



**NATIONAL RIVERS AUTHORITY
SOUTHERN REGION**

RIVER CATCHMENT MANAGEMENT PLANS

OFFER OF SERVICES : MAIN PROPOSAL



RIVER CATCHMENT MANAGEMENT PLANS
PHASE 1

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SEPTEMBER 1990

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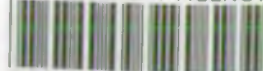
Guildbourne House
Worthing

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Date

24 September 1990

Ext no

National Rivers Authority
Southern Region
Guildbourne House
Chatsworth Road
Worthing
Sussex
BN11 1LD

For the attention of Mr D J Martin

Dear Sirs,

**River Catchment Management Plans
Offer of Services**

In response to your letter of 13 August 1990, we are pleased to submit our proposals for this interesting and strategic project.

We enclose two copies of our Main Proposal and four copies of our briefer Overview document. The Overview summarises the important aspects and benefits of our Proposal whilst the Main Document provides full background details and information.

We have given your requirements detailed consideration and we propose a project team which will produce high quality River Catchment Management Plans in a very cost effective manner. This reflects our keen wish to be part of this work, which we are aware will form an important platform for the future strategy of the National Rivers Authority.

We trust that these documents provide sufficient information for you to evaluate our proposals and we look forward to discussing them further with you.

Yours faithfully,
For and on behalf of
W S ATKINS CONSULTANTS LTD



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Technical Director

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**NATIONAL RIVERS AUTHORITY
SOUTHERN REGION**

RIVER CATCHMENT MANAGEMENT PLANS

OFFER OF SERVICES : OVERVIEW



Introduction

We summarise in this overview our proposals for the preparation of River Catchment Management Plans. Our Main Proposal gives a more detailed description of our methodology, staffing and experience.

We are very enthusiastic about the River Catchment Management Approach and indeed it is part of our own development plan to produce tools such as total catchment models. We are therefore very pleased to have the opportunity to submit this proposal and look forward to discussing it with you further.

River catchments are subject to a variety of uses and pressures and are the basic building blocks for the Corporate Planning function of the NRA. In recognition of this, and the close interaction and potential conflict between the uses, the NRA has decided to produce River Catchment Management Plans (RCMPs). These plans will form the basis of communication, both internally within the NRA and externally with the general public and interested organisations. They will collate information on the existing situation in the catchment, be a vehicle for consultation and aid in the resolution of conflicts. They will allow for a consistent NRA response to external demands and this will help to provide a robust and confident basis for the future implementation of the Plans.

Phase I of the RCMPs, the preparation of which is the subject of this proposal, will include the following activities:

- o Identify USES, actual and potential
- o Establish PRESENT STATE of the catchment
- o Set TARGETS for the future
- o Identify PROBLEMS and CONFLICTS
- o Set out MANAGEMENT OPTIONS

The river catchments covered by this brief are shown below.



Methodology

In preparing our methodology we recognise that a large amount of data already exists, either within the NRA or in other organisations. We also appreciate that a great deal of knowledge and understanding is held by the NRA staff at both Regional and District Level. We therefore see the key role of the Consultant as assembling and incorporating this knowledge and data into the Phase I Plan in an independent and objective manner. However, we recognise the complexity and sensitivity of the task and the considerable managerial and technical skills that will be necessary to bring it to a successful conclusion.

From our experience of similar multifunction studies, we understand the need to use a small team of very competent, experienced specialists who have a working understanding of each others disciplines. The team will be led by an experienced Project Manager who will ensure consistency, quality and completion to time and budget. Since each of the team members is a specialist, they will be able to obtain the maximum benefit from their discussions with NRA staff. They will be able to interpret data rapidly and effectively and extract only that which is directly relevant to the production of the Phase I Plans.

Our methodology is built around this team approach and takes account of the close co-operation that will be required with the NRA. We will carry out the study in stages, which will allow effective discussion, review and refinement of the methodology as the work proceeds.

Inception and Scoping Report

The first stage will be the inception of the study and the production of a detailed Scoping Report. An initial meeting will be held with NRA Southern (NRA-S) Regional staff to discuss the study; meetings with NRA-S District staff will follow to discuss in more detail the extent and type of information available and their views of the catchments. After initial site visits and, if appropriate, discussion with other organisations, we will prepare a Scoping Report for each river catchment. These Reports will form the guidelines for the next stages of the study. This will ensure that only work essential for the preparation of the RCMP's is carried out and that there is consistency in the approach to all catchments.

Data Acquisition and Analysis

The data identified in the Scoping Report will be collected from NRA-S and where appropriate, from other organisations. Wherever possible we will collect processed data or reports rather than primary data. However, we recognise that in several cases, processed data will not exist and in others there may be conflicts or shortcomings in the reports. In these cases we will carry out our own data analysis, but will limit this to be consistent with the aims and requirements of Phase I of the RCMPs.

Set Targets and Identify Problems

When we have assessed the present state of the catchment and the likely future stresses to be exerted on it, we will set targets for each of the various functions. We will perform this in close consultation with NRA-S staff and take due account of the national aims and strategies of the NRA. We will also identify the problems that arise either where different uses have conflicting requirements or where the achievement of the targets may not be readily feasible.

Identify Management Options

We agree with the Study Brief that in some cases a set of policies for the future management of the catchment will be quite evident. In some cases clearly defined problems and conflicts will exist and different management options will be presented in the Phase I Plan. These will then be the subject of extensive consultation before a definitive Plan is produced. Between these extremes, the policies and options may be less obvious; there may be several options to achieve the required goal or the apparent solution may appear too difficult or too costly. It is important that full consideration is given to these cases so that they are seen by all parties to be credible during the later public consultation phase. Our approach to the selection of the option to be presented in the Phase I Plan will involve considerable discussion within the study team and with NRA-S staff.

Reports

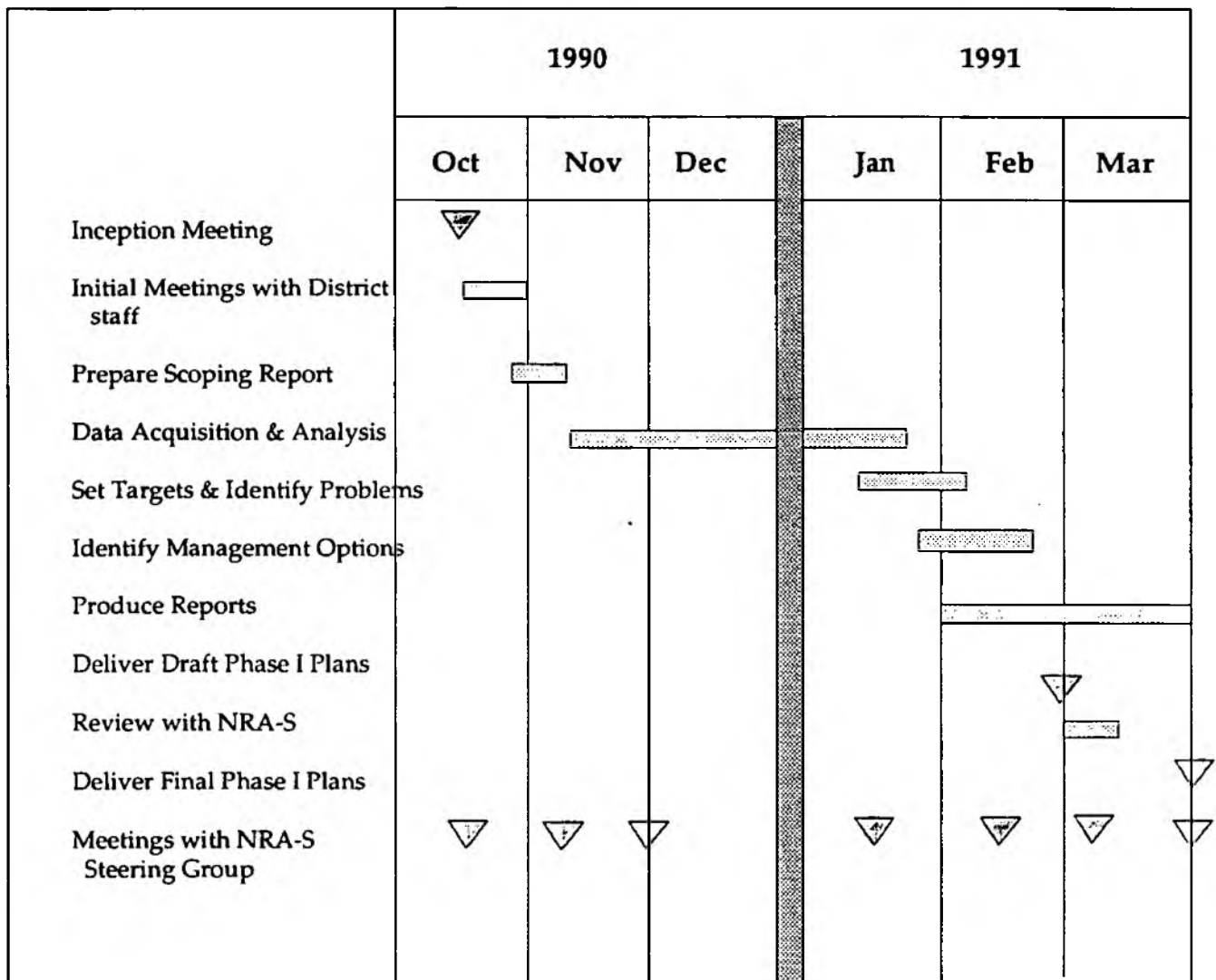
The production of high quality reports is central to the success of the Catchment Management Plans because of their wide exposure to interested bodies and the general public. All aspects of the Report will be prepared in a consistent manner. We will produce Draft Phase I Plans 4 weeks before the Completion Date to allow full discussion and review with NRA-S. The final Plan will then be produced using Desktop Publishing and Computer Aided Draughting techniques in order that it can be made available to NRA-S on completion. A simple example of the type of diagrams produced by our CAD are given in both this and the main reports.



*Recreational Boat Use on the River Great Stour at Grove Ferry
(Photograph taken in connection with Broad Oak Reservoir)*

Programme

Our proposed programme for the production of the Phase I Plans is shown below. This programme will essentially be the same whether the study covers 1, 2 or 3 pairs of catchments. We have recognised the need for close co-operation and liaison with the NRA-S Steering Committee for this work and have therefore allowed for several meetings and review periods.

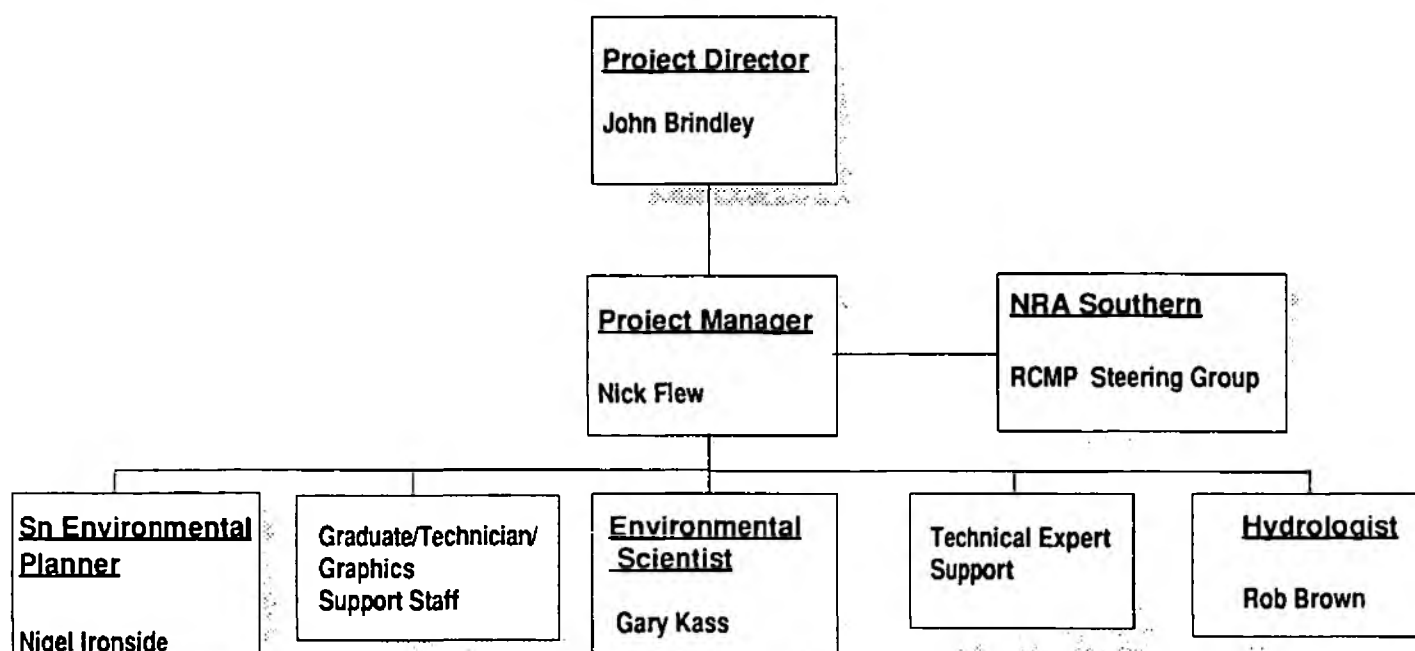


Organisation

Organisation and management will be a vital aspect of this study, particularly if all three pairs of Plans are to be prepared by one Consultant. We have already explained that we will use a small team of experienced specialists which we consider to be very important to the success of the study.

This team is ideally suited to producing River Catchment Management Plans and will work closely and effectively together and with NRA-S staff. If we were to be awarded all the Plans, we would provide this team effectively full-time for the duration of this study and would make them available for any subsequent work on these or other river catchments.

This strong core team will be supported by technicians and graphics staff for the production of the Plans and by other expertise from the WS Atkins Group where this is appropriate. The depth of our strength in these fields allows us to provide other members of staff of a similar quality to those proposed in the team should this be necessary either for this study or for subsequent work.



The Project Director, John Brindley, is experienced in all aspects of water resources schemes and has developed considerable ability in the direction of this type of study through his work on the performance audits and capital investment forecasts for a major proportion of the UK water industry.

The Project Manager, Nick Flew, is managing two river flood studies for the Southern and Severn-Trent Regions of the NRA. He has carried out studies into the water quality of estuarine waters and has extensive experience of effluent treatment.

Nigel Ironside is a Senior Environmental Planner who has spent the last 3 years researching, producing and implementing river catchment management plans in New Zealand.

Robert Brown is a hydrologist who is assessing the hydrological implications of the proposed Broad Oak Reservoir for NRA-S. He has previously investigated fish habitat response and low river flows.

Gary Kass is an environmental scientist who has recently worked in collaboration with NRA Thames Region in carrying out a river catchment management study in south west London.

Experience

WS Atkins are working with NRA-S on a Comprehensive Catchment Study of the River Adur and on the Broad Oak Reservoir Scheme. These demonstrate our capability in all the functions required for this study. We are also working with NRA-Severn Trent on an Investigation of New Main Rivers which, in addition to identifying flood protection standards and solutions, includes a detailed report on the condition and maintenance requirements of over 30km of rivers.

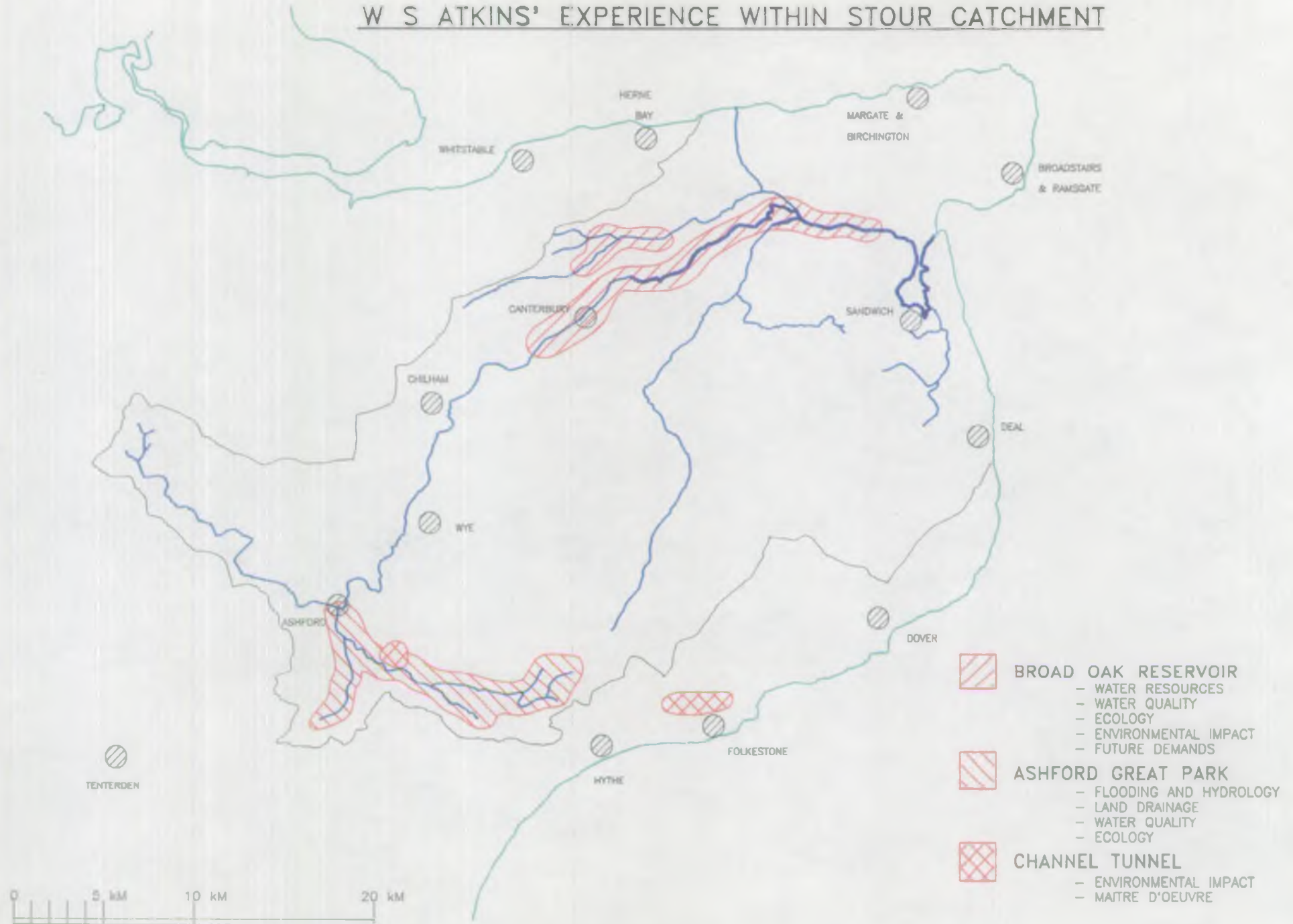
For the Ashford Great Park Development in Kent we are investigating all the land drainage and ecological impacts of the scheme and are monitoring the environmental implications of the nearby Channel Tunnel Terminal Site. We have carried out many Environmental Impact Assessments involving high quality reports and extensive public consultation. These include the proposed barrages across the River Tees near Middlesbrough and the River Tawe in Wales.

This brief resumé of our relevant experience demonstrates our capability to carry out this study. Our Main Offer Document includes more details of our experience in all fields of water engineering and environmental management which we believe will reinforce this view.



*Flooding of Agricultural Land at Mock Bridge near Henfield
(Photograph taken in connection with River Adur Flood Study)*

W S ATKINS' EXPERIENCE WITHIN STOUR CATCHMENT



Financial Proposals

We are aware that River Catchment Management Plans will play a central role in the future strategy of the National Rivers Authority. We are very keen to be involved with this important work and have proposed a team which we believe reflects this. This is also recognised in our financial proposals, in which our staff rates are based on an Association of Consulting Engineers salary multiplier of 2.45. When this is combined with the quality and specialist nature of the team we are proposing, we consider that we can offer the most cost effective approach to the production of the Phase I Plans.

On the basis of the staff resources and rates detailed in our main offer, we estimate that the preparation of one pair of Plans will require an investment of £45,000. Plans for all of the catchments could be produced for £112,000.



Conclusion

In conclusion we are pleased to offer our Services for this strategic and interesting study. We have proposed a strong team which is experienced in this type of work and well used to liaising across functional boundaries. We believe we can offer you the means of obtaining the best value for your investment in the Phase I Plans with the opportunity to continue to benefit, should you need to in the subsequent stages. We look forward to receiving your instructions and working with you on this important project.

2. INTRODUCTION

This offer of consultancy services is made in response to an initial request by National Rivers Authority - Southern Region (NRA-S) on 29th January 1990 for the preparation of River Catchment Management Plans. Following this request, WS Atkins responded, expressing interest in submitting a proposal and attended a meeting in Worthing to discuss the matter. Further to this, the initial brief underwent modifications, and on 13th August 1990, another invitation was made for the submission of a proposal. Following further informal discussions with NRA-S, we now have pleasure in submitting a proposal for this project which promises to be both interesting and valuable.

The scope of the study is set out in the Brief and reiterated in Section 3 of this Offer. The Brief calls for the production of up to six River Catchment Management Plans to be conducted in pairs. The Plans seek to identify the present and likely future uses of each particular river catchment and to highlight any conflicts present or which may arise in the future. The plans will then set out a range of management options aimed at resolving these conflicts for each catchment.

This Offer sets out how we will perform the study, the resources that will be required and the programme of work.

Whilst technical excellence is crucial in a project of this nature, the overall success of the Plans relies upon the manner in which the work is conducted. We therefore propose to adopt a strategic approach which will be characterised by the following principles:

Sensitivity - The nature of a river catchment and its management such is that there are inevitably a wide variety of groups and organisations with a relevant and understandable interest in the use and functioning of the catchment. In order not to compromise the integrity of the concept of catchment management planning we propose to conduct the studies in a sensitive manner. This is particularly important in dealing with third parties, in order to avoid any over-secrecy which could jeopardise the intended open-ness of the RCMP concept.

However, full recognition will be given to the NRA southern region policy of full public participation after Phase I of each plan, at all times.

Integration - We propose to work in very close liaison with NRA Southern Region at both a regional and district level in order that all critical factors are fully described and understood. In identifying potential solutions, such integration will be essential.

Objectivity - Objectivity is the basic principle of planning. It is essential that all studies are not only objective but are seen to be objective. This is of prime importance in River Catchment Management as the resolution of the many conflicting needs and interests of catchment users is the justification for the concept. It is our experience that demonstration of technical competence and an ability to present information effectively engenders a respect for our objectivity. Our experience at public inquiries indicates our independence and credibility, regardless of client.

3. SCOPE OF STUDY

3.1 Introduction

River catchments are subject to a variety of uses. Each use has specific requirements for quality, resource level or physical location. Very often, the requirements for one use are not compatible with those for another, and hence conflicts of interest and needs may arise. The interactions of these conflicts is often complex and a clear, objective framework is necessary in which their resolution can be sought. This is achieved through consideration of a catchment as an integrated geographical unit and this gives rise to the concept of integrated river catchment management. This policy is implemented practically by the production of a River Catchment Management Plan (RCMP). Within the Plan, all the activities that take place within the catchment will be assessed in light of the NRA's statutory management responsibilities.

The plan seeks to accommodate (as far as practicable), the reasonable requirements of all users concerned. Clearly, the relative importance of each use and its requirements will be taken into consideration. Thus, the plan should provide a consensus of opinion and give rise to an agreed strategy for realising the environmental potential of a catchment within prevailing economic and political constraints.

3.2 The Brief

The brief for consultants requires that the following tasks are undertaken:

1. Assemble required information, from both internal and external sources, for the preparation of RCMPs Phase I;
2. Prepare RCMPs Phase I showing management options to achieve targets. The NRA preferred option will normally be made evident.

These tasks are to be performed for the following specified pairs of catchments.

River Medway (to Rochester Bridge)
River Darent and Cray (including
Dartford Creek to the Barrier)

River Stour (Kent)
River Rother (E. Sussex)

River Itchen (to new Itchen Toll Bridge)
River Test (to railway bridge at Totton)

The methodology described for the NRA Welsh Region Study on the fictitious Eurwg Catchment is to be followed closely as the basis for this current study. However, as there are many inherent differences in the Welsh catchments and the catchments of Southern England, this model will be adapted as necessary.

3.3 Uses and Objectives for Catchment

In order to compile and implement the Plan, a wide range of catchment uses will be involved. These include:

- | | | |
|----------------------------|---|--|
| Water Resources | - | Abstractions (potable water, industrial, agricultural), water transfers, discharges, gravel extraction; |
| Flood Defence and Drainage | - | Flood risks, flood protection and land drainage standards, flood water storage and attenuation, wet fencing; |
| Water Quality | - | Sewage and industrial effluent and solid waste disposal, surface and groundwater quality, river classification, pollution sources and loads, mineral working, mine water disposal, urban and agricultural storm water discharge; |

- Conservation - General ecosystem and special areas (eg SSSIs, LNRs, NNRs, SBIs, RSPB Reserves, County Naturalist Trust Reserves etc), geomorphology;
- Fisheries - Salmonids, cyprinids, commercial (fin and shellfish);
- Recreation - Amenity, angling, bathing, immersion sports;
- Navigation - Statutory and common law navigation rights.

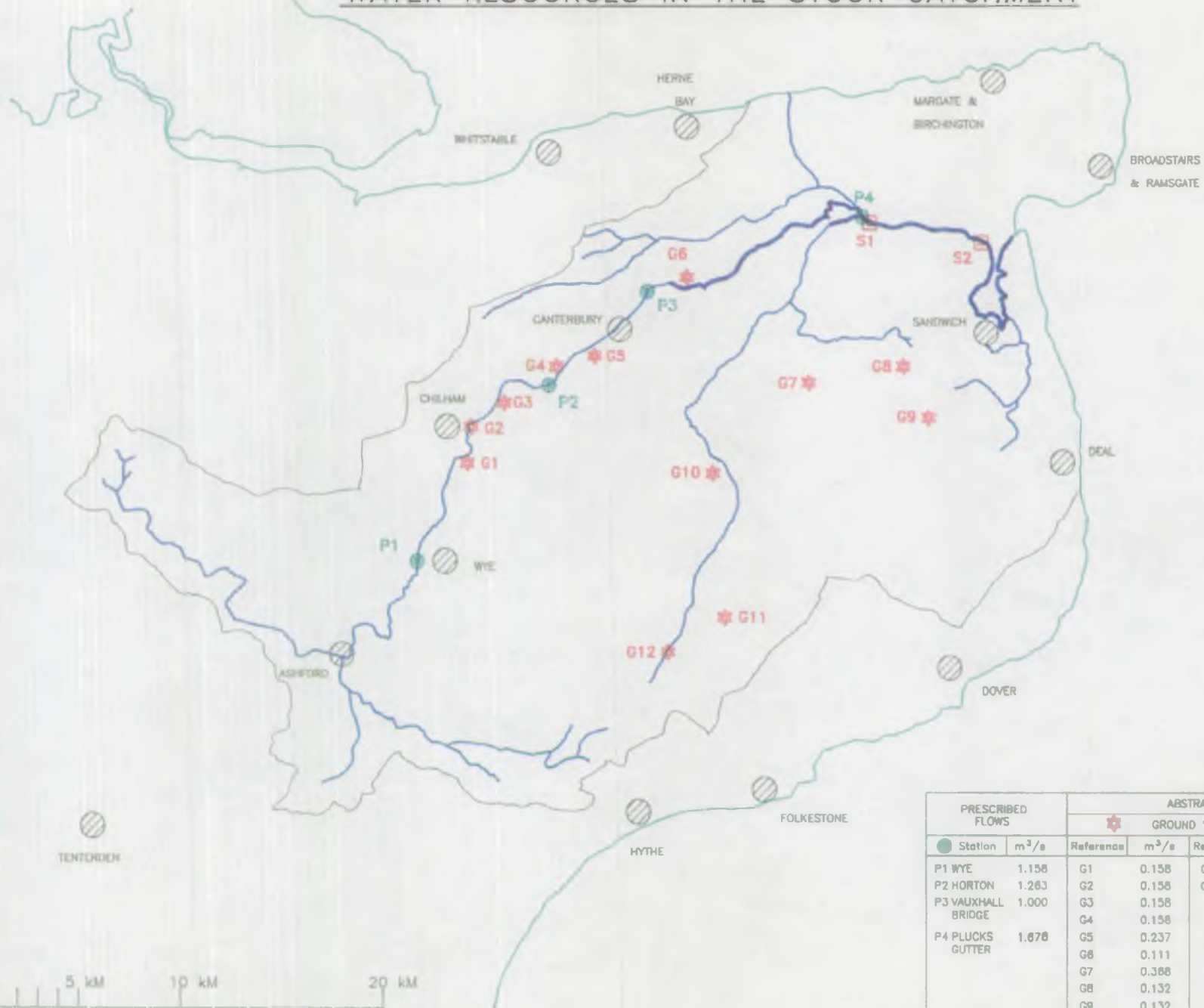
For each catchment to be studied, an assessment of the importance of each individual use will be made. In addition, with reference to identified requirements for each specific use, an assessment of the present state of the catchment will be made. Objectives relating water quality, resources and topography within the catchment and the means of achieving these, will be presented.

3.4 Problems, Conflicts and Solutions

In addition to indicating the existing state of the catchment, Phase 1 of an RCMP project will also identify the future demand likely to be placed on that catchment and its ability to cope with these demands.

Where several identified uses have conflicting requirements these will be identified. For objectives where many users co-exist, the over-riding requirements will be to ensure where possible adequate protection for the use demanding the highest level of quality. However, where uses have directly opposing requirements, these conflicts will be examined in greater detail in order to understand fully the nature of the conflict. Management options aimed at resolving these conflicts will be outlined.

WATER RESOURCES IN THE STOUR CATCHMENT



| PRESCRIBED FLOWS | | ABSTRACTIONS ($> 0.1 \text{ m}^3 \text{ s}^{-1}$) | | | | | |
|--------------------|-----------------------|---|-----------------------|-----------|-----------------------|---------------|-----------------------|
| | | GROUND WATER | | | | SURFACE WATER | |
| Station | m^3/s | Reference | m^3/s | Reference | m^3/s | Reference | m^3/s |
| P1 WYE | 1.158 | G1 | 0.158 | G11 | 0.158 | S1 | 0.116 |
| P2 HORTON | 1.263 | G2 | 0.158 | G12 | 0.158 | S2 | 1.584 |
| P3 VAUXHALL BRIDGE | 1.000 | G3 | 0.158 | | | | |
| P4 PLUCKS GUTTER | 1.678 | G4 | 0.158 | | | | |
| | | G5 | 0.237 | | | | |
| | | G6 | 0.111 | | | | |
| | | G7 | 0.368 | | | | |
| | | G8 | 0.132 | | | | |
| | | G9 | 0.132 | | | | |
| | | G10 | 0.158 | | | | |

4. METHODOLOGY

4.1 General

The study will be carried out at our head office in Epsom and will be under the overall control of the Project Manager who will also be responsible for liaison with the NRA-S.

It is mandatory WS Atkins policy that the project will be subject to a Quality Assurance (QA) Plan. This Quality Plan will be prepared by the Project Manager at the start of the study. This will then remain in force, along with the associated Quality Procedure Manual, during the entire study period. These documents will define the procedures to be followed by the study team.

4.2 Introduction

The programme of the preparation of the RCMP Phase 1 will be approached in six stages. These are as follows::

- | | |
|--------------------------------|--|
| Stage One - Inception | gaining a complete understanding of the RCMP concept and the need for its application in each catchment. |
| Stage Two - Scoping | identification of critical ^{issues} problem areas in each catchment in order to allocate effectively the appropriate resource to the study. |
| Stage Three - Data Acquisition | Physical description of the catchment; Uses of the catchment; Current Condition of the Catchment; ✓ Identification of objectives and ✓ standards; Integration of standards; ✓ Identification of targets ✓ |

| | |
|---|---|
| <p>Stage Four - Identification of problems/iss^{es}</p> | <p>Comparison of current and likely future uses of the catchment with the existing state of catchment. Highlight problems <i>Primitive analysis</i></p> |
| <p>Stage Five - Outlining of Solutions</p> | <p>Identification of management options for each identified problem or conflict.</p> |
| <p>Stage Six - Reporting</p> | <p>Preparation of initial scoping document; <i>→ Stage 2</i> Preparation of RCMP Phase 1; Preparation of supporting technical document</p> |

4.3 Stage One - Inception

This stage will be completed within the first three weeks of the study and consist of the following elements;

- Initial briefing - discussions with NRA Southern Region to establish formal lines of communication at regional and district levels and to identify third parties to be consulted. These meetings will also seek to identify those aspects of each catchment which are fixed (i.e. study boundaries) and any other issues that may influence the scope or programme of work.
- Initial discussions with NRA - discussion with appropriate parties to establish the basic features and to identify critical issues within each catchment.
- Initial site visits - visit to areas of critical importance (where appropriate) in order to appreciate, at first hand, those issues.

4.4 Stage Two - Scoping

This stage will commence shortly after Stage One and will be completed within the first few weeks of the study. The following elements will be included:

- Follow-up discussions - discussions with appropriate contacts within NRA (regional and district) to identify extent and type of information available.
- Initial problem characterisation - a brief, but comprehensive description of critical problems in each catchment will be drawn up relating to the known uses, requirements and targets.
- Target identification - formulation of specific targets and objectives for each use in order to be able to measure objectively the state of the existing and future catchment.
- Staff resource allocation - identification of appropriate level of information required for detailed description of problems and outline solutions. Allocation of staff resources required to achieve this for each catchment.
- Preparation of a scoping report - a report of the initial examination of each catchment and the conflicts which arise will be prepared for the NRA Southern Region. This will include a preliminary set of use assessment targets for NRA's approval. Following full consultation and acceptance of the scoping report by the NRA Southern Region, the remaining stages of the study will be completed.

4.5 Stage Three - Data Acquisition

Water Quality

Specific catchment water quality characterisation will be conducted utilising all existing information and routine catchment monitoring data available. It is envisaged that full use will be made of all available summary reports wherever possible. The characterisation will include both chemical and biological parameters where possible and include both surface and ground water resources. Data from

specific consent monitoring programmes will be used to determine the extent of impact on the catchment water quality by the consented activities and their level of existing compliance with set conditions, as well as intermittent spill problems, eutrophication, storm overflows, etc. Current consent conditions for discharges and future requirements for effluent disposal will be compared with the overall environmental quality standards in order to highlight anomalies for future consideration.

Target water quality parameters from other uses will be collated. Data from external sources such as the Nature Conservancy Council and various higher education establishment etc may be required, but would not be investigated without the full written consent of the NRA Southern Region.

Water Resources

Current surface and ground water licensed abstractions and consented discharges for water company, industrial and agricultural users will be collated and assessed to determine the volume of resources already used. This will be related to relevant measures of low flow, such as ninety five percentile flow, ten day mean annual minimum, flow and mean water table range, at significant locations in the catchment. Actual abstraction and discharge returns for a dry (1989) and normal (1987) year will be collated to determine the actual state and range of fluctuation in consumption of resources. Residual surface and ground water resources will be estimated. Resource controls, such as minimum residual flows etc, will be identified within the catchment, and related to the current status of resources.

Information on future demands will be obtained from NRA forecasts, county and local authority plans, and water supply undertakers. Any major new developments will be identified and their potential requirements assessed.

Flood Defence

Land drainage problems will be ascertained through discussions with Regional and District staff. Maintenance, control, and real time measures currently operative will also be noted. Gauging station records will be assessed and the annual maxima series derived for the following records:

| | | |
|--------|---|-----------------------|
| Stour | - | Horton, Wye |
| Rother | - | Udham |
| Medway | - | Chafford Weir, Teston |
| Itchen | - | Easton, Highbridge |
| Test | - | Broadlands |

Brief flood level calculations will be performed for individual reaches to determine flood risk. If data exists, and it is appropriate, some limited modelling may be carried out. District councils, with the approval of NRA-S, will be approached to request any flooding data, and to identify future plans likely to increase flood risk, such as urban development, improved drainage, flood plain removal.

Recreation

*opportunities for
NRA perception
only.* Data sources able to quantify the present state and future (requirements of) recreational activities within the catchment are likely to come from both the NRA and external clubs and organisation. Data collection will be largely conducted through personal interviews and the use of summary reports, again with the express permission of the NRA where external organisations are concerned. Requirements of various uses will be collated, such as water quality, flow regimes, water levels.

A broad inference of the past growth in recreational activities and the potential future level of these activities will be made using specific club membership figures and county and district structure plans, where appropriate. Where the condition of the river is likely to improve significantly, a similar approach to that adopted for fisheries, below, will be employed to estimate future use.

Fisheries

Information on the present state of the catchment fisheries resource is again likely to be held in various places. Again summary reports are likely to be extensively used and compilation will include quantities as well as presence/absence data where possible. A broad comparison of the existing status of the fisheries resource against what might be theoretically expected for an undeveloped catchment will give a general performance measure for the entire catchment.

The factors affecting the development and/or maintenance of healthy fish stocks such as suitable habitat areas, harmful discharges, availability of food, detrimental flow regimes etc. may then be identified and highlighted.

Conservation

The identification of those reaches requiring specific treatment or protection over and above that likely to be required for the rest of the catchment will be undertaken with reference to existing nationally recognised conservation sites or values.

Brief descriptions will be made of the ecological features of identified areas and their justification for designation as sites of nature conservation value will be given.

Navigation

The identification of all statutory and common law navigation rights will be undertaken for each catchment.

In conjunction with the quantification of existing and likely future recreational and commercial navigational activities for each river, an assessment of the adequacy of existing and future river levels will also be undertaken.

Data Development

In order to maximise the utility of the data collected during the project, where possible a standard logical data structure will be used for collation, interpretation and storage. This data storage structure is displayed in figure 1 and shows three types of attributes for which data is likely to be required including data relating to:

- i) points on the river network;
- ii) sections of rivers between river junction and;
- iii) sub catchment areas.

By collating and storing all project information in this format on standard databases it will allow the data to be linked to other geographical information such as a digital map. Thus, maintaining the possibility that either, within the duration of the project, or at some future date, the information would be available for direct import into a suitable geographical information system (GIS) to enable relational queries and spatial modelling tasks to be undertaken.

4.6 Stage Four - Identification of Problems

This stage will commence during Stage Three, as the nature of the problems existing in each catchment review study become increasingly clear. The following elements will be included:

- Establishment of criteria - for each use identified within the catchment, a suite of requirements, standards and objectives will be drawn up.
- Assessment of catchment status - for each use, the current demands on the catchment will be compared with the criteria identified. This will establish the current state of the catchment with respect to its existing level of compliance with the requirements for the uses to which it is being put.

- Identification of problems - where the assessment element highlights areas where the catchment requirements for particular uses are not being achieved, these will be identified as problems. The complexity of the problems will be investigated and assessed according to the degree of conflict, the ease of solution, and the scale of the problem.

4.7 Stage Five - Outlining of Solutions

As the problems become more closely defined a number of possible solutions or management options will become apparent. This stage will commence towards the end of Stage Four and will consist of the following elements:

- Discussions - discussions will be held with the appropriate contacts within NRA Southern Region to summarise the problems and to identify potential solutions.
- Evaluation of options - for each problem identified a range of management options will be formulated. Each option will be evaluated according to a number of criteria including the scale and complexity of the problem, the practicality of the solution and the inherent cost and resources associated with that solution. In this activity, we will consult very closely with NRA Southern Region regarding the feasibility of each option, taking into account the role of the NRA and its current and future commitments.
- Identification of NRA-preferred options - following the evaluation of options, discussions with NRA Southern Region will identify those options preferred. A description and justification of these choices will be given.

4.8 Stage Six - Reporting

Following the identification of problems and outlining of possible management options, the RCMPs Phase 1 will be compiled for each catchment and a detailed description of the activities undergone in

the course of drawing up each plan. The information will also be held in a supporting technical document and on a computer data-base (possibly dBase III - to be confirmed with NRA Southern Region) for easy access and manipulation and possible future integration into GIS.

The RCMP will follow the basic format specified in the NRA Welsh Region Guidelines for the Eurwg RCMP (although this will be adapted as necessary).

4.9 Further Work

Throughout the proposed study any information gaps identified will be highlighted and noted so that proposals may be drawn up to resolve this at a later date.

Following the definition of problems and identification of management options (including the NRA Southern Region preferred option) we will be in a position to draw up a detailed scope for further work for preparation of presentational documents for Phase 1, public exhibition and consultation of Phase 1 and preparation of Phase 2. Although not included in this offer, we feel that our experience in high-profile, large-scale planning projects gives us the expertise and competence to carry out these additional exercises. We would, in these matters, compile a fully integrated, multidisciplinary team of highly experienced professionals with a range of skills including technical expertise, public relations, marketing, graphic design and desk-top publishing.

Further to the adoption of Phases 1 and 2 WS Atkins will also be in a position to develop a detailed monitoring programme for each catchment plan in conjunction with the NRA, in order to be able to measure performance of the management policies enacted and ensure an early warning of any future catchment management problem.

5. ORGANISATION AND STAFFING

5.1 Project Organisation

The proposed project organisation chart is shown on Figure 5.1. The W S Atkins office responsible for the study will be our head office at Epsom, where all our staff in this proposal are based.

The Project Director will be in regular contact with the study and will assume overall responsibility.

The Project Manager will be responsible for the day to day running of the project and for ensuring consistency, quality and completion to time and budget. He will arrange and attend regular progress meetings and be responsible for liaison with NRA-Southern staff at both Regional and District level.

We will work very closely with NRA staff throughout the study. We have selected team members which are experienced in their disciplines and are able to obtain the maximum out of their discussions with NRA-S staff and other organisations and are able to interpret data rapidly and effectively.

5.2 Project Team

We have found from experience that a project of this type is best tackled by a small team of experienced scientists and engineers assisted by more junior staff and by other specialists only where necessary. The team brings together individuals who are used to working together and are able not only to assist one another in the field but also to contribute to a considerable amount of creative inter-disciplinary discussions. Such discussion and debate is essential in order to identify crucial issues requiring priority attention.

We have summarised below details of the key W S Atkins staff who we will deploy on the studies. Full Cirricula Vitae of each individual are provided in Appendix I.

The core team will be supported by technicians and graphics staff for the production of the Plans and by other expertise from the W S Atkins Group where this is appropriate. The depth of our strength in these fields allows us to provide other members of staff of a similar quality to those proposed in the team should this be necessary either for this study or for subsequent work.

Although it is probably not appropriate for the preparation of the Phase I Plans, we can also call on the services of a number of outside consultants who are acknowledged experts in their fields. This could be appropriate for the public consultation or implementation phases. As an example of the capability we could offer we have included the Curriculum Vitae of Mike Mansell-Moulin who is an internationally recognised hydrologist.

Our team will include the following key members of staff. Their inputs to the study will vary with the number of Phase I Plans that we prepare, and these inputs are detailed in the next section. All of the staff are available to start the study during October, although we reserve the right to replace them with other of equal experience should this prove necessary.

J Brindley - Project Director

Mr Brindley is in charge of W S Atkins work on dams, water resources and river engineering, fields in which he has almost 30 years experience. He is a Panel AR Engineer under the Reservoirs Act 1975. He has developed considerable ability in the direction of this type of study through his work on the performance audits and capital investment forecasts for a major proportion of the UK Water Industry.

N Flew - Project Manager

Mr Flew is a Chartered Engineer with 9 years experience of both flood protection work and effluent treatment. He is currently the Project Manager for the River Adur Catchment Study for NRA - Southern Region

and for the Investigation of New Main Rivers in the Trent Catchment for NRA - Severn Trent. In addition to his role as Project Manager for this study, Mr Flew will also prepare the section of the Plans relating to the flood defence and land drainage functions.

R Brown - Hydrologist

Mr Brown is a hydrologist who is currently involved in assessing the hydrological implications of the Broad Oak Reservoir and abstraction on the Great Stour catchment for NRA-S. He has previously carried out research and fieldwork investigating fish habitat response to modified flow regimes, as well as investigating the implication of water resources on low river flows, for a revision of the UK Low Flow Studies Report.

R Collinson - Principal Environmental Scientist

Mr Collinson is head of the Environmental Assessment and Ecological Studies Department within W S Atkins. He is a Member of the Freshwater Biological Association and has wide experience of environmental impact assessments and studies both in the UK and worldwide. Mr Collinson will ensure that the environmental aspects of the study are performed to the appropriate technical quality.

N. Ironside - Senior Environmental Planner

Mr. Ironside is an environmental scientist who has spent the past three years as Regional Planning Officer for Taranaki Regional Council in New Zealand. In this role, Mr. Ironside was responsible for the research, development, implementation and long-term monitoring of catchment management plans. This involved assessment of catchment issues associated with hydrology, aquatic biology, water quality, land-use, soil conservation, waste disposal, recreation and planning. Prior to his work at Taranaki, Mr. Ironside has worked in the areas of computer systems management, land rehabilitation, land use planning and environmental impact assessment.

Dr. T.J. Cramp - Senior Environmental Scientist

Dr. Cramp is a Chartered Biologist with ten years' experience in the assessment of the aquatic environment. He has carried out extensive work in the areas of environmental planning associated with water development projects, environmental impact assessment (especially with regard to the effects of water pollution) and computer modelling of environmental processes.

G. Kass - Environmental Scientist

Mr. Kass is an environmental scientist, who has worked recently for a Master of Science (Environmental Management) in collaboration with Kingston Polytechnic and NRA Thames Region, carrying out a River Catchment Management Study of a small semi-urban catchment in Surrey/Southwest London. Within this study, Mr. Kass has been responsible for the assessment of the current state of the catchment, the problems associated with its uses and the identification of possible solutions to these problems. In addition, Mr. Kass has experience of investigation and assessment of aquatic, terrestrial and atmospheric pollution.

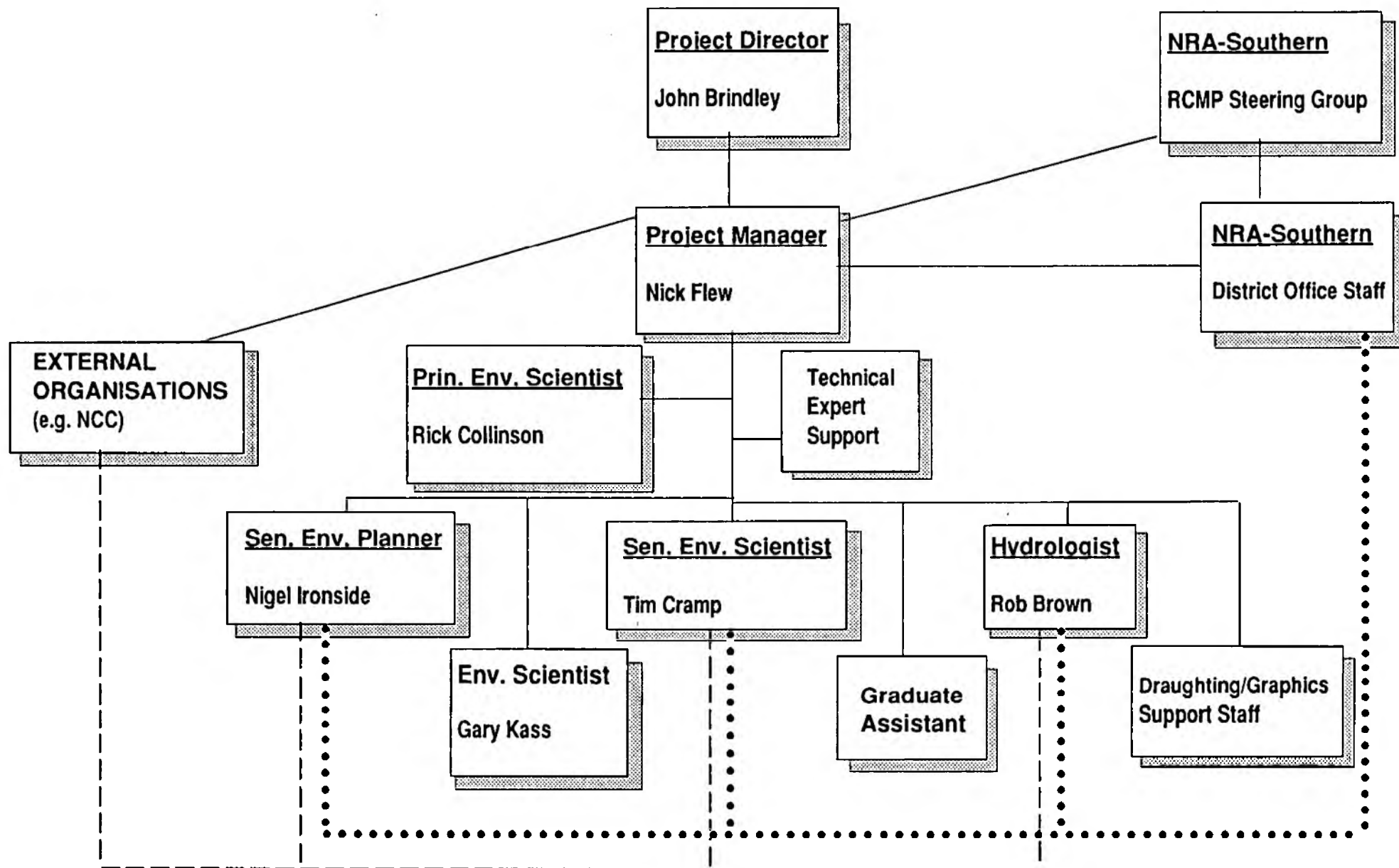


FIGURE 5.1 - PROJECT ORGANISATION CHART

5.3 Staff Inputs

We have given careful consideration to the staff resources required to prepare the Plans, taking due account of the Scope of Work, as set out in the Brief, and our proposed methodology. The small team of specialists that we propose is the most efficient and effective way of carrying out this study and this will minimise the time required by NRA-S staff.

We recognise that the three pairs of catchment have very different characteristics and stresses. However, we consider that each catchment will require the same consistent, logical approach to the preparation of the Plans and therefore the staff resources required for each will be essentially similar. We have therefore provided an estimate for preparing Phase I RCMPs for any individual pair or for all three pairs of catchments.

The fact that the three pairs of catchments are in geographically different areas and are monitored from separate District Offices has played a large part in our assessment of the resources required to prepare all six plans. In order to ensure effective project management we will commit the core of the team effectively full-time to the study. This will provide a minimum of monitoring and review work for the NRA-S Steering Group and will ensure a consistent, high quality approach to the production of the Plans.

The estimated time inputs for the team members are shown on Table 5.1

Table 5.1 - Estimated Time Inputs

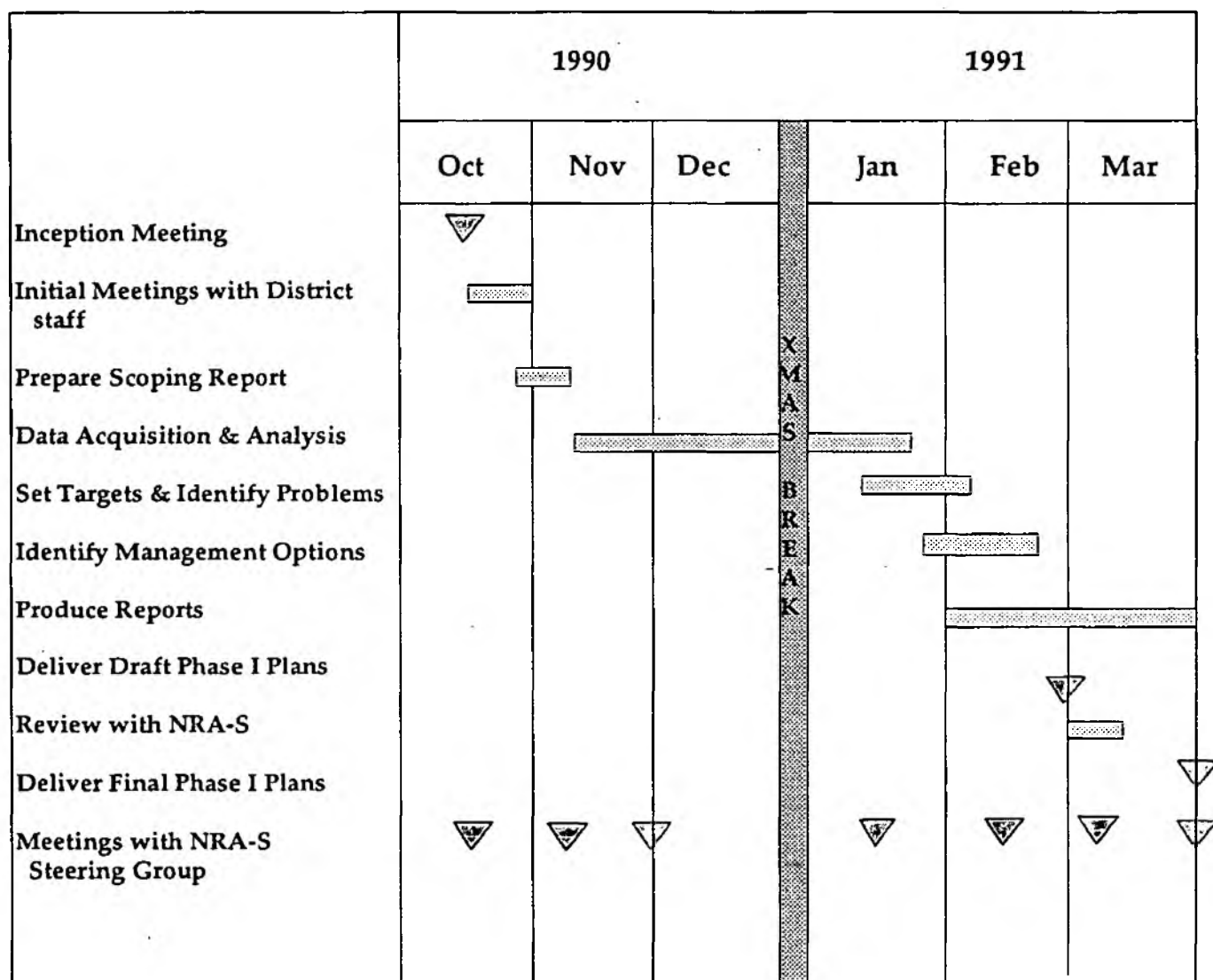
| <u>Name</u> | <u>Title</u> | Estimated Time Inputs (days) | |
|----------------|-----------------------------------|------------------------------|----------------|
| | | <u>1 Pair</u> | <u>3 Pairs</u> |
| John Brindley | Project Director | 5 | 6 |
| Nick Flew | Project Manager | 37 | 84 |
| Rick Collinson | Chief Environmental Scientist | 4 | 8 |
| Nigel Ironside | Senior Environmental Planner | 44 | 89 |
| Robert Brown | Hydrologist | 32 | 80 |
| Tim Cramp | Senior Environmental Scientist | - | 45 |
| Gary Kass | Environmental Scientist | 21 | 45 |
| | Graduate Assistant | 8 | 38 |
| | Computer Draughting Technician | 13 | 30 |
| | Graphics Operator | 13 | 30 |

6. PROGRAMME

Our proposed programme for the production of the Phase I Plans is shown on Figure 6.1. This programme will be essentially the same whether the Plans are to be prepared for 1, 2 or 3 pairs of catchments.

We recognise the need for close co-operation and liaison with the NRA-S Steering Committee for this work and have therefore allowed for several meetings and review periods.

FIGURE 6.1 - PROGRAMME



7.0 FINANCIAL PROPOSALS

7.1 The Study Team

We are aware that River Catchment Management Plans will play a central role in the future strategy of the National Rivers Authority. We are very keen to be involved in this work and have proposed a team which reflects this. In addition we will carry out the study using staff rates based on a competitive Association of Consulting Engineers salary multiplier of 2.45. When this is combined with the quality and level of specialisation of the team, we consider that we can offer the most cost effective approach to the production of the Phase I Plans.

Using the 2.45 salary multiplier, the current rates for the key specialists in the team are as listed below:

| <u>Name</u> | <u>Title</u> | <u>Rate (£/Hour)</u> |
|----------------|--------------------------------------|----------------------|
| John Brindley | Project Director | £70.23 |
| Nick Flew | Project Manager | £38.60 |
| Rick Collinson | Principal Environmental Scientist | £51.45 |
| Nigel Ironside | Senior Environmental Planner | £29.36 |
| Robert Brown | Hydrologist | £30.14 |
| Tim Cramp | Senior Environmental Scientist | £31.43 |
| Gary Kass | Environmental Scientist | £23.28 |
| | Graduate Assistant | £20.67 |
| | Computer Draughting Technician | £22.53 |
| | Graphics Operator | £19.87 |

7.2 Study Estimates

As we stated in Section 5.3 of this Proposal we have given careful consideration to the staff resources required to prepare the Phase I Plans. Our realistic estimate of the time inputs are detailed on Table 5.1 and by using the staff rates in the previous section, we estimate the investment required in the Plans to be:-

| | <u>Any one pair of catchments</u> | <u>All three pairs of catchments</u> |
|--|---------------------------------------|--|
| Staff Time | £47,827 | £104,393 |
| Expenses (travelling, computing, printing, etc) | £ 3,100 | £ 7,200 |
| 5% handling charge for expenses | £ 155 | £ 360 |
| Total Estimate | <u>£45,082</u> | <u>£111,953</u> |

7.3 Terms of Offer

*£51,082
arithmetical error
DSM*

This Offer of Services is made Subject to Contract and is valid until 30 November 1990. The fee proposals are exclusive of Value Added Tax which will be added to invoices at the rate prevalent at that time.

The work will be carried out in accordance with the Association of Consulting Engineers Agreement 1 for Reporting and Advisory Work; 1981, as amended 1989.

We will submit monthly invoices in arrears which will be payable within 28 days.

APPENDIX I

CURRICULA VITAE

| | | | |
|-------------------------------|--|----------------------|----------------|
| <u>NAME OF PERSON</u> | J S BRINDLEY | <u>YEAR OF BIRTH</u> | 1938 |
| <u>NATIONALITY</u> | British | <u>PROFESSION</u> | Civil Engineer |
| <u>POSITION IN FIRM</u> | Technical Director | | |
| <u>SPECIALISATION IN FIRM</u> | Head of W S Atkins work on dams, water resources , river engineering and water company regulation. | | |

KEY QUALIFICATIONS

- Master of Arts, Engineering, Cambridge
- Diploma of Imperial College, Soil Mechanics, London
- Fellow, Institution of Civil Engineers
- Fellow, Institution of Water and Environmental Management
- Fellow, Chartered Institute of Arbitrators
- Member, British Geotechnical Society
- Member, All Reservoirs Panel under Reservoirs Act 1975
- Member of British Section of International Commission on Large Dams

KEY EXPERIENCE

- Assessment of physical and environmental performance of water utilities.
- Planning capital investment to meet medium and long term needs of regulated water utilities.
- Rigorous audit of the gathering and processing of data about the performance of water organisations.
- Modelling and leakage management of water distribution systems.
- Audit and appraisal of major construction proposals.
- Rigorously prepared long-term investment forecasts for major utilities.
- Design and construction of dams and water supply works.
- Geotechnical engineering.

EXPERIENCE in present employment (from 1986)

Named Independent Certifier, under the provisions of the regulated UK Water Industry responsible for auditing and certifying the information on capital investment and performance presented regularly to the Director General by 11 water companies, representing water services to half the population of England and Wales.

Assessor under 1989 Water Act in preparation for the newly regulated regime of the UK industry, auditing the preparation of 20-year forecasts of the expenditure needed to maintain capital works and meet performance requirements for six of the ten UK Water Authorities, serving a total population of 30 million. Signed letters of comfort in respect of 11 billion pounds sterling 10 year investment for the prospectus for the successful public flotation of those utilities.

In a parallel study for six Statutory Water Companies, prepared the estimates for their 20-year capital investment needs, using statistical sampling techniques, detailed engineering studies of selected areas and rigorous development of unit costs bases. With a separate audit team, certified these estimates for the purposes of the new regulatory procedures.

Monitored and cross-certified a study by the UK Water Research Centre on Thames Water's underground assets, assessing the condition and likely expenditure over the next 20 years for 80,000km of water mains and sewers. Presented the results to Thames' Development Group and to the Authority's Main Board.

Hydraulic analysis of water distribution mains for UK Water authorities in London, Yorkshire, Gloucestershire, Leicester, Nottingham, Derby and West Midlands. Measuring flows and pressures in the systems and matching the measured flows with the numerical model. Then assessing the performance of the system and identifying opportunities to improve operations, reduce leakage and economise on fuel costs.

Audit of design of stormwater outflow from the proposed UK terminal of the Channel Tunnel. The primary requirement is that the increased run-off resulting from the large built-up area of the terminal should have no adverse effect on the drainage of the Folkestone area.

Statutory inspections under the Reservoirs Act 1975 of large raised reservoirs. Inspected reservoirs in Humberside, Lincolnshire, Cambridgeshire, Sussex, Essex and Surrey.

Design of embankment sections of 17km Long Severn Barrage from Cardiff to Weston-Super-Mare to generate power from the high tidal range in the Severn Estuary.

Design of three 20m-30m high flood check dams in Oman, to contain the 100 year flood and to protect urban and industrial development downstream. Two dams were gravel embankment and one was designed alternatively in roller-compacted concrete and vibration-compacted concrete.

EXPERIENCE prior to present employment (1967-1986 BINNIE & PARTNERS)

1984-86 LONDON, CHIEF ENGINEER. Responsible for cost and programme aspects of the appraisal of the proposals for the Channel Fixed Link, tunnel or bridge, from which Eurotunnel's was selected.

Leader of group responsible for network analysis, leakage control, etc, related to water distribution in UK and abroad.

Study for three major North London water companies of water resources and alternative bulk supply and transfer arrangements, to analyse options for conjunctive operations.

Presentations in Lima, Peru to a seminar on the control of leakage in water pipes. Also prepared proposals for investigating and analysing the condition of water distribution system for a city in Peru.

Wrote report for Baghdad Water Supply Administration on application of digital mapping database to water distribution and pipelines for the city.

1982 - 1983 C.R.E. KUALA LUMPUR, MALASIA. Responsible for supervision of construction of S. Semenyih water scheme including 49m high earth fill dam, river intake, treatment works 6 r.c. reservoirs and manufacture and laying of over 200 km of pipes 2050 - 750 mm.

1981 - 1982 LONDON, CHIEF ENGINEER. Visiting Expert, Gwangju Water Supply, S. Korea. Design and supervision of construction for World Bank funded 150 Mld supply from reservoir with 45m high rockfill dam through 30km aqueduct of tunnels and pipes.

Cizre Dam, Turkey. Feasibility study in UK on 240 Mw hydropower scheme on the River Tigris.

1979 - 1980 HONG KONG, ASSOCIATE, BINNIE & PARTNERS (HK). Responsible for design and construction supervision of remedial works to high fill slopes in crowded, urban Hong Kong.

1971 - 1979 LONDON, SENIOR ENGINEER

- Feasibility report on use of large tidal inlet for storage of freshwater, Hong Kong.
- Construction supervision in chief of High Island Water Scheme. Also final works Plover Cove water scheme, Hong Kong.
- Design of High Island Water Scheme. Hong Kong including two 100m high rock fill dams built in sea bed and 40km of rock tunnels.
- 75m earthfill dam for water supply, Lantau Island, Hong Kong.
- Severn Barrage UK. Study of floating caissons into position for 7,200 Mw tidal power barrage.

1970 - 1971 GREATER BOMBAY WATER STUDY, INDIA, ENGINEER. Member of team of two engineers in World Bank funded study of the water supply of Bombay including the whole trunk and distribution system, carrying out field measurements and making proposals for improvements.

1967 - 1970 ASSISTANT ENGINEER, BINNIE & PARTNERS, UK

- Prepared Operation and Maintenance Manuals for Mangla Dam, Pakistan.
- Resident Engineer for remedial works to 42m high Balderhead dam UK
- Design of well field and 50km delivery main for water supply to a copper mine in Iran.

1965 - 1967 BALFOUR BEATTY CONTRACTORS, SENIOR SITE ENGINEER. Tunnel engineer on Victoria Line, London underground railway. Site Agent for CEBG 400kV sub-station.

1962 - 1965 BINNIE & PARTNERS. Design of pumping stations and pipelines for Grafham Water Scheme, UK. Design of embankments up to 115m high for Mangla Dam, Pakistan.

1957 - 1959 Military Service, Royal Electrical and Mechanical Engineers; Lieutenant.

CVM09/6A
20/9/90

| | | | |
|-------------------------------|---------------------------|----------------------|----------------|
| <u>NAME OF PERSON</u> | N W J FLEW | <u>YEAR OF BIRTH</u> | 1960 |
| <u>NATIONALITY</u> | British | <u>PROFESSION</u> | Civil Engineer |
| <u>POSITION IN FIRM</u> | Environmental Engineer | | |
| <u>SPECIALISATION IN FIRM</u> | Environmental Engineering | | |

KEY QUALIFICATIONS

- Chartered Engineer
- BA (Hons) Cambridge University, 1981
- Member of the Institution of Civil Engineers
- Member of the Institution of Water and Environmental Management

KEY EXPERIENCE

- River Studies.
- Mathematical modelling of river, coastal and sewerage environments.
- Design and implementation of flood alleviation schemes and river bank works.
- Design, investigation and construction of sewage treatment facilities including oxidation ditches, long sea outfalls and COPA II assessments.

EXPERIENCE1990

PROJECT MANAGER. Investigation of New Main Rivers in the Trent Catchment: NRA, Severn-Trent Region. Responsible for assessing the condition and maintenance requirements of three reaches of river totalling over 30km and carrying out full hydrologic and hydraulic analysis using the MIKE II River Modelling System.

1990

Costello De Bode Reservoir, Portugal. Responsible for investigating the effects of catchment development on the quality of water in the reservoir which is over 40km long and up to 2km wide.

1990

Fowey Estuary Study: South West Water Plc. Responsible for investigating sewage disposal options for the Fowey Estuary, in Cornwall. This includes full water quality modelling using MIKE II and the interpretation of field work.

1990

PROJECT MANAGER. River Avon Barrage: Feasibility Study, Bristol Development Corporation. Responsible for this study which investigates the impact of the barrage on tidal and fluvial flooding, ecology, water quality, sedimentation, groundwater and recreation. A mathematical model of the River Avon and City Docks area has been developed to investigate these matters.

1990

St Austell Coastal Modelling: South West Water Services Plc. Responsible for carrying out preliminary assessments for outfall locations using a 2-dimensional mathematical model.

1990

PROJECT MANAGER. River Adur Flood Study, UK. National Rivers Authority - Southern Region. Responsible for the investigation into flooding in the River Adur Catchment in Sussex. This includes river surveys, hydrology, mathematical modelling using MIKE11, outline design of alleviation schemes and cost: benefit analysis.

1989-1990

PROJECT MANAGER. River Dane Flood Study, UK. Responsible for investigation into the impact of a proposed flood plain development at Northwich. A mathematical model was developed to assess the effects on flood levels and also on the sediment transport and geomorphology of the river system.

1989-1990

PROJECT MANAGER. MIKE11 River Modelling System, UK. Responsible for the marketing, sales and support of MIKE11 software package.

1987-89 RESIDENT ENGINEER on Fowey District Sewage Treatment Works for South West Water. Total value of Contracts : 2.2 million pounds sterling.

1986 ENGINEER on Fowey District Sewage Treatment Works for South West Water. Responsible for detailed design of an entirely new oxidation ditch plant and for modifications to two other works, with a total capital value of 2.1 million pounds sterling.

ENGINEER for the hydrological and hydraulic assessment of 80 bridges on the 300km highway in Cameroun, West Africa.

ENGINEER for various Statutory Reservoir Inspections in UK. Responsible for the analysis of existing spillway arrangements, catchment hydrology and assisting with report preparation and statutory notices.

1985 ENGINEER for the Colombo Stormwater Drainage Project, Sri Lanka. Responsible for hydraulic analysis, evaluation of maintenance and operation requirements and preparation of outline designs to alleviate flooding whilst based in Sri Lanka.

EXPERIENCE (prior to present employer)1984-1985 NORTH BEDFORDSHIRE BOROUGH COUNCIL WORKING ON THE FOLLOWING PROJECTS:

ENGINEER on the Bedford Urban Trunk Sewer Study. Feasibility Study phase. Assessment of Bedford's 115-year-old combined sewerage system using the procedures within the WAA/WRC Sewerage Rehabilitation Manual.

ENGINEER on the Monnow Bridge. Preliminary Stability Study, Monmouth. Investigation into the effect that flood prevention measures to the River Monnow would have on the stability of the medieval bridge. Responsible for hydraulic modelling of river systems.

ENGINEER for the preliminary report on Blagdon Reservoir Spillway following a Reservoirs Act Inspection. Assessment of hydraulic capacity and structural stability of masonry spillway crest.

ENGINEER for the Gillingham Flood Alleviation Scheme, Dorset. Feasibility Study phase. Report outlining proposals for remedial works including evaluation of cost-benefit ratios. Responsible for hydraulic analysis by computer of the three river system including calibrating the mathematical model.

1981-1982 WELSH WATER AUTHORITY

SITE ENGINEER on the River Afan Outfall Scheme, Port Talbot. Construction phase. Supervising construction of sea outfall pumping station incorporating pretreatment area.

SITE ENGINEER on Baglan Long Sea Outfall Remedial Works, South Wales. Investigation into operational problems of existing 43 km long outfall and assessing and carrying out remedial works.

LANGUAGES

English
French
Spanish

SPOKEN

Fair
Basic

WRITTEN

Mother Tongue
Fair
Basic

READING

Fair
Basic

| | | | |
|-------------------------|-------------------------------|----------------------|------|
| <u>NAME OF PERSON</u> | R.P.C. BROWN | <u>YEAR OF BIRTH</u> | 1963 |
| <u>NATIONALITY</u> | British | | |
| <u>POSITION IN FIRM</u> | Hydrologist | | |
| <u>SPECIALISATION</u> | Hydrology and Water Resources | | |

KEY QUALIFICATIONS

- Bachelor of Science (Joint Honours) Geology and Chemistry, Kings College, University of London, 1984.
- Master of Science, Engineering Hydrology, Imperial College of Science and Technology, University of London, 1987.
- Diploma of Imperial College, Engineering Hydrology, Imperial College of Science and Technology, University of London, 1987.
- Member of the British Hydrological Society.

KEY EXPERIENCE

- Regional and statistical analysis of UK low river flows.
- Analysis of impact of abstractions and discharges on low river flows.
- Research into modelling the impact of modifying flow regimes on fish habitat.
- Research into impact of past climatic variability on UK river flows.
- Development of reservoir storage/yield analysis procedures.
- Ongoing drought analysis and flow/borehole level prediction - 1989; short term drought studies.
- MSc thesis : 'Arid zone rainfall-runoff modelling in south west Saudia Arabia: a case study'; 1987.

EXPERIENCE1990W S ATKINS WATER, HYDROLOGIST

- Investgation of hydrological aspects of Broad Oak reservoir promotion in Kent.
- Flood study for dam design in St. Helena.
- Hydrology and recommendations for restoration of landfill site in East Anglia.

1987-1990INSTITUTE OF HYDROLOGY, WALLINGFORD

Regional and statistical analysis of low river flows to update the UK Low Flow Studies manual (Institute of Hydrology, 1980).

- Collation and assessment of data on artificial influences on river basin hydrology.
- Assessment of hydrometric quality of UK flow gauging stations.
- Regional analysis of various low flow statistics.

Modelling the impact of modification of stream flows on in-stream ecological habitat.

- Supervision of pilot study to test suitability of American Physican HABitat SIMulation computer model (PHABSIM) under UK conditions.
- Co-ordination and collection of relevant field data required for PHABSIM.

Study of impact of past climatic variability on long record river flows.

- Analysis of temporal and spatial variability in UK river flows .
- Assessment of hydrological characteristics of 1988/89 mild winter.

Reservoir storage/yield analysis

- Appraisal of Low Flow Studies storage/yield analysis technique
- Development of the new Annual Failure Method for storage/yield analysis.

Analysis of monthly runoff data during drought monitoring periods. (1989-1990).

- Monthly minimum flow analysis for key gauging stations around the UK.
- Reporting on regional patterns derived from above analysis.

Short term drought analysis studies.

- Regional analysis of 1978 and 1984 droughts in south-west Scotland.
- Probability analysis of failure of surface water abstractions.

Prediction of low river flows and borehole levels (1989).

- Serial correlation analysis of various monthly low flow statistics for several rivers and chalk boreholes.
- Prediction of monthly low river flows and borehole levels from previous month's runoff and forecasts of rainfall.

1986-1987

IMPERIAL COLLEGE, LONDON

Hydrological studies in south-west Saudi Arabia.

- Analysis of storm flood events from a wadi in south-west Saudi Arabia.
- Comparison of three standard rainfall-runoff models in modelling these events.
- Recommendations for possible future approaches to flood design in Saudi Arabia.

LANGUAGES

| | <u>Speaking</u> | <u>Reading</u> | <u>Writing</u> |
|---------|---------------------------|----------------|----------------|
| English | * * - Mother Tongue - * * | | |
| French | Basic | Fair | Basic |
| Swahili | Basic | - | - |

| | | | |
|-------------------------------|---|----------------------|-------------------------|
| <u>NAME OF PERSON</u> | R I COLLINSON | <u>YEAR OF BIRTH</u> | 1951 |
| <u>NATIONALITY</u> | British | <u>PROFESSION</u> | Environmental Biologist |
| <u>POSITION IN FIRM</u> | Principal Environmental Consultant | | |
| <u>SPECIALISATION IN FIRM</u> | Environmental impact; Environmental Health; Ecological and pollution assessment | | |

KEY QUALIFICATIONS

- Bachelor of Science (Honours) Biology, 1972
- Master of Science (Environmental Resources), 1973
- Chartered Biologist
- Member of the Institute of Biology
- Member of the Freshwater Biological Association

KEY EXPERIENCE

- Wide experience in environmental impact assessment and environmental health studies worldwide
- Project management of environmental impact studies for major transportation, industrial and housing development projects
- Seconded to BP Petroleum Development to advise and assist on preparation of EIAs onshore and offshore development projects
- Background in freshwater biology, environmental resource development
- Head of Environmental Assessment and Ecological Studies Department

EXPERIENCE in Present Employment (from 1973)1990

PORT OF LONDONDERRY, UK. Project manager of an environmental impact assessment of a proposal to relocate the port facilities of Londonderry. Consideration given to the potential effects of dredging spoil disposal in Lough Foyle, including the impact on wildfowl areas and shellfish beds; assessment of noise and air quality implications including positive benefits arising from relocation activity; landscape and visual amenity effects and health and safety factors.

DEPARTMENT OF TRANSPORT, UK. Environmental assessment of M40 motorway service area; assessment of ecological implications and surface water drainage effects on adjacent SSSI; preparation of proof of evidence for public inquiry presentation.

1987-1989

WEST MIDLANDS PASSENGER TRANSPORT EXEC, UK. Environmental impact assessment of West Midlands Metro; assessment of ecological effects including habitat creation; consideration of visual and neighbourhood amenity issues; investigation of noise, vibration and air quality issues; assessment of social severance factors.

ALLOT, ATKINS, MOUCHEL/CEGB. Environmental assessment of transportation links for Hinkley 'C' power station; evaluation of ecological implications of highway links across low lying wetland areas of the Somerset Levels; discussions with NCC; evaluation of habitat creation proposals.

EUROTUNNEL, UK. Ecological impact assessment of Eurotunnel and their contractors proposals for the construction of the proposed Channel Tunnel development. Recommendations on land-use management and the restoration of ecologically sensitive areas, SSSIs and chalk downland.

SOUTH WEST WATER, UK. ASSESSMENT OF THE ENVIRONMENTAL CONDITION OF THE RIVER EXE ESTUARY IN DEVON. Work included a review of water quality, fisheries and ecology data: water quality, bacteriological and fisheries field study during an intensive monitoring period; input into predictive mathematical modelling exercise for future pollution assessment of the estuary.

1985-1986

DEPARTMENT OF TRANSPORT, UK. Environmental impact assessment of proposed Second Severn Crossing. Appraisal from the point of view of ecological impacts on estuary in saltmarsh and mudflats, wildfowl and wader populations; potential effects on agricultural drainage systems.

COLLINSON R I/C.1.1

February 1990

BRITISH STEEL CORPORATION. REDCAR STEELWORKS. Chlorination of cooling water and the study of associated problems due to pollution, ultimate effect on marine environment.

LEAD CONSULTANT TO VARIOUS COUNTY COUNCIL AND PRIVATE CLIENTS, UK. Investigation of leachate and gas generation problems from landfill sites; assessment of effects on local water courses, groundwater and adjacent developments, eg. agricultural, residential and industrial.

PRIVATE CLIENT. Investigation of the technical and ecological aspects for the creation of an aquatic wildlife area in Kent, England; factors investigated included basic fisheries requirements, associated fauna and flora development, resultant feeding requirements, and habitat needs for wildfowl.

| <u>LANGUAGES</u> | <u>SPOKEN</u> | <u>WRITTEN</u> | <u>READING</u> |
|------------------|---------------|---------------------|----------------|
| English | | -- Mother tongue -- | |
| German | Fair | Fair | Fair |
| French | Fair | Fair | Fair |

| | | | |
|-------------------------------|--|----------------------|-------------------------|
| <u>NAME OF PERSON</u> | Nigel C. Ironside | <u>YEAR OF BIRTH</u> | 1960 |
| <u>NATIONALITY</u> | New Zealand | <u>PROFESSION</u> | Environmental Scientist |
| <u>POSITION IN FIRM</u> | Environmental Planner | | |
| <u>SPECIALISATION IN FIRM</u> | Water quality; aquatic biology; soil conservation; waste disposal; land rehabilitation; impact assessment | | |

KEY QUALIFICATIONS

- Bachelor of Science (Hons), Environmental Science (Plymouth Polytechnic), 1983

KEY EXPERIENCE

- Regional Planning Officer, Taranaki Regional Council, New Zealand
- Water catchment management and planning, compliance monitoring
- Computer systems management
- Land Rehabilitation Consultant, Ministry of Energy, New Zealand
- Mining Engineer, State Coal Mines, New Zealand
- Environmental impact assessment, land use planning
- Data processing
- Soil sampling and analysis

Joined WS Atkins in 1990.

EXPERIENCE Prior to present employer1987-1990

REGIONAL PLANNING OFFICER, TARANAKI REGIONAL COUNCIL, NEW ZEALAND. Involved in the management of Taranaki's water and soil resources. Investigation of water right applications; analysis of water right compliance monitoring data; development, implementation, and long term monitoring of water catchment management plans. Work in hydrology, water quality, aquatic biology, land use, soil conservation, waste disposal, natural hazard and water recreation and planning.

SYSTEM MANAGER. Responsible for the Council's Digital PDP11/23 and its Digital MicroVAX 3400 replacement computer system.

1987

LAND REHABILITATION SPECIALIST, MINISTRY OF ENERGY, NEW ZEALAND. Developed guidelines on acceptable practices and achievable standards of land rehabilitation following mining. Analysis of the problems associated with land restoration specific to the various mining regions throughout New Zealand and the practices available for overcoming them.

1986-1987

ENVIRONMENTAL ACTIVITY MANAGER, STATE COAL MINES, NEW ZEALAND. Responsible for State Coal Mine's compliance with all statutory approvals including Water Rights, Environmental Impact Assessment Procedures and Mining License. Applications for these approvals were undertaken under the umbrella of a mining feasibility study in each case. Soil scientist with State Coal Mines responsible for final land use assessments of disturbed land due for rehabilitation. Supervision of research programmes by the DSIR Soil Bureau and restoration practices on site.

1984-1985

STOLT NIELSEN. Processing and interpretation of real time navigation and sub-sea sensor data of major pipeline and other oil related construction projects. The work was carried out both offshore (North Sea) and onshore.

IRONSIDE N C/C.1.1
August 1990

1983-1984

ALBURY SITE INVESTIGATIONS LTD. Field sampling and laboratory analysis of both the physical and chemical properties of soils for site characterisation studies.

LANGUAGES

SPOKEN

WRITTEN

READING

English

-- Mother Tongue --

| | | | |
|-------------------------------|--|----------------------|-----------|
| <u>NAME OF PERSON</u> | DR T J CRAMP | <u>YEAR OF BIRTH</u> | 1959 |
| <u>NATIONALITY</u> | British | <u>PROFESSION</u> | Biologist |
| <u>POSITION IN FIRM</u> | Senior Environmental Scientist | | |
| <u>SPECIALISATION IN FIRM</u> | Marine Biology; Modelling; Impact assessment | | |

KEY QUALIFICATIONS

- Bachelor of Science (Hons), Environmental Science (Southampton University), 1981
- Doctor of Philosophy, Marine Ecology (Leeds University), 1985
- Chartered Biologist (C Biol)
- Member of Institute of Biology (MI Biol)
- Member of the Institution of Environmental Sciences (MI Env Sci)
- Member of the Marine Biological Association of the UK
- Member of the British Ecological Society

KEY EXPERIENCE

- Computer modelling of environmental processes
- Community ecology of marine meiofauna
- Theoretical ecology and ecological diversity

EXPERIENCE In present employment (from 1989)1990

EPAL, ENTREPRESE PUBLICA DAS AGUAS LIBRES, PORTUGAL. Assessment of the affect on water quality, of planned residential development and recreational use in the catchment area of a major reservoir.

SOUTH WEST WATER SERVICES LTD, UK. Specification and management of marine investigations, including benthic baseline surveys and water quality surveys, for assessing the impact of two long sea outfalls.

WESTMINSTER CITY COUNCIL. Evaluation of planning applications for the Paddington Special Policy Area. Provision of consultancy advice regarding environmental impact of the schemes, especially impacts on water quality.

LLANELLI BOROUGH COUNCIL. Assessment of the impact on water quality in a proposed marina, caused by diversion of a river and impoundment of estuarine waters.

AGID, ALGERIA. Environmental Assessment of two major irrigation schemes, including an investigation of current environmental problems of both areas. Particular attention was paid to water quality and environmental health aspects. Conclusions formed the basis for the evaluation of options concerning use of the water resources.

LONDONDERRY PORT & HARBOUR COMMISSIONERS. Environmental Assessment of a new port facility, considering potential impact of dredge spoil disposal, and positive aspects of relocation and redevelopment of existing City Centre site.

1989

ABU DHABI TOWN PLANNING DEPARTMENT (UAE). Collation of data and identification of development issues regarding environmental aspects of the Comprehensive development plan for the Emirate. Work included reviews of fishery resources, environmental quality, regulation of pollution, and potential for nature conservation.

CONFIDENTIAL CLIENT. Assessment of options for control of biofouling inside the supporting structures of a north sea oil platform.

CRAMP T J/C.1.1

August 1990

WEST MIDLANDS PASSENGER TRANSPORT EXECUTIVE, UK. Environmental impact assessment of two proposed routes for a light rail transit system. Special attention focused on potential habitat disruption and impact on water quality of the canals traversed by the routes.

PIEDA, UK. Non-nuclear environmental assessment of two proposed deep disposal sites for radio-active waste. Consideration of effects of construction and operation on water quality.

EXPERIENCE prior to present employer

1986-1989

Computer modelling of environmental processes and the dynamics of radionuclide transfer in agricultural systems for Associated Nuclear Services, including responsibility for management of codes within the Environmental Assessment Group.

Preparation of specialist literature reviews, and conduct of experimental studies and fieldwork. Work included review of competitive interactions of ion uptake by plants, and recommendations for reducing radiocaesium uptake by crops. Reviews of the dynamics of uranium, nickel and cobalt in soil-plant-animal systems. Review of UK agricultural production systems and element dynamics in young animals. Assessment of occupational exposure limits to toxic chemicals. Experimental studies of transfer of radionuclides to upland plant species. Fieldwork to collect data on the distribution and temporal changes in distribution of caesium from the Chernobyl deposit.

Implementation of Quality Assurance and Working Procedures for compiling literature reviews, writing computer programs, maintaining codes on various machines, and archiving of output, advice on undertaking environmental impact assessments.

1985

Meetings to discuss environmental science studies at KISR, Kuwait.

1981-1985

PhD by research at the Wellcome Marine Laboratory, University of Leeds (UK). Study compared three intertidal sites on a rocky shore showing differing degrees of stress. Multivariate statistical analysis of the free-living nematode communities determined the important physical and biological structuring forces affecting ecological diversity.

1978-1981

University of Southampton (UK). Degree studies in environmental science, including pollution, biological oceanography and ecology courses.

Research project on the dynamics of a polycyclic aromatic hydrocarbon in young oysters.

1978

Smith, Barney, Harris, Upham & Co Inc (USA). Financial analysis.

LANGUAGES

SPOKEN

WRITTEN

READING

English

-- Mother tongue --

NAME OF PERSON G S KASS YEAR OF BIRTH 1964
NATIONALITY British PROFESSION Environmental Scientist
POSITION IN FIRM Environmental Planner
SPECIALISATION IN FIRM Environmental assessment, environmental management, air and water quality studies.

KEY QUALIFICATIONS

- BSc (Hons) Chemistry and Environmental Science (1986)
- Member of the Institution of Environmental Sciences (MI Env.Sc.)
- Graduate of the Royal Society of Chemistry (GRSC)
- MSc in Earth Sciences and Environment (Environmental Management) - thesis carried out on river catchment management.

KEY EXPERIENCE

- Environmental assessment
- River catchment management
- Air and water pollution, ecology and environmental management
- Investigation and assessment of contaminated and derelict land
- Collection and analysis of atmospheric pollution data for UK national monitoring networks
- Assessment of hazards associated with environmental pollutants

EXPERIENCE In Present Employment (from 1987)1987-1990

TEESSIDE DEVELOPMENT CORPORATION. Environmental impact assessment of proposals for a barrage across the R. Tees at Stockton. Hydraulic and water quality studies, assessment of construction impacts and production of Environmental Statement for presentation with Parliamentary Bill.

PIEDA LTD. Technical manager for comparative assessment of non-nuclear environmental impacts to air, noise and water from proposed radioactive waste repository at either Sellafield or Dounreay. Review of existing information and baseline survey for air and water quality.

UK NIREX LTD. Technical Manager for the assessment of non-nuclear environmental impacts from proposals for transportation of radioactive waste materials around the United Kingdom. Air and water quality and ecological assessment.

CEGB. Environmental impact assessment of proposed mining development in Malawi. Baseline monitoring and modelling of air and water quality and meteorology. Establishment of monitoring stations in remote areas and difficult terrain. River-flow measurements for water quality and resource assessment. Sediment and soil sampling for multi-element analysis and radiological modelling.

TECHINT CONSULTANCY, ITALY. Review of environmental impacts arising from sewage-related issues for expansion of Malpensa airport and urbanisation near Milan.

NATIONAL THERMAL POWER COMPANY, INDIA. Environmental management relating to environmental controls for ash disposal mound. Detailed design of baseline and long-term dust and water monitoring schemes.

DYFED COUNTY COUNCIL. Environmental assessment of A484 Llanelli by-pass. Appraisal of air quality, ecological and amenity impacts.

LONDON BOROUGH OF HILLINGDON. Investigation and assessment of contaminated land. Proposals of strategies for reclamation and redevelopment as a nature conservation area.

NURALITE UK LTD. Monitoring of particulates in the workplace for occupational exposure testing.

ICI AGROCHEMICALS. Environmental impact assessment of research station waste incinerator. Emission and dispersion modelling for HCl and dioxins. Assessment of impacts on flora, fauna and humans.

KASS G S/C.2.1
September 1990

PORT GREENWICH DEVELOPMENTS. Environmental impact assessment of proposed housing and commercial development on former gas works site. Measurement of air and noise quality. Modelling of impact of existing and future traffic.

DEPARTMENT OF TRANSPORT, UK. Air quality impact assessment of A13 trunk road improvements. Baseline survey and modelling of air quality taking into account future trends in emission controls. Assessment of nuisance and risks to health from atmospheric pollutants.

DEPARTMENT OF TRANSPORT, UK. Air quality impact assessment of proposed motorway service area on the M40 in Oxfordshire. Preparation of Proof of Evidence for Public Inquiry.

REDLAND AGGREGATES. Investigation of potential for dust emissions from cement and aggregate works. Assessment of local impact and recommendations for control.

ISLAND DEVELOPMENT CORPORATION. Environmental impact assessment of proposed power station at St Helier Harbour, Jersey. Investigation and modelling of air and water pollution from handling of fuel and waste materials.

COOPERS & LYBRAND. Environmental review of proposal for coal-fired power station and bulk-materials handling facilities in Birkenhead, Merseyside. Assessment of sources, dispersion and possible impacts of pollution to air and water from bulk-materials stockpiles.

BASINGSTOKE AND DEANE BOROUGH COUNCIL. Air quality impact of proposed crematorium. Modelling of emissions and likely impact.

KNOWSLEY BOROUGH COUNCIL. Investigation and assessment of ground contamination resulting from past use of an industrial site.

CEGB. Deterministic studies of extreme environmental conditions. Assessment of work on prediction methods for rainfall and temperature extremes based on physical models.

BRITISH GAS. Investigation and assessment of contaminated land at East Greenwich Gas Works site.

PROPERTY SERVICES AGENCY. Investigation and bulk-sampling for determination of environmental hazards.

DEPARTMENT OF THE ENVIRONMENT. Field and laboratory investigations of the effectiveness of portable equipment and investigation techniques for use on landfill sites.

DELYN BOROUGH COUNCIL. Burning waste tip - assessment of combustion abatement techniques. On-site Environmental Safety Officer.

EXPERIENCE Prior to Present Employer

1986-1987 AIR POLLUTION SCIENTIST AT WARREN SPRING LABORATORY. Collection and analysis of ambient air quality data for UK national monitoring networks. Site installation, maintenance and management, quality assurance and quality control including field and laboratory technique standardisation.

1983-1986 UNIVERSITY OF KENT, UNDERGRADUATE PROJECTS. Extensive geological and environmental field studies. Observation of process industries and investigation into potential environmental impacts. Environmental analysis using novel techniques.

LANGUAGES

SPOKEN

WRITTEN

READING

English

-- Mother Tongue --

German

-- Fair --

| | | | |
|-------------------------|---|----------------------|------|
| <u>Name of Person</u> | M MANSELL-MOULLIN | <u>Year of Birth</u> | 1926 |
| <u>Nationality</u> | British | | |
| <u>Position in Firm</u> | Hydrologist | | |
| <u>Specialisation</u> | Hydrologist and Water Resources Planner | | |

Key Data

- World expert on hydrological and water resource studies.
- Extensive experience of regional water resources, project water resources, design and operation, groundwater resources, flood hydrology, urban hydrology, erosion, sedimentation, soil and water conservation, environmental studies and institutional studies.
- Experience in 35 countries worldwide.
- Member of missions by numerous international organisations.

Professional Qualifications

| | |
|------|--|
| 1951 | MA Cambridge University |
| 1956 | DIC London University in Engineering Hydrology |
| 1960 | Companion of Institution of Civil Engineers |
| 1964 | Member of Institution of Water and Environmental Management |
| | Fellow of Royal Geographical Society |
| | Member of British Section of International Commission on Irrigation and Drainage |
| | Member of British Section of International Commission on Large Dams |
| 1983 | Honorary Life Member of British Hydrological Society |

Languages

| | <u>Speaking</u> | <u>Reading</u> | <u>Writing</u> |
|-----------|-----------------|----------------|----------------|
| English | | Mother Tongue | |
| French | Fair | Fair | Fair |
| Urdu | Fair | - | - |
| Chinyanja | Fair | - | - |
| Kurdish | Fair | - | - |

Professional Experience1989

Advising the Allen River Association (Dorset). Heavy public water supply abstractions beside this chalk river are adversely affecting the river's ecology and fishing. I am assisting the Association in its activities to achieve improvements through close liaison with the National Rivers Authority and water supply undertakings.

Sudan. Made initial assessments of the regional surface and groundwater resources in an area of South Darfur and their potential for irrigation developments of different kinds as part of an FAO project formulation mission.

1988-89

Sudan. Development project proposals for village drinking water supplies in an area of South Darfur. Shallow, dug wells constructed mainly by the local communities in wadi alluvial deposits and shallow tubewells in Basement areas.

Made up two UNDP mission visits to South Darfur to plan a rural drinking water supply project for an area of 20,000km² with an average annual rainfall of about 600mm. Proposals for groundwater developments (hand-dug wells and shallow tubewells with handpumps in Basement rocks) linked with sanitation and health improvements were made and a draft project formation report prepared. Community participation was a prime requirement.

1988

Sabah. Visit and assistance to consultants on a major water supply project for Labuan Island, based on abstraction from the tidal zone of the Padas River (8400 sq.km). Sea water intrusion and the effects of extensive forest clearing on the frequencies of low river flows were important part of the studies.

1988

Advice to consultants developing a flood alleviation scheme on the flood runoff characteristics of a 'dry' Chalk valley near the South Coast. Damage had been caused by local flooding in 1980 and 1987, the first on record.

1987

Advising a chalk river protection society in Kent (R Darent) on studies and proposals to alleviate the consequences of exceptionally heavy groundwater abstractions and developments. These have affected all aspects of the river's characteristics, flora and fauna. Liaised closely with the Water Authority and their consultants who were developing a low flow augmentation scheme. Continuing advice reviews and assistance.

1987-88

Oman. Advice to consultants on two flood control dams and schemes in coastal wadi catchments.

PDR Yemen. Leader/member of three UNDP missions leading to a regional rural water supply groundwater project proposal covering about 50 sites and including sanitation and health improvements in a remote, arid desert area. An appropriate workshop and staff infrastructure was planned. Training and community self-help were seen as essential parts of the proposals. Studies to reduce high capital and operating costs of groundwater developments and to avoid the risks of over-grazing near sources were included.

1987

Kenya. Member of dam and project review panel of proposed 65m high earthfill dam for Nairobi water supply.

1987.

India. Member of a World Bank mission to review all aspects of the Hydrology Sector in India and make proposals. Visited a large number of Central Government, State, research, education and other organisations. Examined the situation in parts of the major Godavari river basin before drafting sections of the report and recommendations.

1986

I advised and prepared a full report for a local chalk river protection association in Dorset (R.Piddle). The basin's surface and ground-water resources, the history of water abstractions and use and evidence for changes in the river's conditions were examined. Liaised closely with the Water Authority, who were making major investigations in to all aspects including river flora and fauna; the river being one of the finest spawning nursery streams in the South of England. Continuing advice to improve river conditions.

India. Reviewed the spillway design floods of three large irrigation dams 57-85 m high in Maharashtra and Kerala States for the World Bank. Visited sites and made recommendations.

Iraq. Reviewed the flood histories, reservoir operations and spillway design floods as part of inspections of two major existing dams. Visited both dams.

1985-1986

Cameroon. Visited the Cameroon and advised Atkins on surface and groundwater resources investigations studies for improving the water supplies to two southern towns and water supply master plan, Ebolowa and Sangmelima. ODA.

1985-1986

Iraq Water supply planning studies for Basra. Comparison of alternative sources, including regional groundwater potential. Reviewed the effects of upstream river regulation, water use and irrigation return flows. Water quantity and quality aspects were equally important.

1984

Zambia. Advice and guidance given on the consultant's water resources studies for increasing water supplies to Ndola (1980 population 280,000 persons) in the Copperbelt Province, Zambia. Regional hydrological studies were made to identify alternative schemes and how these could be integrated with the existing surface and groundwater sources. Potential reservoir and intake site yields were estimated after comprehensive data quality control analyses of the limited records. Allowances were made for the effects of man-made influences e.g. trends in nine drainage flows.

1983-84

A groundwater abstraction licence application for irrigation water supplies had been refused on the grounds of the possible adverse effects on one of the Norfolk Broads, designated as a Grade 1 Wetland, on a variety of nature conservation sites and interests and on saline groundwater intrusion. A short study of the complex hydrogeology, drainage and water quality variations was made and field surveys were carried out to reduce important uncertainties. Proposals for the development of an alternative groundwater source were made.

1982-1983

Thailand, Korea. Member of a two-man ADB Formulating Mission to prepare draft Terms of Reference for Consultant Services for the expansion of the water supply systems in 15 cities (1980 population - 7.4 million). Long-term development plans and project feasibility studies were covered. Each city was visited and information on it assembled and reviewed e.g. state of development, population and demand forecasts, water supply system and problems, proposed solutions. Source pollution risks, system leakage losses etc. were identified. Proposals for the organisation and management of the studies and Government's and Cities' inputs were made. The Consultants' outputs, schedules, manpower and budgets were forecast.

Thailand. Member of an ADB Pre-Appraisal Mission to prepare Terms of Reference for basin wide planning studies of the ecologically important, shallow Songkla lake system (Area 1000km²) in Southern Thailand. Urban, water resources, land use, mining, tourism and other developments were adversely affecting the lakes (water quality, sedimentation, saline intrusion, ecology, vegetation), nature reserves, aquaculture and fisheries. The population in the 7000km² catchment area was one million people.

Nigeria, Mambilla. Studies of the conjunctive operation of the hydroelectric reservoirs on the Niger and Benue Rivers with the Mambilla scheme on the Donga River.

1981-1983

Algeria. Greater Algiers water resources master plan studies (12,700 sq. km; 1980 population - 3.2 millions). Several site visits; planned and advised on inventory and conjunctive use studies for water supply and irrigation (estimated year 2010 demands 920 and 740 million cu. m/year respectively) of the region's surface and groundwater resources, requiring precipitation, runoff, flood, river sediment and groundwater studies by project hydrologists. Over 100 possible reservoir sites requiring 30-150 m high dams were studied, nine to feasibility level. Surface and groundwater simulation models were used. The conjunctive use of staged groundwater and surface water schemes was studied, with particular emphasis on the full development of groundwater to defer major capital expenditure funded by IBRD. Project Atkins/Binnies joint venture.

1981

Korea. Member of an ADB Mission to review the feasibility studies of two urban water supply schemes involving the Hoe Ya (30m high) and Gangneung (47m high) fill dams. Made detailed review of the studies with particular reference to diversion and spillway design capacities, reservoir yields and sedimentation.

1979

Peru. Regional groundwater studies, including field investigations and computer modelling, to assess the water supply potential of the aquifers and the layouts and consequences of alternative, possible developments.

1977-1978

Korea. Hydrological Services, Republic of Korea. Project supervisor of a countrywide study to improve the collection, storage, publication and analysis of hydrological information. Countrywide analyses of the main hydrological elements were made and the generalised, IBRD loan.

Brazil. Rio Capim, Belem. Project supervisor of a study to assess the river's potential for barging operations and carried out the hydrological studies, including the effects on low river level possibilities of seasonal forecasting.

1976

Nigeria. Variety of hydrological studies in Nigeria including:

- the Yewa river basin for the Ogun State Water Corporation;
- initial irrigation studies over 2500 km² in Oyo State;
- urban flooding and flood alleviation studies for Akure, capital of Ondo State;
- groundwater resources studies over 90,000 km² of the Basement Complex in Eastern Nigeria;
- adjudication on a dam in Bauchi State;
- advice on irrigation and drainage studies for a 10,000 ha scheme in Imo State.
- Soil erosion and conservation studies, Kenya.

Advised on river transport, agricultural water supplies and other studies in the UK.

Iran, Gol-e-Gohar. Investigations of the water resource in an arid region for a major mine water supply. Groundwater studies involved the drilling and testing of 90 observation and pumping wells.

1975

Pakistan. Lyallpur. Regional surface and groundwater studies, including irrigation canal leakage, for long-term water supply planning.

1974-1975

Saudi Arabia. Wadi Majran Review of surface and groundwater studies, particularly wadi bed recharge, for a 45,000ha flood control and irrigation project.

1971-1973

Nepal. Kathmandu. Studies for WHO of the Valley's water resources and preparation of a master plan for domestic supply and irrigation needs. Surface and groundwater investigations and basin water balance studies.

1971-1972

Kenya. Hydrological studies following field visit for two possible water supply reservoirs near Mombasa, Kenya. and further studies for Nepal (water resources studies for agricultural centres), United Arab Emirates (flood studies), UK and elsewhere.

1969-1970

Malaysia. South-East Johor. Hydrological fieldwork and studies, particularly the consequences of land-use of a 2 800 km² region for multi-purpose development as part of an agricultural, forestry, industrial, mining and urban development master plan. Particular emphasis on flood and sediment yield studies.

1970

Prepared and gave evidence at a public enquiry for the opposers of a proposed chalk groundwater abstraction scheme in Dorset. The licence was not granted by the Minister.

Indonesia. Preparation and presentation of evidence at a Public Enquiry into a proposed groundwater abstraction scheme (Sydling Water, 1971) in England

Member of several appraisal missions for the Asian Development Bank, including:

1969 Consultant

1966-1969

In charge of the work of the firm's department of about 12 hydrologists and of planning their roles in multi-disciplinary teams involved in water resources studies and development throughout the world. Selected schemes from the large number in which he took part in the hydrological fieldwork and analyses include:

- Iran. - Sar Cheshmeh groundwater scheme. Yield of 65 Mld from 15 production boreholes. Subsequently constructed.
- Singapore - Hydrological survey of possible water supply sources.
- Malaysia - Sandakan, Sabah. Groundwater investigations for urban water supply.

1956-1966

Senior hydrologist, London Office.

Responsible for the hydrological aspects of the firm's work in the UK and overseas including hydrological surveys, reservoir design and operation studies, groundwater and river basin developments. Hydrological studies included those for:

- Pakistan - Mangla dam multi-purpose project.
- Malaysia - Malacca river water resources and regulating reservoir studies.
- Hong Kong - Hydrological survey, Hong Kong.
- Malaysia - Hydrological survey, Selangor.
- U.K. - Water resources of the Great Ouse basin.

1956-1959

Iraq. Resident hydrologist. Member of the hydrological survey of Iraq. The survey included comprehensive fieldwork, flood and water resources development duties for the Tigris and Eurphrates river basins.

1959

Joined Binnie & Partners

1954-1955

Ghana. Resident hydrologist carrying out fieldwork and studies for the Volta River project.

1951-1953

hire Valley project, Malawi. Engaged on pre-feasibility topographical and hydrological surveys for multi-purpose water resources development schemes on a 250 km reach of the Shire River.

1951

Joined Sir William Halcrow & Partners

APPENDIX 2

CASE STUDIES AND SUPPORTING DOCUMENTS

ASHFORD GREAT PARK

| | |
|----------|---|
| Country | U.K. |
| Client | Northern England Development Associates |
| Location | Ashford, Kent |

WS Atkins & Partners were commissioned to contribute to an Environmental Statement on Ashford Great Park Development covering all aquatic aspects including surface water disposal, flood alleviation works, sewage disposal facilities, and effects on the aquatic ecology of the proposed lakes and existing watercourses. The development includes new housing, roads, leisure facilities, lakes, etc. to serve the anticipated demand resulting from the nearby Channel Tunnel and rail terminals.

The proposed development includes the excavation of two lakes of approximately 18.5 and 13.9 hectares. These are to be off-set from the main East Stour River but during flood conditions the river would overflow via a side weir. Provision will be made to maintain a small inflow to the lakes under normal flow conditions. The lakes are to be linked in series, and discharged back into the river further downstream.

The ecological impact of Ashford Great Park Development on the aquatic environment was studied in detail. This included surveys on existing water quality in the East Stour River and tributaries, and on vegetation, invertebrates, and fish in watercourses likely to be affected by the project. An assessment was made of the ecological effects of the proposed development on the aquatic environment including the construction of the two lakes.

Recommendations for lake design and maintenance were given, including control of flow and quality of water discharging to the lakes, aquatic planting suggestions, fish stocking, control of mosquito and fly nuisance, and possible use of the lakes. Methods to minimise disturbance and water pollution during actual construction work were also suggested.

IMPACT OF PIPELINING ON RIVERS

| | |
|----------|----------------|
| Country | U.K. |
| Client | National Trust |
| Location | South England |

Atkins were requested to investigate the potential impact of pipeline crossings on a complex of managed trout and salmon rivers in southern England. The most significant impact was identified as the effect on fisheries biology, particularly on spawning activities for some distance downstream of the crossing. Scheduling of the construction activities was arranged to coincide with the fishery closed season, so as to minimise the effects on riparian owners.

Reinstatement of the riverbanks and riverbeds, and the disposal of dredged spoil, were also highlighted as additional problem areas.

Having identified the potential effects of the crossings, rapid survey techniques were employed to assess their magnitude on riverine ecology. Follow-up studies were instigated to monitor the progress of the bank and bed reinstatement programme; this was continued for two years until recovery was adjudged to be satisfactory.

ENVIRONMENTAL IMPACT ASSESSMENT OF A BARRAGE
ACROSS THE RIVER TEES AT STOCKTON NR MIDDLESBROUGH

Country UK
Client Teesside Development Corporation
Location River Tees at Stockton, near Middlesbrough

Teesside Development Corporation elected to construct and operate a barrage across the River Tees at Stockton, near Middlesbrough, as their principal vehicle for the economic regeneration of the Teesside-Middlesbrough region. The barrage development was designed to consist of a solid structure with movable gates and a control mechanism, such that water would be held upstream at a constant level approximating to that of the mean high water spring tide without increasing the risk of flooding of riverside land. In addition, the barrage was intended to exclude saline water and to cause the river directly upstream to become entirely freshwater in time.

Such a development was presented to Parliament in the form of a Private Members' Bill, entitled 'Tees Barrage and Crossing', and included provision within the structural works for a fish pass designed to Ministry of Fisheries and Food (MAFF) specifications, and a canoe slalom. The Bill also presented details of access road construction as part of the barrage development, and road and bridge works to be located upstream of the barrage.

Although not directly requiring such a document, Teesside Development Corporation decided to commission WS Atkins to conduct an Environmental Impact Assessment with respect to the barrage development primarily and prepare a Statement largely in accordance with the Town and Country Planning (Assessment of Environmental Effects) Regulations 1988. As part of this, Teesside Development Corporation also decided to commission other consultants to handle specific aspects of the work, and set the scope of work in consultation with WS Atkins.

Thus, WS Atkins conducted the ecological assessment and commissioned work in the fields of Public Health, Land Use Planning, and Landscape. Work was also conducted by consultants, at the behest of the client, in the areas of: hydrology - the nature of the aquatic regime and the implications of any changes for outfall operation and bank erosion; salinity; water quality; and groundwater - the nature of any changes and the implications for land drainage and structures. The results of these studies were then taken and used to derive the environmental assessment which was subsequently reported on in the five volumes comprising the Environmental Impact Statement. These volumes included two volumes of the Statement itself, two of Appendices and a Non-technical Summary.

CREATION OF AQUATIC WILDLIFE AREA

| | |
|----------|--------------|
| Country | U.K. |
| Client | Confidential |
| Location | Kent |

Atkins investigated the technical and ecological feasibility of creating an aquatic wildlife area in Kent, for private clients. The development centred on two lakes which were designed for a dual purpose, namely providing recreational fishing facilities and also serving as a roosting/nesting area for wildfowl.

Technical considerations included aspects of river diversion and ultimate water quality after passage through the lake-system so as to be acceptable to Water Authority officials. Possibility of treatment was considered in order to meet any imposed standards. Outline engineering design was included so as to guarantee the appropriate water supply, together with maintaining quality by effecting aeration over a small weir system.

Ecological considerations investigated included:

- o fisheries requirements in terms of species suitability.
- o water quality criteria for successful management of the fishery.
- o planned management for appropriate faunal and floral development.
- o consideration of habitat needs for wildfowl.
- o feeding requirements of major faunal species.
- o on-going management/maintenance requirements to perpetuate the desired ecological balance.

A further major consideration was given to the landscape architecture of the project, so as to blend the man-made wildlife area in with a particularly attractive river valley.

PROPOSED ACCESS ROAD, SEVENOAKS GRAVEL PIT

| | |
|----------|----------------------------|
| Country | U.K. |
| Client | Sevenoaks District Council |
| Location | Sevenoaks, Kent |

Sevenoaks District Council requested the services of WS Atkins' Environmental Consultancy to undertake investigations and provide advice on the ecological impacts of a proposed access road to the premises of the West Kent Cold Store Company at Dunton Green, Sevenoaks. They required rebuttal evidence on ecology to the case made by West Kent Cold Storage Company who wish the road to be included in the local plan.

The proposed road passes adjacent to and impinges into a Site of Special Scientific Interest, and a Wildfowl Rserve. Fieldwork and desk research were carried out in order to draw up a Proof of Evidence to rebut the ecological arguments of the opposing ecologist. Impacts of the road on the ecology of the area included surface water disposal, street lighting, air pollution, noise and vibration, fragmentation of habitats, loss of habitat (especially trees) and disturbance during construction.

WS Atkins provided ecological evidence against the proposed road at the subsequent Public Inquiry.

RESERVOIR DEVELOPMENTS FOR NATURE CONSERVATION PURPOSES

| | |
|----------|-----------------------------|
| Country | U.K. |
| Client | Carmarthen District Council |
| Location | Carmarthen |

An assessment was carried out of two shallow reservoirs for a local authority in South Wales, with a view to developing one as a nature reserve and the other for recreational/boating purposes.

The assessment of the site for a nature reserve involved preliminary site investigation, identification of floral and faunal species present, water quality assessment and sedimentation patterns in the reservoir. This work was carried out in conjunction with Atkins engineers and involved discussions with the West Wales Naturalist Trust.

Advice was given regarding reservoir-bed profiling, suitable to provide deeper areas for protection of fish during climatic extremes. Additionally, proposals were made for the formation of a small spit/island within the reservoir to increase the diversity of habitats, for plants, insects, amphibia and birdlife.

Services related to the costing and engineering feasibility of the project were provided, together with landscape architectural requirements and engineering works necessary for the creation of the recreational facilities in the second reservoir.

RIVER TAWE BARRAGE

| | |
|----------|----------------------|
| Country | U.K. |
| Client | Swansea City Council |
| Location | Swansea |

Atkins investigated the environmental effects and hydraulic performance of a proposed barrage constructed across the River Tawe.

The study was broken into three interrelated sub-sections:

- pollution and eutrophication study
- siltation study
- hydraulic performance.

Mathematical and computer models have been used, and physical modelling is also taking place.

For each sub-section, data were gathered from a desk survey and on-site monitoring. Information thus gathered was used to simulate and calibrate models of the relevant physical processes. Thus potential problems such as heavy rainfall, high silt burden, and accidental toxic spillages were investigated. Contaminated sediments were also subjected to special scrutiny, especially with regard to heavy metal and bacteria. These sediments arose from upstream industrial tailings.

The data were used to model loss in dissolved oxygen tension and build up of other pollutants - particularly during low flow, high pollution input conditions.

A significant part of the study investigated the probability of eutrophic conditions developing and its effects on waters behind the barrage. This part of the study included consideration of nutrient levels, insolation, degree of water stratification and factors such as water movements. Possible control procedures and their effects were also included to determine the overall effect of potential poor quality conditions.

EXAMINATION OF WATER QUALITY IN AN ARTIFICIAL LAKE

| | |
|----------|--------------|
| Country | U.K. |
| Client | Confidential |
| Location | Confidential |

An artificial lake was subjected to frequent changes in water quality. Though primarily used for amenity purposes it was situated alongside reservoirs for municipal supply, and the water table was occasionally in continuum with both. In spring or summer months a heavy algal bloom developed and the water became stratified. Occasional fish kills were reported.

Atkins were asked to examine water quality, and the effect of deoxygenation on fish life. In addition, information was also required on sediments and amenity value.

On site chemical analyses and dissolved oxygen and temperature profiles were measured on several occasions. Observations were made on algal bloom development and the normal flora and fauna. The assessment included examination of sediments and fish life by a team of scuba divers. Computer programs were used to develop contours of depth and sediment type from the survey results.

The investigation showed that excessive nutrients resulted in the production of blooms. Deoxygenation of the lower layer occasionally occurred (leading to fish deaths), but generally the waters were not deep enough to enable a deoxygenated condition to stabilise.

ONSHORE OIL - WATER QUALITY SURVEY

| | |
|----------|---------------|
| Country | U.K. |
| Client | Conoco UK Ltd |
| Location | South England |

As part of an environmental protection programme, Atkins were engaged by Conoco UK Limited to monitor surface water quality adjacent to exploratory oil drilling operations in the south of England. Consideration was also given to the possibilities of localised ecological impact on an adjacent fisheries lake and its feeder streams.

Water quality parameters were measured according to EEC guidelines. These included dissolved oxygen, suspended solids, biochemical oxygen demand, sulphates, nitrogen and oil in water concentrations.

Samples were taken before site establishment and during drilling operations. Ecological studies included assessment of existing vegetation and aquatic macro-invertebrates.

Results showed that the exploratory borehole tests had no demonstrable effects on surface water quality, nor on the associated ecosystem.

CASTELO DO BODE RESERVOIR STUDY

| | |
|----------|-------------------------------|
| Country | Portugal |
| Client | EPAL (Water Supply Authority) |
| Location | Castelo do Bode |

A reservoir, originally created for hydro power purposes and now also used for water supply, was subject to considerable environmental pressures. Atkins were commissioned to examine the environmental issues associated with development options. The priority objectives in this major cooperative project were:

- investigation of the environmental quality of the water in one of the major reservoirs supplying potable water to Lisbon, and an investigation of environmental quality in the catchment area;
- development of activities for environmental protection and conservation;
- definition of strategies for regional planning with respect to developments close to reservoirs;
- formulation of management plans for future multiple uses of the reservoir; including recommendations for the reduction of negative impacts in order to safeguard the long-term use of the water.

The approach involved collation of data on the natural environment, water quality, and existing land use and discharges, sediment and water quality sampling and analysis, and modelling of processes within the reservoir. From this study, an assessment was made of the capacity of the water body to receive effluents and the likely impact of future development in the catchment area.

CHANNEL TUNNEL PROJECT

| | |
|----------|----------------------|
| Country | U.K. |
| Client | Channel Tunnel Group |
| Location | Kent/English Channel |

The WS Atkins Group and Sir William Halcrow & Partners were commissioned to carry out an independent audit of the Channel Tunnel Group - France Manche proposal for the Channel Tunnel project. This included organisation and administration aspects, project function and operations, safety, designs, planning, capital costs, environment, employment, financing, traffic and revenues, operating costs and viability.

The audit was aimed at endorsing, questioning, correcting or amending any statements made or impressions given which were central to the accurate description of impacts. It also confirmed that no significant omissions had been made.

Eighteen technical reports were reviewed in connection with environmental matters covering the site selection, the construction and operation and inland road network. A thorough examination of environmental impact assessment was carried out to identify errors of commission or omission and inconsistencies; where possible relevant observations were made known to report authors so that appropriate amendments could be made to the final copies of reports.

ACHELOOS RIVER TRANSFER SCHEME, GREECE

| | |
|----------|------------------------------|
| Country | Greece |
| Client | Ministry of National Economy |
| Location | Thessaly Plain |

WS Atkins International were commissioned in March 1988, in association with Morgan Grenfell, to undertake an economic, environmental and engineering evaluation of a £2bn project to divert a substantial proportion of the Acheloos river through the Pindos mountain range, to supply irrigation water to the Thessaly Plain.

Up to 1,500 million m³ per annum from the average flow of 2,500 million m³ are proposed to be collected and transferred via 4 major dam sites, 2 in the Acheloos catchment area and 2 in the Pinios river catchment area to the east of the Pindos range. The main objective is to supply the Thessaly Plain, the largest integrated agricultural area in Greece, with an improved and secure surface irrigation supply to permit diversification of crops types and cropping patterns and rationalisation of irrigation management in the area.

The project was therefore split into two sub-areas, firstly the main catchment areas containing the 4 dam sites, each of which is earth or rock-filled and up to 170m in height, and the tunnelling complex that would result in the excavation of 1.5 million m³ of rock spoil, and second, the sub-unit covering the Thessaly Plain agricultural area.

The evaluation consisted of a collation and review of all existing economic, agricultural, engineering and environmental reports associated with the project, together with detailed discussions with the relevant ministries and other government authorities with responsibilities for the project. Field trips to all the main features of the scheme were undertaken and discussions held with regional authorities.

The report was structured to provide:

- an economic evaluation of the project suitable for consideration by the European Investment Bank;
- an outline environmental impact assessment suitable to meet the requirements of EEC Directive 85/337 on the requirements to undertaken environmental assessment of major development projects;
- an appraisal of the structural and irrigation engineering aspects of the various sections of the project, including issues of insurance/task assessment, construction requirements and maintenance programmes.

Recommendations were made on institutional and management requirements and the necessity for a detailed environmental impact assessment were highlighted.

COMPARATIVE ENVIRONMENTAL IMPACT ASSESSMENT OF ALTERNATIVE SITES
FOR HYDRO-ELECTRIC POWER DEVELOPMENT ON THE NILE IN UGANDA

| | |
|----------|--------------------|
| Country | Uganda |
| Client | Kennedy and Donkin |
| Location | River Nile |

As part of an ODA-funded power development study of Uganda, a senior ecologist from the WS Atkins Environmental Consultancy was asked to establish and lead a multi-disciplinary local team to investigate the potential environmental impact of constructing and operating hydro-electric power stations at five alternative locations on the Nile.

Two of the sites are in the south of the country, one being a proposed extension of the existing Owen Falls power-station, the other being a dam 3 km further downstream at Bujagali which would create an impoundment extending back to the foot of Owen Falls dam. Two of the northern sites are within Murchison Falls National Park, one of them close to the Falls themselves. The third northern site is just to the east of the Park, close to Karuma Falls. The northern schemes all differ in engineering design: Murchison being a dam/impoundment with underground power station, Ayago being a 'run-of-river' scheme also with underground generating hall, and Kamdini (Karuma) having an integral dam and power station with impoundment.

The strong geographical differences between the sites meant that the studies had to consider the potential impact on a wide range of environmental resources ranging from urban settlements, through forestry and rural agricultural areas to National Park savannah. Baseline studies of ecology and environmental quality were conducted at each site, and the detailed assessments were carried out relating all aspects of the construction and operation of the given scheme to all elements of the local environment.

Finally, a comparative assessment of sites/schemes was made, and the ameliorative measures recommended to minimise adverse impacts were summarised.

W S ATKINS WATER - RIVER STUDIES 1987-1990

| Name of Project & Country | Client | Type of Work & Services provided |
|---|---|---|
| River Tawe Tidal Barrage. Wales | Swansea City Council | Tidal Barrage Scheme. Investigate all water quality and hydrodynamic aspects of the barrage using both physical and mathematical models. |
| Colombo Canal Study. Sri Lanka | World Bank | Study of the Canal drainage system. Mathematical modelling of the extensive canal network and full social impact assessment. |
| Truro Barrage. England | Carter Commercial Development | Tidal Barrage Scheme. Evaluation of the effects of a proposed barrage scheme on flood levels and water quality. |
| Ashford Great Park. England | Ashford Great Park(Phase I) Ltd | Development adjacent to river system. Mathematical modelling of the two river system and flood storage reservoirs using MIKE11 |
| River Calder Flood Study. England | PROBE | Development of existing washland areas. Mathematical modelling of the river and flood plain network using MIKE11. |
| River Beane Flood Study. England | Confidential | Development adjacent to river system. Mathematical modelling using MIKE11 to identify flood levels. |
| Deptford Creek. England | Confidential | Tidal Barrage Scheme. Mathematical modelling of upstream effects of the proposed barrage on water quality and flood levels using MIKE11. |
| River Dane Flood Study. England | Confidential | Development adjacent to river system. Mathematical modelling of river to assess the effects of loss of washland and diversion of river channels. |
| River Adur: Tidal Reaches and East Branch | National Rivers Authority Southern Region | Comprehensive Catchment Study. The study is to investigate the effects of extensive development within the catchment. A mathematical model of the entire river and tidal network is being developed using the MIKE11 system. |
| River Dane: Morphological Study, England | Confidential | Assessing the effects of a proposed development and channel works on the sediment transport at the site itself and in the upstream and downstream reaches. |
| Avon Barrage Bristol, England | Bristol Development Corporation | Tidal Barrage Scheme. Feasibility study for a proposed barrage on the River Avon at Bristol. This includes assessments of the impact on ecology, water quality, recreation, groundwater, flood defence, sedimentation and navigation. A mathematical model of the river system is being developed using the MIKE11 system. |

W S ATKINS WATER - RIVER STUDIES 1987-1990 CONT'D

| Name of Project & Country | Client | Type of Work & Services provided |
|---|--|--|
| Hydrological and Hydraulic Study, Wiltshire, England | Confidential | The study is to investigate stormwater disposal from a new development. This includes hydrological analysis of the development and adjacent rivers and identifies the balancing requirements. |
| Investigation of New Main Rivers in the Trent Catchment England | National Rivers Authority - Severn-Trent Region | The study is to investigate three river systems in the Trent catchment: the River Ryton, River Tean and Lyme Brook. This includes topographic and descriptive surveys and full hydrologic and hydraulic modelling of all the rivers using MIKE11. Flood damage assessment and cost: benefit analysis will also be carried out. |
| River Pool Hydraulic Study England | Confidential | Development adjacent to river system. Mathematical modelling using MIKE11 to identify flood levels. |

CASE STUDY: RIVER ADUR, SUSSEX – COMPREHENSIVE CATCHMENT STUDY

WS Atkins were commissioned by NRA Southern Region to carry out a comprehensive study of the River Adur catchment in West Sussex. The river drains an area of approximately 500km² through a large number of tributaries. An important feature is the tidal section which is embanked and extends nearly 20km inland from the mouth at Shoreham. The catchment is predominantly rural although there are developing areas around the headwaters at Burgess Hill, Hurstpierpoint and Hassocks. The primary aim for the study was to assess the existing flooding risk and the effects of future development.

The study included the following elements:

- Extensive topographical survey
- Hydrological analyses
- Development of a comprehensive catchment model

The mathematical model of the river network was set up using the MIKE 11 computer system. The model analysed the full effects of flood routing, flood plain storage, backwater profiles and the interface between tidal variations and flood flows.

Some details of the model include:

- 15 river branches
- Over 20 subcatchments
- Total river length of some 80 km
- 15 hydraulic structures



River Adur Catchment



River Adur

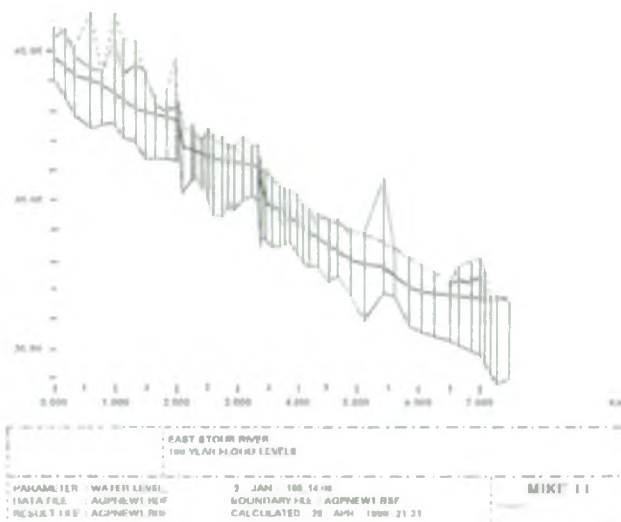
CASE STUDY: EAST STOUR RIVER

WS Atkins were commissioned to advise a developer on the technical issues associated with a large development in Kent. The scheme lies in the catchment of the East Stour River and the Ruckinge Dyke and it was known that part of the site was subject to flooding. The study was therefore required to identify the frequency and extent of flooding, the effects of the development and to identify suitable flood alleviation options.

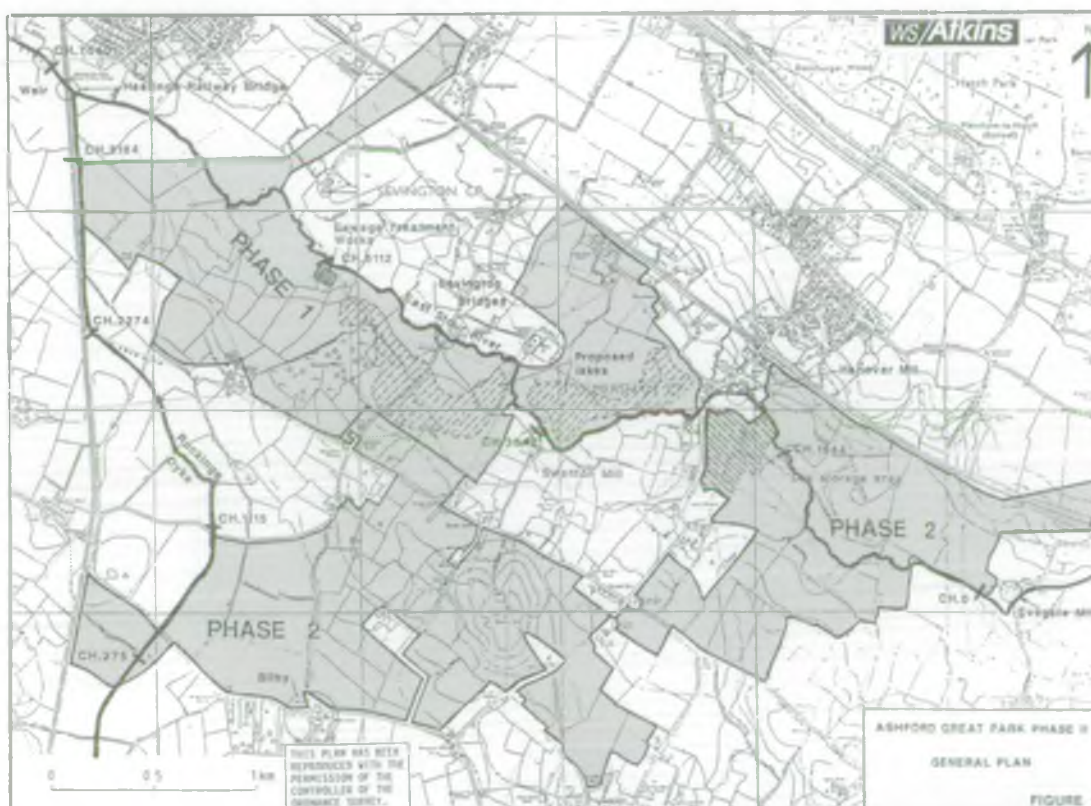
The study involved the following main elements:

- Topographical survey of river channels, flood plains and structures
- Hydrology, including the effect of the development on surface water runoff
- Computer model of the river network hydraulics, including old mill sluices and bridges, using the MIKE 11 package
- Use of the model to assess alleviation options including wet and dry flood storage schemes

The project included discussions and negotiations with the National Rivers Authority and resulted in an agreement which allowed the authority to withdraw its objections to the development.



MIKE 11 Water Level Profile



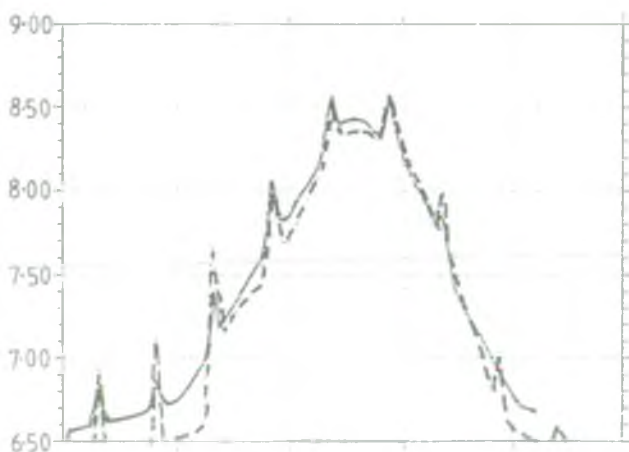
General Plan

CASE STUDY: RIVER AVON BARRAGE SCHEME, BRISTOL

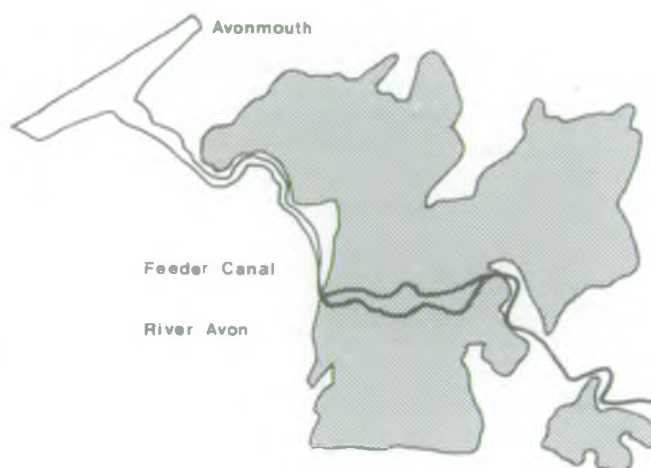
WS Atkins were commissioned by the Bristol Development Corporation to study the feasibility of constructing a barrage across the River Avon. The barrage is intended to maintain a constant upstream water level thus enhancing the visual amenities of the adjacent development areas.

The aims of the study were:

- To consider the likely impact of the barrage on:
 - Flooding risk
 - Water quality
 - Ecology and environment
 - Groundwater
 - Siltation
 - Navigation
- To recommend an appropriate conceptual design
- To prepare outline cost estimates
- To assess the legal aspects of construction



Model Calibration



Development area

A mathematical model of the river and harbour system was developed using the MIKE 11 computer program. This was used to assess not only the risks of tidal and fluvial flooding but also the impact of the barrage on water quality and siltation. The hydrodynamics of the area are complicated with a tidal range of up to 14 metres and river flows varying from nearly zero to 550 m³/sec. The model took account of these variations and demonstrated that the barrage was feasible and defined the parameters to be considered in the conceptual design.



Netham Dam, River Avon

ENVIRONMENTAL HYDRAULICS CAPABILITIES

WS Atkins Water offers advanced analysis and prediction of engineering related hydraulics in the natural environment.

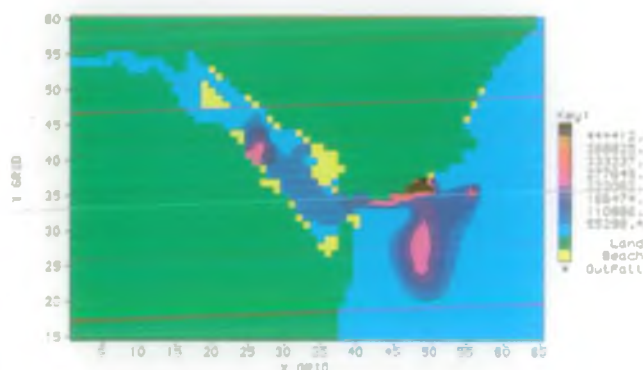
- Coastal Waters
- Estuaries
- Rivers
- Barrages
- Lakes and Reservoirs

Many planning and design studies require an appreciation of hydraulic and related processes in order to identify and minimise environmental impact.

WS Atkins has the experience and technical facilities necessary to solve a wide variety of engineering problems using computer and physical models.

Recent projects include:

- coastal and estuary dispersion
- prediction of tidal flow
- river flow, and water quality modelling
- barrage scheme analysis
- scour/sedimentation studies
- flood routing
- reclamation schemes
- dam break analysis
- environmental data acquisition and analysis
- port and harbour developments



Prediction of estuarine pollutant dispersion



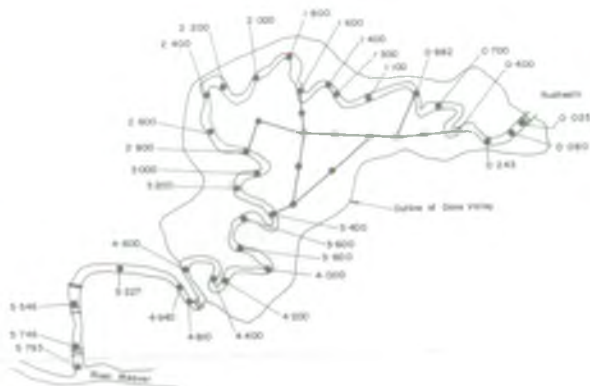
Numerical modelling of Dubai Creek provided a cost effective assessment of the effects of a proposed reclamation scheme

CASE STUDY: THE RIVER DANE AT NORTHWICH

WS Atkins were commissioned to report on the hydrological, hydraulic and morphological aspects of the River Dane at Northwich in Cheshire in association with a large proposed residential development. The development was within the historic flood plain and analyses were required to ensure that the risk of flooding downstream was not increased by the development.

The study involved the following main elements:

- **Hydrological study to identify the magnitude and duration of flood events. This involved analysis of gauging station records and use of the Flood Studies Report**



Model representation of existing river system



Extent of flooding for the 100 year return period event

- **Topographical survey of river channels, flood plains and structures**
- **Development of a computer model of the river hydraulics using the MIKE 11 modelling package. This included the main channel and a quasi-2D network representing the extensive flood plain**
- **Assessment of the effects on the sediment transport regime and longer term morphological changes**

The project included discussions with the National Rivers Authority and the final report was used as evidence at the Planning Enquiry.

CASE STUDY: TRURO RIVER BARRAGE SCHEME

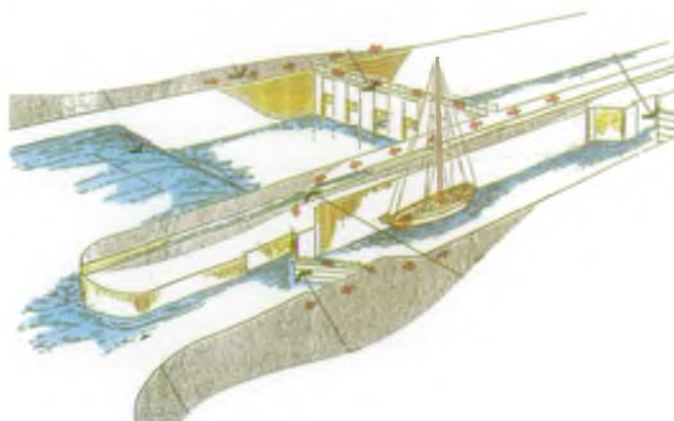
WS Atkins were retained by a developer to evaluate the feasibility of a barrage scheme and associated housing and marina development on the Upper Fal estuary at Truro.

The feasibility study included assessment of the following aspects:

- Flood levels from river discharge and tidal action
- Required hydraulic performance of the structure
- Water quality implications
- Ecological factors
- Navigation

Detailed discussions with interested bodies were taken into account before submission of the proposed scheme for outline planning permission.

LOCK, WEIR AND TIDAL DEFENCE STRUCTURE



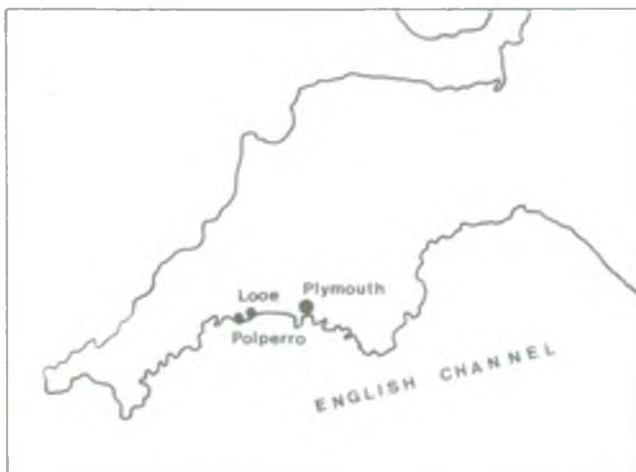
Artists impression of the barrage structure



Upper Fal estuary, Truro

CASE STUDY: PORTWRINKLE COASTAL REGION – WATER QUALITY MODEL

WS Atkins performed an extensive environmental survey and mathematical modelling study of the Portwrinkle coastal region on behalf of South West Water. The objective was to develop, validate and supply a water quality model which could be readily used by designers, planners and environmentalists to evaluate alternative outfall and discharge configurations as part of an overall scheme to improve the water quality in the area.



Location Map of Study Area

The water quality model is based on the Atkins program TIDEFLOW and the Danish Hydraulic Institute program SYSTEM 21 which have been developed for coastal flow modelling.

The model is structured in the same way as other similar models provided to South West Water by WS Atkins. The 200m local model covers an area between Pencarrow Head and Rame Head.

The model performs hydrodynamic calculations and pollutant dispersion and decay at each model timestep. A maximum of 15 parameters can be included in each run. These include current speed, current direction, water surface elevation, salinity and temperature, but any 10 of the following may be added:

- Dissolved oxygen
- Biochemical oxygen demand (fast and slow)
- Ammoniacal nitrogen
- Nitrite nitrogen
- Nitrate nitrogen
- Total organic nitrogen (fast and slow)
- Phosphate
- Total Coliforms
- Faecal Coliforms
- Soluble metals
- User defined pollutant 1
- User defined pollutant 2

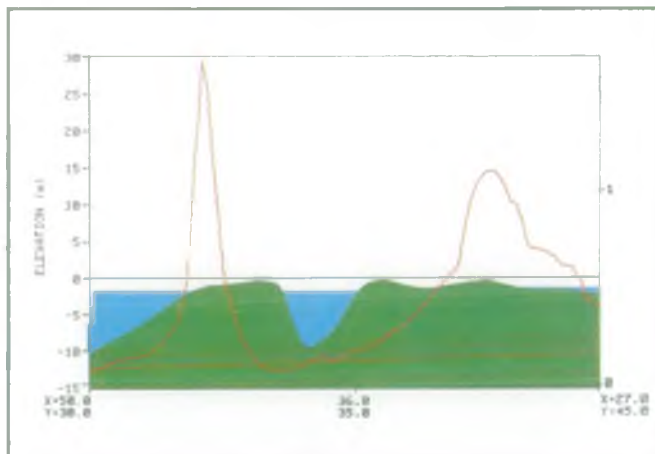
The extensive field survey provided data for validation purposes as well as to permit an assessment of the present condition of the estuary.



Looe Estuary

CASE STUDY : RIVER EXE ESTUARY – WATER QUALITY MODEL

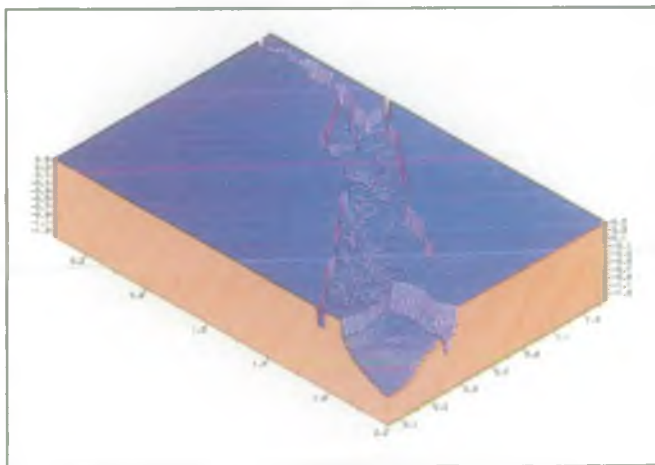
WS Atkins Engineering Sciences was retained by South West Water (SWW) to develop, validate and supply a water quality model of the River Exe Estuary and surrounding coastal region. The objective was to provide SWW with a suite of programs which could be readily used by designers, planners and environmentalists to evaluate alternative outfall and discharge configurations as part of an overall scheme to improve the water quality in the area.



Cross section of pollutant levels

The water quality model was based on the Atkins ES program TIDEFLOW and included several important features:

- Modelling of up to 15 parameters simultaneously
- Interaction and decay of pollutants
- Advanced User Interface for ease of use
- Colour graphics with video option
- Report quality print out
- Inclusion of wind effect on boundary conditions
- Accurate modelling of intertidal areas
- Numerically non-dispersive advection scheme



3 Dimensional bathymetry plot of the Exe Estuary

CASE STUDY : RIVER EXE ESTUARY – WATER QUALITY MODEL (Cont'd)

The model is capable of considering pollutants as well as the hydrodynamic parameters. A maximum of 15 parameters may be included in any run and where appropriate their interactions and decay rates are included in the calculations. The parameters available within the model are:

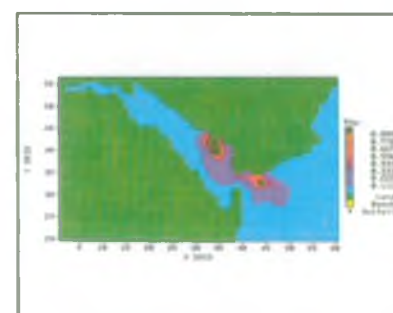
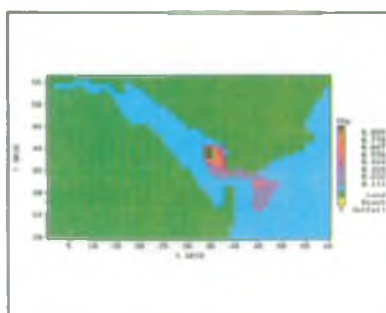
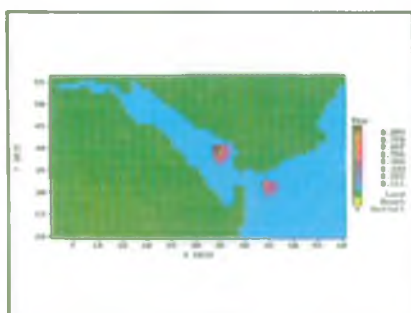
The project involved an extensive field survey to provide data for validation purposes as well as to permit an assessment of the present condition of the estuary. The following parameters were measured:

- Tidal height
- Current speed
- Current direction
- Salinity
- Temperature
- Total coliform
- Faecal coliform
- Algae
- 2 user defined parameters

- Dissolved oxygen
- Biochemical oxygen demand
- Sediment oxygen demand
- Organic nitrogen
- Ammoniacal nitrogen
- Nitrite nitrogen
- Nitrate nitrogen
- Phosphate

- Tidal height
- Current speed
- Current direction
- Salinity
- Temperature
- Suspended solids
- Bathymetry

- Dye dispersion
- Nutrients
- Bacteria
- Dissolved oxygen
- Biochemical oxygen demand
- Benthic species



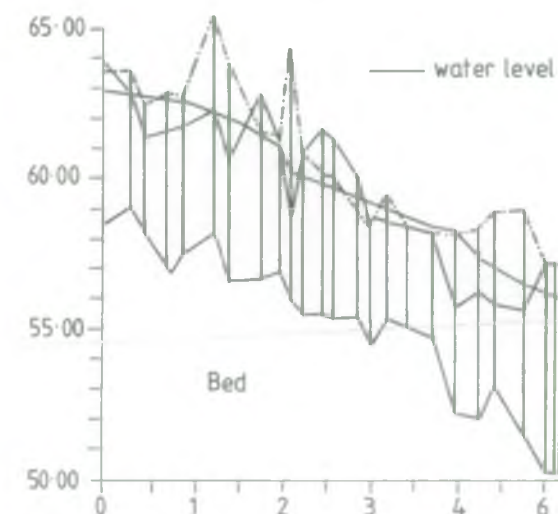
Sequence of pollutant concentrations within the estuary

CASE STUDY: RIVER CALDER FLOOD STUDY

WS Atkins were commissioned to investigate part of the River Calder upstream of Brighouse near Leeds. Survey data for the river channel and flood plains was collected and a hydrological assessment carried out for the catchment. A hydraulic computer model of the river network was developed using the MIKE 11 river modelling system.

The model included the following interesting features:

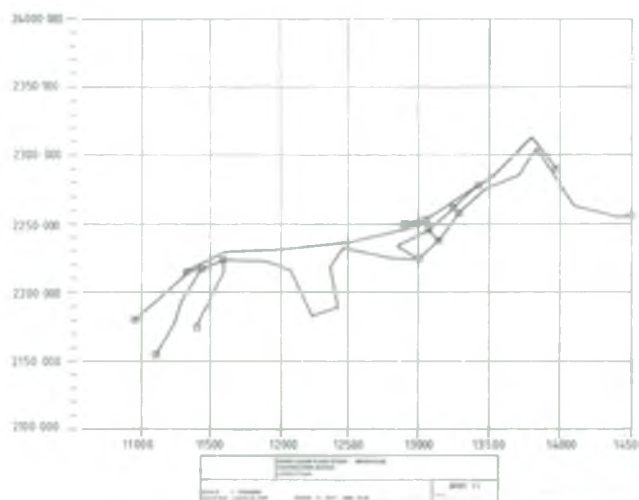
- Extensive interconnection of channels and flood plains
- Quasi-2D modelling of flood plain cells
- Old masonry arch bridge
- Several weirs including a gauging station



| | | | |
|--------------------------------------|-------------|-------------------------------------|---------|
| RIVER CALDER FLOOD STUDY - BRIGHOUSE | | | |
| EXISTING CONDITIONS | | | |
| CALIBRATION FOR 1967 FLOOD EVENT | | | |
| PARAMETER | WATER LEVEL | 13 - JAN - 1, 98 00 | MIKE 11 |
| DATA FILE | 11EXCAL.RDF | BOUNDARY FILE - 1967CAL.BSF | |
| RESULT FILE | 1967CAL.RPF | CALCULATED - 11 - OCT - 1999, 09:48 | |

MIKE 11 Water Level Profile

Unsteady flow analyses were carried out and the model calibrated against observed flood data. The effects of proposed and historic developments in the flood plain were assessed as part of the planning requirements. The model was used to investigate a proposed 150,000m³ flood storage area and to examine various inlet spillway arrangements.



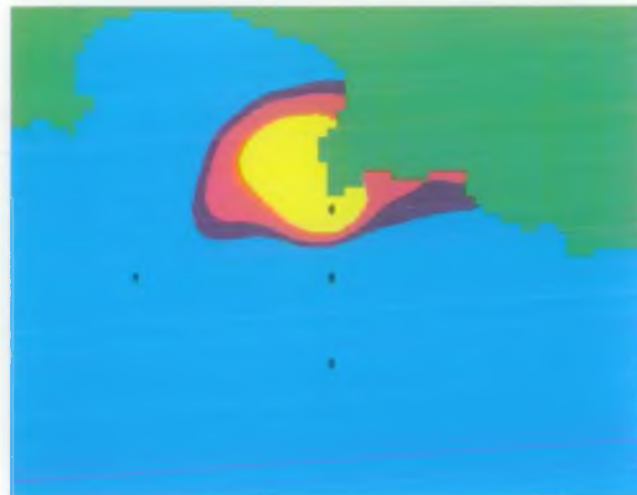
MIKE 11 Layout Plan

CASE STUDY: ST AUSTELL COASTAL REGION – WATER QUALITY MODEL

WS Atkins performed a mathematical modelling study of the St Austell coastal region on behalf of South West Water. The objective was to develop, validate and supply a water quality model which could be readily used by designers, planners and environmentalists to evaluate alternative outfall and discharge configurations as part of an overall scheme to improve the water quality in the area.

The water quality model is based on the Atkins program TIDEFLOW and the Danish Hydraulic Institute program SYSTEM 21 which have been developed for coastal flow modelling.

The model is structured as a series of nested grids. The coarsest 3km grid extends over the English Channel from Land's End to Eastbourne, extending to the French coast. A 1000m Bay grid model extends from Lizard Point to Lyme Regis, whilst a 200m local model covers the study area between Dodman Point and Neland Point.



Contour Plot of Pollutant Discharge

The model includes several important features:

- Modelling of up to 15 parameters simultaneously
- Interaction and decay of pollutants
- Advanced User Interface for ease of use
- Colour graphics with video option
- Report quality printout
- Inclusion of wind effect on boundary conditions
- Accurate modelling of intertidal areas
- Numerically non-dispersive advection scheme
- Plume model to calculate 3-dimensional distributions from buoyant jets and plumes

A maximum of 15 parameters can be included in each run. These include current speed, current direction, water surface elevation, salinity and temperature, and any 10 water quality parameters.

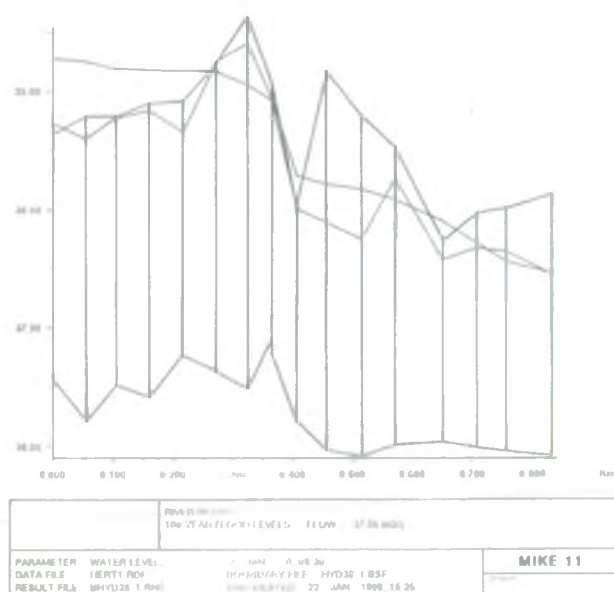
The project included an extensive field survey to provide data against which the model was validated.



Location Map of Study Area

CASE STUDY: RIVER BEANE FLOOD STUDY, HERTFORD

WS Atkins were commissioned to investigate the flood levels on the River Beane in Hertford in the vicinity of a proposed development site. A flood alleviation scheme had already been constructed to a 70 year protection standard and the study was required to assess flood levels that would be experienced during a 100 year flood event.



MIKE 11 Profile Plot



Location Plan

The MIKE 11 modelling package was used to develop a hydraulic model of the river incorporating irregular weirs and a siphon overflow structure. Hydrological assessments of the magnitude of return period flows were made and the model used to predict the flood levels. Sensitivity analyses were carried out for both channel roughness factors and the discharge coefficients of structures to establish their effect on the predicted values.

Srinagar/Dal Lake Environment Project India

Client: **Overseas Development Administration**

Srinagar is the chief city of Kashmir in Northern India, with a population of more than half a million. It faces major urban management problems, including chronic under-investment in utilities, a plethora of agencies responsible for development and regulation and a rapidly growing population with rising aspirations concerning sanitation, health and the environment.



These problems are made even more urgent because of the rapid environmental degradation of the adjacent Dal and Nagin Lakes, caused mainly by pollution from the major population centres, but to a lesser extent by people who live and work on islands created artificially in Dal Lake.



We were appointed by the ODA to formulate and appraise a set of projects designed to jointly solve the problems of basic services provision and of lake pollution. The study team was also asked to consider proposals made both by the State government and by a consortium of UK companies. The team included a sociologist, water and sanitation engineers, an economist, public health expert and environmentalist.

The sociologist first examined the socio-economy, population, housing and service provision in the city. Detailed studies were then conducted of housing areas experiencing particular problems with sanitation and community health. Existing low cost sanitation schemes and health programmes and their potential for broader replication were considered. At the same time we examined the sustainability of proposed sewerage systems, their institutional requirements and the need for public education and participation in service delivery and maintenance.

A particular study of lake dwellers was also undertaken and recommendations were made for reducing their negative impacts on the lake. Finally, the institutional context of urban development was considered and measures proposed to strengthen capabilities.

Water Supply, Sanitation and Surface Water Drainage Project Sri Lanka

Client: **National Water Supply and Drainage Board**



This work formed part of a much wider study of sewerage and surface water drainage within the area of Greater Colombo. The aim of the social study was to determine whether surface water drainage components could be justified within the project by the World Bank, on the grounds of their contribution to the enhanced welfare of the urban poor in Colombo.

The results of the investigation into two areas chosen for study indicated that a wider ranging investigation had to be made of the whole of Colombo rather than concentration on the Municipality. This resulted in the inclusion of the major canal system in the study as this forms an important part of the city's overall drainage problem. The banks of the canals were occupied by the shanty towns of the very poor resulting in major difficulties in maintenance.



Field study was made of the extent and distribution of the poorest sectors of the urban population and of their environmental problems relating to clean water provision, sanitation and sewerage needs, and rainwater and waste water runoff. The results of this work were integrated with other water related development programmes.



Efficient maintenance of the canals required the relocation of the shanty town dwellers in order to gain access. We identified further maintenance difficulties caused by drainage problems in areas to which the authority had no access. Exact relocation requirements for each settlement were proposed as part of the engineering programme. The settlements needing to be wholly or partially demolished were identified and the appropriate relocation or site and service schemes proposed and costed together with basic utility requirements.

Hydrogeology and Water Resources of the Greater Manah Area Sultanate of Oman

Client: **Public Authority for Water Resources**

Due to increased demands in the Greater Manah area, the Public Authority for Water Resources commissioned us to carry out a detailed study of the water resources of the region. Previous investigations were evaluated and a programme was set up for geological field work, geophysics, water sampling and chemical analysis, test drilling and aquifer pump testing.

The geological surveys showed that the alluvial cover was thin and that the alluvium was underlain by

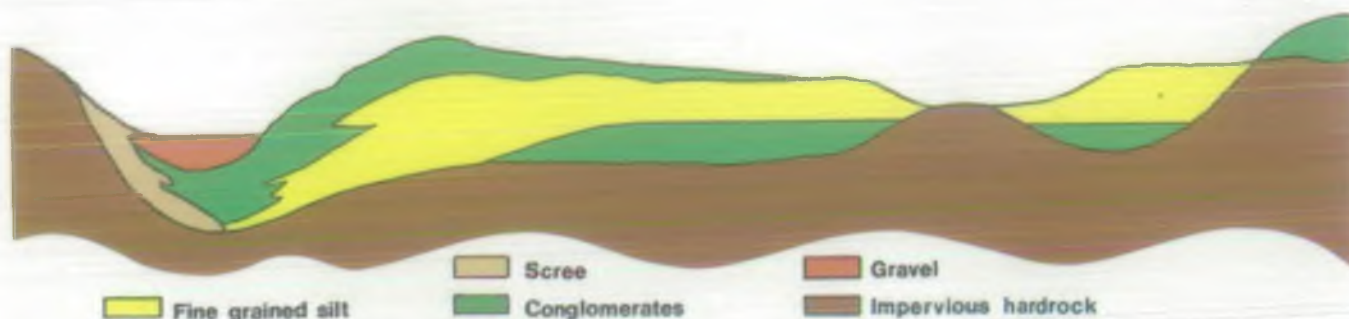


impervious hardrock of various formations. Only in buried wadi channels could significant quantities of water be expected for exploitation. To locate the buried channels a programme of geophysical investigations was undertaken. Electrical resistivity soundings and constant separation electrical traverses were used to locate the optimum sites for test drilling.

Test drilling was carried out to evaluate the aquifer characteristics by aquifer pump testing. A detailed examination of the recorded surface flows was needed to be able to understand the interaction between surface water and groundwater.

A study of the groundwater chemistry was also used to evaluate areas of good potential. Some parts of the region have unacceptably high salinities whilst others are hyperalkaline and encrust pumps and screens with carbonate material. This hyperalkaline water is derived from the mantle sequence of rocks in the area.

The final requirement was to calculate how much groundwater was safely available for use. A mass balance approach was adopted to obtain this result. As the buried channels are essentially separate systems each system required an independent survey.



Water Resources Impact Study: Open-Cast Lead/Zinc Mine India

Client **Hindustan Zinc Limited**

The Rampura-Agucha lead/zinc mine is to be an open-cast pit operation producing 3000 tonnes of ore a day for 25 years. The excavation will eventually be 200m deep and about 1 kilometer long. A concentrator is to be located on the site with associated tailings disposal dams.

Three aspects of the water resources were investigated as part of an environmental impact assessment:

- impact of the mine and its operation
- impact of the wellfield to supply the mine
- establish baseline conditions

The mine site is a peneplain of metamorphic rocks that were judged unlikely to yield large quantities of water into the pit. However, the threat of monsoon rainfall run-off flooding the pit was thought to be high. As any water in the pit would become contaminated suitable disposal measures were recommended. These were aimed at reducing pollution risks to the environment and increasing the water available for processing activities.

The problems likely to arise from rainfall on the waste dumps were assessed as the waste has a high ratio of available lead and zinc which could be leached out. Therefore, means of stopping leachate infiltration to groundwater and runoff to surface sources were proposed.

Pollution risks from the tailings dam were assessed and recommendations made about the disposal design concepts. These included thickeners to reduce water content of tailings, impermeable liners to the bunds, re-use/recycling of all decant water and monitoring networks to detect any pollution that might occur. Advice on appropriate designs were also submitted for construction of the dam.



The Rampura-Agucha region is semi-arid with no perennial streams or rivers. The required water supply of 4 million cubic metres per year was to be obtained from groundwater. Previous investigations attempted to show that sufficient water was available in a thin, narrow band of alluvium. Reassessment by WS Atkins of existing data showed this was not likely to be the case. Insufficient resources existed to supply the mine without causing serious derogation of supplies to local farmers. During any drought period the supply to the mine could not be guaranteed. Further investigations were recommended to establish where groundwater could be obtained safely and protection measures were devised to reduce interference from and to local farmers.

A monitoring programme was established to determine what the baseline water quality conditions of the area were and a monthly water level monitoring network was set up to further investigate the alluvial water source for the mine.



Ndola Long Term Water Study Zambia

Client: **Ndola Urban District Council**

We carried out a long term water study including a water master plan and a feasibility study for the city of Ndola (population 300,000). The annual rate of population increase is 4.5 per cent and water demand is rising accordingly.

For the water master plan, future water demands were estimated and compared with the combined capacities of existing water sources and current development of the Misundu and Bwana Mkubwa schemes.

A hydrological study was carried out to determine the yields of the various rivers in the area. Available data was analysed to determine flood and drought frequencies on each of the rivers and hence reservoir and dam sizes at various sites on the Kafulafuta and Kafubu rivers.

Following selection and client approval of the most suitable scheme — Lower Kafulafuta, a feasibility study and outline design was undertaken to provide cost estimates and construction timetables for the various elements of the scheme.

The implications of the additional amount of water supply on the proportionate increase of sewage effluent and its disposal was examined. The management and staffing of the water supply and sewerage function of the Ndola Urban District Council were also reviewed.



APPENDIX 3

LETTER OF INVITATION



Geoffrey Robinson
Flood Defence Manager
MA (Oxon) C.Eng. MICE MIWEM

Our ref. DJM/FD10.5
Your ref.

National Rivers Authority
Southern Region

J Brindley Esq
W S Atkins Consultants Ltd
Woodcote Grove
Ashley Road
Epsom
Surrey KT18 5BW

| | |
|------------------------------|------|
| WS Atkins Consultants | |
| WATER Division | |
| For / PM | |
| 15 AUG 1990 | |
| To act | |
| Reply | File |

13 August 1990

To see: Copy to:

Dear Mr Brindley,

River Catchment Management Plans

With reference to our earlier communication on the above subject in early 1990, the NRA Southern Region is now in a position to proceed with its pilot exercise to prepare River Catchment Management Plans. I enclose the following additional papers which should be added to those which you received last January.

1. Revised draft Brief for Consultants.
2. Eurwg Catchment Management Plan Phase 2 'Resolution of Catchment Problems'.
3. NRA Southern Regional Handbook.

Item 2 is a further stage in the work done by the NRA Welsh Region relating to the fictitious River Eurwg. Please let me know if you require further copies of the papers previously sent.

We are proposing to hold a short, informal discussion of the documents and any initial proposals, questions, etc. you may have at this office on Friday 24th August. Please 'phone me to arrange a suitable time.

Yours sincerely,

D J Martin
Regional Planning Engineer

enc



Made with Recycled Fibre

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APPENDIX 4

TERMS OF REFERENCE

NATIONAL RIVERS AUTHORITY
SOUTHERN REGION



NRA

RIVER CATCHMENT MANAGEMENT PLANS
BRIEF FOR CONSULTANTS

Revised August 1990

TABLE OF CONTENTS

1. General Overview
2. NRA Mission Statement and Aims
3. Brief
4. Details of first set of catchments to be studied.

NATIONAL RIVERS AUTHORITY
SOUTHERN REGION

RIVER CATCHMENT MANAGEMENT PLANS

BRIEF FOR CONSULTANTS

1. GENERAL OVERVIEW

Introduction

The National Rivers Authority (NRA) is a new national body which has taken over the regulatory and protective functions relating to the water environment. These functions were formerly exercised by the regional water authorities. The NRA's Objectives are appended; those relating to its primary functions come under one of the headings of Environmental Protection (which includes Water Quality, Fisheries and Conservation) Water Resources and Flood Defence (formerly known as Land Drainage and Sea Defence). The Southern Region of the NRA now wishes to engage consultants to help with the preparation of River Catchment Management Plans (RCMPs) within the Region.

Purpose and Benefits

Recognising the close interaction and potential conflict between its functions, the NRA has fixed on the individual river catchment as the basic building block for Corporate Planning. River Catchment Management Plans will accordingly:

- a) collate information on the existing situation in terms of standards achieved, uses of water and land associated with it
- b) be a vehicle for consultation with interested external organisations
- c) resolve conflicts in relation to uses,
- d) be a basis for consistent NRA response to external demands and
- e) communicate NRA local policies to the general public
- f) help secure resources for development of the Plans.

Procedure

It is expected that the procedure will be refined in the light of consultants' proposals and early experience, but initial thoughts are:

- 1. Identify all current and likely future uses of the catchment in general terms.
- 2. Obtain current data on catchment condition for all functions.
- 3. Identify requirements as far ahead as we can reasonably foresee and functional targets separately for each use.

4. In consultation with NRA staff, collate the requirements, identifying likely problems and conflicts.
5. Outline management options for consideration by the NRA.

The outcome of the above will then be released for public consultation as the RCMP Phase 1. Following comment and discussion, agreed solutions will be published as a formal RCMP Phase 2 which will be a plan of actions, by the NRA and others, for the catchment and a programme, costs and targets for the first 5 years.

Experience of Welsh Region

A considerable amount of preparatory work has been done by the Welsh Region of the NRA. This includes the preparation of a trial RCMP for a fictitious catchment, the "Eurwg". Documents prepared by the Welsh Region are appended for information. It should however be noted that the Welsh model has been prepared in the context of conditions, pressures etc. in their Region and some change of emphasis is appropriate for the Southern Region. Nevertheless the depth of study represented by the Welsh model will be required; the specific functional requirements for the Southern Region are given in Section 3.

S.24 Survey Records

Following the requirements of S.24 of the Water Act 1973 regional water authorities were each required to prepare a "Survey of Existing Water Use and Management". The preparatory work for this was carried out in the Southern Water Authority in the late 1970s and the Survey published in 1980. The volumes and plans relating to this will be available to the successful consultant(s).

Requirements

Proposals are invited from suitably experienced consultants for the execution of the following tasks.

1. Assemble required information, from both internal and external sources, for the preparation of RCMPs Phase I for specified catchments (see Section 4).
2. Prepare RCMPs Phase 1 showing management options to achieve targets: the NRA-preferred option will normally be made evident.

This is the limit of work required initially, but it is anticipated that the consultant will then be asked to:

3. Prepare presentational material on the draft Phase 1 Plans
4. In association with NRA staff carry out formal public consultation on draft Phase 1 Plans.
5. Prepare RCMPs Phase 2 incorporating agreed plans and programmes for action.

Appraisal of Proposals and Payment

Consultants should submit their proposals for the preparation of RCMPs Phase 1 for six catchments, paired together as shown in Section 4. They should not assume that Plans for all six catchments will be done by a single consultant, but are welcome to submit alternative proposals and estimates based on their preparing Plans for more than one pair of catchments.

Proposals should comprise at least the following elements:

Outline method statement for executing the work.

Examples of relevant diagrammatic, graphic and mapping output.

CVs of key staff who will be responsible, showing the relevance of their qualifications and experience.

Schedule of inclusive rates for their services.

Estimate of the total cost of preparing each pair of Plans based on an estimate of staff time (which should be quoted) at the scheduled rates plus an allowance for expenses etc.

Proposals will be appraised and the successful consultant(s) selected on the basis of a combination of the above. The lowest estimated total cost will not be the sole consideration.

Timetable

Representatives of consultants shortlisted will be invited to a short informal discussion of this Brief in August. Following that, the timetable will be as follows:

| | |
|--------------------|---|
| 24 September 1990: | Submission of consultants' formal proposals |
| 8 October 1990: | Notification of successful consultant(s) |
| 31 March 1991: | Presentation of RCMPs Phase 1. |

13 August 1990

RCMPBrie.DJM

2. NRA MISSION STATEMENT AND AIMS

MISSION STATEMENT

The National Rivers Authority will protect and improve the water environment. This will be achieved through effective management of water resources and by substantial reductions in pollution. The Authority aims to provide effective defence for people and property against flooding from rivers and the sea. In discharging its duties it will operate openly and balance the interests of all who benefit from and use rivers, ground waters, estuaries and coastal waters. The Authority will be businesslike, efficient and caring towards its employees.

AIMS

1. To achieve a continuing improvement in the quality of rivers, estuaries and coastal waters, through the control of water pollution.
2. To assess, manage, plan and conserve water resources and to maintain and improve the quality of water for all those who use it.
3. To provide effective defence for people and property against flooding from rivers and the sea.
4. To provide adequate arrangements for flood forecasting and warning.
5. To maintain, improve and develop fisheries.
6. To develop the amenity and recreational potential of waters and lands under NRA control.
7. To conserve and enhance wildlife, landscape and archaeological features associated with waters under NRA control.
8. To improve and maintain inland waterways and their facilities for use by the public where the NRA is the navigation authority.
9. To ensure that dischargers pay the costs of the consequences of their discharges, and as far as possible to recover the costs of water environment improvements from those who benefit.
10. To improve public understanding of the water environment and the NRA's work.
11. To improve efficiency in the exercise of the NRA's functions and to provide challenge and opportunity for employees and show concern for their welfare.

3. BRIEF

Referring in Section 1 - General Overview to the paragraph 'Procedures', the requirements of the consultant in preparing RCMPs Phase 1 may be summarised as:

1. Identify USES, actual and potential
2. Establish PRESENT STATE of the catchment
3. Set TARGETS for the future state of the catchment in relation to actual and potential uses.
4. Identify PROBLEMS and CONFLICTS
5. Set out MANAGEMENT OPTIONS for the achievement of targets and the resolution of problems and conflicts.

Uses

The following possible uses have been identified:

- Basic Amenity
- General Ecosystem Conservation
- Special Conservation Areas (eg. SSSIs)
- Salmonid Fishery
- Cyprinid Fishery
- Commercial Fishery
- Commercial Shellfishery
- Angling
- Boating
- Immersion Sports (incl. Bathing)
- Potable Water Abstraction
- Industrial Abstraction
- Agricultural Abstraction
- Water Transfer
- Mineral Working
- Solid Waste Disposal
- Industrial Effluent Disposal
- Sewage Effluent Disposal
- Surface Water Drainage of Urban Development) including Flood
- Surface Water Drainage of Agricultural Land) Protection
- Wet Fencing and Livestock Watering
- Water Power (including Mill Rights)
- Flood Water Storage
- Navigation

The consultant will need to identify which of these uses is relevant to the particular catchment or reach under study. Some information from outside the NRA will be required, eg. local authority development plans.

Present State

The consultant will need to establish the present state of the river and catchment in relation to sets of parameters associated with each NRA function. Normally the seaward limit for the plan will be where it joins open sea. Rivers where this is not clear are given a more specific limit in Section 4.

1. Water Quality

This will be based on suites of Environmental Quality Standards relating to use. The majority of these are given in the Annexes to relevant EC Directives. The present state will be the record of compliance with these.

Most of this information is available within the NRA Southern Region.

2. Conservation

The present state relates to the preservation of water quality and flow within the relevant targets shown in Section 4.4 of the Welsh Region's Eurwg document. Information is mostly available within the NRA Southern Region.

3. Fisheries

Assessment of the present state requires the compilation of a database showing the presence of cyprinid and salmonid fish and eels. Much information is available within the NRA Southern Region, but information will also have to be obtained from outside fishery interests.

4. Resources

Assessment of the present state of the catchment will encompass:

- a) Geological/hydrogeological data, including waste disposal sites and mineral workings.
- b) Resource areas with long term average availability in relation to demand.
- c) Residual resources and groundwater recharge
- d) River flow parameters at key stations: 95 percentile, indices of low flow etc.
- e) Groundwater levels
- f) Licensed and other protected abstraction rights for public water supply, industrial and agricultural purposes (including fish farms and cress growing)
- g) Resource controls: minimum residual flows, prescribed compensation, augmentation and maintained flows. Groundwater controls.

5. Flood Defence

Performance measures and standards for Flood Defence are at present the subject of discussion and study within the function across the country. Different measures and standards were inherited from regional water authorities and the need for harmonisation is clear. Table 1 shows the interim measures and standards currently in force. These are based on those in use in the Thames Region, and consultants' proposals should be based on them.

Assessment of the present state of the catchment will therefore require the consultant to:

- a) Identify and classify land at risk from flooding into the broad use classes set out in Table 1. Information will come from current Ordnance Survey data, but some reference to Structure and Local Plans may be required. In some catchments (particularly the R. Medway and R. Stour) the NRA main river is fed by extensive subsidiary drainage systems operated and maintained by Internal Drainage Boards (IDBs). Liaison with these IDBs will be necessary in such cases.

- b) Identify areas of land where use is dependent on pumped drainage or where levels are critical for gravity drainage.

- c) Establish present level of river maintenance activity and assess effectiveness

This will require information from Flood Defence operational staff at the locations shown in Section 4.

- d) Establish present level of flood protection for each of the areas identified in (a)

This will require obtaining historic flood discharge and level data from NRA hydrometric records and elsewhere and/or obtaining data for the determination in broad terms of the rainfall and run-off characteristics of the catchment. From these it will be necessary to determine the extent and level of flooding for events with the return periods mentioned in Table 1.

- e) Review current local flood forecasting and warning procedures.

6. Navigation

A statutory navigation right exists over a considerable length of the non-tidal R. Medway, and common law rights exist up to the tidal limits on other rivers. Boating as a recreational activity may be a use on other river lengths. Assessment of the present state for this function will need to establish the adequacy of levels and flows for the purpose.

RIVER CATCHMENT MANAGEMENT PLANS : FLOOD DEFENCE

TABLE 1 Land Use Bands and Target Standards of Service

| <i>Land Use Band</i> | <i>Description of Typical Land Use</i> | <i>Target Standard of Service</i> |
|----------------------|---|--|
| A | A reach containing the urban elements of residential and non-residential property distributed over a significant proportion of its length, or densely populated areas over some of its length. Any agricultural influence is likely to be over-ridden by urban interests. Amenity uses such as parks and sports fields may be prominent in view of the floodplain's proximity to areas of population density. | These heavily built-up areas should be protected to a standard such that the risk of flooding in any one year is no greater than 1 in 50. In some areas, higher standards may be applied. |
| B | Reaches containing residential and/or non-residential property either distributed over the full length of the reach or concentrated in parts but characterised by lower densities than Band A. | Buildings should be protected to a standard such that the risk of flooding in any one year is between 1 in 20 and 1 in 50. However, agricultural or amenity land found in these areas could remain susceptible to regular flooding. |
| C | Limited numbers of isolated rural communities or urban fringe at risk from flooding, including both residential and commercial interests. Intensive agricultural use could also be included. | The chance of flooding property in any one year would be between 1 in 10 and 1 in 50 years. Agricultural or amenity land, however, could be susceptible to more regular flooding. |
| D | Isolated, but limited numbers of residential and commercial properties at risk from flooding. Agricultural use will probably be the main customer interest with arable farming being a feature. In undeveloped pockets of largely urban use, amenity interests may be prominent. | Agriculture and amenity land in this band should be protected to a standard such that the chance of flooding or prolonged bankfull events in any one year, at a time when crops are normally susceptible to damage (ie March to October inclusive), is between 1 in 2 and 1 in 5. |
| E | There are likely to be very few properties and major roads at risk from flooding in these reaches. Agricultural use will be the main customer interest with either extensive grassland or, where the flood plain extent is small, arable cropping being the most common land uses. Amenity interests are likely to be limited to public footpaths along or across the river. | Agricultural land in this category could be susceptible to yearly waterlogging and/or flooding, possibly occurring on several occasions throughout the year. Protection should be maintained to a standard which reduces the risk of either type of event to between one and three times per year at a time when crops are normally susceptible to damage. |
| F | Any area to which a lower standard of service is offered for environmental or economic reasons. | |

Targets

Taking into account:

- a) NRA national Aims and functional strategies,
- b) current uses and likely future demands,
- c) the present state of the catchment as set out above,

the consultant will be required, in consultation with NRA staff, to set targets for the future state of the catchment. These may encompass:

1. Water Quality targets: these will be based on Water Quality Objectives related to use. A Master Objective will be derived for each reach.
2. Targets for Resource availability in relation to forecast demands (including level and flow in the river): these may involve modifications to surface and groundwater abstractions, new reservoirs, flow augmentation from groundwater, effluent recharge to aquifer. The revision or ultimately revocation of licences may be considered.
3. Targets for flood protection according to Table 1 land use classification: these would include the consideration of policies for responding to development proposals, capital investment and possible changes in maintenance activity.
4. Targets for the maintenance or establishment of fisheries.
5. Targets for positive conservation enhancements: this is additional to consideration of the conservation implications of projected changes under any other heading.
6. Targets for the maintenance or establishment of water-based recreation.
7. Targets for flood forecasting and warning.

Targets for other functions and uses (eg. Navigation) may be appropriate for some catchments.

In all cases it is envisaged that the targets for the general parameters of water quality, level and flow will be based on the ruling requirements of the use requiring the highest standard.

Conflicts and Problems

Notwithstanding the last paragraph above, there will be cases where the 'ruling requirement' principle is not applicable, i.e. where different uses have directly conflicting requirements. In addition, there will be cases where, although the target may be clear-cut, its achievement may not be readily feasible. In such cases, the RCMP Phase 1 will identify the conflicts and problems, and outline management options for their resolution.

Management Options

In some cases it is envisaged that a set of policies for the future management of a catchment will fall easily out of the RCMP Phase 1 exercise. In these cases Phase 2 will involve simply the public presentation of a clear-cut plan and programme to external interested organisations and the general public. In cases where there are conflicts and problems however, the options for catchment management will be the subject of extensive consultation of the external organisations, before a definitive plan and programme are drawn up.

Presentation of Phase 1

RCMPs should be brief, presenting key data only, self contained and well illustrated with line drawings, diagrams and synoptic maps.

The primary medium for presenting the data will be maps. In general one sheet, preferred size A3, will cover each of the uses listed above where these are relevant to the catchment. It may be possible to combine two or more of the more straightforward uses on one sheet. Diagrams will also help to illustrate such features as the catchment's response to flooding events, the operating characteristics of installations, prescribed flows, inward and outward water transfers etc. If necessary, back-up data on particular aspects will be the subject of a separate and more detailed report for internal use.

Requirements will vary between catchments depending on the uses, but the following data as a minimum will also need to be recorded on maps:

1. Location of the catchment in the Regional context.
2. River map showing main topographical features and relevant installations with major impact (e.g. abstractions, discharges, transfers).
3. Administrative boundaries.
4. Geology/hydrogeology.
5. Areas of flood risk according to Table 1 classification.

Geographical Information Systems

The NRA Southern Region is not yet equipped to cope with a computer-based Geographical Information System, but proposals for the submission and handling of data by computer will be welcome.

Modelling

It is not envisaged that the level of information required will necessitate modelling. The consultant may however choose to recommend this if it is seen as necessary for the definitive planning in Phase 2.

Research and Development

In any areas where the Phase 1 RCMP studies shows that knowledge is inadequate, the consultant may recommend that research should be undertaken. This encompasses research both into the principles and practice of catchment planning, as well as into the attributes of specific catchments.

4. DETAILS OF CATCHMENTS

Plans are to be prepared for the following six catchments, paired geographically. In each case the location of the NRA District Office with operational responsibility for the catchment is given.

| | | |
|--|-------------|------------|
| River Medway (to Rochester Bridge) |) | |
| |) | Tonbridge |
| River Darent and Cray (including |) | |
| Dartford Creek to the Barrier) |) | |
| River Stour | (Kent) | Canterbury |
| River Rother | (E. Sussex) | Rye |
| River Itchen (to new Itchen Toll Bridge) |) | |
| |) | Winchester |
| River Test (to railway bridge at Totton) |) | |

For details of NRA organisation and location of District Offices, see Guide to Southern Region.

DJM/JB
13 August 1990

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