

Rivers Severn and Stour Comparisons

Turbidity, Water Chemistry and Waterweed



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July 2026

Foreword

These two rivers are very different in length and catchment area. While the Severn is around 220 miles long, the quoted distance for the Stour is around only 25 miles. For the Severn, it is the tributaries, such as Coal Brook and the Stour, which have the industrial legacy, though the larger river is arguably more affected by agriculture along its banks and some of its tributaries.

Such differences make comparisons between rivers difficult, exacerbated by the geological differences through which each passes and from which its tributaries are sourced. The Severn rises as the Afon Hafren amongst acid upland mire whereas at least the eastern arm of the Stour is linked to flushes on the Clent Hills, some of which are clearly calcareous, as evidenced by the presence of tufa.

Nevertheless, for those of us living in the Wyre Forest District, some differences are very evident. For example, though both rivers become more turbid after heavy rain, it is more transient in the Stour, and in the Severn the turbidity is perceived to last longer now than before. Another stark difference is that all the waterweed, once plentiful, has been lost from the Severn over the last decade, whereas in 2025 even Water Crowfoot *Ranunculus* species were widespread and sometimes luxurious in their growth in the Stour, including where it passes through the town of Kidderminster.

This year-long study aims to provide figures that give better measure to these observations.

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Executive Summary

The approach is based on taking water samples from the River Severn at Bewdley and four points along the Stour through Kidderminster every week for a year. It started in February 2025 and concluded at the end of January 2026. Measurements of turbidity, pH, conductivity and temperature were taken on the river bank and a 250ml sample collected in a plastic jar for determination of phosphate, ammonium, and nitrate at home, with occasional measurement of calcium.

Estimates of species and quantity of waterweed were recorded through the summer of 2025 at locations throughout Kidderminster. Water crowfoot was found throughout the town, occasionally with species of *Myriophyllum* and narrow-leaved *Potamogeton*. These species became scarce beyond the downstream end of the town, and were reduced to just *Sparganium emersum*, also scattered throughout the town. *Myriophyllum* species and narrow-leaved *Potamogeton* were also found, though scarce, adjacent to the Wilden Marsh nature reserve, later in the summer. No waterweed of any type was observed in the Severn at Bewdley during the survey year.

The report also takes advantage of similar data collected by groups such as the Kinver Climate Action Group, collated by the Severn Rivers Trust. These provide a wider context for the variation in measurements taken along the Lower Stour.

Although significant rain events affecting the two rivers are not always the same, sufficient are, to allow comparison of their respective responses. Turbidity is usually but not always associated with a rise in river level following rainfall events. The intensity of the turbidity rises higher in the Severn and lasts for longer than in the Stour. At least one significant peak for the Severn in May 2025 could not be attributed to rainfall or any other known activity.

Looking at the four points through Kidderminster, there is the usual pattern of more concentrated constituents in the summer. There is evidence that the Oldington sewage treatment works outfall contributes more phosphate-P to an already enriched river, but that nitrate, at unusually high concentration in the Stour, originates further upstream. Phosphate-P in the Stour is above the Water Framework Directive 0.1ppm threshold for Good Ecological Status for most of the year.

Many factors are likely to contribute to why waterweed is found in one river and not in the other. While an increase in turbidity may be important in its own right, it has to be considered in combination with P-adsorption onto clay particles, and how all factors have come together to sustain a sediment-rich layer covering the river bed, instead of a covering of gravel.

It is suggested that the complexity of the interactions are in the same order of magnitude as those for the Norfolk Broads decades ago, and that a first step in finding a way forward is to get all parties and sources of information together at a carefully-constructed conference.

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1. Background and approaches

- 1.1. It is important to recognise that, particularly for the Severn, the study relates to a very small proportion of the rivers' lengths. This is why the following section describes the total extent of each, and how the study areas fit within them. Information is available from beyond these confines, and where available this is also given to help provide a wider context. There is no implication that these additional sources are used to their full potential, and it remains for their originators to provide detailed analysis and interpretation.
- 1.2. The water chemistry and other quality parameters are explored to compare the Wyre Forest District part of the Severn with the Kidderminster stretch of the Stour. The contributors of silt and solutes lie upstream of the study areas, but for the Stour there is a focus on how constituents change from the river's entry to Kidderminster town to its exit, and the two known sewage treatment works outfalls just to the south. These include the emergency discharge from the Hoo Brook pumping station, and the Oldington Outfall.
- 1.3. While there are sewage treatment works discharging a little further upstream than the Severn sampling point, greater input is thought to be in the Shrewsbury area, where the sewage collection network is known to overload frequently. There is a works outfall south of Bridgnorth, others along the lengths of Borles Brook and another joining a small stream tributary of the Severn at Hampton Loade. There are also several CSOs or Combined Sewerage Outfalls, between Upper Arley and Stourport. In the past there has been at least one unregulated discharge into Dowles Brook, some 1.4km upstream of its confluence with the Severn. It has been beyond the scope of a single person to sample around all of these, though it is hoped that the River Guardian Scheme, organised under CARP, will be able to explore them further in the future.
- 1.4. The analytical kits available to individuals and voluntary groups fall short of the sophisticated tools used by bodies such as the Environment Agency (EA). Their strengths and weaknesses have been looked into by workers at Cardiff University (Cardiff University, 2022), at the behest of those concerned with pollution on the River Wye. While the accuracy of, for example, the Hanna hand-held instruments, is less than for the EA measurements, it is both indicative and comparative within its own dataset. While accuracy is important when determining whether samples conform to, for example, the Water Framework Directive, samples analysed with the same kit over a period of time, even if less accurate, are still comparable. Again, while maybe not precisely accurate, they are still indicative of the 'ball-park' magnitude of the concentration within the water sample. If challenging the findings, the onus is then on the EA to check out whether the conclusions drawn from the measurements are of consequence to them.
- 1.5. From some perspectives, such as those of a county or national database, it is important for the identification of waterweed specimens to be accurate, preferably down to sub-species where such exist. In other contexts, such as this survey, the requirement is more binary, in that weed is either present or absent. Additional ecological inferences about conditions in the river can be drawn from genus or even species, though such precision is sometimes difficult when observing from a bridge or bankside, without collecting a specimen. The approach in this project aims at a reasonable compromise between time taken and accuracy.
- 1.6. An earlier report (Meade, 2024), uses EA plant records to show that the diversity of the river bank flora is diminished. Unreported records from 2025 show some species, such as Flowering Rush, to be more widespread than was previously thought.

2. Contexts and sampling points

2.1. The River Severn, which rises and flows through Wales as the Afon Hafren, is around 224 miles long and has a catchment of approximately 21,000 square kilometres. Its span, and the position of the sample points are shown in Figure 1.

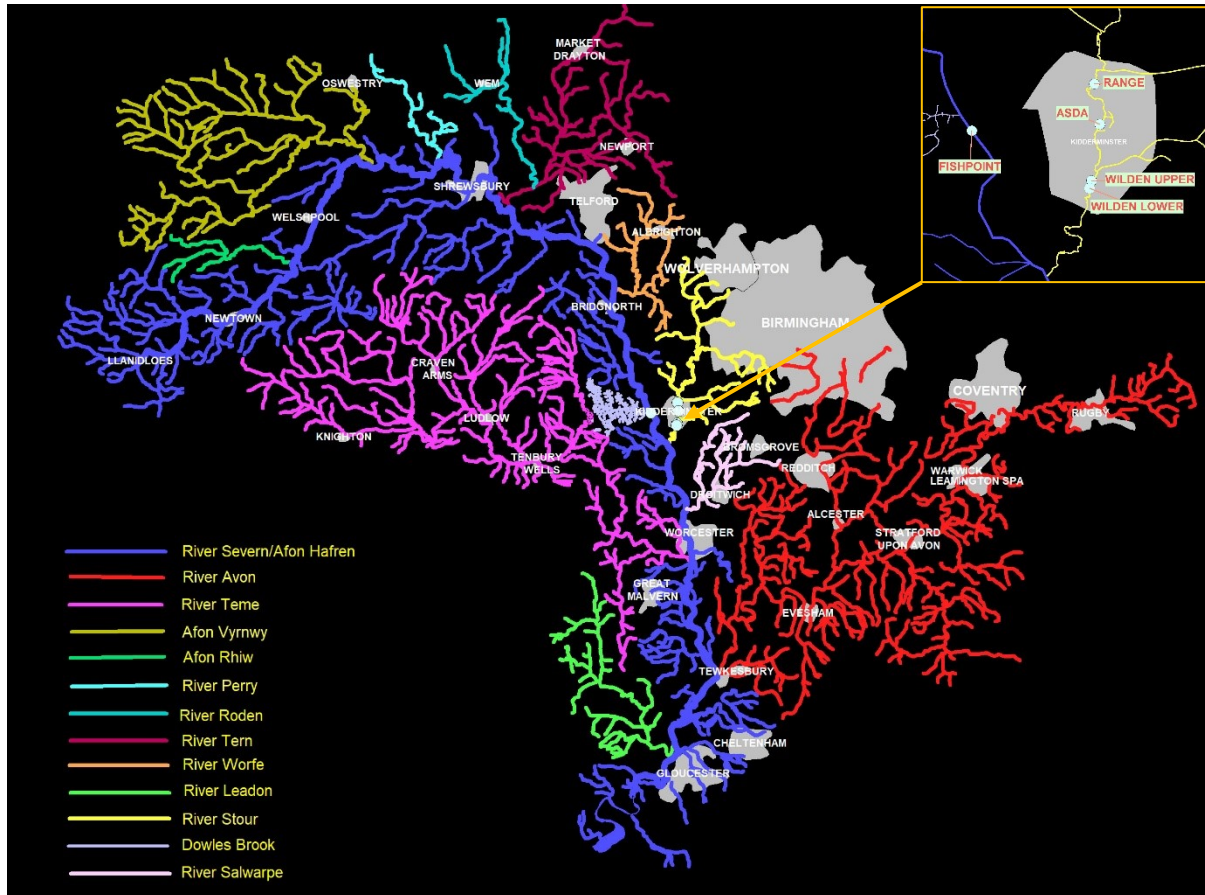


Figure 1 River Severn catchment with tributaries. Inset top right shows named sample points. The watercourses and town polygons were digitised from OS maps © Ordnance Survey. Gaps occur where no watercourse could be picked out on the map, particularly in urban areas.

2.2. The figure shows the position of the five sampling points across the two rivers. For the Stour all are close to its confluence with the Severn, and that for the Severn is about halfway along its course. For the Severn, samples were taken from an anglers' platform, labelled here as Fishpoint; for the Stour, the river enters the town of Kidderminster close to The Range car park, and leaves it behind the Asda car park. The Oldington Sewage Treatment Works outfall (Figure 2) is opposite the Wilden Marsh Nature Reserve, Site of Special Scientific Interest (SSSI), so that Upper Wilden is upstream of it, and Lower Wilden downstream. The Upper Wilden point is downstream of a pumping station close to the Hoo Brook tributary (Figure 3), which has an overload outfall into the River Stour. There are many outfalls into the river as it runs through the town as two parallel channels, but nothing is known of their connections or if they discharge anything other than surface water from the streets. No formal outfall survey has yet been carried out along the River Stour.

2.3. The Stour catchment (Figure 18), though on a scale one-tenth of the Severn, is similarly complex. It has two major arms, converging near Stourbridge (Black Country Society, 2021). Smestow Brook receives water from the west side of both Wolverhampton and Birmingham, while that from the east is from flushes in the Clent Hills, converging near Halesowen.



Figure 2 Oldington Outfall 30th January 2026.

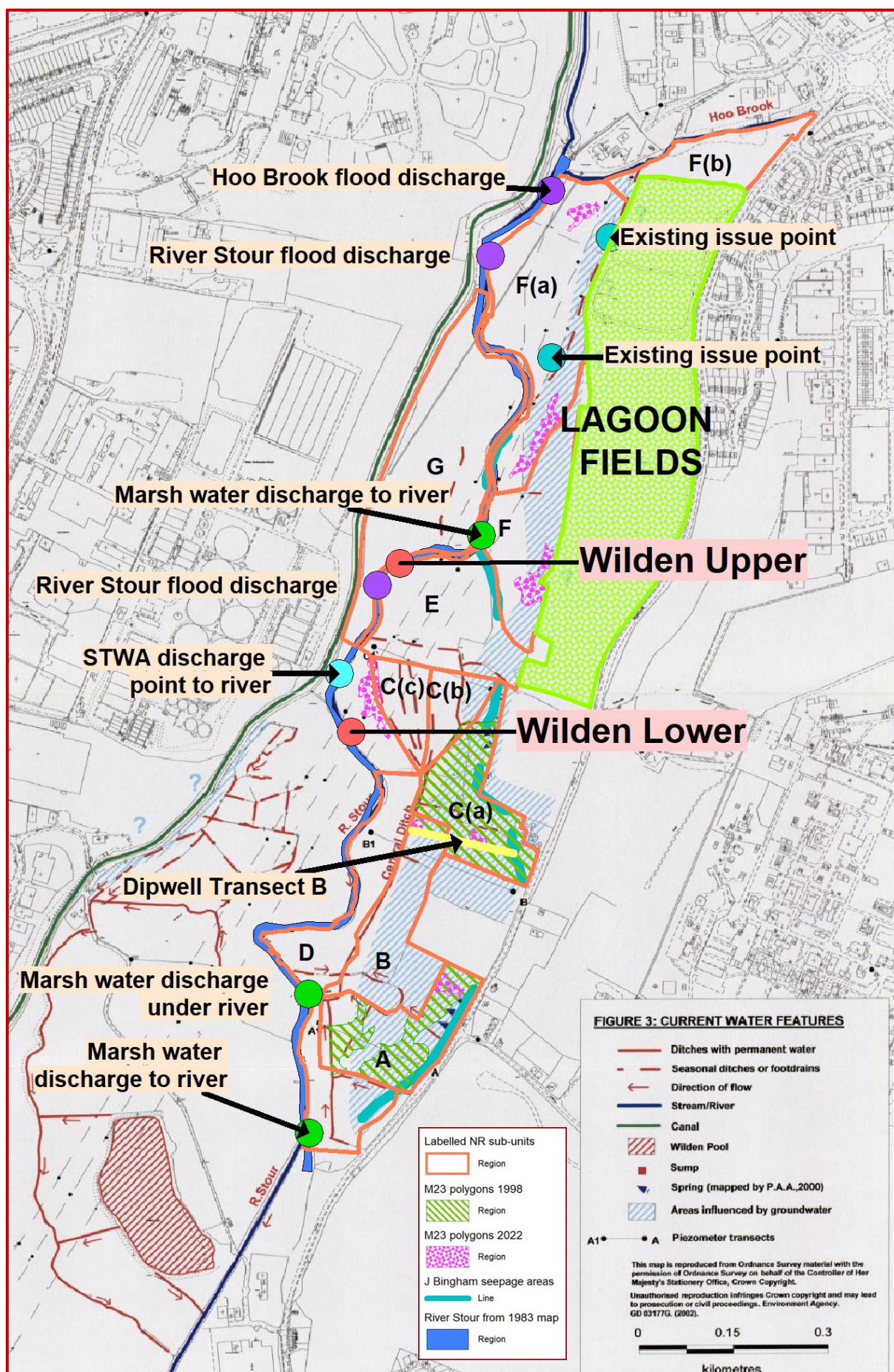
(Roger Meade)



Figure 3 Hoo Brook Pumping Station outfall

(Clive Wood)

- 2.4. The presence of foam on the surface in Figure 2 is misleading, in that much of it is formed after the river passes over riffles just upstream of the outfall.



- 2.5. While much of the information on Figure 4 is peripheral to this report, it emphasises the importance of river water quality where the special interests, such as groundwater-fed wetlands, are vulnerable to seasonal flooding from the 'River Stour flood discharge' point. There was a conscious decision in the 2006 Water level Management Plan, written by the EA, to substitute the failing groundwater supply to the marsh with river water. While the length of river from which water floods over the marshland is upstream of the Oldington Outfall, the high concentration of phosphate and nitrate measured in all four Stour samples is potentially damaging to these special interests.

3. Making the measurements and their limitations

- 3.1. Samples were taken weekly from the five points shown on Figure 1. Water was scooped up, either in a bespoke stainless steel extendable sampling pot, or in a plastic jug suspended from an extendable garden tool appliance. The turbidity, pH, conductivity and temperature were measured on the river bank, before a sample was transferred to a 250ml plastic screw-lid jar. The same jar was used for each sample point throughout the year of sampling. This is significant only in that the opacity of jars varied according to source by the end of the project, see Section 10.
- 3.2. The turbidity was measured using a Jackson Tube graduated in Nephelometric Turbidity Units (NTUs). Other tests completed on the river bank were made with a Hanna Combination pH and conductivity meter, which compensates for temperature. In the home laboratory each sample was measured for phosphate and ammoniacal N using Hanna Checkers and nitrate using Pro JBL Aquatest, a colorimetric method which, as sold, relies on matching colours on a comparator card. Accuracy was improved by comparing the absorption of each sample with that of a range of nitrate solutions from 5 to 50ppm, as read in a ScienceScope Logbook colorimeter at 470nm.
- 3.3. As samples were all taken from the river bank, it could not necessarily be from the main flow current. It was possible to reach closer to the river centre at the Asda sampling point for the Stour, and the other three positions enabled a couple of metre's reach from the bank. For the Severn, being from an angling point on a very wide river, it was closer to the bank. Wilden Upper was around 200m upstream of the Oldington Outfall, and Wilden Lower around 100m downstream of it.
- 3.4. Turbid samples settled out quicker for the Stour points, suggesting coarser sediments. On most occasions they were allowed to settle for a couple of hours before pipetting the requisite 10ml for the Hanna Checkers and JBL Aquatest. Any residual turbidity was removed from the calculation by zeroing the instruments on a blank sample. Attempts to record turbidity as absorbance by the colorimeter were abandoned as readings were very low. It was hoped that the temporal colour changes underpinning the turbidity could have been recorded at different wavelengths on the colorimeter, but it was too insensitive to provide meaningful comparisons.
- 3.5. Calcium, or hardness, was measured in some samples using titration with EDTA in alkaline solution, with murexide as indicator. The mean of three replicates was recorded.
- 3.6. Sample jars were washed thoroughly between occasions, and the collecting utensils also washed to reduce cross-site contamination.

- 3.7. Weekly samples are no substitute for continuous monitoring, such as obtained with a sonde. Discharges may be short-lived, or happen overnight, so would be missed by being taken regularly between 08:00hr and 11:00hr on a Friday. As always, a single measurement is an advance on none, so weekly measurements may pick up overall trends, if not their detail.
- 3.8. Other observations were included as the project progressed. While little was visible in either river when in spate and consequently turbid, these included waterweed and fish fry. The mass presence of the Banded Demoiselle *Agrion splendens*, a damselfly, was observed rather than noted. It is particularly prolific alongside the Stour at Wilden Marsh between May and August.

4. Comparative water level fluctuations

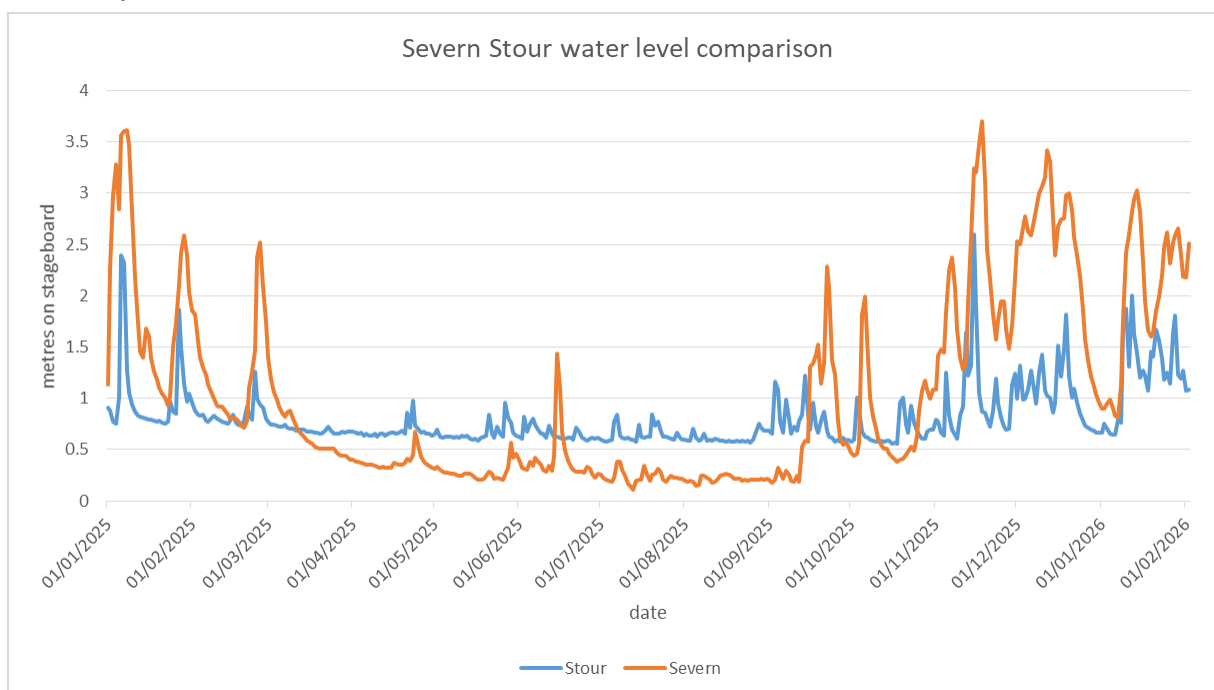


Figure 5 Comparative daily water level fluctuations between the Severn and Stour.

- 4.1. Mean values for daily recorded water levels for both rivers close to the sampling points are given in Figures 5 and 6. The data is downloaded from the riverlevels.uk website, selecting those that were recorded between 31 January 2025 and 1 February 2026. In Figure 5 the electronic gauge reading is plotted against date, and in Figure 6 the percentage of records falling within each 10cm incremental range is given.
- 4.2. While peaks on the two traces mostly coincide, there are some where the Severn rises proportionally more than the Stour, and *vice versa*. This could be explained by the regional variability of rainfall events, and that the Severn has a far larger catchment, originating on high ground in west Wales.
- 4.3. The difference between lowest and highest water level for each river shown in Figure 5 is 2.038m for the Stour and 3.593m for the Severn. The relative positions on the chart are not of consequence because the water level as shown in Figure 5 is determined by a stageboard (electronically) and is not reduced to Ordnance Datum, or to lowest value for each, as has been done in Figure 6.

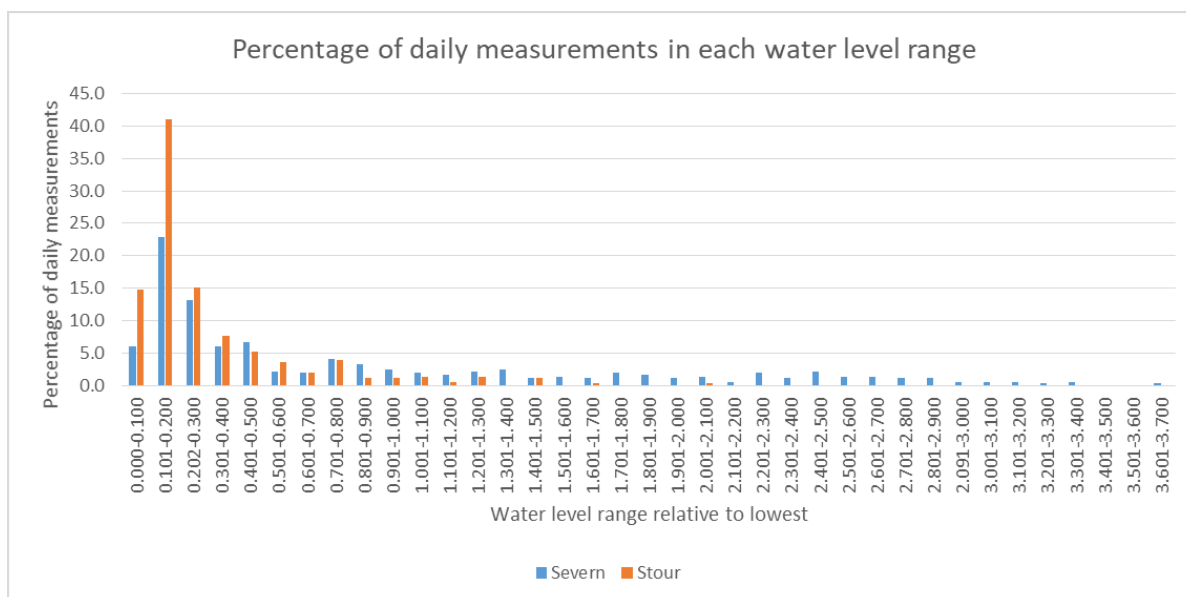


Figure 6 Frequency of water levels in 10cm increments, each river range zeroed on its lowest value

- 4.4. The River Stour water level stays within a 30cm fluctuation range for 70% of the year, with just one peak at 2m above the baseline. Most peaks are within 1-1.5m of the baseline. It shows that the river level rises and falls quickly for each rain event, and rarely plateaus above the baseline figure for longer than two or three weeks, likely to be when more than one rain event occurs in succession.
- 4.5. For the River Severn the baseline is low and slightly declining between May and August, with a few fairly temporary spikes in response to rain events. The first five range classes in Figure 6, which represent the summer plateau, occupy 48% of the year. The remainder of the range classes are spread out over a longer period than for the Stour, suggesting that the water level is slower to rise and subside around each rain event, or group of rain events. The overall recorded range for the year is just over 3.5m, a metre and a half more than in the Stour.
- 4.6. It is assumed that the water velocity is positively correlated with the water level, though no figures have been researched. It is not uniform over the cross section of the river and would be a difficult parameter to explore in relation to its effect on the survival of waterweed. It is likely though, that the river approaches more closely to laminar flow as the depth increases.

The water level in the River Severn fluctuates over a wider range than in the River Stour. The Stour varies by less than 30cm over 77% of the year, compared to the Severn's baseline 50cm fluctuation over 48% of the year. The peaks are also different, with the Severn rising exceptionally by around 3.5m, and the Stour by 2m. The water rises and falls within the Stour more quickly than in the Severn in response to rain events.

5. Turbidity, pH and conductivity in the Severn

- 5.1. The display of these parameters uses a weekly plot of river levels. A comparison of daily and weekly figures is provided in Figure 7. It shows that some of the peak detail is lost when using weekly figures.

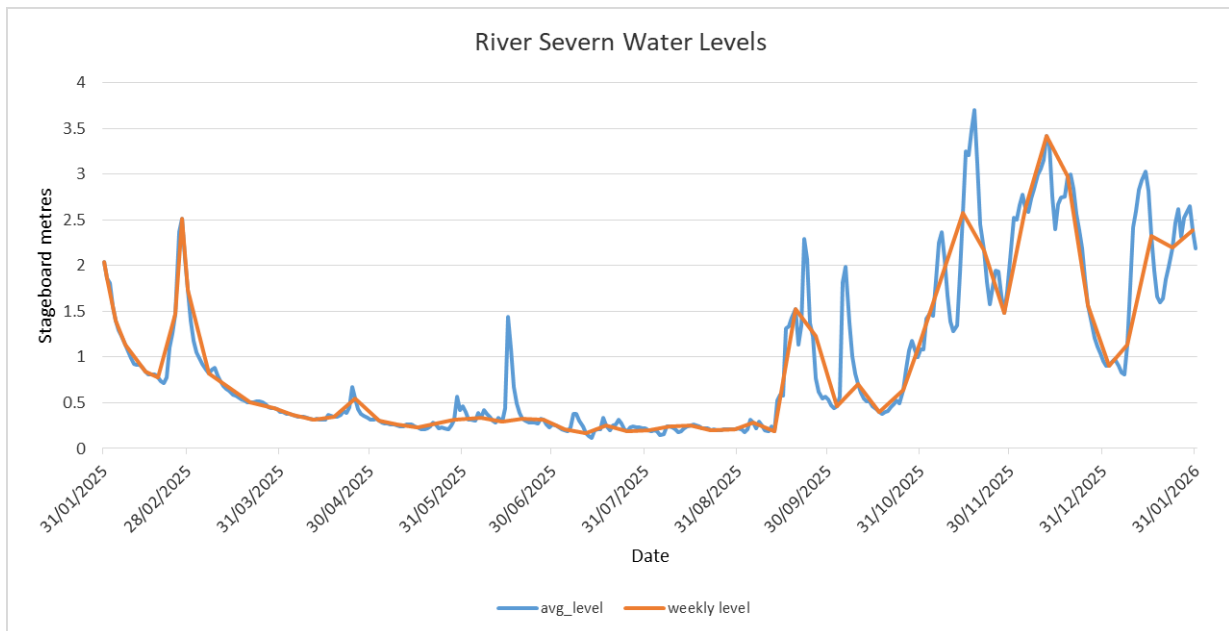


Figure 7 Comparison of average daily and weekly water levels to describe the Severn variation

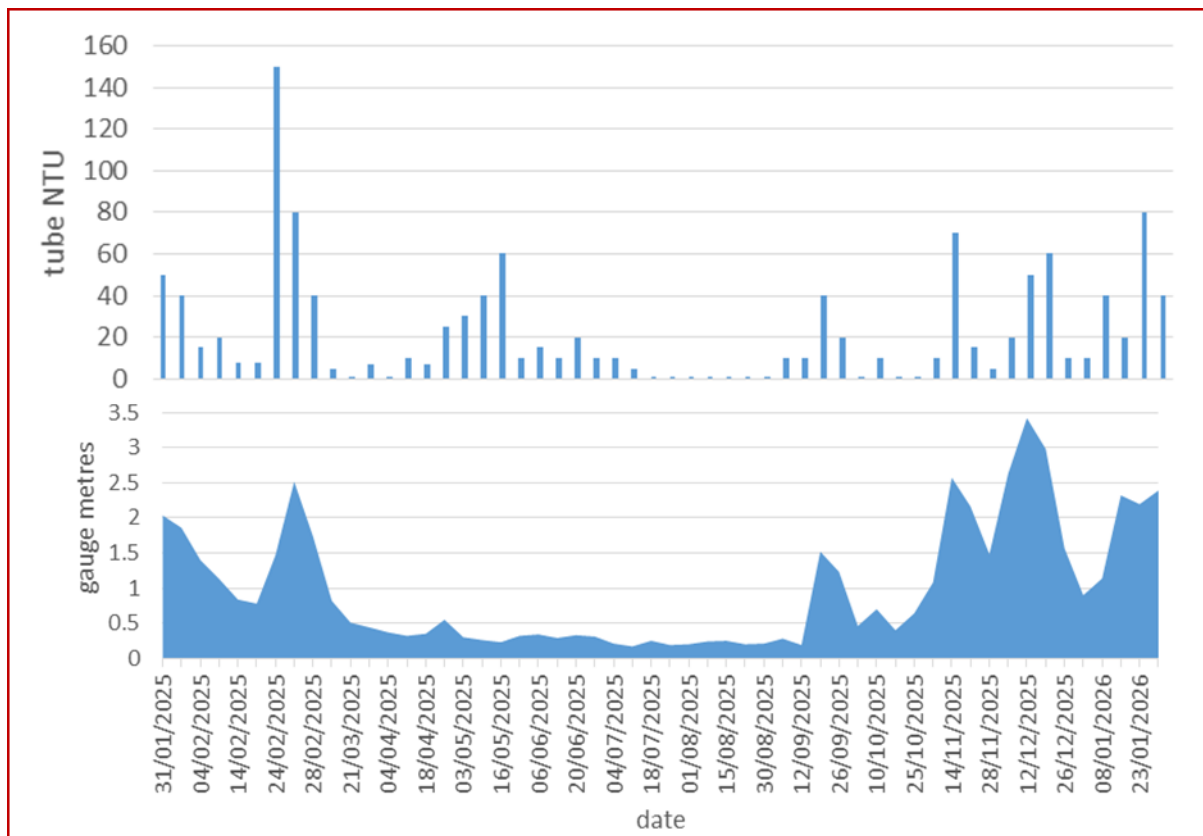


Figure 8 Comparison of turbidity and water level for Bewdley Severn using weekly data

- 5.2. Figure 8 shows that in most cases the turbidity peak coincides with that of high water level. The exception is a turbidity peak around 16th May, which has no high water counterpart. The weekly plot of water level (top) is compared with the plot from daily data (bottom) in Figure 7. Although there is a water level peak on the daily data plot for 15th June, at a value of 1.44m, it came a month later than the turbidity peak of 16th May. The turbidity on 16th June

is above baseline and provides a very subdued turbidity peak of 20NTU, small by comparison with 60NTU on 16th May. The photographs taken on each sampling occasion show nothing to explain the 16th May turbidity peak. Though river colour changes subtly as described in Section 8, nothing was recorded or is evident in the photographs to suggest, for example, that it might have been caused by an algal bloom. Other possibilities include run-off from large-scale building groundworks upstream of Bewdley, unrelated to rainfall events.

- 5.3. The least turbid value recorded by the Jackson Tube is 5, so when less turbid it was recorded as <5. In order to register as a number in the chart, all <5 values were entered in the spreadsheet behind Figure 8 as 1. Figure 8 shows that <5 was maintained throughout July and August, and represents its baseline value. It was also achieved for short periods in March, April, September and October.
- 5.4. Conductivity, pH and temperature are shown in Figure 9. The pH meter was changed as indicated, as the electrode was suspected of malfunction within the confines of the red box.
- 5.5. As is to be expected, the water temperature ranges from around 5°C in winter to 25°C in the peak of summer. The Severn was always sampled before the Stour, any time between 07:00hr and 09:00hr, which in winter was before any contribution from the sun. At other times, the air temperature rose rapidly in the first part of the day, before sampling took place.
- 5.6. The conductivity ranges between 200 and 600µs, the pattern being the inverse of the water level. It implies that the conductivity, dependent on the concentration of ions in the water, is lower when a greater volume of water is in the river to dilute it. Conductivity is likely to be dependent on relative contributions from the many different sources, those of upland Wales and recently-fallen rain being scarcer in ions, except for hydrogen, than those closer to Bewdley with sources composed largely of mineral-enriched groundwater.
- 5.7. The measurement of pH at the start was affected by a faulty electrode in the pH meter (red box in Figure 9), so little confidence can be placed in the low pH values entered at the start of the survey. There is no reason to think it affected conductivity readings. Similar low values were not experienced in the following winter. The river has a comparatively high pH, with the maximum values of over 9 occurring at much the same time as the mid-May turbidity peak. There is no additional evidence to suggest the two have a common cause.

Date	wlevel	Turbidity	pH	cond	temp	PO ₄	PO ₄ -P	NH ₄	NO ₃	NO ₃ -N	Ca
04/04/2025	0.370	1	8.44	561	13.5	0.14	0.05	0.00			
16/05/2025	0.230	60	9.18	592	16.7	0.09	0.03	0.00	21	4.7	
20/06/2025	0.330	20	8.02	350	21.3	0.33	0.11	0.08	15	3.4	
18/07/2025	0.250	1	8.12	506	22.3	0.39	0.13	0.00	27	6.0	
01/08/2025	0.200	1	8.34	470	18.8	0.41	0.13	0.00	19	4.3	
08/08/2025	0.240	1	8.33	510	18.9						57.2
05/09/2025	0.280	10	8.11	496	16.7	0.37	0.12	0.00	19	4.3	
10/10/2025	0.700	10	7.98	242	13.5	0.16	0.05	0.01	11	2.5	
25/10/2025	0.640	1	8.32	403	10.4						46.5
14/11/2025	2.573	70	7.79	180	11.2	0.13	0.04	0.16	11	2.4	
21/11/2025	2.162	15	8.03	268	5.4						33.6
02/01/2026	0.899	10	8.08	436	5.0	0.28	0.09	0.00	18	4.1	
08/01/2026	1.137	40	8.25	509	3.7	0.22	0.07	0.02	13	3.0	57.1
30/01/2026	2.391	40	8.29	307	6.7	0.23	0.07	0.09	11	2.5	

Table 1 Concentration of measured plant macronutrients and calcium (as hardness).

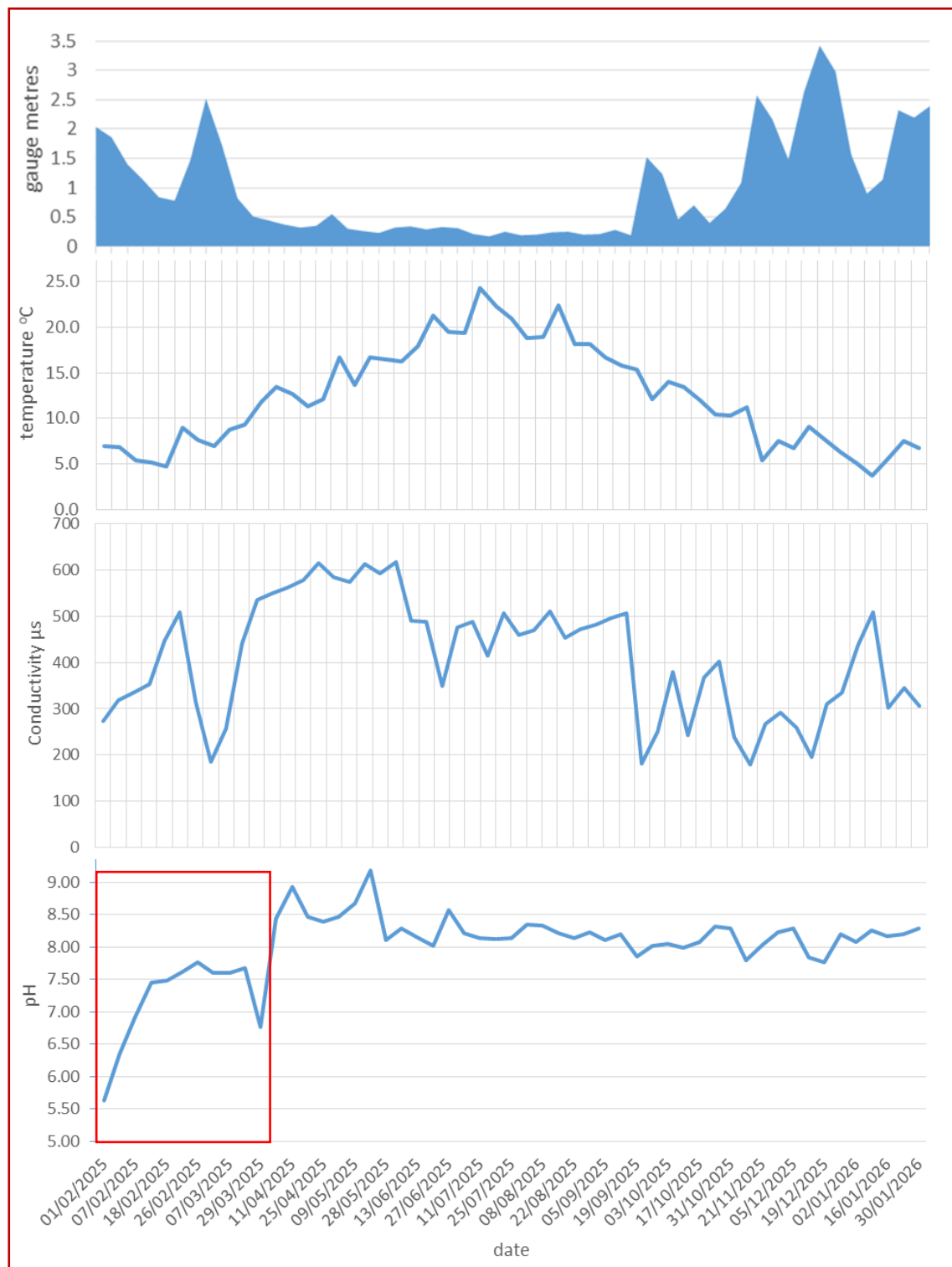


Figure 9 Water temperature, conductivity, and pH

5.8. The plant macronutrients phosphorus and nitrogen were measured on a limited number of occasions as CARP Citizen Scientists already take regular samples close to Bewdley, and each test has a cost element. Unique to this project, calcium (as hardness) was measured for a few samples. All records are given in Table 1.

- 5.9. There is not necessarily an inverse relationship between water level and the concentration of ions, though there is a tendency for P, for example, to be higher at low water level, and nitrate follows the same pattern. Ammonia spikes are seen at higher water level, but, exceptionally, at low water levels as well.

The Severn has a high pH throughout the year. By contrast, the conductivity, a way of measuring the ionic content of the water, varies so as to suggest it is more dilute when the flow velocity and water volume is high. The sediment load as measured by its turbidity is generally higher with elevated water level and flow velocity. There was an exception in mid-May when a moderate peak in turbidity occurred without a water level rise, linked to a slight higher (more alkaline) pH. So far, it remains unexplained.

Plant macronutrients were not measured sufficiently frequently to pick up variation with water level, but to provide a baseline comparison with figures for the River Stour.

6. Stour comparative turbidity and water chemistry; relationship with outfalls

- 6.1. Alongside the preceding characterisation of the River Severn, the second objective was to look for differences in water quality along a short stretch of river through and south of Kidderminster. In particular, to see if there are differences in the constituents being measured that could be attributed to outfalls from sewage treatment works, or from overflows at the Hoo Brook pumping station.
- 6.2. Also to pursue the difference in waterweed presence between the two rivers, presented in Section 7, by comparing the turbidity measured in the Severn with that in the Stour. (Figure 10).

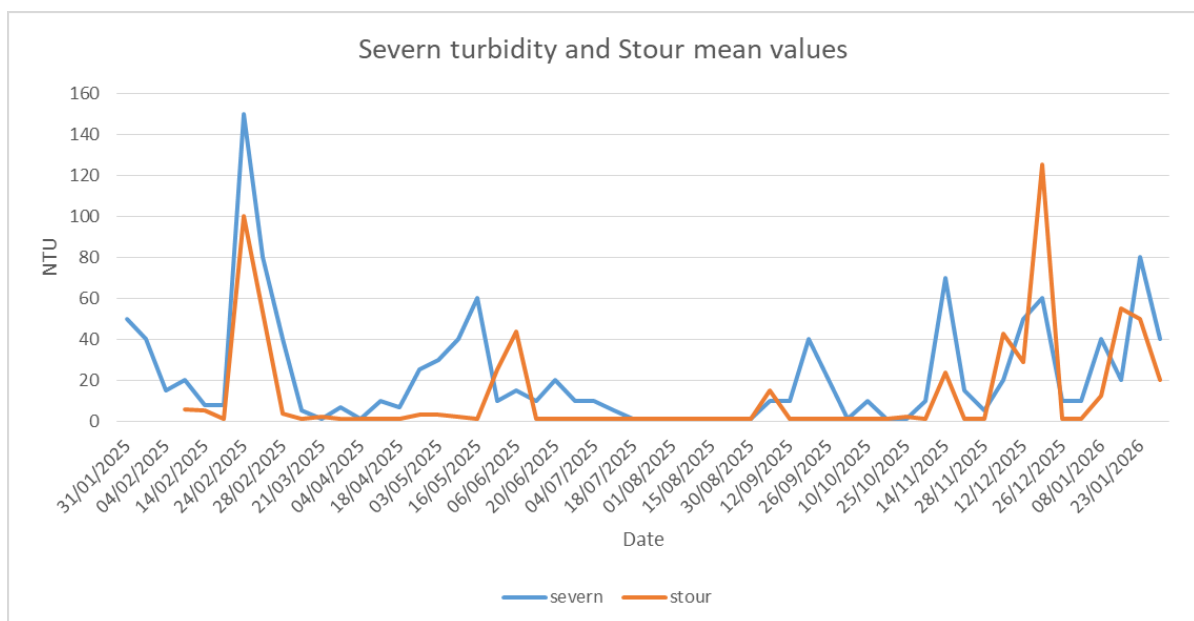


Figure 10 Turbidity comparison, Rivers Severn (Bewdley) and Stour (mean of four locations)

6.3. There are exceptions when the two traces do not coincide. One is the unexplained mid-May peak on the Severn and another in September. Most turbidity coinciding on both river are higher in the Severn, but there was an exception in December when the Stour reached 120 NTU and the Severn only achieved 60 NTU. The higher turbidity in the Severn during events affecting both, last longer in the Severn. Overall, it is true to say that the Severn carries more sediment contributing to turbidity, manifest in higher peaks that are slower to clear.

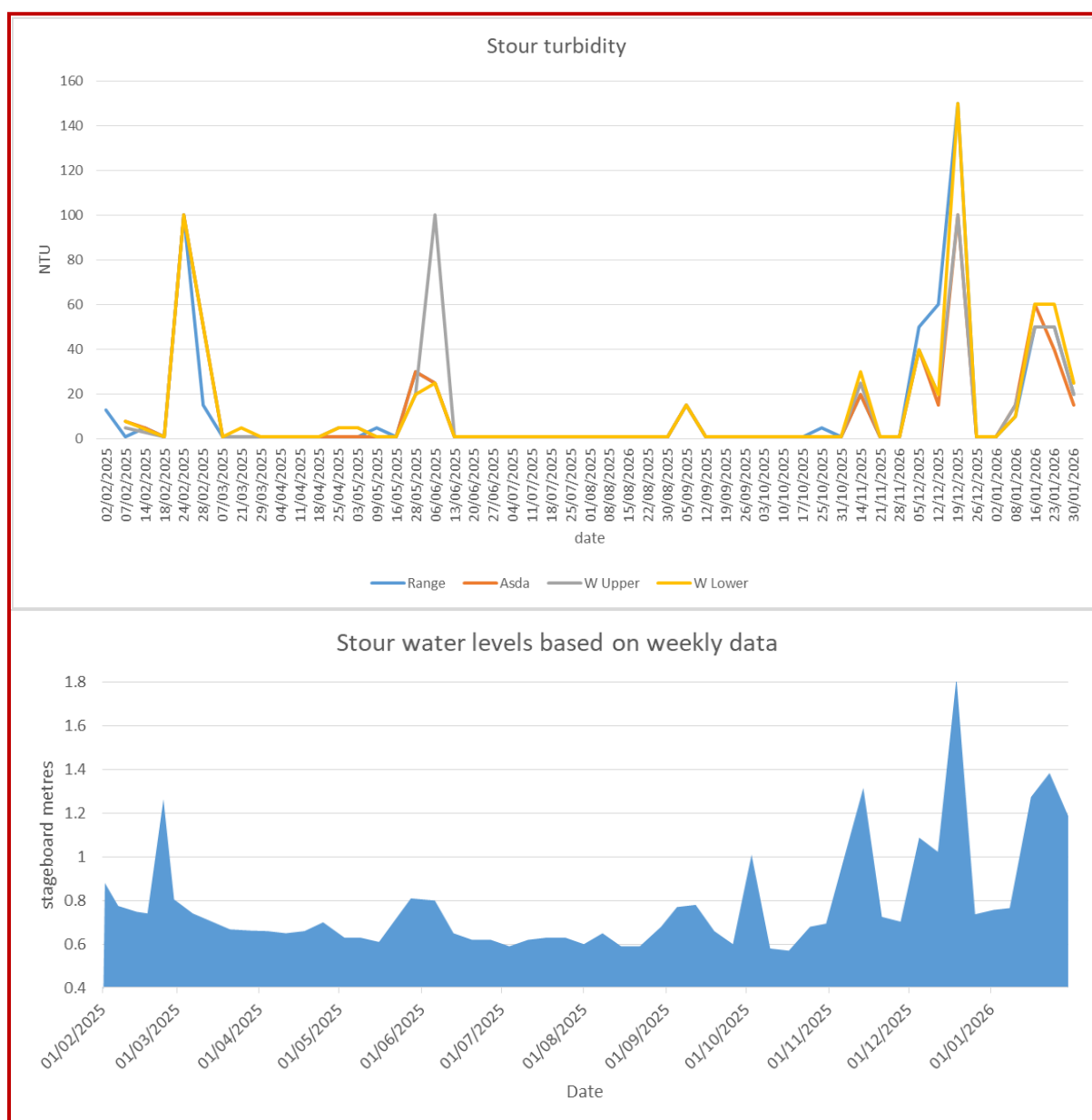


Figure 11 Turbidity and its relationship with weekly river water level data

6.4. Turbidity peaks at the same time as water level except for one example on 1st October, where the high water level was not matched by an increase in turbidity.

6.5. Calcium (hardness) was higher in the Stour, average 83.9ppm (min 74.8ppm, max 94.8ppm), compared to 48.6ppm (min 33.6ppm, max 57.2ppm) in the Severn.

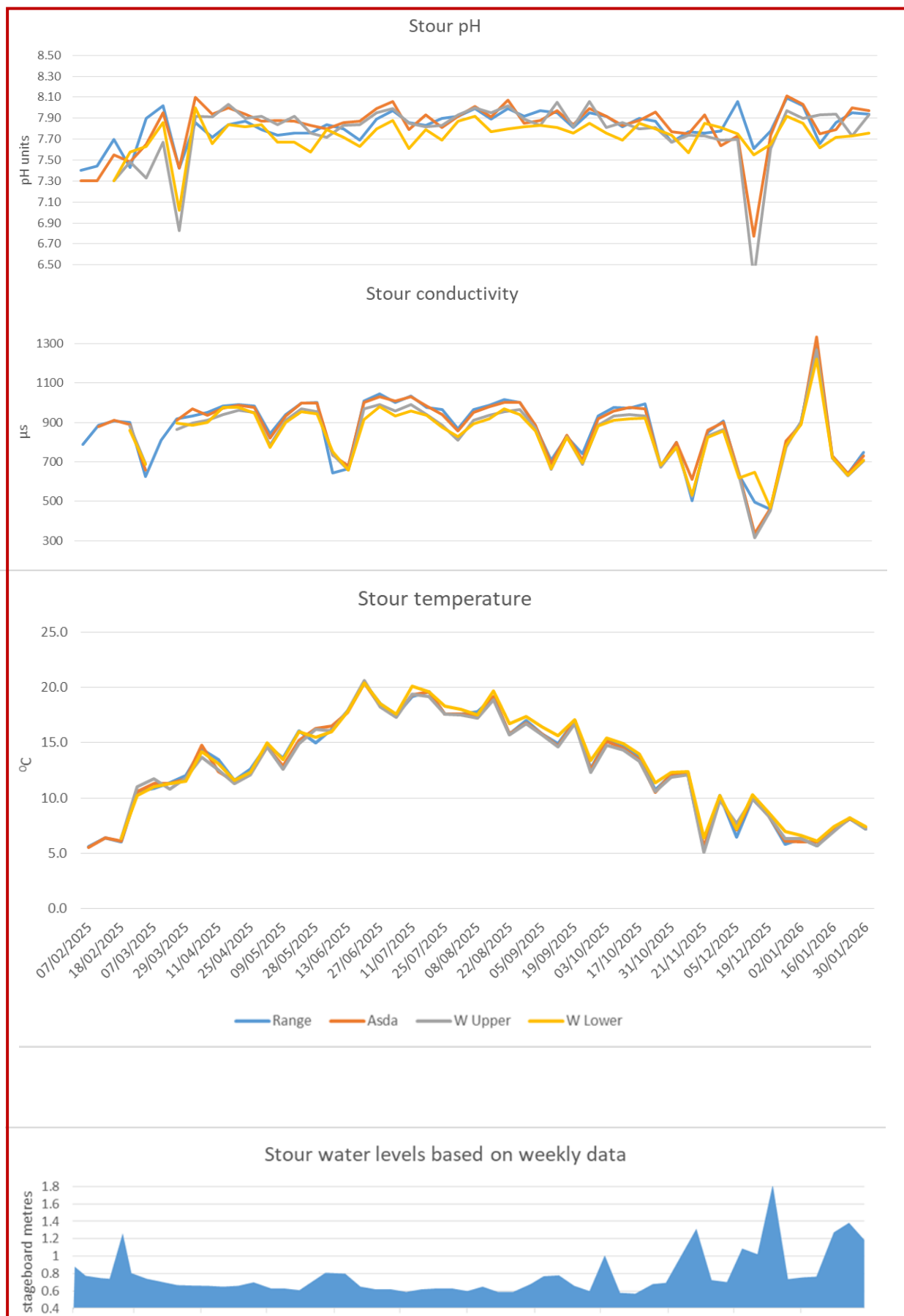


Figure 12 Water quality attributes – pH, conductivity and temperature

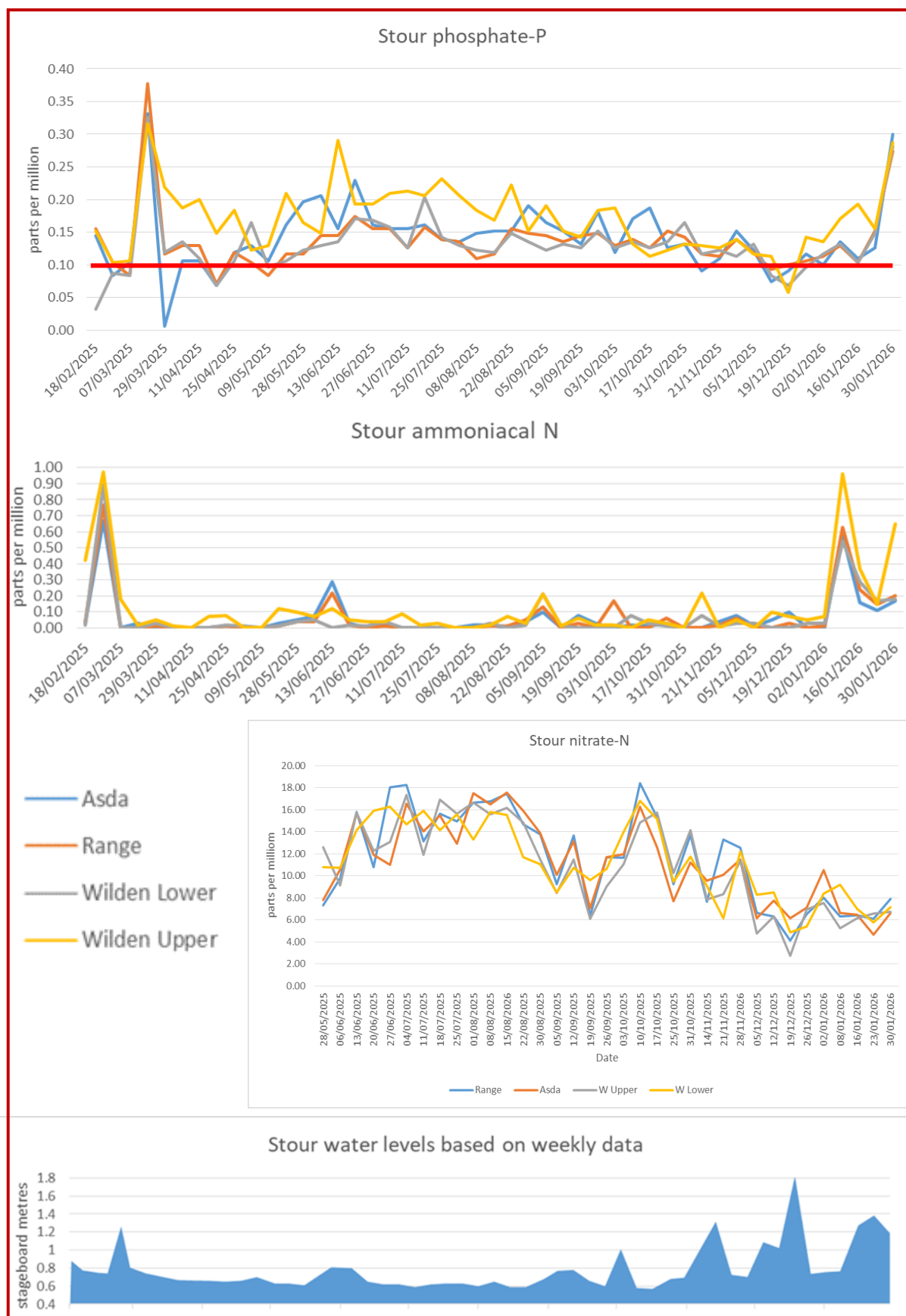


Figure 12 Water chemistry attributes – phosphorus and nitrogen. The WFD 0.1 ppm threshold for Good Ecological Status is added as a red line.

- 6.6. There is a tendency for the pH to be slightly lower (more acidic), downstream of the Oldington Outfall. There were occasions in March and December when there was a marked drop in pH, but is not always spread across all four sampling points and does not coincide consistently with water level events. On the first occasion, it was 6.83 at Wilden Upper, and 7.02 at Wilden Lower, when Range and Asda were both 7.42. In this case, it suggests water of lower pH entering the river from Hoo Brook, which is downstream of Puxton where the water level was 0.662, very much within the lower ranges. On 12th December, with an elevated water level of 1.023, there were pH values of 6.77 and 6.38 respectively at Asda and Upper Wilden, but 7.61 and 7.55 at The Range and Wilden Lower. No explanation can be offered for the positioning of the differences.
- 6.7. The electrical conductivity is variable, the only discernible pattern being falls coinciding with water level peaks on 24th February and 19th December. Water levels were 1.264 and 1.82, while conductivity was 660 μ s and 460 μ s. This may reflect a difference in the contributions from the different tributaries during heavy rain, something that would be heavier in some locations than in others. The water level chart offers no explanation involving dilution for the changes in conductivity throughout the summer.
- 6.8. The water temperature has a winter low of 5°C, as did the Severn, but at 20°C did not reach the 25°C seen in the Severn. As with the Severn, the air temperature increased rapidly during the sampling occasion in all but winter, so that the sequence in which the points were sampled may have an effect on the recorded temperature. Air temperature was always noticeably lower where the river is overshadowed by trees, though flow is fast, and it is unlikely to be reflected in the water temperature.
- 6.9. Phosphorus, plotted in Figure 12 as such and not as ppm phosphate, shows the greatest difference of items measured between Lower Wilden, downstream of the Oldington Outfall, and samples upstream of it. The average for each sampling station taken over the whole data set was: Range 0.14ppm, Asda 0.14ppm, Upper Wilden 0.13ppm and Lower Wilden 0.17ppm. There were occasions, such as in mid-April, when P at Lower Wilden was 0.05ppm higher than the other stations. It had 0.2ppm, compared to 0.11, 0.13 and 0.11 for The Range, Asda and Upper Wilden respectively, some 67% higher. As shown in Table 1, the measured range for the Severn was from 0.04ppm to 0.13ppm. No significant differences were seen between up and downstream of Hoo Brook, though it was not seen to discharge at any time.
- 6.10. Ammoniacal nitrogen shows two peaks, on 24th February 2025 and 8th January 2026. They coincide with high water levels, 1.264 on the first and 0.765 on the second. The ammonium peaks were 0.67ppm, 0.77ppm, 0.89ppm and 0.97ppm for the four points in sequence for the first, and 0.58ppm, 0.63ppm, 0.54ppm and 0.96ppm for the second. Though variable, Lower Wilden, being downstream of the Oldington Outfall, had the highest value. The high values in all suggest ammonium was being contributed upstream of Kidderminster as well as from Oldington, all arising during periods of high water level and increased water volume.
- 6.11. Nitrate values are very variable, and do not correlate with sampling station, time of year or the water level. While there were peaks in the middle of the summer and again in October, the overall trend in nitrate N is down from the beginning to the end of the sampling. A colorimeter was only used to measure the colour developed within the test from mid-May onwards. Previously, it was recorded by matching the colour with the chart provided. The correlation between the two diverges with increasing concentration, as shown in Figure 13. As the colour increases, each step in concentration of nitrate is greater, so the mismatch becomes amplified.

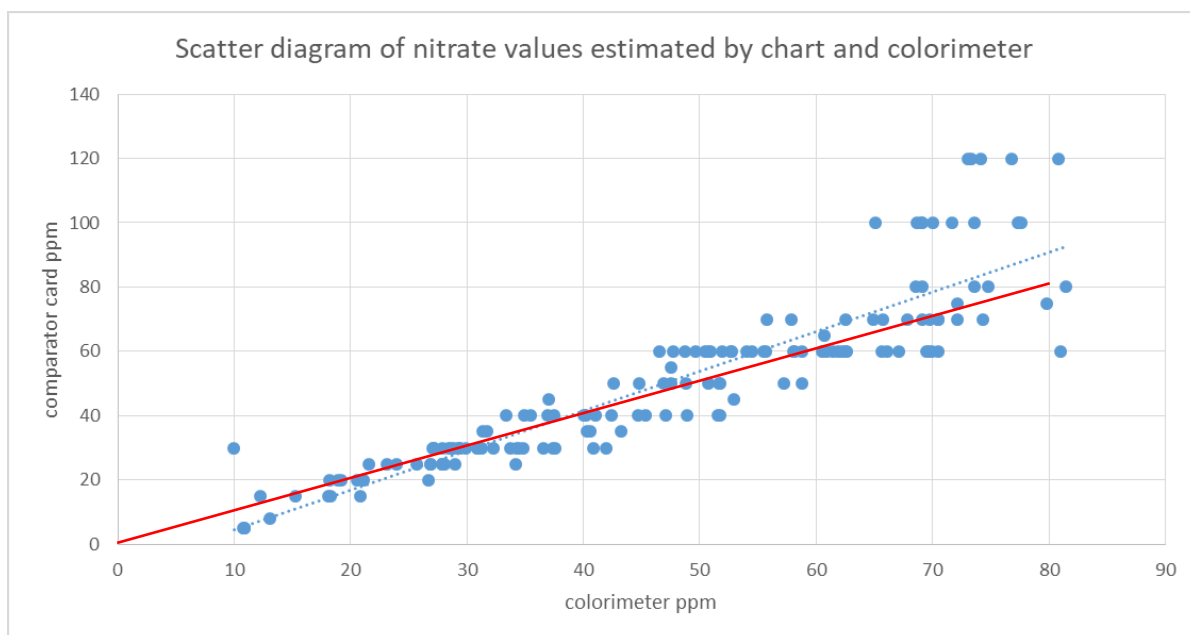


Figure 13 Relationship between the concentrations of nitrate estimated from the chart or colorimeter, with Excel trend line. The added red line illustrates perfect correlation.

6.12. The nitrate-N values derived from the comparator card have not been added to Figure 12 because of their potential inaccuracy. The total range beyond mid-May is from 2ppm to 18ppm; seven measurements taken on samples from the River Severn over the same period ranged between 2.4ppm and 6ppm, the Stour being potentially three times as high.

Turbidity in the Stour has lower peaks and falls more quickly after a high water level event than in the Severn. Though other factors are variable, such as pH, electrical conductivity and nitrate-N, there is insufficient information to link them to water level for any of the four samples points. By contrast, phosphate-P concentration increases in summer, and on many occasions is higher downstream of the Oldington Sewage Treatment Works outfall, exceptionally by 67%. Similarly, ammoniacal N, which shows two water level-related peaks, is slightly higher downstream of the outfall. For most of the year the phosphate-P concentration in this part of the River Stour exceeds the 0.1ppm Water Framework Directive threshold for Good Ecological Status more frequently than in the River Severn.

7. The distribution of waterweed

7.1. This account is available within the Wyre Forest Study Group's 2025 Annual Report (Meade, 2026), and is repeated here because it is relevant to the water chemistry observations.

7.2. Throughout 2024 and 2025 much survey effort went into looking for waterweed between Bridgnorth and Bewdley in the River Severn. On casual observation, there is currently none, except for Amphibious Bistort *Polygonum amphibium*, rooted within the river bank, mostly north of Arley. This contrasts with how it was, up to around five years ago, for which there is copious photographic evidence of dense beds of aquatic *Ranunculus* species, or Water Crowfoot, in many places. The demise of the waterweed, as shown in Environment Agency data between 2002 and 2022, is recorded in Meade (2024).

7.3. The decline in biota is not restricted to the waterweed, and members of the Study Group have reported the loss of molluscs and bryophytes, with a concomitant rise in filamentous green algae, and possibly *Melosira*, a colonial diatom, mixed with a fine buff-coloured sediment that obscures the formerly gravel-covered river bed. Details of these surveys are also included in Meade (2024). A comparison of macrophyte and invertebrate-based indices for assessing the ecological status of the river are compared in Meade, Averill & Ponman (2025).

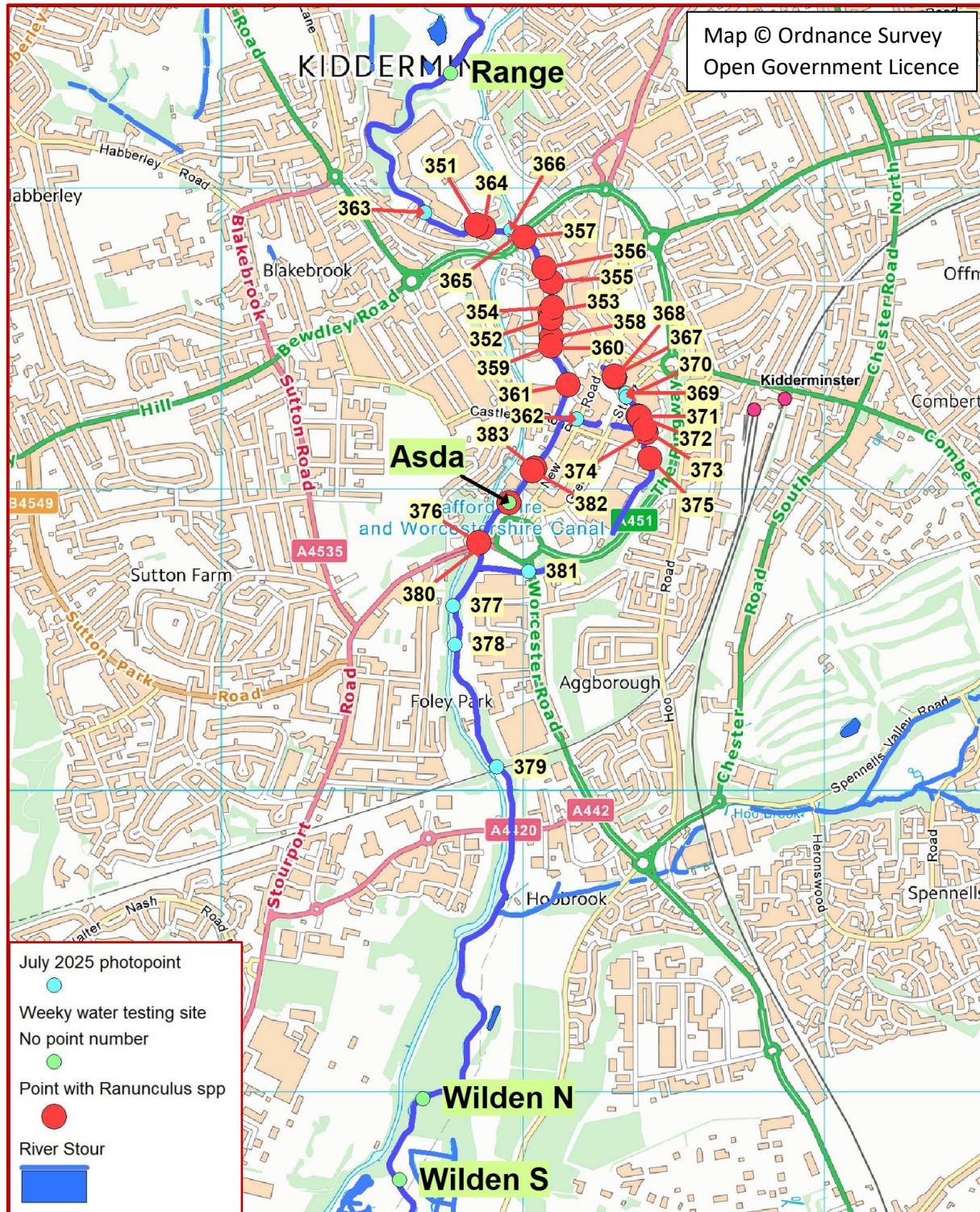


Figure 14 Waterweed sampling points and the four used for water testing

point	Notes	<i>Sparganium emersum</i>	Narrow-leaved <i>Potamogeton</i>	Aquatic <i>Ranunculus</i> spp	<i>Myriophyllum</i> spp
351	<i>Sparganium emersum</i> plus another	+++	++	(+)	-
352	Possible <i>P. pectinatus</i> and <i>Ranunculus</i> downstream	+++	++	+	-
353	<i>P. pectinatus</i> & <i>Ranunculus</i>	+	++	++	+
354	<i>Ranunculus</i>	+++	-	+	-
355	<i>P. pectinatus</i> & <i>Ranunculus</i>	++	++	+++	-
356	Possible <i>P. pectinatus</i> and <i>Ranunculus</i> upstream		++	+	-
357	Possible <i>P. pectinatus</i> and <i>Ranunculus</i> downstream	++	+++	++	-
358	River splits, runs under shops. <i>Ranunculus</i> .	-	-	+++	-
359	From bridge	+	++	++++	-
360	Mostly <i>Sparganium emersum</i>	++++	-	-	-
361	Mixed upstream, downstream <i>P. pectinatus</i>	+++	++	+++	-
362	Narrow waterway, a 'cut'?	+	-	-	-
363	Only <i>Sparganium emersum</i> seen, very little	+	-	-	-
364	<i>P. pectinatus</i> & <i>Ranunculus</i>	++	+	++	-
365	<i>P. pectinatus</i> & <i>Sparganium emersum</i>	+	+++	-	-
366	From canal; <i>Sparganium emersum</i>	+	-	-	-
367	<i>P. pectinatus</i> , <i>Ranunculus</i> , <i>Sparganium emersum</i>	+	+++	+	-
368	<i>Sparganium emersum</i> , <i>Ranunculus</i>	++	-	++	-
369	<i>Sparganium emersum</i> , <i>P. pectinatus</i>	+	+	-	-
370	Overgrown, no visibility	-	-	-	-
371	<i>P. pectinatus</i> , <i>Ranunculus</i> , <i>Sparganium emersum</i>	-	++	++	-
372	<i>Ranunculus</i>	+	++	+++	-
373	<i>P. pectinatus</i> & <i>Ranunculus</i>	-	++	+	-
374	<i>P. pectinatus</i> & <i>Ranunculus</i>	-	++	+++	-
375	<i>Sparganium emersum</i> , <i>Ranunculus</i>	+	++	+++	-
376	Bare, snagged strand of <i>Ranunculus</i> ?	-	-	(+)	-
377	Wooded, distant <i>Sparganium emersum</i>	+	-	-	-
378	Wooded, few strands of <i>Sparganium emersum</i>	+	-	-	-
379	Wooded, few strands of <i>Sparganium emersum</i> , silt	+	-	-	-
380	<i>P. pectinatus</i> . <i>Typha latifolia</i> , <i>S. emersum</i>	+	+	-	-
381	Diffuse <i>Sparganium emersum</i>	+	-	-	-
382	Mostly <i>Sparganium emersum</i> , strand of <i>Ranunculus</i> ?	+++	++	(+)	-
383	<i>Sparganium emersum</i> , <i>Ranunculus</i>	++	-	++	+

Table 2 Distribution of waterweed species along the River Stour through Kidderminster. A highly subjective and arbitrary score has been applied for each type, with ++++ as the highest cover.

- 7.4. The two other weekly water sampling locations at Wilden Marsh both had waterweed, the most northerly with *Sparganium emersum* and *Potamogeton pectinatus*, the other with *Sparganium emersum* and *Myriophyllum* species. The *Ranunculus*, that was identified as *R. penicillatus* subsp. *pseudofluitans* at one location in Kidderminster, is confined to the town, being absent from The Range, as the most northerly site, and downstream from the Worcester Road roundabout in the south. However, three other species of waterweed have been found further downstream, and Water Crowfoot is reported to be growing in the River Stour near Kinver.
- 7.5. The Stour was not examined between Point 379 and the Wilden Upper sampling station. In order of frequency, *Sparganium emersum* is commonest and is the sole weed representative for much of this urban river. *Myriophyllum* species were least frequent, with *Ranunculus* and narrow-leaved *Potamogeton* being recorded at a similar frequency and abundance score.

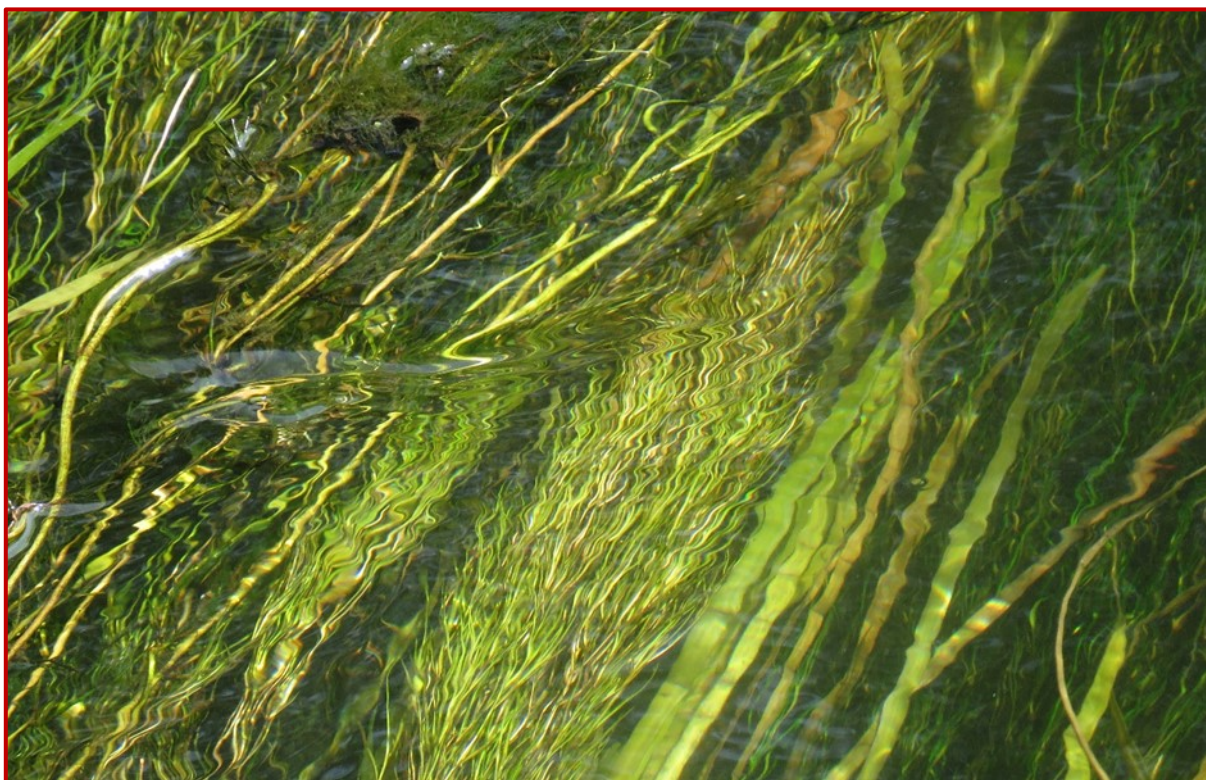


Figure 15 A mix of waterweed species in the Stour: *Ranunculus* spp, *Potamogeton pectinatus* and *Sparganium emersum* at Point 361

Despite having a higher concentration of phosphate-P and nitrate-N in the water compared to the 'weedless' Severn, the Stour had copious weed along its length through Kidderminster in 2025. It included plentiful *Ranunculus* Water Crowfoot, and had at least three other species of waterweed.

8. Other perspectives on Severn and Stour water quality

Turbidity

- 8.1. In this study reliance has been placed on turbidity as the index of suspended matter. There are others, such as suspended solids, and a comparison of data collected by the EA with the turbidity readings would be of interest. Beyond this, there is the evidence of the eye, able to

pick up changes in colour, but suspect due to its dependence on particular lighting conditions and observer differences.

- 8.2. At the outset, attempts were made to match water colour to various charts, including those deemed to measure turbidity (in NTU), but none really captured the changes being seen especially in the Severn. For example, river colour following a period of heavy rain resembles tomato soup (Figure 16), whereas when several days have passed, it may still be turbid, but the colour changes to olive-brown (Figure 17).



Figure 16 River Severn Bewdley 27 January 2026



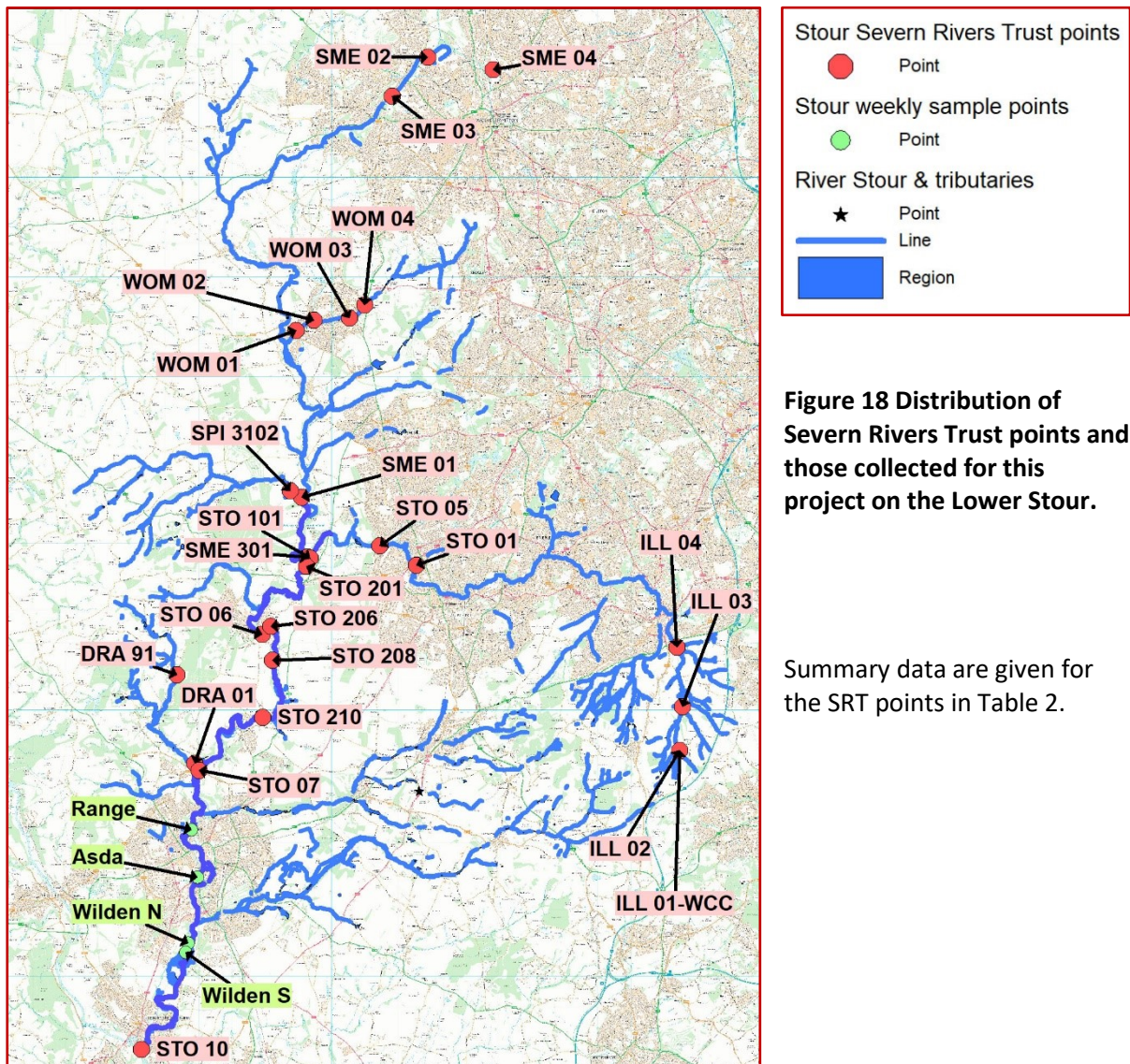
Figure 17 River Severn Upper Arley 27 October 2023

8.3. To discriminate between particles contributing to turbidity has been beyond this project, but may involve mineralogy to footprint the source, and the identification of unicellular or fragmented filamentous green algae to characterise the green element in the colour. It becomes important to explore this in the light of the river bed having become covered by a mix of filamentous green growth and silt, to the detriment of plant life and invertebrates, both of which have declined (Winnall, 2025).

Turbidity is made up of more than one component, and this is apparent from colour changes in the water. It is a subject requiring deeper study.

Water quality context – the Upper Stour

8.4. This study has been set in the Lower Stour, around the town of Kidderminster, and on the Severn at Bewdley. More is known about the Stour catchment, from measurements taken by local assemblages such as the Kinver Climate Action Group and collated by the Severn Rivers Trust. Their information is presented to provide a context for the Lower Stour work, and to show where gaps in knowledge and understanding still exist.



Site	metric	conduct- ivity µs	Phosphate (ppm)	Nitrate as Nitrogen (ppm)	Turbidity (NTU)	pH
DRA 01	AVERAGE	794	0.59	8.8	11	
	MIN	576	0.35	5.0	10	
	MAX	1020	1.09	10.0	12	
DRA 91	AVERAGE	397	0.22	3.0	21	
	MIN	304	0.06	2.0	11	
	MAX	500	0.71	5.0	27	
ILL 01-WCC	AVERAGE	564	0.14	4.4	15	8.7
	MIN	318	0.00	1.0	11	8.1
	MAX	878	1.17	10.0	50	8.8
ILL 02	AVERAGE	542	0.03	2.1	21	8.5
	MIN	348	0.00	0.0	11	8.3
	MAX	625	0.12	5.0	75	8.7
ILL 03	AVERAGE	528	0.25	3.0	16	8.6
	MIN	333	0.02	2.0	11	8.4
	MAX	632	0.80	5.0	35	8.8
ILL 04	AVERAGE	565	0.20	4.0	21	8.4
	MIN	363	0.00	1.0	11	8.2
	MAX	748	0.51	10.0	70	8.5
SME 01	AVERAGE	832	0.80	8.4	11	7.3
	MIN	419	0.27	2.0	11	7.3
	MAX	1010	1.34	20.0	11	7.3
SME 02	AVERAGE	931	1.86	7.5	11	7.5
	MIN	570	0.65	0.5	11	7.3
	MAX	1090	7.40	10.0	11	7.7
SME 03	AVERAGE	858	0.96	6.6	12	7.4
	MIN	503	0.36	5.0	11	7.2
	MAX	1007	1.34	10	15	7.5
SME04	AVERAGE	980	0.98	5.0	11	7.4
	MIN	560	0.74	5.0	11	7.3
	MAX	1330	1.15	5.0	12	7.5
SME 301	AVERAGE	809	0.96	5.8	11	
	MIN	407	0.21	2.0	11	
	MAX	1072	2.13	10.0	11	
SPI 3102	AVERAGE	445	0.23	2.8	11	
	MIN	272	0.00	2.0	11	
	MAX	542	0.30	5.0	13	
STO 01	AVERAGE	1057	0.14	2.6		
	MIN	732	0.00	2.0		
	MAX	1280	0.36	5.0		
STO 05	AVERAGE	556	0.14	2.4	12	
	MIN	481	0.05	2.0	12	
	MAX	624	0.22	5.0	12	
STO 06	AVERAGE	1272	0.67	10.5	19	
	MIN	436	0.34	2.0	11	
	MAX	5490	1.64	20.0	100	
STO 07	AVERAGE	536	0.45	5.7	43	
	MIN	452	0.24	2.0	11	
	MAX	683	0.73	10.0	105	
STO 10	AVERAGE	772	0.63	17.5	19	
	MIN	475	0.28	5.0	11	
	MAX	959	1.71	50.0	100	
STO 101	AVERAGE	920	0.24	3.3	12	
	MIN	490	0.00	1.0	11	
	MAX	1332	1.02	5.0	20	
STO 201	AVERAGE	855	0.70	4.8	12	
	MIN	427	0.33	2.0	11	
	MAX	1150	1.71	10.0	17	
STO 206	AVERAGE	879	0.51	6.7	11	
	MIN	590	0.26	5.0	11	
	MAX	1170	0.66	10.0	11	
STO 208	AVERAGE	854	0.67	13.3	11	
	MIN	646	0.22	10.0	11	
	MAX	1066	1.65	20.0	11	
STO 210	AVERAGE	835	0.67	10.0	11	
	MIN	690	0.38	10.0	11	
	MAX	1082	1.13	10.0	11	
WOM 01	AVERAGE	654	0.75	7.0	44	
	MIN	441	0.45	5.0	11	
	MAX	856	0.97	10.0	240	
WOM 02	AVERAGE	631	0.62	7.4	31	
	MIN	372	0.00	2.0	11	
	MAX	821	1.06	10.0	150	
WOM 03	AVERAGE	572	0.32	6.8	11	
	MIN	472	0.10	2.0	11	
	MAX	706	0.58	10.0	11	
WOM 04	AVERAGE	578	0.33	5.0	11	
	MIN	474	0.05	5.0	11	
	MAX	744	0.62	5.0	12	

Table 2 Summary data for SRT points. Each set of figures is derived from a varying number of measurements, which may also be from different times of year.

8.5. Figure 8 shows that coverage is patchy, with no values for Hoo Brook or Blakedown Brook, both of which have sizeable catchments to the east, some sources for Blakedown Brook being on the south side of the Clent Hills. There are also noticeable gaps to the north west towards Enville. Allowing for errors in the location coordinates, there are some pairs of points close to the confluence of the main stream and the tributaries that provide useful comparisons for where the higher values are originating, or which tributaries dilute concentrations in the main course of the river.

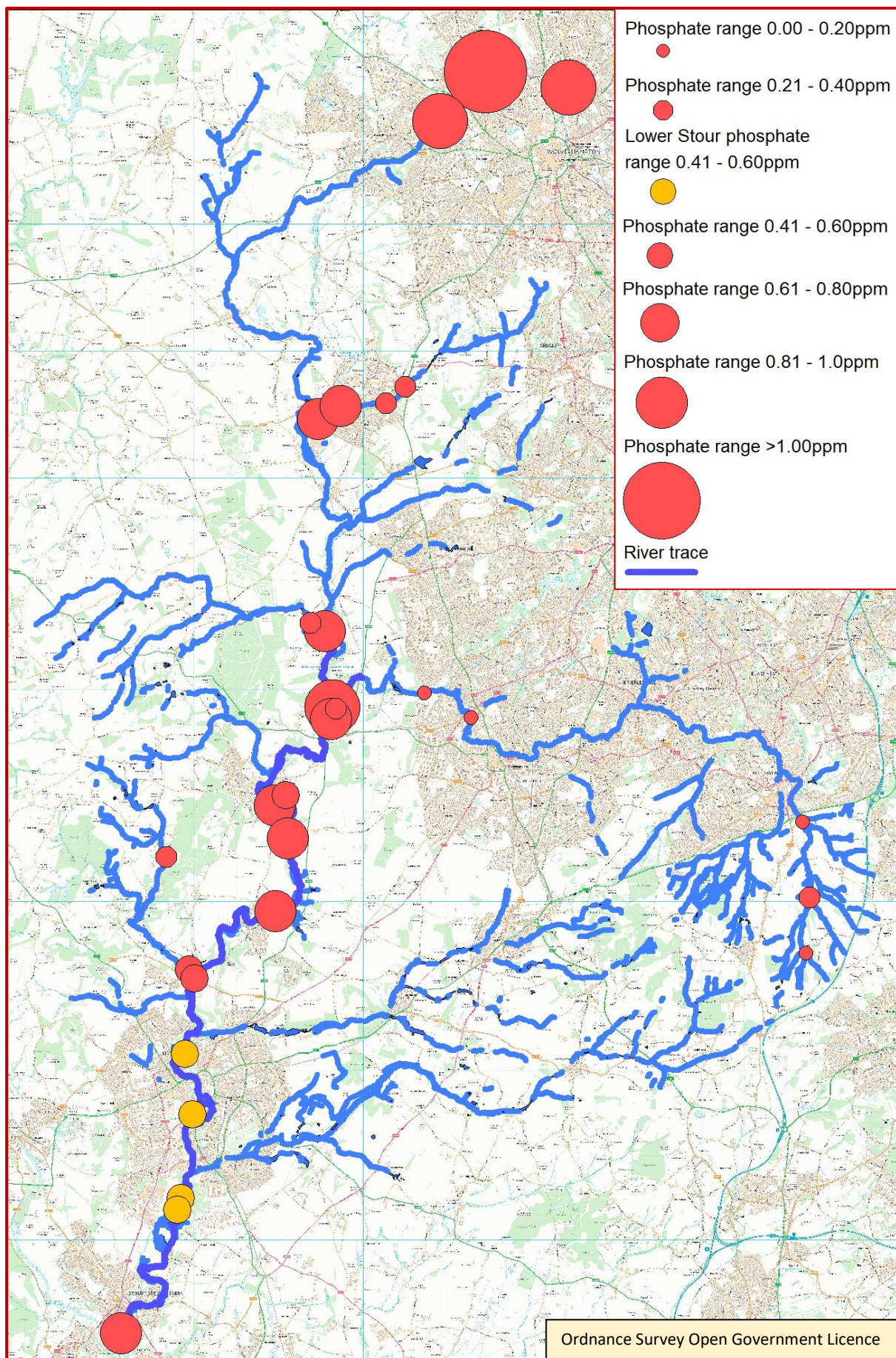


Figure 19 Averaged phosphate concentrations in size classes from SRT and project measurements

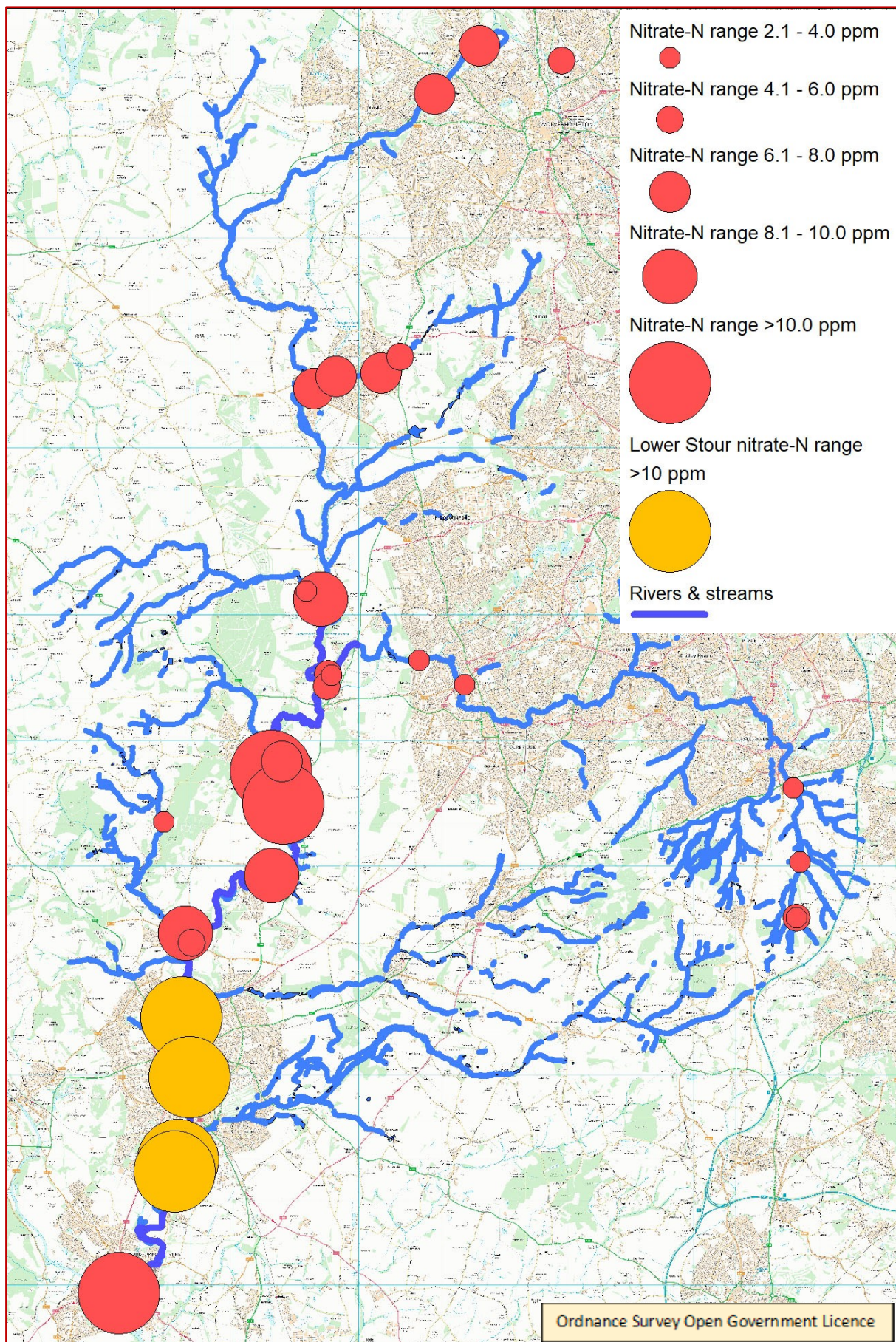


Figure 19 Averaged nitrate-N concentrations in size classes from SRT and project measurements

- 8.6. The maximum and minimum values given in Table 2 shows just how variable figures from any particular point can be. It diminishes the credibility of the average value as a steady state measurement, as does the range of dates (not shown) over which samples were taken. High flow is often associated with dilution of the constituents, so summer values are generally higher than winter at the same point. Comparing mostly summer figures with mostly winter figures from another can further erode the accuracy of any differences shown by the use of average figures.
- 8.7. Given these two caveats, it is important to see if plotting the average values fits with intuitive concepts of how the load increases with greater distance downstream, or how a high value may be diminished downstream by dilution with less loaded water from a tributary. To provide an assimilable graphic, and cope with the symbol sizes available in the mapping program, the average values for phosphate concentration and nitrogen present as nitrate at each point have been reduced to size classes and plotted on Figures 18 and 19.
- 8.8. As expected, the phosphate values are high at the source of the Wolverhampton arm of Smestow Brook, but much lower at the few measured sources on the north of the Clent Hills. Phosphate remains relatively low past Halesowen and Stourbridge, until the two strands of the river join together. Phosphate values remain high down as far as Kinver, below which it is possible that water from tributaries dilutes it to the values measured through Kidderminster. It climbs once again in the only further sample close to the confluence with the Severn.
- 8.9. While nitrate-N values are high from the outset in Smestow Brook, they are diluted by the Halesowen arm of the Stour after confluence, but rise again significantly around Kinver. After a degree of dilution south of Kinver, values rise again to over 10ppm after Kidderminster, a value that is sustained for the remainder of its course to Stourport.
- 8.10. Further useful information may come from plotting the electrical conductivity in the same way as for phosphate and nitrate-N. Without companion figures for other ions, such as calcium, it would be difficult to interpret. The higher pH values (not included in Table 2) show a high (alkaline) value for the north Clent sources, consistent with calcareous springs and seepages. As seen from measurements made on the Salwarpe, salty springs can cause very high peaks of electrical conductivity. Values in excess of 1000 μS are shown in Table 2 for a number of point maxima, which, when compared with values between 200 μS – 600 μS for the Severn at Bewdley, are high.

9. Rubbish content of the Stour

- 9.1. The focus has been on turbidity and the dissolved constituents of river water, but there is another dimension, that of plastic and other rubbish. A significant rise in water level is accompanied by a flotilla of rubbish down the river, much of it plastic, of apparently unknown origin. It is the policy of some landowners to adopt the view that the next flood will take most of it away, but where does it go? Initially, into the River Severn, then into the estuary, an SAC and SSSI for its dependent wildlife. Having one of the largest tidal ranges in the world, the rubbish will be flushed out into the sea, where it affects fish, cetaceans, and other marine life, as seen on television, courtesy of Liz Bonnin and others.



Figure 20 Washed up on the banks of the Stour in Wilden Marsh Nature Reserve, SSSI, 30 January 2026. As left by the flow, no sorting or heaping.



Figure 21 Rubbish collecting around tree branches 30 January 26, Wilden Marsh

9.2. On 30 January 2026 not only had some of the rubbish 'beached', it had formed large slicks around tree branches dipping in the river (Figure 21), and coating some of the bankside vegetation. It included large metal objects such as fire extinguishers, such as had been seen on the river bed upstream at least two years earlier.

9.3. A press release was issued after the 30 January event and was reported in the Kidderminster Shuttle.

Large quantities of rubbish, particularly plastic, enter the Stour and are deposited temporarily on adjacent land. Much of it is later washed further down to the Severn, and hence out to sea. It is a danger to wildlife, an eyesore, and is total anathema to a society that prides itself on recycling and safe disposal of rubbish.

10. And finally – the mystery of the cloudy jars

10.1. Looking at the EA's online list of organic chemicals identified in the rivers, there is much to learn about which of them is likely to affect the ecology. In taking weekly samples for a year, the same acrylic jar was used for each sample point throughout. At the end, the jar used for the Severn remained clear, but all four used for the Stour were distinctly cloudy (Figure 22).

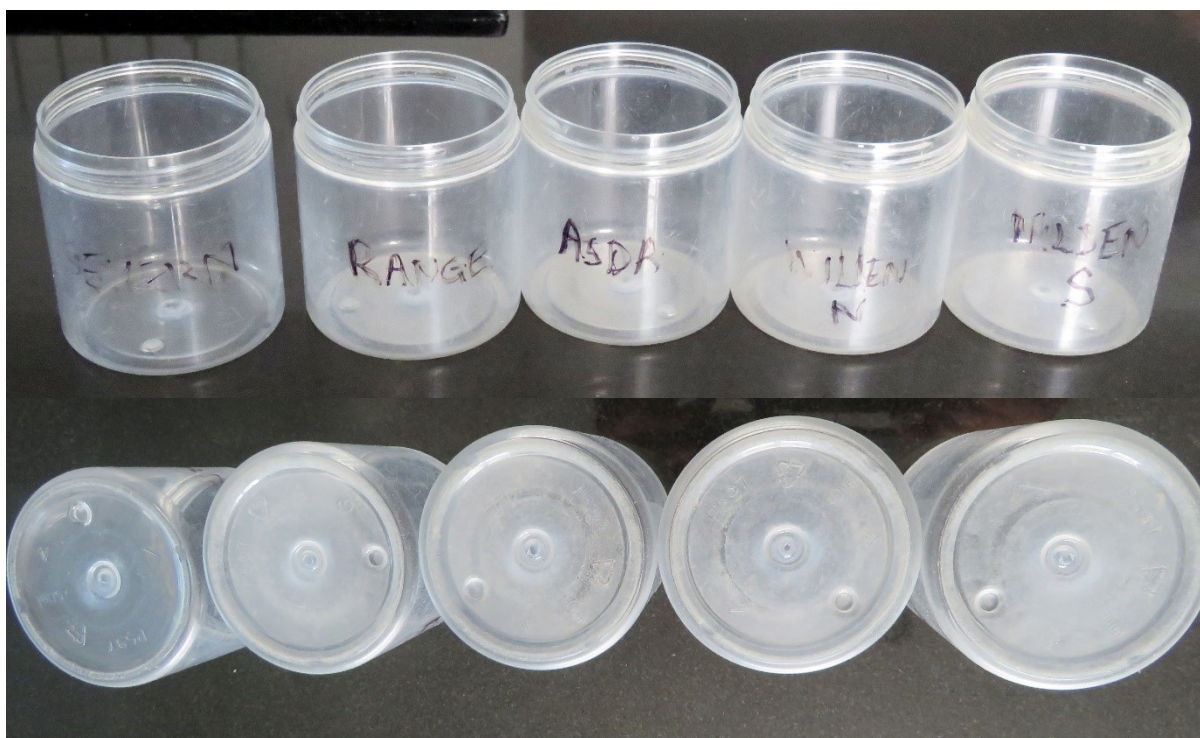


Figure 22 Weekly sample jars left to right: Severn, Range, Asda, Wilden Upper, Wilden Lower

10.2. The difference in opacity suggests the River Stour contains substances that etch acrylic plastic, but that they are absent or much more dilute in the River Severn.

11. Conclusions about the differences and their causative agents

11.1. While no river has a completely relevant analogue, the next best thing has been to compare that part of the Middle Severn flowing through Wyre Forest District with the lower reaches of the River Stour, which joins it as Stourport. There are three main points in the comparisons. The noticeable turbidity of the Severn, even in summer, is allegedly a recent phenomenon, and needed to be documented. Possibly linked to the turbidity, this length of the River Severn has no discernible waterweed, except for Amphibious Bistort, *Polygonum amphibium*, which grows attached to the banks rather than colonising the open deeper water. Whereas, the Stour was seen to have plenty of waterweed, and the project provided the opportunity to check this was true, by recording sightings and taking photographs. Finally, there was the contention that the Oldington Sewage Treatment Works in Kidderminster may be responsible for significantly adding to the concentration of phosphate and other nutrients to the River Stour.

Turbidity

11.2. The weekly measurements of turbidity in the Severn and at four locations on the Stour has shown that the Severn becomes more turbid than the Stour when responding to heavy rainfall events, and the elevation in turbidity lasts for longer. Consequently, the Severn can be described as more turbid than the Stour. It raises the question as to whether this alone could account for the difference in the growth of waterweed, or be just one component in a more complex web of events leading to that outcome.

11.3. It also raises the question as to what gives rise to the turbidity. A turbidity peak was noted in the Severn during mid-May 2025 that was not associated with a rise in water level. Without frequent monitoring on foot or via drone survey it is not possible to keep track of what is happening upstream that could give rise to the turbidity. To speculate on a few possibilities, it could be groundworks on a new building site close to the river, forestry clearance, ploughing close to the river, or the cleaning out of settling lagoons. There is no evidence for any of these, nor will there be without the necessary monitoring and survey being set up. In the absence of planned surveillance we are entirely dependent on serendipity.

11.4. It has been observed by local naturalists that the river bed has changed from gravel to a mix of filamentous green material in combination with a brown, largely organic precipitate. Anglers report that stronger currents have moved gravel down river. Given the comparative hydrodynamics of gravel and the fine organic precipitate, a current strong enough to move gravel would dislodge the precipitate first, and then reveal whatever lay beneath the gravel.

11.5. The link between the water turbidity and the physical nature of the river bed is unknown. Are the smaller particles simply trapped by the filamentous growth of algae or *Melosira* (a diatom), or is it a living 'schmutzdecke'¹, perhaps encouraged by higher than ideal plant nutrients? It is important to understand the relationship, and how, if at all, it affects the germination and establishment of waterweeds. Though the slower-flowing parts of the Stour have silty sediment, other places, such as behind Asda, still have a gravel bed.

¹ **Schmutzdecke**^[1] (German, "dirt cover" or dirty skin, is a [hypogeal](#) biological layer formed on the surface of a [slow sand filter](#) and a form of [periphyton](#).^[2] The schmutzdecke is the layer that provides the effective purification in [potable water](#) treatment, the underlying sand providing the support medium for this biological treatment layer. The composition of any particular schmutzdecke varies, but will typically consist of a gelatinous [biofilm](#) matrix of [bacteria](#), [fungi](#), [protozoa](#), [rotifera](#) and a range of aquatic [insect](#) larvae. As a schmutzdecke ages, more algae tend to develop, and larger aquatic organisms may be present including some [bryozoa](#), [snails](#) and [annelid](#) worms. *Wikipedia*.

Turbidity peaks higher in the River Severn and lasts longer than in the Stour. The dynamics of its formation, and links with the current state of the river bed needs to be understood. Beyond this, how, if at all, the change away from gravel on the river bed affects water-weed establishment.

Status of the waterweed and its relationship with nutrients

- 11.6. Although the concentration of dissolved phosphate has fallen in the River Severn over the last decade, its reduction has coincided with the loss of the waterweed. To speculate, is it possible that the phosphate is bound onto clay particles that get incorporated into the mix of green filaments and sludge? Or, does it promote 'schmutzdecke' growth, which might actually reduce the concentration of free phosphate, but make the riverbed unsuitable for waterweed (and other creatures)?
- 11.7. Given the observed change in river dynamics, which is widely thought to involve more intense flow for shorter periods, why does this layer not get washed away, when the previous gravel cover is reputed to have been taken downstream?
- 11.8. The Google AI Overview compiles the following notes: "Phosphate binding onto clay in rivers (adsorption) is the primary process controlling phosphorus transport and bioavailability. Phosphates adhere to active sites (like iron, aluminium, and calcium) on the clay surfaces. This dynamic regulates nutrient loads, impacting riverine **eutrophication** and **algal blooms**." [\[1, 2, 3, 4, 5\]](#).
- 11.9. "How Binding Occurs:
Surface Complexation: Dissolved phosphates (orthophosphates) form stable chemical bonds with metal oxides and hydroxides located on the edges and surfaces of clay particles. [\[1\]](#)
pH Dependency: In acidic or neutral conditions (pH <7), binding is primarily driven by aluminium and iron oxides. In alkaline conditions (pH >7), phosphates typically react with calcium to form compounds like apatite. [\[1\]](#)." *The Severn is >pH7.0, and has a relatively high calcium concentration of around 40ppm – 60ppm.*
"Reversible Desorption: This binding is reversible. If river phosphate levels drop (e.g., entering pristine, unpolluted waters), clay-bound phosphates can desorb back into the water, continuously supplying nutrients. [\[1, 2, 3, 4, 5\]](#)".
- 11.10. In essence this means the measurement of phosphate in the water does not represent all that is available to the biota within a sediment, and such binding could alter its concentration along the course of a river.
- 11.11. It is arguably surprising that water crowfoot flourished in the Stour in 2025, in the Kidderminster area, where phosphate concentration is usually above the WFD 0.1ppm phosphate-P threshold for Good Ecological Status. In addition, nitrate concentration is very high, boosted in the Kinver area where paradoxically water crowfoot was also recorded as flourishing. It suggests that the species has considerable resilience when it comes to concentrations of P and N in the water, though less so to the physical changes, such as increased turbidity and modification of the river bed. This view is supported by the widespread observations that it grew densely along the Severn when P concentration in the water was considerably higher than it is today.

A relevant case-study: Why did plants disappear from the Norfolk Broads?

Aquatic plants (macrophytes) largely disappeared from the Norfolk Broads in the mid-20th century due to **severe nutrient pollution (eutrophication)**, which fuelled dense algal blooms. This blocked sunlight and caused plants to die off. [1, 2]

The catastrophic loss of these plants was driven by a chain of interconnected environmental issues:

- **Nutrient Pollution (Eutrophication):** High levels of phosphorus and nitrogen entering the water from agricultural runoff and treated sewage discharges triggered massive growths of phytoplankton (algae). [1]
- **Lack of Sunlight:** The rapid growth of algae turned the water murky and brown. This blocked sunlight from reaching the riverbeds, preventing underwater plants from photosynthesizing and surviving. [1, 2]
- **Sediment Disturbance:** Heavy boat traffic churned up fine sediments from the bottom of the shallow lakes, increasing turbidity and further blocking light. [1, 2]
- **Toxic Blooms:** Periodic outbreaks of toxic algae (like *Prymnesium*) further decimated the ecosystem's delicate balance. [1]
- **Climate Change & Salinity:** Rising sea levels and tidal surges have increased the salinity of the water, threatening ancient freshwater plant species that cannot tolerate salty conditions. [1, 2]

Today, environmental groups and the [Broads Authority](#) are actively working to restore plant life by **improving water quality and managing sediment**. Notable restoration projects, such as the one at [Hoveton Great Broad](#), utilize bio-manipulation and nutrient stripping to return lakes to their historically clear, plant-rich state. [1, 2, 3]. *Google AI Overview*.

The experience on the Norfolk Broads, and more recently on the River Wye, demonstrate how complex the relationship between macrophyte growth and the aquatic conditions can be. Also, that it can need the public to challenge official convention, and for academics to be inventive when seeking solutions. In the absence of any strong leadership or apparent curiosity from official bodies to define and solve the problem, it is important to pool our knowledge and identify a critical path to improvement. **The established way is to organise a conference.**

Sewage treatment works outfalls on the Stour

11.12. This report has not looked at EA macrophyte and invertebrate data in the same way as was done for the Severn (Meade, 2024; Meade *et al.* 2025). Given the amount of waterweed cover seen around Kidderminster in 2025 it is unlikely to fail a condition assessment based on macrophytes, and it has a large population of the Banded Demoiselle damselfly, *Agrion splendens*. It cannot be described as a brown and weed-less river, even though it carries a substantial load of plastic and other debris when the river level is high. Despite this, it has an odour that is associated with so many urban rivers that is not apparent along the Severn, especially when flowing over riffles or weirs.

The primary sewage treatment works (STW) and wastewater facilities along the River Stour in the West Midlands are managed by [Severn Trent Water](#). These facilities play a critical role in managing wastewater for the Black Country and Worcestershire before discharging treated effluent back into the river system. [\[1, 2, 3, 4\]](#)

The main facilities located along the Stour corridor from its upper reaches down to the River Severn include:

- **Roundhill Sewage Treatment Works (Kinver/Stourbridge):** The largest STW in this catchment, serving a population equivalent of over 300,000 across the Stourbridge and Dudley areas. The site also features a major anaerobic digestion facility. [\[1, 2, 3\]](#)
- **Caledonia Sewage Works (Lye/Stourbridge):** Located near Engine Lane in Lye, this works primarily serves the heavily industrialized sectors and densely populated areas of the Black Country. [\[1, 2, 3\]](#)
- **Oldington Sewage Treatment Works (Kidderminster):** Located further downstream in Worcestershire, this facility manages the bulk of the wastewater from the Kidderminster and Stourport areas before the river flows toward the Severn. [\[1\]](#)

In addition to these major treatment plants, the River Stour catchment relies on several Combined Sewer Overflows (CSOs) located at points like Mill Lane and Cradley Heath to release excess water during heavy rainfall. [\[1, 2, 3\]](#). *Google AI Overview*

11.13. Figures provided via Severn Rivers Trust show there is already a substantial concentration of phosphate, taken by some as an index of treated sewage discharge, before the river approaches the Oldington Works in Kidderminster. Phosphate concentration is high along most of the course of the Stour and is not noticeably increased when using the coarse plotted concentration range classes used in Figure 19. However, the weekly figures were able to pick up elevated phosphate concentrations attributable to Oldington on occasions. Given that the river exceeds the WFD Good Ecological Status threshold along much of its length, it would be rash to downplay the importance of any additional P contributed by any of the outfalls.

The Oldington Sewage Treatment Works is the last in a chain of treatment plants that discharge into the River Stour. Though the discernible contribution of additional phosphate from Oldington is small compared with the load acquired further upstream, its importance should not be downplayed in a river already exceeding the Water Framework Directive threshold of 0.1ppm phosphate-P for Good Ecological Status.

11.14. It should also be emphasised that carrying out regular sampling once a week, mid-morning on a Friday, would not pick up discharges made at other times, such as during the night.

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References

- Cardiff University, 2022.** Wye catchment citizen science water quality monitoring report March 2021 – February 2022. Natural Environment Research Council.
- Meade, R. 2023.** The vegetation of Wilden Marsh, Kidderminster, as an indicator of site condition. Unpublished report.
- Meade, R. 2024.** Biodiversity loss in the River Severn Worcestershire and its tributaries, Middle Severn Catchment. Plant indicators & water quality. Unpublished report.
- Black Country Society. 2021 (approx.).** The West Midland River Stour. Web page.
- Meade, 2026.** Waterweed in the Lower Stour. In: Wye Forest Study Group Annual Report for 2025.
- Meade, R, Averill, M and Ponman, T. 2025.** Good Ecological Status? The disturbing case of the Middle Severn. *British Wildlife*. December 2025, 183-189.
- Winnall, R. 2025.** From Afon Hafren to the Worcestershire Severn: 2017-2018 and more recent changes. *Proceedings of the Worcestershire Recorders Annual Meeting*, 2025.