

THE INFLUENCE OF VARIATIONS IN FLOW ON GENERAL QUALITY ASSESSMENT OF RIVERS

The Environment Agency monitors river quality through spot sample analyses of Biochemical Oxygen Demand (BOD), ammonia and Dissolved Oxygen (DO%). The data are used for chemical classification in the General Quality Assessment (GQA) scheme for rivers. The Agency assesses the reasons for any changes in overall and regional GQA results. Such changes may have a variety of causes, including variations in river flow, variability in the degree of algal growth, sampling, and changes in the flow and quality of sewage treatment works effluents. Variations in river flow in particular are thought to have a large impact, and Agency has in the past attributed apparent deterioration in river quality to low river flows. However, no formal method exists to quantify the effect of a change in flow on quality, and so the Agency has had to rely on the observations and the experience of its staff. It therefore commissioned a statistical study of the relationship between flow and various measures of water quality, including GQA class.

The aims of the project were to build up an understanding of the relationships between quality and flow for the three GQA determinands, and to clarify how any relationships found are influenced by the nature of the river. The project also assessed how much year-to-year variation in regional and national GQA results are attributable to changes in the flows. Several different but complementary methods were used depending on the degree of data aggregation involved:

- Low-level - no data aggregation, individual samples used.
- High-level - data aggregated over time and determinands, but not over different sites.
- Regional-level - data aggregated over time, determinands and sites.

At each level, various statistical techniques were applied to flow and quality data. For the low and high-level approaches all 565 GQA sites in Thames Region were used and supplemented by selected sites in other regions. For the regional-level approach, several other aggregated data sets were analysed.

The main findings were:

- Statistically significant correlations between individual GQA determinands (DO%, BOD and ammonia) and flow are found at only about half of Thames Region sites, and are weak, providing no convincing evidence of an effect of flow on GQA results.
- The extent to which GQA class varies appears to be largely unrelated to variation in site mean flow. Sites with more variable flow are not more likely to have a significant quality versus flow association.
- Previous Agency examinations of aggregated data appeared to show quite strong associations between GQA change and flow, but were compromised by the presence of strong autocorrelation arising from the use of 3-year rolling GQA results.
- The absence of clear evidence of relationships at the level of individual data points is not inconsistent with a strong high-level GQA versus flow association, but it severely hampers attempts to explain such an association.

- It is concluded that an association between GQA and flow exists, at some sites at least, but is not readily discernible at the individual determinand and site levels for several reasons. These include (a) the limitations of monthly GQA data in relation to infrequent and transient events, and (b) the complexities of behaviour of individual GQA determinands, especially dissolved oxygen, in response to low flows.

This R&D Technical Summary relates to information from R&D Project E1-112 reported in detail in the following output:-

R&D Technical Report E1-112/TR – The influence of variations in flow on General Quality Assessment of rivers

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Project Manager: Juliane Stuve / Simon Bingham Thames Region / Head Office

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Rio House
Waterside Drive
Aztec West
Almondsbury
Bristol BS32 4UD

Tel: 01454 624400

Fax: 01454 624409