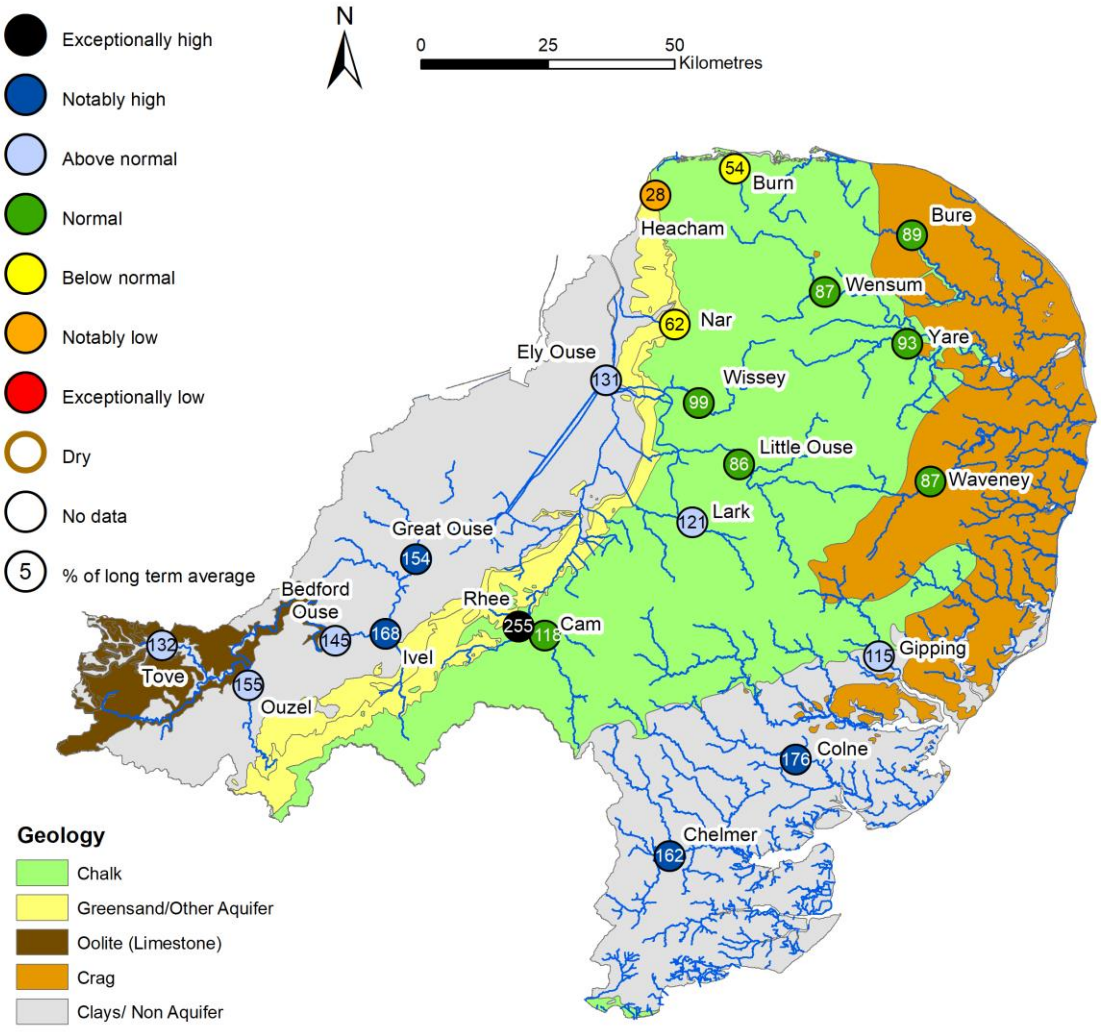


(Source: Met Office. Crown copyright, 2023). All rights reserved. Environment Agency, 100024198, 2023

4 River flows

4.1 River flows map

Figure 4.1: Monthly mean river flow for indicator sites for March 2023, expressed as a percentage of the respective long term average and classed relative to an analysis of historic March monthly means Table available in the appendices with detailed information.



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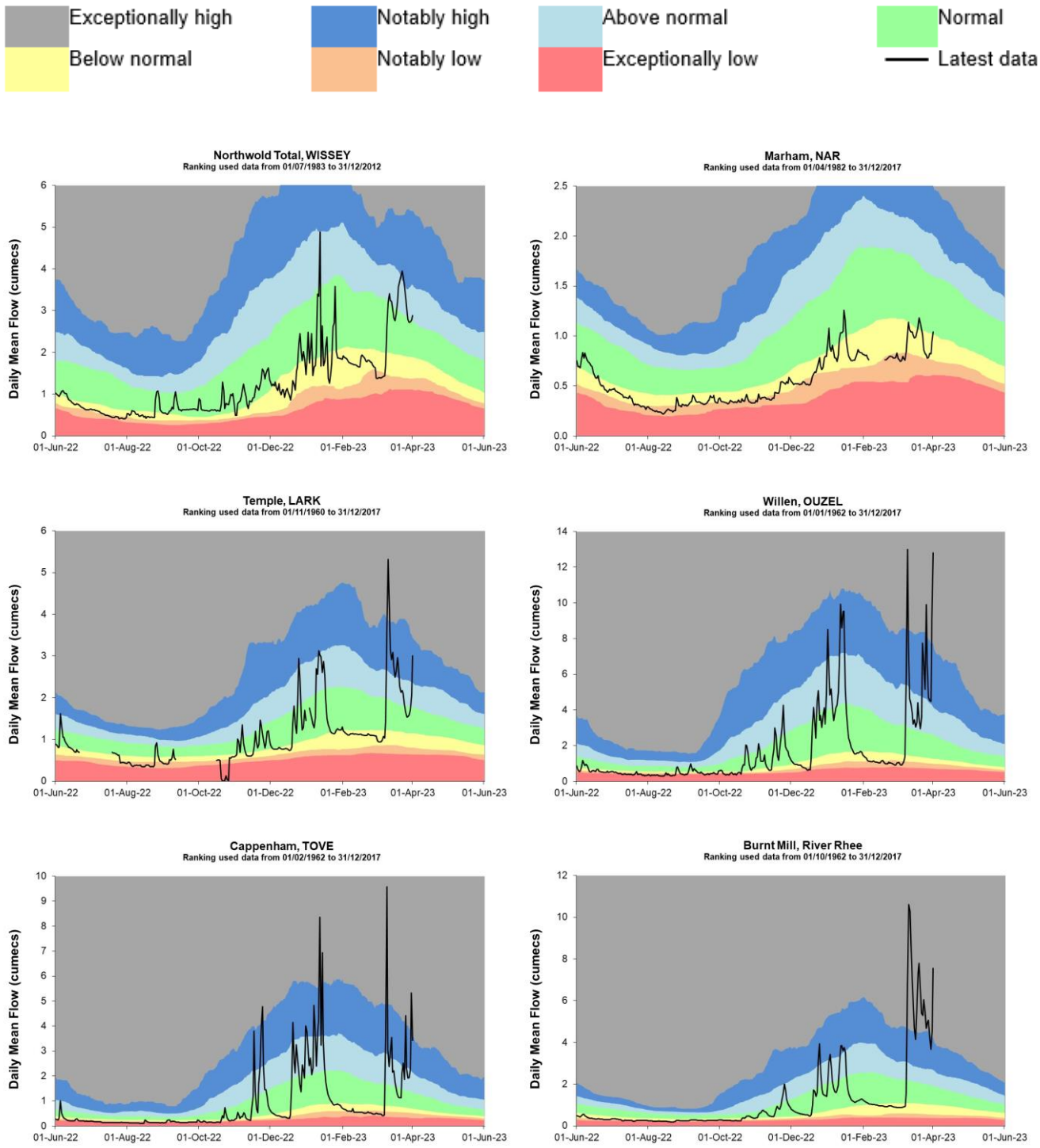
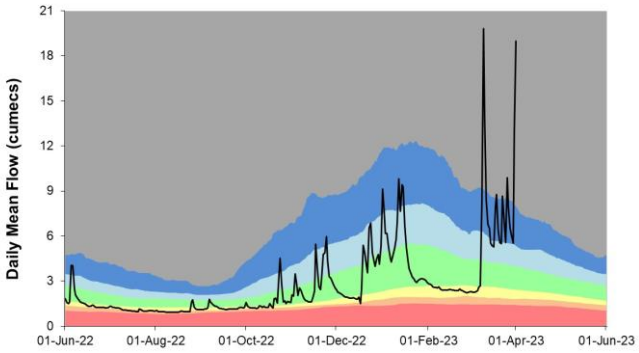
4.2 River flow charts

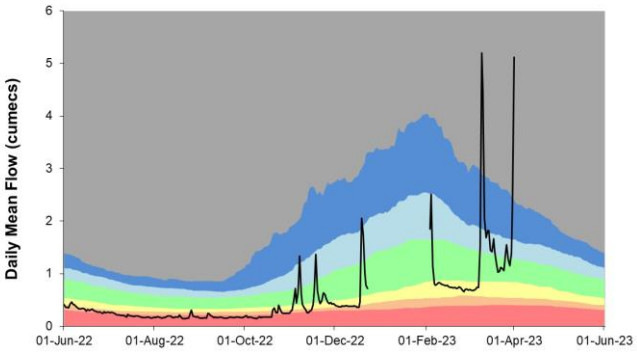
Figure 4.2: Daily mean river flow for index sites over the past year, compared to an analysis of historic daily mean flows, and long term maximum and minimum flows.



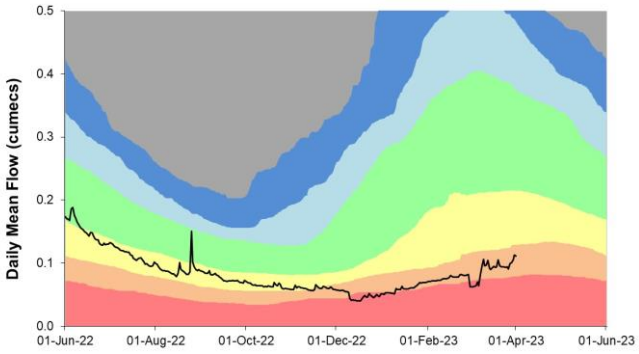
Blunham, River Ivel
Ranking used data from 01/08/1959 to 31/12/2017



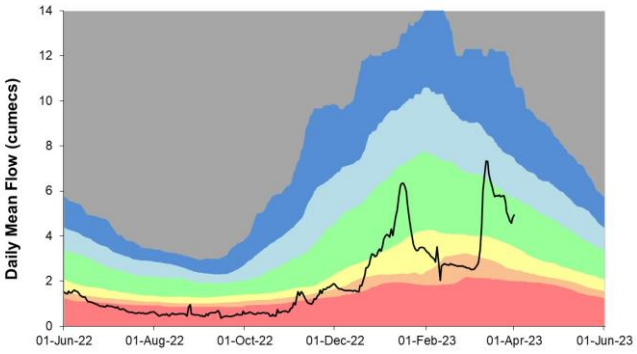
Dernford, CAM
Ranking used data from 21/02/1949 to 31/12/2017



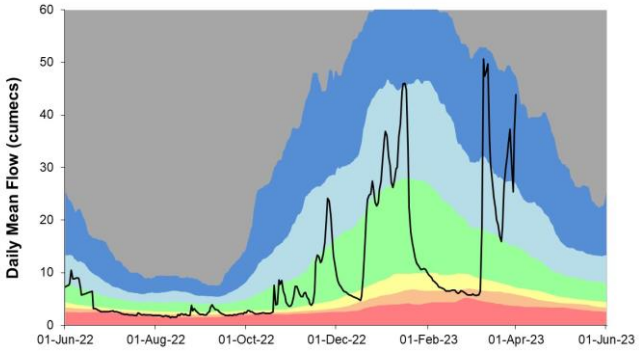
Heacham, HEACHAM
Ranking used data from 01/11/1965 to 31/12/2017



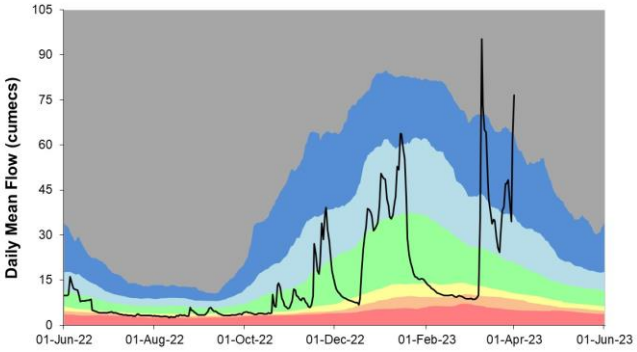
Abbey Heath, LITTLE OUSE
Ranking used data from 01/06/1968 to 31/12/2017



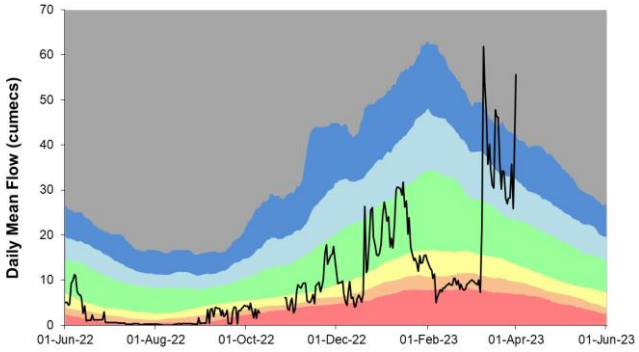
Roxton, GREAT OUSE
Ranking used data from 23/10/1972 to 31/12/2017



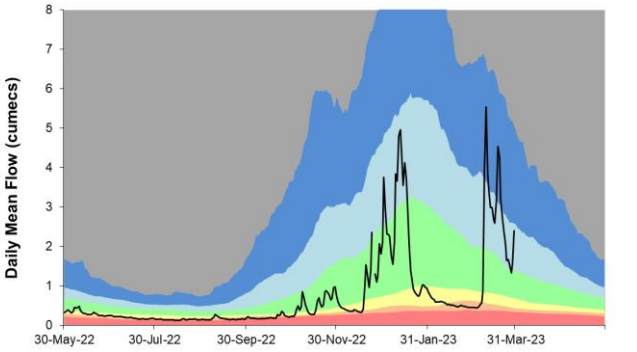
Offord (Gross flows), GREAT OUSE
Ranking used data from 01/01/1972 to 31/12/2017



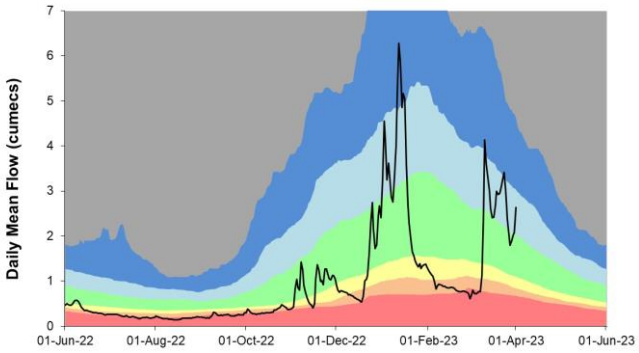
Denver, ELY OUSE
Ranking used data from 01/11/1971 to 31/12/2017



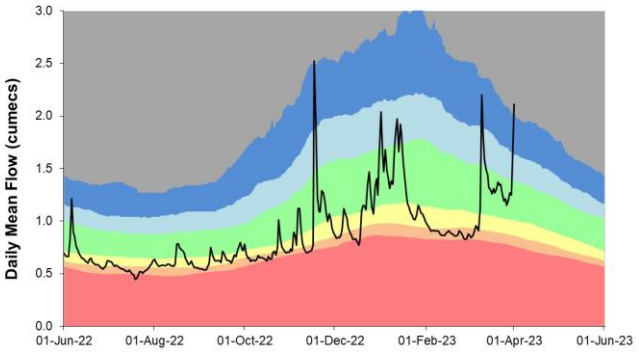
Bramford, Gipping
Ranking used data from 01/07/1969 to 31/12/2017



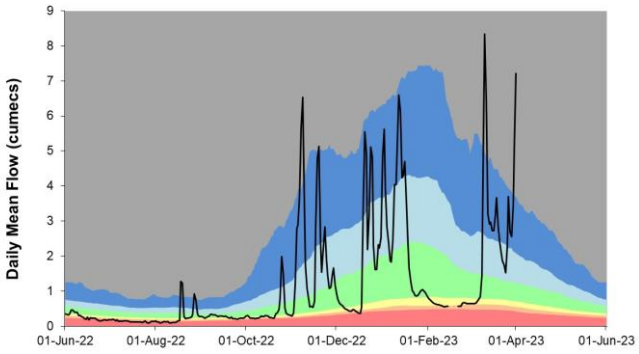
COLNEY, River Yare
Ranking used data from 01/01/1970 to 31/12/2017



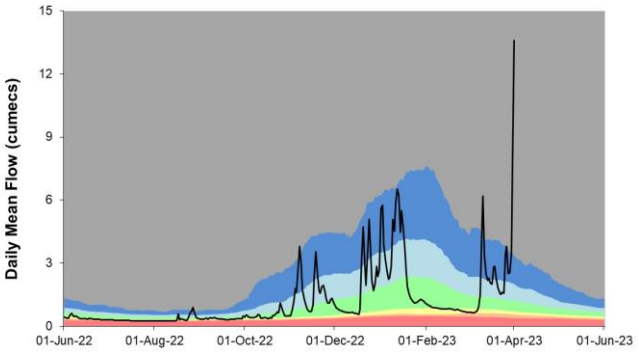
Ingworth, Bure
Ranking used data from 01/06/1959 to 31/12/2017



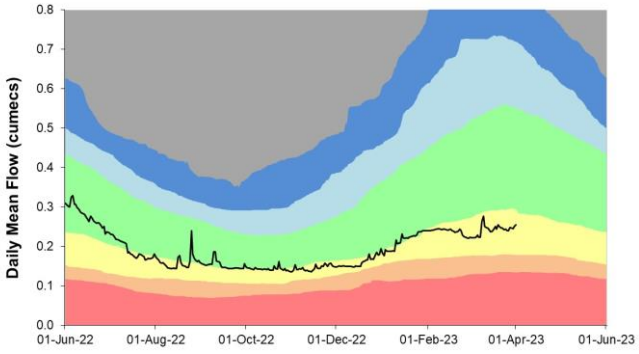
Lexden, Colne
Ranking used data from 01/10/1959 to 31/12/2017



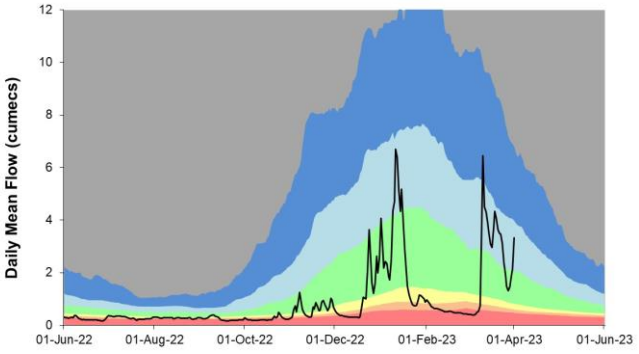
SPRINGFIELD, River Chelmer
Ranking used data from 01/01/1970 to 31/12/2017



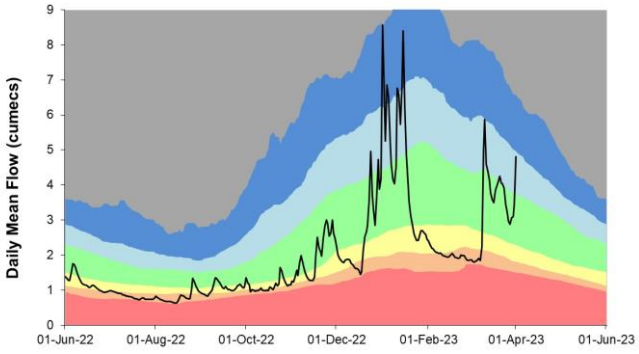
BURNHAM OVERY TOWN, River Burn
Ranking used data from 01/01/1970 to 31/12/2017



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

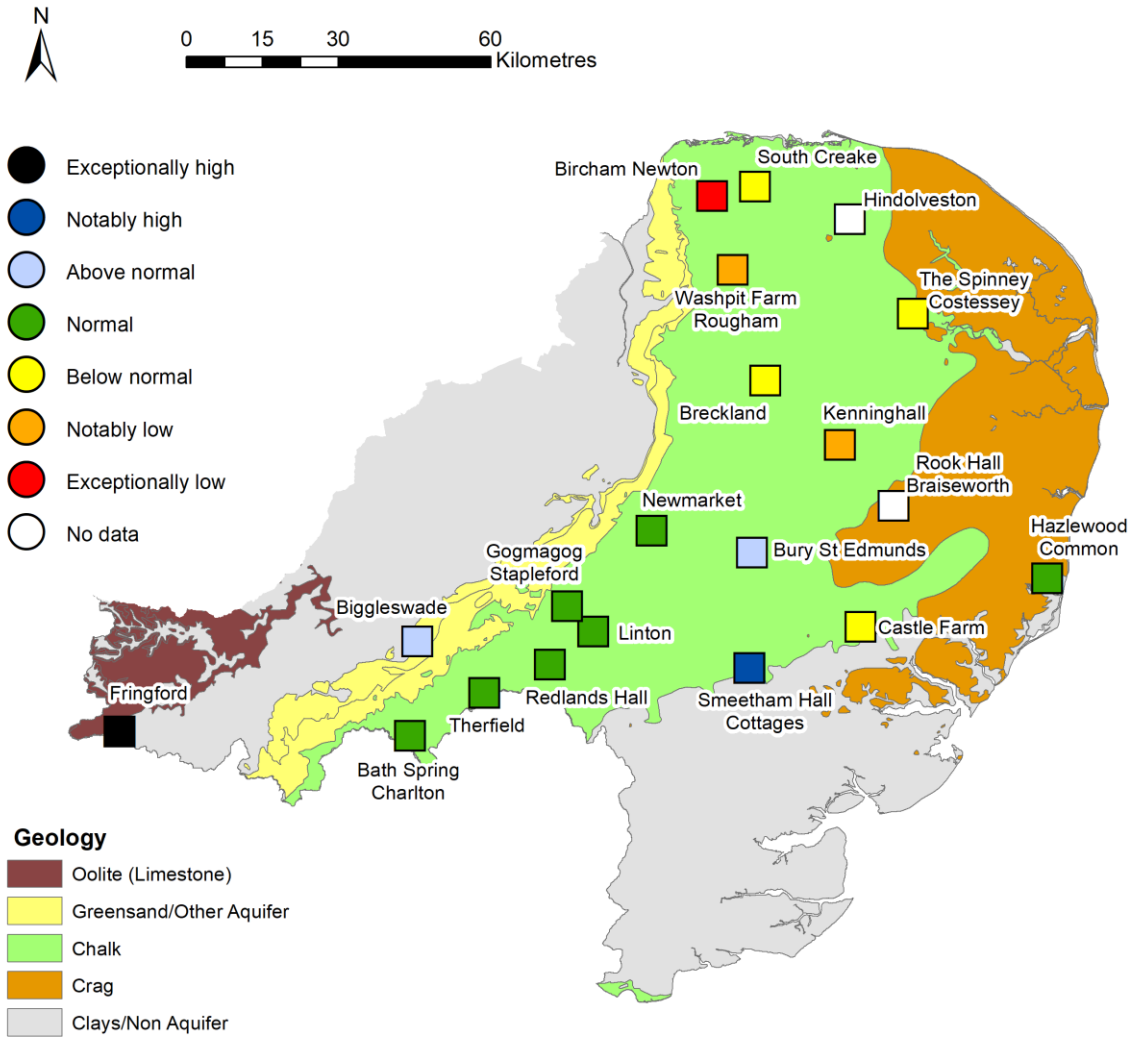


Source: Environment Agency.

5 Groundwater levels

5.1 Groundwater levels map

Figure 5.1: Groundwater levels for indicator sites at the end of March 2023, classed relative to an analysis of respective historic March levels. Table available in the appendices with detailed information.



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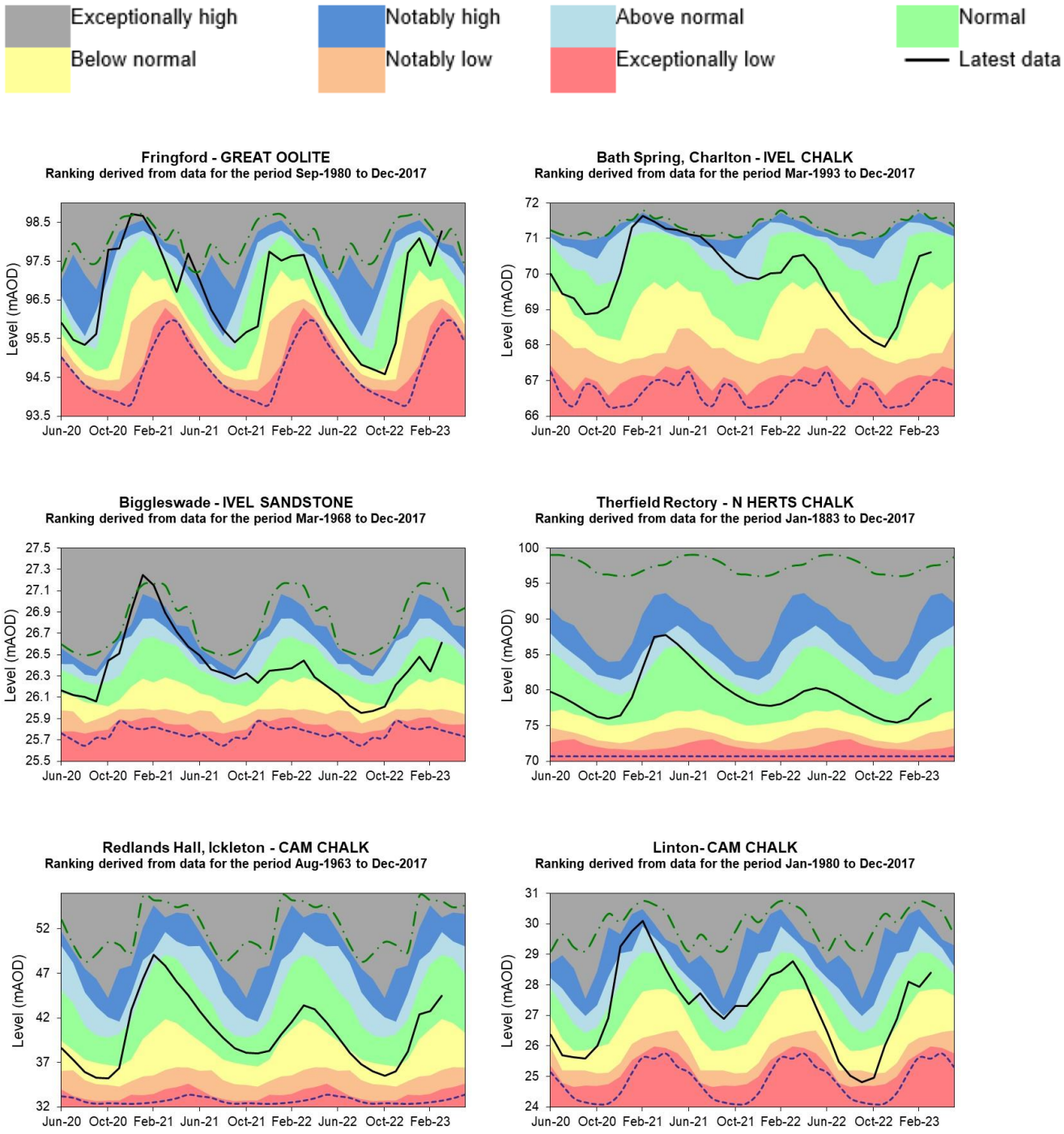
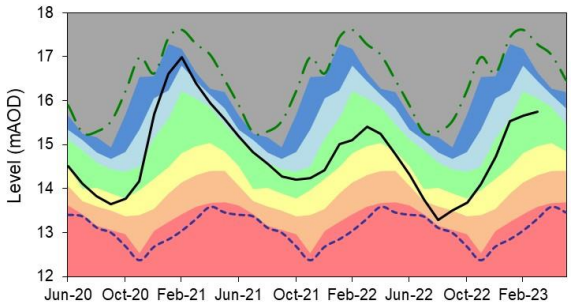
5.2 Groundwater level charts

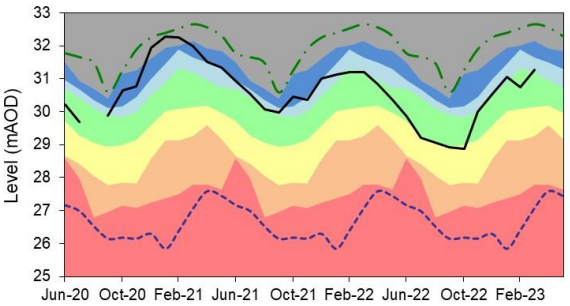
Figure 5.2: End of month groundwater levels at index groundwater level sites for major aquifers. 22 months compared to an analysis of historic end of month levels and long term maximum and minimum levels.



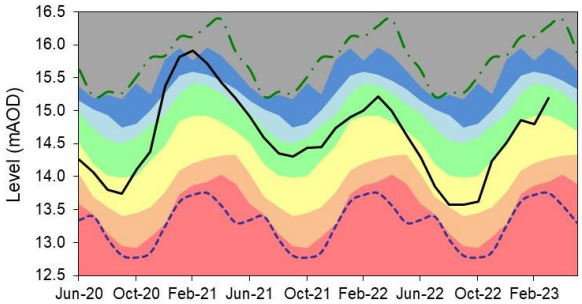
Gog Magog, Stapleford - CAM CHALK
Ranking derived from data for the period Jan-1980 to Dec-2017



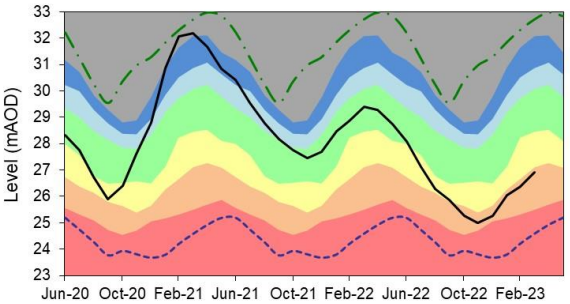
Bury St Edmunds - UPPER LARK CHALK
Ranking derived from data for the period May-1983 to Dec-2017



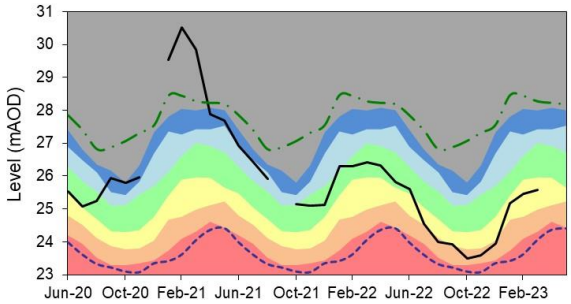
Newmarket - SNAIL CHALK
Ranking derived from data for the period Feb-1983 to Dec-2017



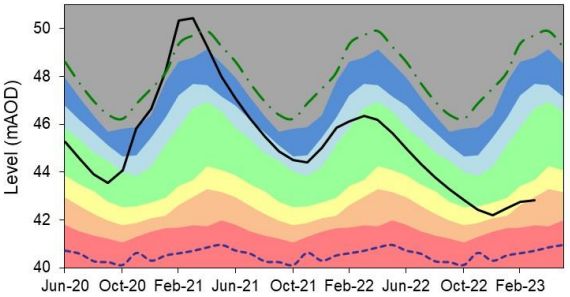
Kenninghall - LITTLE OUSE CHALK
Ranking derived from data for the period Aug-1973 to Dec-2017



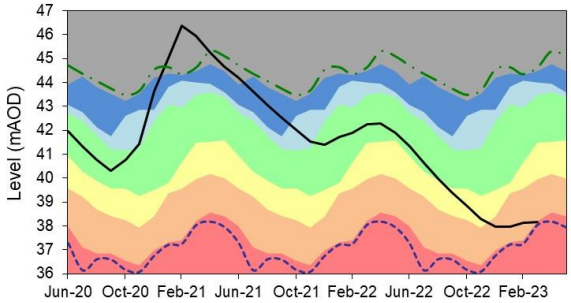
Breckland - WISSEY CHALK
Ranking derived from data for the period Jan-1971 to Nov-2017



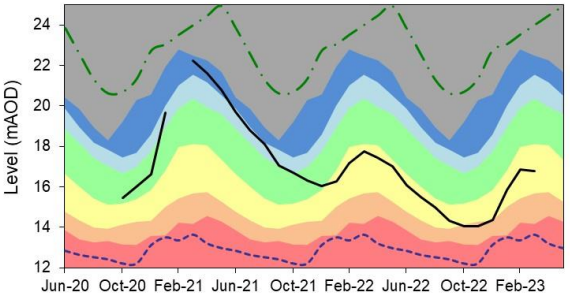
Washpit Farm, Rougham - NW NORFOLK CHALK
Ranking derived from data for the period May-1950 to Dec-2017

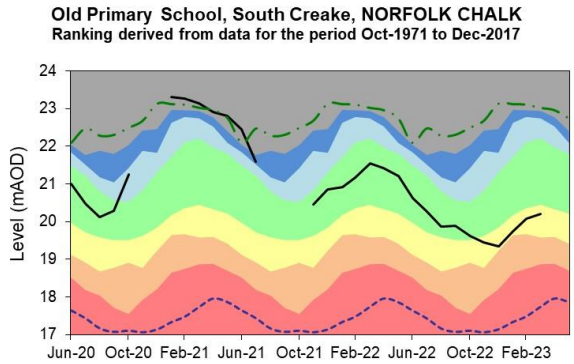


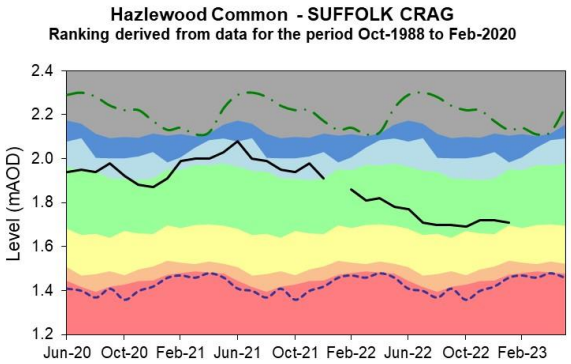
Bircham Newton- NW NORFOLK CHALK
Ranking derived from data for the period Mar-1995 to Sep-2017

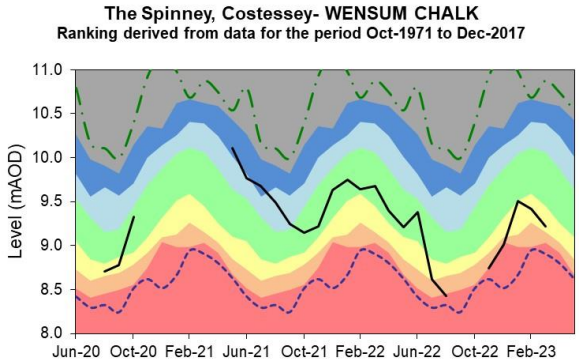


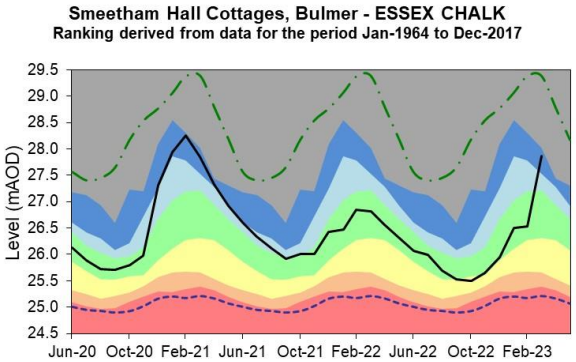
Castle Farm, Offton - MID SUFFOLK CHALK
Ranking derived from data for the period Mar-1967 to Dec-2017

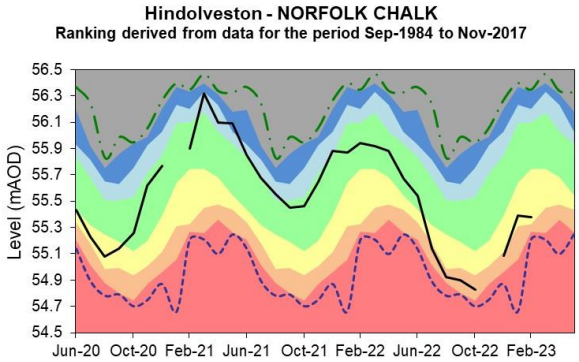


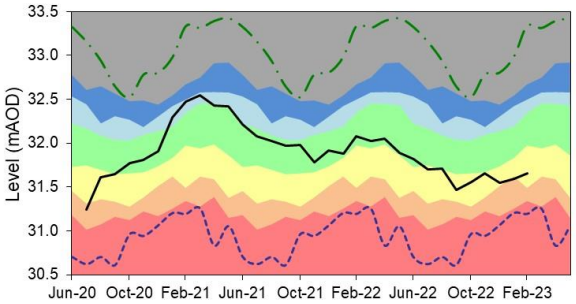








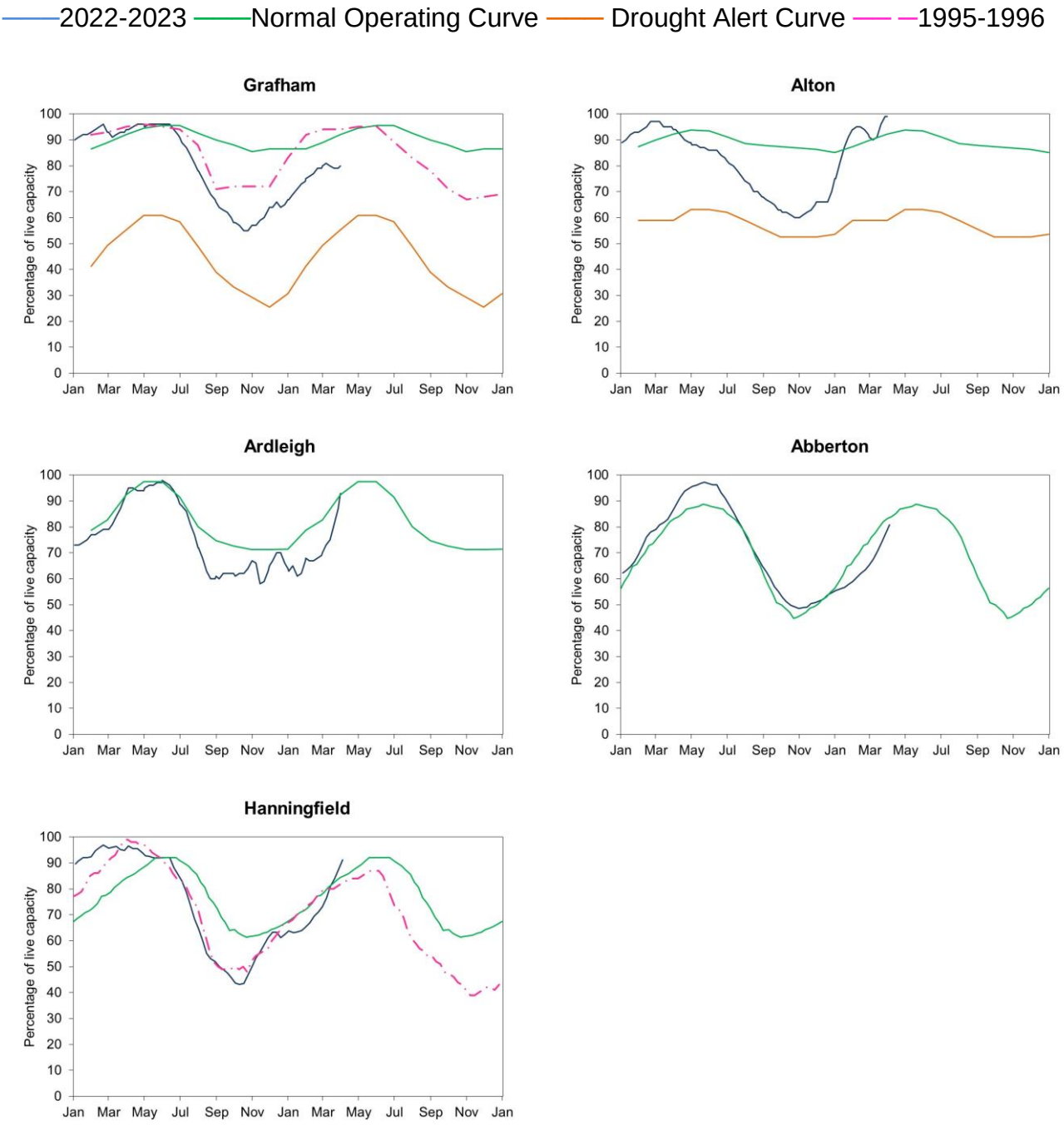




Source: Environment Agency, 2023.

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.



(Source: water companies).

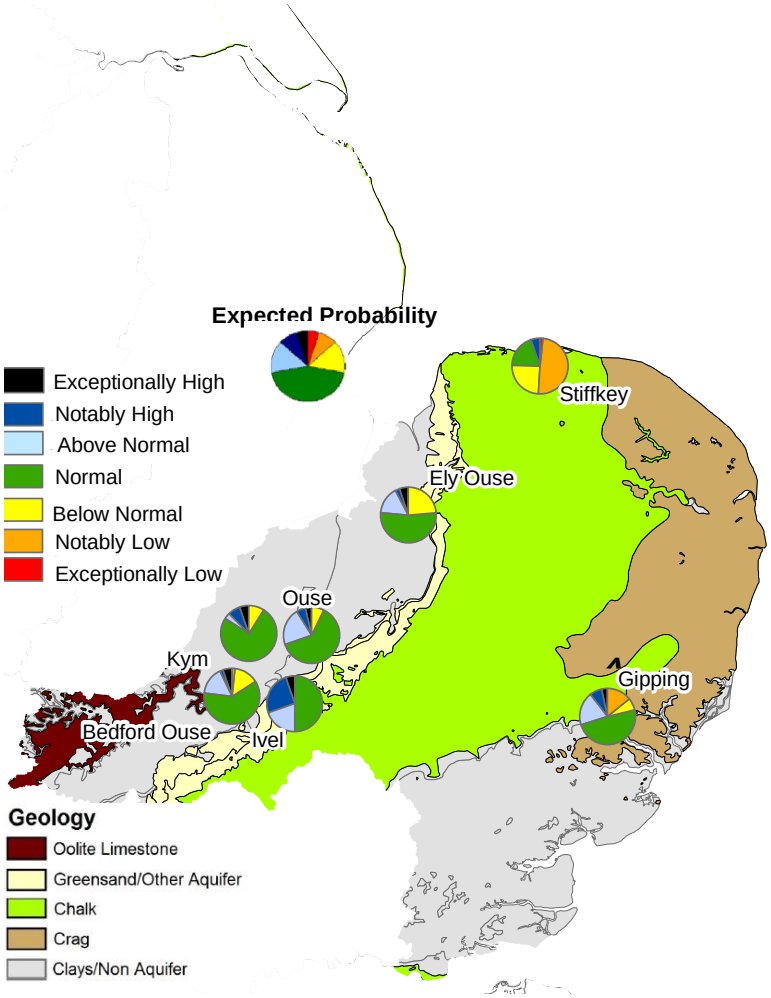
6.1 Reservoir Stocks Map

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

7 Forward Look

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

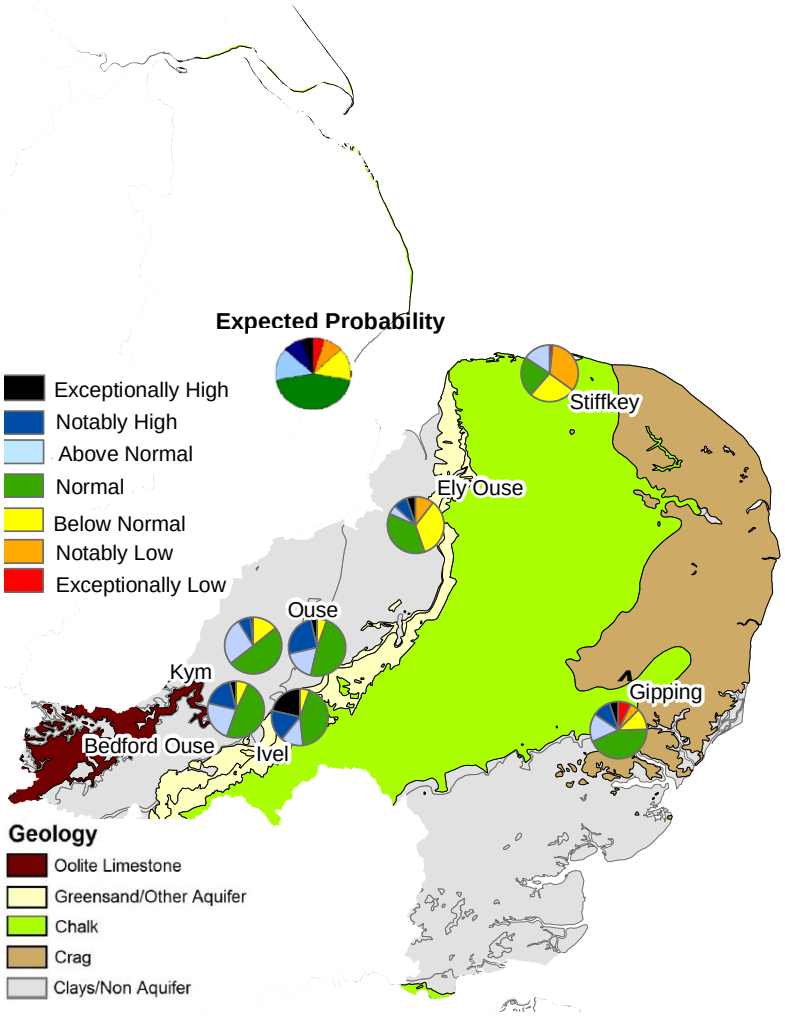
Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are 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 September 2023

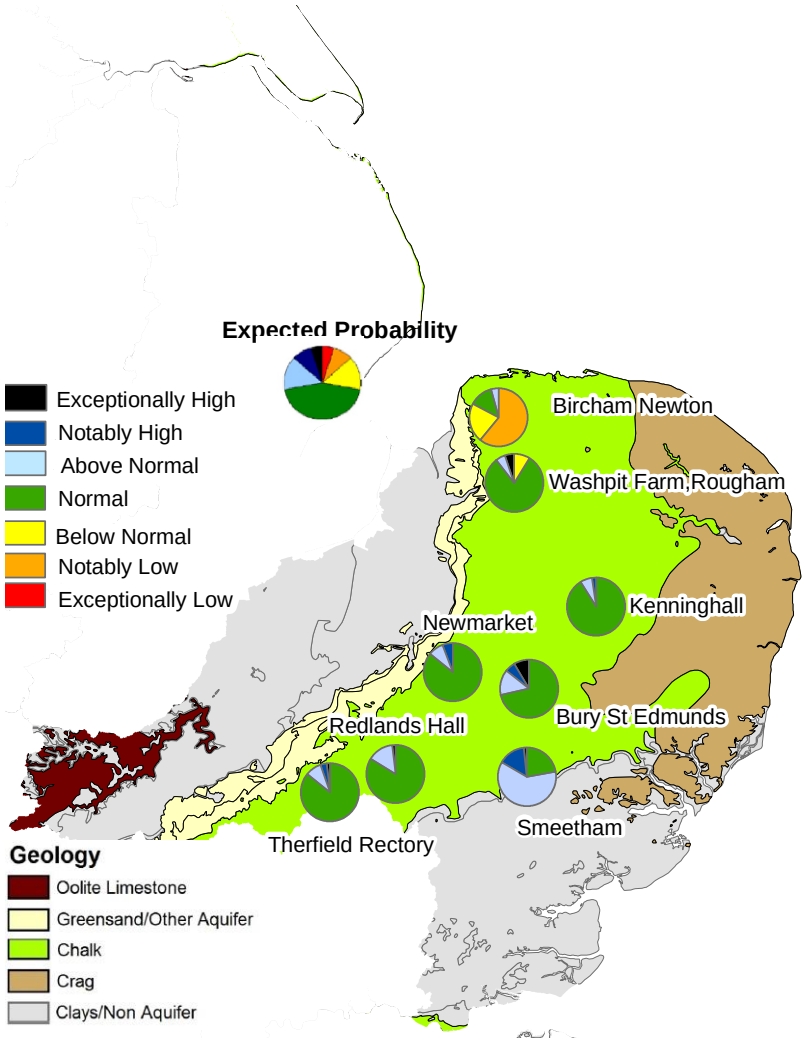
Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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



Pie charts indicate probability, based on climatology, of the 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

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

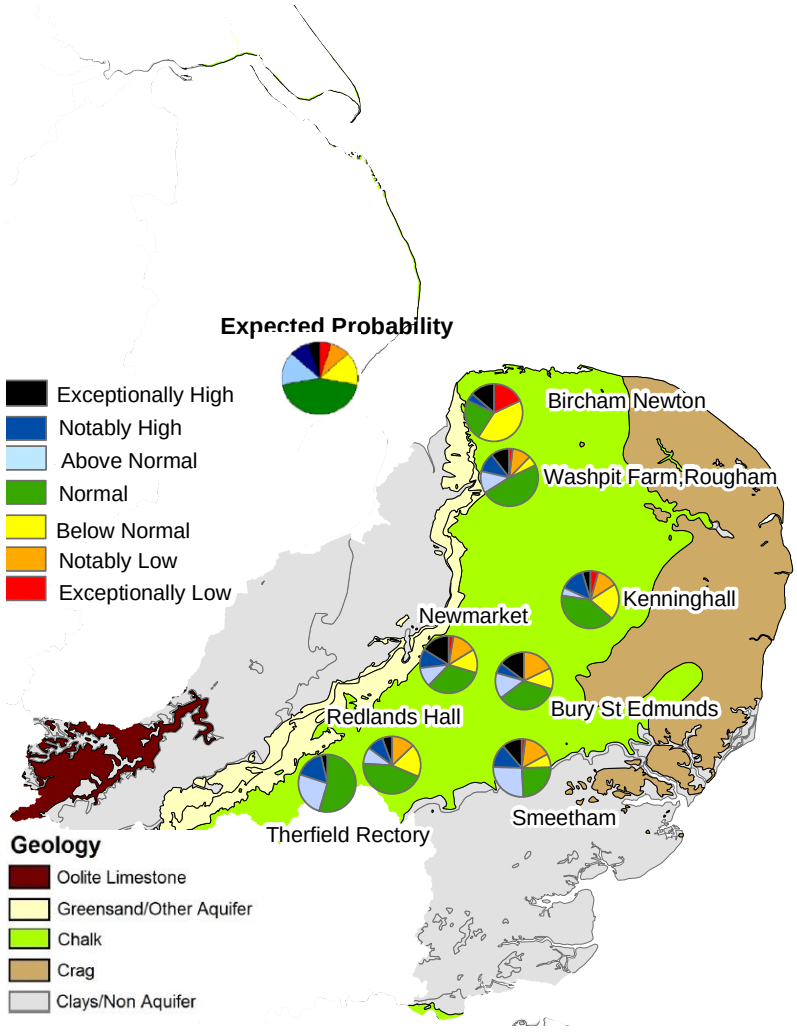
Exceptionally high or low levels are those which would typically occur 5% of the time within the historic record. Notably high or low levels are those which would typically occur 8% of the time. Above normal or below normal levels are those which would typically occur 15% of the time. Normal levels are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

7.4 Forward Look – Probabilistic ensemble projection of groundwater levels at key sites in March 2024

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 (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 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	Mar 2023 rainfall % of long term average 1961 to 1990	Mar 2023 band	Jan 2023 to March cumulative band	Oct 2022 to March cumulative band	Apr 2022 to March cumulative band
Broadland Rivers	188	Exceptionally High	Normal	Normal	Notably low
Cam	255	Exceptionally High	Above normal	Notably high	Normal
Central Area Fenland	216	Exceptionally High	Normal	Above normal	Below normal
East Suffolk	204	Exceptionally High	Normal	Above normal	Below normal
Little Ouse And Lark	213	Exceptionally High	Normal	Above normal	Below normal
Lower Bedford Ouse	256	Exceptionally High	Above normal	Exceptionally high	Normal
North Essex	235	Exceptionally High	Above normal	Above normal	Normal
North Norfolk	163	Notably High	Normal	Normal	Below normal
Nw Norfolk And Wissey	192	Exceptionally High	Normal	Normal	Below normal

South Essex	210	Exceptionally High	Above normal	Above normal	Normal
Upper Bedford Ouse	240	Exceptionally High	Above normal	Notably high	Normal

9.2 River flows table

Site name	River	Catchment	Mar 2023 band	Feb 2023 band
Abbey Heath	Little Ouse	Little Ouse	Normal	Notably low
Blunham	Ivel	Ivel	Notably high	Below normal
Bramford	Gipping	Gipping	Above normal	Notably low
Burnham Overy	Burn	Burn	Below normal	Below normal
Burnt Mill	Rhee	Rhee	Exceptionally high	Below normal
Cappenham	Tove	Tove	Above normal	Notably low
Colney	Yare	Yare	Normal	Notably low
Denver	Ely Ouse	Cutoff and Renew Channel	Above normal	Notably low
Dernford	Cam	Cam	Normal	Below normal
Heacham	Heacham	Heacham	Notably low	Exceptionally low
Ingworth	Bure	Bure	Normal	Notably low
Lexden	Colne	Colne Essex	Notably high	Notably low
Marham	Nar	Nar	Below normal	Notably low
Needham Weir Total	Waveney (lower)	Waveney	Normal	Exceptionally low

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

9.3 Groundwater table

Site name	Aquifer	End of Mar 2023 band	End of Feb 2023 band
Bath Spring, Charlton	Upper Ivel Chalk	Normal	Normal
Biggleswade	Ivel Woburn Sands	Above normal	Normal
Bircham Newton	North West Norfolk Chalk	Exceptionally low	Notably low
Breckland	Wissey Chalk	Below normal	Below normal
Bury St Edmunds	Upper Lark Chalk	Above normal	Normal
Castle Farm, Offton	East Suffolk Chalk	Below normal	Below normal
Gog Magog, Stapleford	Cam Chalk	Normal	Normal
Hazlewood Common	East Suffolk Crag	Normal	
Hindolveston	Norfolk Chalk		Below normal
Kenninghall	Little Ouse Chalk	Notably low	Notably low
Linton	Cam Chalk	Normal	Normal
Newmarket	Snail Chalk	Normal	Below normal

Old Primary School, South Creake	North Norfolk Chalk	Below Normal	Below normal
Redlands Hall, Ickleton	Cam Chalk	Normal	Normal
Rook Hall, Braiseworth	East Suffolk Chalk		Below normal
Smeetham Hall Cottages, Bulmer	North Essex Chalk	Notably high	Normal
The Spinney, Costessey	Wensum Chalk	Below Normal	Below normal
Washpit Farm, Rougham	North West Norfolk Chalk	Notably low	Below normal
Therfield Rectory	Upper Lee Chalk	Normal	Normal
Fringford P.s.	Upper Bedford Ouse Oolitic Limestone (great)	Exceptionally high	Normal

9.4 Ensemble Projections Tables

.9.4.1 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	0.0	0.0	0.0	0.0	0.0	1.8	0.0
Notably Low	1.8	0.0	0.0	0.0	0.0	49.1	14.0
Below Normal	14.3	8.9	0.0	7.1	23.7	24.6	7.0
Normal	60.7	75.0	50.0	62.5	52.6	19.3	49.1
Above Normal	16.1	3.6	19.6	21.4	15.8	0.0	19.3
Notably High	1.8	7.1	25.0	5.4	2.6	5.3	7.0
Exceptionally High	5.4	5.4	5.4	3.6	5.3	0.0	3.5

.9.4.2 Probabilistic ensemble projection of river flows at key sites in September 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	0.0	1.8	7.0
Notably Low	0.0	0.0	0.0	0.0	10.5	33.3	5.3
Below Normal	7.1	14.3	5.4	5.4	34.2	26.3	12.3
Normal	48.2	50.0	42.9	48.2	36.8	22.8	43.9
Above Normal	23.2	26.8	12.5	17.9	5.3	15.8	15.8
Notably High	17.9	7.1	17.9	25.0	7.9	0.0	10.5
Exceptionally High	3.6	1.8	21.4	3.6	5.3	0.0	5.3

.9.4.3 Probabilistic ensemble projection of groundwater levels at key sites in September 2023

Percentage of pie chart for each band

Site	Therfield Rectory	Redlands Hall	Newmarket	Washpit Farm	Bircham Newton	Kenninghall	Bury St Edmunds	Smeetham
Exceptionally low	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Notably low	0.0	0.0	0.0	0.0	60.9	0.0	0.0	0.0
Below normal	0.0	0.0	0.0	8.8	21.7	0.0	0.0	0.0
Normal	85.7	83.6	85.7	80.7	13.0	91.1	71.4	22.2
Above normal	8.9	14.5	8.6	5.3	4.3	6.7	14.3	61.1
Notably high	3.6	0.0	5.7	0.0	0.0	2.2	5.7	14.8
Exceptionally high	1.8	1.8	0.0	5.3	0.0	0.0	8.6	1.9

.9.4.4 Probabilistic ensemble projection of groundwater levels at key sites in March 2024.

Percentage of pie chart for each band

Site	Therfield Rectory	Redlands Hall	Newmarket	Washpit Farm	Bircham Newton	Kenninghall	Bury St Edmunds	Smeetham
Exceptionally low	0.0	0.0	2.7	1.8	18.2	4.5	0.0	1.9
Notably low	0.0	13.0	13.5	10.7	0.0	11.4	17.6	15.1
Below normal	0.0	18.5	13.5	5.4	40.9	20.5	11.8	7.5
Normal	54.5	44.4	32.4	48.2	22.7	40.9	35.3	24.5
Above normal	25.5	9.3	10.8	12.5	0.0	4.5	14.7	26.4
Notably high	16.4	9.3	10.8	10.7	4.5	13.6	5.9	13.2
Exceptionally high	3.6	5.6	16.2	10.7	13.6	4.5	14.7	11.3