THE STATE OF THE FOSS, RIVER FOSS SOCIETY, September 2025

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1 Introduction

The River Foss rises in the Howardian Hills northeast of Oulston Reservoir, flowing for approximately 21 miles (33 km) and dropping 300 ft (90 m), before joining the River Ouse in York City centre (Figure1). The Foss Catchment Area is about 66 square miles (172 square Km) and includes the area drained by the Foss and its tributaries.

North of Strensall the land is dominated by arable farming with occasional villages. The river is increasingly urban south from the town of Strensall, albeit with occasional farms. Before reaching York, the river follows Huntington Road, which is developed for housing and industry, but the river is often tree-lined and is managed as part of Green Corridors York [1], by St Nicks, between Sessions Nature Reserve and Monk Bridge immediately north of the York city walls, and at West Nooks north of Haxby Weir.

The Foss is a heavily modified river. In the late 1700s and early 1800s the Foss was canalised towards, but not quite reaching, Stillington [2, 3]. In York the banks were replaced with brick, stone and concrete and further upstream sections were straightened, and several locks were added. In more recent times, the 1970s – 2020s, the Internal Drainage Board (IDB) has undertaken dredging and created two-stage channels as far north as Towthorpe Bridge. Two-stage channels comprise a relatively narrow low-flow channel and a wider upper benched channel that creates more water capacity in times of flood [3,4]. In addition to modifying the substrate, creation of these two-stage channels has had an impact of the bankside environment, and both The

Yorkshire Wildlife Trust and St Nicks have been active in improving these channel habitats [1,4,5].

Yorkshire Water operates a large Sewage Treatment Works (here called Walbutts STW) just north of Strensall, and ten smaller works throughout the Foss catchment area (Figure 2). Yorkshire Water also operates 31 Combined Sewage Overflows (CSOs) within the Foss catchment. England's sewage systems combine both foul water and rainwater for treatment at Sewage Treatment Works (STWs). In times of high rainfall, the STWs are sometimes unable to process the volume of fluids and the CSOs can legally discharge sewage directly into the river. Hours of CSO discharge in 2023 and 2024 are illustrated for the Foss catchment in Figure 3. Hours of discharge does not directly equate to volumes discharged as this will be impacted by flow rates specific to each CSO.

Yorkshire water completed an upgrade for the West Lilling CSO in 2024 so the large numbers seen in Figure 3 should be much reduced in future. In addition to Yorkshire Water's operations there are septic tanks and private sewage treatment facilities in the Foss catchment, but the locations of many of these are not known.

Under the Water Framework Directive the Environment Agency (EA) periodically reports environmental parameters, on the River Foss [6], most of which are beyond the scope of this document. The EA divides the Foss catchment area into six segments for reporting purposes:

- Foss from Source to Farlington Beck
- Foss from Farlington Beck to the Syke
- Foss from the Syke to the Ouse
- Farlington Beck
- Tang Hall Beck
- The Syke

Except for the segment Foss from Source to Farlington Beck, which is Good, the EA classifies the Foss segments as Fail, Bad or Poor based on a variety of parameters: Phosphate, Ammonia, Mercury, Invertebrates, Macrophytes and Phytobenthos, Polybrominated diphenyl ethers, and Perfluorooctane sulphonate. Where known, the sources of these problems are Domestic General Public, Agriculture and Rural Land Management, Water Industry, and Urban and Transport.

The River Foss Society (RFS) has been monitoring the Foss water quality and habitat to better understand their impact on wildlife. Nitrates, phosphates, turbidity and temperature have been monitored at five sites since 2017 as part of the global Freshwater Watch programme [7]. Aquatic invertebrates are monitored at 20 sites starting in 2022, and dissolved oxygen, conductivity and pH at 13 sites since 2023 (Figure 4). This document summarises our current understanding of the State of the Foss in mid-2025.

2 Nitrates and Phosphates

Method and measurement accuracy

Nitrate and phosphate measurements are collected using Freshwater Watch protocols [7]. These involve half-filling a plastic tube, which contains a reagent, with river water, waiting for three (for phosphate) or five (for nitrate) minutes and then comparing the colour of the liquid to a chart. A reading is matched to, or interpolated between, six different shades on the chart. Some variation in reading can be expected depending on how precise the filling of the tube, the accuracy of the timing and the difficulty of matching subtle shades and the ability to interpolate between shades, particularly at the low end of the phosphate scale. Nonetheless the method is adequate for distinguishing between low, medium and high measurements. When interpreting the data we have used average data for each location. Some locations are more regularly sampled than others which could result in some averaging biases, but we have been explicit in the discussions below.

Observations

The average nitrate readings from 2017 to 2025 are shown in Figure 5. The nitrates show medium values at Sheriff Hutton Bridge and high, but slightly declining, values from Strensall to the city centre at Hungate Bridge. Average Phosphate readings in Figure 6 show generally low values with the only medium average value at Strensall. Figures 7 and 8 show the annual averages for nitrates and phosphates by year at the five locations. For nitrates (Figure 7) the Sheriff Hutton Bridge samples have lower values than the downstream locations. At each of the five locations nitrates can be seen to be broadly reducing through time, except for 2025 which shows that nitrate values increase at Haxby Locks, Huntington Church and Hungate Bridge. Annual phosphate averages (Figure 8) are consistently low at Hungate Bridge but more variable at the other locations. All locations show low phosphate readings for 2024 and 2025. It should be noted that lower reliability is placed on the average nitrate and phosphate numbers at Sheriff Hutton and Strensall for 2023, and for Strensall in 2024 due to several months of missing data.

Discussion

Nitrates are relatively low at the Sheriff Hutton Bridge location which is in a farmland environment. Nitrates increase downstream, peaking at the town of Strensall, and declining gradually into the city of York. It seems unlikely that the increase downstream is due to farming and may be related to continuously discharged sewage treatment effluent at the Walbutts STW. Continued decline into York can be interpreted as a reduction from the input source due to dilution.

The Foss catchment area is a Nitrate Vulnerable Zone [8], designated as being at risk from agricultural nitrate pollution. Land in an NVZ has specific rules on use of nitrogen fertilizer and storage of organic manure. The annual declining trends for nitrate readings suggests that nitrate management practices are generally improving, but the high nitrate readings from Haxby Locks, Huntington Church and Hungate Bridge in 2025 are currently unexplained.

Phosphates are generally low, but with a higher long-term average at Strensall, suggesting a possible input from the Walbutts STW. Walbutts STW currently has an EA RNAG (Reason for Not Achieving Good) notice in relation to relatively high Phosphate discharges. It is possible that other local factors are causing these changes, including private sewage treatment, or localised farming practices, but the RNAG demonstrates the need for improvement at the STW.

The EA reports Phosphates [6] on a scale of Bad-Poor-Moderate-Good-High on all segments of the Foss Catchment Area. In 2019 phosphates were Moderate in all segments except for the Syke, which was Bad. In 2022 results were the same, except The Foss from Farlington Beck to the Syke, which was Poor.

3 Dissolved Oxygen, Temperature, Conductivity and pH

Method and measurement accuracy

Following a widely reported fish die-off below the Sustrans Bridge (Figure 2) on Huntington Road in June 2023, the RFS began monitoring dissolved oxygen (DO), water temperature (T), conductivity (CD) and pH. A PCE-PHD1 meter was used to record each parameter. The instrument manufacturer quotes an accuracy of +/- 0.4mg/l for DO measurement, +/- 0.8ºC for temperature, +/- 0.02mS for conductivity and +/- 0.02 for pH. The meter is calibrated monthly against standard solutions.

Measurements were taken immediately above Castle Mills lock between July 2023 and June 2025 on a weekly basis. From 9th June to 5th August 2025 a break in measurements was enforced by the erection of an eight-foot safety fence in preparation for the replacement of the lock gates. The measurements were resumed on 5th August after the fencing was removed. The results are shown in Figure 9a and include flow rate data from the Huntington Road monitoring station [9]. DO measurements were also recorded between September 2023 and September 2025, at several locations between Castle Mills lock and Haxby while walking along the Foss (Figure 2). The first two pilot surveys were conducted through to Strensall but later surveys, with more locations sampled, stopped at Haxby footbridge. The results from Castle Mills Lock to Haxby footbridge are shown in Figure 9b.

Observations

It is well established that an inverse relationship exists between DO and T, such that dissolved oxygen increases as temperature goes down; Figure 9a (top) clearly shows this relationship for the Castle Mills lock sampling. DO also shows a relationship with flow rate, with DO increasing as flow rate increases, although the flow rate data is spikier than the DO data. CD measurements (Figure 9a, middle) appear to be very variable, and with downward spikes in CD coincident with upward spikes in flow rate, but this relationship is not seen in May 2025. Figure 9a (bottom) also appears to show minor reductions in pH associated with increased flow rate, but again this relationship is not seen in May 2025. A broad relationship of pH with season is also apparent, with pH peaking around April, as flow rate begins to decline, but more data is required to confirm this relationship.

An anomaly in these data occurred on 28th May 2025 when the DO dropped to an all-time low of 2.7 mg/l coincident with an all-time low of pH 7.24. Three days later a sudden drop in CD was recorded. These drops do not appear to be related to flow rate. These anomalous readings were coincident with another fish die-off seen as far upriver as the Sustrans Bridge.

The DO surveys along the river are shown in Figure 9b for six dates between July 2024 and September 2025. Consistent trends within this data are difficult to see, but there is a suggestion of lower DO in an area between Huntington Road Footbridge and All Saints Church and decreasing DO downstream from Huntington Road Footbridge to Castle Mills Lock, although the May 2025 measurements, under drought conditions and very low water flow, show a reverse trend through the city.

DO is higher in times of flood (January 2025 compared to May 2025) than in times of drought, as shown in Figure 9b.

Discussion

Dissolved oxygen enters rivers from the atmosphere in rain, in turbulent waters where oxygen is mixed with water (at rapids, weirs and waterfalls), and as a byproduct of aquatic plant and algal photosynthesis. DO also varies with temperature (lower temperatures, higher DO), atmospheric pressure (lower pressures, lower DO). Photosynthesis provides oxygen to water and vegetation decay removes oxygen. Eutrophication is an excess in richness of nutrients, for example nitrates and phosphates, that cause excess algal growth. Decay of algae consumes and therefore reduces DO. There is therefore a complex relationship between the amount of DO and rainfall (flow rate), temperature, turbulence, atmospheric pressure, photosynthesis and organic decay. Each of these variables also have different response periods: flow rate and atmospheric pressure can change over minutes/hours; water temperature over days or even weeks; photosynthesis is diurnal and seasonal; and the impact of organic decay will depend on flow rate, temperature and algal quantity. DO responds to all these factors on an hourly, daily and seasonal basis, and we cannot break out specific contribution of these variables to changes in DO. However, rainfall, flow rate, temperature and photosynthesis all vary seasonally as does DO. Rainwater contains high saturation levels of DO and these saturation levels are further increased at lower temperatures when water has increased capacity to hold DO. Higher rainfall and lower temperatures between October and April are associated with higher flow rates and increased DO. Conversely, in times of summer drought, and possible eutrophication, DO is inherently lower due to lower rainfall and higher temperatures, and it is at these times the river environment becomes increasingly stressed.

The up spikes with flow, that coincide with down spikes in CD and pH, most likely reflect the impact of dilution on these two parameters.

Aquatic life is dependent on DO to breathe and when DO decreases, aquatic life, and particularly fish, become increasingly stressed (Figure 10 [10]).

Pike, which are regularly seen in the Foss are relatively tolerant of low oxygen levels, but when DO gets below 5ppm (5mg/L) fish die-offs are increasingly likely. We do not have data for the June 2023 fish die-off, but for the May 2025 die-off the DO and pH, (and nearly coincidentally CD) are seen to drop rapidly. We are unclear whether fish die-off is related to natural DO variation with T, but rapid changes in pH and to some extend CD at the time of the May 2025 fish die-off suggests there may be an additional stress on the Foss at that time, possibly pollution. The DO levels this summer of drought have been very low, a minimum of 1.7 mg/l being recorded of 8th September.

It was reported in the York Press (22 June 2023) [11] that at the time of the June 2023 die-off that the EA said they believed the deaths were caused by high temperature and low atmospheric pressure (which results in further reduction in DO in water). The EA noted that at the time fish die-off was widely reported across Yorkshire, but they confirmed that no water analysis from the Foss had been undertaken by them at the time. Conversely Professor Alistair Boxall of York University was reported (York Press 29 June 2023) [12] as saying samples taken from New Earswick at the time confirmed sewage in the River Foss, with nitrate levels 80 times those of Sheriff Hutton, plus high ammonia levels, with Paracetamol analysis pending. Paracetamol levels from samples taken at New Earswick on 20 June 2022 were confirmed by Dr John Wilkinson of York University, as among the highest ever reported in any river in the world (York Press 12 July 2023 [13]), and a clear indicator of sewage pollution. However, it should be noted that the fish die-off occurred from the Sustrans Bridge into York and was not noted between New Earswick and Yearsley Bridge (Figure 2) so a causal relationship of fish die-off to sewage is unproven. Yorkshire Water confirmed that they were not being investigated by the EA in relation to the incident. Sewage discharges from CSOs, associated with high rainfall during thunderstorms, would have been legal, and would have prevented sewage overrunning the system.

Fish die-offs are not fully understood, but drought, high temperatures, and low flow lead to reduced DO and less dilution of pollutants, which increases stress on aquatic life. The RFS plans increased DO, CD and pH monitoring to better understand the relationship of these parameters to environmental stress.

4 Aquatic Invertebrates

Method and measurement accuracy

Biological monitoring for aquatic invertebrates is undertaken by RFS volunteers at 20 sites within the Foss catchment, 15 on the Foss and five on tributaries. Samples are collected to professional standards (coordinated and quality controlled by Barbara Hilton who previously worked as a freshwater biologist) using a three-minute kick-sample, with a 1mm mesh net, working across and upstream at each sample site with a one-minute hand wash of large stones where appropriate.

Samples are then hand-picked to identify and count up to 30 taxa at family level or higher where possible and scored using two biotic indices: the Biological Monitoring Working Party (BMWP) and Average Score Per Taxon (ASPT) [14]. The taxa are scored for their tolerance of, or sensitivity to, organic pollution on a scale of 1 – 10, 1 for tolerant and 10 for sensitive, and also scaled for abundance. The scores are added for the BMWP index and then averaged, by dividing the BMWP score by number of taxa, for the ASPT index.

Samples are taken a minimum of twice annually, in spring and autumn, and ideally monthly. Repeat samples have been taken for quality assurance and invertebrate identification is quality assured by B Hilton in person or with animals photographed or preserved in a dilute ethanol solution on site and emailed or given to her.

The scores reflect the water quality and how impacted the site is, by oxygenation for example, dredging or other substrate variation. Scores may also vary seasonally. In addition, scores could be impacted by the quality of the kick sampling (the kicking, net handling or timing) and by the tenacity of the sample pickers. Rigorous training and quality control minimise these issues.

To gain a robust view of biological monitoring results it is recommended BMWP and ASTP scores are both considered during analysis. BMWP and ASTP scores have been variously examined as maximum and minimum at each sample location by year, minimum and maximum at each location from 2022 to 2025, or as various averages by year or over several years. Data are presented as both graphs and maps (Figures 11, 12 and 13) and include the quality classifications for the BMWP and ASTP scores.

Observations

Figure 11 shows minimum and maximum recorded BMWP scores within the Foss catchment area from 2022 to 2024. The maximum scores show that the Foss is in a Fair to Good state upstream from Sheriff Hutton Bridge, that it is Poor to Fair between Strensall Weir and Willow Bank; it is Good again at Sessions Nature Reserve, and Fair at Yearsley Canal and Poor in the City Centre. Most of the becks (The Sike, Black Dike, and Westfield Beck) are Poor quality, but Farlington Beck is Fair and has shown improvement over the years. On the BMWP scale there are no Very Poor or Very Good scores.

Figure 12 shows the equivalent minimum/maximum ASTP scores, and maximum scores suggest the Foss is Slightly Impacted to Unimpacted with all the best scores again upstream from Sheriff Hutton Bridge. The Sike and Strensall Weir are Moderately Impacted and Westfield Beck scores as Polluted or Impacted.

Figure 13 shows a map of maximum scores for both BMWP and ASTP for 2024 to provide a single-year view. These scores both show improved results north of Strensall with lower and variable scores to the south. Westfield Beck again scores poorly, as do The Sike and Black Dike on the BMWP scores.

Discussion

Upstream from Sheriff Hutton Bridge the Foss is generally in a good, not very good, state with respect to both BMWP and ASTP scores suggesting that farming is having some detrimental impact on aquatic life. The situation from Strensall southwards is more varied but generally poorer, with the section from Strensall to Willow Bank only Fair. This could be interpreted as the detrimental impact from the continuous discharge from Walbutts STW and is coincident with the increase in Nitrates and Phosphates noted above. CSO discharges may also play a part. The Willow Bank sample site was dredged in September 2022, and this will have had a negative impact on invertebrate scores. Willow Bank scores were low in 2022, and showed some improvement to early 2024, but this improvement was not sustained. The values at Black Dike and The Sike, as well as Westfield Beck are degraded, and water flowing from these becks into the Foss may also cause some local problems. Interestingly the site at Sessions Nature Reserve scores well, suggesting the impact from Westfield Beck entering the Foss is limited. Sessions Nature Reserve enjoys a shallow stoney substrate with riffles and likely increased DO and probably reflects an improved local habitat. Scores generally decline into the city with local improvement in some of the Yearsley Weir samples, again a well-oxygenated environment.

Westfield Beck is generally poor, and problems with a private sewage outfall have been noted here (and reported to the EA), although the beck is also poor above this outfall. Farlington Beck, when originally surveyed in 2023 scored poorly and sewage fungus, related to poorly maintained septic tanks, was present. In 2024 Farlington Beck saw an improvement in scores, thought to be associated with improvement to private sewage facilities, and in 2025 the first large Stonefly nymph was found – a pollution intolerant species.

5 Other Studies

York University has been active in studying the River Foss for several years. Burns *et al* (2018) [15] studied pharmaceutical concentrations at five sites on the Foss demonstrating a significant increase in concentrations between Sheriff Hutton [Bridge] and Strensall (Figure 14), apparently coincident with increased population and increased input from STWs and CSOs. Burns *et al* note an inverse relationship between flow and pharmaceutical concentration below the Walbutts STW and relate this to dilution of waste-water discharge in times of higher flow rate. Pharmaceutical concentrations remain similar from Strensall to Yearsley Bridge and decline in the city centre, perhaps due to dilution, biodegradation or sorption into the sediment [15]. Occasional spikes in pharmaceutical concentrations are also seen (March and August, Figure 14), and these relate to increased detection of paracetamol and metformin (Type 2 diabetes medication), perhaps related to discharge from septic tanks or CSOs, although the latter should not have been operating at this time [15].

The RFS is currently involved in three University projects: Ecomix, AQuA and Environmental Sustainability.

Ecomix *(led by Professor A Boxall)*

The Ecomix study investigated chemical pollutants at 17 sites in rivers across Yorkshire. Weekly composite samples were taken at three sites located on the Foss at Stillington, on Huntington Road near Yearsley Bridge, and in the city centre at the Merchant Adventurers' Hall (Figure 2). The chemical contaminants from six different sources are being analysed:

- Pet medicines
- Pesticides and fertilisers
- Livestock medication
- Human medication
- Cosmetics, soaps and sunscreens
- Road run-off (brakes, tyres, metals)

The results of this study are not yet published but will provide a detailed evaluation of the component pollutants in rural, suburban and city centre locations and will look at toxic combinations of chemicals and their impact on aquatic invertebrates. An early Ecomix news article was released by the Guardian (May 2025) [16].

AQuA *(Led by Dr J Wilkinson)*

The AQuA project [17] is in the early stages and is focussed on improving the quality of, and expanding engagement in, citizen science. It is focussed on understanding chemical and biological pollutants across Yorkshire's rivers. A pilot study was undertaken in 2024 with systematic sampling due to begin in 2026. The pilot study looked at coliform bacteria, and total pharmaceutical concentration, from 62 different pharmaceuticals, in 56 locations across Yorkshire. Eleven samples from the River Foss and one from New Earswick nature reserve lake were collected by RFS volunteers. Coliform bacteria on the Foss were somewhat variable, with the control sample from the lake being pristine. Pharmaceutical concentrations in the Foss were high, equating to the 80th percentile and above when compared to samples across Europe (Wilkinson 2022 [17]), and some of the worst seen in the Yorkshire pilot study.

The RFS is currently undertaking an outfall safari (survey) to identify possible input locations of pollution on the Foss prior to selecting, with other AQuA partners, about 15 locations for the main study. Sites will be sampled four times per year to help understand seasonal variation in pollutants.

Environmental Sustainability - Litter *(Led by Professor S Levett)*

The RFS regularly undertakes litter picks on the banks and in the river Foss. The RFS worked with University of York students who undertook a litter survey in 2024 and classified observed litter into categories and highlighted litter hotspots. Within the river drinks packaging comprised over 60% of litter noted, while on the banks drinks packaging was 30% only surpassed by “Small miscellaneous” at 30%.

Litter hotspots were identified for within the river and bankside. For litter within the river the city centre was the worst area but for bankside littering the sections at Earswick and north of Link Road were worst. The section immediately downstream of Yearsley Bridge was highlighted as another area with a littering problem both within the river and on the banks.

As a result of this study a proposal for increased signage with positive wildlife messaging was put to City of York Council and is under consideration (Figure 15).

6 Water Vole, Otter, Mink and birdlife

Surveys for Water Voles have been undertaken on the Foss by the RFS, St Nicks and the EA for several years. They are present in some places but no longer abundant. In 2023 Water Voles were present downstream of the Huntington Road footbridge (near Yearsley Grove/Highthorn Road) but were absent in 2024 and 2025, following a wet and flood-prone winter in 2023/2024. Water Voles are still present on Westfield Beck where steep vegetated banks provide a good habitat, seemingly oblivious to the poor water quality noted above. Water Vole sightings and evidence have recently been seen at Hull Road Park on Osbaldwick Beck, a tributary of the Foss, following rewilding and habitat improvement by St Nicks. The upper reaches of the Foss are not fully surveyed as access to the river is not always possible in farmland, but the Yorkshire Wildlife Trust undertook brief surveys before bank improvement work at Stillington, with no Water Vole reported there.

Fife and Walls (1973) [2] note that Water Voles were common on the Foss in 1972, prior to bank reprofiling which they suggest may reduce habitat suitability and they also note the first appearance of American Mink, a notorious Water Vole predator, on the Foss near Oulston, in 1968. The River Foss Society commissioned an update survey of the vertebrates of the Foss in 2017 and this, with reports on invertebrates, plants, and biodiversity, is documented in Hammond 2017 [18, 19, 20, 21,22]. Habitat destruction and Mink have likely both contributed to the Water Vole population decline. The RFS and St Nicks now have an active programme of trapping and humanely dispatching Mink on the Foss, and this may help Water Voles to survive. Coincident with Mink monitoring and removal, Otter have been reported on the Foss in 2024 and 2025, seen in the Foss Basin, and near Yearsley Pool and south of the ring road bridge.

The Foss enjoys a wide variety of birdlife, but a full documentation is beyond the scope of this work. Kingfishers are reasonably common, and the apex predators Tawny Owl and Sparrowhawk are both present on the green corridor between Monk Bridge and Sessions Nature Reserve. On the river Moorhen and Mallard are common, Swans, Canada geese, Graylag Geese, Cormorants and Grey Herons are often present, and Goosanders and Egret and occasionally seen.

American Signal Crayfish are an invasive non-native species in England, but not yet seen on the Foss, although the native White-clawed Crayfish are present in the upper reaches. Hopefully weirs and old locks along the Foss will act as an effective barrier to the Signal Crayfish.

7 Summary and conclusions

The principal sources of pollution in England's rivers are broadly from farming, sewage and road runoff and each of these are a potential pollutant source on the Foss. The immediate river environment is impacted by canalisation in the 1700s, and recent work by the Internal Drainage Board with dredging and bank modification south from Towthorpe Bridge.

Broadly the Foss catchment can be divided into five regions with respect to our understanding of pollutants, land use and the environment (Figure 16): Area 1 is the farm-dominated section above Walbutts STW; Area 2 is the Foss south of Walbutts STW to Monk Bridge; Area 3 is York City Centre; Area 4 the severely impacted tributaries or becks that flow into the Foss; Area 5 is Tang Hall Beck/Osbaldwick Beck, and similar areas, where the RFS does no pollution monitoring. The area boundaries are indicative and subject to change as more detailed information becomes available.

Area 1: Farming dominates the northern part of the Foss catchment, upstream of Walbutts STW at Strensall. This area has the best aquatic invertebrate scores using both the BMWP and ASPT indices.

Area 2: At Walbutts STW there is continuous discharge of treated water and south of here there are increased numbers of CSOs and presumably increased pollutants from road runoff as the area becomes more urban. We have noted an increase in nitrates and phosphates as well as reduced aquatic invertebrate scores downstream of this location. Previously published work (Burns *et al* 2018 [15]) also shows an increase in total pharmaceuticals south of the Walbutts STW. The section around Willow Bank was dredged by the IDB in the early 2020s and it is not clear what the relative impacts of water quality and dredging were on aquatic invertebrate populations at this location.

At the Sessions Nature Reserve aquatic invertebrate scores improve to good again, despite influx from the polluted Westfield Beck (Area 3) immediately upstream and this is interpreted as due to low volumes entering the Foss from the beck, and a much-improved local river habitat at the nature reserve.

South of the nature reserve invertebrate scores remain fair to good before declining at the Merchant Adventurers' Hall in York City Centre. It is unclear whether this decline is habitat induced or due to further degradation in water quality or both. The section south of Sessions Nature Reserve to Yearsley Bridge was modified to a two-stage channel in approximately 2019, but it is unclear what impact this had on wildlife.

DO measurements in Areas 2 and 3 have given some insights into the potential causes of fish die-offs. The work done to date provides a valuable baseline for DO variation but also acts as a real-time early warning for when the river is particularly stressed.

Area 3: York City centre, which is characterised by industrialised brick, stone and concrete banks with limited bankside vegetation and low aquatic invertebrate scores.

Area 4: Black Dike, The Sike and Westfield Beck are three becks that show lowest aquatic invertebrate scores. Poorly treated sewage has been observed in Westfield Beck. Farlington Beck would have been included in this category when monitoring started, but water quality improvement, probably associated with improved private sewage treatment, led to a rapid recovery of aquatic invertebrate scores, and this is now included in Area 2.

Area 5: refers to regions where the RFS is not active in pollution monitoring and where we have no data to interpret.

For the Foss it is not all bad news: Farlington Beck has improved from poor to good water quality from 2023 to 2025, Water Voles are present, if not abundant, Otter have returned to the Foss in the last two years, and native Crayfish are present too.

8 What's next?

Although the story of increased pollution from the source of the Foss to York is not unexpected there is significant room for improvement in water quality in the river. The RFS is involved in the ongoing Ecomix and AQuA projects with the University of York and both these studies are focussed on understanding detailed causes of pollution. Both studies work with other stakeholders, including Yorkshire Water and the Environment Agency, to understand effective solutions that deliver water quality improvements.

Yorkshire Water have significantly increased investment across Yorkshire for the 2025-2029 Asset Management Plan, with £8.4bn assigned to asset upgrades across Yorkshire, approximately an 8-fold increase on the previous five years. On the Foss this investment will fund phosphate reduction at eight locations, upgrades to six high-impact CSOs (Flaxton, Huntington Road, Sand Hutton, Heworth Green and Foss Islands), and ten continuous monitoring stations for chemical pollutants by 2029.

The RFS will continue monitoring the Foss to better understand the relative impacts of water quality and habitat on biodiversity. Sharing data and engaging with other stakeholders including the Environment Agency, Yorkshire Water, conservation and environmental bodies, and local councils, will enable us to advocate for, and actively contribute to, improvement of the water quality and habitat of the River Foss. Improvements in water quality and the environment should be reflected in improved scores in nitrates, phosphates, and aquatic invertebrates in the coming decade.

9 Acknowledgements

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Many RFS members have collected data on the River Foss over many years, and their contributions and help are gratefully acknowledged.

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22. **Hamond M, 2017**: Invertebrates of the River Foss. https://www.riverfosssociety.co.uk/wp-content/uploads/2018/06/Invertebrates-of-the-River-Foss.pdf

11 Figures

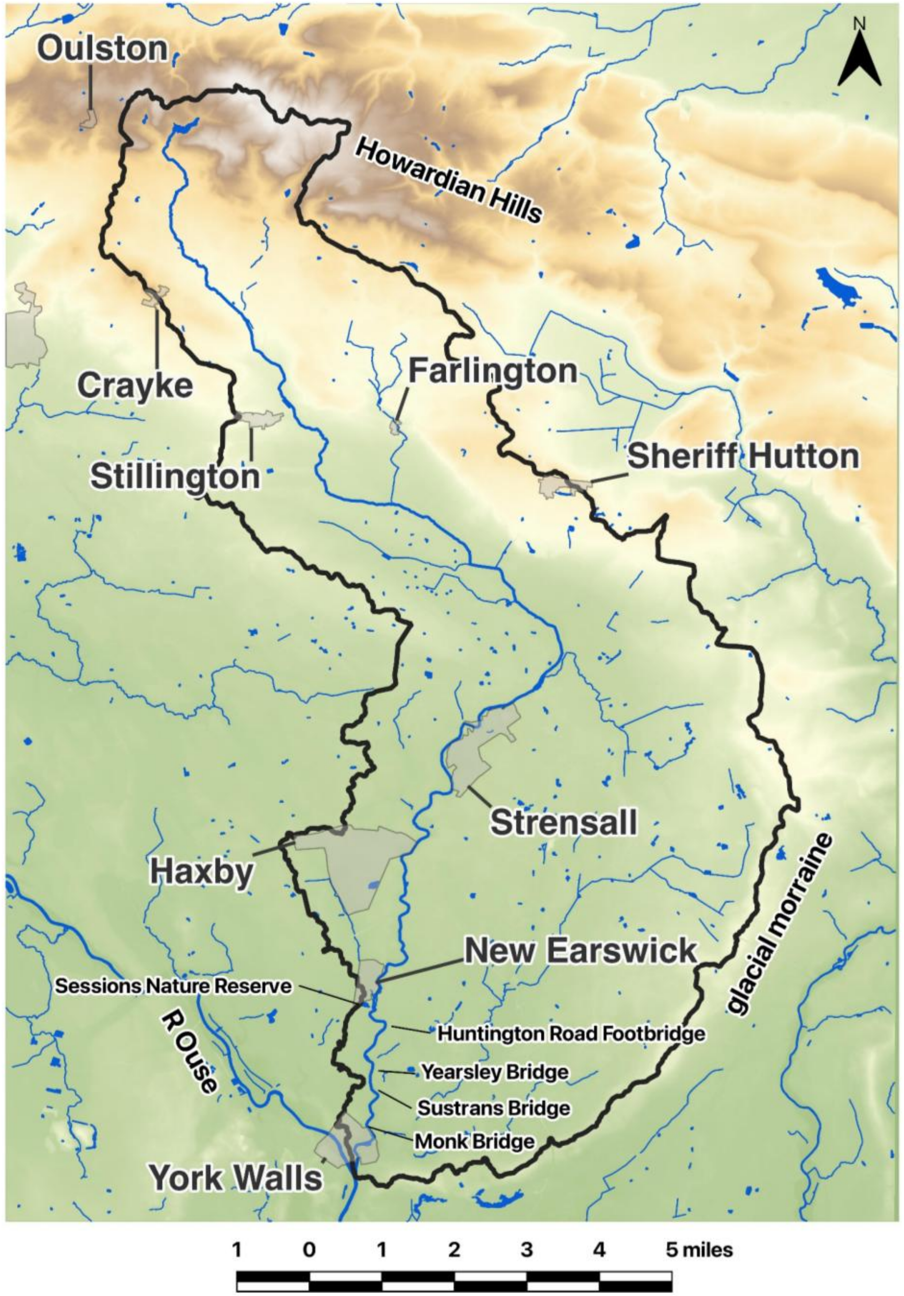


Figure 1: The Foss catchment area (black outline) on Lidar elevation background

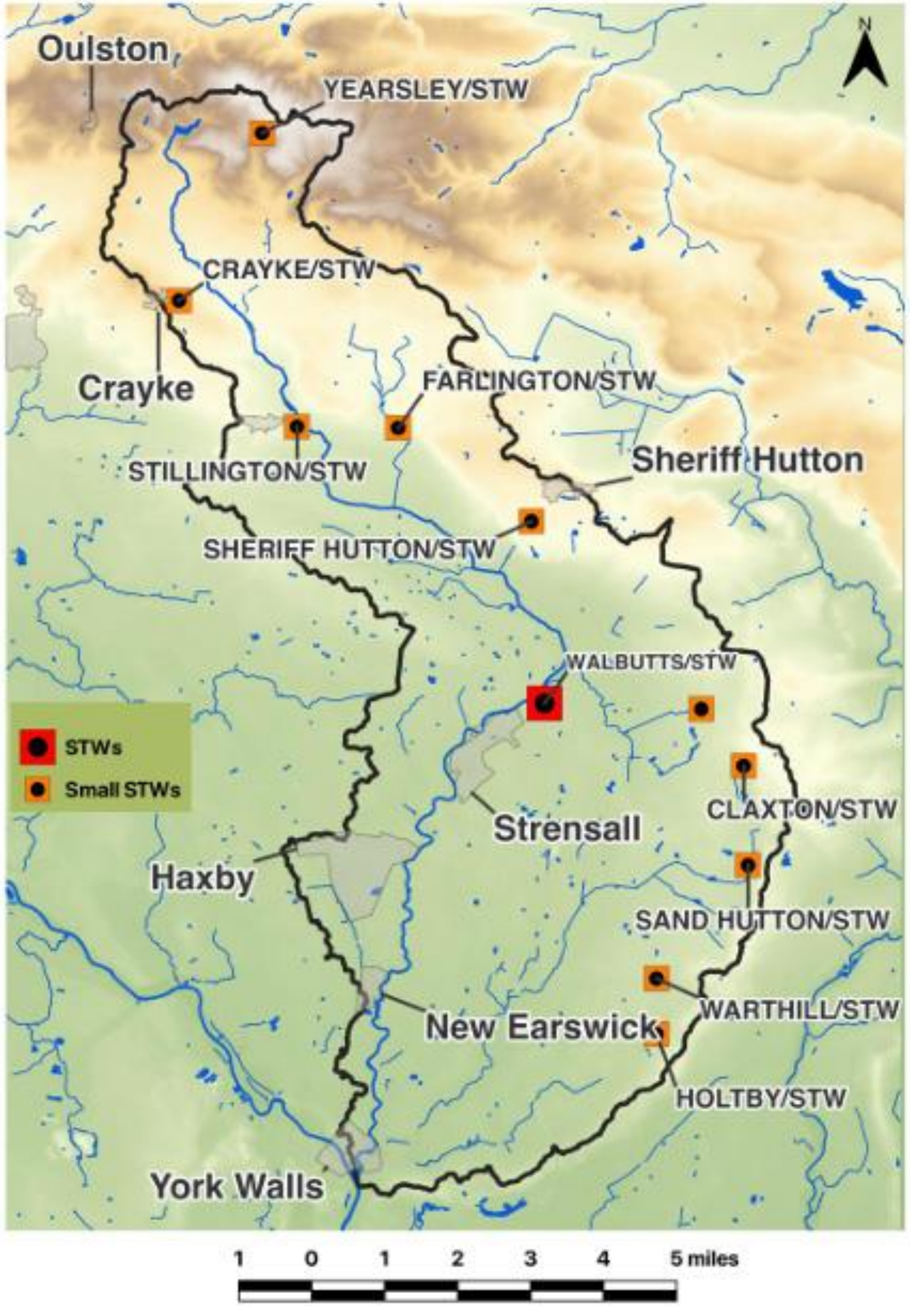


Figure 2: Yorkshire Water Sewage Treatment Works (STWs)

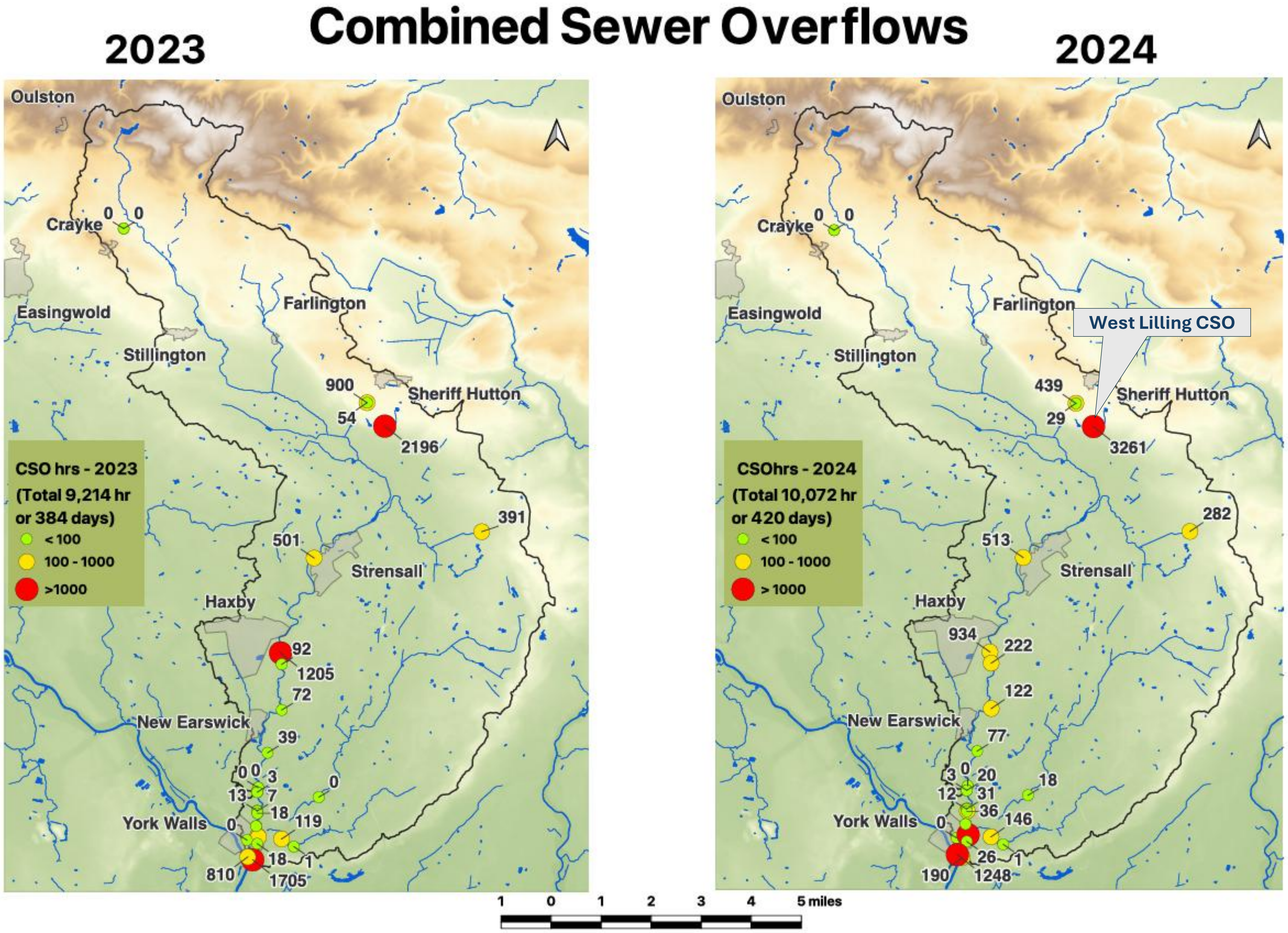


Figure 3: Yorkshire Water Combined Sewer Overflows (CSOs), with scale discharge hours for 2023 and 2024

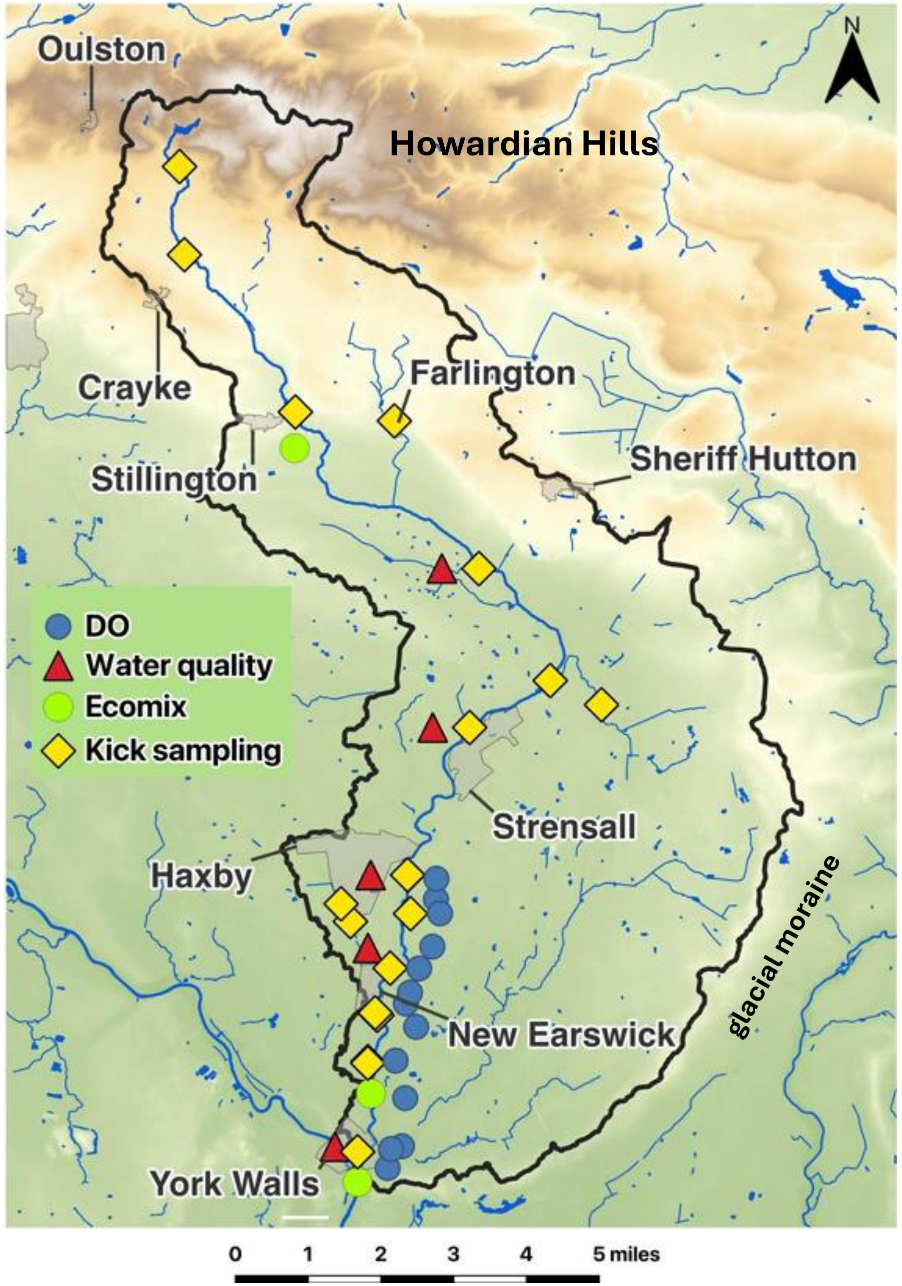


Figure 4: River Foss Society citizen science sampling locations

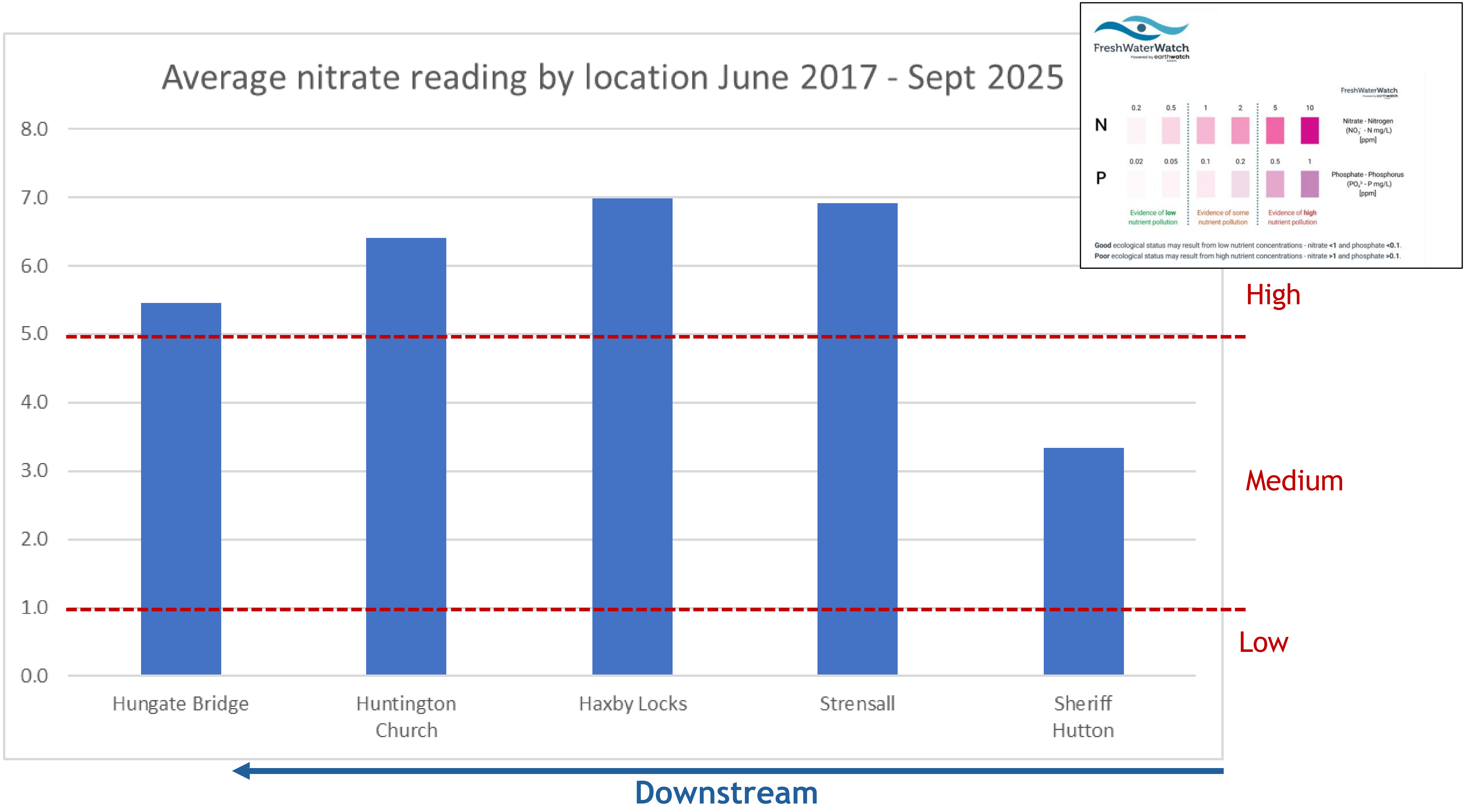


Figure 5: Average nitrate values from 2017 - 2025

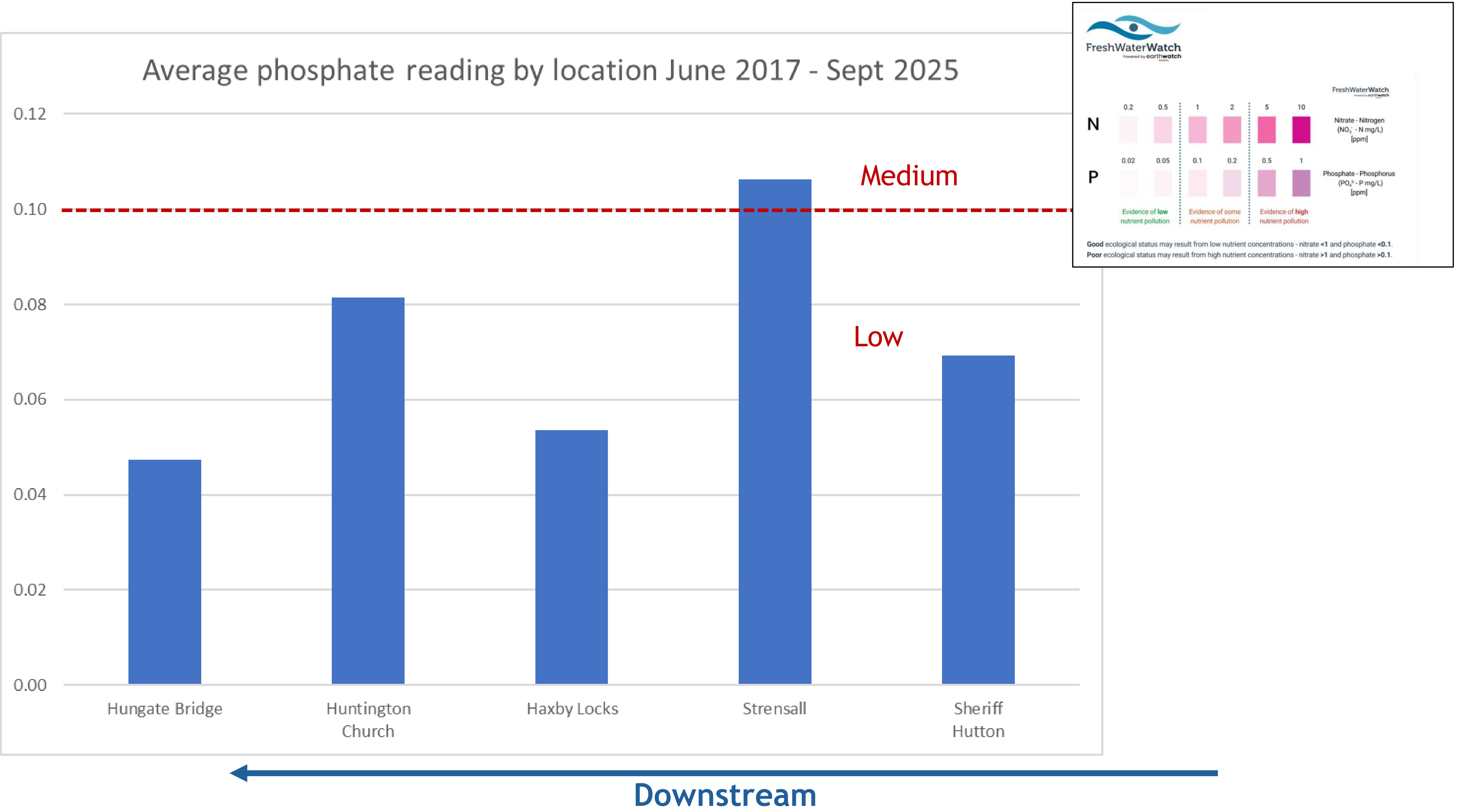


Figure 6: Average phosphate values 2017 - 2025

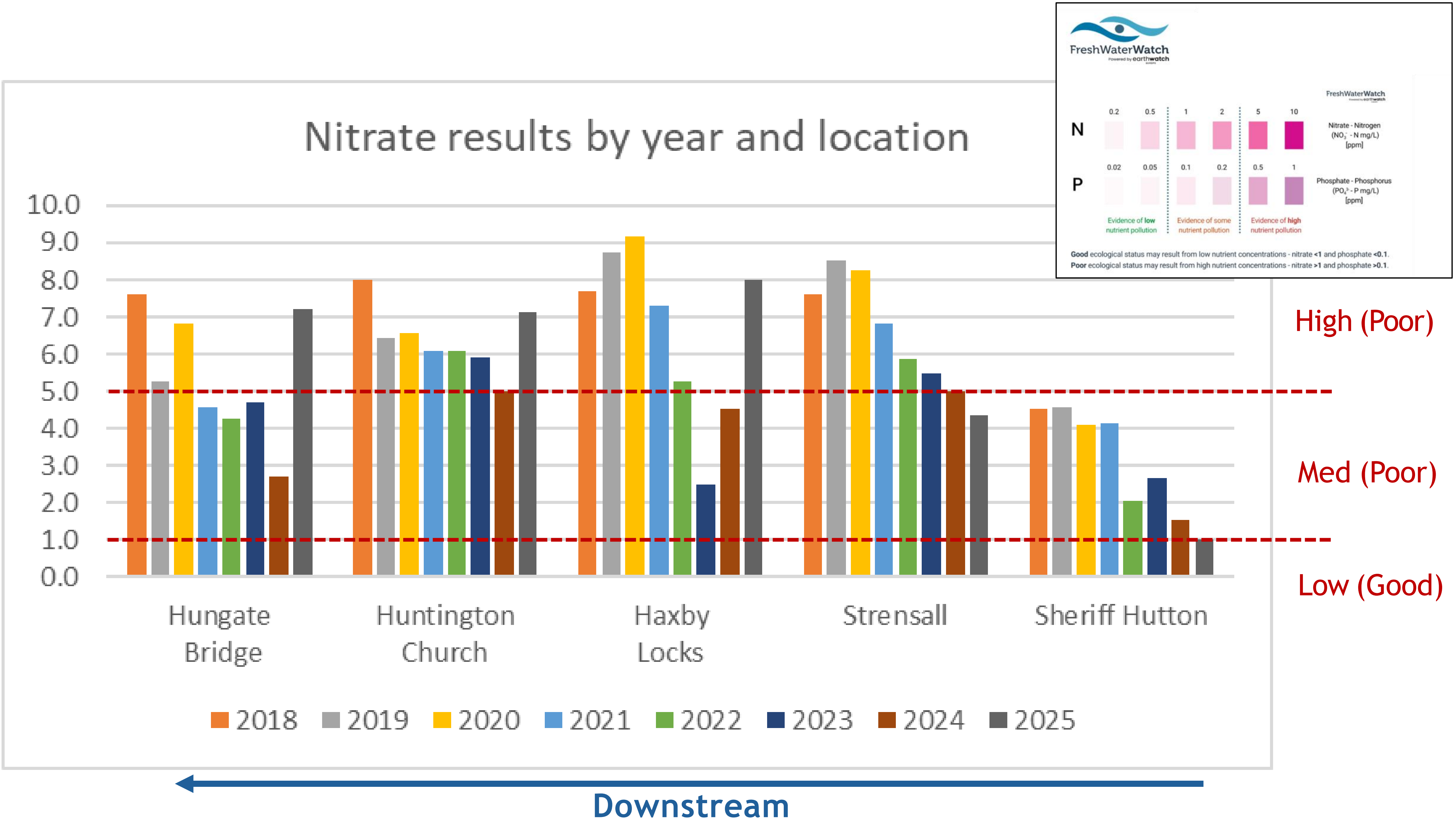


Figure 7: Average nitrate values by year and location

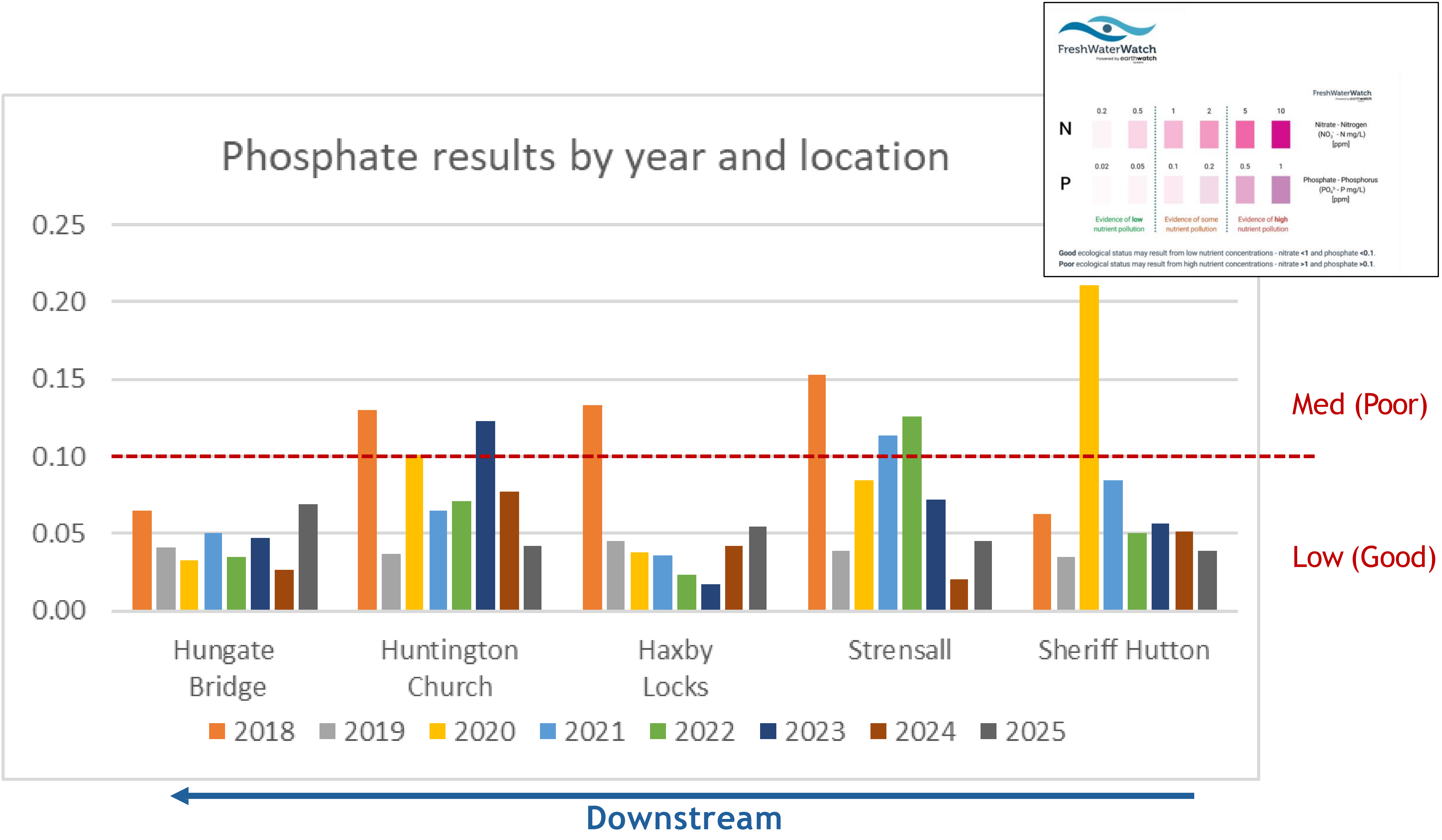


Figure 8: Average phosphate values by year and location

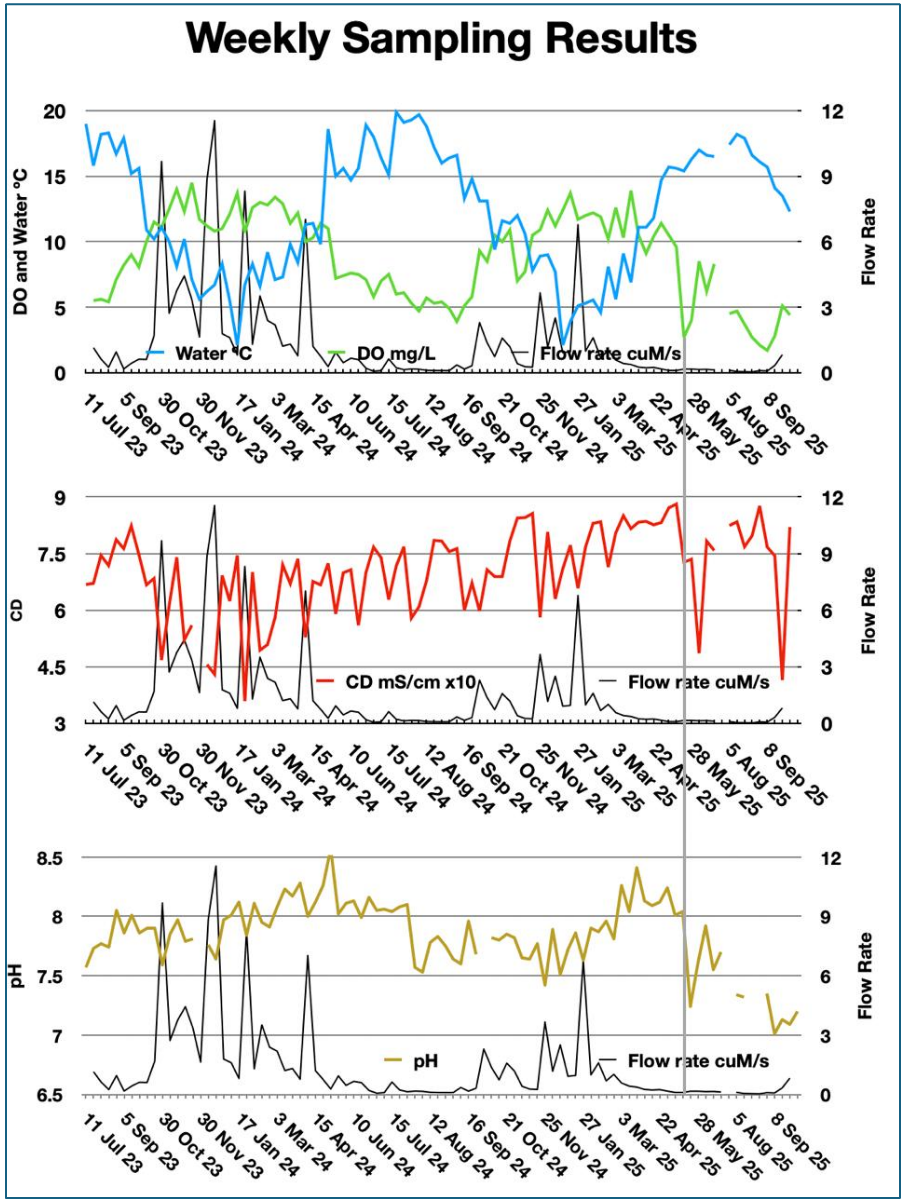


Figure 11a

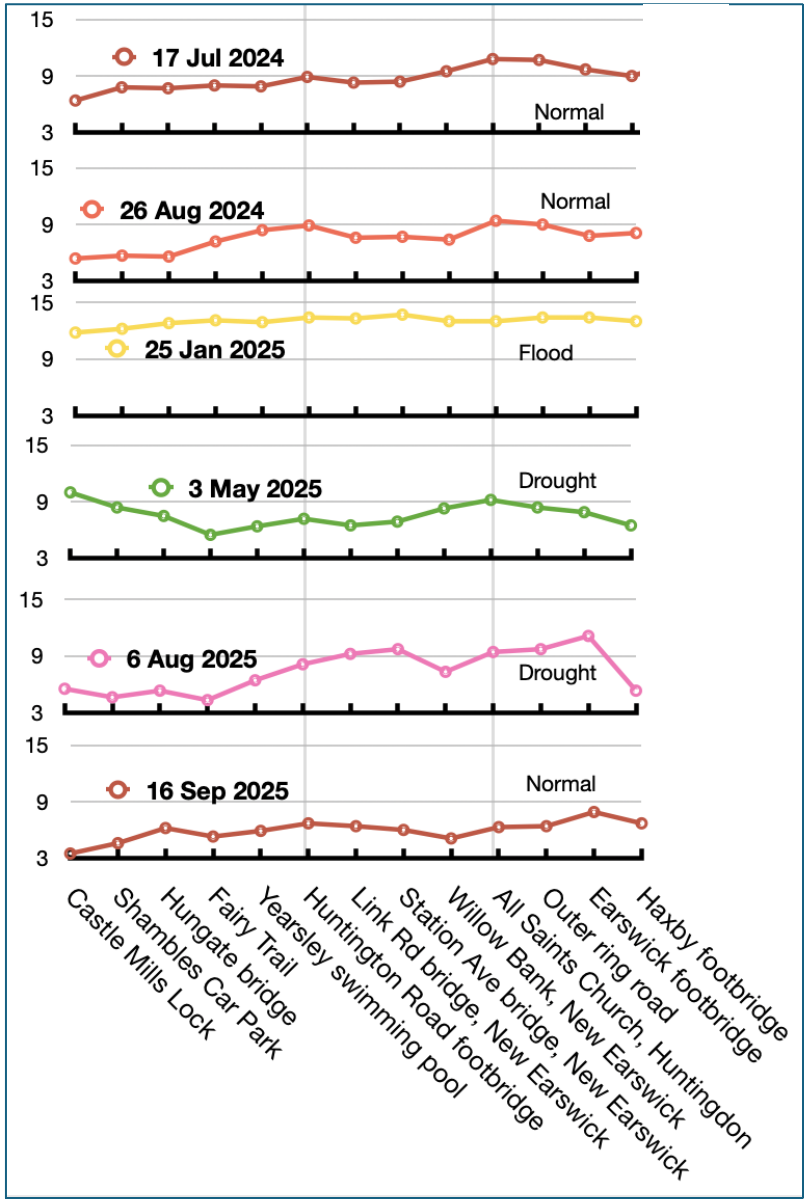


Figure 11b

Figure 9: Dissolved oxygen, Temperature, conductivity, pH and flow rate. 11a: weekly at Castle Mills Lock, 11b: DO along the Foss

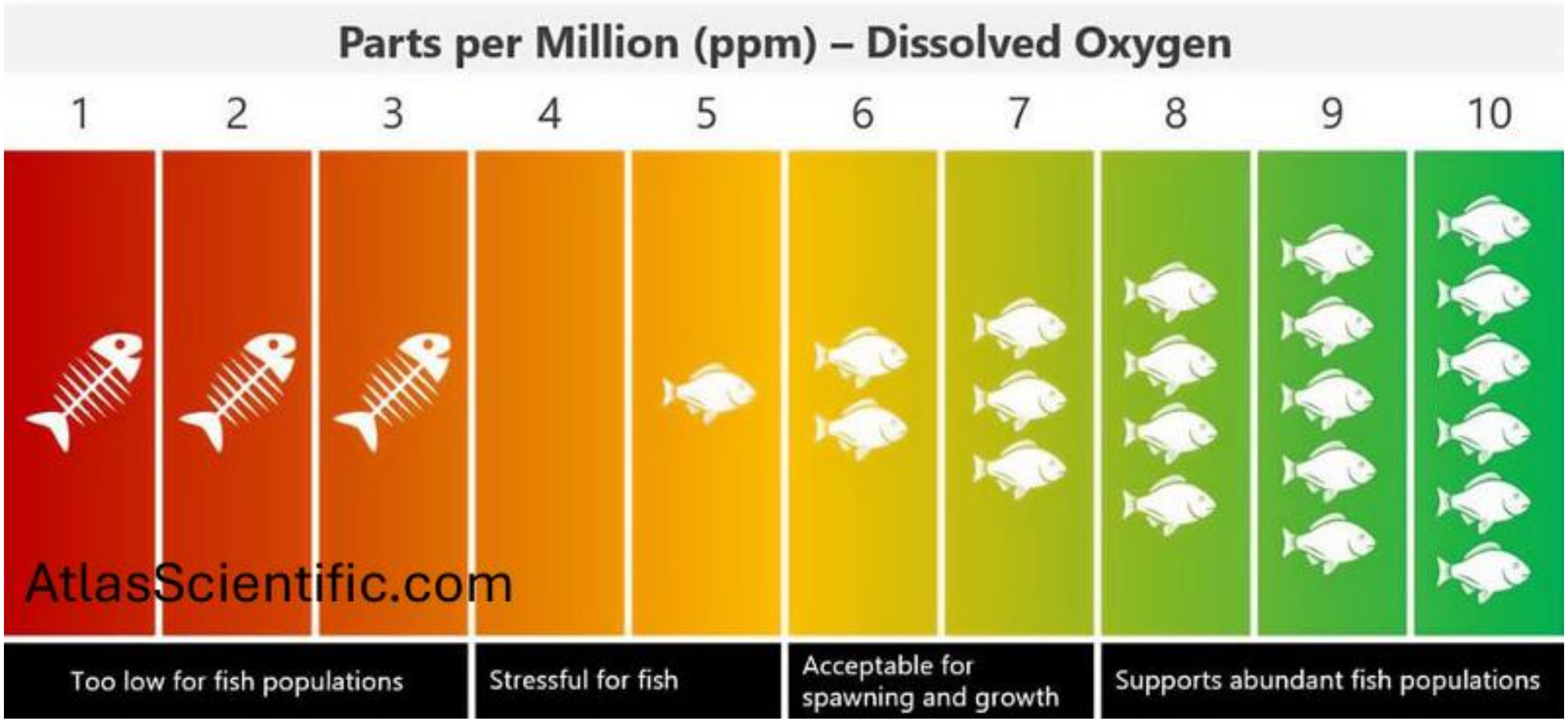
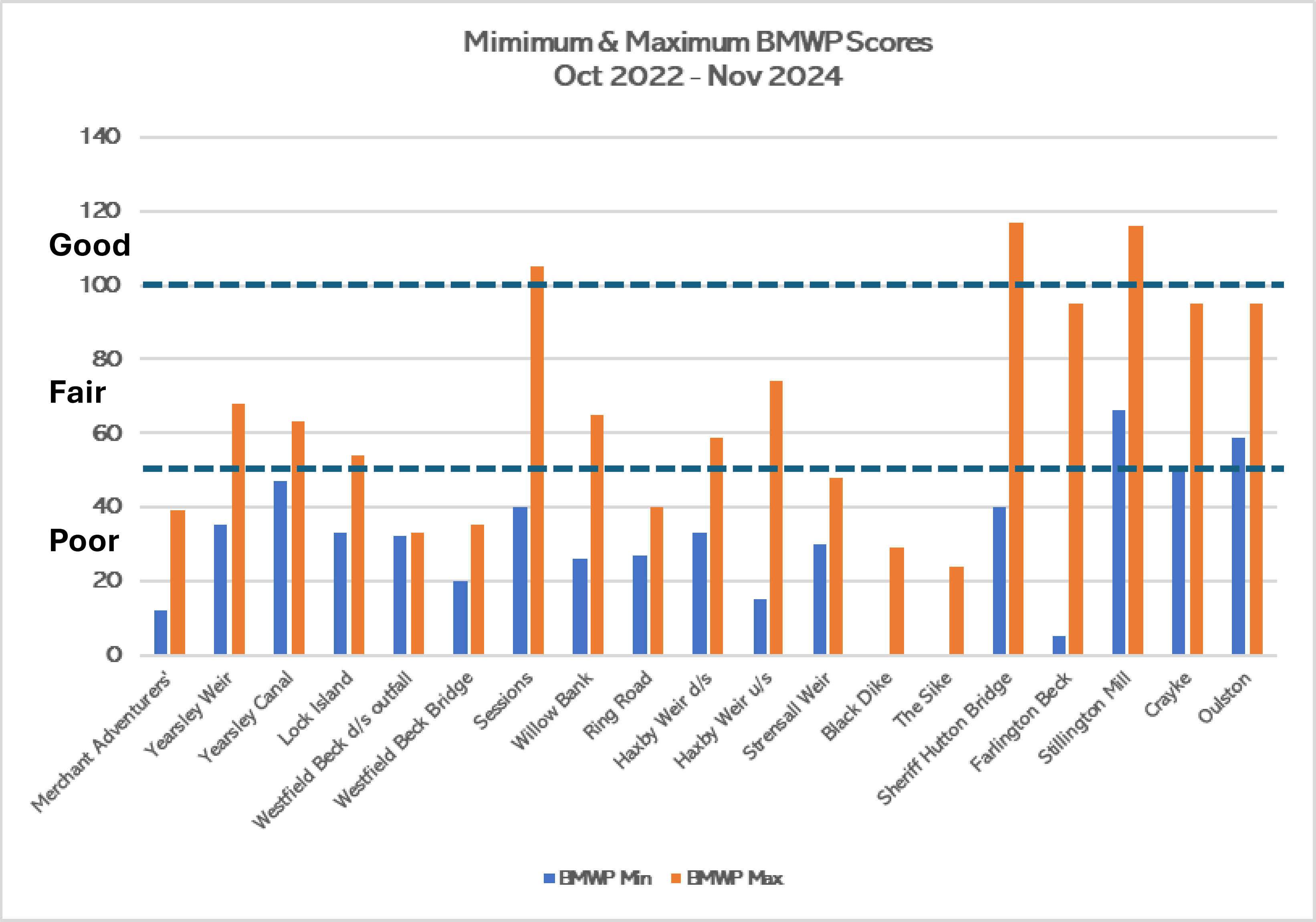


Figure 10: Tolerance of fish to variation in dissolved oxygen (from AtlasScientific.com)



BMWP score	Biological quality
0-15	Very poor
16-50	Poor
51-100	Fair
101-150	Good
>150	Very good

Figure 11: Minimum and maximum BMWP scores on the Foss October 2022 – November 2024

ASPT score	Interpretation
<3.6	Heavily polluted
3.61-4.2	Polluted or impacted
4.21-4.8	Moderately impacted
4.81-5.4	Clean but slightly impacted
>5.4	Unpolluted, unimpacted

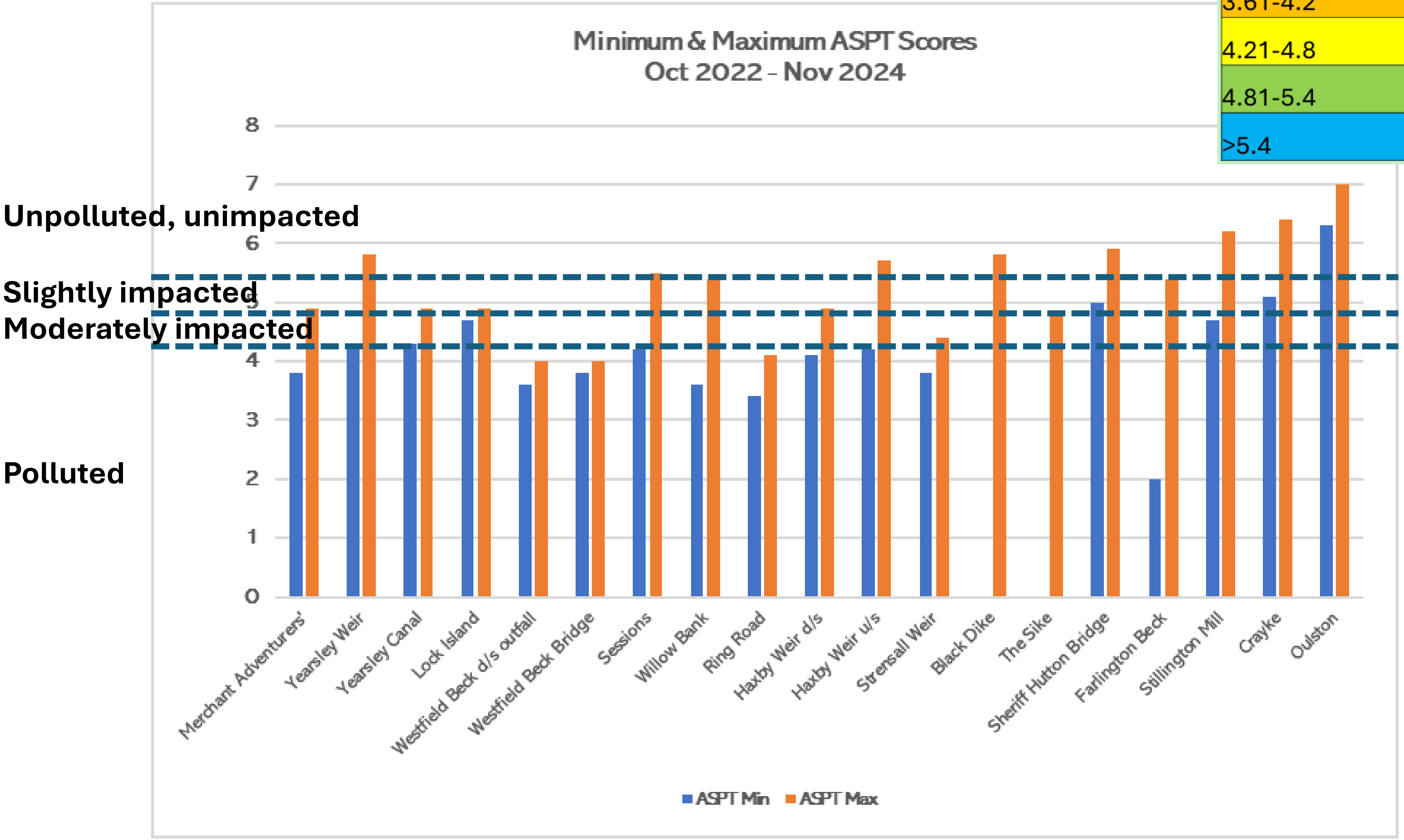
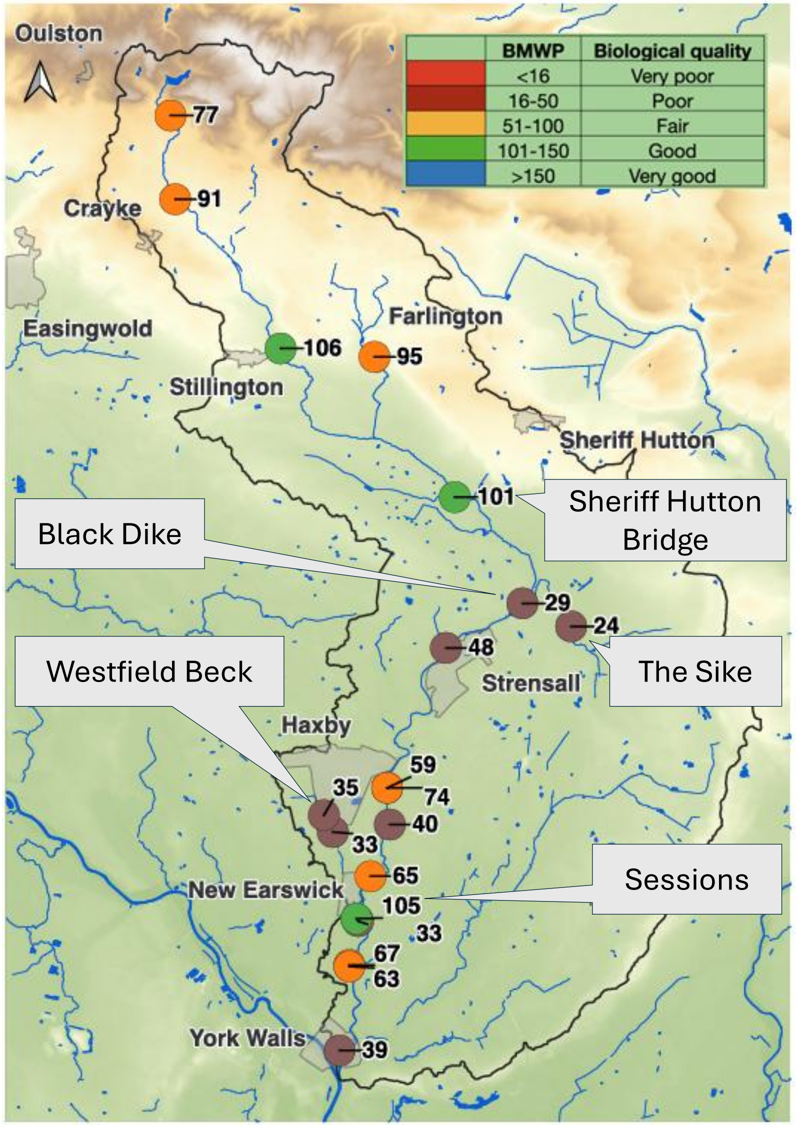


Figure 12: Minimum and maximum ASPT scores on the Foss October 2022 – November 2024

BMWP



ASPT

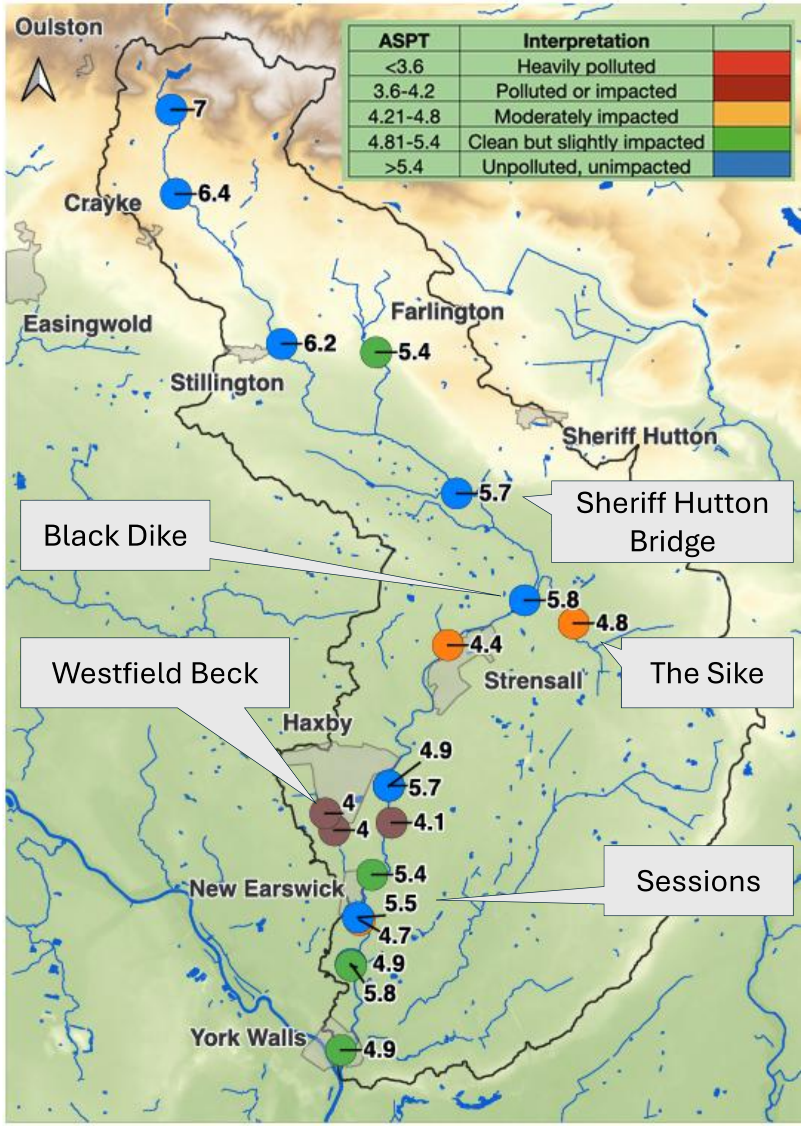


Figure 13: Maximum BMWP and ASPT scores for 2024 within the Foss catchment area

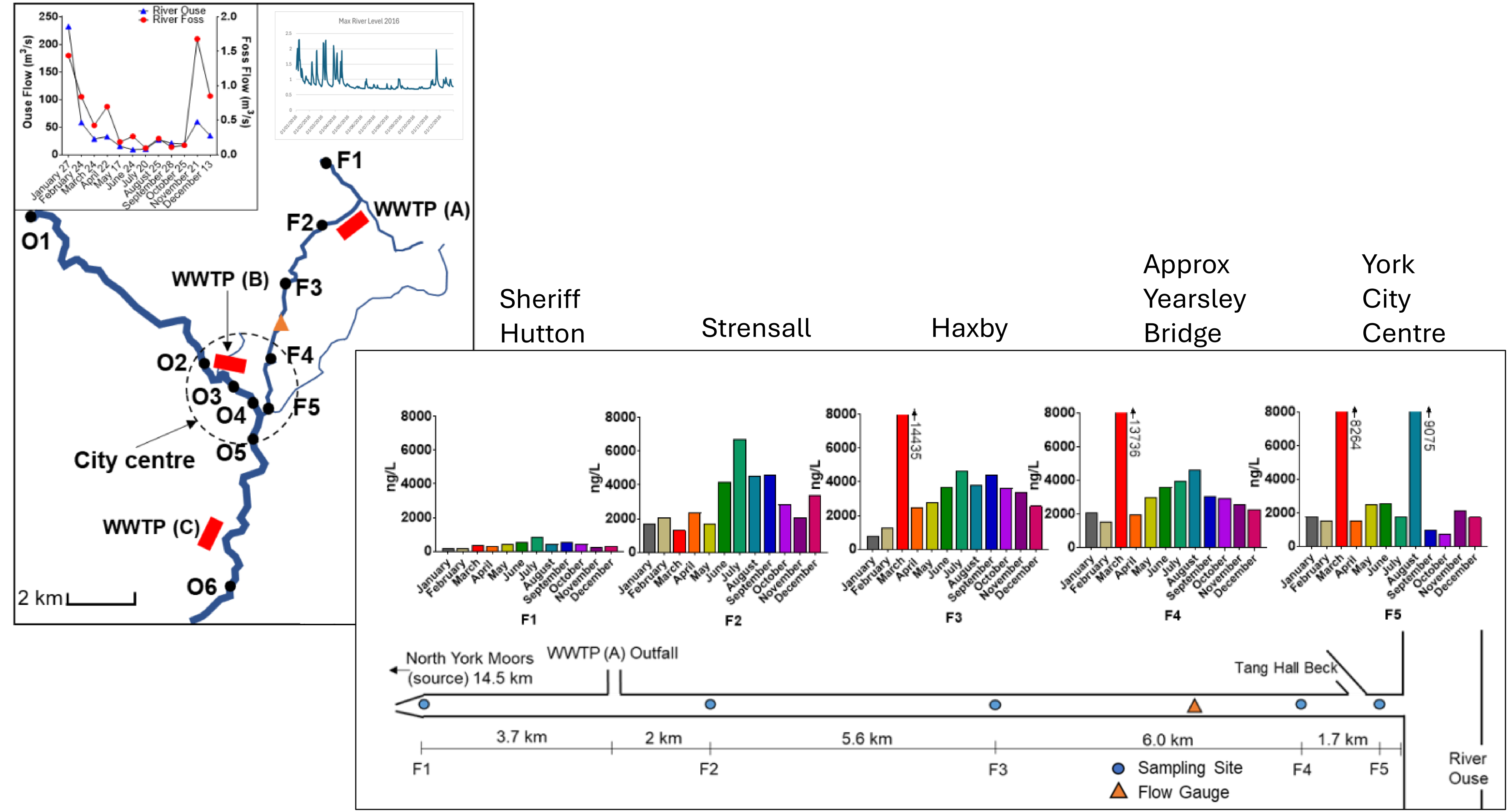


Figure 14: Total pharmaceutical concentration (ng/L) by month, River Foss, 2016, (from Burns *et al*, 2018)

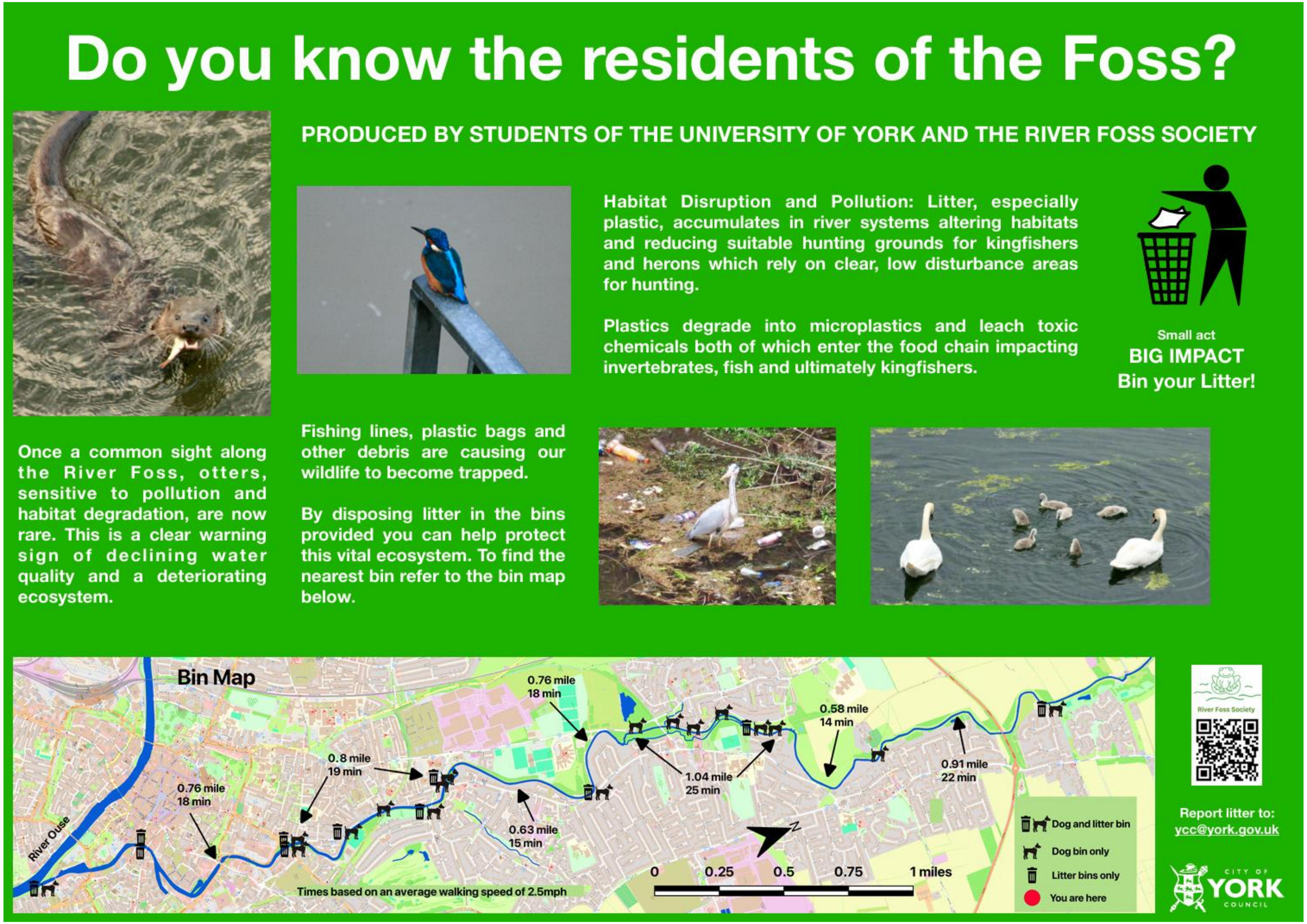


Figure 15: Proposed RFS, University of York and City of York Council signage for River Foss bins and wildlife

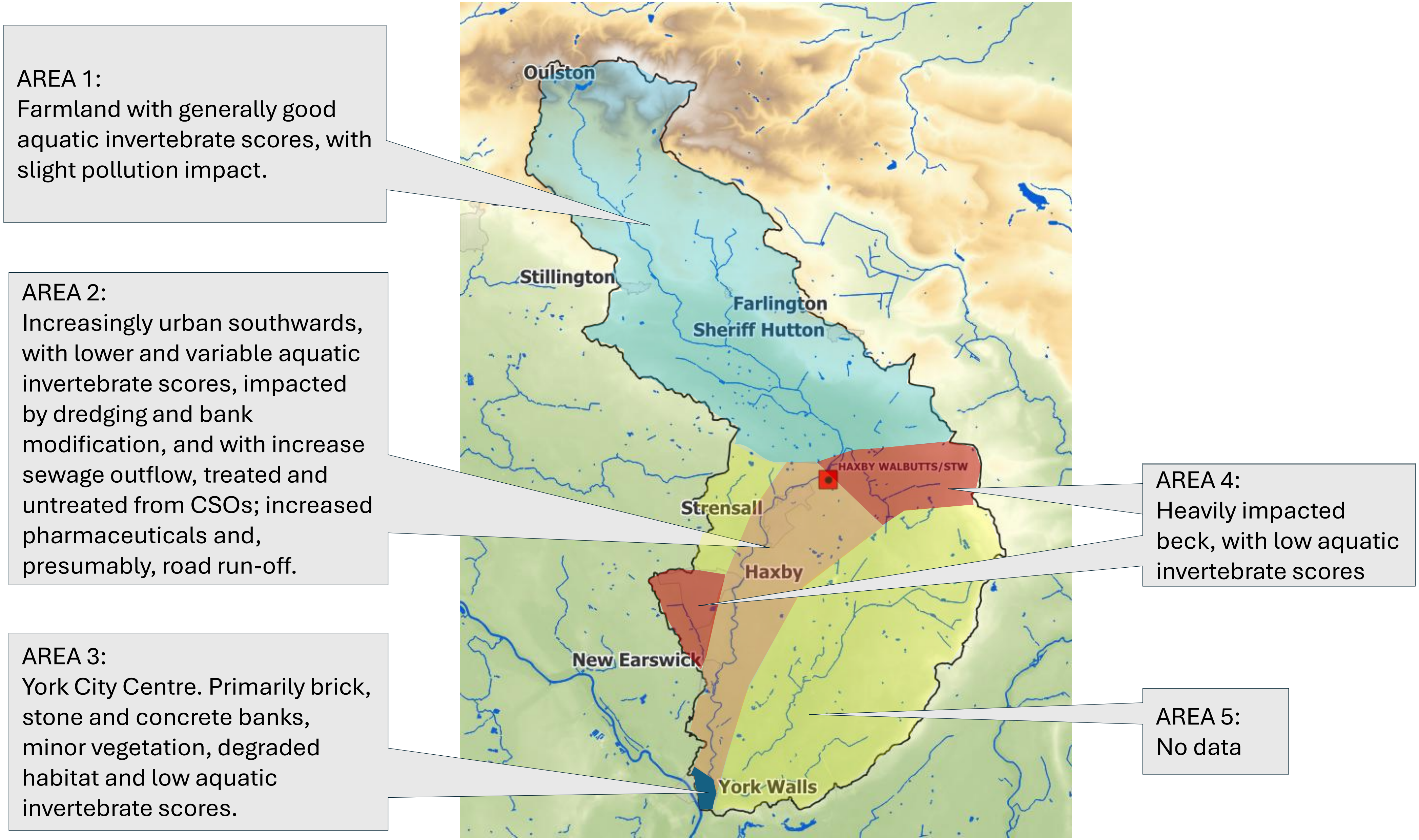


Figure 16: River Foss catchment area divided into five areas dependent on water quality observations and aquatic invertebrate scores