UK: Low flow investigations on the River Wylye

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6.1.1 Background

Study Area: location and geography

The River Wylye (Figure 1) has a catchment area of 470km² and is a renowned southern English Chalk stream. It is situated in the country Wiltshire and drains to the River Avon which flows south through the city of Salisbury to the sea at Christchurch. The catchment is underlain by a major Chalk aquifer, although except for the uppermost reaches the river itself runs over alluvial gravels. Various springs lie at the junctions between the layers of Chalk and also between Chalk and Greensand, these contribute significantly to baseflow. The uppermost reaches of the main river, and its two tributaries – the Chitterne Brook and River Till are natural "winterbournes", ephemeral streams which dry up each summer.

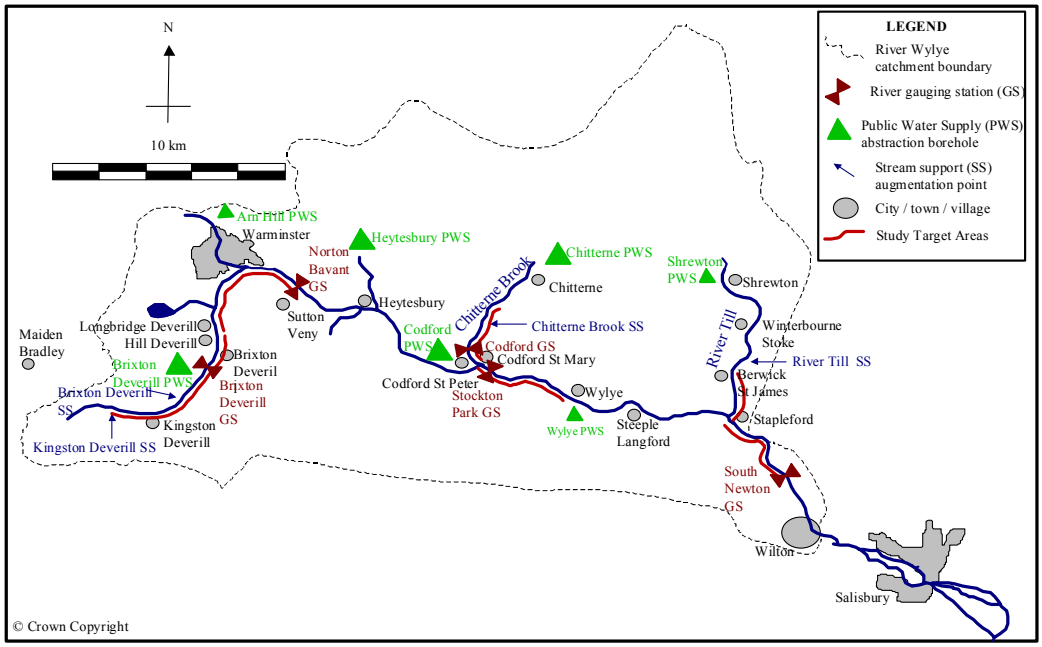

Figure 1. ***River Wylye Catchment***

Water Resources Development

In the catchment there are several pumped groundwater abstractions for public water supply. In addition, river flows have been augmented from pumped groundwater in the upper Wylye ('stream support'); this has been trialled on the Chitterne Brook also. The catchment has been utilised for water resources since before 1970, there have been several phases of development where overall yield of the catchment was increased. However, the quantity of water taken has been below licensed quantities. Many of the abstractions are some distance from the river in the upper parts of the catchment; these

intercept groundwater which would have reached the river. Others, located in the lower catchment, are in higher transmissivity areas close to the river; these can be considered to draw water from the river itself. This complexity necessitated the development of a regional numerical groundwater model, developed by consultants Halcrow, to link the flow regime of the river to climate and abstraction in a spatially explicit manner.

6.1.2 Need for an Environmental Flow Assessment

It was perceived that the headwaters were suffering from significant flow reductions, that these had become more severe as abstraction levels increased, and that habitat for salmonid fish was being negatively impacted. As part of wider investigations into the management of the catchment, the Environment Agency commissioned a river habitat modelling study. This was undertaken by CEH Wallingford with assistance from University College Worcester and CEH Dorset. The aim of the study was to assess the flow regime changes caused by the abstractions in terms of usable physical habitat (for salmonid fish).

6.1.3 Environmental flow approach used

On the basis of the groundwater modelling work, groundwater management units (GMUs) were defined. This in turn led to the definition of lengths of river channel linked to the GMUs. These were termed “Target Areas” (TAs), six were selected for further study, each was 4-6km long. Three were on smaller stream sections – Upper Wylye, Chitterne Brook and River Till. These areas were believed to be most influenced by abstractions. There were also three areas on larger sections of the main river, these were selected mainly as controls.

Each TA was represented by between one and three shorter (50-150m) reaches of river. These were carefully selected to contain the hydraulic meso-habitats of the TA in similar proportions. In each reach, more detailed cross-section surveys of the hydraulic meso-habitats were undertaken. Thus the upscaling to the TA scale was implicit within the modelling, very little work had to be done to adjust proportions of meso-habitat types.

Predominant meso-habitats were shallow glide (SG), deep glide (DG) and riffle (RIF); with DG increasing and SG and RIF decreasing as one moved downstream. Within the representative reaches, the more detailed cross-section survey data was then used to model the relationships between physical habitat for life stages of trout and salmon, and river discharge. Habitat suitability indices (HSIs) for salmonids in southern Chalk streams were supplied by the Environment Agency. Four river flow time series scenarios (for 1975-1994) were supplied by the Agency from the groundwater model, representing different abstraction regimes: Historical, Naturalised, Full Licence Abstraction from the catchment, and Full Licence Abstraction without the Chitterne groundwater source.

Physical habitat time series models were then produced using the discharge time series for each scenario. Flow and habitat duration curves were produced, using selected months applicable to particular life stages (April to September for adult trout and fry / juvenile trout and salmon, and November to December for spawning trout and salmon). However, duration curves lose information about the temporal sequencing of events and can hide important habitat bottlenecks. Thus for some TAs, a further investigation of reductions / increases in physical habitat during the period 1988 and 1994 was undertaken (e.g. Figure 2). Here a baseline scenario was selected (in this case the natural regime). Each other scenario was compared to natural on a monthly time step. Differences were presented in relative and absolute terms. The resulting reduction time series illustrated how abstraction and natural climate variation interacted to produce habitat losses in some summers but not others. Other graphical analysis, including plotting duration curves and comparing reductions arising from two different scenarios were also used.

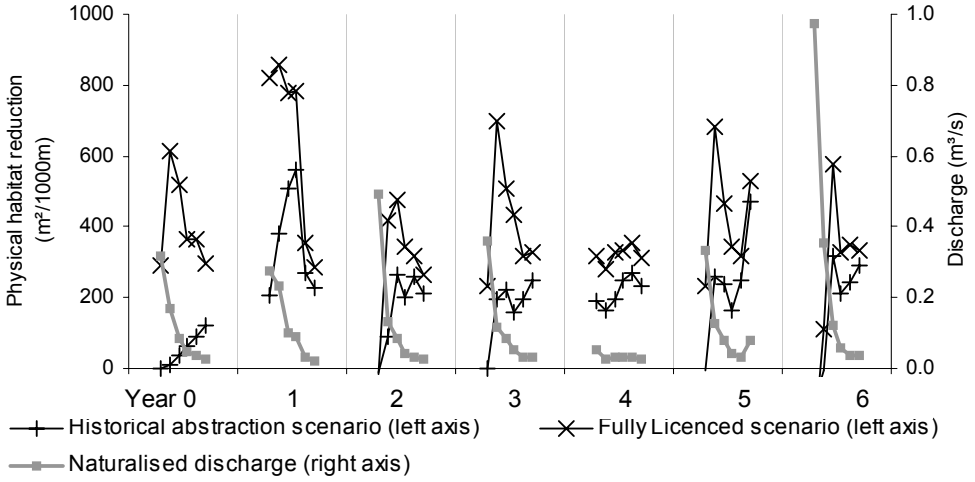

Figure 2. Example monthly habitat reduction time series (April to September only plotted)

6.1.4 Management Actions: decisions taken and implications

The combined modelling of several Target Areas enabled integrated decision making using results from a number of separate GMUs within the catchment.

There has not been a single decision arising out of the study. The model highlighted the high upstream/downstream differences in fish habitat in the upper section of river, arising from combinations of flow and channel morphology. Through comparison with other habitat modelling studies on other rivers, it also highlighted the un-naturally wide channel this could have arisen because of the 'stream support'.

A further conclusion was the further negative effects of Full Licence Abstraction to physical habitat on the Chitterne Brook, and the potential benefits of cessation of abstraction from the Chitterne groundwater source (compared with the historical regime). For the three TAs on the main River Wylye, current levels of abstractions were not causing excessive losses of physical habitat.

6.1.5 Lessons learnt

The study demonstrates both positive and negative aspects. On the positive side, the end-users had a clear view of the study aims, and how these aims should be investigated. Initial analysis results were passed to the Agency, who used them to fine-tune a second round of abstraction scenarios which were then analysed. However, there were also negative aspects. The fact that the modellers did not have complete control over the data collection led to confusion regarding the effects of weed growth on hydraulics. In addition there was not the opportunity to refine the definition of the management units based on preliminary modelling results.