

Modelling Water Flow and Water Quality: An Evaluation of the ISIS Model in the River Avon, United Kingdom

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Abstract

A conceptual deterministic hydrodynamic-water quality model, ISIS, was used to stimulate flow in the Warwickshire River Avon, UK under a range of flow conditions. ISIS was also used to assess the impact of flow on water quality under each flow condition. The mid Avon section receives high nutrients (nitrogen and phosphorous) loads from 3 major sewage treatment works as well as from diffuse sources leading to the growth of planktonic blooms. The approach in this study was based on the assumption that any reduction in river velocity may result in lower dissolved oxygen concentrations and provide opportunities for planktonic blooms. The ISIS model consists of two components, ISIS-Flow and ISIS-Quality. ISIS has a well-established flow routing component and provides an opportunity to examine water quality, sediment and nutrient transport and the biological response of the River Avon to nutrient availability. Furthermore, it enables interactions between bed-sediments and the water column to be predicted.

ISIS-Flow was found to accurately predicted flow variations at two stations (Warwick and Stratford) located on the river network. ISIS-Quality output provided a reasonable outcome in terms of predicting DO, BOD, Total Nitrogen, Ammoniacal Nitrogen and Nitrate-N. A sensitivity analysis for ISIS-Quality revealed that only changes in the temperature dependency factor and nitrogen decay parameters had a significant impact on the predicted output of the Dissolved Oxygen module. Evaluations regarding the user friendliness of the model, as well as specific evaluations regarding the ability of the model to predict water quality in the Avon, are also presented.