# RIVER WYLYE
# Low Flow Study

## Progress and further investigations

ENVIRONMENT AGENCY

## FOREWORD

In 1991 the National Rivers Authority (now part of the Environment Agency) commissioned Sir William Halcrow & Partners to study in two phases the influence of abstractions for public water supply on low flows in the Upper Hampshire Avon. In Phase 1, Halcrow estimated the effect of abstraction on all five tributary areas which make up the Upper Hampshire Avon, including the River Wylye. This was completed in 1993.

Of the five sub-catchments the Wylye is the most affected by abstractions. Beginning in 1993, Phase 2 focused on low flows in the Wylye and was completed earlier this year. This leaflet summarises the results, the actions taken and outlines the further work necessary to more fully resolve appropriate action in the Wylye catchment.




## STUDY AREA

The River Wylye rises from springs in the Cretaceous Upper Greensand of West Wiltshire. The head of the river itself, however, is not always found at the same point. Depending on the time of year, the location can be anywhere between the villages of Maiden Bradley and Kingston Deverill. From its source, the river flows north-eastwards over the Lower Chalk, cutting through the escarpment at Brixton Deverill and then back onto the Greensand near Longbridge Deverill. Here the river's flow and size is augmented by further spring flows. It then flows south-east, again over the Lower Chalk and then, from Wylye village, over the Middle Chalk, and, beyond South Newton, over the Upper Chalk, on its way to join the River Nadder at Wilton.

The only sizeable tributaries to the River Wylye are the Chitterne Brook, which flows into the main river between Codford St. Peter and Codford St. Mary, and the River Till which flows in at Stapleford.

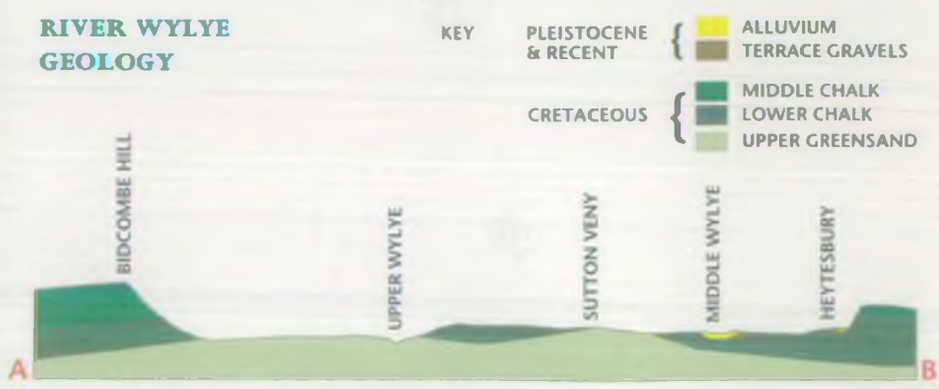
Both the Chalk and the Greensand are gently dipped, relatively thick and highly absorbent to water. Consequently, these 'aquifers' contain a large volume of groundwater draining slowly south-eastwards. This makes the Wylye an attractive location for public water supply (PWS) boreholes. Wessex Water operates 7 groundwater sources for PWS in the catchment and additionally pumps groundwater from two sources in the Upper Wylye to support stream flow during dry periods.

The PWS sources were all licensed by the Agency's predecessor authorities. Abstraction from these sources and conditions on the licences are carefully monitored and enforced by the Agency. Abstractions from other groundwater and surface sources in the catchment have relatively little bearing on river flow problems.

## BACKGROUND

Before this study the most notable hydrological investigation of the River Wylye was the Upper Wylye investigation of 1972. This was conducted by the River Authority to investigate the potential for public water supply abstraction from boreholes at Brixton Deverill, Heytesbury and Chitterne. Abstraction licences were subsequently granted, with conditions, including a provision for stream augmentation to avoid detrimental environmental damage.

Throughout the 1970s and the 1980s abstraction from PWS sources in the catchment gradually increased but within the allowance of the licensed abstractions. By 1990, in the middle of the 1988-92 drought, public claims of low flows in the Wylye caused by abstraction were being received. Consequently, in 1991 this current study of the Wylye catchment was commissioned. Based on computer modelling of the aquifer-river system and analysis of historic and newly collected environmental data the study was in two parts:



## SCOPE FOR FLOW IMPROVEMENT

Summer flow improvements at critical points would benefit the river through improved fisheries and in visual amenity related to an increase in depth of flow. An assessment has been made of the increase in river depth at various flow targets and the following reaches have been identified that would benefit from a maintained summer flow of 2-3 Ml/d:

- Brixton Deverill to Hill Deverill. Improved summer flows at Brixton Deverill would smooth out the flow pattern in the Upper Wylye thus giving greater security to fish production upstream of Longbridge Deverill. Amenity benefits could be realised but these would also require channel improvements.

- Below Chitterne Village on the Chitterne Brook. The general environment of the lower part of the Brook is affected more by abstraction than weather variations. There is a very good case to be made for summer flow improvements at Codford St Peter to restore fish habitats and to conserve aquatic ecology.

- In the River Till below Berwick summer flow improvements in dry years would safeguard amenity value and fish populations.

There is evidence that the augmentation of Upper Wylye flows from Kingston Deverill to Brixton Deverill is greater than required. Summer flows in this reach are usually above the critical 2-3 Ml/d. It is also concluded that summer flow improvements are not a priority on the Heytesbury Brook given the limited impact on and value of the amenity and fisheries here. Similarly, the minor, secondary impact abstraction has on flow and the environment of the upper, winterbourne reaches of both the Chitterne Brook and the River Till suggests there is little urgency for improvements in these locations.

There is at present poor evidence to conclude whether the 20-25% flow reduction in the Middle/Lower Wylye has a dramatic effect on fisheries and ecology. The results of continuing impact assessment work are necessary before objective conclusions can be reached.

## OPTIONS TO ACHIEVE FLOW IMPROVEMENTS

Practical options to increase the summer flows in the key locations were considered. These were evaluated using the computer model for the period 1990-93 and assuming a 2-3 Ml/d flow target; this period being a relatively dry period with public water supply abstractions operating at the highest historic level. Following the consideration of technical and financial factors the following schemes were selected as worthy of further investigation:

- Upper Wylye: continued flow augmentation at Kingston Deverill, increased augmentation at Brixton Deverill and constant abstraction at Brixton Deverill (rather than seasonal at present).
- Chitterne Brook: augmentation upstream of Codford St Peter using a new borehole and revised pumping regime - use of Chitterne source in summer, Codford in winter.

- River Till: augmentation upstream of Berwick St James using a new borehole and revised pumping regime - use of Chitterne source in summer, Codford in winter.

Consultants recommended that conclusions for the Middle/Lower Wylye should await the outcome of further studies although the schemes above would give some benefit, not least by promotion of nurseries to support fisheries. The extent of impacts in the main river is confused by other factors such as changes in land drainage, increased siltation associated with arable land runoff and nutrient enrichment from fertilisers and waste water discharges. Such problems are being confronted in other work involving the Agency and the farming community of the upper catchment through the Hampshire Avon Catchment Management Plan.

## IMMEDIATE ACTION AND EARLY CONSIDERATION

Options for early improvements to summer flows all involve drilling additional boreholes for river flow augmentation and changes to the operation of existing public water supply boreholes. Also, the flow targets identified were calculated mainly on the basis of improved depth of flow to provide reasonable visual amenity. In the Middle/Lower Wylye, hard evidence is still being sought of the connection between abstractions and environmental detriment.

Our consultants recommended the following programme for immediate action and early consideration:

- With Wessex Water identify the location, field trialing, operation and monitoring of the suggested new river augmentation schemes on the Chitterne Brook and River Till.
- Discuss with Wessex Water the practicalities of changes to their abstractions at Bnxton Deverill, Chitterne and Codford, including suggested increase in river augmentation at Brixton Deverill.
- Conduct a comprehensive fish survey to determine the durability of the decline in environmental features in the early 1990s.
- Assess the relationship between flow and fish habitat to build on the provisional flow targets and to ascertain whether such flow targets are appropriate in the Middle/Lower Wylye.

## CURRENT PROGRESS

### Brixton Deverill, Chitterne and Codford Abstractions

The Agency is in discussions with Wessex Water concerning the practicalities of increasing the river augmentation at Brixton Deverill and whether the pattern of pumping for PWS can be altered at these sites.

### Augmentation schemes

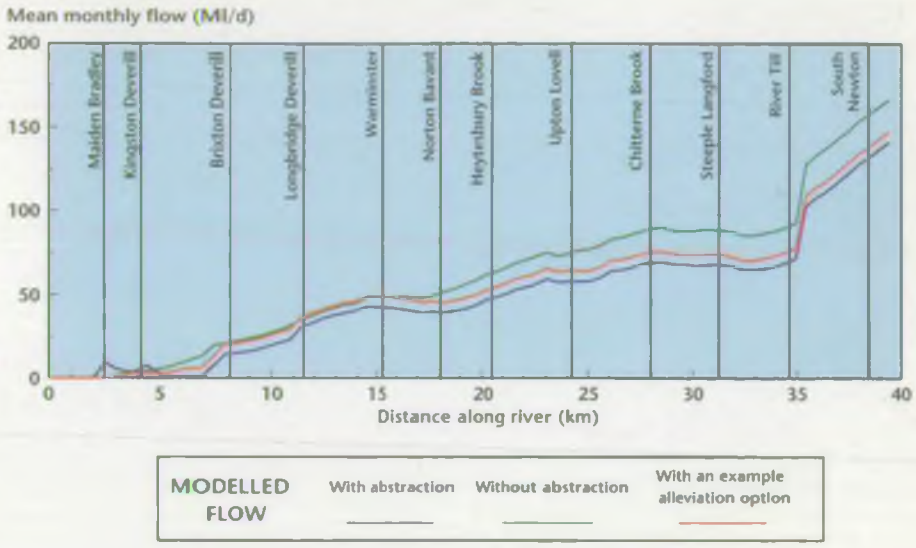
Wessex Water has agreed to investigate with the Agency the field testing of augmentation boreholes on the Chitterne Brook and the River Till. Ideally both boreholes would pump suitable water from the Upper Greensand formation. The programme is as follows:

- Borehole location - Wessex Water is negotiating with landowners for identified sites near the Chitterne Brook and the River Till. The Agency has proposed the location of the discharge points: 1 km north of Codford on the Chitterne Brook and just upstream of Berwick St James on the River Till. The boreholes should be drilled by the end of 1996.
- The boreholes would be test pumped in successive summers from 1997 to 1999 to ascertain reliability and effectiveness.
- Monitoring will be conducted by both the Agency and Wessex Water to check any effect of these boreholes on flows in the river, groundwater levels and adjacent water interests.
- On the basis of the results a set of rules will be drawn up governing the augmentation operation.

These schemes are aimed at delivering the necessary priority improvements in the Chitterne Brook and River Till. Benefits will also accrue to the main Wylye.

# RIVER WYLYE

Flow accretion for September 1990




- In the vicinity of Norton Bavant abstractions have increased the natural river leakage during dry periods and summer flows are reduced by about 10-20%.

- The greatest influence is in the reach between the confluences of the Heytesbury Brook and River Till. Summer flows in this reach have typically been reduced by 20-25%. If abstraction was increased to its full licensed limit then summer flows would be typically reduced by 30-40%.

- Environmental evidence suggests that abstraction is only one of the contributory factors that have affected fisheries, the others are: the 1988-92 drought, siltation, algal growth, swans, and discharge from Warminster sewage treatment works.

### Tributaries

Abstraction has affected flows in the Wylye's tributaries: the Heytesbury Brook, the Chitterne Brook and the River Till. All of these are winterbournes, the sources of which would naturally migrate downstream during dry periods. Abstraction has reduced flow and may have moved the winterbourne's source.

- Heytesbury Brook. With no abstraction the Heytesbury Brook would dry up each year for about seven months at its confluence with the River Wylye. Abstractions have caused the natural period of no flow to extend by an average of one month per year. This has probably been detrimental to the aquatic plant-life, although the effect is not as great as in the other tributaries and is based on limited evidence. If abstraction was to increase to its limit then the Brook would dry up for an additional two months compared with natural conditions.

- Chitterne Brook. On average, under natural conditions, the Chitterne Brook would flow for about five months each year from Chitterne village. In wet winters the Brook would flow from Imber village, upstream of Chitterne. During the testing of the Chitterne source in 1972 the Brook ceased flowing about one month earlier than it would have done naturally. Model results show that the pattern of flow/no flow in the Brook during the 1988-92 drought would have been no different under natural conditions. This indicates that the influence of weather and not abstraction can be predominant on flow. Nevertheless, in an average rainfall year, such as 1993, it would appear that at Chitterne the Brook ceased flowing 2 months earlier and resumed flowing 2 months later than it would have done under natural conditions. At Codford, the Brook has ceased to flow at times because of abstraction. If abstraction was to increase to its full limit then even more significant changes would occur in the Chitterne Brook.

- Such changes would have a marked impact on trout spawning. In particular, since the 1988-92 dry period cessation of flow through Codford has occurred each year: Fisheries data collected during 1988-92 suggests the Brook's decline as a spawning area during that period. Recent surveys have shown that aquatic plant-life has recovered.

- River Till. In average conditions the Till's source is upstream of Berwick St James. In wetter winters it rises at the village of Tilshead. Between Berwick and Tilshead the river is a winterbourne. Abstractions cause only a small reduction in flows in this reach but in dry years can cause the river to stop flowing one month earlier than under natural conditions. Environmental impacts caused by these flow changes appear relatively minor. Abstractions have a significant impact on the Till downstream of Berwick, the typical reduction in summer flows in this reach being some 25-40%. Whilst fish population impacts are likely, other ecological impacts are minor since a reasonable flow is available in most years. If abstraction was to increase to its full limit then in most years there would be periods of no flow at Berwick.

## PUBLIC WATER SUPPLY SOURCES - MAXIMUM LICENSED QUANTITIES

| SITE | SOURCE | LICENSED DAILY VOLUME | |
|---|---|---|---|
| | | Millions of litres | Millions of gallons |
| Chitterne & Codford | Chitterne | 20 | 4.4 |
| | Codford | 26 | 5.7 |
| Upper Wylye | Brixton Deverill Boreholes | | |
| | For public water supply | 18 | 3.9 |
| | For river augmentation | 8 | 1.8 |
| | Heytesbury boreholes | | |
| | For public water supply | 15 | 3.3 |
| | Kingston Deverill boreholes | | |
| | For river augmentation | 10 | 2.2 |
| Arn Hill | 2 boreholes | 2 | 0.4 |
| Shrewton | 2 boreholes | 2 | 0.4 |
| Wylye | 2 boreholes | 1 | 0.2 |

- Phase 1 - a general assessment of the impact of abstraction in the five sub-catchments of the Upper Hampshire Avon: the Rivers Ebble, Nadder, Wylye, Bourne and the Upper Avon.

- Phase 2 - a more detailed study of the Wylye, to include suggestions for actions required to reduce the incidence or consequences of low flows.

## PHASE 1 INVESTIGATIONS

In Phase 1, the consultants constructed a regional hydrological model for the entire Upper Hampshire Avon. This was used to examine the effect of abstraction on river flow and groundwater levels by comparing these under conditions of no abstraction (natural) and under conditions of actual abstraction (with abstraction). A preliminary assessment was also made of factors influencing the aquatic environment and of the local history of ecology and fisheries.

The broad conclusion from this work was that PWS groundwater abstractions did have a significant effect on dry season flows where sources were located in sensitive upper or winterbourne reaches. These sites within the Upper Hampshire Avon include the Nine Mile River, the Upper Wylye, the Chitterne Brook, the River Till and the River Bourne. Phase 1 confirmed that of all the Upper Hampshire Avon sub-catchments the Wylye is the most significantly affected by abstractions. In the future the Nine Mile River and the River Bourne should be examined. Elsewhere river conditions in general may have been as much influenced by weather variations or changes in agricultural land-use and practice.

## PHASE 2 INVESTIGATIONS

These required a more detailed model of the Wylye sub-catchment. To ensure a sufficiently accurate match between the model and reality this used historic recorded data such as rainfall, river flow and water table levels, as well as additional catchment data such as aquifer properties obtained from newly drilled observation boreholes. The model was completed in 1995.

The model was used to assess the impact of actual and licensed abstractions on flow in the Wylye catchment. Factors other than abstraction can influence the condition of the river, and these and the limited environmental impact information were taken into account as far as was practical.

In respect of the conclusions about the impact of the full licensed quantities it must be said that there is considerable room for doubt that these could be simultaneously or in some cases individually achieved. The prognostications for a 'worst case scenario' should therefore be treated with some caution.

On the basis of these estimated impacts the scope for improvements to flow was examined. A number of options emerged: for immediate action; for early consideration; and for the longer term.

## ABSTRACTION IMPACTS ON RIVER WYLYE

### Upper Wylye

The typical impact of historic abstractions in this part of the catchment has been to reduce low flows by about 20%. If the full licensed quantity was abstracted then during most summers there would be no flow at Brixton Deverill. Flow impact descriptions for the reaches comprising the Upper Wylye are presented below with relevant environmental observations:

- Kingston Deverill to Brixton Deverill. Water pumped from groundwater sources to augment flows along this reach has resulted in greater flows and fish densities than would have occurred naturally. There has been an improvement associated with the increase in flow.

- Brixton Deverill to Hill Deverill. Here abstraction has reduced typical summer flows by 50-60% despite the augmentation upstream. During dry periods abstraction lowers the local water table resulting in leakage through the river bed. This may affect the quality of fisheries further downstream at Longbridge Deverill.

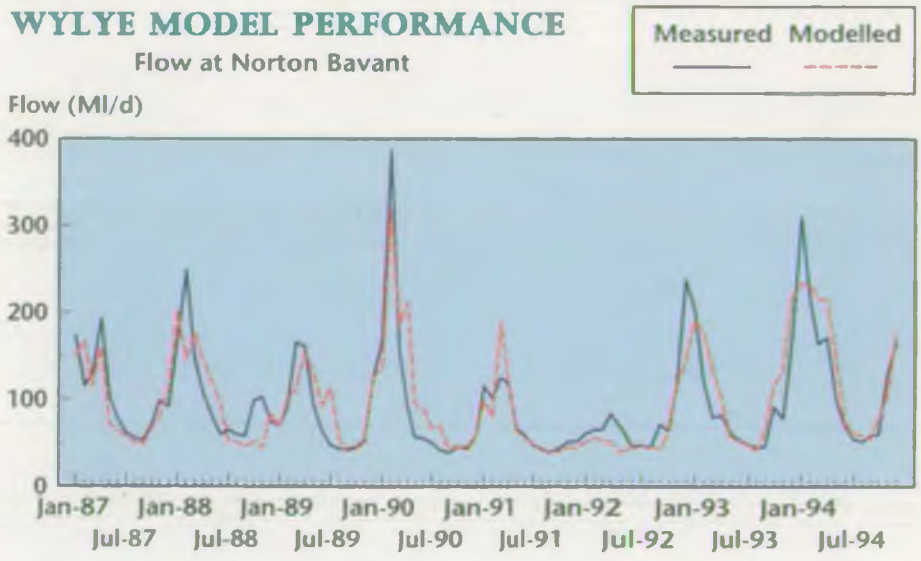
- Longbridge Deverill. Abstraction has had less effect here than at Brixton Deverill because of the strong emergence of Upper Greensand springs: Summer flows are reduced by about 20%. Data from 1991/92 show poor numbers of juvenile fish but this may have been caused mainly by dry weather.

### Middle/Lower Wylye

- Under natural conditions flows generally increase downstream although during the summer and autumn when the water table can be lower than the river bed the river leaks. Leaking stretches have been identified at three places: from Norton Bavant to Upton Lovell; near the confluence with the Chitterne Brook; and just upstream of the confluence with the River Till.

## WYLYE MODEL PERFORMANCE

Flow at Norton Bavant



### Environmental studies

The Agency together with the Wiltshire Fisheries Association confirmed a need for further fisheries and ecological studies to assist conclusions about the ecological impact of abstractions to support the 'snapshots' taken during the 1988-92 drought. The following comprises the Agency's commitments to fill the gaps in present knowledge:

### Survey of local knowledge of the river's aquatic environment

The Agency has commissioned a survey of local people to record their knowledge of the river's environment. This will be used to review the importance of abstractions as an influencing factor in the Middle and Lower Wylye. The survey report will be ready by the end of 1996. Common themes emerging include complaints that the river channel is over-wide and fish habitat problems are related to siltation and the influence of flow and of swans on important aquatic plants.

### Environment Agency fisheries surveys

During 1996-97, the Agency will be conducting the following fisheries surveys in the Wylye catchment:

- A general survey of the fish population along the entire main river.
- A detailed survey of fish population and composition at key sites.
- A survey of angling quality at various locations in the Wylye at different flows.
- A winter survey of trout breeding success as river conditions permit. A particular focus will be the winterbourne tributaries.

The results of these surveys will be compared with previous studies to help clarify whether the adverse changes observed during the 1988-92 drought are permanent. The angling quality survey will help to assess appropriate flow targets.

### Physical habitat assessment

This project will examine the relationship between physical needs of trout and flow in the Wylye catchment. This may make possible a measure of the impacts of abstraction alone, divorced from the other influences at work on environmental change. The Institute of Hydrology and Worcester College will jointly conduct the work which involves habitat mapping, channel description and flow measurement at six locations in the catchment:

- in the Upper Wylye near the Deverills.
- upstream of Norton Bavant gauging station.
- the Middle Wylye downstream of Stockton.
- the Chitterne Brook at Codford.
- the River Till upstream of Stapleford.
- the Lower Wylye near South Newton.

### Other related Environment Agency work

The Agency has devised a "Land care" project aimed at controlling inputs of silt and other diffuse land-based pollutants to the Hampshire Avon catchment. This includes the examination of erosion risk areas within the Wylye catchment with a view to controlling sediment runoff. The problem of excess algae is also being investigated by the Agency.

## PROGRAMME FOR THE LONGER-TERM

To address the most urgent problems the Agency is progressing the options for immediate action and early consideration within our programme of work for 1996/97. The additional environmental studies will be completed by the 1997 summer. These will enlarge on judgements of the impact of abstractions on the aquatic environment as concluded in Phase 2 and help to clarify the significance of impacts in the Middle/Lower Wylye. By this time we shall also report the drilling and initial test-pumping of the new augmentation boreholes.

Beyond this we shall also be concerned with the merits of the additional stream augmentation boreholes and a revised pumping regime as assessed over the next two summers. At this stage, however, it is premature to suggest what measures may be desirable should the continuing work demonstrate that radical improvements are necessary for the main Middle/Lower Wylye. It is apparent that an overall reduction to the quantity of water licensed for public water supplies could cause major socio-economic difficulties unless an effective strategy is in place to provide alternative sources of drinking water at reasonable cost. This dimension for the future has already been raised with Wessex Water and it will be the intention of the Agency to keep this matter in view in its review of water resources development strategies. In this respect the Agency has already commissioned work on the costs and benefits of remedies to River Wylye low flows as background information to environmental remedies.

We will produce another report in 1997 incorporating the results of the continued environmental studies and the latest progress with the augmentation boreholes and revised pumping regime.

ENVIRONMENT AGENCY

## THE ENVIRONMENT AGENCY

The Environment Agency, which began operations on 1 April 1996, brought together the National Rivers Authority, Her Majesty's Inspectorate of Pollution, the Waste Regulation Authorities and several smaller units from the Department of the Environment.

The new Agency provides an integrated approach to the protection and management of the land, air and water environment. Its main functions include pollution prevention and control, waste regulation, flood defence, water resources, fisheries, recreation and conservation.

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