Project 407

Review of Fluvial R & D - Topic C1: Supporting Information

Binnie, Black and Veatch

R & D Project Record 407/3/N & Y

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NRA

National Rivers Authority

Review of Fluvial R&D - Topic C1: Supporting Information

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R&D Project Record 407/3/N&Y

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APPENDIX D

CURRENT FLUVIAL R&D PROJECTS

- UK Organisations
- Overseas Organisations

APPENDIX A

PROJECT INVESTMENT APPRAISAL

. Objectives

Overall Project Objective

To identify and prioritise a strategic NRA research programme in the specific area of Fluvial Defences and Processes and to ensure that the NRA's programme interfaces with other external and internal R&D programmes.

Specific Objectives

1. To appraise the UK and overseas state of knowledge on the relevant subjects, and the research programmes being undertaken or projected for these subjects.

2. To determine both the actual and perceived gaps in knowledge, resulting in recommendations for research or, in the case of imaginary gaps, identifying where dissemination of information or training might be appropriate.

3. To recommend areas, with priorities, where further research is needed and indicate where possible the cost/benfits.

. Background

Under Section 105 of the Water Resources Act 1991 the NRA has a duty to exercise general supervision over all matters relating to flood defence. Flooding arising from inland rivers as a result of heavy rainfall represents a significant proportion of these activities. Capital and Revenue work programmes undertaken by the NRA on fluvial flood protection amount to some £100 million annually.

The key elements of Topic C1 are to provide an understanding of engineering hydrology and river channel hydraulics and to ensure that river structures or man-made river channels are functional, flexible in concept, harmonise with their environment and are cost effective.

The NRA needs to undertake a strategic overview of this area of work in order to identify

1. its further R&D requirements;
2. the present state of knowledge;
3. the related programme of R&D
4. the dissemination of knowledge which will best address the gaps in knowledge

Context

Mr Thompson will need to take account of NRA reports on flood channel facility {C01(90)2}, sediment and gravel transport review {C05(90)1}, phase A/B flood channel facility manual {C01(90)1}, fluvial management practices, review of coastal defence R&D {C06(91)5}, review of catchment appraisal control R&D {C03(91)4}, flood forecasting models {C02(90)3 and 1991 MAFF review.

The review will also liaise with the similar review of conservation R&D undertaken by Nigel Holmes of Alconbury Consultants (NRA Contact Point is Paul Raven).

Strategy

Method

a. Review background documents to determine how the NRA interpret their statutory duties in this area of flood defence.

b. Consultations with senior staff in each region plus Head Office.

c. Identification of the NRA's interest in each area regarding such items as river hydrology, hydraulics, structures, engineering design, data, management and maintenance and conservation.

d. Development of subject headings to include data, techniques, procedures etc and the linkages between them. This will enable every R&D item to be seen in context.

e. Appraise the UK and overseas knowledge on the relevant subjects and the research programme being undertaken or projected for these subjects.

f. Hold "brainstorming" meeting with senior flood defence and selected conservation staff.

g. Determination of both the actual and perceived gaps in knowledge, which would result in recommendations for research or in case of imaginary gaps, identifying where dissemination of information or training might be appropriate.

h. To recommend areas where R&D is required with an indication of cost/benefits and the priorities. This will include drafting the initial appraisal of selected priority projects.

i. Produce draft report

j. Produce final report.

APPENDIX B

REGIONAL STAFF CONSULTATION

NATIONAL RIVERS AUTHORITY Job No 4176

REVIEW OF FLUVIAL R&D RELATED TO FLOOD DEFENCE

CONSULTATIONS WITH SENIOR STAFF - BRIEFING NOTE 14.10.92

1. Introduction

1.1 Binnie & Partners have been appointed to carry out a review of the NRA's Flood Defence R&D programme for Topic C1 - Fluvial defence and processes. The principal subject headings within this topic are:

- hydrology
- hydraulics
- fluvial models
- sediment supply and transport
- river structures (including river banks).

1.2 The main objective of the project is to identify and prioritise a strategic R&D programme for the topic, taking note of other R&D work that is being carried out both within the NRA and externally. Specific objectives are:

- to appraise the UK and overseas state of knowledge on relevant subjects and the research programmes being undertaken or proposed;
- to determine actual and perceived gaps in knowledge, resulting in recommendations for research or (for imaginary gaps) dissemination of information or training;
- to recommend areas where further research is needed, assign priorities and indicate, where possible, costs and benefits.

1.3 The approach to the study is:

i) review background documents to determine NRA's duties and obligations;

ii) hold consultations with senior staff in each region and HQ to identify areas of interest and concern with regard to the subjects covered by the topic;

iii) develop a framework of subject headings for the topic, showing the linkages between them so that every R&D item can be seen in context;

iv) appraise UK and overseas knowledge and R&D programmes on the relevant subjects;

v) hold "brainstorming" meeting with senior flood defence and conservation staff;

vi) determine actual and perceived gaps in knowledge and recommend areas where further research is needed.

1.4 The study is to be completed by end-December 1992 with the regional consultation meetings being carried out in late October - early November. This note is intended to provide background information to the NRA staff who will be attending these meetings to ensure that the liaison will be as productive as possible while minimising the demands on time.

2. NRA's Duties, Obligations and Aims

2.1 A note describing the NRA's duties, obligations and aims with regard to flood defence and R&D is attached as Annexe A and is the main source for the following comments.

2.2 Various sections of the Water Resources Act (1991) place the following statutory duties on the NRA:

- to exercise a general supervision over all matters relating to flood defence;
- to have regard for, enhance, conserve and preserve the water environment;
- to make arrangements for the carrying out of research and related activities (whether by the Authority or others) in respect of matters which impinge on the functions of the Authority.

2.3 In response to these duties the NRA has developed the following specific aims in relation to flood defence:

- to provide effective defence for people and property against flooding from rivers and sea;
- to provide adequate arrangements for flood forecasting and warning;
- to prevent the creation or extension of flooding risks by influencing control over new development.

Other NRA aims having a bearing on flood defence but not directly associated with it are:

- to develop the amenity and recreation potential of water and land under the Authority's control;
- to conserve and enhance wildlife, landscape and archaeological features associated with water under NRA control;
- to improve and maintain inland waterways and their facilities for use by the public where the NRA is the navigation authority.

2.4 The NRA do not appear to have made any specific statement concerning the aims of its R&D programme. By inference, however, these aims are:

- to support its policy development;
- to improve its ability to carry out its statutory duties;
- to improve its efficiency or effectiveness in carrying out its business;
- to increase its general knowledge and understanding, particularly of the aquatic environment.

2.5 The NRA has stated that its R&D needs should be set principally by its mainstream technical and scientific staff, in its different functional areas, as the end-users of research. The programme should therefore be directed towards applied research with specific objectives, undertaken to gain the knowledge needed to develop specific products, processes or systems,

and experimental development drawing together this knowledge and practical experience to produce new or improved products, processes, systems, services or procedures. Very often what is required is not a high-level technical appreciation of a problem but a guidance on how to use presently available knowledge more effectively.

2.6 When considering individual projects the NRA have determined that they should be assessed on the basis of the estimated costs and benefits that will accrue to the NRA. This can be difficult to determine, however, and the following qualitative criteria may also be used:

- the problem addressed should significantly affect the efficiency or effectiveness of the NRA;
- it relates to national policy issues or is relevant to most regions;
- the relevance of the problem addressed is unlikely to diminish in the future;
- the results can be applied over a wide range of situations and are not site-specific;
- it does not duplicate other research and the objective could not be achieved without the NRA's involvement.

3. NRA's Current R&D Programme

3.1 The NRA's current R&D programme comprises a total of 136 on-going projects with a further 109 proposed new starts over the next 5 years, together having a total estimated cost of about £22M. The projects are organised in 7 Commissions, listed in Table 1. The distribution of projects and estimated cost by Commission are shown in Figures 1 and 2.

3.2 The flood defence related projects (those in Commission C) are organised in 6 Topics, given numbers from 1 to 8 omitting 5 and 7. These are listed in Table 2 and the distribution of projects and estimated costs shown in Figures 3 and 4. There are a total of 30 on-going projects and 17 new starts over the next 5 years with a total estimated cost of about £2.85M. Of these 8 on-going projects and 2 new starts costing a total of £0.58M are related to Commission C1. These projects are listed in Table 3.

4. Previous Reviews of Fluvial R&D

4.1 As part of an appraisal for the future programme for SERC open channel research carried out in 1991, all NRA regions were sent a questionnaire and asked to indicate the need for R&D work to be carried out in each of 28 subject areas. The results of this survey are attached in Table 4.

4.2 In 1992 MAFF appointed an Advisory Committee to report on future objectives, opportunities and priorities for Flood and Coastal Defence Research and Development. Chaired by Peter Ackers the Committee had members with formal representation and liaison roles with all relevant bodies. It was divided into three working groups covering:

A Coastal defence and protection
B Fluvial protection and land drainage
C Socio-economic and operational issues.

Each working group divided their subject into a number of R&D areas, listed in Table 5, and identified desirable projects within this framework. A total of 59 projects were identified in

Subject B, listed in Table 6.

5. Framework for Consultations

5.1 Given the objectives of the present study (outlined in Section 1 above), the consultations need to address the following questions:

1. What is the most appropriate framework for the R&D work to be carried out under Topic C1?

2. What are the links between the various items in this framework and between these items and items in other topics and commissions?

3. What are the subjects in which R&D work is needed and how do these subjects fit into the framework?

4. What priorities should be attached to R&D work in each of these subjects?

These questions need to be considered in the light of NRA's assumed aims with regard to R&D, outlined in Section 2.4 above.

5.2 To provide a starting point for the consultations a possible framework is given in Table 7, which is divided into four parts. This is based upon four main themes into which the work associated with the topic may be divided:

C1(a) Developing methods of determining the response of river catchments to meteorological events;

C1(b) Developing methods of predicting in- and out-of-channel flows and water levels at all times;

C1(c) Developing methods of designing and constructing efficient, economic and appropriate structures for controlling flows and protecting against water levels;

C1(d) Identifying ways of improving the efficiency and effectiveness of carrying out these tasks.

In broad terms, Theme A is concerned with hydrology, Theme B with hydraulics, hydraulic modelling and sediment transport, Theme C with river structures and Theme D with information transfer and training.

Table 1 NRA R&D Commissions

A	Water quality
B	Water resources
C	Flood defence
D	Fisheries
E	Recreation and navigation
F	Conservation
G	Cross-functional

Table 2 Topics for NRA R&D Commission C - Flood Defence

C1	Fluvial defences and processes
C2	River flood forecasting
C3	Catchment appraisal and control
C4	Operational management
C5	Not used
C6	Coastal and tidal processes
C7	Not used
C8	Response to emergencies

Table 3 Project in NRA R&D Topic C1 - Fluvial Defences and Processes

Ref No	Title
On-going projects	
CO1(90)1	SERC flood channel facility (Phase 2)
CO1(91)2	Infiltration methods for run off control
CO1(91)3	Large-scale model investigation of a two-stage channel
CO5(91)3	Design and operation of trash screens
CO5(91)3	Stabilisation of earth embankments - soil nailing
CO5(91)1	Sediment and gravel transportation
CO5(91)4	Pumping stations - efficiency, operation and life cycle costs
CO1(91)1	Rainfall frequency studies
Proposed new start	
CO5(91)2	River bank erosion protection
CO1(92)1	Review of fluvial R&D related to flood defence

Table 4 SERC Flood Channel Facility Review March 1991

Response to Questionnaire by NRA regions : March 1991

Responses from 11 questionnaires maximum of 55 points

Each respondent was asked to indicate the importance of his own work of R&D in each topic area.

Rank	Score	Subject
1	46	Bank erosion
2	45	Flood flows estimation
3	45	Capacity of multistage channels
4	43	Maintenance of gravel beds
5	42	Channel siltation
6	41	Capacity of channels with inundated berms
7	40	Local scour
8	39	Capacity of channels with single bank working
9	38	Bed degradation
10	37	Capacity of channels with islands
11	37	Deposition of polluted sediments
12	36	Capacity of inbank flows
13	36	Debris - in channel
14	36	Debris - on screens
15	35	Control of inbank sedimentation
16	34	Water quality in environmentally enhanced channels
17	34	Resuspension of polluted sediments
18	33	Dispersion of polluted sediments
19	32	Flood zoning
20	31	Capacity of braided channels
21	30	Dispersion - inbank flows
22	28	Velocity related damage
23	28	Silt related damage
24	26	Control of attached algae
25	24	Capacity of artificial channels
26	20	Siltation of flood plains
27	17	Reservoir siltation
28	17	Dispersion - flood flows

Table 5 MAFF Advisory Committee Report - Main R&D Areas

A	**Coastal Defence and Protection**
A1	Offshore and inshore forcing processes
A2	Surf zone processes
A3	Coastal zone morphodynamics
A4	Soft engineering
A5	Hard engineering
A6	Materials and resources
A7	Asset management
B	**Fluvial Protection and Land Drainage**
B1	Precipitation
B2	Flood hydrology
B3	Hydraulics and morphology
B4	Environmentally sensitive management
B5	River engineering
C	**Socio-economic and Operational Issues**
C1	Project appraisal
C2	Operations management
C3	Scheme design
C4	Economics

ANNEX B: FLUVIAL WORKING GROUP R&D PROPOSALS			Priority	Cost £000	Category	Duration years
Precipitation	B1.1	Daily rainfall archiving	1	3000	D	>5
	B1.2	Radar/forecasting of severe local storms	1	400	ONB	2
	B1.3	Quantitative interpretation of radar data	1	600	BONF	2
	B1.4	Radar archiving and data retrieval for planning	1	350	DON	>5
	B1.5	Radar-derived spatial rainfall statistics	2	300	DNB	2
	B1.6	Flood modelling incorporating snowmelt and remotely sensed data	2	100	ONP	2
	B1.7	HYREX: hydrological radar experiment	3	2500	FOB	>5
Flood hydrology	B2.1	Urban growth hydrology	1	440	FNM	3
	B2.2	Monte Carlo and threshold simulation	1	315	NOM	3
	B2.3	Continuous simulation for flood frequency designs	2	150	NB	3
	B2.4	Water level records in near estuary reaches	2	80	DNM	2
	B2.5	Flood-plain digital terrain data studies	2	150	DOP	2
	B2.6	Snowmelt modelling for flood forecasting	2	30	NO	1
	B2.7	Sheet runoff from over-grazed land	3	90	FE	3
	B2.8	Eulerian and Lagrangian studies for rarer storms	3	60	BND	3
	B2.9	Artificial intelligence for rainfall-runoff model choice	3	100	BO	2
Hydraulics and morphology	B3.1	Computational hydraulic models	1	750	NBO	>5
	B3.2	Out-of-bank flow measurement by advanced methods	1	250	FB	>5
	B3.3	Post-project appraisal	1	20	FM	1
	B3.4	Resistance of channels and flood-plains	1	500	BPN	>5
	B3.5	Sediment mechanics and morphology	1	240	BPE	3
	B3.6	Education and training	1	180	MOE	3
	B3.7	Field measurements of flood discharge	2	210	FPM	3
	B3.8	Hydraulic performance of structures	2	150	BLF	3
	B3.9	Floods and pollution	2	180	BLF	3
	B3.10	Statistical assessments	2	150	BNM	3
	B3.11	Instrumentation	2	100	FLD	2
	B3.12	Revetments	2	150	FLOM	2
	B3.13	Expert systems	3	200	NMO	>5
Environmentally sensitive management	B4.1	Management of bankside vegetation	1	150	FEO	3
	B4.2	Assessment of river restoration: review practice	1	240	EFO	3
	B4.3	Assessment of river restoration: use of PHABSIM	1	210	FNE	3
	B4.4	PPA: timescale, success of enhancement projects	1	210	FEPO	3
	B4.5	Techniques and materials: two stage channels	1	375	FEP	3
	B4.6	Management of aquatic veg: extent of weed problem	1	60	FEO	2
	B4.7	Hydraulic performance of environmentally preferred river channels	2	20	M	1
	B4.8	Role of artificially created wetlands	2	420	EPO	3
	B4.9	Water level variation and flood-plain impacts	2	60	FEP	2
	B4.10	Relationship between field and controlled water levels	3	60	FEO	2
	B4.11	Channel protection using vegetation	3	40	FEO	2
	B4.12	Water level management impact on quality	3	45	FEO	3
River engineering	B5.1	Lowland catchment study: results	1	20	FEO	1
	B5.2	Effect of sea level rise on pumping	1	60	FNE	1
	B5.3	Maintenance of lowland drainage systems	1	80	FM	2
	B5.4	Runoff response of large catchments	1	210	DPN	3
	B5.5	Performance of surface water infiltration systems	2	80	FM	2
	B5.6	Alternative energy sources for pumping stations	2	20	MOE	1
	B5.7	Design criteria for high and low discharges	2	50	EPO	2
	B5.8	Surface water retention reservoirs	3	15	MO	1
	B5.9	Discharge pipe design	3	60	FLM	2

Table 7 Framework for NRA Topic C1 R&D
Part 1 - Theme C1(a) Response to Meteorological Events

Reference	Subject	
C1(a)1	Precipitation	- rainfall - snowmelt
C1(a)2	Run-off	- natural - agricultural - urban
C1(a)3	River flows	- flood - drought - tidal influences
C1(a)4	Data	- instrumentation - collection, storage and retrival
C1(a)5	Forecasting	- rainfall - snowmelt - river flow

Table 7 **Framework for NRA Topic C1 R&D**
Part 2 - Theme C1(b) Prediction of Flows and Water Levels

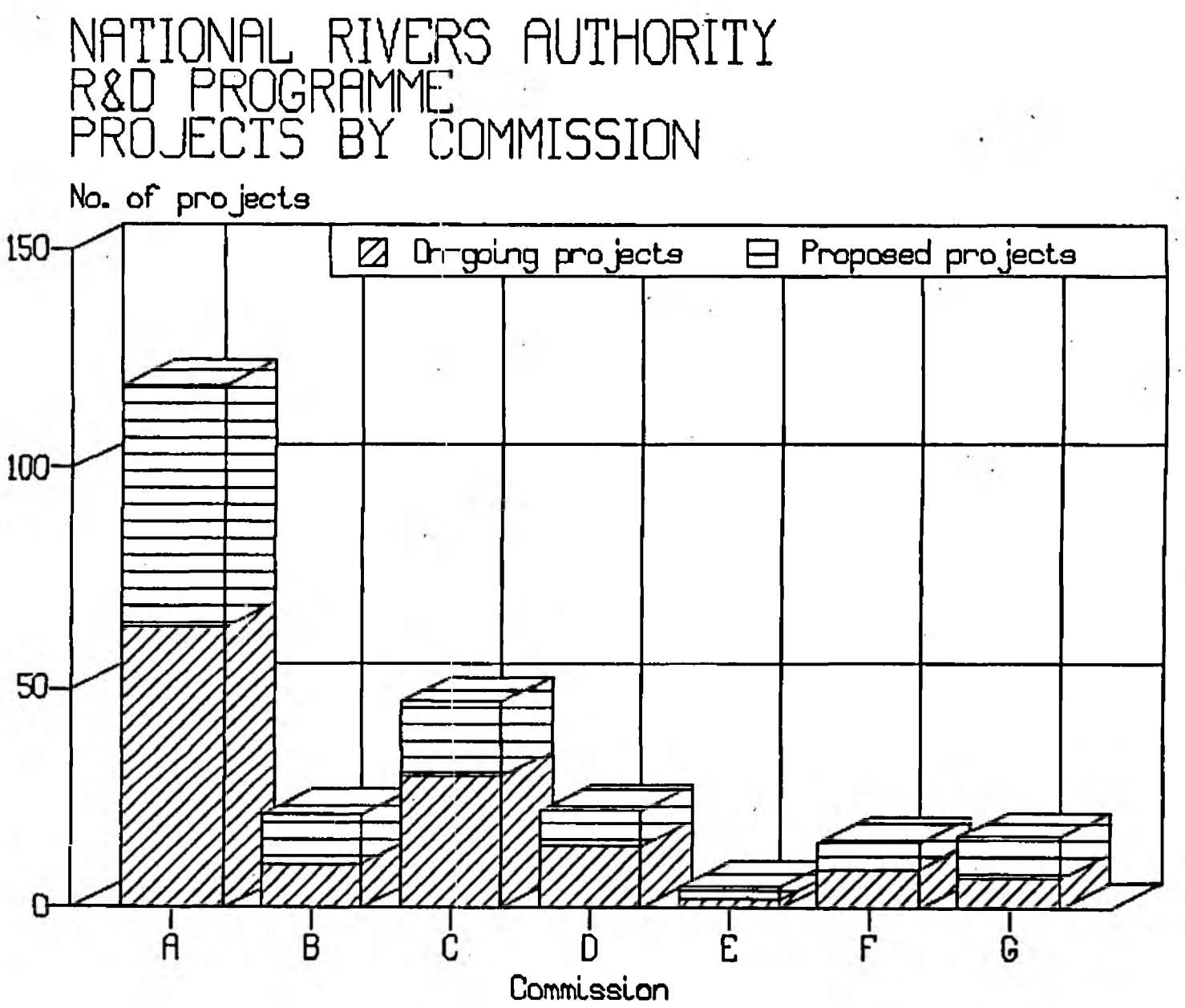
Reference	Subject	
(i) Hydraulics (Relationship of water level to channel geometry and flow)		
C1(b)1	Channel friction	- river bed - river bank - flood plain
C1(b)2	Discharge capacity	- artificial channels - natural channels - braided channels - channels with islands - two-stage channels
C1(b)3	Waves	- wind generated - boat generated
C1(b)4	Energy dissipation	- natural - artificial
C1(b)5	Data	- instrumentation - collection, storage & retrieval
C1(b)6	Hydraulic modelling	- 1-D - 2-D
(ii) Sediment transport (Relationship of channel geometry to water level and flow)		
C1(b)7	Sediment types and sources	- catchment - river bed - river bank
C1(b)8	Conditions at the bed	- siltation - degradation - local scour
C1(b)9	Conditions at the bank	- meandering - bends - wave attack - stability
C1(b)10	Conditions in the flood plain	- accretion - erosion
C1(b)11	Data	- instrumentation - collection, storage & retrieval
C1(b)12	Sediment transport modelling	- 1-layer - 2-layer - multi-layer

Table 7 **Framework for NRA Topic C1 R&D**
Part 3 - Theme C1(c) Control and Protection Structures

Reference	Subject	
C1(c)1	Flow control	- weirs - gates - trashracks
C1(c)2	Sediment control	- silt traps - dredging - reservoirs
C1(c)3	Energy dissipation	- stilling basins - bed protection
C1(c)4	Bank protection	- high-velocity flows - low-velocity flows - environmentally sensitive
C1(c)5	Flood banks/walls	- stability - settlement - seepage - weathering - environmentally sensitive
C1(c)6	Washlands	- inflow - storage - outflow
C1(c)7	Land drainage	- drainage channels - river outfalls, free and flapped - pumping stations

Table 7 Framework for NRA Topic C1 R&D
Part 4 - Theme C1(d) Improving Efficiency and Effectiveness

Reference	Subject	
C1(d)1	Assessment and execution	- asset inventory - scheme prioritisation - design team selection - whole project costing - post project appraisal - quality assessment
C1(d)2	Computer systems	- data collection, storage & retrieval - artificial intelligence
C1(d)3	Information transfer/ education	- design procedures - design manuals - inter-functional communications - inter-regional communications - in-career training


NATIONAL RIVERS AUTHORITY
R&D PROGRAMME
PROJECTS BY COMMISSION
No. of projects
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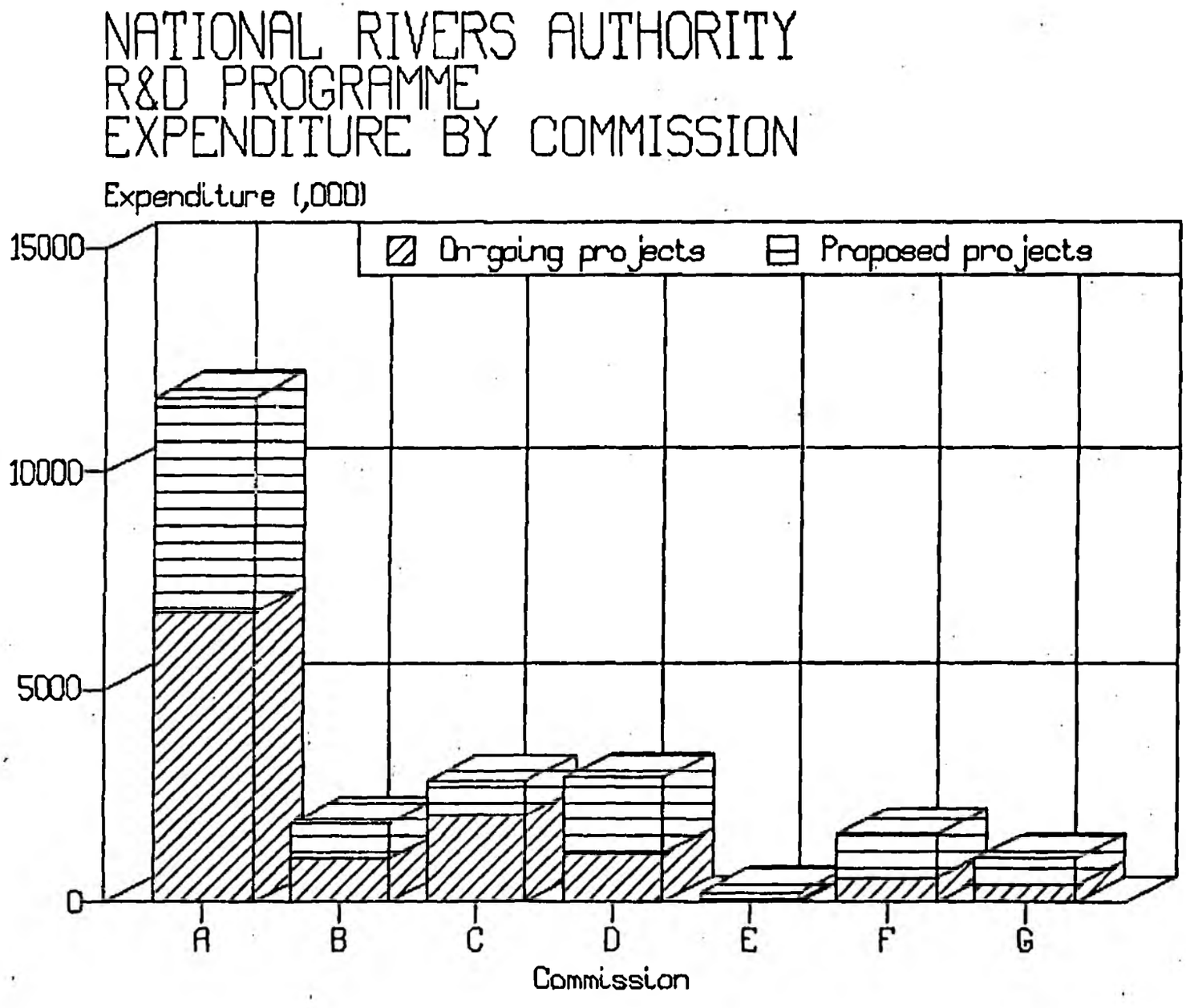
100
50
0
On-going projects
Proposed projects
A
B
C
D
E
F
G
Commission

Figure 1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R&D PROGRAMME
EXPENDITURE BY COMMISSION
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5000
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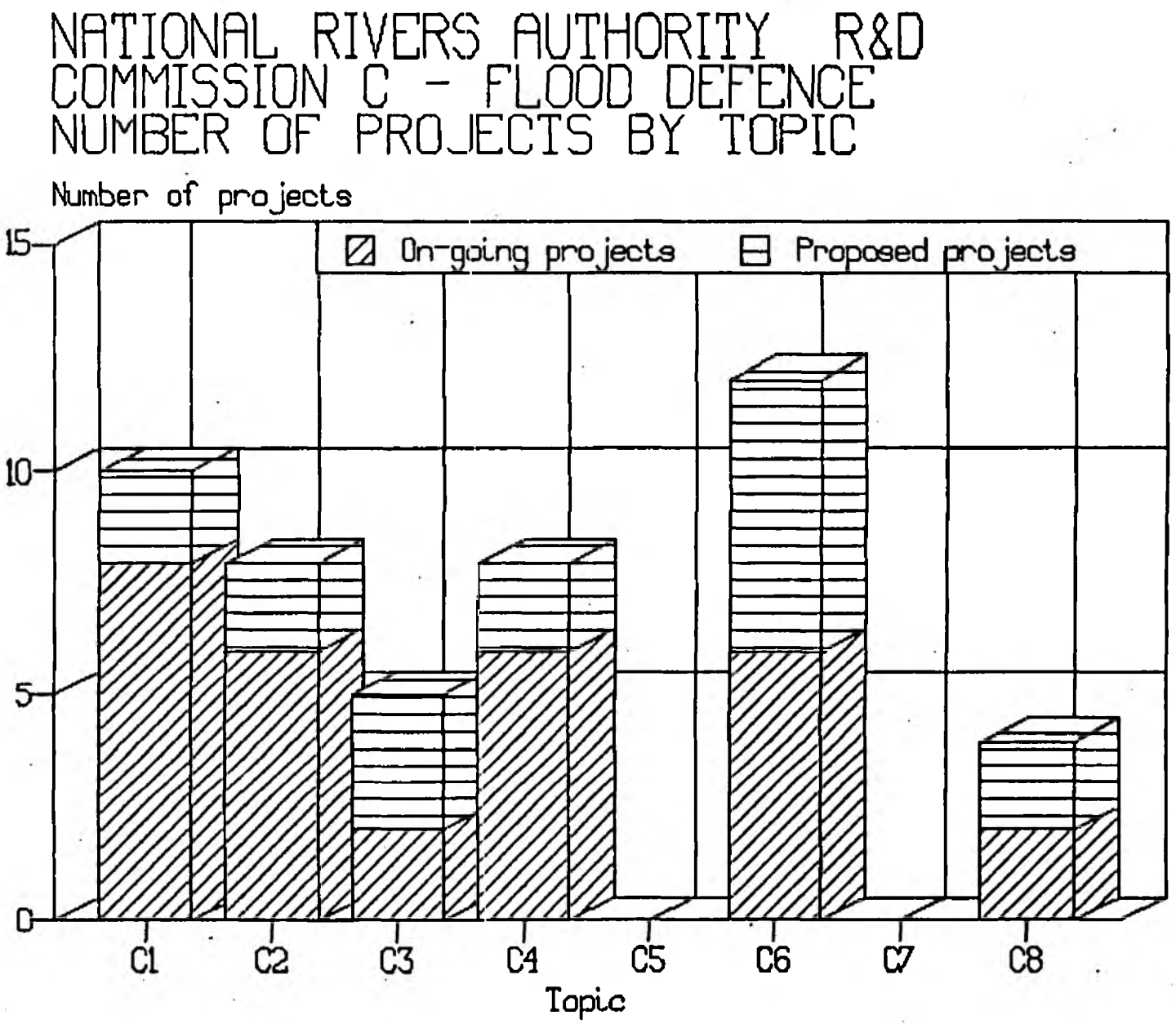
On-going projects
Proposed projects
A
B
C
D
E
F
G
Commission

Figure 2


NATIONAL RIVERS AUTHORITY R&D
COMMISSION C - FLOOD DEFENCE
NUMBER OF PROJECTS BY TOPIC
Number of projects
15
10
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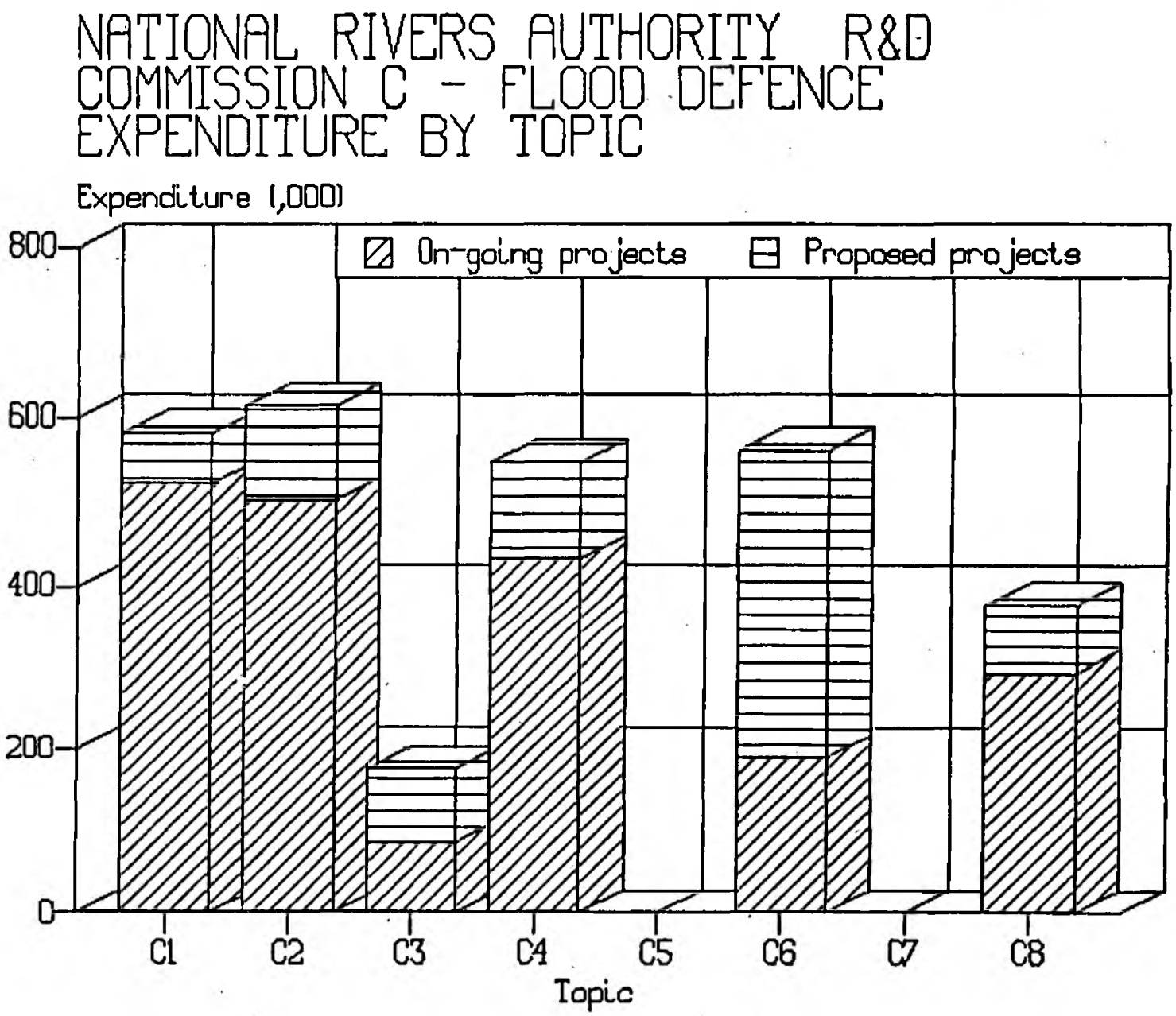
On-going projects
Proposed projects
C1
C2
C3
C4
C5
C6
C7
C8
Topic

Figure 3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COMMISSION C - FLOOD DEFENCE
EXPENDITURE BY TOPIC
Expenditure (,000)
800
600
400
200
0
On-going projects
Proposed projects
C1
C2
C3
C4
C5
C6
C7
C8
Topic

Figure 4

ANNEXE A.

REVIEW OF FLUVIAL R&D RELATED TO FLOOD DEFENCE

1. THE NATIONAL RIVERS AUTHORITY - STATUTORY DUTIES AND OBLIGATIONS

1.1 Introduction

1.1.1 The statutory duties of the National Rivers Authority (NRA) were set down prior to its formation in the Water Act 1989. The duties and obligations of the Act and other associated legislation have since been incorporated in the Water Resources Act 1991. The purpose of the new Act, as described in its preface, was to consolidate enactments relating to the National Rivers Authority and the matters in relation to which it exercises its functions.

1.1.2 Part IV of the Water Resources Act 1991 deals specifically with flood defence and land drainage. Under Section 105 of the Act the NRA has a duty placed on it to exercise general supervision over all matters relating to flood defence. Apart from this general duty, the NRA is specifically responsible for over 800 Km of sea defences and the monitoring and maintenance of over 36,000 Km of main river and associated embankments. Under the Act the NRA may undertake improvement and maintenance works on, or in connection with, main river and sea defence. The Authority also has a statutory duty to have regard for, enhance, conserve and preserve the water environment.

1.1.3 Flood defence is one of the key activities of the Authority, some 3,600 employees, out of a total work force of 7,400, working in the flood defence function and many others involved in providing essential support. Capital and revenue expenditure on fluvial flood protection accounts for some £100 million of the Authority's annual budget.

1.1.4 Part 1, Section 2(3) of the Water Resources Act 1991 places a statutory duty on the NRA "to make agreements for the carrying out of research and related activities (whether by the Authority or others) in respect of matters to which the function of the Authority relate".

1.2 Flood Defence - The Authority's Aims

1.2.1 Being mindful of its responsibilities for protecting people and property from flooding, the NRA has established specific aims in relation to Flood Defence. These are:

- To provide effective defence for people and property against flooding from rivers and the sea.
- To provide adequate arrangements for flood forecasting and warning.
- To prevent the creation or extension of flooding risks by influencing control over new development.

1.2.2 The construction and maintenance of land drainage and flood defence works also provides the NRA with opportunities to pursue other policies which have a bearing on flood defence works, but are not directly associated with them, namely:

- To develop the amenity and recreational potential of water and land under the Authority's control.
- To conserve and enhance wildlife, landscape and archaeological features associated with water under NRA control.
- To improve and maintain inland waterways and their facilities for use by the public

where the NRA is the navigation authority.

1.2.3 The NRA, like other public bodies, has to perform its functions under financial constraint and is adopting a business approach to the management of its assets. It is anxious to demonstrate to Government and the public that it is achieving value for money in the pursuit of the above aims.

1.2.4 The Authority is also mindful of the greater public awareness, in recent years, of the ecological and conservation impacts that flood defence works can have on the environment. It takes very seriously its statutory obligation to enhance, conserve and preserve our rivers and the adjoining riparian land.

1.2.5 The Authority is also aware of the potential future problems that might result from the impacts of climate change, which include increased storminess as well as the effects of global warming.

1.3 Research and Development

1.3.1 As indicated in para 1.1.4, the NRA has a statutory duty under the Water Resources Act 1991 to make arrangements for carrying out research and development. It is the NRA's strongly held view that the R&D programme must be strongly orientated towards the needs of the 'end user'. It must be directed towards improving the efficiency and effectiveness of the Authority in the performance of its operational duties, and where relevant, may include the development of NRA policy. The NRA are conscious that potential savings are possible from improved techniques of analysis, planning, design and maintenance in the exercise of their flood defence function and that these can be achieved through R&D specifically aimed at the river environment.

1.3.2 To date, the NRA's R&D programme has mainly been concerned with projects which were started before the formation of the Authority or were intended to meet the Authority's immediate operational needs. It is anticipated that the programme will increase slowly in the coming years and will increasingly include more projects of direct relevance to the Authority's Function, Strategy and Business Plan and will deal with strategic operational issues, placing less emphasis on immediate results.

1.3.3 The NRA's needs in respect of fluvial R&D are directly related to its responsibilities for the management of flood defence, fisheries, water quality and conservation of our rivers. It has been observed that management not only includes the maintenance of the rivers but their modification by new and improvement works in response to changing physical and social pressures. in order to deal with potential problems there is a need to:

i) Monitor until a potential problem is perceived

ii) Analyze to identify what corrective action is necessary, if any

iii) Implement corrective procedures

iv) Continue to monitor.

1.3.4 The ongoing problems likely to be experienced in our rivers are the result of serious flooding, erosion, silt deposition and the need for dredging and the pressures and obligations to control them in an environmentally acceptable manner. In addition, climatic changes are likely to compound some of these problems.

1.3.5 If the NRA is to manage its rivers more efficiently and cost effectively, continuing R&D work is necessary if these benefits are to be realised - a fact acknowledged by most NRA officers. Enquiries have indicated that all wish to see R&D continued at its present level

and many feel that the work should be expanded.

1.3.6 Meeting the demands to reduce flood hazards, provide better warnings of their approach requires better estimates of flood flows and frequencies and improved level predictions based on improved channel hydraulics and modelling techniques. Satisfying the statutory obligation to improve amenity and at the same time conserving and enhancing the natural environment calls for R&D work into environmentally sensitive watercourse management, the design of environmentally acceptable channels and river morphology.

1.4 Dissemination of R&D Information

1.4.1 It is a general concern of officers within the NRA that more effort needs to be expended in bringing the results of pertinent research to the attention of practising engineers responsible for the design of flood defence works. This includes information about current research being sponsored or carried out by the NRA or in allied organisations and what the results of the research were (ie. how they could be applied).

1.4.2 It was considered that the process of dissemination would benefit considerably by the development of standard codes of practice covering planning, design philosophy, conservation issues and project evaluation, takin in the best practices currently in use in the Authority. This would enable best practices to be shared and adopted by all regions and would ensure an effective and uniform approach to problems by all regions and their consultants.

1.4.3 In the development of the above best practices it is essential that there should be an adequate feedback of information about the performance of completed works. This will entail the carrying out of post project appraisals and R&D work should be devoted to the development of a suitable standard approach. This would also require close co-operation between those responsible for the design of flood prevention works and those who have the duty of maintaining them. Some doubts have been expressed about the degree of separation which sometimes exists between these two sections and administrative steps might be necessary to ensure that feedback occurs.

1.4.4 In respect of some complex problems like sediment processes within rivers, the pressing need of practising engineers within the NRA is not for a high level specialist technical appreciation of sediment transport and deposition, but guidance on how to use the best available present knowledge, more effectively, in their work.

Table 3.1 Response to Questionnaire by NRA regions : March 1991

Responses from 11 questionnaires maximum of 55 points

Each respondent was asked to indicate the importance of his own work of R&D in each topic area.

Rank	Score	Subject
1	46	Bank erosion
2	45	Flood flows estimation
3	45	Capacity of multistage channels
4	43	Maintenance of gravel beds
5	42	Channel siltation
6	41	Capacity of channels with inundated berms
7	40	Local scour
8	39	Capacity of channels with single bank working
9	38	Bed degradation
10	37	Capacity of channels with islands
11	37	Deposition of polluted sediments
12	36	Capacity of inbank flows
13	36	Debris - in channel
14	36	Debris - on screens
15	35	Control of inbank sedimentation
16	34	Water quality in environmentally enhanced channels
17	34	Resuspension of polluted sediments
18	33	Dispersion of polluted sediments
19	32	Flood zoning
20	31	Capacity of braided channels
21	30	Dispersion - inbank flows
22	28	Velocity related damage
23	28	Silt related damage
24	26	Control of attached algae
25	24	Capacity of artificial channels
26	20	Siltation of flood plains
27	17	Reservoir siltation
28	17	Dispersion - flood flows

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Meeting Notes

SUBJECT **MEETING WITH NRA SOUTHERN**	FILE NAME & NUMBER 4176-2
	Review of Fluvial R&D
Date & Time 11.30am 2.11.92 Location NRA (Southern) Offices, Worthing	MEETING NUMBER 1
Recorded by R Young	

PARTICIPANTS' NAMES	TITLE	REPRESENTING
D Martin	Acting Reg. F. Def. Man.	NRA (Southern)
R Young	Project Manager	B&P

Circulation D Martin, G Thompson, D Hockin, File

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
1.	The purpose of the meeting was to discuss matters relevant to the review of fluvial R&D related to flood defence currently being carried out by B&P.		
2.	RY went through the Briefing Note circulated prior to the meeting, addressing: i) the aim of the review and the approach being adopted; ii) the aims of the NRA's R&D programme and the way in which it is structured, noting that the review relates specifically to Topic C1 (fluvial defences and processes) of Commission C (Flood Defence); iii) the results of the recent MAFF review of flood and coastal defence R&D and how the present study relates to this; iv) the draft framework for Topic C1 R&D presented in the note.		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
3.	In the general discussion that followed a number of points came up. These are given below, in no particular order of priority. i) RY stated that the framework was intended to be a comprehensive list of the subjects covered by Topic C1. This does not imply that an R&D project is needed for each item. ii) DM pointed out that the framework included a number of subjects which might be included in other topics or commissions. RY agreed but pointed out that one of the purposes of the review is to identify such links. iii) DM listed the subject areas that are of concern to NRA (Southern): • integration of rainfall data into hydraulic models allowing them to be used for real-time flood forecasting and control; • cost-effective design/maintenance of embankments to avoid cracking at the crest; • design/maintenance of runoff storage ponds for roads/motorways; • environmentally friendly methods of river bank protection; • polluted sediments (specifically creosote); • whole project costing (including demolition and linked with whole project environmental assessment); • design procedures/manual preparation. iv) DM also listed subjects he felt to be of general interest but not specific to the present review: • post project appraisal; • quality assurance; • computer systems (data collection etc, artificial intelligence); • review of training courses.		
4.	DM wished to discuss the review at the next Area Manager's meeting on 10.11.92. He will ask them for their views on subjects of concern in the region, on possible R&D projects and on priorities and will send any comments to B&P by the end of November.		

MEETING WITH NRA SOUTH-WEST

4176-2 Review of Fluvial R&D

2.30 pm 5.11.92
NRA (South-West) Offices, Exeter
R Young

Bob Halton	Chief Engineer	NRA(SW)
Richard Young	Project Manager	B&P
(Graham Bull on leave)		

1. The purpose of the meeting was to discuss matters relevant to the review of fluvial R&D related to flood defence currently being carried out by B&P.

2. The Briefing Note circulated before the meeting was discussed and the following points arose:

   (i) BH agreed that NRA's R&D should be aimed at improving its ability to carry out its duties and that it should generally be directed towards applied rather than fundamental research.

   (ii) Originally NRA did not favour joint funded projects but this is changing. RY agreed joint funding is an efficient way of undertaking R&D provided objectives are well defined and understood by all participants.

(iii) Some of the subjects listed in the topic framework fell under topics/commissions. RY noted this but pointed out that one of the purposes of the review is to identify links.

3. BH suggested that the following links were important:

(i) Hydrology (included in C1 for determination of design events) has clear links with Topic C2 (River flood forecasting) and Commission B, Water Resources.

(ii) Hydraulic modelling has links with all other topics in Commission C and with many other commissions, particularly Water Quality and Water Resources.

(iii) Strong links between Flood Defences and Conservation although in SW this mostly concerns appearance. Recreational aspects (walking, fishing etc) not generally an issue with regard to Flood Defence.

(iv) Obviously strong links between C1 and C8, Response to Emergencies.

4. BH pointed out that most of the rivers in the region are relatively short and steep and that this controls the flood defence concerns in the region. Points that arose during the discussion included:

(i) bed or bank friction not generally a concern as rivers are steep;

(ii) 2-stage channels not often found and therefore not a concern;

(iii) most defences protect urban areas and are "hard";

(iv) where there are "soft" defences these are generally fairly low and do not often suffer from weathering, stability or settlement problems;

(v) annual capital works budget for flood defence is ~£6M, of which the majority is currently spent on coastal or estuarine works; most inland towns with flooding problems have reasonable defences (although these may need renewal in due course);

(vi) river bank protection is a problem in some areas, although this has become less important since the NRA stopped preventing erosion of farmland;

(vii) little problem with sediment - few silt traps, no dredging and no reservoir silting problem;

(viii) no washlands and few pumping stations, so neither are a concern.

5. Subjects that BH felt could usefully be addressed by the NRA (either as R&D or under some other programme) included the following:

5.1 Hydrology

- review of flood studies report;
- assessment of alternative modelling approaches (eg. Monte Carlo modelling);
- review of existing rainfall/runoff models and recommendations concerning which to use and when;
- assessment of catchment wetness for rainfall-runoff models.

5.2 Hydraulics

- review of hydraulic models (1D and 2D) defining limitations and recommending which to use when;
- inventory of existing river and estuary models.

5.3 Structures

- trash racks are major problem requiring basic research (possibly including model testing) and design guidance;
- review of bank protection (building on CIRIA work), assessing new products and environmentally sensitive methods.

5.4 Assessment, communication and training

- whole project costing, particularly paper assessment of maintenance, repair and operation costs;
- review of QA practices possibly of some value (but see also below);
- artificial intelligence in flood warning systems (highlighting unusual conditions);
- national training courses, organised in-house with two aims:
  (i) to disseminate information
  (ii) to promote inter-regional links;
- project management guidelines (use of time sheets, jobs control etc. - particularly important in view of market testing and client/contractor split initiatives);
- review of drawing/document archiving systems;
- preparation of design guides/manuals covering wide range of subjects including:
  (i) energy dissipation structures
  (ii) hydrological and hydraulic models (see above)
  (iii) bank protection.

6. Other matters that arose during the meeting were as follows:

(i) SW Region instituted a QA system about 12 months ago and are reasonably happy with it;

(ii) CIRIA report on stabilisation of old quay walls extremely useful but needs extending to cater for use with flood defence structures;

(iii) BH not aware the manual on Maintenance of Flood Defence Systems is in preparation.

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Meeting Notes

SUBJECT	**REVIEW OF FLUVIAL R&D**	FILE NAME & NUMBER 4176-2
Date & Time Location	10.11.90 @ 11:00am NRA (Anglian) offices, Peterborough	MEETING NUMBER 3
Recorded by	R Young	

PARTICIPANTS' NAMES	TITLE	REPRESENTING
I Hart	Engineering Manager	NRA
R Weedon	Principal Engineer	NRA
P Barham	Conservation Officer	NRA
R Young	PEM	B&P

Circulation: All present + G Thompson, D Hockin, File.

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
1.	The purpose of the meeting was to discuss matters relevant to the review of fluvial R&D related to flood defence currently being carried out by B&P.		
2.	RY went through the Briefing Note circulated prior to the meeting addressing: a) the aim of the review and the approach being adopted; b) the aim of the NRA R&D programme; c) the draft framework for Topic C1 presented in the note.		
3.	A general discussion following during which a number of points arose. These are collected under suitable headings below, not necessarily in the order in which they were discussed.		
4.	**General Points** a) The area covered by the Anglian Region is large and relatively flat, with rivers that generally have low gradients and with much of the land protected being used for agriculture. Much of the		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY

design work is carried out in-house. These conditions affect the problems faced and therefore the areas of concern identified.

b) The principal needs are for reviews of current practices and the preparation of guidance manuals rather than the carrying out of original research. "Guidance" is important : any manuals should present the options available and identify the conditions for which they are suited, leaving the responsibility for selecting which option to use in a particular case to the designer.

c) It is important that conservation and engineering issues should be considered together during the design process rather than conservation issues being looked at after the engineering assessment has been made.

5. **Links With Other Topics/Commissions**

The following links between the items listed in the draft framework and other topics/commissions were noted:

Item in Topic C1 framework	Links to
C1(a)	C2, B, A, G
C1(b)	C3, C4, F, G
C1(c)	C3, C4, C8, E, F, G
C1(d)	G

6. **Possible Research Subjects**

Subjects raised during the meeting as being of concern or where information appeared to be out-dated or lacking were as follows:

Theme C1(a) Hydrology

- The effect of under-drainage on run-off from agricultural land (noting that MAFF appear to have examined this but will not make the results available);
- Review of flood routing models to determine advantages and disadvantages in different circumstances;
- Calibration of structures (weirs, gates, etc) during flood conditions rather than during normal flows;
- Review of methods of archiving historic data to make it readily accessible;
- Review of methods of out-of-bank flow measurement.

Theme C1(b) Hydraulics

- Review of seasonal variations in channel friction and how these are affected by different management practices;

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	• Influence of weed growth on sediment trapping; • Review of environmentally sensitive sediment management techniques; • Review of channel design methods covering particularly: - two-stage channels - channels in flat areas - natural channels, utilising geo-morphological approaches; • Review of available hydraulic models. Theme C1(c) Structures • Review of environmentally sensitive alternatives to conventional structures for river control and energy dissipation; • Modifications to conventional structures to maximise recreational uses; • Review of embankment design practices and analytical techniques taking note of: - need to use indigenous materials - adverse ground conditions - problems of raising and strengthening existing banks; • Design of reliable maintenance-free flap valves. Theme C1(d) Information transfer and training • Preparation of manuals describing good current practice seen to be very valuable; • Some benefit in having national training courses to promote inter-regional exhange of information.		

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Meeting Notes

SUBJECT	MEETING WITH NRA WESSEX Review of Fluvial R&D	FILE NAME & NUMBER 4176-2
Date & Time Location	11:00 am 16.11.92 NRA (Wessex) offices, Bridgewater	MEETING NUMBER 4
Recorded by	R Young	

PARTICIPANTS' NAMES	TITLE	REPRESENTING
W Grigg	Operations & Maintenance	NRA (Wessex)
C Hayward	New Works	NRA (Wessex)
R Young	Project Manager	B&P

Circulation: All present + G Thompson, D Hockin, File

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
1.	RY opened by explaining the purpose of the study and going through the Briefing Note circulated before the meeting, addressing in particular: i) the aim of the NRA's R&D programme; ii) the approach being adopted for the study; iii) the results of earlier reviews; and, iv) the draft framework for the topic given in the note.		
2.	RY suggested that the sequence of the discussion should be: i) brief over-view of the characteristics of the Wessex Region to get the Regions' perceived R&D needs in context, ii) comments on the proposed framework for Topic C1 R&D including links to other commissions, iii) specific areas of concern which could be addressed in the R&D programme.		

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ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
3.	**Overview of Wessex Region**		
3.1	The region is divided into three areas, each with its own characteristics : i) Bristol Avon - A fairly small catchment subject to development pressures but in which little new work is anticipated in the near future. The main problems are associated with debris removal and with estimating the effect of new development on runoff. ii) Avon and Dorset - Covers the Hampshire Avon, the Stour and the Frome and includes important areas of sea defences. Defences consist largely of raised embankments and the major fluvial problems are related to weed growth and control. iii) Somerset - This covers the low-lying lands associated with the Somerset Levels and the sea defences adjacent to the Bristol Channel. Defence consists largely of raised embankments with pumping; there are 24 pumping stations in the area. Major problems relate to water level control, repair and maintenance of flood embankments, dredging and methods of dealing with the very heavy silt loads encountered (largely derived from the sea).		
3.2	The annual maintenance and new works programmes each have a value of about £5M. About 50% of the design and appraisal work and 25% of the construction work for the capital programme are done in-house.		
4.	**Comments on Proposed R&D Framework** i) It was felt that the impact of conservation issues should be given greater emphasis, possibly to the extent of having a separate section of its own within the framework. The need to take conservation issues into account at all stages (feasibility/ appraisal, design, construction, operation and maintenance) was stressed throughout the meeting. ii) A number of over-laps with other topics within Commission C were noted, in particular: C1(a) with C2 C1(b)(i) with C2 Waves with C6 Estuaries with C6. iii) Links with other commissions were noted, most particularly with F and G. A point given special emphasis was the interaction between channel/bank maintenance practices and conservation aims.		

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ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
5.	**Specific Areas of Concern**		
5.1	General Comments i) Important that the outcome of R&D is presented in a way that can be used easily by practising engineers. This can most easily be done by preparation of guidance notes on particular topics. Very often these notes would summarise existing best practices rather than present new work, allowing the user to examine the different options open to him for carrying out a particular task. ii) The proposed changes to the NRA structure and the introduction of market testing will mean that in future channel maintenance is likely to be put out to tender. Writing and assessing such tenders will need the maintenance requirements to be established much more rigorously than at present, requiring detailed knowledge of channel roughness, range and variation and probably requiring, ultimately, a hydraulic model of each river.		
5.2	C1(a) Hydrology i) need for improvement to runoff forecasting, linking weather radar output to prediction of river levels. However, work is already in hand and additional costs probably unecessary, except as mentioned below; ii) impact of land drainage on runoff; iii) impact of urban development on runoff; iv) guidance on appropriate combination of events to take to model tidal/river flow interaction. v) guidance on relationship between frequency and physical extent of event, to assist operational response decisions.		
5.3	C1(b) Hydraulics i) estimation of channel friction, particularly in response to: · effect of different maintenance practices · seasonal effects; ii) afflux at bridges, culverts and other structures major problem, USBR manuals need to be updated; iii) geomorphological approach to river management, particularly with regard to river bank stability, sediment movement, need for dredging, changes in hydraulic gradient; iv) modelling of sediment transport and particularly scour (rate at which bed will scour during floods and how this will effect water levels); v) review of hydraulic models needed, both steady-state (backwater curve) and dynamic models; vi) guidance on monitoring behaviour of rivers, particularly with regard to river and aerial surveys.		

FILE NUMBER MEETING NUMBER

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
5.4	C1(c) Structures i) main problem is design of gate/sluice structures to prevent jamming during operation; ii) design guidance notes would be useful; iii) guidance for automation of structures, giving best practice for both control (automatic and remote) and monitoring.		
5.5	C1(d) Information Transfer/Training i) real need for proper analysis and storage of existing data (this applies particularly to hydrological data and doesn't really fall under R&D but nevertheless identified as cause for concern); ii) information transfer and communication between regions currently poor; iii) inter-regional seminars to discuss capital schemes and operational procedures would be very useful; iv) guidelines for preparation of operational hand-over packages (transfer information from designers to operators) very useful.		

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Meeting Notes

SUBJECT	**MEETING WITH WELSH NRA** Review of Fluvial R&D	FILE NAME & NUMBER 4176-2
Date & Time Location	16.11.92 @ 2.30 pm NRA (Wales) offices	MEETING NUMBER 5
Recorded by	R. Young	

PARTICIPANTS' NAMES	TITLE	REPRESENTING
Terry Widnall	SE Area General Manager	NRA
Richard Howell	Conservation & Recreation Officer	NRA
Geoff Bayliss	Flood Defence Officer	NRA
Richard Young	Project Manager	B&P

Circulation: All present + G Thompson, D Hockin

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
1.	RY opened the meeting by going through the Briefing Note circulated before the meeting, mentioning in particular:- (i) the purpose of the study and the approach being adopted; (ii) the aim of the NRA's R&D programme; (iii) the result of earlier reviews and; (iv) the draft framework for the topic given in the note.		
2.	RY suggested that the discussion should generally follow the sequence:- (i) brief over-view of the characteristics of the Welsh Region, to set subsequent comments in context; (ii) general comments on the R&D programme; (iii) comments on the proposed framework;		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	(iv) specific areas of concern that could be addressed in the R&D programme. The notes that followed are organised as above.		
3.	**Overview of Welsh Region**		
3.1	The region contains a number of relatively short, steep rivers giving rise to discrete local problems, generally covering relatively small areas. Some design work is carried out in-house but the bulk (80%) is put out to consultants.		
3.2	The nature of the region's rivers means that erosion in high-energy flows is a matter of some concern. Fishing is important and therefore the impacts of both capital and maintenance works on fish (eg. gravel spawning ground) are important.		
4.	**General Comments on R&D Programme**		
4.1	R&D must show practical applications in short time scale, demonstrating benefits and cost savings. Therefore important to address items which represent significant expenditure to the NRA, such as channel maintenance etc.		
4.2	Avoid collection of data for the sake of it.		
4.3	Preparation of guidance notes and manuals thought to be very useful. Two such reports are the UEA reports on:- "River Engineering in gravel based rivers" "Review of Bank Erosion Techniques in High Energy Rivers"		
4.4	There would be considerable advantage in carrying out detailed monitoring of selected schemes/catchments. This would be a long-term commitment, with regular up-dated reports to indicate long-term effects of schemes.		
4.5	More opportunities for discussion of problems/solutions between the region would be useful. This could take form of a list of contacts with experience of particular problem and encouragement to get in touch with them. This could cover not only design and management, but also emergency conditions.		
5.	**Comments on Proposed Framework**		
5.1	"Design for maintenance" needs to be included as a separate item in the framework.		
5.2	"Changes in land-use and effect on run-off" could also be included separately.		
5.3	"Conservation implications" already mentioned in C1(c) and not appropriate to identify it as a separate subject; the aim should be to ensure that they are taken into account in all work anyway.		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
5.4	A number of over-laps with other commissions were noted, particularly with B, F, G, C2 and C4.		
6.	**Specific Areas of Concern**		
6.1	**C1(a) Hydrology**		
	(i) Effect of changes in land-use (particularly agricultural field drainage and afforestation) on run-off;		
	(ii) Problems with accessing and processing historic data (much data exists but without having been processed and therefore not in a readily accessible form);		
	(iii) Review of hydrological modelling techniques and capabilities of different models very useful (should also cover hydraulic modelling, see below).		
6.2	**C1(b) Hydraulics**		
	(i) need for guidelines on how channel resistance (discharge capacity) is affected by various conditions or methods of management, particularly:- • single bank working • river bed with boulders • fishery protection groynes		
	(ii) energy dissipation in steep rivers (eg. drop weirs etc); need for guidance notes/review;		
	(iii) sediment movement can be a problem eg. in fishing pools, meandering into flood-banks (indicating need for geomorphological approach to river analysis);		
	(iv) impact of shoal removal on conditions downstream (particularly environmental implications, erosion problems);		
	(v) disposal of dredged materials can be expensive.		
6.3	**C1(c) Structures**		
	(i) fool-proof fish pass design;		
	(ii) guidance on bed stabilisation/erosion control;		
	(iii) alternatives to block-stone for bank protection in high energy flows;		
	(iv) means of tying in-filled breach in bank to non-breached section.		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
6.4	**C1(d) Information transfer/training** (i) whole project costing important, particularly when assessing maintenance requirements; (ii) long-term monitoring of selected schemes representing range of conditions and regions would be very useful. All aspects (including conservation impacts, maintenance practices) should be undertaken; (iii) more in-career training needed.		

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Meeting Notes

SUBJECT	**FLUVIAL R&D REVIEW** **Consultation with Thames NRA**	FILE NAME & NUMBER 4176
Date & Time Location	1.12.92 @ 10:30am Thames NRA HQ	MEETING NUMBER # 6
Recorded by	R M Young	

PARTICIPANTS' NAMES	TITLE	REPRESENTING
Andy Stuart	Acting Project Manager	NRA
Doug Mills	Technical Support Manager (Survey/Modelling)	NRA
Andrew Brookes	Senior Technical Officer Geomorphology	NRA
Richard Young	Associate/PEM	B&P

Circulation: All above, GT, DH, File

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
1.	RY opened by explaining the purpose of the study and going through the Briefing Note circulated before the meeting, mentioning in particular: i) the aim of the NRA's R&D programme; ii) the approach to the study being adopted; iii) the results of earlier reviews, particularly the SERC Flood Channel Facility questionnaire and the MAFF Advisory Committee review; iv) the draft framework for Topic C1 R&D given in the note.		
2.	RY suggested that the sequence of the discussion should be as follows: i) general comments on NRA's R&D Programme; ii) comments on the proposed framework for Topic C1 R&D, including links to other topics/commissions; iii) specific areas of concern which could be addressed in the R&D programme.		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
3.	**General Comments on R&D Programme** (i) R&D must be focussed on immediate and long-term needs of NRA; (ii) Prioritisation and selection of R&D projects must take note of links/impacts between the various R&D topics and commissions; (iii) Inter-functional transmission of information about R&D projects appears to be inadequate. (iv) R&D must be presented in a way that can be used by people on the ground - preparation of a PIGN is not always sufficient and additional means (training etc) of making information available needs to be considered. Procedure should be: Research - Simple guidelines/procedure - Distribution (v) In some areas, reviews of existing information and presentation in usable form would be more valuable than carrying out further R&D. (vi) Need for cross-fertilisation with other research organisations (eg. MAFF) as the perception is that communication is poor (ie MAFF are known to have carried out research into subjects of interest but the results have not been made available within NRA).		
4.	**Proposed Framework for Topic C1 Research** (i) no major comments forthcoming; (ii) considerable over-lap with other topics/commissions noted, in particular: C1(a) with C2 and B C1(b)(i) with C2, C3, C4 C1(b)(ii) with C3, C4, D, E C1(c) with C4, D, E, F (iii) all subjects have links with Commission G.		
5.	**Areas of Concern (and additional comments)**		
5.1	C1(a) Hydrology (i) extreme event rainfall profiles (ii) run-off from urban areas (iii) work on data collection/retrieval already in hand (iv) review of flood run-off models already done but results not widely circulated (v) general feeling is that existing procedures are adequate and further R&D is unlikely to have major impact on them.		
5.2	C1(b) Hydraulics (i) estimation of channel friction is major problem, particularly:		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	• 2 stage channels • effect of different maintenance practices • seasonal effects what research has been carried out is not readily usable; review of existing information very timely (ii) head loss at structures is also major problem; particularly: • bridges • culverts • skew weirs • structures with multiple gates data on culverts in USBR manuals useful but not broad enough; (iii) considerable information on waves already available in Commission E; (iv) energy dissipation in natural channels links to catchment topography work carried out in Topic C3; (v) Thames locked into one hydraulic model so not interested in review - this work carried out already and presented at meeting (although results possibly not well publicised); (vi) importance of geo-morphological approach to river hydraulics and sediment transport emphasised (see copy of letter from Andrew Brookes attached).		
5.3	C1(c) Structures (i) problems identified (not all of which are amenable to R&D) include: • gate vibration • seal friction • protective coating for steelwork • design to comply with Health & Safety requirements • trash screens (note - research already in hand) • silt traps • advice on circumstances dictating choice of structure • risk assessment concerning flood storage reservoirs • effect of erosion on inadequately designed defences • means of isolating existing structures for maintenance (where design does not allow for this); (ii) preparation of design guidance notes etc seen as useful.		
5.4	C1(d) Information Transfer Training (i) quality assurance assumed to include quality audits; (ii) post project appraisal is frrequently key to both identification and effective undertaking of R&D projects; (iii) needs for information transfer/training etc referred to above.		

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Meeting Notes

SUBJECT	REVIEW OF FLUVIAL R&D MEETING WITH NRA NORTHUMBRIA	FILE NAME & NUMBER 4176-2
Date & Time Location	1330 hrs Wednesday 4th November 1992	MEETING NUMBER X 7
Recorded by	D.L. Hockin	

PARTICIPANTS' NAMES	TITLE	REPRESENTING
Mr.A.Clarke	Area Engineer (North)	NRA Northumbria
Mr.D.Archer	Principal Hydrologist	NRA Northumbria
Mr.D.L.Hockin	Consultant	B&P

Circulation: A.Clarke, R.Young, G.Thompson, File.

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
1.	The purpose of the meeting was to discuss matters relevant to the review of fluvial R&D related to flood defence currently being carried-out by B&P.		
2.	DLH went through the Briefing Note circulated prior to the meeting. Attention was drawn to the main points listed in the Briefing Note, namely:- i) the aim of the review and the approach that was being adopted; ii) the aim of the NRA's R&D programme and the way in which it is structured, indicating that the present review is specifically concerned with Topic C1 (fluvial defences and processes) of Commission C (flood defence); iii) the results of the recent MAFF review of flood and coastal defence R&D and its relation to the present study;		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	iv) the results of the response by the NRA Regions to the questionnaire issued during the SERC Flood Channel Facility Review. Tony Clarke said he was doubtful if the Northumbrian Region could contribute very much to the study in view of the fact that the Region only carried-out some two capital projects each year. DLH said that despite this fact there must be some areas where they would benefit from R&D and it was an opportunity of bringing their particular needs to the notice of the NRA at national level. A general discussion then followed and the following points were made:-		
3.	PROPOSED FRAMEWORK FOR NRA TOPIC C1 R&D Table 7 Part 1 - Theme C1(a) Response to Meteorological Events. C1(a)2 * DA mentioned the problems that Northumbria have encountered in respect of the run-off from catcments whose characteristics have been materially altered by substantial opencast mining and subsequent reinstatement. He thought that an additinal class of catchment should be included to cover this and suggested "artificial". * DA also indicated that their region had extensive areas of forest and that considerable changes in run-off when ground was first planted, and to a lesser extent when trees were felled. Was there a need for a special heading to cover this situation which did arise in other Regions? C1(a)4 * It was considered that C1(a)4 had strong links to Commission B and that there was also a link to C4, Operational Management. C1(a)5 * Both AC and DA saw a strong link between this reference and C2 and the need to avoid duplication of effort. * The collection of snow melt data was also considered to be linked to Topic C4. * A link was perceived between "forecasting" in C1(a)5 and "Response to emergencies" covered by Topic C8.		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	Table 7 Part 2 - Theme C1(b) Prediction of Flows and Water Levels C1(b)2 * Both AC and DA considered that the discharge through culverts and bridges should be included as subjects in this reference. * Northumbria along with several other Regions have problems associated with very steep channels and it was thought that this might also be considered as a separate subject. Table 7 Part 3 - Theme C1(c) Control and Protection Structures C1(c)2 * AC asked whether "silt traps" also covered the provision of gravel traps. Table 7 Part 4 - Theme C1(d) Improving Efficiency and Effectiveness. C1(d)1 * Both AC and DA considered this reference most important in view of the division of responsibility now experienced in The NRA between client, contractor and operational management.		
4.	NORTHUMBRIA REGION'S SUGGESTIONS FOR R&D PROJECTS & PRIORITIES. Following discussion the following the following items of R&D were consdidered to be most important:- 1. Investigation into the frequency of flash floods, the areas covered by them, intensity of rainfall experienced, including their probability of occuring at a given location. 2. The need to update and improve the accuracy of methods of flood estimation, making use of additional data that has been accumulated since the FSR was first produced. 3. The need to consider how representative our present records are by examining long term records and looking at historical events and the geomorphology of respective catchments. 4. The need for the systematic collection of sediment transport data by establishing a national network of sampling stations, covering different types of rivers and catchment geology. The sample catchments to be greater than 500 sq.km.		

FILE NUMBER MEETING NUMBER

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
5.	ANY OTHER RELEVANT MATTERS AC and DA agreed that the provision of practical guides and manuals telling them how to apply the latest research and developments, would in many instances be more helpful than additional research. DA wondered whether the system of producing detailed frameworks for the different research topics didn't lead to a degree of overlap in research effort, but he didn't suggest an alternative solution.		

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Meeting Notes

SUBJECT: REVIW OF FLUVIAL R&D MEETING WITH NRA NORTH WEST	FILE NAME & NUMBER 4176-2
Date & Time: 1400 hrs Monday 9th November 1992 Location:	MEETING NUMBER ~~1~~ 8
Recorded by: D.L. Hockin	

PARTICIPANTS' NAMES	TITLE	REPRESENTING
Mr.P.Walsh	Flood Defence Manager	NRA (N.West)
Mr.R.R.Westley	Engineering Manager	NRA (N.West)
Mr.A.H.Taylor	Mechanical Services Manager	NRA (N.West)
Mr.P.Spencer	Modelling Engineer	NRA (N.West)
Mr.P.Younge	Planning Engineer	NRA (N.West)
Mr.D.L.Hockin	Consultant	B&P

Circulation: R.R.Westley, R.Young, G.Thompson, File

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
1.	Peter Walsh NRA(NW), Flood Defence Manager sat in and contributed for the first half hour of the meeting, but then had to leave and RRW acted as the main respondent on the NRA side.		
2.	The purpose of the meeting was to discuss matters relevant to the review of fluvial R&D related to flood defence currently being carried-out by B&P.		
3.	DLH went through the Briefing Note circulated prior to the meeting. Attention was drawn to the main points listed in the Briefing Note namely:- i) the aim of the review and the approach that was being adopted; ii) the aim of the NRA's R&D programme and the way in which it is structured, indicating that the present review is specifically concerned with Topic C1 (fluvial defences and processes) of Commission C (flood defence);		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	iii) the results of the recent MAFF review of flood and coastal defence R&D and its relation to the present study; iv) the results of the response by the NRA Regions to the questionnaire issued during the SERC Flood Channel Facility Review. In order to make the best use of the available time, DLH suggested that the following items should be considered in sequence:- a) Framework for NRA Topic C1 R&D b) Current NRA research programme, MAFF Review and SERC questionnaire topics c) NW Region's suggestions for R&D items d) NW Region's priorities in respect of R&D e) Any other relevant matters		
a)	**PROPOSED FRAMEWORK FOR NRA TOPIC C1 R&D** The four parts of the draft framework were considered in order, the following observations being made by the NW staff:- Table 7 Part 1 - Theme C1(a) Response to Meteorological Events. C1(a)5 PW was of the oppinion that "Forecasting" was the wrong title for C1(a)5 and that "Prediction" was more suitable. He was also of the oppinion that statistical analysis should be included as a specific subject in Part 1 of the framework Table 7 Part 2 - Theme C1(b) Prediction of Flows and Water Levels. C1(b)1 * RRW thought that the title of C1(b)1 "channel friction" was too narrow and that "channel resistance" was more appropriate, as it would cover other channel losses that must be considered, such as those at bends, meanders, junctions, contractions, expansions etc. C1(b)2 * PW and the others felt that the discharge through culverts should be included as one of the subjects in C1(b)2. The widely used U.S. Department of Transportation Hydraulic Charts only cover a limited number of sections and further work was considered necessary.		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	* PS thought that discharge through bridge openings should be included in C1(b)2. * RRW felt that discharge capacity and water surface profiles at channel junctions should constitute one of the R&D subjects included * Some discussion took place about the division of Part 2 into two sections - Hydraulics and Sediment Transport - as to whether this was necessary. PW thought that Part 2 should be reviewed and clarified. Was it necessary to have both C1(b)8 and C1(b)9 and couldn't they be brought together under "channel conditions"? * PW was insistent that the framework should include the design of environmentally acceptable channels and establishing the balance between their hydraulic design and environmental acceptability. Table 7 Part 3 - Theme C1(c) Control and Protection Structures. C1(c)1 * RRW thought that the title should be "Flow and level control" to acknowledge the fact that level control is one of the basic uses of gates or sluices, particularly by regions with navigational responsibilities. C1(c)6 * RRW and others considered that the title "Washlands" was far to restrictive and only ref3erred to one form of storage. It was considered that "Flood storage" would be preferable and would embrace washlands as well as offstream and onstream flood storage ponds and reservoirs. * It was felt that there were links between C1(c)6 and C1(c)3 through the need for energy dissipation at outlets from storage ponds and reservoirs and also to C1(c)7 by way of discharge through outfalls. C1(c)7 * There were doubts expressed about the inclusion of "drainage channels" in view of the subjects set down in Part 2 of Table 7. What was this item supposed to cover? * RRW noted that there didn't appear to be any subject heading in any part of the framework that would cover peat shrinkage or other ground subsidence or settlement that could affect the discharge from a drainage system.		

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	Table 7 Part 4 - Theme C1(d) Improving Efficiency and Effectiveness C1(d)1 * AHT asked whether "whole project costing" was the same as "life cycle costing" taking into account all design, construction, operating and maintenance costs throughout the life of the project. * A similar query was raised concerning the item "quality assessment". Was the item supposed to be "quality assurance" and if not, what did it cover?		
b)	**CURRENT NRA RESEARCH PROGRAMME, MAFF REVIEW & SERC QUESTIONNAIRE.** The NRA representatives were aware of the present NRA research programme and had also studied the MAFF review and the topics listed in the SERC Review quetionnaire.		
c)	**NORTH WEST REGIONS SUGGESTIONS FOR R&D TOPICS.** The NW representatives were asked by DLH to give their oppinions as to the most important subjects for research and development - bearing in mind the NRA's criteria for assessing such projects. The following suggestions were made by R.R.Westley, P.Spencer and Phil.Younge R.R.Westley * The most important subject as far as he was concerned was the study of the effects of silt deposition on the stability of channel banks. The deposition of silt on the banks of the River Mersey and the subsequent induced bank slips had cost the N.W.Region over £1M/annum in the past two years. A solution to the problem or its alleviation following hydraulic or other studies would lead to substantial financial savings. P.Spencer * PS was concerned at the lack of gauged data for urban catchments -particularly the smaller catchments and the need to obtain this and develop more accurate methods of estimating run-off for these conditions. * He was also concerned with the difficulties of collecting data in these urban areas in the face of vandalism and thought that some study should be carried-out into the problem. * The Flood Studies Report should be updated in the light of the additional data gathered since its publication and in particular, a new slim guide to its use should be prepared,		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	incorporating the material in the numerous supplementary reports. * There was a need for a guidance document on the capacity of channels with drowned berms. He didn't seem overpleased with the information that had come out of the SERC study so far! * He considered that there was a need for a new backwater model. Model HEC 2 was available but was old fashioned and not 'user friendly'. Equations have been improved and there is a need for an improved and more accurate model. This particularly applies where steep, supercritical channels are involved. * Bridges - there are a number of methods of calculating the sfflux through bridges and a need to carry-out an assessment of these and produce a guidance manual for practising engineers. The possibility of producing a good computer program for dealing with the problem should also be considered. * Weirs - non-standard weirs are often encountered and there is little guidance or data on establishing accurate discharge curves for them. Some further research or the preparation of guidance notes would be helpful. (quoted rectangular weir without end contractions and dropped centre section). * Further R&D work required to improve the accuracy of flood computational methods to meet higher demands being made in respect of cost/benefit analysis. * Manning's 'n' - estimates of roughness commonly made by considering the photographs in Ven Te Chow's 'OPen Channel Hydraulics'. The illustrations are of American rivers. Isn't it time that a similar set of photographs of British rivers? Phil.Younge * There is a need for further study of the discharge through culverts -taking into account more cross-sections than are covered by the U.S. charts. * Debris - considerable problems are caused by the debris that collects in channels at bridges and on screens. Investigation might lead to the cost of dealing with it. * Further research work is required in order to give practising engineers guidance in the design of environmentally acceptable channels.		

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	* The question of flood zoning is likely to be of increasing importance in the United Kingdom in the future. Practical guidance notes and recommendations should be produced for practising engineers following consideration of methods adopted in the U.S. and elsewhere.		
d)	**NORTH WEST REGION'S PRIORITIES IN RESPECT OF R&D.**		
	After some discussion it was agreed that the priorities for R&D work as far as the North West Region is concerned are:-		
	1. Study of the effects of siltation on bank stability.		
	2. Improved data and methods of computing urban flood flows.		
	3. Improved channel backwater program - inbank flows essential, overbank flows desirable.		
	4. Guidance on calculating head losses at bridges and production of comprehensive computer program.		
	5. Design information and guidance for environmentally acceptable channels.		
	6. Production of British photographic guide to channel rugosity.		
	7. New updated slim guide to Flood Studies Report.		
	8. Improved methods and guidance notes for establishing accurate head/discharge curves for non-standard weirs.		
e)	**ANY OTHER RELEVANT MATTERS.**		
	The NRA representatives agreed that their work would be made much easier if practical guidance notes and manuals were issued telling them how to make effective use of the latest available research and practice in their field.		

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Meeting Notes

SUBJECT REVIEW OF FLUVIAL R&D MEETING WITH NRA YORKSHIRE	FILE NAME & NUMBER 4176 - 2
Date & Time 1430 hrs. Wednesday 11th November 1992 Location	MEETING NUMBER X 9

Recorded by D.L. Hockin

PARTICIPANTS' NAMES	TITLE	REPRESENTING
Mr.D.Wilkes	Flood Defence Co-ordinator	NRA (Yorkshire)
Mr.K.Allison	Civil Engineer	NRA (Yorkshire)
Mr.J.Pygon	Conservation Officer	NRA (Yorkshire)
Mr.D.L.Hockin	Consultant	B&P

Circulation D.Wilkes, R.Young, G.Thompson, File

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
1.	David Rooke, Northern Area Engineer was scheduled to come to the meeting but was unable to attend.		
2.	The purpose of the meeting was to discuss matters relevant to the review of fluvial R&D related to flood defence currently being carried-out by B&P.		
3.	DLH went through the Briefing Note circulated prior to the meeting. Attention was drawn to the main points listed in the Briefing Note, namely:- i) the aim of the review and the approach that was being adopted; ii) the aim of the NRA's R&D programme and the way in which it is structured, indicating that the present review is specifically concerned with Topic C1 (fluvial defences and processes) of Commission C (flood defence);		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	iv) the results of the response by the NRA Regions to the questionnaire issued during the SERC Flood Channel Facility Review. In order to make the best use of the available time, DLH suggested that the following items should be considered in sequence:- a) Framework for NRA Topic C1 R&D b) Current NRA research programme, MAFF Review and SERC questionnaire topics. c) Yorkshire Regions suggestions for R&D items d) Yorkshire Regions priorities in respect of R&D e) Any other relevant matters		
a)	**PROPOSED FRAMEWORK FOR NRA TOPIC C1 R&D** The four parts of the draft framework were considered in order, the following observations being made by the Yorkshire NRA staff:- Table 7 Part 1 - Theme C1(a) Response to Meteorological Events. C1(a)4 * DW expressed the Yorkshire Regions interest in the development of telemetry systems for obtaining real time data and the links between developments in this field and items in C1(a)3 and C1(a)5. Table 7 Part 2 - Theme C1(b) Prediction of Flows and Water Levels C1(b)1 & C1(b)2 * The general concensus of oppinion was that these two sections should be combined. * KA raised the question of discharge capacity through bridge openings (see N.W.Report) and suggested that this subject should be included. * The question of discharge over washland banks was raised at this point and it was decided that it would best be covered by C1(c)1. Table 7 Part 3 - Theme C1(c) Control and Protection Structures		

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	C1(c)1 * It was considered that "flumes" should be included in the subject headings. C1(c)4 & C1(c)5 * KA pointed out the link between C1(c)4 and C1(c)5 and indicated that bank materials, construction and maintenance were of considerable importance and should be covered here or in some other part of the research programme (C4 ?). C1(c)6 * It was agreed that the subject title "washlands" was too restrictive and that "flood storage" would be preferable. * KA indicated that it was not just inflow, outfall and storage that concerned them in respect of washlands, but the need for more information on flow within the washland after it came into use. The question of discharge into washlands over floodbanks forming long natural spillways was also raised at this point and it was decided that it could be covered in C1(c)1. Table 7 Part 4 - Theme C1(d) Improving Efficiency and Effectiveness C1(d)1 * DW asked where cost/benefit analysis and any associated R&D fitted into the fluvial defence framework or other topics or commissions. Could it be considered as being considered by "scheme prioritisation"? * As at N.W., the meaning of "quality assessment" was raised. Did it mean "quality assurance" or was it an appraisal of the quality of work or workmanship - rather a subjective subject! * DW commented on the increasing importance of design team selection when increasing amounts of work were being put out to consultants and other agencies by the NRA. He thought that this subject should deal with the selection of 'outside' teams as well as those composed of NRA staff.		
b)	**CURRENT NRA RESEARCH PROGRAMME, MAFF REVIEW & SERC QUESTIONNAIRE.** The NRA representatives were aware of the present NRA research programme and had also studied the MAFF Review and the topics listed in the SERC Review questionnaire.		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
c)	**YORKSHIRE REGION'S SUGGESTIONS FOR R&D TOPICS.** The Yorkshire representatives were asked by DLH to give their oppinions as to the most important and urgent subjects for research and development - bearing in mind the NRA's criteria for assessing such projects. The following suggestions were made by John Pygon, Ken Allison and David Wilkes:- J.Pygon * There was a clear need for more information and guidance on the design of environmentally acceptable and sensitive channels and floodbanks. * There was a need to for guidance and the development of systems of cost/benefit analysis that embraced total benefits - including environmental costs and benefits. * Studies should be carried-out and guidance given on the establishment of a comprehensive design system, incorporating environmental requirements, that would cover scheme promotion, design team selection, post project appraisal and whole project costing (or lifetime costing). K.Allison * KA considered that further study and improved accuracy in establishing channel resistance and capacity were the first priority. Of the latter, channel capacity was considered the more important of the two. * He was concerned that research should be directed towards 'real channels' i.e. those encountered by the practising engineer in the urban environment, affected by the past works of man, rather than theoretical mobile bed channels and research of rather an indefinite nature into channel morphology. * More accurate information is required in respect of the discharge into washlands or flood storage ponds over long lenghts of overspill bank. * Further studies are required of flows within washlands after after water has spilled into them from the river. * Need for the collection of more data from urban catchments. * Need to digitise all national rainfall data. * Need to update FSR in light of additional records since first published.		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	* ~~Link between flood defence and water resource R&D and the~~ need for co-operation and avoidance of duplication in research work. * Further information and guidance required in respect of the effects of vegetation on channel capacity. * Practical guidance on assessing the discharge of two stage channels. (doubts expressed as to the 'practical' nature of manuals that might be forthcoming from the SERC studies!). D.Wilkes * Concern at the multiplicity of river models and of the oppinion that an 'audit' should be carried-out by competent and unbiased persons and a guidance document produced on model performance and their selection and use.		
d)	**YORKSHIRE REGION'S PRIORITIES IN RESPECT OF R&D.** Following discussion it would appear that the main priorities as far as the Yorkshire Region are concerened are:- 1. Improved methods of estimating channel capacity - including two stage channels. 2. Guidance on the design of environmentally acceptable channels and floodbanks. 3. Additional information on the effect of snowmelt on flood flows. (I.O.H. are already preparing a model for Yorkshire Region). 4. Audit and guidance document on the selection and use of river models. 5. Collection of additional data and the development of more accurate methods for computing the run-off from urbanised catchments. 6. Extending and digitising the present rainfall data.		
e)	**ANY OTHER RELEVANT MATTERS.** The NRA representatives agreed that the provision of guides and manuals telling them how to make effective use of the latest research and developments would in many instances be more helpful than additional research.		

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Meeting Notes

SUBJECT: REVIEW OF FLUVIAL R&D MEETING WITH NRA SEVERN/TRENT	FILE NAME & NUMBER 4176 - 2
Date & Time: 1030 hrs Friday 13th November 1992 Location:	MEETING NUMBER X 10

Recorded by: D.L. Hockin

PARTICIPANTS' NAMES	TITLE	REPRESENTING
Mr.R.Main-Smith	Princ.Eng. Policy & Planning	NRA S/T
Mr.S.Powers	Princ.Eng. Lower Trent	NRA S/T
Mr.D.L.Hockin	Consultant	B&P

Circulation: R.Main-Smith, R.Young, G.Thompson, File.

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
1.	The purpose of the meeting was to discuss matters relevant to the review of fluvial R&D related to flood defence currently being carried-out by B&P.		
2.	DLH went through the Briefing Note circulated prior to the meeting. Attention was drawn to the main points listed in the Briefing Note, namely:- i) the aim of the review and the approach that was being adopted; ii) the aim of the NRA's R&D programme and the way in which it is structured, indicating that the present review is specifically concerned with Topic C1 (fluvial defences and processes) of Commission C (flood defence); iii) the results of the recent MAFF review of flood and coastal defence R&D and its relation to the present study;		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
	iv) the results of the response by the NRA Regions to the questionnaire issued during the SERC Flood Channel Facility Review. In order to make the best use of the available time, DLH suggested that the following items should be considered in sequence:- a) Framework for NRA Topic C1 R&D b) Current NRA research programme, MAFF Review and SERC questionnaire topics c) Severn/Trent Region's suggestions for R&D items d) Severn/Trent Region's priorities in respect of R&D e) Any other relevant matters		
a)	**PROPOSED FRAMEWORK FOR NRA TOPIC C1 R&D.** The four parts of the draft framework were considered in order, the following observations being made by the Severn/Trent staff:- Table 7 Part 1 - Theme C1(a) Response to Meteorological events. C1(a)1 & C1(a)2 * RMS indicated that could be possible close links between work carried out under the above references and research that could be carried-out under topics C2 and C3 and care must be taken to avoid any duplication of effort. Table 7 Part 2 - Theme C1(b) Prediction of Flows and Water Levels. C1(b)2 * SP pointed out that provision should be made under this reference for work on the discharge capacity of bridges and culverts. C1(b)8 & C1(b)9 * RMS and SP thought that there were too many separate references in Part 2 and that C1(b)8 and 9 could be combined under the general heading of "conditions in channel" * Both RMS and SP pointed out that practising engineers are more often concerned with scour at structures rather than general bed scouring. The possibility had to be considered during the design		

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	stage and there must be a subject 'pigeon-hole' for this in the framework as well as for scour in natural channels. The subject could also be of some concern in C1(c)5. Table 7 Part 3 - Theme C1(c) Control and Protection Structures C1(c)1 * Both RMS and SP indicated that flumes and siphons should be included as subject headings under this reference. * The various types of control used in flood storage - both washlands and flood storage reservoirs could either be included under this reference or under C1(c)6 - some indication should be given to avoid any confusion. Possibly "outfalls" could be transferred to C1(c)1, drainage channels omitted altogether and reference C1(c)7 left to deal with pumping stations. C1(c)2 * Do gravel traps need to be included as a separate subject heading in this reference or is "silt traps" a generally acceptable, all-inclusive heading? C1(c)5 * It was felt that there was a link between this item and the asset survey being carried-out under Topic C4. C1(c)6 * It was considered that that the subject heading of "Washlands" was too narrow and that "Flood storage" would be preferable. * RMS thought that flood storage was a form of flow control and consideration might be given to incorporating the subjects in C1(c)1 and scrapping C1(c)6. C1(c)7 * What does this cover in view of C1(b)1 and C1(b)2 ? Couldn't drainage channels be dropped or included in the above references ?		
b)	**CURRENT NRA RESEARCH PROGRAMME, MAFF REVIEW & SERC QUESTIONNAIRE.** The NRA representatives were aware of the present NRA research programme and had also studied the MAFF Review and the topics listed in the SERC Review questionnaire.		

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
c)& d)	**SEVERN/TRENT REGION'S SUGGESTIONS FOR R&D TOPICS AND PRIORITIES.** The Severn/Trent representatives were asked to give their oppinions as to the most important and urgent subjects for research and dvelopment - bearing in mind the NRA's criteria for assessing such projects. The following suggestions were made and are set down in order of priority:- 1. Debris - further study is required of the impact of debris on flows in channels and the problems created by it at control points, bridges, screens etc. 2. Erosion & Deposition - further study required in order to find methods of reducing erosion and controlling deposition - with the object of minimising maintenance costs. 3. Further work and guidance notes required on the design of environmentally acceptable channels and channels with submerged berms. 4. Flood zoning - this was seen as something that will be of increasing importance in the U.K. and a study should be carried-out with a view to producing guidance notes to ensure a unified approach in all regions. 5. Bank vegetation - a study should be made of the effects of bank vegetation on channel capacity. This should include the seasonal effects and changes brought about by channel maintenance. 6. The mapping of flood plains and systems of recording the data are of increasing importance. Guidance on the best available systems is required. (Subject might be covered in Topic C3 !) 7. Models - there is a need for a "Which" unbiased guide to the river models that are presently available giving information on their strengths and weaknesses - in particular how accurately they deal with such things as flow through bridges and culverts. 8. It was felt that there was a need for a publication giving an overview of research topics and their possible application to the work of practising river engineers. The publication should include a bibliography of further reading.		

FILE NUMBER MEETING NUMBER

ITEM NUMBER	NOTES	DUE DATE	FOLLOW-UP ACTION BY
e)	**ANY OTHER RELEVANT MATTERS.** The NRA representatives were agreed that the provision of guides and manuals telling them how to make effective use of the latest research and developments would, in many instances, be more helpful than additional research. Stewart Powers however was strongly opposed to any suggestion that an NRA comprehensive design manual should be produced. He was of the oppinion that such a publication would soon be considered as 'holy writ' by the powers that be and would stifle further progress and innovation.		

APPENDIX C

BRAINSTORMING SESSION

NATIONAL RIVERS AUTHORITY Job No 4176

REVIEW OF FLUVIAL R&D RELATED TO FLOOD DEFENCE

BRAINSTORMING SESSION - BRIEFING NOTE 11 January 1993

1. Introduction

1.1 Binnie & Partners have been appointed to carry out a review of the NRA's Flood Defence R&D programme for Topic C1 - Fluvial defences and processes. The overall objective of the review is to identify and prioritise a strategic R&D programme for the topic, taking note of other R&D work being carried out by the NRA and externally. Specific objectives are:

- to appraise the UK and overseas state of knowledge on relevant subjects and the research programmes being undertaken or proposed;
- to determine actual and perceived gaps in knowledge, resulting in recommendations or (for imaginary gaps) dissemination of information or training;
- to recommend areas where further research is needed, assign priorities and indicate, where possible, costs and benefits.

1.2 Discussions have been held with senior staff in the regions and HQ as part of the study, to identify areas of interest and concern with regard to the subjects covered by the topic. This process is to continue during a brainstorming session with selected staff to be held on 19th January 1992. The purpose of this note is to provide background information to the people participating in the brainstorming session.

1.3 Administrative details concerning the session and a list of participants are being sent with this note.

2. Purpose of Brainstorming Session

2.1 The purpose of the brainstorming session is to discuss and answer the following questions:

1. What should be the aims of the NRA's R&D programme related to flood defence in general and this topic in particular?

2. How should the other NRA functions be taken into account when developing the R&D programme for the topic?

3. What projects should be included in the R&D programme for the topic, what priority should be attached to them and why and the benefits that are likely to result?

2.2 In answering these questions the views of staff in the regions need to be taken into account and a brief summary of the main points to come out of the regional meetings is therefore included in this note. This is followed by brief discussions of the three questions given above.

3. Outcome of Regional Meetings

3.1 Another Briefing Note was circulated to all NRA staff attending the regional meetings. The contents of the note included:

- a brief description of the aims of the study and the approach being adopted;
- an outline of the NRA's duties, obligations and aims, including the inferred aims of its R&D programme;
- a brief description of the current NRA R&D programme;
- a summary of the results of previous reviews of fluvial R&D, carried out by NRA and MAFF;
- a list of the subjects included in the scope of Topic C1, divided into hydrology, hydraulics (including hydraulic modelling and sediment transport), river structures and information transfer and training.

A copy of the note is attached.

3.2 Each region was asked for their general comments on the NRA's R&D programme, for their comments on the list of subjects covered by Topic C1 given in the Briefing Note (particularly concerning links or overlaps with other R&D topics/commissions) and for specific areas of concern which they would like to see addressed in the R&D programme. As might be expected, the response from each region varied, largely as a result of differences in regional characteristics but affected also by individual experience. Nevertheless, a number of common features emerged and are summarised below.

3.3 Comments on the NRA's R&D programme included the following:

- The programme must be properly focused on the NRA's immediate and long-term needs, producing results that will give identifiable savings by improving the efficiency and effectiveness of the organisation. This is not perceived to be the case at present.

- The programme must be organised as efficiently as possible, taking into account the needs not only of flood defence but also of the NRA's other functions (particularly conservation, navigation, fisheries and recreation). This cross-functional approach should be considered when identifying and specifying individual research projects as well as when setting out the overall programme.

- To ensure that the intended improvements are achieved the results of any R&D must be relayed to the regions rapidly and in a form that is readily usable. Time (and money) should also be allowed for training staff in its use. Again, this is not perceived to happen at present.

- Reviews of current practice and guidance notes on available techniques would, for some subjects, be more valuable than further research.

3.4 Comments on the list of subjects were as follows:

- Some of the subjects may be more appropriately considered under other R&D topics (for example some of those in the section on hydrology overlap with Topic C2, River Flood Forecasting),

- need to emphasise links between flood defence and other NRA functions, particularly conservation but also navigation, fisheries and recreation, pointing out that decisions (concerning both scheme design and river management) taken for flood defence reasons can affect or be affected by these other functions.

Two more general points follow on from the second comment; first the need to consider other NRA functions from the very beginning of the scheme assessment/design process and, second, the need to take an overall geomorphological approach when assessing the effects of both new schemes and river management proposals.

3.5 A fairly large number of concerns that could be addressed in the R&D programme were mentioned during the meetings. The ones mentioned most frequently (and in various forms)

were:

- guidance on flow resistance/conveyance and how this is affected by different channel sections (two-stage channels, meandering streams etc), by different management practices (weed, grass and shrub cutting, single bank working, different dredging practices), at different seasons;

- guidance on the discharge characteristics (especially at high flows) of a wide range of hydraulic structures, particularly bridges and culverts of different shapes but also gate structures, skewed weirs, fish passes etc;

- review of hydraulic models and modelling techniques, both steady-state and dynamic, indicating their complexity, ease of use, adaptability and cost and identifying the types of model appropriate for different types of problem;

- guidance on sediment management techniques, sediment transport modelling and application of geo-morphological techniques to these subjects.

3.6 Other interesting suggestions included:

- effect of land use changes (particularly field drainage and afforestation) on runoff rates;
- review of Flood Studies Report techniques for flood estimation;
- design of structures to prevent mal-operation (particularly jamming of gates);
- guidelines for operational handover documentation;
- detailed long-term monitoring of selected schemes;
- bank protection in high energy flows;
- methods of repairing breaches in tidal and non-tidal river banks..

4. The Aims of the NRA's R&D Programme

4.1 The Briefing Note circulated before the regional meetings suggested that the aims of the NRA's R&D programme should be to support its policy development, improve its ability to carry out its statutory duties and its efficiency/effectiveness and to increase its general knowledge and understanding of the aquatic environment. Individual projects should be assessed in the light of their costs and benefits to the NRA and the problems addressed should

significantly affect its efficiency or effectiveness, relate to national policy issues, be of general application and relevant to most regions rather than site-specific, unlikely to diminish in the future and not duplicate other research.

4.2 Although useful as general guidelines, these aims give little assistance in setting out a programme for a particular topic. More specific aims are required for this, developed in response to such questions as:

- what does the NRA need to know about fluvial defence and processes?
- is the need for this knowledge likely to change as the role of NRA changes, in particular with the introduction of market testing, the proposed division of client and contractor services and the possible increase in the use of external contractors for design, construction and management/maintenance works?
- will the progress towards multi-functional, catchment-based management alter the knowledge required or the way in which this knowledge should be organised?
- should the R&D programme concentrate on the collection of new information and the development of new techniques or on the consolidation and dissemination of existing knowledge?
- how should the R&D programme be organised to allow its results to be brought into general use as rapidly as possible?

5. Effect of NRA's Other Functions on Flood Defence R&D Programme

5.1 The purpose of this question is to identify the links between the various NRA functions so that individual R&D projects can be selected and specified in a way which will provide the greatest amount of information at the most economical cost. "Links" in this context is taken to mean those actions which are primarily related to one function but which also have an effect on another function. To take an example; weeds in rivers may be cut for flood defence purposes (to increase conveyance) but this action may affect navigation and conservation.

5.2 There are essentially two problems here, one of identification and one of presentation. One presentation possibility is a matrix, as shown in Table 1. The identification of important links and the clearest way of presenting the information are both matters to be addressed during the brainstorming session. The method of presentation should, as far as possible, demonstrate the unified cross-functional approach that is implied in the NRA's adoption of catchment-based management.

6. Selection of R&D, Priorities and Costs

6.1 The final and most important part of the session will be the selection of candidate R&D projects for Topic C1, agreeing priorities and estimating costs. In doing this, attention must be paid to work that is already in hand or proposed elsewhere, for example as a result of the MAFF Advisory Committee report referred to in the Briefing Note for the regional meetings. Due note may also be given to the outcome of these meetings, summarised in Section 3 above.

Action	NRA Function					
	Flood Defence	Water Quality	Water Resources	Fisheries	Recreation and Navigation	Conservation
Construction						
Flood bank	XX	O	O	O	X	X
Drainage	XX	X	X	O	O	X
Bank protection	XX	O	O	X	X	X
Weir	X	X	XX	X	X	X
Lock	X	X	O	O	XX	X
etc						
Operation						
Weed removal	XX	O	O	O	X	X
Dredging	XX	X	O	X	X	X
Grass cutting	XX	O	O	O	X	X
Shrub/tree pruning	XX	O	O	O	X	X
Flow management	X	O	XX	X	X	X
etc						

XX Function indicating the action
X Function affected by the action
O Function not affected by the action

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NATIONAL RIVERS AUTHORITY Job No 4176

REVIEW OF FLUVIAL R&D RELATED TO FLOOD DEFENCE

OUTCOME OF BRAINSTORMING SESSION 19.1.93.

1. BACKGROUND

1.1 Binnie & Partners have been appointed to carry out a review of the NRA's Flood Defence R&D programme for Topic C1-Fluvial defences and processes. The objective of the review is to identify and prioritise a strategic R& D programme for the topic, taking note of other R&D work being carried out by the NRA and externally.

1.2 When the scope of the review was determined the importance of drawing on the experience of staff directly involved with flood defence on a day-by-day basis was recognised. To enable this to take place a programme of meetings with senior staff in each region and HQ was arranged. A number of the individuals at these meetings were then invited to attend a brainstorming session at which three issues were to be addressed:

1. What should be the aims of the NRA's R&D programme related to flood defence in general and this topic in particular?

2. How should the other NRA functions be taken into account when developing the R&D programme for the topic?

3. What projects should be included in the R&D programme for the topic, what priority should be attached to them and why and what benefits are likely to result?

1.3 The brainstorming session took place at NRA's London office on 19 January 1993, starting at 10.30 am and continuing until about 4.30 pm. this note describes the activities that took place and summarises the results obtained.

2. ATTENDANCE AND PROCEDURE

2.1 A list of the people attending the meeting, the regions in which they work and their job titles is given in Table 1. The session was led by David Woodward from Henley management college and three representatives from the study consultants (two from Binnie & Partners) were also present.

2.2 The programme adopted for the meeting was as follows:

10.30-11.00	Introduction
11.00-12.45	Exercise 1 - Picture writing
12.45-1.30	Lunch
1.30-4.30	Exercise 2 - Key phrase sorting
4.30-4.45	Summing up

The instructions for each exercise are given in Tables 2 and 3.

2.3 In Exercise 1 the participants were divided into three groups which were placed in separate rooms. Each group was asked to discuss what the NRA should be doing in 5 years time, what would hinder the progress to this and how this should be reflected in the R&D programme. They were then asked to draw a picture to convey their ideas and afterwards to talk the whole group through the picture.

2.4 In Exercise 2 a statement related to flood defence and the NRA was displayed and discussed. Following this each participant was asked to write down some key-words or phrases describing an idea prompted by the statement. These ideas were sorted into categories and their relevance to the NRA in general and the R&D programme for Topic C1 discussed. Participants were then asked to consider whether the value of the ideas in each category should be classified as High, Medium or Low and whether the achievement would be Easy, Medium or Difficult.

3. RESULTS ON PICTURE WRITING SESSION

3.1 The pictures produced by each of the three groups are shown in Figures 1, 2 & 3. The ideas behind each picture are discussed briefly below.

Group 1 - Tree (Figure 1)

3.2 The representation of the NRA in 5 years time chosen by Group 1 was a tree with seven branches, one for each of the NRA's functions. These were arranged like a fan, all having equal importance, so that together they would be reminiscent of a catchment (thus emphasising the importance of both a multi-functional and a catchment wide approach to the NRA's activities). The outline of the foliage was coloured green not only because foliage is this colour but also to stress the NRA's commitment to the environment.

3.3 For the tree to flourish strong roots are needed, in particular appropriate techniques, accurate and sufficient data, well defined standards of service, an educated work force and an educated public (achieved through consultation). During the subsequent discussion appropriate management practices, a strong company ethos and a diversity of approach were also suggested as being important roots. The key to obtaining and maintaining strength in the roots was considered to be adequacy of funding ie money.

3.4 The factors that could hold back the growth of the tree were represented by a chain saw. The thoughtless continuation of traditional practices was considered to be a potentially important impediment, although the point was made that these practices may have developed for sound reasons and that they need to be carefully assessed before being discounted. In contrast to this, too rapid change was also considered to be dangerous because of the uncertainty that would result and the impact on staff morale and commitment. The third hindrance noted was spending pressures due to inadequate resources.

3.5 R&D, represented by a watering can, was considered to be the main factor that would promote growth, through its stated aims of improving the effectiveness and efficiency of the NRA's operations and so providing good value for money. An important aspect of this was thought to be the promotion of a comprehensive, all

round approach to all activities, summarised in the phrase 'design for all seasons'.

Group 2 - Swimmer (Figure 2)

3.6 Group 2's picture represented the NRA as a swimmer (to indicate the link with water) reaching towards a leaf-shaped cloud (again green to symbolise commitment to the environment) with veins suggestive of rivers and streams in a catchment. Whether the choice of a cloud as the goal was intended to suggest its nebulous nature or the perceived difficulty of achieving it was not made clear. The cloud contained symbols representing the current functions of the NRA and the ones that will be added when HMIP is incorporated (Integrated Pollution Control and Waste Disposal).

3.7 The group considered that a number of practices would need to be introduced to the NRA if the goal is to be achieved successfully. These include multi-functional catchment management, a common rational approach, flood plain rather than river management and value for money.

3.8 Weights connected to the swimmer's legs were intended to represent the factors that would hold prevent attainment of the goal. Politics, inadequate funding, excessive bureaucracy and contractor practices were identified as being possibly important in this context, as were leadership (presumably if inadequate) and strategic agreements (presumably if these agreements involve excessive compromise, indicating a link with politics). During discussion insufficient staff with right approach or qualifications was also suggested as being a possible hindrance.

3.9 R&D was thought of as assisting the swimmer to achieve his goal and was denoted by a coach with a megaphone and a tool kit containing bolt cutters to allow the weights to be removed. Specific bolt cutters included new or revised planning, design and management techniques together with a manual of existing best practice. The point was made during discussion that it was important to provide the right tools at the right price and that this could best be done by concentrating on the heaviest weight.

Group 3 - Catchment (Figure 3)

3.10 The picture put forward by Group 3 was more direct than the other two, showing a typical catchment with symbolic representation of the major matters concerning flood defence rather than the NRA in general. The separation between main river and non-main river was indicated by a tributary extending beyond the flood plain (which was clearly marked). The importance of data was indicated by a radar scanner in the upper reaches, conservation by trees in the flood plain, heritage by windmills, fisheries by fish, navigation by a boat, recreation by an angler and water resources by a weir. Water quality aspects were represented by homes and a factory and the impact of the NRA's own works by a dragline operating on the riverbank.

3.11 The importance of the environment and the need to value environmental benefits was represented by a pair of scales while the need for an integrated approach to catchment management was shown by three inter-locking circles. A computer and operator placed within the inter-locking section indicated the importance of modelling to the NRA's activities, for use by all functions not only as a planning tool but also as a management system.

3.12 A number of points arose during discussion, in particular the need for an integrated approach to flood plain development control involving all interested parties (local authorities, counties and NRA) and the need to organise the use of models and collection of modelling data so that all functions can make use of them. The need to maintain a proper data-base system for each catchment was emphasised, as were the dangers of moving to a 'cook-book' approach to engineering rather than dealing with problems on their merits. A potential obstacle to the flood defence function was considered to be the availability of money (particularly the need to raise the money from a number of different sources)while practices that need to be introduced included the presence of ex-flood defence staff in senior positions within the NRA and the proper recording of costs to assess value for money (particularly of maintenance). Finally, the lack of a channel classification system to assist in the general operation of the flood defence function was cited as a serious obstacle to the introduction of a unified, national approach.

Conclusions

3.13 Overall the three groups had very similar ideas about the direction in which the NRA should be moving. They all highlighted the importance of environmental considerations and at least hinted at the need for the NRA to be seen by the public as being concerned with environmental matters. The importance of a multi-functional catchment based approach, with proper co-ordination between functions, was emphasised as was the need to consider the whole flood plain rather than just the river channel.

3.14 There was considerable agreement also about the possible obstacles, the three most important being seen as inadequate funding (which was also related to the way in which funding is obtained), the difficulty of bringing about the changes needed (particularly where this involved breaking with traditional practices, although a warning note about trying to introduce change too rapidly was also raised) and inadequate management allied to over-complicated procedures tending to stifle individuality. There was also some concern about whether the NRA would have sufficient numbers of staff with the ability, training and experience needed by the new organisation.

3.15 The obstacles listed above were reflected in the needs of the organisation that were identified, particularly the need for effectiveness, efficiency and value for money, the need for good management to promote this and the need for education and training. R&D was seen as making a major contribution to supplying these needs by providing improved techniques for the planning, design and management of all functions. It was stressed, however, that R&D should be cost-effective and therefore should be focused on real and significant obstacles to the proper functioning of the NRA.

4. RESULTS OF KEY PHRASE SORTING SESSION

4.1 Following a short discussion the participants were asked to focus on the needs of the Flood Defence Service, statutory, technical and managerial. There followed a period of about 10 minutes, during which a total of 113 key points prompted by this were written down. These points were each discussed and sorted into a total of 17 categories, of which 12 (containing 56 points) were considered to relate to Flood Defence R&D Topic C1. The remaining 5 topics were concerned with more general aspects of the NRA; the environment (4 points), job costing (7 points), external/statutory issues (12 points), training (10 points) and management (24 points). A full list of all the points mentioned, grouped into categories, is given in Annexe A.

4.2 The NRA staff members present at the meeting were asked to assess the value of each category and how difficult it would be to attain. Table 4 lists the categories and gives the results of this assessment. The categories are ranked by a range of criteria (number of votes for high or medium value, easy or medium attainment and different combinations of these) in Table 5. The numbers of appearances of each category in the top 3 and top 6 of the rankings are given in Table 6 which indicates that the following categories were considered both valuable and attainable (with greater emphasis on the former):

1	Post project appraisal
4	Best practice manual
10	Designing with nature
12	Specification methods
7	Model appraisal/assessment
5	Data needs for flow regimes

Discussion

4.3 A number of interesting points were raised by the key point sorting exercise, the first being the obvious concern of the participants with matters not directly concerned with topic C1, particularly management issues (25 out of 113 points raised) but also external/statutory issues (12), training (10) and job costing(7). Of the categories within the topic, numbers 3 and 11 (flood plain definition and change in land use

effects) had a number of votes for high value but few for medium value and did not score highly on attainment. Number 2 (total catchment modelling) scored reasonably well for value but very low on attainment. Numbers 6, 8 & 9 (river typology, model application and model specification) were all medium to low scorers on both counts and appeared to be of relatively little interest, only attracting 2, 1 and 1 key points respectively during the original brainstorming session. Number 7 (model appraisal/assessment) also appeared to be of relatively little interest initially, attracting 0 key points, but nevertheless scored sufficiently well in the voting stage to be placed in the group of valuable and attainable categories.

4.4 The two categories that scored best in the exercise were numbers 1 and 4 (post project appraisal and best practice manual). These scored consistently well both on value and attainment. Number 10 (designing with nature) also scored consistently, as did number 12 (specification methods). Number 7 (model appraisal/assessment) was relatively low in value but was considered easy to attain while number 5 (data needs for flow regimes) was higher in value but considerably more difficult to attain.

4.5 Looking in more detail at the key points listed under each category (Annexe B) suggests that had more time been available for the sorting procedure some of the points may have been moved to different categories. A number of the points under 'Training' for example, would equally well be included under category 4 (best practice manual) for example, and vice versa. Overall, however, it would appear that the categories selected do represent the points they contain reasonably well.

4.6 It is possibly dangerous to draw too many conclusions regarding specific research projects from the results of the session, nevertheless some of the points listed in Annexe B could well form the basis for future work. A representative selection is given in Table 7.

5. CONCLUSIONS

5.1 The brainstorming session gave useful information concerning the direction in which the group perceived the NRA should be moving/what is needed by the NRA to achieve this. This information will be of assistance in identifying and prioritising an R&D programme for Topic C1 but may also have wider application.

5.2 There was considerable emphasis on the importance of environmental issues to the NRA and the need for a multi-functional, catchment-based approach. The need for good management was also emphasised, inadequate management being identified as being one of the possible obstacles to achieving the aim of taking proper care of the nation's rivers. Other obstacles were inadequately trained staff and inadequate funding.

5.3 A wide range of points were suggested as being important in relation tot he statutory, technical and managerial needs of the NRA. These were categorised, the categories relevant to R&D topic C1 generally considered to be both valuable and reasonably attainable including:

Post project appraisal
Best practice manual
Designing with nature
Specification methods (particularly for river management)
Model appraisal/assessment
Data needs for flow regimes

TABLE 1

ATTENDANCE AT BRAINSTORMING SESSION 19.1.93.

Name	Organisation	Position/interest
1. Session facilitator		
David Woodward	Henley Management College	Consultant
2. NRA HQ (and advisor)		
Mervyn Bramley	Bristol	Head of R&D
Lindsay Pickles	Bristol	R&D Commissioner, Flood Defence
Paul Raven	Bristol	R&D Commissioner, Conservation
Nigel Holmes	Alconbury Consultants	Conservation advisor
3. NRA Regions		
Peter Barham	Anglia	Conservation and recreation
Alex Bound	Thames	Operations
Andrew Brookes	Thames	Geomorphology
Bill Grigg	Wessex	Operations
John Outram	Severn Trent	Operations
Peter Spencer	North West	Hydraulic modelling
David Wilkes	Yorkshire	Project leader
4. Study Consultants		
Graham Thompson	Binnie & Partners	Partner
Richard Young	Binnie & Partners	Associate/Project Manager
David Hockin	Ex NRA North West	Consultant

TABLE 4

CATEGORIES, WITH VALUE AND ATTAINMENT ASSESSMENTS

		Value			Attainment		
Category	No of key points	High HV	Medium MV	Low LV	Easy EA	Medium MA	Difficult DA
1. Post project appraisal	6	8	3	0	5	4	2
2. Total catchment modelling	4	4	7	0	0	0	11
3. Flood plain definition/ identification	6	6	4	1	3	5	3
4. Best practice manual	6	9	1	1	4	7	0
5. Data needs for flow regimes	8	7	3	1	1	8	2
6. River typology	2	4	5	2	2	8	1
7. Model appraisal/assessment	0	4	5	2	6	4	1
8. Model application	1	2	9	0	1	8	2
9. Model specification	1	4	5	2	3	6	2
10. Designing with nature	15	7	3	1	2	8	1
11. Change in land use effects	11	5	2	4	1	7	3
12. Specification methods	5	6	4	1	4	5	2

TABLE 5

CATEGORY RANKINGS

Value		Attainment		Value + attainment	
HV	HV+MV	EA	EA+MA	HV+MV+EA	HV+MV+EA +MA
4	1	7	4	1	4
1	2	1	7	7	1
5	8	4	10	4	10
10	4	12	6	12	8
3	10	9	1	3	5
12	5	3	12	10	12
11	12	10	9	9	7
2	3	6	8	8	6
6	7	8	5	5	3
7	6	5	3	2	9
9	9	11	11	6	11
8	11	2	2	11	2

Key: HV High value
MV Medium value
EA Easy attainment
MA Medium attainment

TABLE 6

RANKING SUMMARY BY NUMBER OF APPEARANCES

	Number of appearances		Total
Category	in Top 3	in Top 6\	(Top 3+7 op 6)
1	5	6	11
2	1	1	2
3	0	3	3
4	5	6	11
5	1	3	4
6	0	1	1
7	2	2	4
8	1	2	3
9	0	1	1
10	2	5	7
11	0	0	0
12	0	5	5

TABLE 7

SELECTED KEY POINTS FROM APPENDIX A

1. Detailed post project appraisal of selected schemes
2. Preparation of best practice manual for flood defence works
3. Techniques for river restoration
4. Geomorphological approach to river problems
5. Effect of different maintenance practices
6. Methods of specifying for maintenance contracts
7. Classification of river type for improved river management
8. Selection of contractors

Exercise 1

STEPS

1 Spend 5 minutes individually thinking about where you think the flood defence service should be in 5 years time. What do you think will hinder the achievement of this? How should the R&D strategy reflect this?

Sketch a picture/cartoon that conveys your ideas.

Write down any key words or phrases that you think help describe your image.

2 In your team come to a consensus about your views. Combine the pictures (or draw a completely new one) on a flip chart and again add (agreed) key words or phrases. You have twenty five minutes for this phase.

3 Talk the whole group through your combined picture (five minutes).

Exercise 2

STEPS

1 Use the statement displayed as your starting point. What ideas spring to mind? On an empty Post-It write down key-words or phases which describe that idea.

2 When the leader says "Time" put the sheet back into the centre of the table.

3 Take another sheet from the pile.

4 Read any Post-Its already completed.

5 Write any ideas on a fresh Post-It again using key-words or phrases to describe the idea.

6 Repeat steps 2 to 5 until leader stops the exercise

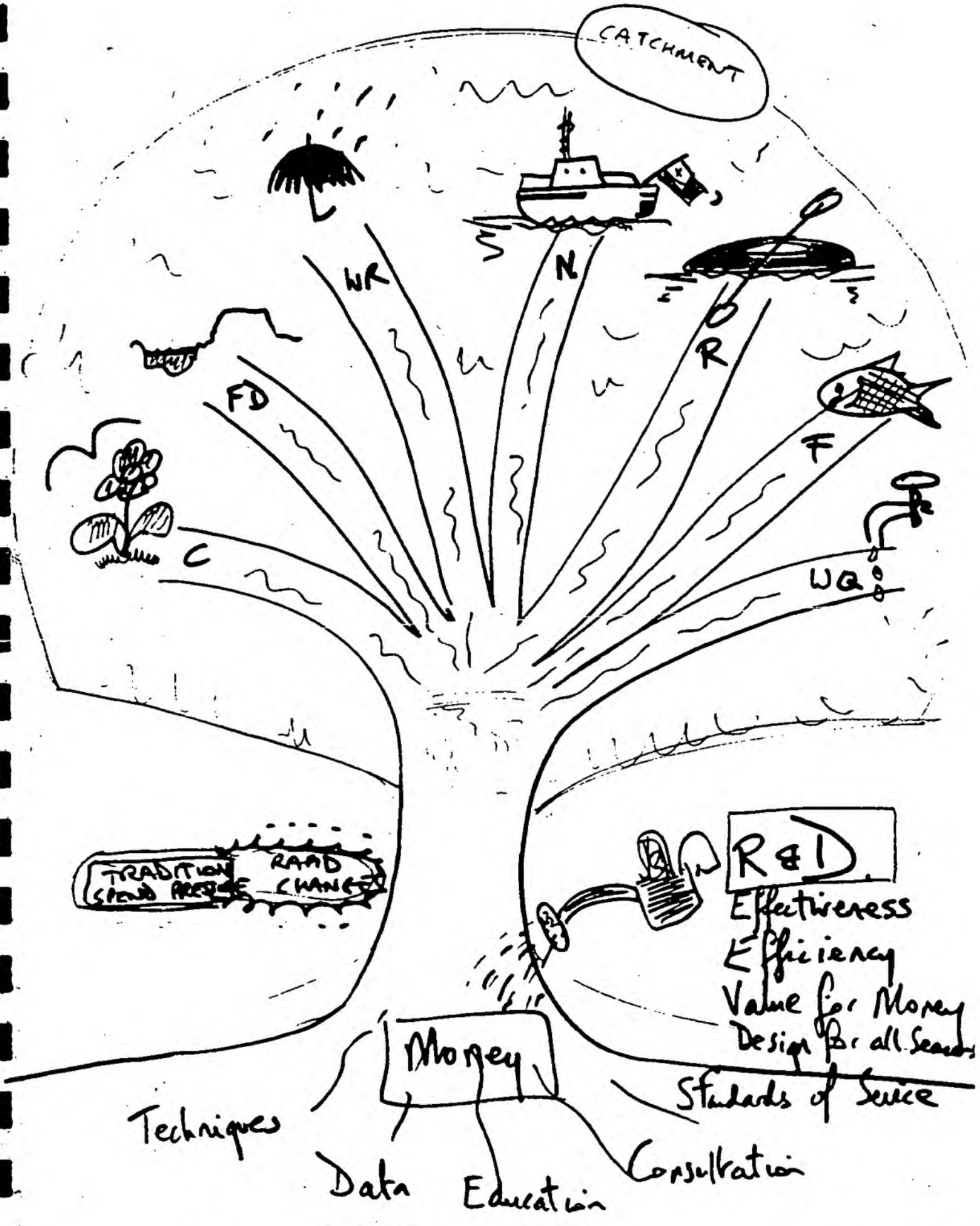

FIGURE 1: TREE (GROUP ONE)

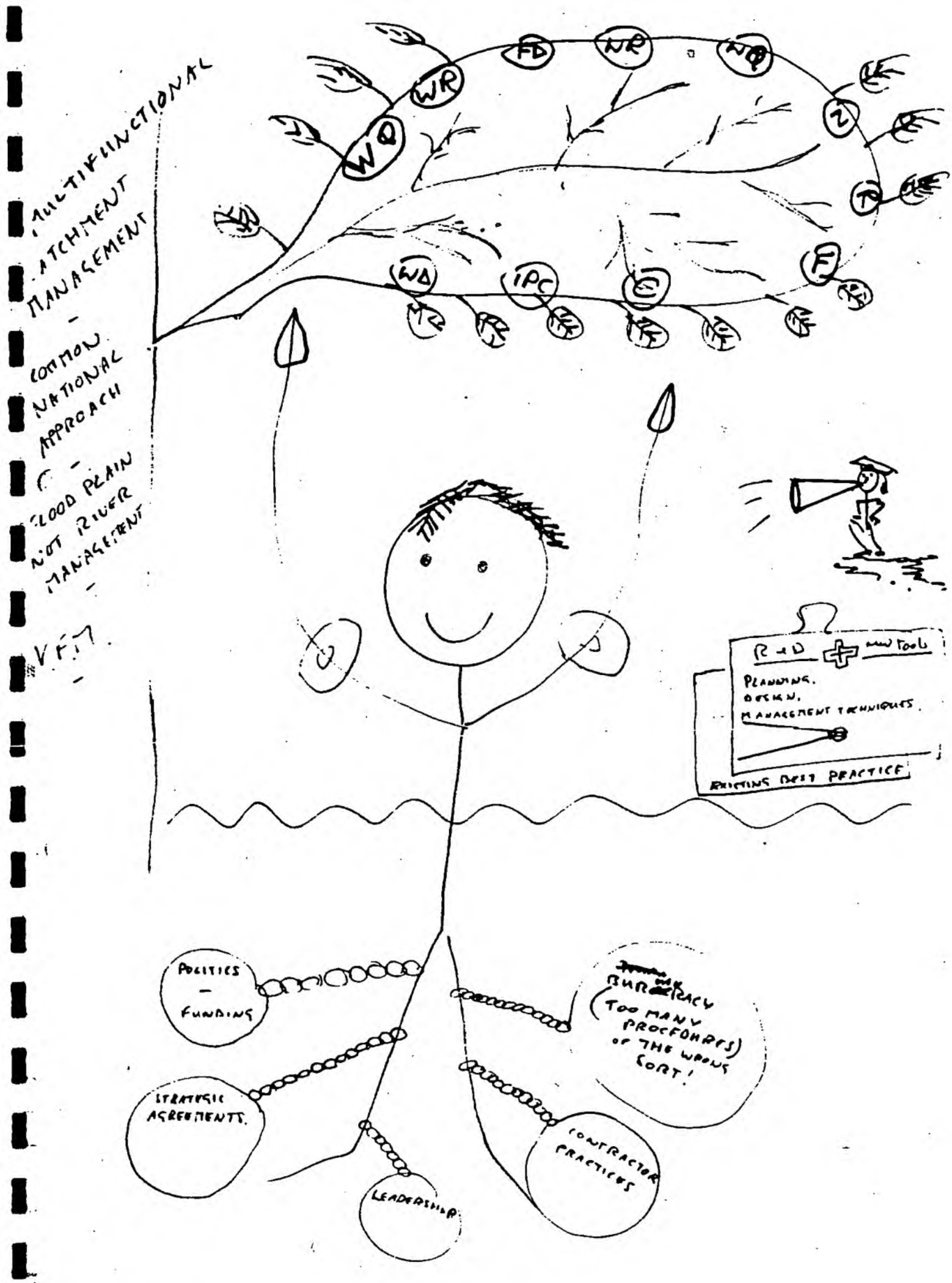

FIGURE 2: SWIMMER (GROUP TWO)

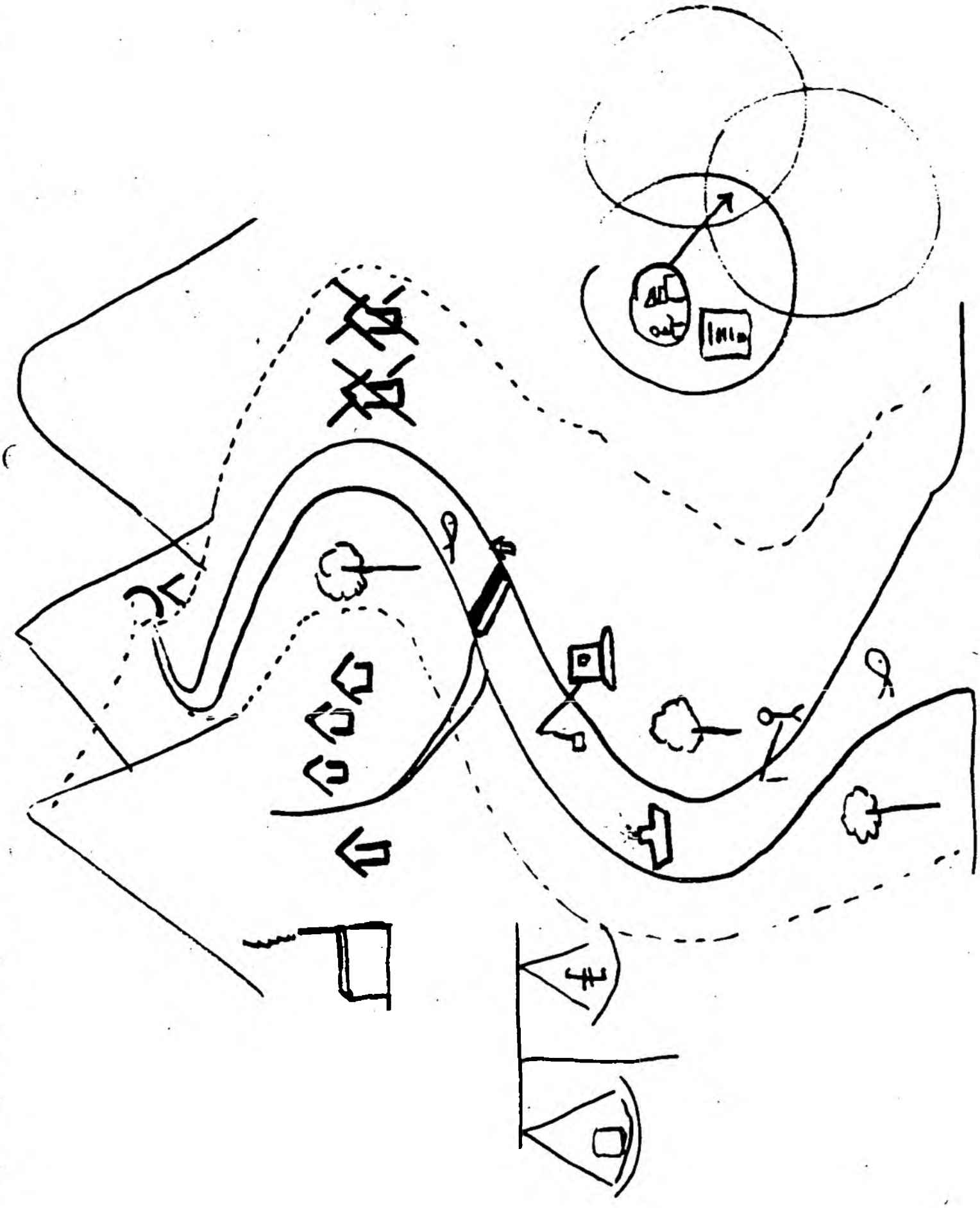

FIGURE 3 : CATCHMENT (GROUP THREE)

ANNEXE B

RESULTS OF NRA BRAINSTORMING MEETING HELD IN LONDON ON 18 JANUARY 1993

1. POST-PROJECT APPRAISAL

- Greater use of post-project appraisal to assess R&D requirements.
- Post-Project Appraisal & Audit - Learn by past mistakes and successes. Draw on the experience obtained over the last 5, 10, 50 years.
- How do maintenance practices affect flood defence?
- PPA of both FD technical "value" and environmental impact.
- Monitor specific schemes/catchments closely to get long-term data.
- Need for historical data on assets (Maintenance & operation).

2. TOTAL CATCHMENT MODELLING

- Integrate models for main and non-main river, sewers and groundwater catchments for completeness.
- Catchment Modelling - to integrate the models to be used for flood forecasting, management, design etc. with other functions models.
- Catchment-based approaches (model; channel classification) enabling flood defence resources to be more appropriately targetted.
- Produce catchment data base for use by all functions.
- Look to enhance water resources through FD.
- Definition and use of full flood system catchment wide concepts rather than reach specifications.
- Modelling techniques to give answers useful to several disciplines.

3. FLOOD PLAIN - Definition & Identification

- Reduce L/SoS in rural areas - allow rivers to be natural again.
- Use of flood plains as both flood defence assets and conservation assets.
- Is flooding in flood plains welcome? - ie. it reduces flood risk in areas where flood damage may be expensive.
- Identify land at risk from flooding in the absence of artificial flood defences.
  Rapid, cost effective method.
  To provide consistent results across whole of country.
  DO NOT GET STUCK WITH NEED FOR ABSOLUTE ACCURACY.
- Increase use of floodplains for flood defence and attenuate hydrographs.
- Flood Zoning concepts and definition for different uses/concerns.

4. BEST PRACTICE MANUAL FOR ENVIRONMENTAL ASPECTS OF FLOOD DEFENCE

- Engineer training to include more information on hydrology, fluvial processes, ecology etc.
- Ecologist training to include more on engineering, hydrology, geology, river processes etc.
- Training of Non-FD people in FD problems and solutions.
- Improved holistic education.
- Training for catchment managers for the future needs.
- Common catchment vision.
- An understanding of environmental issues - and consequences.
- Produce practical guidelines for morphological approach to river problems.

5. DATA NEEDS FOR ALL FLOW REGIMES

- Improve knowledge of urban run-off - by R&D and additional data.
- Use gauge station data to produce catalogue of channel roughness at near bank full discharge.
- Catalogue time to peak for existing gauging stations.
- Appropriate levels of detail for each task.
  - modelling data
  - project management data.
- Need for reliable flood flow data.
- Monitoring techniques to establish what flows are in the river, and the bank full capacity.

6. RIVER TOPOLOGY FOR FDS

- Timescales - Relate flood defence problems to the appropriate timescale (1, 10, 10,000 years etc).
- River Topology - Classification of river types for improved river management.

7. MODEL APPRAISAL ASSESSMENT

8. MODEL APPLICATION

- Calibration of structures
  - Data
  - Easily understood analysis rules.

9. MODEL SPECIFICATION

- User specification of computer modelling requirements.

10. DESIGNING WITH NATURE

- Do we have 'natural rivers'?
- What are environmental implications?
- Restoration of rivers as primary aim, not flood defence - especially in rural areas.
- River restoration - "natural rivers" as customer requirements and therefore FD needs may need readdressing.
- Explore, through practical means, technical approaches to restoring wildlife value as suggested by legislation.
- Simplified internal liaison.
- Use of geomorphology as design process in both flood defence and restoration - ie. the two should be planned together.
- Design for all season. Explore best design for both low flows and flood flows, for improved navigation and water quality and fisheries.
- Develop soft options into appropriate restoration.
- Environmentally acceptable designs. Research into "soft" solutions, especially monitoring their success (eg. willow spiling).
- Geomorphology. Use of river morphology in the development of strategic research (eg. Standards of Service) and applied research problems.
- Working with nature - all engineering works to result in self-sustaining system which maximises stability and minimises maintenance. Also needs to address target levels of service within that.

11. CHANGE IN LAND USE - EFFECTS

- Landownder requirements should not overide overall catchment requirements.
- Land use requirements - long-term agricultural/development plans.

12. SPECIFICATION

- Standard conditions of contract for contractor/consultants.
- Methods of assessing whether a sucessful contractor can do the work prior to award.
- Improved specifications for schemes/projects - detailed briefs to determine severity of problems. Where do you stop the detail of the brief?
- Techniques for writing briefs and specifications for contracted services.
- Methods of specifying for maintenance contracts.

13. ENVIRONMENTAL

- Environmental Standards of Service.
- The economics of environmental assessment and to integrate EA with cost benefit techniques.
- Environmental Assessment. As a means of integrating functional views into the solution of a flood defence problem.
- Cost-benefit analysis for environment/recreation.

14. JOB COSTING

- Proper justification of maintenance work.
- Job costing systems.
- Value for money. New techniques? Strategies to save money. What causes a problem? Is there a better and cheaper solution (eg. the do nothing)?.
- Ensure proper mechanism available for comparison of own staff and work force with outside bodies. Ensure that all factors involved are taken into consideration.
- Identify expenditure on individual aspects of work.
- Consider life cycle costings not go for immediately cheapest solution.
- Integration of capital and maintenance. An understanding of whole project costs.

15. EXTERNAL / STATUTORY

- How to deal with the constraints of flood defence committees who control funding and have a vested interest.
- Identify resource implications of statutory duties.
- Liaison with other land drainage authorities.
- Regular liaison with other bodies re: flooding problems.
- Consultative liaison groups.
- Clarify rôle of NRA where there are objectors to it's proposals.
- Link planning requirement with other strategic approaches eg. local authority.
- NRA contribution towards changed or improved legislation ie. make sure legislation bye-laws etc are appropriate.
- Explain who are the prime movers:
  - FD Managers
  - RFDC's
  - Government
  - Local people.
- Customer requirements:
  - User group feelings.
- Lobby insurance companies so that they do not insure properties in flood risk areas.
- Legal requirements for protection of people, but what about property?

16. MANAGEMENT

- Asset audits. Ensure that river & cost per river records are available.
- Quality control measures.
- Consideration of management issues such as Standards of Service implications - rather than just technical issues.
- Identify minimum requirements for beaurocratic infrastructure.
- Get rid of people who are still in landowners pocket!!
- Get NRA to sort out it's information systems (computer) Log Jam.
- How to reduce power of IS Depts compared with computer users?
- Treat IS with extreme caution - rely on common sense.
- Reveiw administration procedures to reduce 'paper pushing' and free staff to concentrate on real problems.
- Use technical staff more effectively - eg. engineers may not make good administrators.
- Multi-functional approach. Explore ways of integrating eg. through Environmental Assessment.
- Sharing of data and resources.
- Most economical use of resources (human, financial, data etc).
- Maintain an experienced, qualified, professional staff.
- Select Managers, particularly "top" managers, more carefully!!
- Encouragement of regional initiatives - not just the imposition of national procedures and practices.
- Test methods of management to meet FD and other needs.
- Supportive rather than dictatorial managment.
- Stop all R&D until outputs from existing projects have been appraised/implemented.
- Improved outputs with respect to operational staff.
- Ensure that R&D done is for the benefit of activities upon which most money is spent.
- Promote the use of the "coach". Who is the person and how could they operate?
- An appreciation of the disruption caused by restructuring!
- A National approach or framework with the ability for local/area staff to implement with freedom. National consistency for a National body.

17. TRAINING

- More effort required in taking pure R&D output and fitting it to the current and future business needs of the Flood Defence Service.
- More emphasis on staff development & benefits of belonging to and participating in professional organisations (ie. appropriate one!) - RESIWEM.
- Spend more money on education and training on ideas which are already understood.
- Education of Managers to reduce mis-perceptions (eg. of what can be done with present data - "a detailed study will determine whether the return period was 15 or 17 years").
- Improved Training - Seminars required on specialist areas to educate non-specialist project managers.
- R&D which is simple to use (eg. with graphs, diagrams, choices - or with an Idiot's Guide attached).
- Improved committment to R&D to make it more user-oriented.
- Transfer of information between regions.
- Better transfer of information within the organisation, on problems and techniques for solving them.
- Feedback existing research and current industry practice.

APPENDIX D

CURRENT FLUVIAL R&D PROJECTS

UK Organisations

Ministry of Agriculture, Fisheries and Food (MAFF)

D.1 MAFF do not carry out any R&D directly but fund work carried out by other organisations. The majority of the work of interest is currently being undertaken by Hydraulics Research and the Institute of Hydrology and is discussed under those headings.

D.2 MAFF have recently (1992) undertaken a detailed review of R&D needs related to flood and coastal defence. A total of 50 projects related to fluvial flooding were identified and prioritised. These are listed in the briefing note prepared for the regional consultations (Appendix B, Briefing Note, Table 6).

Hydraulics Research Ltd. (HR)

D.3 The R&D work that is to be carried out by HR and funded by MAFF in the forthcoming year includes the following:-

- the application of 2-D and 3-D numerical models to assess the degree of error that can be expected when using 1-D models for complex flow situations,
- calibration criteria for numerical models,
- 1-D backwater modelling in meandering compound channels,
- methods of measuring flood flows,
- catalogue for channel roughness assessment,
- effect of channel maintenance (weed cutting) on capacity,
- improved procedure for calculating flow resistance due to channel bends,
- scoping study to identify areas of research that would benefit from mobile bed studies on the SERC Flood Channel Facility.

The scoping study for the SERC Flood Channel Facility is to be completed by July 1993 at which stage the question of whether to modify the facility for mobile bed studies will be made.

Institute of Hydrology (IOH)

D.4 The R&D work carried out by IOH is generally of less relevance to the subjects covered by Topic C1 but fluvial hydraulics play some part in the following projects:-

- within channel transport of contaminated sediments,
- integration of radar-rainfall-runoff models with hydraulic models for real-time flood forecasting,
- the role of balancing/settling ponds in urban areas, focused in particular on hydraulic modelling and sediment transport.

Construction Industry Research and Information Association (CIRIA)

D.5 Relevant R&D work CIRIA currently have in hand includes:-

- design of flood storage ponds,
- performance of wedge-shaped blocks in high velocity flow,
- field evaluation and demonstration sites for bioengineering and bank protection,
- manual on infiltration methods for stormwater run-off control.

CIRIA have recently published one report and two books which are relevant to Topic C1:-

- Scope for control of urban run-off, R123/R124, 1992 (Maskell, Leonard & Sherriff)
- Protection of river and canal banks, 1989 (Hemphill & Bramley)
- Use of vegetation in civil engineering, 1990 (Coppin & Richards)

Institution of Civil Engineers (ICE)

D.6 The ICE do not fund research but have recently published reports on research priorities for construction (1990) and long-term and fundamental research for civil engineering (1992). These include the following topics:-

- geomorphological classification of rivers,
- interaction of flow over flood plains and river channels,
- investigation of bank and bed erosion,
- weedcutting and weed control methodologies,
- investigation and improvement of the stability of canal banks and embankments.

Overseas Organisations

Danish Hydraulic Institute (DHI)

D.7 The work being carried out at DHI is largely related to numerical hydraulic modelling, current studies including:-

- flood plain sedimentation for incorporation in a 1-D numerical model,
- multi-layer cohesive and non-cohesive sediment transport modelling, 1-D and 2-D,
- control and optimisation in 1-D numerical models.

Delft Hydraulics (DH)

D.8 At Delft, as at DHI, research is concentrated on fundamental issues with the priority areas being associated with numerical and physical modelling. Numerical modelling includes 2-D and 3-D models, with and without sediment transport phenomena, and considerable effort has been put into grid generation and flow visualisation. A 2-D morphodynamic model has been developed as well as models for examining the transport and behaviour of a variety of pollutants. Much attention has also been paid to the investigation of scour problems

and erosion downstream of structures.

American Society of Civil Engineers (ASCE)

D.9 A review of recent papers published in the ASCE journals shows general interest in numerical modelling techniques, geomorphology and the effect of vegetation on channel flow and capacity. A paper describing future trends and needs in hydraulics emphasises the importance in river engineering of understanding the local physical processes involved in the supply and movement of sediment, pointing out that there is often a wide (and generally unseen) gulf between the conditions on which theoretical approaches are based and the conditions encountered in the field.

Australian Civil Engineering Transactions (ASCT)

D.10 Papers published recently indicate that basic R&D on flow in two-stage channels is being carried out and that potentially useful relationships have been developed for the analysis of such flows.