Institute of Freshwater Ecology

RIVER KENNET REPORT JULY 1996

M Ladle PhD

Report To: Thames Water plc
CEH Project No: T11064B7
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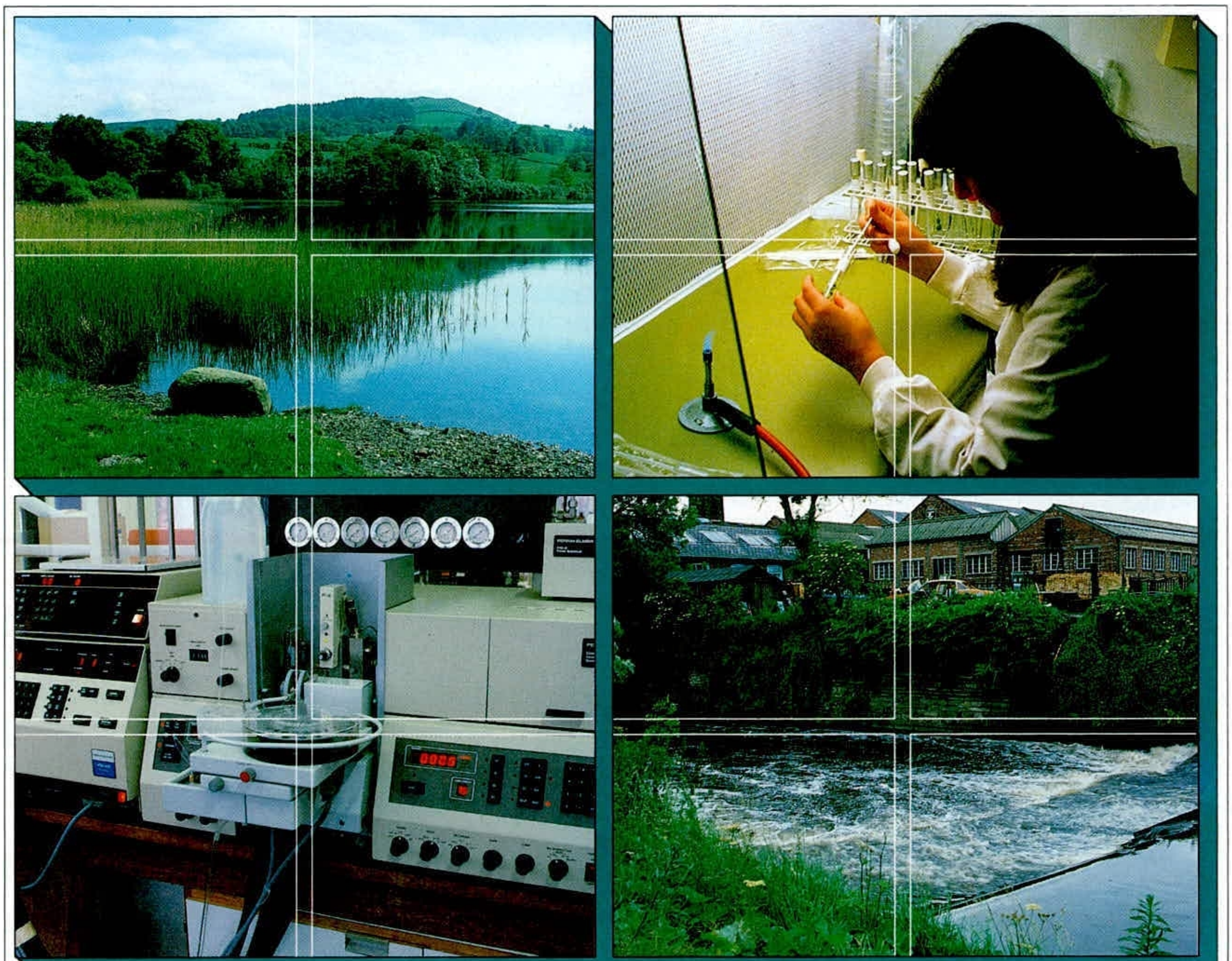

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River Kennet Report July 1996

Dr Mike Ladle B.Sc., Ph.D. Deputy O.I.C. IFE River Laboratory. 32 years experience of chalk stream ecology. Leader of research on chalk stream detritus dynamics, invertebrate taxonomy, recirculating streams and ecosystem manipulation, chalk stream invertebrate population dynamics, world authority on the taxonomy of Oligochaeta, Simuliidae and Bivalvia and head of chalk stream fish population studies. Author of 80 scientific publications, 76 contract reports and a large number of popular publications.

Introduction

At the request of Yvette de Garis and Peter Spillet a visit was made to Thames Water in Reading at 09.30 on 25 June 1996. The brief was to comment on the character of parts of the River Kennet in the vicinity of the Axford abstraction point. It was a pleasant sunny day and there had been no substantial rain in the few days preceding the visit. Accompanied by Miss de Garis the first site examined was at Knighton because the water keeper had said that a later visit might "interfere with his fishermen." Subsequently the most upstream site (Fyfield, upstream of Marlborough) was inspected and then those further downstream, site by site, returning for discussions with Peter Spillet at 16.30 hr.

Sites for study were selected by Thames Water and, although a choice was offered, no comment was made on the distribution of the sites to be visited. At each site the character of the stream was observed and noted. At selected sites believed (by Thames Water and agreed by the consultant) to be appropriate, a simple record of river habitat characteristics was made along a 50m section. In addition a 1 minute FBA pond net sample was taken, at selected sites, over a range of instream habitats roughly in proportion to their availability. The invertebrates present in the sample were placed in a white tray, on the river bank, and identified to family level.

Characteristics of chalk streams

General

"Chalk streams are the products of a unique combination of geology, climate, fauna, flora and human management" (Ladle and Casey 1979). A wide range of rivers, observed over many years has been used as the baseline of comparison in this report. Unless specifically mentioned by name, comparisons are generalised rather than with particular rivers.

In relation to the flow characteristics of such rivers the components which are operational include

- (1) DISCHARGE The volume of water passing downstream over a given period of time. The seasonal pattern of variation in discharge is of great importance. Typically such a stream should vary little between maximum and minimum discharges (for example range 3:1 (R. Itchen) to 14:1 (R. Wylye)), although small tributaries may dry completely in late summer.

- (2) VELOCITY The actual speed of water flow within the channel. To some extent deficiencies in discharge can be compensated by reductions in channel cross section or increases in slope which may locally increase velocities. There is a natural, seasonal, restriction of high velocity flows (up to 0.5 ms^{-1}) to 'runs' between weed/sediment banks which permits the propagation and establishment of flow sensitive *Ranunculus* plants. **Where reference is made to the effects of low flows in this report it should be appreciated that no judgement is implied as to the factors , natural or otherwise, responsible for these conditions. The effects of natural and artificial reductions in discharge/velocities are effectively indistinguishable.**

Water temperatures vary little over the year being buffered by the constant temperature of the spring (ground water) flows. Suspended solids concentrations are normally low and the water is consequently very clear. Water chemistry is stable and plant nutrients are generally in excess of plant growth requirements. The pH is normally within the range 7.5-8.5. The substratum consists of a flint gravel pavement and an overlying mosaic of plants, and fine sediments. Under normal conditions gravel pavements and macrophytes are clean and free of algae and fine deposits, the only exception being during the seasonal diatom blooms of Spring and Autumn.

The annual cycle of such streams usually consists of rapid growth of the submerged macrophyte *Ranunculus penicillatus* (Chalk Stream Water Buttercup) in the Springtime. At the same time of year there is often a "bloom" of brown diatom algae on stream bed stones and plants. As discharge declines, in early Summer, the submerged macrophytes trap fine sediments and the increased hydraulic resistance, caused by the combination of growth of plant material and accumulation of sand and silt, sustains the water levels in the stream.

Following the flowering of *Ranunculus* in May-July (earlier further upstream) the submerged plants decline in vigour and are often overgrown, particularly in smaller streams, by emergent macrophytes such as watercress or *Apium* (Fools Cress). The Autumn increase in discharge normally results in "rip out" of this shallow rooted emergent vegetation and redistribution of fine sediment. In Summer the margins of these streams generally exhibit a dense growth of herbs of many species and trees such as willows and alder are also characteristic.

In winterbourne streams, where the discharge is ephemeral in nature, the flora and fauna tend to be less diverse and to consist of organisms specialised to withstand the dry period. For example, species of *Ranunculus* adapted to survive the period of dryness as seeds often supplant the chalk stream water buttercup. Emergents such as *Apium* may sometimes be dominant in streams which are prone to drying out. Some chalk stream invertebrates are effectively adapted to existence in ephemeral streams and species such as *Ephemerella ignita* and *Metacnephia amphora*, which have drought resistant oviposition strategies, may attain high levels of abundance.

In perennial chalk streams there are large variations in percentage *of Ranunculus* cover, between years, in any given stream. Factors such as shading, low summer flows, winter rip out and weed cutting practice are all of relevance. It is not possible to give absolute values for the range of cover area in chalk streams in good condition, but peak cover of 50% to 80% of the stream bed is not unusual. In open, gravel bedded streams, with stable discharge regimes and no external stress it would be unusual for the annual maximum growth of *Ranunculus* to be less than say 20% of the stream bed area.

The varied habitats presented by plants and sediments and the associated wide range of food sources, support a rich and diverse fauna of invertebrates. Many of the invertebrate species achieve high population densities, grow rapidly and in consequence produce a rich supply of fish food. The fish communities are themselves diverse with, typically, bullhead, minnow, stone loach, sticklebacks, trout, eel, lampreys and, particularly further down stream, grayling and pike. In the lower reaches of large chalk streams dace, roach and perch are often present and barbel and chub have sometimes been introduced. Most species grow quickly and mature early relative to those living in many other types of stream. Management and exploitation of these streams and their surroundings by man has taken place for centuries and involves manipulation, at all levels, from abstraction of ground water and changes in land use to stocking of fish and predator control.

The River Kennet

Verbal discussions

Thames Water provided the following, verbal, information in relation to the present study. The abstraction borehole in question is at the village of Axford. The borehole is licensed for a peak abstraction of 20.5 Ml/d unless the flow in the river at Knighton falls below 69 Ml/d, at which times the peak licensed abstraction is reduced to 13.1 Ml/d. The abstraction site lies between Marlborough and Hungerford. Other possible influences on the river include a discharge of sewage effluent at Marlborough. Downstream of Marlborough there are many changes due to management activities mostly associated with fishing (channelisation, tree and shrub control, mowing of banks, stocking with fish). The intention was to walk some distance at each site in order to view the river.

In 1994 Thames Water applied to renew the variation to their abstraction licence at Axford for a third time. The NRA (EA) determination introduced a three phase programme, becoming progressively more restrictive over a ten year period. Ultimately the outcome is a substantial reduction in the licensed abstraction under low river flows.

The history of the River Kennet in this area is complex. Every time there has been an application to abstract it has, apparently, created a public outcry. Until 1993 the NRA seemingly suggested that the impact of the abstraction was minimal. The local fishermen and fishery owners are clearly articulate and good at PR. There is little public access because the water is owned by syndicates and used for "good" trout fishing. The fishing interests have pushed the NRA into more work on the river, there being a general view that the trout fishing is currently less good than it used to be, despite there being little apparent evidence of change. There are lots of stocked trout present in the river with large fish being seen at virtually every observation point.

The remit was to give a view on the current status of this stretch of the River Kennet and to say whether any problems were apparent and if so what the origins of those problems might be. The impact of the abstraction in late summer is often more than 10% of the monthly flow at Knighton where the discharge is gauged. The Environment Agency have commissioned a general ground water model but not specifically dealing with the area in question. The upstream section of the cone of depression is predicted, by the Environment Agency's groundwater model, to lie at Stitchcombe mill.

There are several other water quality issues on the upper Kennet worthy of note. It is recognised that there have been low dissolved oxygen concentrations recorded in the Kennet in recent years. These have commonly been attributed to the combination of early morning troughs in concentrations after night time respiration by aquatic plants and low DO concentrations in incoming ground water (Paul Whitehead, Reading University). In addition Marlborough Sewage Treatment Works was proposed by the former NRA for the installation of a phosphate removal plant (following pressure from English Nature). The problem was said to be not whether phosphorous was an issue but whether its removal would make any difference to the ecological integrity of a chalk river such as the Kennet. Also, in recent months, the Kennet has been proposed for designation as an SSSI.

General

Within the reaches observed, the Kennet had all the visible characteristics of a small to moderately sized chalk stream and was instantly recognisable as such. The channel was mostly square or trapezoidal in section and more or less level bottomed, with a pavement of flint gravels and varying amounts of sand and silt overlaying this. The bed sloped gently and the water flowed mainly in the form of glides, shallow pools and short riffle sections. There were both deep and shallow sections and a range of pools, riffles and glides distributed throughout the reaches examined and the proportional representation of such variations seemed not unusual for a stream of this size.

The water was generally clear so that the entire bed was visible and the character of the sites ranged from a small stream, at Fyfield, which apparently dries up in the summer months, to a sizeable river at Knighton. Dependent largely on the degree of management taking place the river banks and surroundings were heavily tree covered and shaded in places or alternatively, carefully mown, often with a marginal strip of tall herbs, rough grassland or fen. The submerged macrophyte flora consisted largely of *Ranunculus spp.* with *Callitriche, Schoenoplectus* and *Zannichellia palustris* also present in places. Trout (brown) were seen at all sites and grayling and rainbow trout only at Knighton.

Specific

Fyfield SU 150 683

Upstream of Marlborough and well outside the supposed cone of depression from Axford. The channel was small, perhaps 5m wide, with sparse growths of *Ranunculus* (flowering at time of visit) on a mixed bed of coarse and fine flint gravels. The margins were well covered with vegetation with nettles and *Apium* dominant. Other plants present included *Phalaris, Veronica* and *Salix.*

Assessment - If the stream, at this point, dries up in some summers it is likely that the *Ranunculus* present is *R. peltatus* (which produces viable seed) rather than the normal chalk stream water buttercup (which propagates vegetatively). It is also probable that *Apium nodiflorum,* because of its amphibious character, may dominate the channel flora in some years following severe drought. The observed section was fairly heavily shaded by trees and because of this perhaps not a particularly typical example of a winterbourne.

Manton SU 172 689

Again upstream of Marlborough and outside the Axford cone of depression. About 7m wide and 0.2m deep. Some *Ranunculus* downstream of the bridge some *Lemna* upstream opposite lawns and gardens. Marginal vegetation consisted of nettles (*Urtica*), *Epilobium hirsutum, Veronica, Petasites, Myosotis, Mentha, Salix, Alnus, Fraxinus, Crataegus* and *Sambucus.* The bed was composed of clean flints and the velocities appeared to be typical of a chalk stream of this size. This reach is an area in which the NRA are said to have carried out their 5 year rolling fish stock survey.

Assessment - A fairly typical small chalk stream with all the apparent characteristics of such a watercourse.

Stitchcombe Mill SU 229 693

The Stitchcomb Mill reach, inspected from the adjacent road bridge, was an attractive section and perhaps the most characteristic reach of chalk stream seen. The river bed showed c. 50% cover of *Ranunculus.* The river was very variable in width with a wide relatively deep hatch pool but otherwise mostly shallow (0.3m) with a substratum of gravel and sand. The stream was bordered by *Epilobium hirsutum, Rumex, Urtica, Scrophularia, Salix, Fraxinus,* and *Populus.* This represents a normal mix of marginal plants, with the trees scattered along the banks and only moderate shading. The BMWP score, (not a useful measure of invertebrate diversity at this level of sampling effort) from the simple 1 minute kick, was only 75 but the ASPT, a much more reliable index of water quality at any level of sampling, was 5.0. (NRA values, derived from information provided for June 1991, based on 3 minute kick and laboratory identification - BMWP 160 ASPT 5.3). In the sample *Gammarus pulex, Ephemerella ignita* and Baetidae were all extremely abundant. Trout were present in large numbers.

Assessment - The most attractive and characteristic chalk stream reach examined. *Ranunculus* growth was vigorous and healthy and the gravel bed was largely clear of silt deposits with the exception of the slow flowing marginal areas. Shading was not excessive, marginal plants were a typical association of species and the fauna was abundant and reasonably varied.

Axford upstream SU 239 698

The bed of the river was entirely visible and the site was surveyed from the left bank. The floodplain was symmetrical with a straightened, probably resectioned channel. The banks were steep, about 0.8 m high and essentially of earth with no recent modifications or features. The substratum was of irregular flint gravel and the water was 0.3 m deep with a rippled (upstream) or smooth (downstream) flow pattern. The left bank was uniformly covered by tall herbs and occasional trees (see below) and behind the bank top was a broad mown path to improve access for anglers. The right bank was fenced and inaccessible being overgrown with a simple semi-continuous mixture of scrub and small trees, creating a certain amount of shade; at the downstream end there were mostly tall herbs. Behind the left bank was rough pasture and behind the right bank, extensive fen.

"Axford upstream" was a well kept trout fishery with a broad bankside cover of tall herbs including *Mentha, Epilobium hirsutum, Filipendula ulmaria, Agrimonia eupatorium, Myosotis, Valeriana, Cirsium, Veronica, Lycopus* etc. and a closely mown walkway along the banktop. The instream plants consisted of *Zannichellia* and some clumps of *Callitriche. Ranunculus* was seemingly absent from the study reach. The calculated BMWP score was 87 and the corresponding ASPT 5.4. The most abundant invertebrates were again *Gammarus pulex* and *Ephemerella ignita.* Four families of mayflies were noted to be present. Large trout were again observed to be present at high density. Birds noted included coot, moorhen, mute swan and sedge warbler. A number of butterflies were present on the bankside herbs.

Assessment - The channel had undoubtedly been straightened at some time and the left

bank had been cleared of trees close to the water's edge and regularly mown in order to provide easy conditions for fly fishing. The dense mat of *Zannichellia* with clumps of *Callitriche*, on the bed of the channel, had trapped silt leaving the gravel runs reasonably clear with relatively fast flow. The presence of the above plants tends to indicate weak flow (poor flushing properties) and/or mild organic enrichment. *Zannichellia* often replaces *Ranunculus* in chalk streams where conditions of reduced flow and organic enrichment prevail. Heavy stocking with farmed fish had taken place and the input of excretory products from these animals must contribute, in some slight degree, to improving the habitat for *Zannichellia*. The section of river containing the *Zannichellia* did not appear to be unduly influenced by the presence of a sluice some distance downstream. As at other sites the impact of this stocking on native fish populations must also be considerable. The general impression was that more water in the summer months would be beneficial to both plants and fauna. It is difficult, if not impossible, to separate the various components of the discharge pattern (cross sectional area changes, maximum:minimum discharge ratio, mean velocity) as being responsible for changes in biotic characteristics because of the spatial and temporal interaction of physical characteristics with biological aspects (backing up of flows, channel cross section restriction).

Axford downstream SU 243 700

This site (Axford downstream) was again surveyed from the left bank. Even though the site was only a short distance downstream of site 6, the water was turbid and this made it impossible to see the bed of the deeper mid section of the channel. The floodplain appeared to be more or less symmetrical with a square sectioned channel 12-13 m wide and earth bank heights of 0.8 m to 1.0 m. A short section of the right bank had been reinforced. The water was rather deeper (>0.6 m) in the central channel than at some other sites, probably due to recent dredging activity. The substratum consisted mainly of a loose pavement of irregular flint gravel and pebbles and the water flow was rippled. The channel had clearly been resectioned with a deeper mid section and shallow margins. There was almost 100% cover of *Ranunculus* in the central deep channel. The visible bed consisted of large stones (coarse gravel) and the left bank, which was mown, had been built up possibly with the spoil from earlier dredging or redistribution of bank materials.

A broad strip along the left bank was mown and the marginal vegetation consisted of a mixture of tall herbs, as at site 6 these included *Mentha, Epilobium hirsutum, Filipendula ulmaria, Agrimonia eupatorium, Myosotis, Valeriana, Cirsium, Veronica, Lycopus* etc. The BMWP score for the 1 minute pond net sample was 77 and the ASPT 5.5. The most abundant animals were *Gammarus pulex* and *Ephemerella ignita*. The section was again heavily stocked with large trout. Reed or sedge warblers and chaffinch were heard along the bankside. Crickets were noted along the waters edge.

Assessment - The channel had probably been straightened. The left bank had been cleared of trees close to the water's edge and was regularly mown in order to provide easy conditions for fly fishing. The central channel had been deepened relatively recently giving the cross section a markedly terraced composite profile. The disturbance of chalk stream substrata by activities such as dredging may have the effect of modifying bed permeability or hydraulic resistance. Changes in permeability could clearly result in loss or gain of water through the substratum according to the hydrostatic relationships between river water and ground water (which may change over the year). In some instances it is possible that the protective "armouring" effect of stream bed flint pavements could be removed exposing less stable, deeper sediments to erosion but there was no indication of such an effect in this case. The central deeper part of the channel was thickly overgrown with *Ranunculus*.

Presumably the logic behind the dredged central strip was that, when water levels are low the residual flow, being restricted to a narrower channel, would maintain reasonable depth for plants and fish and have greater velocities than if the residual discharge were spread over the full channel width. It is also possible that the shallow marginal areas could, by supporting growths of submerged and emergent plants, further confine the central channel but there was no evidence of this having occurred.

Heavy stocking with farmed fish had taken place and as at other sites the impact of this on native fish populations must be considerable. Again the general impression was that more water in the summer months would be beneficial to both plants and fauna. By restricting channel width, either through seasonal plant encroachment or by dredging/embankment conditions can be locally improved for rheophilous (flow loving) chalk stream organisms. Inevitably, however, there is a concurrent loss of total habitat area for which the only solution is more water.

Ramsbury SU 274 714

This section was about 14-16 metres in width with earth banks of about 1 m in height. The left bank was a sloping heavily overgrown strip of sedges giving way to a thickly silted river bed, behind the sedges was rough pasture. The right bank was a steep earthen face at the margin of a rough pasture. Ten metres of the right bank was overlain (rather than reinforced) by timbers. There were no trees along the right bank and the left bank had sparse isolated tree cover. The water depth was >0.4 m and the loosely packed gravel bed was overlain by a film of silt. The flow was smooth and the channel may at some time have been widened. Small areas of marginal dead water were present.

This site at Ramsbury was somewhat wider than many of the others but the flow was still reasonably strong. There was no shading and no appreciable poaching of the banks by animals but deep silt deposits, which gave off methane bubbles, were present close to the left bank in the downstream part of the reach. There were no water plants and the stream bed gravels were coated in silt. A broad marginal cover of *Carex* was present along the whole of the left bank. The recorded BMWP score at this site was 53 only (presumably low because of the uniform habitat) and the ASPT was 4.8. The most abundant invertebrates were, *Gammarus pulex*, *Micronecta* and *Caenis* (a silt loving mayfly). Stocked trout were numerous and a juvenile *Cottus* was taken in the pond net sample.

Assessment - The impression was that the channel at this point had been artificially widened at some time in the past. The absence of plant growth, even though there was minimal shading, reasonable velocities and, at least for part of the channel, a firm gravel substratum, suggests that some periodic factor had been operative in removing plant growth and preventing recolonisation at a later date. This factor does not appear to be competition with filamentous green algae, as may sometimes be the case. The most - likely reason for the existing absence of macrophytes is bed disturbance or exceptionally

low flows at some time in recent years causing. Subsequently, variable discharge regime or low summer flows, aggravating the effects of siltation, could have prevented reestablishment of plants. Even in this open and featureless stretch of water stocked trout were rising regularly. Initially the channel probably requires a good scour out by high flows. Some narrowing would also be beneficial.

Knighton SU 295 710

Knighton was the most downstream site examined and is the point at which the discharge of the river is gauged. The water was clear and the bed of the river was entirely visible. The site was surveyed from the left bank and the channel appeared to lie in a symmetrical flood plain. The flow was essentially a shallow glide over the entire length and may have been affected in the downstream part of the reach by the presence of a weir. The steep banks were essentially of earth and showed no evidence of recent modification although it is likely that in the past they had been resectioned. The channel was 12 -13 metres wide and the banks about 1.2 - metres in height. Water was generally about 0.3 metres deep. The bed of the stream in the surveyed section was essentially sand downstream and irregular flint gravel and pebbles upstream. The flow was a smooth glide and there were no obvious channel features or modifications. The left bank consisted of a broad mown access/fishing path and the right bank was essentially backed by broadleafed woodland. The right bank was of earth and had a more or less vertical profile while the left bank sloped less steeply. The entire section was heavily - shaded. The bankside vegetation was often dominated by nettles (*Urtica*) but other plants which were represented included *Petasites, Filipendula, Agrimonia, Carex, Iris, Acorus, Typha, Glyceria, Myosotis, Symphytum* and others. The river bed gravels in the downstream end of the reach (nearer the weir) were colonised by patches of *Ranunculus* with small amounts of *Callitriche*. No water plants were present downstream of the weir despite the broad unshaded nature of the gravel bed. A wide range of invertebrates were collected by the simple 1 minute kick sample technique, and examined in the field giving a BMWP score of 96 and and an ASPT of 5.33. *Gammarus pulex, Ephemerella ignita* and *Micronecta poweri* were all extremely abundant. Lots of large stocked trout were present as were grayling of all sizes. A grass snake was observed swimming across the river.

Assessment - It is always difficult to assess the effects of past management but it seemed obvious that the left bank of the channel had been cleared of trees close to the water's edge and was again regularly mown in order to facilitate angling. It is also likely that the channel had at some time been straightened and/or resectioned. In the absence of weed the superficial silt and sand deposits were widespread over the gravel bed. From the point of view of management it would seem that some reduction of tree shading along the south bank might enhance weed growth and, in doing so, could generate more clean gravel runs and thus, by creating instream cover, increase the number of potential trout territories. Heavy stocking with farmed fish appeared to have taken place and the impact of this on native fish populations must be considerable. The general impression was that less shading, less stocking and more water in the summer months would be beneficial in sustaining the character of a natural chalk stream.

General discussion.

Bed sediments (substratum)

The bed sediments of the River Kennet sites examined were, on the whole, what might be expected. Most sites had a typical flint gravel pavement underlying banks of finer sediment associated with aquatic plants. Downstream of and including the Axford upstream site however, superficial siltation of the gravels was more extensive than would be expected and although in some cases this may have been due to the presence of obstructions in or resectioning of the channel it could probably be removed by improved flushing discharge patterns.

Habitat modification

Historically many chalk streams were modified by the construction of bypass channels, controlled by hatches, to assist the operation of mills and water meadows. The practices of channel modification, dredging, bank realignement or reinforcement and weed cutting were almost universal in the early part of the 20th century. In the present day, although the original reasons for these structures and activities have largely gone, some sluices and hatches remain operational and weed cutting is still widespread. The level of management activities on the regions of the River Kennet examined were quite characteristic of many chalk streams in Hampshire and Dorset. Almost all small to medium sized chalk streams are still subject to management, usually for the purposes of fly fishing, so the features noted above as associated with angling should not be regarded as atypical with the possible exception of the apparent very high levels of stocking with large trout. The lower reaches, downstream of Stitchcombe Mill, were quite heavily managed to improve access and ease of fishing but, although 'above average', in this respect, were by no means extreme.

With regard to the interpretation of observations; the interactions between channel modifications and discharge/velocity characteristics make it difficult to be dogmatic. Overwidening of channels can result in sediment accumulation and create conditions

adverse to maintenance of the channel flora and fauna as may excessive poaching of the banks by livestock or extensive agricultural activity within the vicinity of the stream channel. All of these conditions can, to some extent, simulate the effects of reduced discharges. None of these activities were particularly in evidence at the River Kennet sites observed, which leads me to conclude that the observed deficiencies of instream macrophyte cover at Knighton and at Ramsbury (downstream) and the presence of a large colony of *Zannichellia* weed at Axford upstream could be indicative of deficiencies in discharge conditions. The apparent attempts to dredge the central channel at Axford downstream would seem to be management resulting from percieved deficiencies in discharge in the season of low discharge. The vegetation changed little in overall composition between Stitchcombe Mill and Knighton but the local absences or deficiencies of *Ranunculus* in reaches which might be expected to support rich growths suggest that conditions are less than ideal for this species. Excessive siltation, inappropriate discharge regime and inadequate velocities are probable causes of these decficiencies.

In this respect it should be realised that the following consequences may stem from low discharges although other factors, as outlined above, may contribute to changes in aquatic vegetation and could in fact be solely responsible at particular sites. There is no simple means of attributing vegetational changes to any one causal factor :-

1. Increased nutrient/pollutant concentrations which may stimulate weed growth and favour species other than *Ranunculus*.

2. Disproportionately small increases in winter flows of ground water may hamper flushing out of fine sediments.

3. Reduced or delayed Autumn increases in flow may result in failure to rip out declining weed growth resulting in diminished or weak growth in the following year.

4. Reduced spring and summer discharges which, in the absence of strong weed growth, fail to maintain clean gravel-bedded runs in which macrophytes can initiate the following season's growth

Inevitably the above account is somewhat repetitive because of the nature of the observations made. In general the description of the channel banks, the channel and the associated vegetation will be reasonably accurate and probably not dissimilar to the results of existing river corridor surveys. However, it should be borne in mind that the Biological Monitoring Working Party score values, based only on crude bankside analysis of invertebrates from 1 minute pond net samples, are likely to be very low. Nevertheless the Average Score Per Taxon reported should not be dissimilar from the 'true' values which would be obtained from more detailed sampling and analysis. These figures are only intended to be rough guide to the water quality conditions in the river and any value greater than about 4.5 may be regarded as satisfactory (all samples were better than this). In my experience the diversity of chalk stream invertebrate communities is very robust and is sustained even when flow conditions have deteriorated markedly.

In summary, low flows tend to result in reduced or modified weed growth and silting of the river bed. These effects were noticed at the following sites - Axford upstream, Axford downstream, Ramsbury and Knighton and can be exacerbated by excessive shading of the channel, destruction of land surface vegetation by farming, quarrying and other activities, high inputs of nutrients or pollutants and dredging or widening of the channel. It is not, of course, possible to attribute, unequivocally, the observed condition of the River Kennet to any particular factor or combination of these factors.

Documents consulted in drafting this report

NRA (1994) River Kennet Catchment Management Plan, Final Report. 99pp.

Ladle M. & Casey H. (1979) The Ecology of Southern English Chalk Streams The Salmon and trout Magazine

Ladle M. & Casey H. (1991) The Chalk Stream Revisited The Salmon and Trout Magazine

Appendices

Data sheets used in survey and analysis of results.

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1996 RIVER HABITAT SURVEY with IFE mods for plant genera and fencing

A BACKGROUND MAP-BASED INFORMATION

Altitude(m)
Solid geology code
Distance from source (km)
Height of source (m)

Slope (m/km)
Drift geology code
Significant tributary ?
Water Quality Class

Flow category (1-10)
Planform category
Navigation ?

B FIELD SURVEY DETAILS

Reference network site number:

Mid-site grid reference of network site if different from designated location:

Grid Reference: River:

Date ..../..../1996 Time: .... Surveyor name .... Accreditation code........

Adverse conditions affecting survey? No ☐ Yes ☐ *If yes, state* ....

Bed of river visible? No ☐ partially ☐ entirely ☐ *(tick one box)*

IFE single photograph: general character? No ☐ Yes ☐ *(tick one box)*
(duplicate will be made by scanning)
and, as required, special feature ? No ☐ Yes ☐ *(tick one box)*

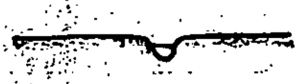
Site surveyed from: left bank ☐ right bank ☐ channel ☐ *(tick as appropriate)*

C PREDOMINANT VALLEY FORM *(tick one box only)*

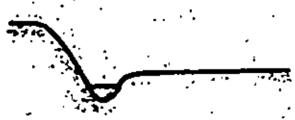

☐ shallow vee


☐ concave/bowl
(If U-shaped glacial valley - add "U")


☐ deep vee


☐ symmetrical floodplain


☐ gorge


☐ asymmetrical floodplain

Terraced valley floor? No ☐ Yes ☐ | IFE - VALLEY FORM NOTES:

D NUMBER OF RIFFLES, POOLS AND POINT BARS *(indicate total number)*

Riffles
Pools

Unvegetated point bars
Vegetated point bars

SEND COMPLETED FORMS WEEKLY plus all water samples and expenses claims TO F.H. DAWSON, IFE, RIVER LABORATORY, EAST STOKE, WAREHAM, BH20 6BB

1996 RIVER HABITAT SURVEY: TEN SPOT CHECKS

TALLY (use 𝍸) for - Riffles Pools Unveg. side bars Veg point bars

E PHYSICAL ATTRIBUTES *(to be assessed across channel within a 1m wide transect)* [1] = one entry only

Spot check 1 is: upstream ☐ downstream ☐	1	2	3	4	5	6	7	8	9	10	
LEFT BANK **TICK if functional fence**											
Material [1] *NV,BE,BO,CO,GS,EA,PE,CL,CC,SP,WP,GA,BR,RR,BW*											
Bank modification(s) *NK,NO,RS,RI,PC,BM,EM*											
Bank feature(s) *NV,NO,EC,SC,PB,VP,SB,VS*											
CHANNEL NEW - substrate shape codes =	*FLat OVoid ELongate SPheroid CUboid POlyhedral IRregular Other - note*										
Channel substrate [1] *NV,BE,BO,CO,GP,SA,SI,CL,PE,AR*											
Substrate shape *FL OV EL SP CU PO IR, Others - note*											
Flow type [1] *FF,CH,BW,UW,CF,RP,UP,SM,NP,NO*											
Channel modification(s) *NK,NO,CV,RS,RI,DA,FO*											
Channel feature(s) *NV,NO,RO,MB,VB,MI,TR*											
RIGHT BANK **TICK if functional fence**											
Material [1] *NV,BE,BO,CO,GS,EA,PE,CL,CC,SP,WP,GA,BR,RR,BW*											
Bank modification(s) *NK,NO,RS,RI,PC,BM,EM*											
Bank feature(s) *NV,NO,EC,SC,PB,VP,SB,VS*											

F BANKTOP LAND USE AND VEGETATION STRUCTURE *(to be assessed over a 10m wide transect)*

Land use: choose ***one*** *from BL, CP, OR, MH, SC, TH, RP, IG, TL, WL, OW, SU*

	1	2	3	4	5	6	7	8	9	10
LAND USE WITHIN 5m OF BANKTOP (L)										
LEFT BANK-TOP *(structure within 1m)* B/U/S/C										
LEFT BANK FACE *(structure)* B/U/S/C										
RIGHT BANK FACE *(structure)* B/U/S/C										
RIGHT BANK-TOP *(structure within 1m)* B/U/S/C										
LAND USE WITHIN 5m OF BANK TOP (R)										

G CHANNEL VEGETATION TYPES *(10m wide transect: E (≥ 33% area) or tick (present) 500m 'catch-all'* ↓

	1	2	3	4	5	6	7	8	9	10	
NONE / PLANT GENERA - list first 5											
Bryophytes/lichens |											
Emerg broad-leaved herbs |											
Emerg reeds/sedges/rushes |											
Floating-leaved (rooted) |											
Free-floating |											
Amphibious |											
Submerged broad-leaved |											
Submerg fine/linear-leaved |											
Filamentous algae |											

L CHANNEL DIMENSIONS *(to be measured at one site on a straight uniform section, preferably across a riffle)*

LEFT BANK		Banktop width (m)		RIGHT BANK	
Banktop height (m)		Water width (m)		Banktop height (m)	
Embanked height (m)		Water depth (m)		*Embanked height (m)*	

If trashline lower than banktop break in slope, indicate: height (m) = width(m) =

Bed material at site is: consolidated (compact) ☐ unconsolidated (loose) ☐ unknown ☐

Location of measurement is: riffle ☐ run or glide ☐ other ☐ *(tick one box)*

M ARTIFICIAL FEATURES *(indicate total number or tick appropriate box)*

None ☐ Number of Culverts = Weirs = Outfalls = Fords =

Footbridges = Roadbridges = Other =

Is water impounded by weir/dam? No ☐ Yes, <33% of site ☐ >33% of site ☐

N EVIDENCE OF RECENT MANAGEMENT *(tick appropriate box(es))*

None ☐ Dredging ☐ Mowing ☐ Weed-cutting ☐

Enhancement ☐ Other ? State ....

O FEATURES OF SPECIAL INTEREST *(tick appropriate box(es))*

None ☐

Waterfalls > 5m high ☐ Artificial open water ☐ Bog ☐ Other (state) ....

Braided/side channels ☐ Natural open water ☐ Carr ☐

Debris dams ☐ Water meadow ☐ Marsh ☐

Leafy debris ☐ Fen ☐ Flush ☐

P CHOKED CHANNEL *(tick one box)*

Is 33% or more of the channel choked with vegetation? NO ☐ YES ☐

Q NOTABLE NUISANCE PLANT SPECIES *Use ☐ or E (≥ 33% banklgth)* IFE note LARGE STANDS of others eg

None ☐ Giant Hogweed ☐ Himalayan Balsam ☐ Japanese Knotweed ☐ Other? Nettle Rhododendron bracken

R OVERALL CHARACTERISTICS *(Circle appropriate words, add others as necessary)*

Major impacts: landfill - tipping - litter - sewage - pollution - drought - abstraction - mill - dam - road - rail - industry - housing - mining - quarrying - overdeepening - afforestation - fisheries management - silting - other? =

Land Management: set-aside - buffer strip - headland - abandoned land - parkland - MoD - other? =

Animals: otter - mink - water vole - kingfisher - dipper - grey wagtail - sand martin - heron - dragonflies/damselflies

Other significant observations:

S ALDERS *(tick appropriate box(es))*

Alders? None ☐ Present ☐ Extensive ☐ Diseased Alders? None ☐ Present ☐ Extensive ☐

SITE NO.

1996 RIVER HABITAT SURVEY: 500m SWEEP-UP

H LAND USE WITHIN 50m OF BANKTOP *Use E (≥ 33% banklength) or ✓ if present*

	L	R		L	R
Broadleaf/mixed woodland *(BL)*			Rough pasture *(RP)*		
Coniferous plantation *(CP)*			Improved/semi-improved grass *(IG)*		
Orchard *(OR)*			Tilled land *(TL)*		
Moorland/heath *(MH)*			Wetland (eg bog, marsh, fen) *(WL)*		
Scrub *(SC)*			Open water *(OW)*		
Tall herbs - *rank vegetation* (TH)			Suburban/urban development *(SU)*		

I BANK PROFILES *Use E (≥ 33% banklength) or ✓ (present)*

Natural/unmodified	L	R	**Artificial/modified**	L	R
Vertical/undercut			Resectioned		
Vertical + toe			Reinforced - whole bank		
Steep (>45°)			Reinforced - top only		
Gentle			Reinforced - toe only		
Composite			Artificial two-stage		
			Poached		
			Embanked		
			Set-back embankments		

J EXTENT OF TREES AND ASSOCIATED FEATURES

TREES *(tick one box per bank)*

	Left	Right
None	☐	☐
Isolated/scattered	☐	☐
Regularly spaced, single	☐	☐
Occasional clumps	☐	☐
Semi-continuous	☐	☐
Continuous	☐	☐

ASSOCIATED FEATURES *(tick one box per feature)*

	None	Present	E (≥33%)
Shading of channel	☐	☐	☐
Overhanging boughs	☐	☐	☐
Exposed bankside roots	☐	☐	☐
Underwater tree roots	☐	☐	☐
Fallen trees	☐	☐	☐
Coarse woody debris	☐	☐	☐

K EXTENT OF CHANNEL FEATURES *(tick one box per feature)*

	None	Present	E
Waterfall(s)	☐	☐	☐
Cascades(s)	☐	☐	☐
Rapid(s)	☐	☐	☐
Riffle(s)	☐	☐	☐
Run(s)	☐	☐	☐
Boil(s)	☐	☐	☐
Glide(s)	☐	☐	☐
Pool(s)	☐	☐	☐

	None	Present	E (≥33%)
Marginal deadwater	☐	☐	☐
Exposed bedrock	☐	☐	☐
Exposed boulders	☐	☐	☐
Unvegetated mid-channel bar(s)	☐	☐	☐
Vegetated mid-channel bar(s)	☐	☐	☐
Mature island(s)	☐	☐	☐
Unvegetated side bar(s)	☐	☐	☐
Vegetated side bar(s)	☐	☐	☐

Indicate predominant flow sequence *(select up to three features)*:

TABLE 1

FAMILIES	SCORE
Siphlonuridae Heptageniidae Leptophlebiidae Ephe merellidae Potamanthidae Ephemeridae Taeniopterygidae Leuctridae Capniidae Perlodidae Perlidae Chloroperlidae Aphelocheiridae Phryganeidae Molannidae Beraeidae Odontoceridae Leptoceridae Goeridae Lepidostomatidae Brachycentridae Sericostomatidae	10
Astacidae Lestidae Agriidae Gomphidae Cordulegasteridae Aeshnidea Corduliidae Libellulidae Psychomyiidae Philopotamidae	8
Caenidae Nemouridae Rhyacophilidae Polycentropodidae Limnephilidae	7
Neritidae Viviparidae Ancylidae Hydroptilidae Unionidae Corophiidae Gammaridae Platycnemididae Coenagriidae	6
Mesovelidae Hydrometridae Gerridae Nepidae Naucoridae Notonectidae Pleidae Corixidae Haliplidae Hygrobiidae Dytiscidae Gyrinidae Hydrophilidae Clambidae Helodidae Dryopidae Elminthidae Chrysomelidae Curculionidae Hydropsychidae Tipulidae Simuliidae Planariidae Dendrocoelidae	5
Baetidae Sialidae Piscicolidae	4
Valvatidae Hydrobiidae Lymnaeidae Physidae Planorbidae Sphaeriidae Glossiphoniidae Hirudidae Erpobdellidae Asellidae	3
Chironomidae	2
Oligochaeta (whole class)	1