River phosphate and water quality

Phosphate in rivers

Phosphorus can occur in rivers in a number of forms but not as the free element. The most readily detected form is the reactive phosphorus that is soluble in water as single phosphate units (orthophosphate) rather than more complex compounds with more phosphate units. Forms of reactive phosphorus can be soluble in water, associated with particles in the water or in the sediment. In addition, there can be unreactive phosphorus in these categories. A dynamic relation exists between the various forms of phosphorus in a river. High rainfall and an increase in turbidity are likely to disturb the riverbed leading to an increase in detected phosphorus levels. The Environment Agency reports total phosphorus in all forms not phosphate to reflect this complexity. Orthophosphate rather than other forms are readily detected by simple methods and is usually the principal form present in river water that is not turbid.

The majority of reactive phosphorus was detected in the soluble forms for two chalk rivers the Itchen and Test but further 15-20% was in the particulate group (Shaw *et al*, 2021). The values vary considerably along, and among, rivers. The underlying geology affects the values with granite adding little phosphorus in contrast to greensand (over which The Asker flows after issuing from chalk springs). In addition, differences in flow rate and changes that occur for instance after prolonged rainfall will alter the values. Increases are also caused by pollution events. These include a wide range of agricultural activities and sewage-related discharges.

Guidance on how to determine if the water quality suggests pollution.

Levels greater than 50μg/L soluble phosphorus (equivalent to c150μg/L orthophosphate) may indicate some pollution but this threshold will depend upon other factors as mentioned above (Chalk Stream Restoration Group, 2021). Government data suggests c40% of rivers in the South-West had >100 μg/L phosphate in 2009 [defra-stats-observatory-indicators-da3-120224.pdf (publishing.service.gov.uk).]

Increases from a usually detected concentration of soluble phosphate for a river flowing at its normal level may be indicative of a possible pollution event. The likelihood of detecting this depends upon the frequency of sampling. A concurrent increase in conductivity may also be indicative of an increase in phosphorus. Turbidity and phosphorus levels are also positively correlated (Villa *et al*., 2019).

The value of contributing to the national monitoring systems.

Biological indicators can be a more reliable indicators of pollution than measurement of phosphate levels. A substantial fall in the score for eight pollution-intolerant riverflies would be of particular concern. For instance, the score for the Asker is typically c12 for the months from April to September inclusive but if a threshold of 4 was recorded into the national system then the Environment Agency would investigate the cause.

The West Country CSI charity has many volunteers entering data for rivers in this part of England. They have now begun to enter riverfly data onto their cartographer site. Their entries for 2022 cover 100 rivers and streams in the South-West and a total of 127 sample sites is summarised in Table 1. The ranks rather than scores are provided for the reported variables to facilitate comparison of the three CROWD rivers with others in the region.

The ecological score (30, maximum 100) for the Char places it 125 of 127 sample sites and 98th of 100 rivers.
This score is probably of insufficient rigour to be of value. Westcountry CSI have clarified that their surveys are only anecdotal for ecology and have yet to fully integrate Riverfly data into their reports. The difference in the overall health scores of the three CROWD rivers is not large but banding places the Asker in a different category. The rank for the Char is much lower because many rivers score overall between that for the Asker and it. The low ranks for high total dissolved solids associated with the Asker and Mangerton are probably not a concern Both are chalk streams and likely to have naturally higher values than most of the reported rivers associated with a different geology.

Nutrient neutrality

Many of England's most internationally important water dependent places (lakes, rivers, estuaries, etc.) are designated as protected under the Conservation of Habitats and Species Regulations 2017 (as amended). Two catchment areas in West Dorset i.e. i) Poole Basin and ii) Chesil Beach and the Fleet are covered by this legislation (Dorset Council, 2023) but the rivers considered in CROWD do not flow into either of these two catchments.

Table 1: River health score and ranks for 100 rivers with 127 sample sites collated by Westcountry CSI from volunteer entries for 2022.

CROWD river	Overall health band	Overall health score	Overall rank by sample site	Rank (not scores); the health band is indictated by the cell colour				
				Ecology†	Pollution	total dissolved solids*	Turbidity	Phosphate
Asker	B	61.6	71	48	52	118	61	61
Char	C	54.6	111	125	113	97	86	68
Mangerton	C	58.4	91	92	22	111	93	69

Key: River Health scores (0 to a maximum of 100)				
A	B	C	D	E
>80	60-80	40-60	20-40	<20

* estimated from conductivity

† probably unreliable, see text

References

Chalk Stream Restoration Group (2021) Catchment Based Approach: Chalk Stream Restoration Strategy 2021, Main Report Chalk Stream Strategy - CaBA (catchmentbasedapproach.org).

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