Monthly water situation report: Yorkshire Area

1 Summary - March 2024

March rainfall was a little above average. River flows in most catchments fluctuated between normal and above normal for the time of year with a few higher peaks. In contrast, in the Chalk-fed Hull catchment flows were exceptionally high for the first three weeks. Soils remained saturated throughout Yorkshire. Groundwater levels declined in all aquifers. Reservoir stocks also decreased slightly but remained above average for the time of year.

1.1 Rainfall

Monthly rainfall was still a little above average but more typical for the time of year than preceding months. Using the Met Office Had-UK data set, catchment averaged rainfall ranged from 101% to 131% of the long term average (LTA) in most of Yorkshire's catchments, but only 90% of the LTA in the Rye. The monthly totals were classified as above normal in the Pennine catchments and normal for the eastern half of the area.

Using the same Had-UK data set, Yorkshire as a whole recorded the wettest 9 month period from July to March in a 150 year record, and also the wettest 6 month winter period from October to March. However the majority of the unusually high rainfall totals were captured in the preceding months up to February. For individual catchments it was the highest ranking July to March rainfall period for the Nidd, Ouse, Wharfe, Derwent, Aire, Calder, Don and Hull catchments, with the Swale and Ure second wettest and Rye third wettest in the record. All catchments also ranked first or second wettest in 150 years for the six month totals October to March.

Rain was frequent through the month with only a brief settled period from 3 to 8 March, but with no major storms. In the Pennine catchments there were few dry days. The wettest periods were the first two days of the month and particularly the 13 to 14 March. The Don and Rother had a more even temporal distribution of rain during the month. Further east, the Derwent and Hull also had frequent rainfall with low daily totals. The wettest spells were 1 to 4 March, 16 to 17 and 26 to 31 March in the Derwent, and 31 March in the Hull.

1.2 Soil moisture deficit

Soils were saturated and classified as wet every week of the month across Yorkshire. The frequent spells of rain ensured the soils remained wet and very little change in soil moisture deficit occurred across the region.

1.3 River flows

Monthly mean flows were in the above normal or notably high range on the Wharfe, Nidd, upper Ure and Don and in the normal range elsewhere in Yorkshire. The range of flows for Yorkshire was typically 70% to 162% of the LTA. The exception was the West Beck in the Hull catchment which, with the support of groundwater spring flows from the Chalk, remained exceptionally high for the first part of the month with a monthly mean 167% of the LTA. Notably high monthly mean flows in the Nidd were influenced by both wet weather and larger than usual releases from Gouthwaite reservoir to facilitate scheduled reservoir safety improvement works.

Although rain was persistent throughout the month, the majority of daily mean flows stayed within normal or just above normal range across Yorkshire. The Pennine-fed rivers began March with either normal or above normal flows and a small peak on the 3rd at many sites. Flows in these catchments peaked in response to mid-month rainfall on the 10th to 14th. Daily mean flows rose to exceptionally high during this period and then receded to above normal during the second half of the month in the north and west Pennine-fed rivers. On the Don and Rother high flow episodes on day 17 to 19 and in the last week of the month were more significant than elsewhere in the Pennines.

On the River Derwent and its tributary the Rye a steady decline in baseflow was observed through the month and flows fell into the normal range for the time of year. This corresponded to a decline in groundwater level in the Corallian limestone and other aquifers. Flows in the Esk in the north-east were also typical for March and showed little variability.

Flows gradually declined through the month on the chalk-fed West Beck in the upper Hull catchment, from exceptionally high to above normal from 22nd onwards.

1.4 Groundwater levels

Magnesian Limestone

The groundwater level within the Magnesian Limestone at Brick House Farm decreased but remained exceptionally high for the time of year.

Millstone Grit

The groundwater level decreased within the Millstone Grit at Hill Top Farm and was notably high for the time of year. *It should be noted that this observation borehole is used for water abstraction by means of a pump. Therefore the groundwater level recorded here may be subject to the effects of this.*

Sherwood Sandstone

The groundwater level in the Sherwood Sandstone decreased slightly at both Great Ouseburn (exceptionally high) and Riccall Approach Farm (notably high).

Corallian Limestone

The groundwater level greatly decreased within the Corallian Limestone at Sproxton and passed into the upper part of the normal range for the time of year.

Chalk

The groundwater level decreased at both Wetwang (northern Yorkshire Wolds chalk) and Dalton Estate (central Yorkshire Wolds chalk). The level at Wetwang was above normal while that at Dalton Estate was notably high.

1.5 Reservoir stocks

Total reservoir stocks remained close to capacity with a very slight decline of less than 2% during March. This is typical for the month and at month-end total stocks were approximately 2.5% above the LTA.

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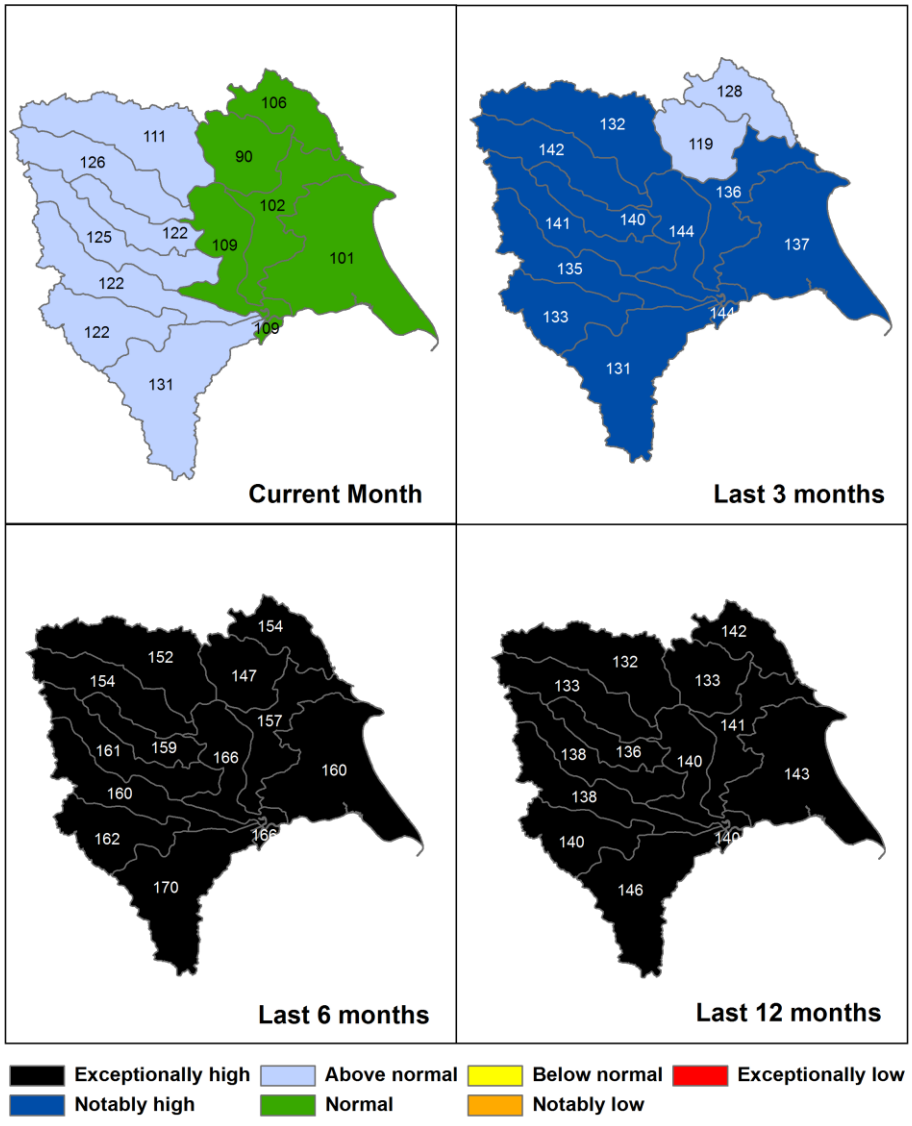
2 Rainfall

2.1 Rainfall map

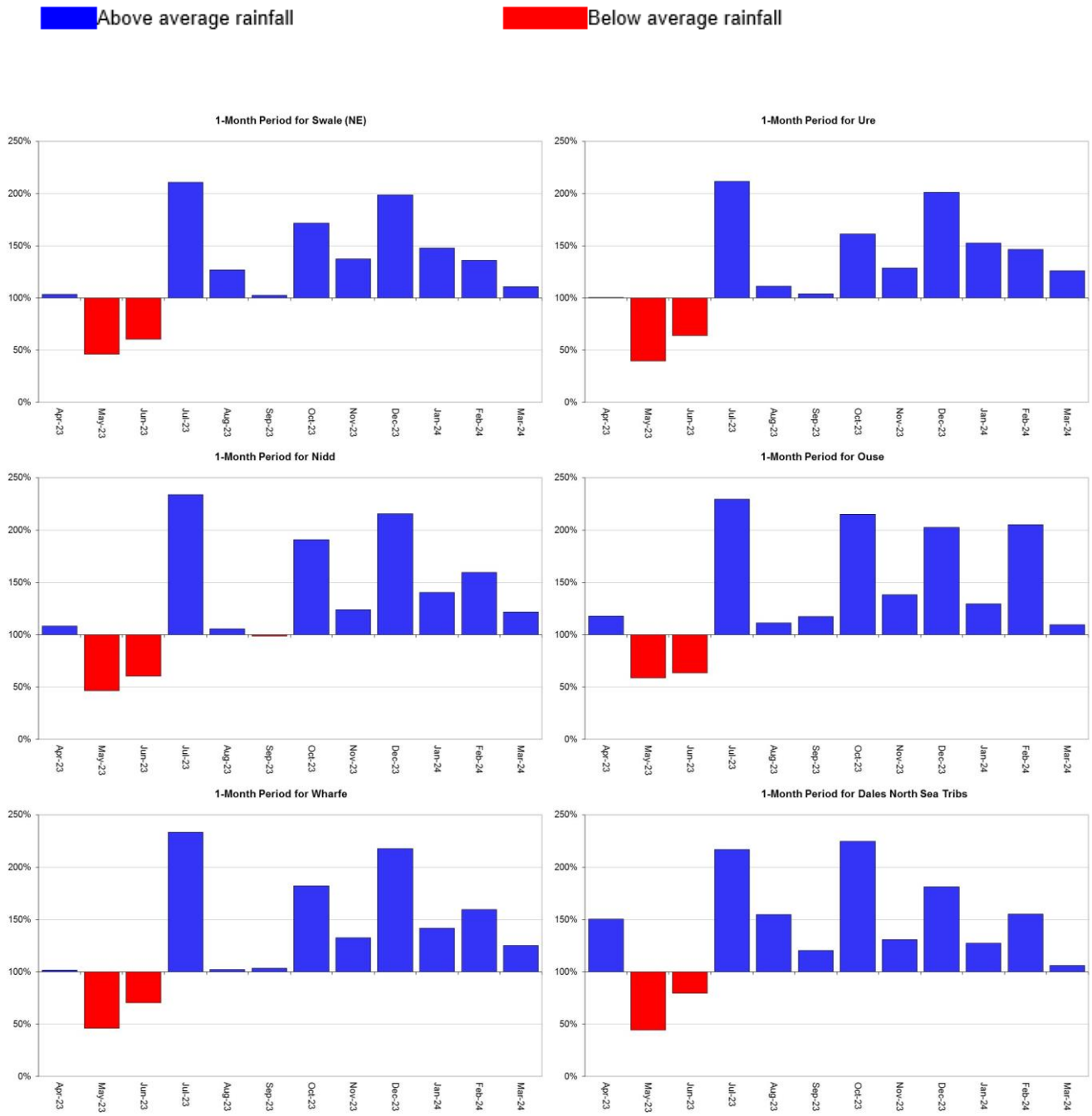
Figure 2.1: Total rainfall for hydrological areas for the current month (up to 31 March 2024), the last 3 months, the last 6 months, and the last 12 months, classed relative to an analysis of respective historic totals. Table available in the appendices with detailed information.

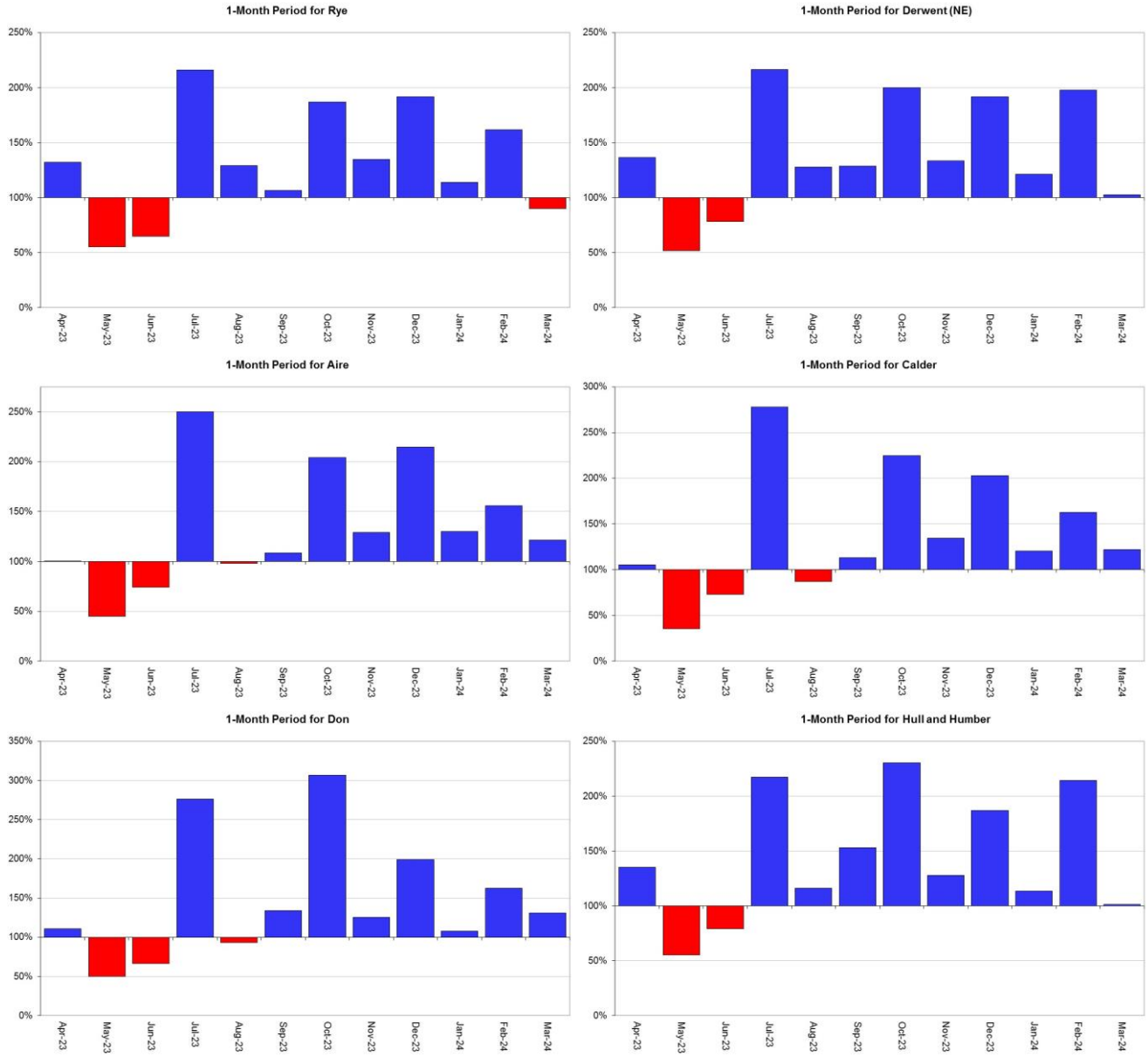


HadUK data based on the Met Office 1km gridded rainfall dataset derived from rain gauges (Source: Met Office. Crown copyright, 2024). Provisional data based on Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. Crown copyright. All rights reserved. Environment Agency, 100024198, 2024.

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 catchment.



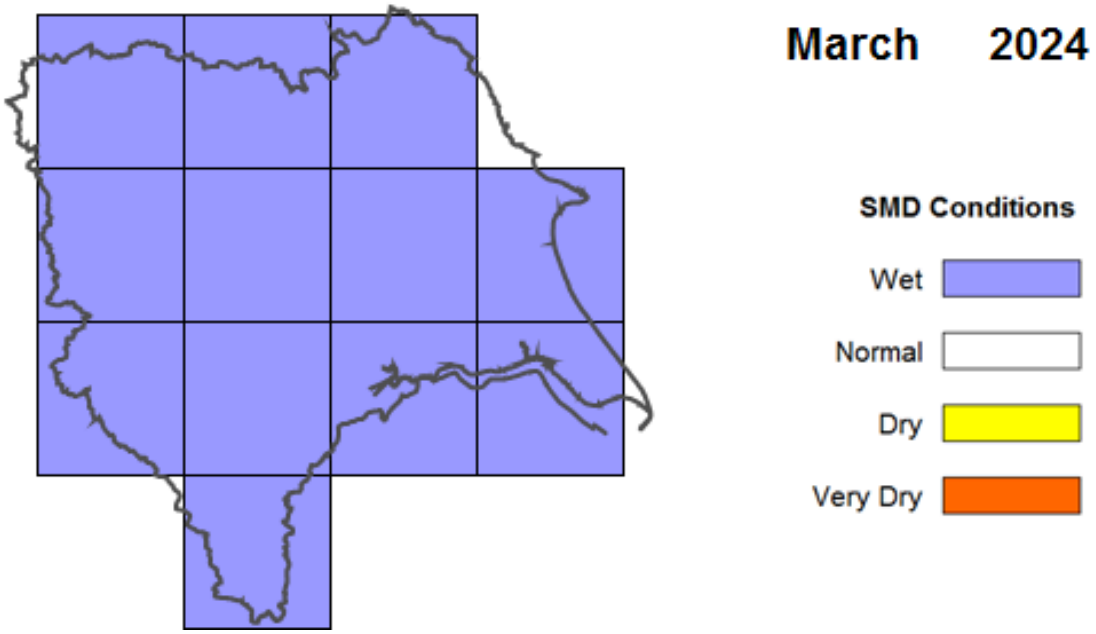


Rainfall data for 2023 and 2024, extracted from Environment Agency 1km gridded rainfall dataset derived from Environment Agency intensity rain gauges. (Source: Environment Agency. Crown Copyright, 100024198, 2024). LTA rainfall data prior to 2023, extracted from Met Office HadUK 1km gridded rainfall dataset derived from registered rain gauges (Source: Met Office. Crown copyright, 2024).

3 Soil moisture deficit

3.1 Soil moisture deficit map

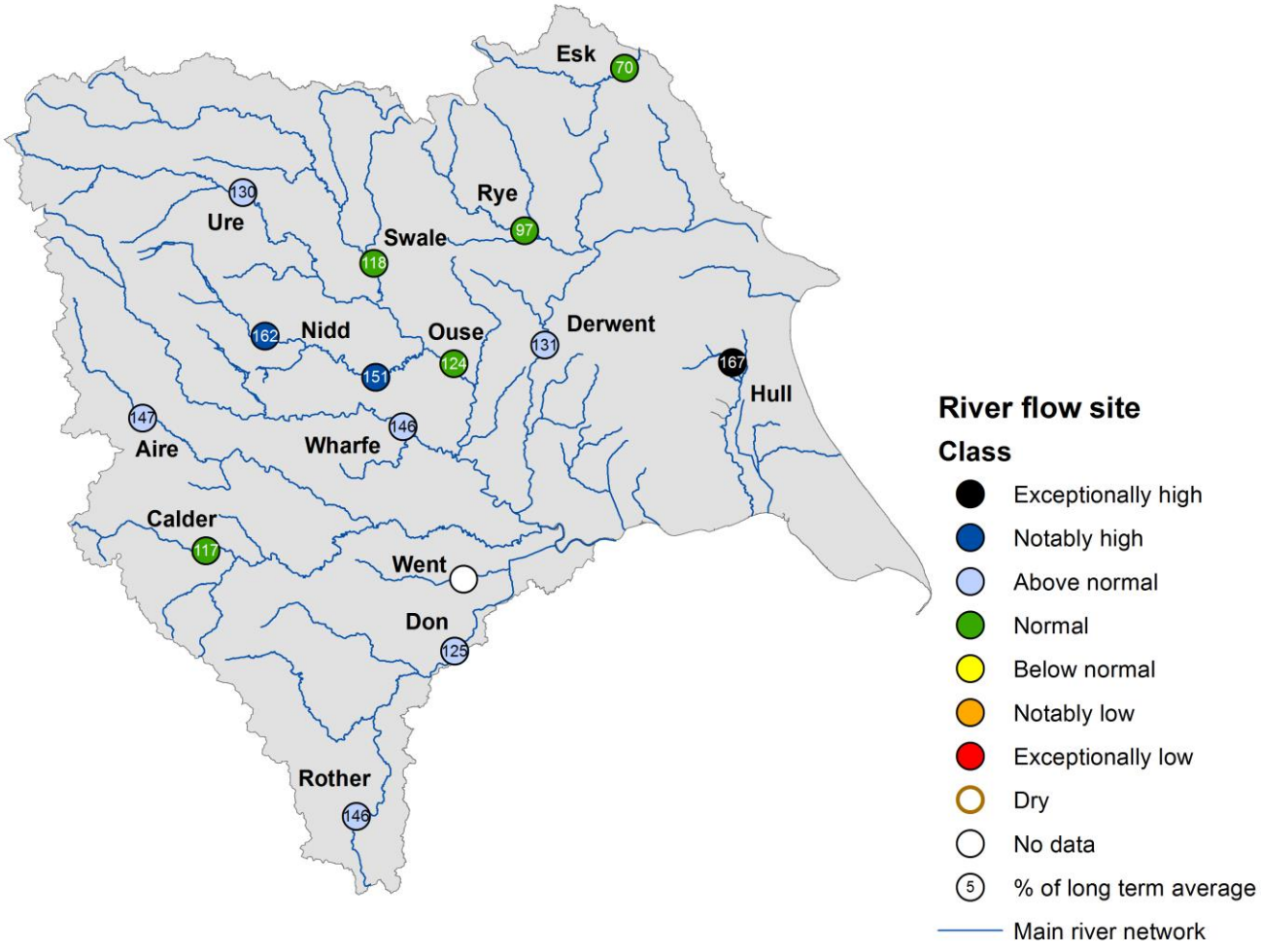
Figure 3.1: Soil moisture deficits for month ending 31 March 2024. Shows the difference (mm) of the actual soil moisture deficit from the 1961 to 1990 long term average soil moisture deficits. MORECS data for real land use.



4 River flows

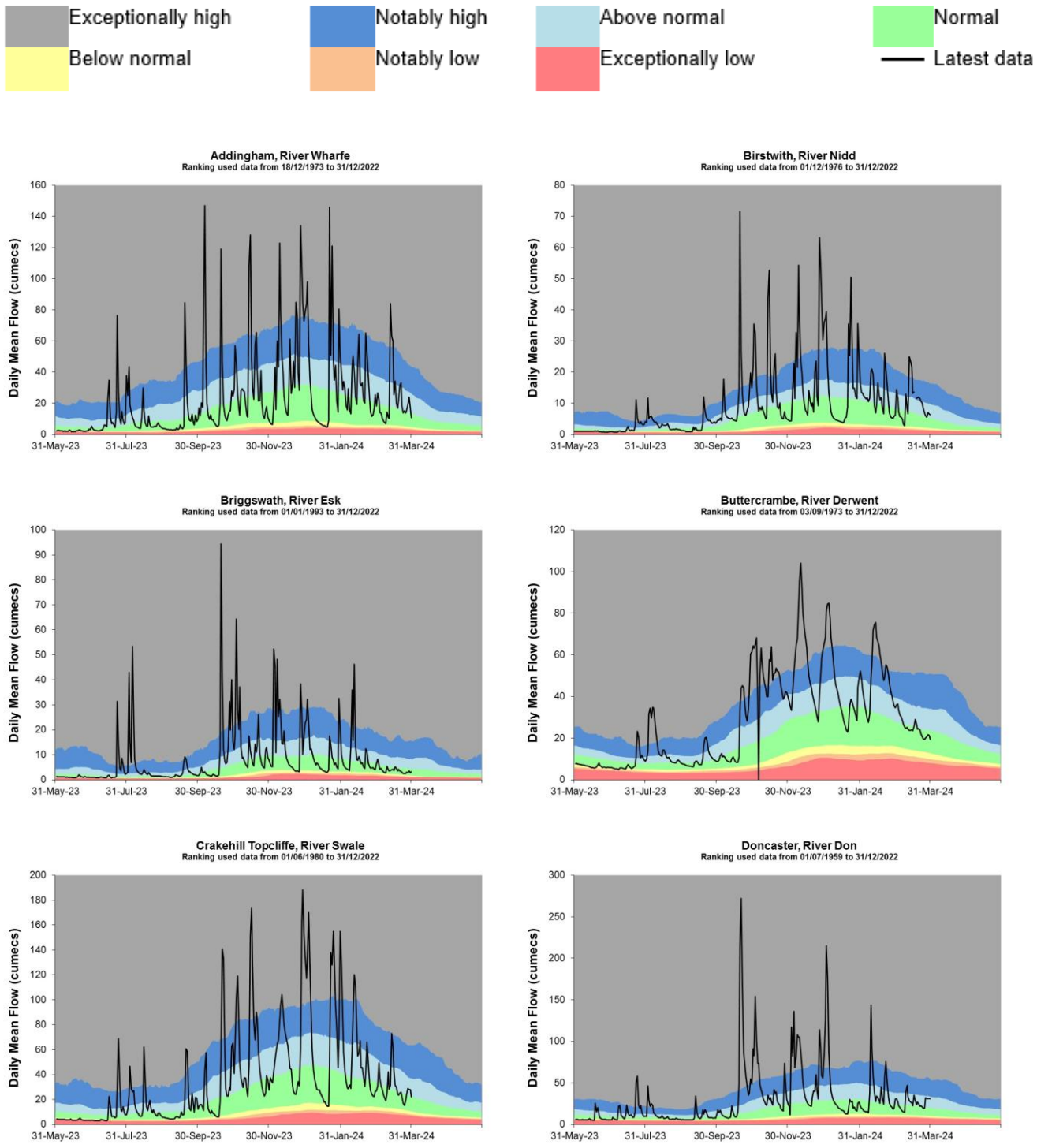
4.1 River flows map

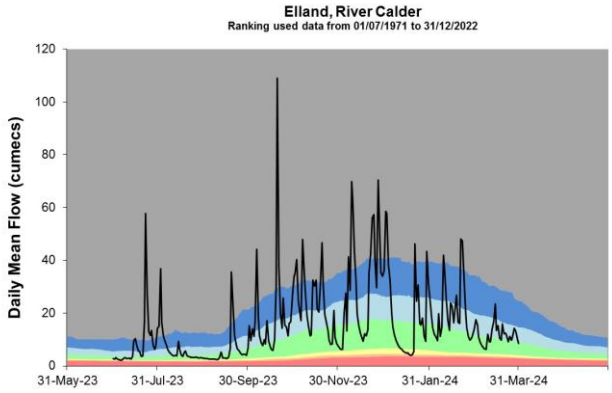
Figure 4.1: Monthly mean river flow for indicator sites for March 2024, expressed as a percentage of the respective long term average and classed relative to an analysis of historic March monthly means. Table available in the appendices with detailed information.

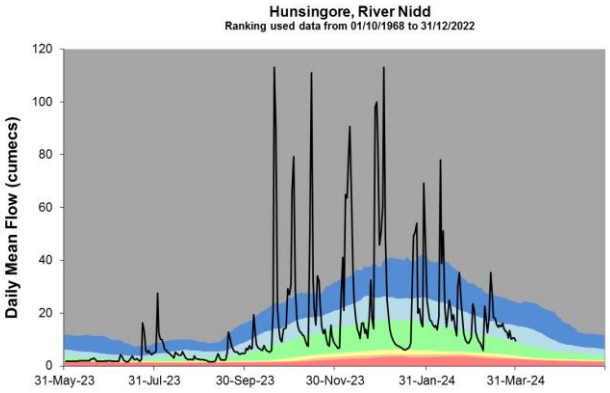


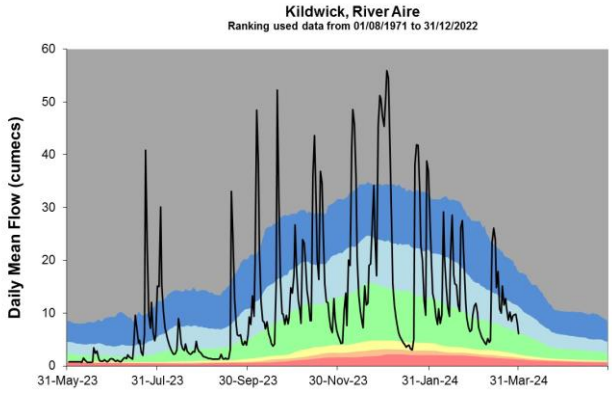
4.2 River flow charts

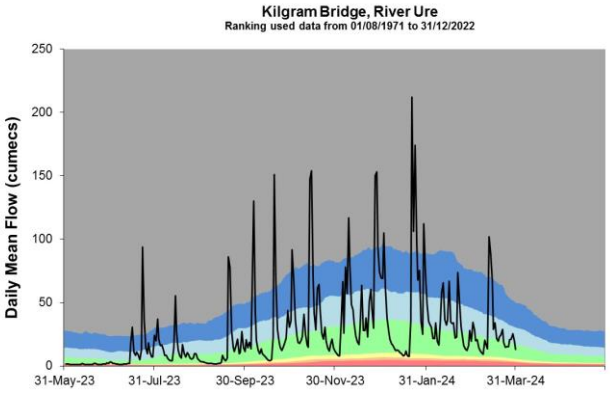
Figure 4.2: Daily mean river flow for index sites over the past ten months, compared to an analysis of the range of historic daily mean flows.

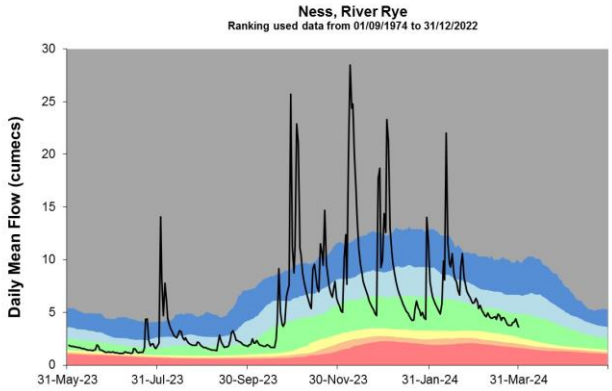


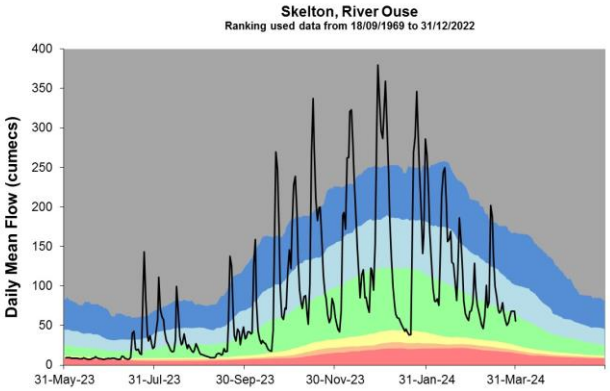

Elland, River Calder
Ranking used data from 01/07/1971 to 31/12/2022
Daily Mean Flow (cumecs)
0
20
40
60
80
100
120
31-May-23
31-Jul-23
30-Sep-23
30-Nov-23
31-Jan-24
31-Mar-24

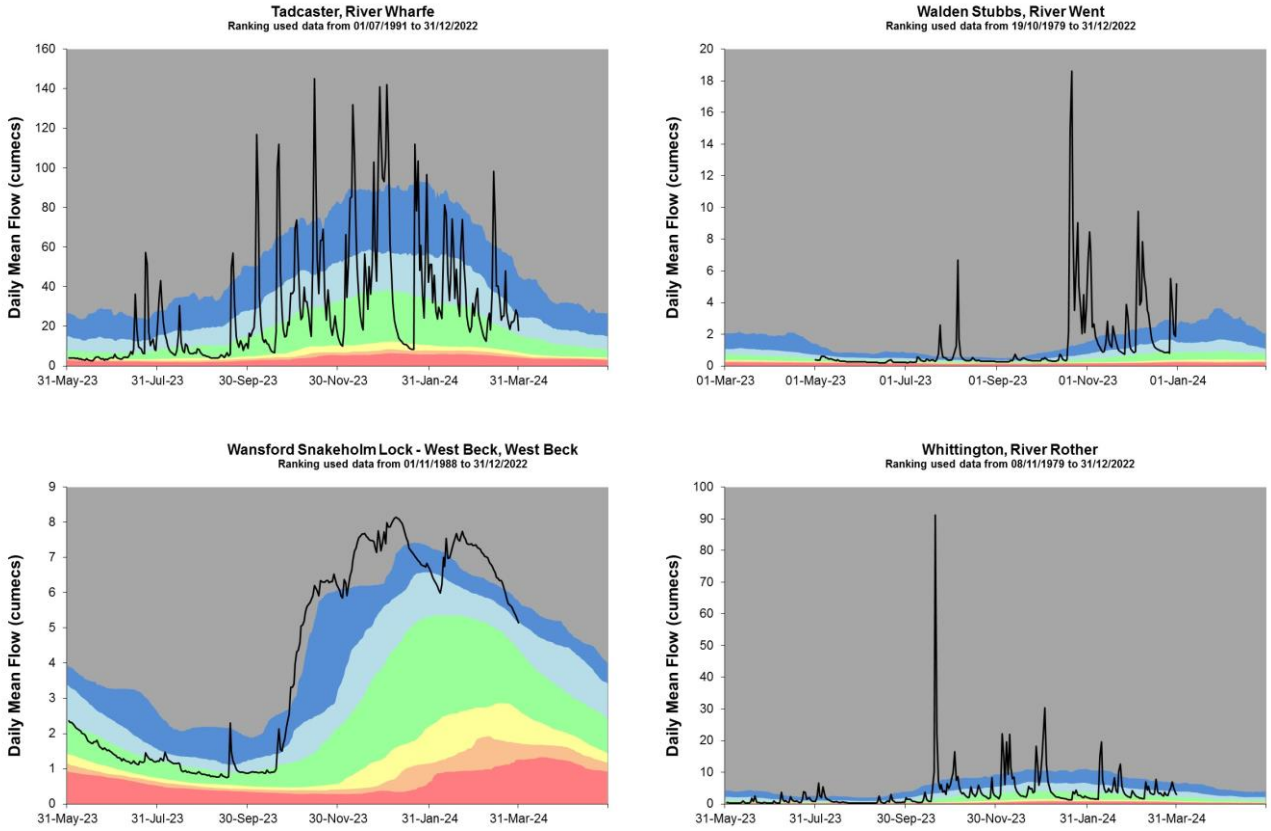

Hunsingore, River Nidd
Ranking used data from 01/10/1968 to 31/12/2022
Daily Mean Flow (cumecs)
0
20
40
60
80
100
120
31-May-23
31-Jul-23
30-Sep-23
30-Nov-23
31-Jan-24
31-Mar-24


Kildwick, River Aire
Ranking used data from 01/08/1971 to 31/12/2022
Daily Mean Flow (cumecs)
0
10
20
30
40
50
60
31-May-23
31-Jul-23
30-Sep-23
30-Nov-23
31-Jan-24
31-Mar-24


Kilgram Bridge, River Ure
Ranking used data from 01/08/1971 to 31/12/2022
Daily Mean Flow (cumecs)
0
50
100
150
200
250
31-May-23
31-Jul-23
30-Sep-23
30-Nov-23
31-Jan-24
31-Mar-24


Ness, River Rye
Ranking used data from 01/09/1974 to 31/12/2022
Daily Mean Flow (cumecs)
0
5
10
15
20
25
30
31-May-23
31-Jul-23
30-Sep-23
30-Nov-23
31-Jan-24
31-Mar-24

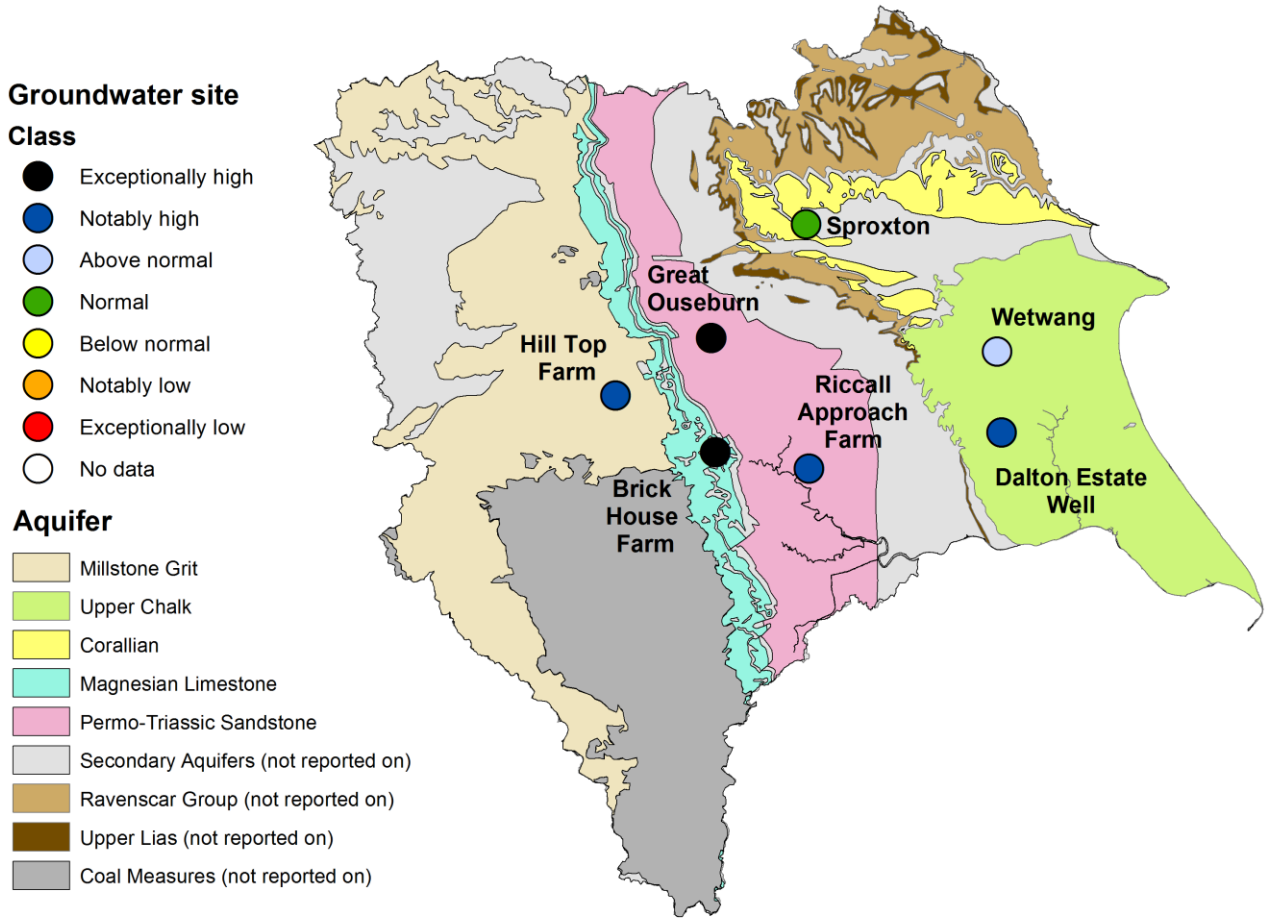

Skelton, River Ouse
Ranking used data from 18/09/1969 to 31/12/2022
Daily Mean Flow (cumecs)
0
50
100
150
200
250
300
350
400
31-May-23
31-Jul-23
30-Sep-23
30-Nov-23
31-Jan-24
31-Mar-24



5 Groundwater levels

5.1 Groundwater levels map

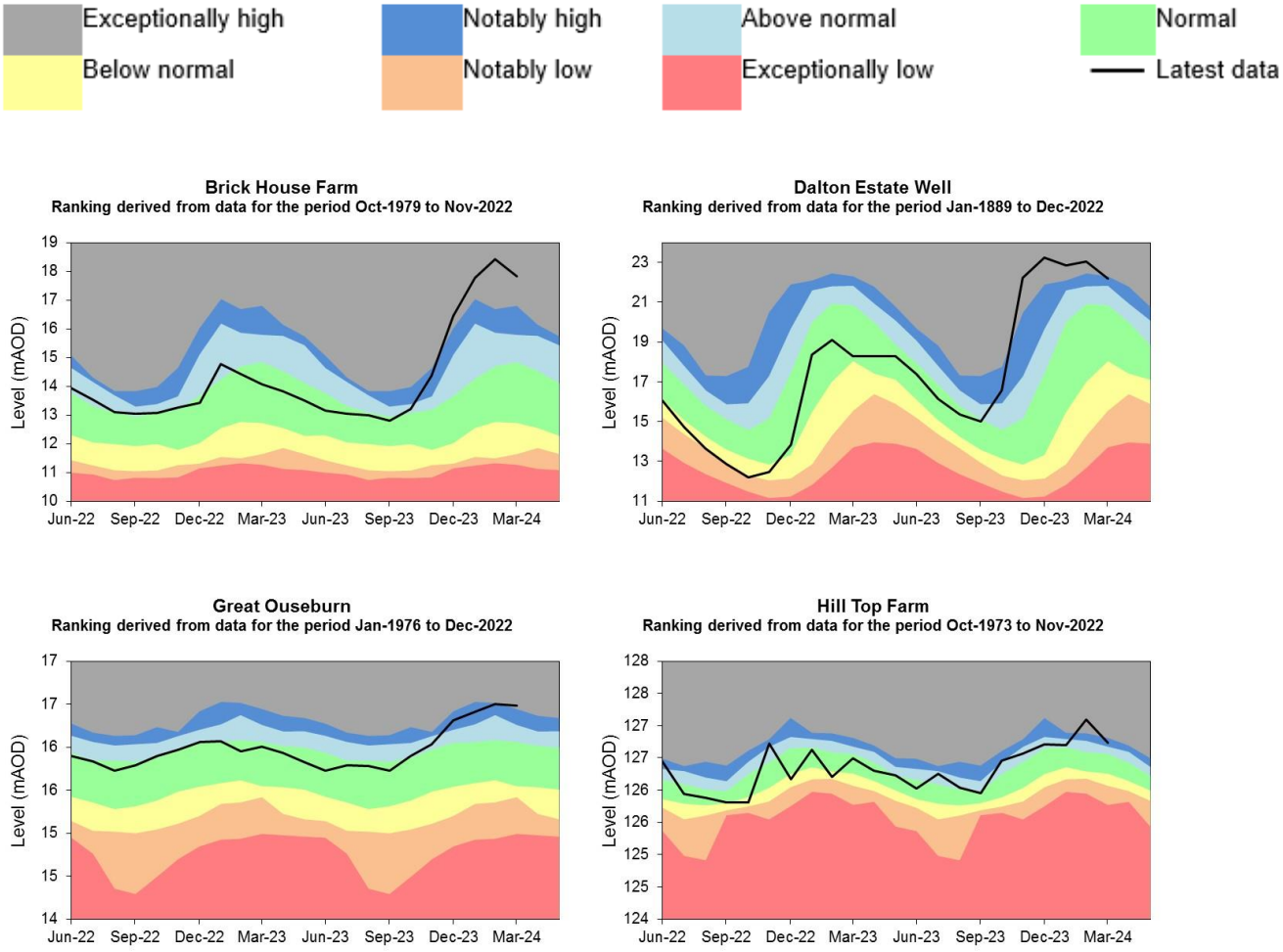
Figure 5.1: Groundwater levels for indicator sites at the end of March 2024, classed relative to an analysis of respective historic March levels. Table available in the appendices with detailed information.

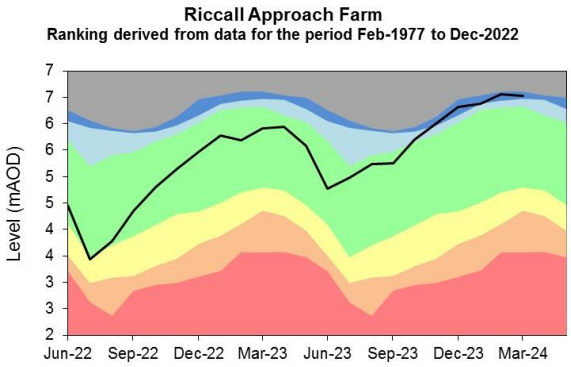


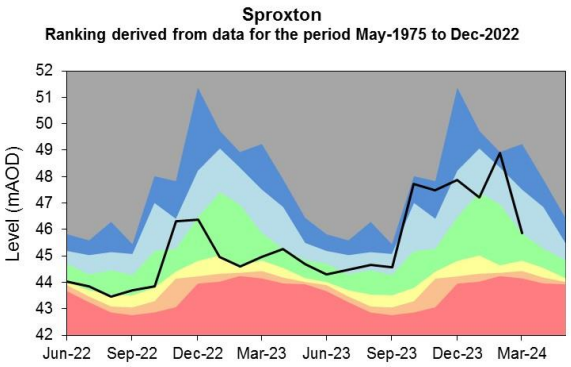
(Source: Environment Agency). Geological map reproduced with kind permission from UK Groundwater Forum, BGS copyright NERC. Crown copyright. All rights reserved. Environment Agency, 100024198, 2024.

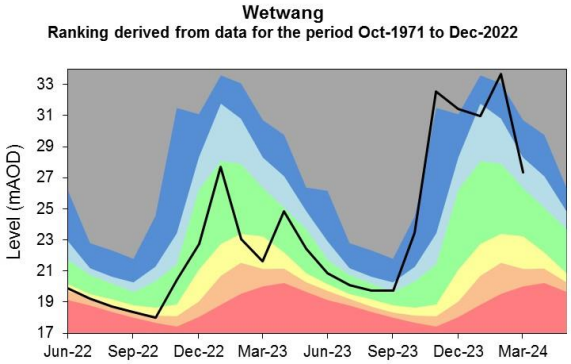
5.2 Groundwater level charts

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.





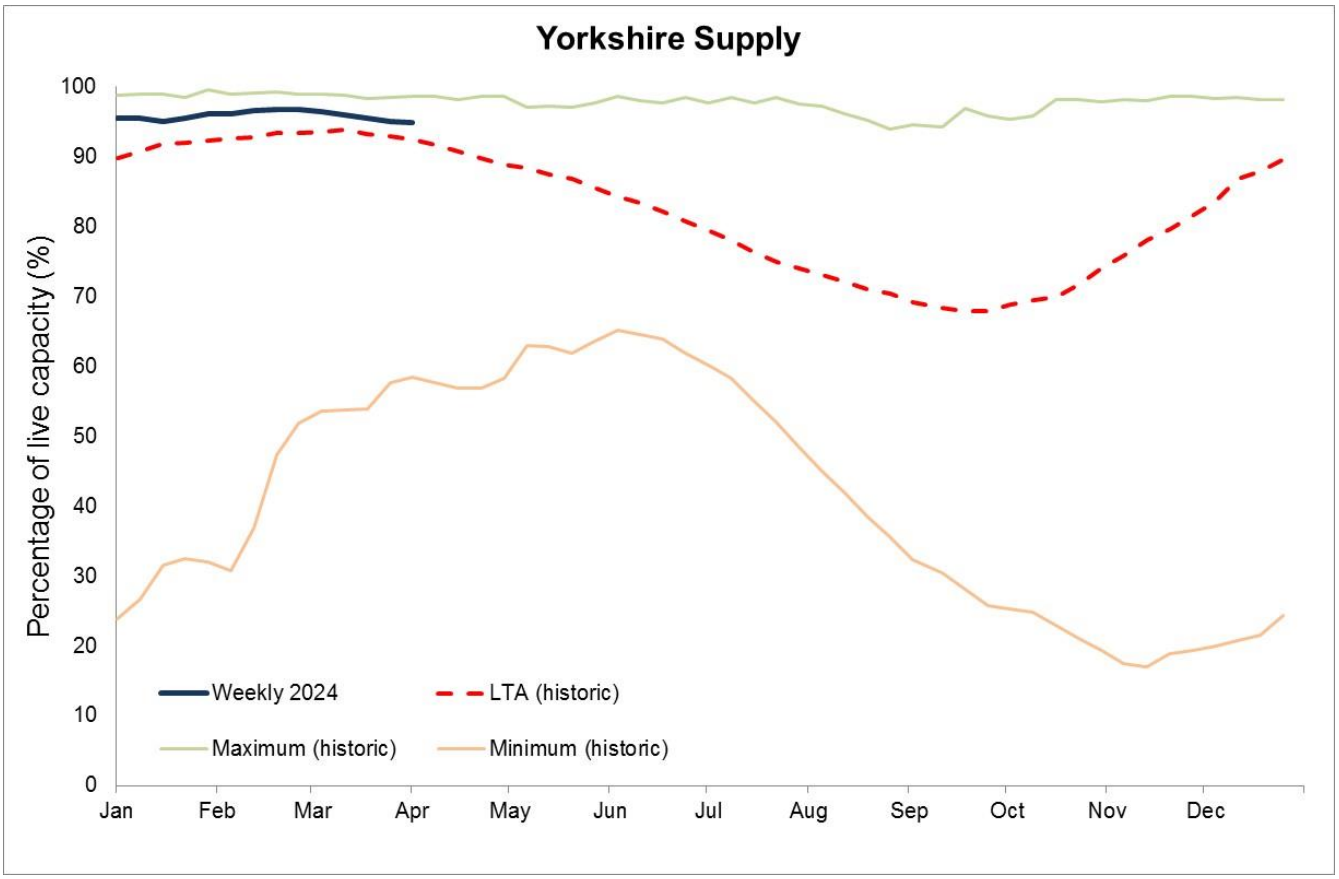




 N.B. Hill Top Farm observation borehole is used for abstraction. Therefore the groundwater level record will be directly affected by pumping

6 Reservoir stocks

Figure 6.1: End of month regional reservoir stocks compared to long term maximum, minimum and average stocks. Note: Historic records of individual reservoirs and reservoir groups making up the regional values vary in length.



7 Glossary

7.1 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).

7.2 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.

8 Appendices

8.1 Rainfall table

Hydrological area	Mar 2024 rainfall % of long term average 1961 to 1990	Mar 2024 band	Jan 2024 to March cumulative band	Oct 2023 to March cumulative band	Apr 2023 to March cumulative band
Aire	122	Above Normal	Notably high	Exceptionally high	Exceptionally high
Calder	122	Above Normal	Notably high	Exceptionally high	Exceptionally high
Dales North Sea Tribs	106	Normal	Above normal	Exceptionally high	Exceptionally high
Derwent (ne)	102	Normal	Notably high	Exceptionally high	Exceptionally high
Don	131	Above Normal	Notably high	Exceptionally high	Exceptionally high
Hull And Humber	101	Normal	Notably high	Exceptionally high	Exceptionally high
Nidd	122	Above Normal	Notably high	Exceptionally high	Exceptionally high
Ouse	110	Normal	Notably high	Exceptionally high	Exceptionally high
Rye	90	Normal	Above normal	Exceptionally high	Exceptionally high

Swale (ne)	111	Above Normal	Notably high	Exceptionally high	Exceptionally high
Ure	126	Above Normal	Notably high	Exceptionally high	Exceptionally high
Wharfe	125	Above Normal	Notably high	Exceptionally high	Exceptionally high

8.2 River flows table

Site name	River	Catchment	Mar 2024 band	Feb 2024 band
Addingham	Wharfe	Wharfe Middle	Above normal	Above normal
Birstwith	Nidd	Nidd Middle	Notably high	Above normal
Briggswath	Esk	Esk Yorks	Normal	Above normal
Buttercrambe	Derwent	Derwent Yorks Middle	Above normal	Exceptionally high
Crakehill Topcliffe	Swale	Swale Lower	Normal	Above normal
Doncaster	Don	Don Lower	Above normal	Above normal
Elland	Calder	Calder Yorks Upper	Normal	Notably high
Hunsingore	Nidd	Nidd Lower	Notably high	Above normal
Kildwick	Aire	Aire Upper	Above normal	Above normal
Kilgram Bridge	Ure	Ure Middle	Above normal	Above normal
Ness	Rye	Rye	Normal	Notably high
Skelton	Ouse	Ouse Yorks	Normal	Above normal
Tadcaster	Wharfe	Wharfe Lower	Above normal	Above normal
Wansford Snakeholm Lock	West Beck	Hull Upper	Exceptionally high	Exceptionally high

Whittington	Rother	Rother Yorks	Above normal	Above normal

8.3 Groundwater table

Site name	Aquifer	End of Mar 2024 band	End of Feb 2024 band
Brick House Fm	Wharfe Magnesian Limestone	Exceptionally high	Exceptionally high
Dalton Estate Well	Hull & East Riding Chalk	Notably high	Exceptionally high
Great Ouseburn	Sherwood Sandstone	Exceptionally high	Notably high
Hill Top Fm	Millstone Grit And Carboniferous Limestone	Notably high	Exceptionally high
Riccall Approach Farm	Sherwood Sandstone	Notably high	Notably high
Sproxton	Sherwood Sandstone	Normal	Notably high
Wetwang	Hull & East Riding Chalk	Above normal	Exceptionally high