

ECONOMIC EVALUATION OF
ENVIRONMENTAL BENEFITS OF
RESTORING A FLOW REGIME
TO THE RIVER DARENT

Upon its formation in 1989 the National Rivers Authority (NRA) identified a number of rivers which were thought to be over-abstracted. The majority of these lie on chalk outcrop geology which, because of its high yield, has been widely developed for public water supply purposes at low cost. Probably the best known of these is the River Darent in North Kent. To determine whether expenditure on remedial measures is justified, the Southern Region of NRA has to carry out an environmental cost benefit analysis for the alleviation of the low flows in the catchment. Preliminary literature searches indicated that whilst the use of economic instruments is not new, the techniques had not been applied to (i) any water quantity study or (ii) a river restoration project. For the study to proceed a specification for economic appraisal had to be drawn up. Guidance was taken from the UK Department of Environment's publication "Policy Appraisal and the Environment", but no water quantity based guidance is given and so further research was required. River restoration was targeted at a flow regime which was designed to be environmentally acceptable. This was derived from ecological surveys and groundwater modelling. The environmental benefits derived from the stored regime are to be evaluated using the Contingent Valuation Method (CVM), assessing both use and non-use valuations. Catchment specific variations on the basic CVM techniques were explored, with consideration given to such items as payment vehicle, boundary limitations and survey size. Consideration was also given to the Hedonic Price Method (HPM) and the Travel Cost Method (TCM) for evaluating benefits.

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ECONOMIC EVALUATION OF ENVIRONMENTAL BENEFITS OF RESTORING A FLOW REGIME TO THE RIVER DARENT

1. AN INTRODUCTION TO ALF AND LICENCES OF RIGHT

Upon formation the National Rivers Authority (NRA) identified a "top twenty" list of catchments subjectively judged to be affected by over-abstraction, where quantities of water abstracted for public water supply were impacting upon the local environment. The list was well publicised and providing the alleviation of low flows (ALF) was targeted in the NRA's Corporate plans.

Uppermost in the listing was the River Darent. Located in Kent to the southeast of London (See figures 1 and 2) problems with low flows had been identified since the mid 1970's.

Impetus for this programme extended from a piece in the 1988 publication "Liquid Assets" commissioned to document the likely effects of the then impending privatisation of the Water Authorities on Wildlife Habitats and Landscape.

A section on over abstraction drew attention to fault lines in the draft Water Resources Legislation (now the Water Resources Act [WRA] 1991) which protected Licences of Right.

Licences to abstract water were first created under the 1963 WRA. However in many cases water users have historic rights to take water which pre-date that Act. The Act required that existing users were given Licences of Right to abstract to the full capacity of existing installed pumps without regard to the impact upon the environment.

A Licence of Right can be altered if the holder agrees to the variation, however if the regulating authority, now the NRA, decides unilaterally to vary the Licence the 1991 Act provides for the holder to claim compensation covering the cost of replacement sources. To date this sequence of events has not occurred, therefore no legal case history is available to assess the outcome of successful revocation.

"Liquid Assets" cited the study completed by consultants Halcrow for the then Thames Water Authority "Study of Alleviation of Low River Flows Resulting from Groundwater Abstraction" (1987-89). The report covered six rivers which suffered "visible deterioration of the water environment". "Liquid Assets" went on to expand the case study for the Misbourne, but one of the other five rivers was the Darent. In the case of the Darent the Licences granted to the then Metropolitan Water Board have been able to meet growth in demand over the last 30 years and not be fully utilised. If applied for today the current volumes would not be granted.

N R A

(SOUTHERN REGION)



R. DARENT

FIGURE 1 LOCATION OF THE RIVER DARENT IN KENT

FIGURE 2 THE RIVER DARENT CATCHMENT

Location Map

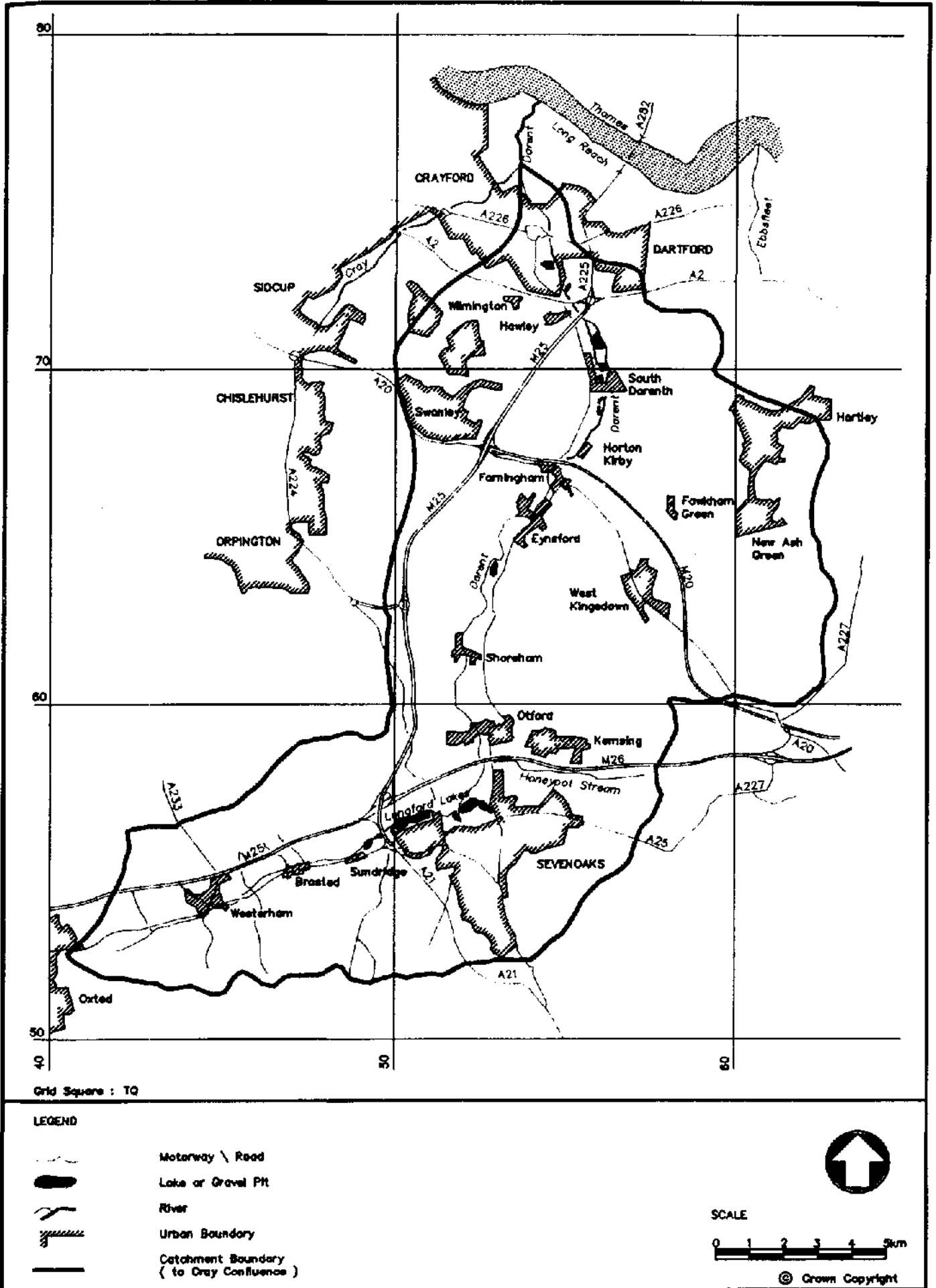


TABLE 1.

Administration History of the Darent

Before 1974

All river functions	Kent River Authority
1974 - 31.8.1989	
Land Drainage	Southern Water
Water Supply	Thames Water
Sewerage	Thames Water
Water Resources, Environment & Fisheries	Thames Water
1.9.1985 - 31.3.1990	
Land Drainage	Southern NRA
Water Resources, Environment & Fisheries	Thames NRA
1.4.1990 - Onwards	
Land Drainage, Water Resources Environment & Fisheries	Southern NRA

The Darent has had mixed service from the water bodies over the past twenty years with responsibilities for land drainage, flood defence and water resources often split between the two bodies of Southern and Thames (See table 1).

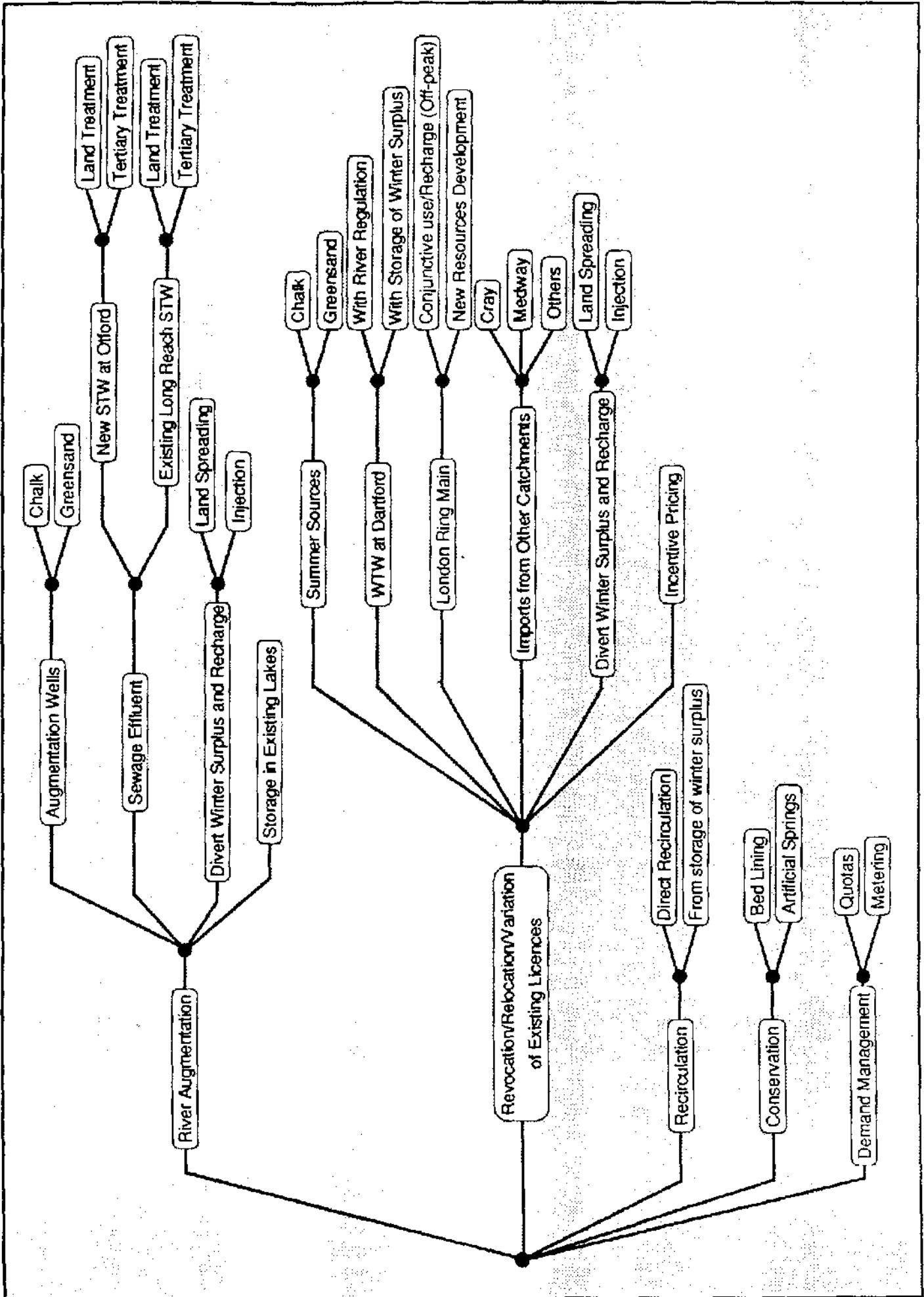
2. NRA SOUTHERN AND THE DARENT

In 1990 the Darent became the sole responsibility of Southern Region NRA and so the baton of alleviating low flows in the Darent was passed to the Resources Department of the Region. Consultants Mott Macdonald were commissioned to investigate possible solutions along with the construction of a complex multi-layer surface and groundwater computer model.

A series of possible options were developed and publicised in 1991 (See fig 3 Options Matrix). Source: Darent Catchment Investigation, Mott Macdonald 1991. All were Civil Engineering solutions which might provide sufficient water to allow restoration of a flow regime to the catchment but without varying or revoking any of the abstraction licences. Each had a capital cost associated with it but still did not tackle the main cause of low flows - the licensed quantities.

During 1992 a joint project team made up of staff from NRA and Thames Water Utilities Limited (TWUL) took these options forward and developed a plan which is intended to return a specific flow target to the catchment. The capital and operating costs have been estimated

FIGURE 3 OPTIONS MATRIX (SOURCE GDC MACDONALD) Summary of Options



but before NRA can commence with its side of the plan a full project appraisal of costs and benefits has to be carried out following H M Government's Treasury guidelines.

3. COST AND BENEFITS

Government policy calls for full cost appraisal of projects and ALF is no exception.

"Good appraisal leads to better decisions and value for money. It calls for flexibility and imagination" (Treasury Green Book 1991).

The need for imagination has never been more true than in the case of attempting to appraise and value the benefits of ALF to the environment.

The need to include the cost or benefit to the environment in any appraisal is clear where the problems of over abstraction are caused by large abstractions placed within catchments, primarily for public water supply. Charges made for the abstracted quantities do not reflect the impact upon the environment. OFWAT, the water companies regulatory body, recognises this

"The structure of these (abstraction) charges seeks to reflect costs but the level is typically too low to give abstractors correct economic signals about the costs their use imposes on the environment and on other water users".

(Annex 2 - Environmental Costs)

Prof David Pearce in "Blue print for a Green Economy" (1989) argued that environmental cost should be included in any study.

"One of the central themes of environmental economics is the need to place proper values on the services provided by natural environments.

The central problem is that many of these services are provided "free". They have zero price simply because no market exists in which their true value can be revealed through acts of buying and selling".

This has now become enshrined in Government thinking.

It is clear from previous reports and numerous quotations in the literature that the Darent Valley has and continues to provide an important service to both those who live locally and further afield. The NRA requires the value of that benefit as well as deriving the potential benefits gained from resolving the effects of overabstraction.

Prof David Pearce again "An improvement in environmental quality is also an economic improvement if it increases satisfaction or welfare".

4. SOURCES

The principle difficulty with preparing a tender specification for estimation of the monetary benefits was the lack of case studies based on improving water quantities. The environmental

economics of improvements to water quality has been researched (Green et al 1990, 1991) along with site specific recreation studies. In this case water quality is not an issue. All effluent from the catchment is captured by a trunk sewer and taken northward to the Thames estuary. Here about 170 megalitres a day is treated and discharged directly to the Thames. This maintains the Darent at its high quality level (Category NWC Class 1b). Literature searches completed on behalf of the NRA and by the authors into water quantity based projects revealed little both in UK and internationally (NRA R&D report "Evaluation of the Costs and Benefits of Low Flow Alleviation").

Further guidance was sought from the Department of the Environment "Policy Appraisal and the Environment" (1991). This publication sets out the basis of the theories, defining those environmental resources and assets for which judgements over impact are subjective.

Quoting from this booklet Water Resources are considered to be:

"freshwater (surface and underground) for abstraction and consumption".

No reference is given to the effects that consumption can have. In the case of the Darent it is over consumption which is damaging the environment.

What was gained from the publication was the overall economic theory, the concepts and jargon involved.

All aspects of environmental benefits must be considered. By doing so Total Economic Value (TEV) can be derived. TEV comprises the sum of four components.

- i Actual Use
- ii Option Use
- iii Existence Value
- iv Bequest Value

i) Actual Use

The value of the use or visits made by individuals or groups to the river. This should increase if the condition of the river is improved.

ii) Option Use

Valuing the possibility of choosing to visit the river in the future. That choice may be influenced by the future condition of the Darent.

iii) Existence Value

The value that individuals place upon the river being in a good condition - for its own sake. This may become a moral question.

iv) Bequest Value

The value that an individual places upon knowing that the river will be available to future generation of users.

Research around the subject was carried out to identify TEV components relevant to ALF and the Darent.

5. SPECIFICATION STRUCTURE

With so little available case data it was proposed that the study be carried out in two phases. The first, Outline Procedure Proposal would be submitted to DoE to ensure that the proposed methodology was acceptable under current economic theory.

The second phase would be the Implementation.

A structure for the study was proposed ensuring coverage of all aspects of TEV. The subject areas are:

Phase One

1. Identifying Impacts
2. Quantifying Impacts
3. Identifying Uncertainties
4. Review of Impact of returning flows
5. Precautionary approach to flows
6. Survey Techniques

Phase Two

1. Survey (pilot)
2. Results analysis
3. Full survey
4. Analysis

All six subject areas within phase one are discussed below:

5.1 IDENTIFYING IMPACTS OF OVERABSTRACTION

Stretches of the river several kilometres long dried in 1976 and again during the 4 year drought period 1989 to 1992. With little or no water in the river immediate ecological effects and some actual costs are obvious. Fish have to be rescued and placed in safety. Much of the fish population in the downstream reaches perished during the 1976 drought, but extensive stocking took place between 1977 and 1979 - about 11,000 coarse fish and 8,000 Brown Trout parr.

(Present day costs are £3.50 per pound for coarse fish and 40p per fingerling of Brown Trout parr)

Surveys undertaken in late 1979 and 1980 pointed to:

"a successful return of fish stock with a more than adequate basis for establishing a thriving self-sustaining community as long as the river did not dry out again" (Halcrow 1987)

Unfortunately the river has dried. Much of the fish population has been taken from the lower reaches and transferred to the southern end, above Sevenoaks or the adjacent lakes. None have been returned to date as flows are not considered stable enough.

Coarse fishing is now largely restricted to off-line lakes, remnants of the gravel extraction industry. One of the Clubs owning lakes has some 2,500 members with a waiting list of 400.

Association with the low flows is a change in bankside and instream vegetation. *ENTEROMORPHA* an indicator of pollution and a variety of *CLADOPHERA* (blanket weed) is now evident on the middle and lower reaches of the river. Other changes have taken place. It has been noted that with the river becoming a series of isolated ponds

"the frog population has boomed and preying upon them has been an explosion of grass snakes"

(J Purseglove 1992)

5.2 QUANTIFYING IMPACTS **THE NEED AND DEVELOPMENT OF THE EAFR AND TARGET FLOW**

The River Darent is unique: substitution of another river of identical nature, access and activity base, but not suffering from over abstraction is not possible. In this way the return of a flow regime can be thought of as the design and valuation of a new resource.

From this the importance of the returned flow regime is clear and has to be established before benefits can be assessed. These flows will be the new resource, or Environmentally Acceptable Flow Regime (EAFR), that would be restored and maintained.

5.2.1 EAFR (1990)

Work carried out by consultants W S Atkins (1990) set the first initial range of targets, based on macro invertebrate studies using RIVPACS (River Invertebrate Prediction and Classification System)¹

A number of river sites were sampled and the populations compared with what RIVPACS predicts should be found given the survey data captured at the sites. One, Shoreham, was found to be a match with a theoretically pristine chalk stream and was then used to predict flows for the other sites.

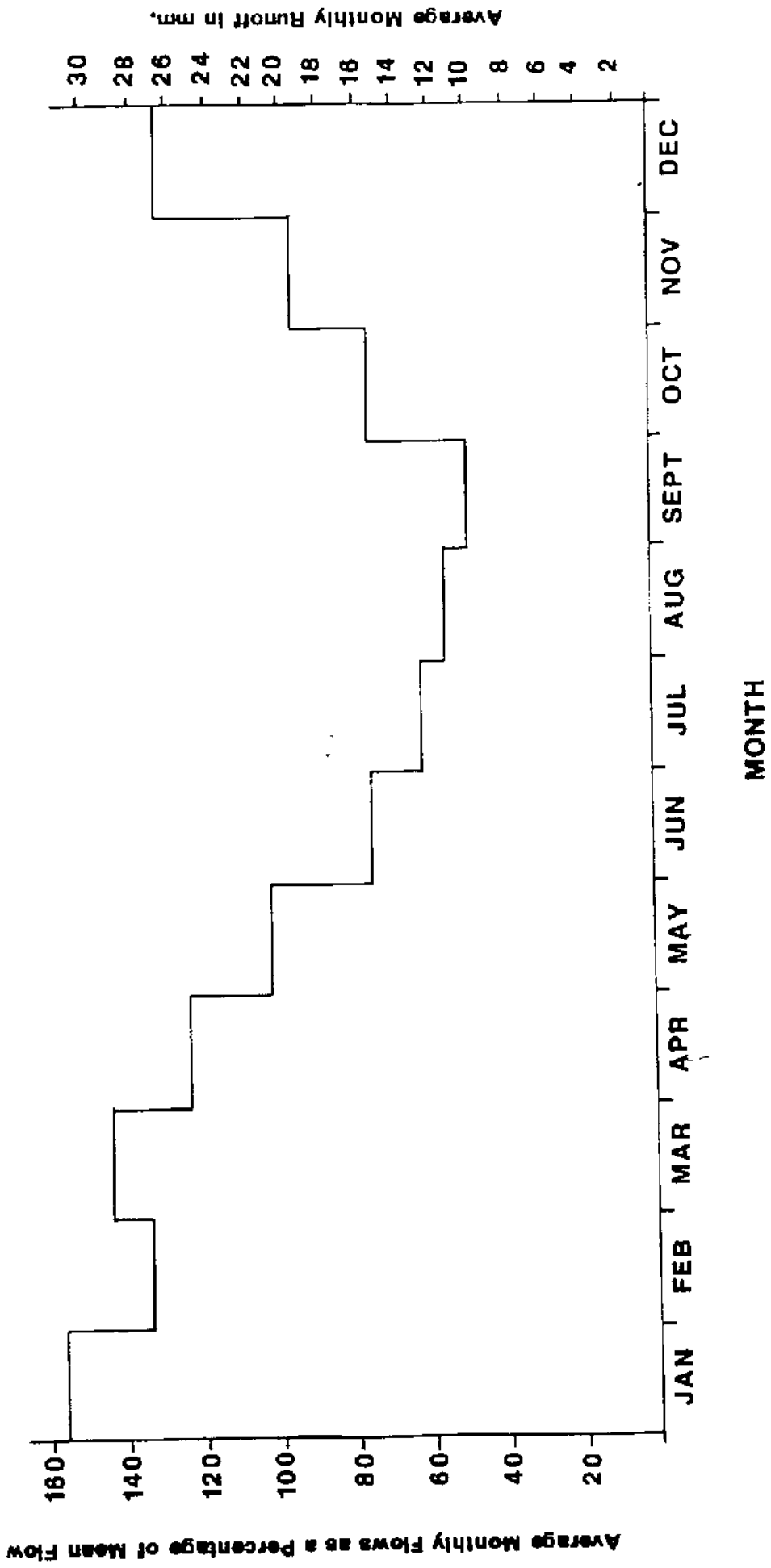
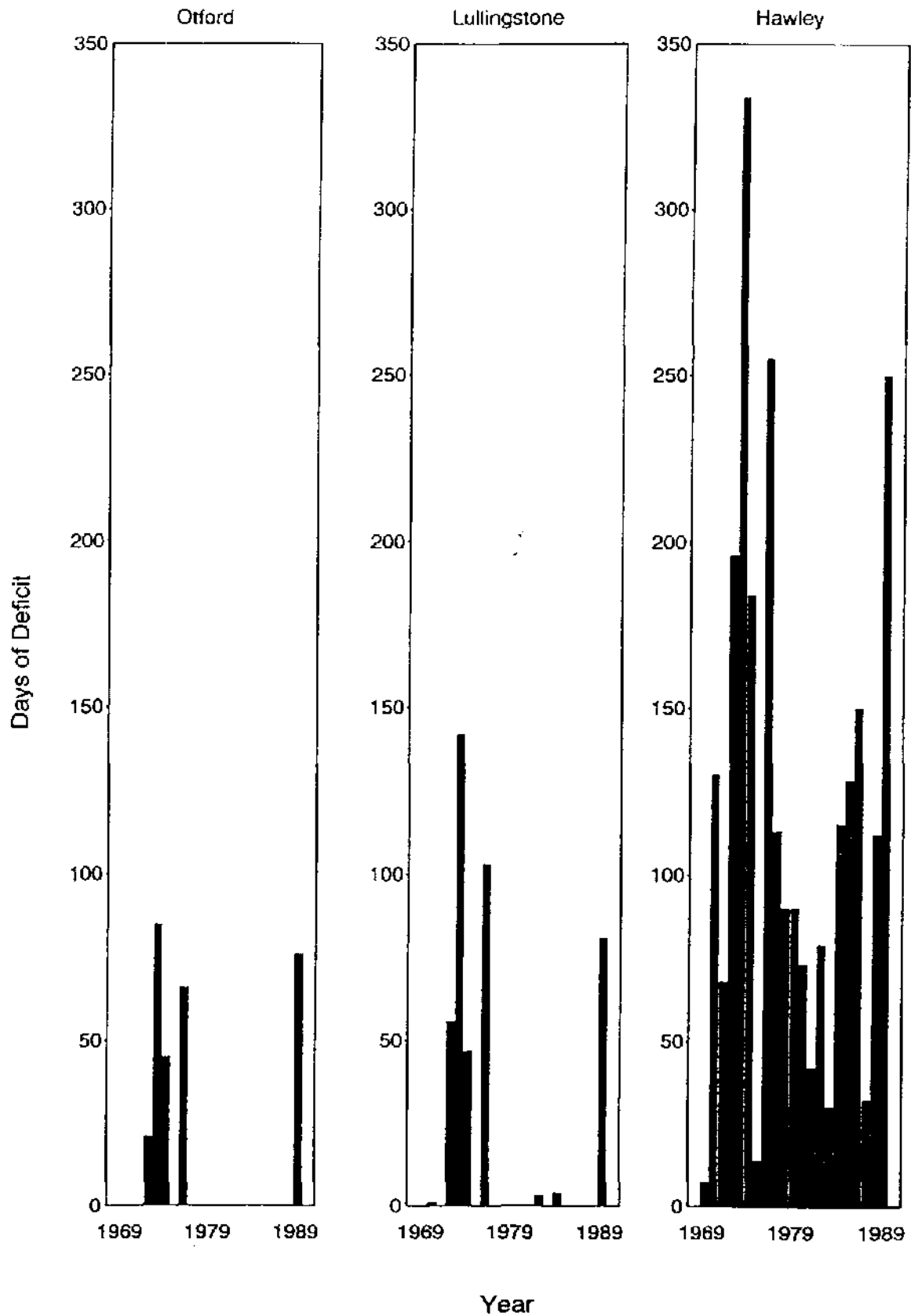


FIGURE 4 SEASONAL EAFR (SOURCE WS ATKINS)
Seasonality of Flows at Lutlिंगstone Gauging Station

FIGURE 5 DEFICIT DAYS BELOW EAFR 1969 - 1989
 (SOURCE GDC MOTT MACDONALD)

Days of Deficit



The flows were produced for three strategic points in the catchment where gauging stations are located. The primary values were mean annual flows without seasonality.

Annual flow patterns were achieved by matching mean monthly EAFR flows to a proportion of the average flow seasonally experienced within the catchment (see fig 4).

Much criticism can be made of the methodology but as an initial study it did provide an order of magnitude for the impact upon river flows. Figure 5 illustrates the number of days between 1968 and 1990 during which the mean daily flow fell below the EAFR. The scale of deficit is clearly seen at the lower end of the catchment.

(Footnote 1 - A combination of an assessment of both types of species present, and the relative abundance of families. This predicts the type of communities of invertebrates that should occur at undisturbed sites. There are targets against which the observed values can be compared.)

The principle instrument used in this method is the flow statistics generated from the gauging stations but these were built after more intensive abstraction commenced (see fig 6).

Until full catchment computer modelling was available in 1993, producing naturalised flows, the EAFR (1990) had to be the regime to work toward, and was detailed in the specification.

5.2.2 FLOW TARGET (1992)

In the "Plan for the Darent" report produced by NRA and TWUL staff the flow regime proposed is 50% of the naturalised 1:20 year monthly low flow. This Flow Target (1992) produces an accretion profile which exceeds the Atkins EAFR (1990) (see fig 7). This will be incorporated into the CBA study.

5.3 IDENTIFYING UNCERTAINTIES

There is much debate over whether the Darent can be considered a pure Chalk stream. Many of the typical characteristics are missing and the headwaters of the river rise on greensand.

Recent computer modelling has shown that the river remains in contact with the greensand at all times whilst on the Chalk the river is perched.
(see fig 8, Geology of the Darent Valley).

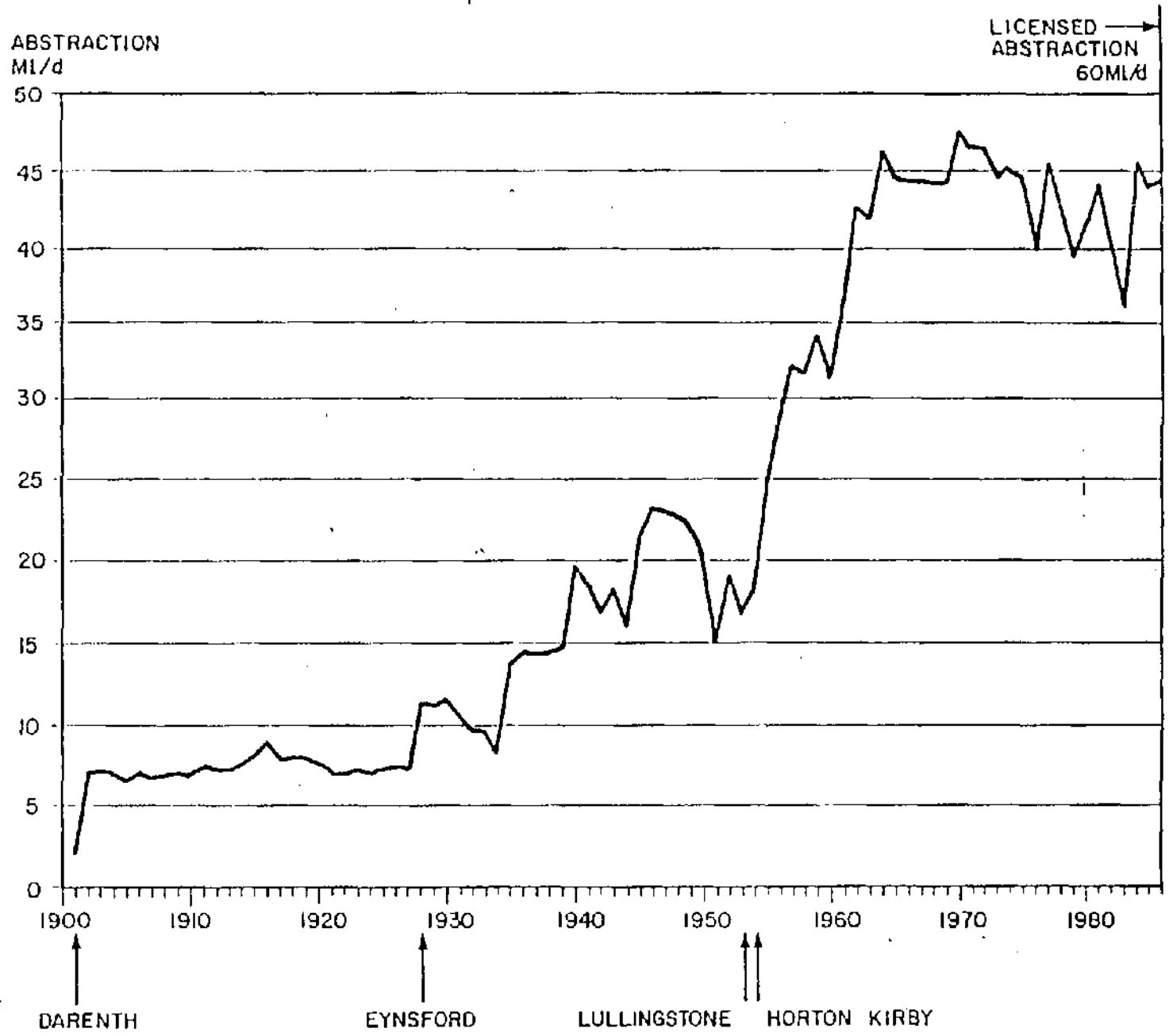
A crude sediment balance indicates that more suspended solids are carried on the Darent than on the chalk rivers of the Test and Itchen in Hampshire. Historically the clarity of the Darent could be attributed to the presence of water mills and meadow operations, with freshnets flushing silt away.

5.4 REVIEW OF IMPACT OF RETURNING FLOWS

RIVER DARENT

FIGURE 6 COMMENCEMENT OF ABSTRACTION FROM CHALK SOURCES
FLOW RECORDS START 1963 (SOURCE HALCROW)

COMMENCEMENT OF
PUMPING STATIONS



ACCRETION PROFILE FOR AUGUST 1976

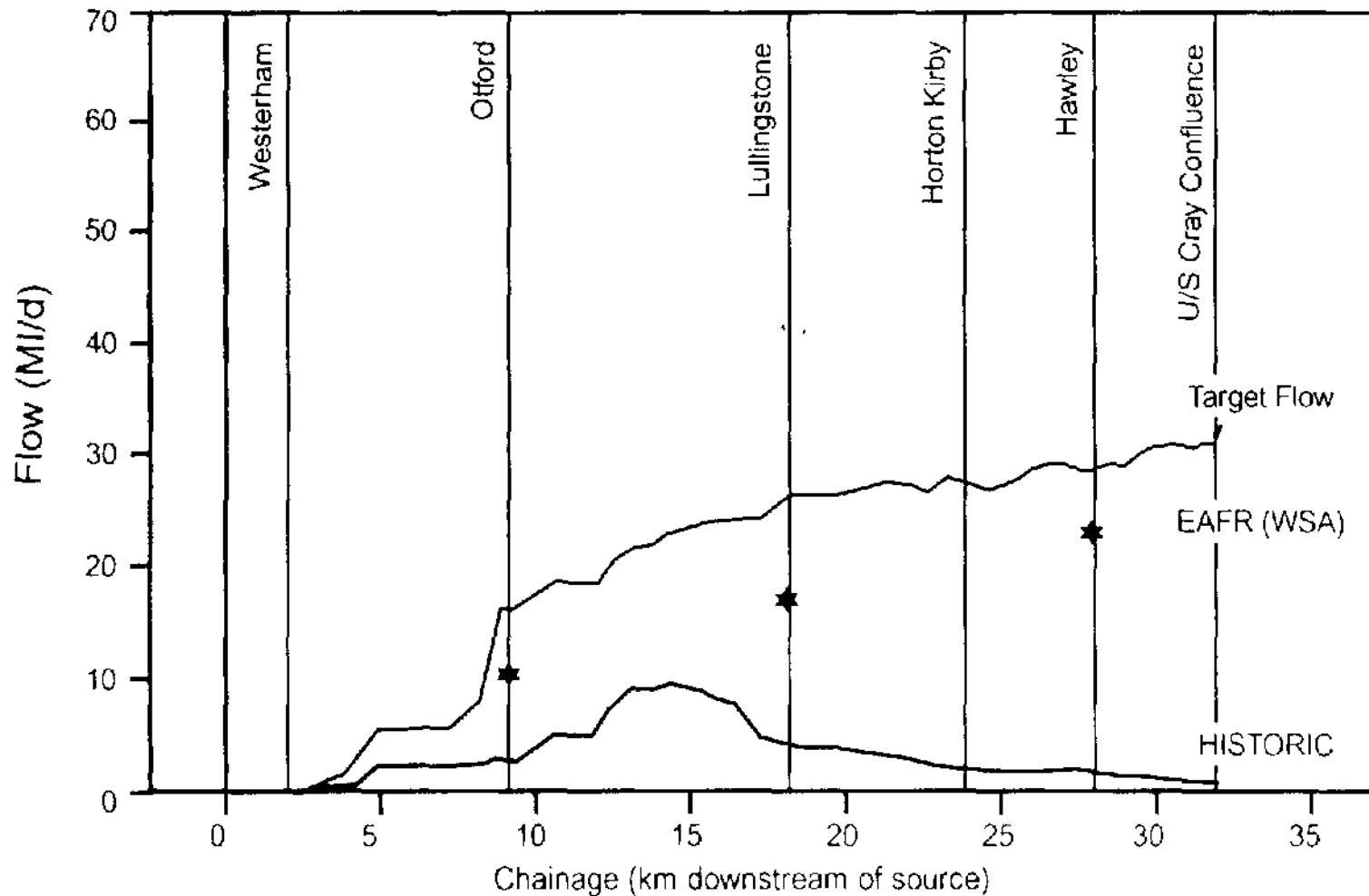
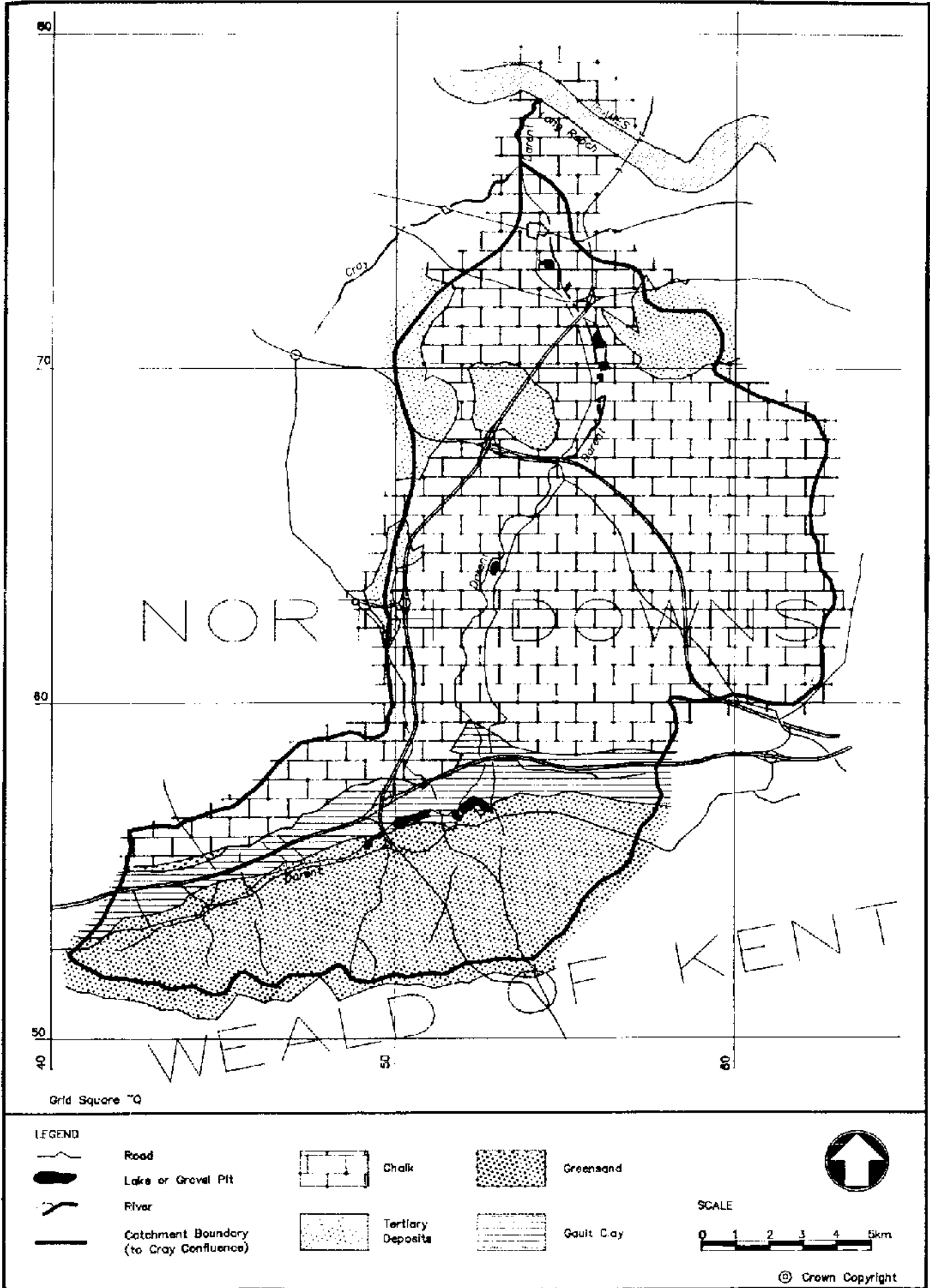


FIGURE 7 FLOW PROFILES FOR THE DARENT
ACTUAL 1976: EAFR 1990: FLOW TARGET 1992



**FIGURE 8 GEOLOGY OF DARENT CATCHMENT
(SOURCE GDC MOTT MACDONALD)**

Solid Geology



Impacts of returning flows are not restricted to continuous discharges along the watercourse. Too much water could impose costs such as flooding of properties. The technical solution proposed can be controlled to prevent sudden natural flash floods being compounded by augmentation water.

The augmentation outfalls must be carefully designed to prevent damage to the river bed material. Some designs such as bubbling water up through the bed could have positive effects such as the cleaning of gravel shoals which in turn may encourage fish spawning.

These impacts must be assessed as Costs or Benefits in order that net benefits are realised.

5.5 PRECAUTIONARY APPROACH

A number of research projects are currently being undertaken into the definition of environmentally acceptable flows. Packages such as PHABISM (Physical Habitat Simulation) are being evaluated but the conclusive outcome of the research will not be available for this project.

With the derivation of the Flow Target (1992) a seasonal regime is proposed for return to the river. This exceeds WS Atkins EAFR (1990) and should therefore support more ecology. A review of the extent of species and the possibility of establishing a brown trout fishery is to be carried out.

5.6 METHODS AND GROUPS

The methodologies which can be employed in obtaining TEV for non-market values are well documented. Specific application to the Darent had to be explored in order to determine the relevance of each. No final decision was made at the time of specification as to the suitability of each but some discussion was presented and critical comment invited. Benefits need to be obtained from three groups:

- i. Residents
- ii. Visitors
- iii. Non-users

Different techniques can be employed with each and these are discussed here with specific reference to the Darent project.

6.1 HEDONIC PRICE - RESIDENTS

Based on the underlying assumption that the price paid for a complementary good reflects the purchasers willingness to pay for an environmental good.

This area of Kent is considered to be of outstanding natural beauty. The Darent Villages are a well known attraction and riverside property will always be popular.

Housing with riverside frontages or riparian ownership may fluctuate in value if the river disappears. Some scale of this is given from work completed in 1992 for the NRA.

"Riverside sites generally command a higher premium of between 5 and 10% and locations with mooring facilities could see premiums in excess of 15%".
(NRA R & D Report Economics of Water Resource Management)

A practical difficulty with this approach is the recent fall in property prices and a stagnation of the housing market. Whilst this may effect the present situation, desirable property with waterside access may still attract buyers.

It would be difficult to measure the benefit per unit of water returned per property, the concept of pounds per megalitre on a house price is hard to separate from other incremental factors. However the presence of some water, flowing at a rate considered visually acceptable versus no water at all, must be possible.

This captures values/benefits for those living in the valley, residents who choose the amenity of a Chalk stream.

There is also a perception amongst residents alongside the Darent of the problem of subsidence, associated with the drying and drought conditions, found at riverside premises. Claims on insurance policies are likely to increase premiums, therefore it is felt that the return of a consistent flow may reduce this possibility.

6.2 TRAVEL COST - VISITORS

A valuation of site characteristics of a particular environmental feature and the cost a household is willing to incur to use that feature.

The method has been used widely in the USA for recreation valuation, but the UK application is more limited. TCM has been used in the USA with respect to increased flow quantities and the recreational benefits resulting from the extra water. Loomis and Creel (1992) tested four seasonal patterns of additional flow and obtained the increased values placed by river site users upon the extra water.

They conclude that this recreational use is competitive with water value for agricultural purposes (barley, alfalfa hay, safflower and sugar beets). This water also flows into the San Francisco Bay but no value is available for the perceived benefits to the city.

The volumes considered by Loomis and Creel are far larger than those for the Darent where quantities are in the order of an additional 7300 Ml per annum.

Experience in Britain is more mixed. In studying recreational visits to beaches, Green et al (1990) found that frequency of visit was associated with travel time only for local visitors (resident within 3 miles). Green argues that TCM measures the expectation of enjoyment when the individual sets out on a visit, only if the individual has visited before will TCM be accurate. A previous visit made to a dry river may well affect an individuals willingness to undertake another, but the choice of visiting of an alternative river identical to the Darent is unavailable. This lack of substitute may render this method unusable.

Work by Radford (1982) using TCM to establish anglers values for a salmonoid fishery on the Wye did produce a figure of £5.25 per trip (1982 prices).

Little or no information is available at present to ascertain the numbers of game fishing visits made to the River Darent. If after the return of the flows a game fishery can be sustained new anglers may visit the river. However these cannot be counted as positive benefits as this additional fishing on the Darent is likely to be a substitute for another activity currently undertaken elsewhere. In this way the Darent's benefit is anothers loss or cost, which must be included in the equation.

6.3 CONTINGENT VALUATION METHODS (CVM) - ALL GROUPS

Using a carefully worded questionnaire people are asked what they would be willing to pay (WTP) or willing to accept (WTA) in compensation for a specified change in environmental resources or goods.

CVM has been widely used in recreation based studies in the UK and a recent NRA study into flood prevention of the Norfolk Broads used the technique to question face to face some 3200 people over 31 days.

Only CVM can capture USE and NON USE values so the technique will be applied on the Darent.

It is possible to use postal surveys which are undoubtably cheaper but the above study for NRA obtained only a 35.1 % return (of which 31.5 % were usable). The Loomis Creel Study carried out to obtain recreation benefits due to increased flows also undertook a postal survey with 35 % return.

6.3.1 Darent Methodology

To obtain values users and non-users will be presented with a questionnaire and information concerning the problems of the Darent. Three scenarios are to be illustrated and their WTP will be elucidated.

1. The status quo or current position:
Abstraction licences are not fully utilised with approximately 70% of the licensed total being abstracted. This level has been held following a "gentlemans" agreement with TWUL. This would measure the respondents WTP for the current situation to continue - the "do nothing" option.
2. The "bottom line" position:
TWUL can legitimately abstract up to 100% of their licences. At present an abstraction of 70% is effecting the river; 100% would markedly increase the duration and spatial distribution of that impact. This would represent a WTP to prevent 100% abstraction and further environmental damage. This 100% abstraction is legal and possible.

3. **The Flow Target (1992)**

This would be the flows which would be returned and maintained under the joint NRA and TWUL agreement. This would be the respondents WTP for an improved or new resource.

The duration and extent of each can be illustrated with photographs and accretion profiles obtained from the catchment computer model.

6.3.2 ISSUES INFLUENCING THE SURVEY

CVM is based upon the hypothetical assumption that the stated WTP reflects the actual WTP. Many forms of bias can be introduced so it is important to ensure that the survey questions are credible and can be identified with the problem.

*** Bias of payment vehicle**

A respondent will require to know how money allocated to ALF will be collected. The method or vehicle thought at present to be most credible is that of the domestic water charge. An expected difficulty with this is the protest voters who feel that the abstractor who has benefited from cheap water resources should now pay for the damage. Another popular target is TWUL shareholders who, it is felt, should put the river restoration before profits. These protest votes are valid expressions of discontent but may cause difficulty if they are numerous.

Boundary difficulties may occur in questioning those in and around the catchment. If the water bill payment vehicle is to be realistic it may only be applied to those areas which receive supplies from the Darent. However TWUL operational zones do not coincide with the river valley boundaries or those of NRA Southern Region.

Payment made for ALF by Southern Region may be funded from the Water Resource Account, ie abstraction charges paid to the Region by all nine Water Companies in the Region. If the cost of the remedy is passed on as higher abstraction charges every one of the nine water companies in the Region will pay. Those outside Southern NRA, but inside TWUL Darent supply zones (users) will not. In this situation many non-users will pay regardless of their preferences and questions of morality.

*** Hypothetical Bias**

If it is felt that no real payment will ever be made replies could become irresponsible and irrelevant. It must also be clear that a solution is possible. The Darent Action Plan leaflet carries a short paragraph describing the importance of the study in getting DoE approval.

*** Operational Bias**

The payment vehicle and ALF must be closely linked. As abstracted water is paid for by the majority of residents the link is real. Visitors and non users pay water bills else where so again the link is valid. However questions of consumption quantities and issues such as metering of domestic supplies may cloud discussions. Some respondents may feel that water charges are too high already and may not complete the exercise, again a form of protest vote.

*** Strategic Bias**

This becomes a problem when respondents feel that ALF will be provided regardless of their expression of WTP. Typically this underestimates WTP. It is impossible to exclude people from a river footpath as there can never be an admission fee. If it is felt that regardless of WTP the Darent's problems would be solved values promised may be incorrect. Again information about the need for a full appraisal must be available. The alternative is that an individual who is very keen to see a solution may propose values which are too high in the hope of securing ALF.

6.3.3 POPULATIONS - DEFINITION AND AGGREGATION

For use benefits a specific resident population can be identified and projections of increase in use made. In river quality studies Flood Hazard Research Centre proposed a two kilometre zone. For the Darent this may present difficulties with a linear feature containing good linear access, but concentrations of population at spot locations.

USERS 1/ RESIDENTS

The river has good access along much of it's length between Dartford and Sevenoaks. The Darent valley footpath encourages many local people to walk alongside the watercourse and many residents take the opportunity to walk dogs and children along the path.

Houses back on to the river and many gardens have been designed so that views of the river are afforded.

Resident population data can be derived from household numbers data held by Office of Population Census and Survey (OPCS) for wards impinging on or lying within the boundaries finally accepted as enjoying proximity to the river.

USERS 2/ VISITORS

Many of the sites along the Darent can be described as Honey pot locations. Visitors concentrate on a small number of locations with easy access. One is Eynsford village where a riverside pub combined with a form of village green attracts family picnics and paddling children. Because of the intense popularity of this site the parish council is investing in geotextile and new turf to prevent further damage to the village green.

A number of visitor centres exist along the river with the most recent completed in the last three years. Complete with car park and cafe this centre is primarily educational and informative. It also offers riverside access to disabled visitors as well as able bodied members of the public. Visitor numbers will be harder to establish as few formal records are currently kept.

Forecasting future numbers is problematical in itself.

The Broadlands study obtained user values of WTP per annum of between £24.94 and £19.42 per visitor (figures obtained from on site surveys).

If the flow target (1992) allows the return of a game fishery the numbers of anglers will increase. Measuring this will be more complex than simply monitoring the increase in Rod Licences as these permits are now transferable to anywhere in England and Wales. In 1991 The Sports Council found that on average £350 per person participating was spent on angling. Multiplying this figure by the expected increase on anglers could give an estimate of the increased value of the fishery.

NON USERS option or existence value

Much national publicity has been made of the Darent's state and case. National newspapers ran front page stories following the speech made by the NRA Chairman, Lord Crickhowell (June 15 1992).

However the wider debate over ALF should be national in context informing respondents of all over-abstracted rivers and then focusing on the Darent. Non-use values are contentious but are thought likely to provide the largest monetary value in any appraisal.

The Broadlands postal survey obtained a mean non-use valuation of £21.75 pa for the preservation of the Norfolk Broads. Like Darent this is a unique location.

But Green argues that any values obtained would be spurious

"It is not known why the public attach such values to environmental resources or precisely what environmental resources it is that they are valuing."

Knowing this, the questionnaire must be clear in identifying that flow quantities are the dominant issue.

"What the public may perceive and therefore value as a desirable environment may still not coincide in detail with the ecological preferable management strategy for the habitat"

(Green and Tunstall 1990)

In the Broadlands study it is argued that non-use value sums are unreliable: that whilst non-users do value the preservation of the Broads, the non-use valuation is seen as Charitable-Donation response rather than a strict WTP. This response may vary according to the good/change in provision considered.

To ensure that the river flow and level functions are concentrated on the illustrations covering the three scenarios must clearly indicate volumes and aquatic dependants. Perception of water quality often varies on visual grounds but Green found upon wider questioning that the pollution of rivers quickly became a moral issue and that WTP motivations for cleaner rivers did not vary widely. Statements concerning the morality of polluting rivers scored as highly as those specifically about cleaning up watercourses, however the most important issue was that of public health.

Issues on general conservation and the morality of drying up rivers are bound to be included in respondents judgements, but by clearly illustrating the flow/no flow/improved flow choices

at spot locations and duration for reaches of the river, decisions should be concentrated on the ALF issue.

The aggregation of the non-use population and the contribution provided causes some debate. On a simple basis this population could be defined as

- i. "Near Darent"
 - NRA Regions Southern and Thames 16.1 Million People
 - NRA Regions Southern, Thames and Anglian (roughly SERPLAN) 21.4 Million People
- ii. "All National ALF"
 - Population of England and Wales 50.6 Million People

Assuming 2.4 people per household the WTP values would be multiplied by 6.7, 8.9 and 21 million respectively to give values added via the household water rate.

(Source : NRA Facts 1990)

Multiplying values of WTP by such populations may produce very large benefit sums.

A similar zonal technique was used on the NRA Broadlands CVM study.

This study obtained non-use values of WTP per annum of

Near Broadlands	£ 32.5m	(population 6.69 million)
Elsewhere in GB	£ 77.3m	(population 48.95 million)

What may require testing is the present of a distance - decay function. It may be that interest and consequently valuations placed on the Darent reduces with distance from the river, however national publicity may affect this. Television images of the dry river bed have featured in UK networked programmes such as Panorama (27.4.92) and even as incidental items on Australian programmes!

7. CONCLUSION

Costs associated with the alleviation of low flow conditions effecting the River Darent have been obtained. The benefits to the environment have to be captured in order that funding may be made available. Benefits are associated with returning a flow regime, seasonal in nature, to the river but appraising these environmental improvements is not straight forward.

The lack of case study research into the field has lead to the production of a tender specification for a project unique in it's objectives.

The technique most likely to capture economic values is that of CVM. The application of questionnaires to assess benefits from flow quantity will form case study material, not just for other ALF rivers which the NRA is aiming to solve, but within the general environmental economics literature.

The difficulties of obtaining robust use and non-use values must not be underestimated. The validity of the techniques is not in question however understanding the motives underlying expressions of value is.

At present the Darent's revival would appear to depend upon the application of these techniques which seek to convert the very real wishes of some sectors of the public into action. Whether sufficient expressions of value will be forthcoming remains to be seen.

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