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The impact of sampling regime on the accuracy of water quality status classifications under the Water Framework Directive

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By 2015, EU regulatory agencies have a statutory obligation to meet the EU Water Framework Directive (WFD) target of "good ecological status" in all relevant inland and coastal waters. A significant amount of work is being undertaken to refine and improve the UK WFD water quality targets so that they better relate to the ecological status of a system. In 2013 new phosphorus (P) targets have been set, stipulating required lower mean annual "reactive" P concentrations, and recommendations published for more stringent pH, dissolved oxygen and ammonia targets. Despite this work, there are no guidelines on the sampling regime which should be employed to ensure compliance as part of the WFD classification system. Without guidance on how WFD water quality assessments should be done, regulatory agencies are at risk of misclassifying a system and of failing to identify systems which are ecologically at risk.

Water quality is normally evaluated using routine monitoring programmes which use water samples collected, typically, at monthly intervals. However, new technologies are now allowing the collection of high-frequency (sub-daily) measurements of a range of water quality parameters which are revolutionising our understanding of freshwater nutrient cycling dynamics and the processes which control them. High-frequency and weekly water quality datasets for two lowland UK catchments, the River Enborne and The Cut, have been analysed to assess the impact of sampling frequency on the accuracy of WFD status classification. The Enborne is a rural catchment, impacted by agricultural runoff and sewage treatment works (STWs) discharges, and The Cut is a highly urbanised system significantly affected by STW discharges.

On the Enborne, total reactive P (TRP) was measured hourly and soluble reactive P (SRP) measured weekly. Under the new WFD targets, although the mean annual P concentrations were similar, 0.173 and 0.136 mg/l-P for TRP and SRP respectively, the two "reactive" P fractions resulted in different system classification: TRP "poor"; SRP "moderate", highlighting the implications of using filtered vs. unfiltered P fractions in the WFD assessments. The mean TRP concentration of 0.237 mg/l-P in the growing season (April – September) was also significantly higher than the annual mean. This is significant, as the growing season is the period of lowest flow, greatest water residence time, highest temperatures, and high insolation, giving a greater risk of eutrophication, one of the issues the standard is supposed to protect against. On The Cut, the assessment of dissolved oxygen was significantly affected by the sampling regime employed. The high-frequency data demonstrated that by reducing the sampling frequency to monthly, the system could be classified as either 'moderate' , 'good' or 'high'. The time when the sample was collected altered the WFD status achieved, with samples collected in late afternoon achieving the highest classification. These results demonstrate the vulnerability of WFD assessments to low-frequency, time-limited monitoring practices. The findings also raise questions over the merit of mean annual targets and how catchment managers can relate spot sample results to these targets in order to identify potential periods of ecological risk.