Flooding Survey June 1990

Upper Severn Catchment

NRA
National Rivers Authority
Severn-Trent Region

RIVER CATCHMENT AREAS

Severn-Trent Region Boundary

Catchment Boundaries

Adjacent NRA Regions

1. Upper Severn **2.** Lower Severn **3.** Avon **4.** Soar
5. Lower Trent **6.** Derwent **7.** Upper Trent **8.** Tame

NRA

National Rivers Authority
Severn-Trent Region

FLOODING SURVEY

JUNE 1990

SECTION 136(1) WATER ACT 1989

(Supersedes Section 24(5) Water Act 1973

Land Drainage Survey dated January 1986)

UPPER SEVERN CATCHMENT

SHROPSHIRE AND POWYS

FLOOD DEFENCE DEPARTMENT
NATIONAL RIVERS AUTHORITY
SEVERN-TRENT REGION
SAPPHIRE EAST
550 STREETSBROOK ROAD
SOLIHULL
W MIDLANDS B91 1QT

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Lower Trent Catchment and Nottinghamshire
River Avon Catchment and Warwickshire
River Soar Catchment and Leicestershire
River Tame Catchment and West Midlands
Upper Trent Catchment and Staffordshire
River Derwent Catchment and Derbyshire
Lower Severn Catchment, Gloucestershire and Hereford and Worcester

LIST OF APPENDICES

REFERENCES

1 "Interim Report - Section 24(5) Survey" - Published by Severn-Trent Water Authority, July 1978.

2 "Flood Studies Report" Vols I-V, Natural Environmental Research Council (1975).

3 "The Benefits of Flood Alleviation" - E C Penning- Rowsell and J B Chatterton, published by Saxon House, Teakfield Ltd.

4 "Medway Letter" - Ministry of Agriculture and Fisheries (1933). Available in Wisdom's "Land Drainage", Sweet and Maxwell, London (1966).

5 DoE Circular 17/82 - "Development in Flood Risk Areas - Liaison between Planning Authorities and Water Authorities" published in 1982.

GLOSSARY OF TERMS

ADAS	- Agricultural Development and Advisory Service: part of the Ministry of Agriculture, Fisheries and Food (MAFF).
Arterial drainage	- The drainage channels conveying surface water run-off, effluent, etc. (excluding farm ditches, underdrainage and sewers) to the estuaries.
Benefit	- The return from investment in flood alleviation and land drainage improvement schemes.
Benefit area	- The geographical area in which direct benefit is obtained, usually either the maximum extent of flooding in an urban area or the land below the 'Medway Letter Line' in an agricultural area.
Catchment	- The geographical area from which rainfall will drain, by gravity, to a particular river and its tributaries.
Design flood	- The maximum flood for which the flood alleviation works will provide protection.
Discount rate	- The rate for converting all current and future benefits to present values.
Flood Q (T)	- The flood with a recurrence interval or return period of T years.
Floodplain	- The area of land adjacent to a watercourse which is inundated when the flow in the watercourse exceeds the capacity of the channel. The outer limit is usually the maximum extent of past recorded floods.
Freeboard	- See section 2.6.3.
Gross margin	- The gross output of an agricultural enterprise less the variable costs.
Intangible benefits	- The benefits that result indirectly from flood alleviation works, but which are not normally financially quantifiable. These can include freedom from anxiety, potential loss of life, cost of emergency services, etc.
Land potential	- An indication of soil profile characteristics such as structure, texture, depth, stoniness, etc which determines the ability of a soil to produce crop growth.
Main river	- The watercourses shown on the statutory 'main river maps' held by the National Rivers Authority and the Ministry of Agriculture, Fisheries and Food. The NRA has permissive powers to carry out works of maintenance and improvement on these rivers.
Mean annual flood Q	- The arithmetic average of annual maximum floods.
Normal water level	- The water level under average flow conditions.
Return Period	- The average length of time separating flood events of the same magnitude.
Underdrainage	- The drainage required in fields to ensure that the whole area drains satisfactorily to farm ditches or arterial watercourses. This may be tile drains, mole drains or subsoiling.
Variable costs	- Costs incurred in producing a crop, excluding fixed costs such as rent, rates and permanent labours. Variable costs include costs of seed, fertiliser, concentrates, vetinary costs, sprays and casual labour.

PREFACE

THE NATIONAL RIVERS AUTHORITY

The National Rivers Authority was established in September 1989 to be responsible for protecting and improving the water environment. It is an independent public body responsible for the regulatory functions formerly carried out by the water authorities, along with other important statutory duties. Its main tasks are:

- flood defence
- water quality and pollution control
- water resource management
- fisheries, conservation and recreation
- navigation

The NRA is a national body with a small central policy unit. Most of the employees work for the ten regional units which undertake day-to-day operations.

The NRA has a chairman, who along with other members is appointed by the Government - 12 by the Department of the Environment, 2 by the Ministry of Agriculture, Fisheries and Food and one by the Welsh Office. The MAFF appointees have a special responsibility for representing land drainage and fisheries interests.

SEVERN-TRENT REGION

The Severn-Trent Region is the second largest of the 10 regional units of the NRA both in size and population. It covers a diverse area of more than 8,000 square miles (21,600 sq km) and includes nearly 4,000 miles of rivers and watercourses.

The region is based upon the catchments of the Rivers Severn and Trent. The borders stretch from the Bristol Channel in the south to the Humber Estuary in the north, from Mid-Wales to the East Midlands.

The NRA is not responsible for navigation in the Severn-Trent Region. This is the responsibility of the British Waterways Board and a number of navigation trusts.

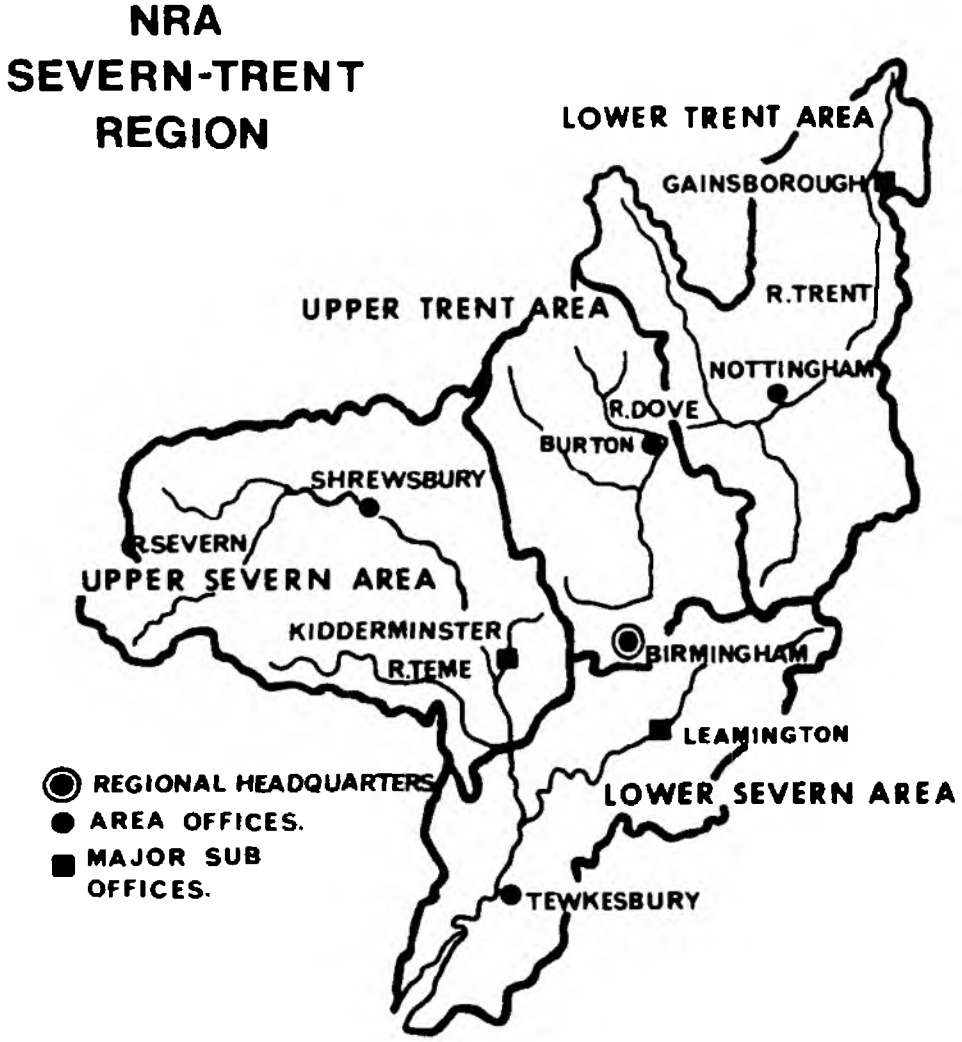
The headquarters of the NRA Severn-Trent Region is in Solihull, West Midlands.. The Area organisation is catchment based with four areas of roughly equal size, achieved by dividing the Severn catchment at the confluence of the Severn and Teme and the Trent catchment at the Trent-Dove confluence. These areas are called Upper Severn, Lower Severn, Upper Trent and Lower Trent, with area offices at Shrewsbury, Tewkesbury, Burton-on-Trent and Nottingham. Within each area there are smaller sub-offices and depots.

The NRA in the region works with three statutory committees which meet in public three or four times a year:-

Flood Defence Committee - This committee has 21 members appointed by the NRA, MAFF and local authorities. The committee has executive powers to discharge the NRA's flood defence and land drainage functions.

Rivers Advisory Committee - This committee is appointed by the NRA to advise on the broad framework of river basin management. It consists of representatives of local authorities, leisure groups, conservation interests, industry and agriculture and other interested parties.

Fisheries Advisory Committee - This committee has 15 members and advises the NRA on the discharge of statutory duties to maintain, develop and improve fisheries.



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CHAPTER 1

SUMMARY

1.0 SUMMARY

1.1 Introduction

1.1.1 This updated survey is one of eight surveys on the major river catchments in the Severn-Trent Region. Each survey provides information appertaining principally to a major catchment, extended to include the whole of the major County associated with it.

1.1.2 The primary purpose of the surveys is the identification and evaluation of flooding and land drainage problems and this summary provides information to facilitate rapid assimilation and comparison of costs, benefit/cost ratios and priority categories of these problems.

1.1.3 This survey supersedes the 1980 survey and the 1982 and 1986 revisions

1.2 Coding System

1.2.1 Every problem identified has been given a code number. The code numbers appropriate to each problem were originally classified in the "Interim Report of Survey"[1] of July 1978. That original classification remains unchanged for this Report but numbers have been added where new problems have been identified since the publication of the Interim Report. The codes applicable to catchments and County and District Councils are shown in Appendix A4 and the format of the code is as follows:

	x	xx	xxx	xx
	Catchment	County	District	Number
eg	1	83	310	27
	Upper Severn	Salop	Oswestry	Problem No.

1.3 Priority Categories

1.3.1 In order to establish a range of priorities to which an individual improvement scheme can relate, all improvement schemes have been categorised on the basis of:

(i) the size of the benefit/cost ratio
(ii) the cost of the arterial part of the improvement works (ie. excluding field drainage and ditching costs).

These categories are shown below.

Category by Benefit/Cost Ratio

CATEGORY	BENEFIT/COST RATIO	
	GREATER THAN	LESS THAN
1	2.0	
2	1.0	2.0
3		1.0

Category by Arterial Costs

CATEGORY	ARTERIAL COST (£'000)	
	GREATER THAN	LESS THAN
A	1000	
B	500	1000
C	100	500
D	50	100
E	10	50
F		10

1.4 Summary of Problem Evaluations

1.4.1 The problem evaluations which are shown in detail in Appendix A1 are summarised in Table 1. This Table shows costs, benefit/cost ratios and priority categories for every problem identified, and enables District Councils and County Councils to assimilate rapidly the total extent of improvements required in their areas and the priorities of the individual requirements within that total.

1.4.2 The page number within Appendix A1 of the evaluation of every identified problem is shown adjacent to the problem number in column 2 of Table 1.

1.4.3 It should be noted that the costs and benefits are to a December 1989 price base and that the watercourses marked * are main river or partly main river.

1.4.4 In some cases a single solution covers a number of identified problems. In these cases, the solution is detailed under the first problem number and all other relevant problem numbers are referred to it.

1.5 Summary by Priority Category

1.5.1 Tables 2 and 3 summarise, for both main river and non-main river, the numbers of problems in each category and the total cost of their associated improvement works. This summary includes only those problems in the catchment area and has been prepared primarily to provide the Ministry of Agriculture, Fisheries and Food with an overall appraisal of the total cost of improvements required throughout the Region. The total cost includes anticipated capital expenditure on current main river schemes and therefore represents a global summary of ongoing and future capital expenditure.

1.6 Identification of problems and their evaluation

1.6.1 The primary purpose of this Survey is to enable rapid identification of problems and the improvement works required to these problems. This can be done using the following system:

i) EITHER
Identify on the 1:25,000 scale maps, which accompanied the 1980 Report, the area of interest and note the code number of the benefit area or point source shown.
OR
Knowing the District or County Council in which the interest lies identify the relevant code number (see Section 1.2 of this Report and Appendix A4).

ii) Refer to the "Summary of Problem Evaluations" in Table 1 for brief details of costs, benefit/cost ratios and priority categories for the requisite watercourses in that District. All costs and benefits are at a December 1989 price base.

iii) Further information on individual schemes will be found in the detailed reports in Appendix A1. The relevant page is shown in the "Summary of Problem Evaluations".

1.6.2 The sheet numbers on the 1:25,000 scale maps in the 1980 album can be located by reference to the grid system shown on the rainfall map at the front of that album. The following diagram shows, as an example, the method for locating sheet number SK 46.

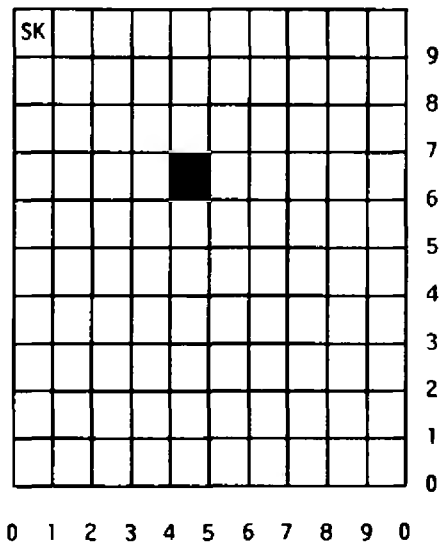

TABLE 1

SUMMARY OF PROBLEM EVALUATIONS

Note: All costs and benefits are to December 1989 price base
* Main River
\# New problems since 1986 revision

Code Number	Appendix A1 Page No.	Watercourse	Location	Arterial Cost (£'000)	Benefit/ Cost	Priority Category
BRIDGNORTH DISTRICT COUNCIL						
1-83-110-1	1	None	SJ 790 030	Highway problem		
1-83-110-2	2	Wesley Brook	SJ 743 067	167	0.3	3C
1-83-110-3	4	River Worfe	SJ 762 023	159	0.3	3C
1-83-110-4	5	Albrighton Brook	SJ 795 045	127	0.3	3C
1-83-110-5	-	Borle Brook	SO 753 817	Problem alleviated		
1-83-110-6	-	Alveley Brook	SO 746 863	Problem alleviated		
1-83-110-7	7	Quatt Brook	SO 754 884	14	0.5	3E
1-83-110-8	8	*River Severn	SO 750 831	432	0.5	3C
1-83-110-9	9	*River Severn	SO 724 943	689	0.4	3B
1-83-110-10	10	*River Severn	SO 723 913	1983	0.5	3A
1-83-110-11)						
1-83-110-12)	12	Stratford and Hilton Brooks	SO 757 945	418	1.4	2C
1-83-110-13	-	Tributary of Harley Brook	SJ 618 016	Problem alleviated		
1-83-110-14	13	Mad Brook	SJ 709 042	291	1.8	2C
1-83-110-15	14	Burlington Brook	SJ 761 113	112	1.5	2C
2-83-110-1	15	River Corve	SO 547 901	173	5.1	1C
2-83-110-2	16	River Rea	SO 662 804			
2-83-110-3	17	Un-named	SO 604 888			
NORTH SHROPSHIRE DISTRICT COUNCIL						
1-83-210-1	-	Tetchill Brook	SJ 380 296	Problem alleviated		
1-83-210-2	-	*River Perry	SJ 398 252	Scheme completed		
1-83-210-3	18	*River Roden & Back Brook	SJ 511 285	845	5.2	1B
1-83-210-4	20	War Brook	SJ 432 206	660	1.4	2B
1-83-210-5	21	Sleap Brook	SJ 472 271			
1-83-210-6	22	River Roden	SJ 462 334	424	7.9	1C
1-83-210-7	23	Wolverley Brook	SJ 472 306	1078	7.2	1A
1-83-210-8	-	Tributary of Sleap Brook	SJ 498 275	Problem alleviated		
1-83-210-9	24	Wemsbrook	SJ 509 286	170	0.4	3C
1-83-210-10	25	*River Roden	SJ 565 240	542	1.2	2B
1-83-210-11	26	Hawk Lake Brook	SJ 552 291	219	6.2	1C
1-83-210-12	27	Sundorne Brook	SJ 536 174	415	1.0	2C
1-83-210-13	28	Steel Brook	SJ 553 358	164	5.4	1C
1-83-210-14	29	Sandford Brook	SJ 581 341	326	3.2	1C
1-83-210-15	30	Darliston Brook	SJ 586 331	259	4.6	1C
1-83-210-16	31	Sidley Moor Brook	SJ 555 308	300	5.8	1C
1-83-210-17	32	*River Tern	SJ 642 242	381	8.1	1C
1-83-210-18	33	Platt Brook	SJ 631 227	285	2.8	1C
1-83-210-19	34	*Potford Brook	SJ 635 222	430	2.7	1C
1-83-210-20	35	Smythemoor Brook	SJ 630 328	167	4.4	1C
1-83-210-21	36	River Tern	SJ 698 368			
1-83-210-22	37	Sambrook	SJ 714 260	259	5.5	1C

Code Number	Appendix A1 Page No.	Watercourse	Location	Arterial Cost (£'000)	Benefit/ Cost	Priority Category
1-83-210-23	38	River Tern	SJ 672 336	1081	2.6	1A
1-83-210-24	39	Houlston Brook	SJ 485 264	652	3.4	1B
1-83-210-25	40	Tributary of River Tern	SJ 736 418	61	3.3	1D
1-83-210-26	42	Tributary of Soulton Brook	SJ 540 298	308	8.2	1C
1-83-210-27	43	Muckleton Brook	SJ 602 201			
1-83-210-28	44	*River Tern	SJ 628 315	666	2.7	1B
OSWESTRY BOROUGH COUNCIL						
1-83-310-1	45	Woolston Brook	SJ 318 243			
1-83-310-2	46	*River Morda	SJ 305 245			
1-83-310-3	47	Frankton Brook	SJ 365 299	291	10.8	1C
1-83-310-4	48	Tributary of River Perry	SJ 315 329	383	0.4	3C
1-83-310-5	49	Tributary of River Perry	SJ 312 315	320	0.4	3C
1-83-310-6	50	*River Perry	SJ 347 303	473	1.4	2C
1-83-310-7	52	Common Brook	SJ 337 308	196	1.0	2C
1-83-310-8	53	Hindford Brook	SJ 332 326	389	4.4	1C
1-83-310-9	-	*River Perry	included with 1-83-310-6			
1-83-310-10	54	Tributary of River Perry	SJ 360 297	326	1.4	2C
1-83-310-11	-	River Morda	SJ 290 280	Problem alleviated		
SOUTH SHROPSHIRE DISTRICT COUNCIL						
1-83-410-1	-	*River Camlad	SJ 273 003	Problem alleviated		
1-83-410-2	55	Worthen Brook	SJ 318 043			
1-83-410-3	-	Aston Brook	SJ 344 062	Problem alleviated		
1-83-410-4	56	Worthen Brook	SJ 334 042	167	1.9	2C
1-83-410-5	58	*River Camlad	SO 249 997	199	0	3C
1-83-410-6	59	Cound Brook	SO 461 953			
1-83-410-7	60	Cardingmill Stream	SO 454 941	231	0.2	3C
1-83-410-8	61	Tributary of Aylesford Bk	SJ 274 014			
1-83-410-9	62	Crankwell Brook	SO 221 990	185	1.4	2C
1-83-410-10	63	Aylesford and *Rea Brooks	SJ 277 015	232	1.1	2C
2-83-410-1	64	Brockton Brook	SO 327 858	6	2.3	1F
2-83-410-2	65	River Clun	SO 396 758	294	3.5	1C
2-83-410-3	66	*River Corve	SO 494 790	55	0	3D
2-83-410-4	67	Town and Marsh Brooks	SO 454 933	323	2.2	1C
2-83-410-6	-	Tributary of River Clun	SO 391 817	Problem alleviated		
2-83-410-7	68	Tributary of Brockton Brook	SO 319 873	Highway problem		
2-83-410-8	-	Tributary of Brockton Brook	SO 337 890	Problem alleviated		
2-83-410-9	-	Tributary of River Onny	SO 433 827	Problem alleviated		
2-83-410-10	-	Town and Marsh Brooks	included with 2-83-410-4			
2-83-410-11	69	River Kemp	SO 335 857	311	3.4	1C
2-83-410-12	70	River Redlake	SO 373 743	81	3.2	1D
2-83-410-13	71	River Redlake	SO 315 765	12	3.5	1E
2-83-410-14	72	*River Teme	SO 300 724			
2-83-410-15	-	River Clun	included with 2-83-410-2			
2-83-410-16	74	Ledwyche Brook	SO 540 764	26	3.7	1E
2-83-410-17	75	Tributary of Mill Brook	SO 635 767			

Code Number	Appendix A1 Page No.	Watercourse	Location	Arterial Cost (£'000)	Benefit/ Cost	Priority Category
2-83-410-18	76	*River Corve	SO 555 907	153	3.9	1C
2-83-410-19	77	Pye Brook	SO 537 847	58	0	3D
2-83-410-20	78	Clee Brook	SO 560 843	26	0	3E
2-83-410-22	79	*River Teme	SO 523 693			
2-83-410-23	80	River Teme	SO 245 760		8.5	1F
2-83-410-24	81	Gosford, Orleton and Brimfield Brooks	SO 486 669	101	4.5	1C
2-83-410-25	82	*River Teme	SO 592 683	1294	0.9	3A
2-83-410-26	83	Corn Brook	SO 617 685	3	0.4	3F
2-83-410-27	84	River Redlake	SO 302 767	86	3.5	1D
2-83-410-28	85	Ledwyche Brook	SO 567 700	26	3.6	1E
2-83-410-29	86	Tributary of Brockton Brook	SO 321 870	3	0	
2-83-410-30	87	Tributary of Brockton Brook	SO 324 885			
2-83-410-32	88	Colly Brook	SO 580 730			
2-83-410-33	89	#River Clun	SO 304 807			
SHREWSBURY AND ATCHAM BOROUGH COUNCIL						
1-83-510-1	90	Minsterley Brook	SJ 384 066	210	2.9	1C
1-83-510-2	92	America Brook	SJ 375 154	66	1.6	2D
1-83-510-3	93	Pontesford Brook	SJ 408 076	130	0.9	3C
1-83-510-4	94	Habberley Brook	SJ 403 037	9	1.6	2F
1-83-510-5	-	Tributary of Rea Brook	SJ 443 097	Problem alleviated		
1-83-510-6	-	Tributary of Rea Brook	SJ 484 101	Problem alleviated		
1-83-510-7	95	*Rea Brook	SJ 433 098			
1-83-510-8	96	Tributary of Cruckton Brook	SJ 412 095	52	0	3D
1-83-510-9	97	Cruckton Brook	SJ 433 097			
1-83-510-10	98	Bagley Brook	SJ 493 131	205	0.4	3C
1-83-510-11	99	Tributary of Rea Brook	SJ 481 099	210	0.1	3C
1-83-510-12	100	*River Perry	SJ 440 174			
1-83-510-13	101	Cob Brook	SJ 481 192	9	2.0	2F
1-83-510-14	102	Cot Brook	SJ 489 134	435	0.3	3C
1-83-510-15	-	Radbrook	SJ 490 120	Problem alleviated		
1-83-510-16	104	*River Severn	SJ 505 140	3458	2.9	1A
1-83-510-17	105	Cound Brook	SJ 567 062	701	1.3	2B
1-83-510-18	107	Cound Brook	SJ 558 057	98	0.5	3D
1-83-510-19	108	*River Severn	SJ 594 045	144	0	3C
1-83-510-20	-	Battlefield Brook	SJ 525 146	Problem alleviated		
1-83-510-21	109	*Rea Brook	SJ 489 107	12	0.4	3E
1-83-510-22	110	*Rea Brook	SJ 482 100	53	2.2	1D
WREKIN DISTRICT COUNCIL						
1-83-710-1	111	*River Severn	SJ 672 034	3263	0.2	3A
1-83-710-2	112	*River Severn	SJ 694 025	337	2.6	1C
1-83-710-3	113	Coal Brook	SJ 667 038			
1-83-710-4	114	Coal Brook	SJ 668 040	46	0.6	3E
1-83-710-5	115	Un-named	SJ 673 075	20	0.9	3E
1-83-710-6	-	Ketley Brook	SJ 668 118	Problem alleviated		
1-83-710-7	-	Tributary of Beanhill Brook	SJ 638 123	Problem alleviated		

Code Number	Appendix A1 Page No.	Watercourse	Location	Arterial Cost (£'000)	Benefit/ Cost	Priority Category
1-83-710-8	116	Tributary of Ketley Brook	SJ 675 105			
1-83-710-9	117	*River Strine, Red Strine & Commission Drain	SJ 640 150	2860	2.6	1A
1-83-710-10	-	*River Meese	SJ 648 207	Problem alleviated		
1-83-710-11	119	Strine Brook	SJ 719 184			
1-83-710-12	121	*Hurley Brook	SJ 645 156			
1-83-710-13	122	Wrockwardine Brook	SJ 639 121	84	1.7	2D
1-83-710-14	123	Tributary of Hurley Brook	SJ 659 109			
1-83-710-15	124	#Moorfield Brook	SJ 735 192			
GLYNDWR DISTRICT COUNCIL						
1-84-110-1	125	*River Tanat	SJ 150 240			
MONTGOMERY DISTRICT COUNCIL						
1-86-210-1	126	Tributary of River Banwy	SH 965 125	43	0.2	3E
1-86-210-2	-	Cerrig-y-Groes	SH 946 135	Problem alleviated		
1-86-210-3	127	River Banwy	SJ 083 077	127	1.1	2C
1-86-210-4	128	River Vyrnwy	SJ 069 127	37	0	3E
1-86-210-5	129	Wig Brook	SJ 076 128	124	0.7	3C
1-86-210-6	-	*River Tanat & River Eirth	SJ 053 262	Scheme completed		
1-86-210-7	130	River Banwy	SJ 134 082	210	0.3	3C
1-86-210-8	131	Luggy Brook	SJ 199 022	130	0.4	3C
1-86-210-9	132	*River Vyrnwy	SJ 142 115	49	0.4	3E
1-86-210-10	133	The Brogan	SJ 143 168	363	0.6	3C
1-86-210-11	134	*River Vyrnwy	SJ 160 129	340	0	3C
1-86-210-12	135	Afon Cain	SJ 175 193	101	0	3C
1-86-210-13	136	Afon Cain	SJ 192 208	202	1.0	2C
1-86-210-14	137	*River Severn	SJ 229 040	1205	0	3A
1-86-210-15	138	Coed-y-Dinas	SJ 229 066	227	0.1	3C
1-86-210-16	140	Tributary of River Severn	SJ 230 048	84	0.4	3D
1-86-210-17	141	*River Severn	SJ 219 030	98	0.2	3D
1-86-210-18	142	*River Severn	SJ 245 095	164	0.3	3C
1-86-210-19	143	*River Severn	SJ 245 089	236	0.1	3C
1-86-210-20	144	*River Severn	SJ 236 069	323	0	3C
1-86-210-21	145	Lledan Brook	SJ 225 076			
1-86-210-22	146	Hem Brook	SJ 241 995	95	1.9	2D
1-86-210-23	147	Bull Dingle Brook	SJ 227 077			
1-86-210-24	148	Pwll Trewern	SJ 266 115			
1-86-210-25	149	*River Severn	SJ 261 145	908	0	3B
1-86-210-26	150	River Severn	SJ 299 169			
1-86-210-27	151	Bele Brook	SJ 274 157			
1-86-210-28	152	*River Vyrnwy	SJ 203 179	66	0	3D
1-86-210-29	153	Tributary of River Vyrnwy	SJ 209 181	118	1.1	2C
1-86-210-30	154	*River Vyrnwy	SJ 227 204	398	0.5	3C
1-86-210-31	156	*River Severn and River Vyrnwy	SJ 411 145	13959	2.5	1A
1-86-210-32	158	*Afon Cerist	SN 965 881	219	0.1	3C
1-86-210-33	-	Cwm Du Brook	SN 953 845	Problem alleviated		
1-86-210-34	159	River Trannon and Gleiniant Brook	SN 970 905			

Code Number	Appendix A1 Page No.	Watercourse	Location	Arterial Cost (£'000)	Benefit/ Cost	Priority Category
1-86-210-35	160	Afon Garno	SN 957 978	314	1.8	2C
1-86-210-36	161	Colwyn Brook & Tributary	SO 010 910	112	0.7	3C
1-86-210-37	162	Manthrigg Brook	SO 037 922			
1-86-210-38	-	River Mule	SO 141 899	Problem alleviated		
1-86-210-39	163	Bechan Brook	SO 144 935	110	1.2	2C
1-86-210-40	164	Lliffior Brook	SO 190 987	81	0.1	3D
1-86-210-41	165	Llandyssil Brook	SO 198 952			
1-86-210-42	166	Sarn Brook	SO 187 911	43	1.0	3E
1-86-210-43	167	*River Severn	SO 208 983	63	0.1	3D
1-86-210-44	168	River Caebitra	SO 244 929	63	0.5	3D
1-86-210-45	169	Tributary of River Camlad	SO 273 937	271	0.3	3C
1-86-210-47	170	*Afon Garno	SO 025 917	190	0.1	3C
1-86-210-48	171	River Severn	SN 912 845	89	0.3	3D
1-86-210-49	-	Holywell Brook	SJ 252 163	Problem alleviated		
1-86-210-50	172	*River Camlad	SO 273 947	424	2.3	1C
1-86-210-51	173	Acre Brook	SJ 315 160	1208	1.9	2A
1-86-210-52	174	Wern Llwyd	SJ 230 054	213	1.2	2C
1-86-210-53	175	*Guilsfield Brook	SJ 274 156	1219	1.0	2A
1-86-210-54	176	*River Severn	SO 180 955	133	0.9	3C
1-86-210-55	177	Tributary of Sarn Wen Bk	SJ 283 183			
1-86-210-56	178	Tributary of Gwyfer Brook	SJ 279 172			
1-86-210-57	179	Sarn Wen Brook	SJ 268 184			
1-86-210-58	180	Un-named	SJ 327 160			
1-86-210-59	181	*River Vyrnwy	SJ 269 198			
1-86-210-60	182	*River Severn	SO 040 915			
1-86-210-61	183	#Afon Cain	SJ 143 196			
RADNOR DISTRICT COUNCIL						
2-86-310-1	184	River Teme	SO 288 726	332	1.9	2C
2-86-310-2	-	River Teme	included with 2-83-410-23			
2-86-310-3	185	Ffrwdwen Brook	SO 225 745	81	0.2	3D
2-86-310-4	186	Warren Brook	SO 199 793	Highway problem		
2-86-310-5	187	Wylcwm Brook	SO 278 718	98	0	3D
2-86-310-6	-	*River Teme	included with 2-83-410-14			
2-86-310-7	188	Cil Owen Brook	SO 187 810	9	1.4	2F
WYRE FOREST DISTRICT COUNCIL						
1-87-910-1	189	*River Severn	SO 779 765			
NEWCASTLE-UNDER-LYME BOROUGH COUNCIL						
1-99-510-1	190	Coal Brook	SJ 685 341	355	0.8	3C
1-99-510-2	191	River Tern	SJ 726 390	484	0.9	3C
STAFFORD BOROUGH COUNCIL						
1-99-710-1	192	Back Brook	SJ 779 200	412	4.2	1C
1-99-710-2)						
1-99-710-3)	193	*River Meese & Lonco Brook	SJ 731 222			

TABLE 2

SUMMARY BY PRIORITY CATEGORY – UPPER SEVERN CATCHMENT
NON-MAIN RIVER

	A		B		C		D		E		F	
	NUMBER OF SCHEMES	TOTAL COST (£000s)	NUMBER OF SCHEMES	TOTAL COST (£000s)	NUMBER OF SCHEMES	TOTAL COST (£000s)	NUMBER OF SCHEMES	TOTAL COST (£000s)	NUMBER OF SCHEME	TOTAL COST (£000s)	NUMBER OF SCHEMES	TOTAL COST (£000s)
1	2	2,159	1	652	14	4,013	1	61	–	–	–	–
2	1	1,208	2	1,361	14	3,194	3	245	–	–	2	18
3	–	–	–	–	21	4,914	6	467	6	203	–	–
TOTAL	3	3,367	3	2,013	49	12,121	10	773	6	203	2	18
										TOTAL	73	18,495

TABLE 3

SUMMARY BY PRIORITY CATEGORY – UPPER SEVERN CATCHMENT
MAIN RIVER

	A		B		C		D		E		F	
	NUMBER OF SCHEMES	TOTAL COST (£000s)	NUMBER OF SCHEMES	TOTAL COST (£000s)	NUMBER OF SCHEMES	TOTAL COST (£000s)	NUMBER OF SCHEMES	TOTAL COST (£000s)	NUMBER OF SCHEME	TOTAL COST (£000s)	NUMBER OF SCHEMES	TOTAL COST (£000s)
1	3	20,277	2	1,511	4	1,572	1	53	–	–	–	–
2	1	1,219	1	542	2	705	–	–	–	–	–	–
3	3	6,451	2	1,597	11	2,778	3	227	2	61	–	–
TOTAL	7	27,947	4	2,805	17	5,055	4	280	2	61	–	–
										TOTAL	34	36,148

CHAPTER 2

THE SURVEY

2.0 THE SURVEY

2.1 Introduction

2.1.1 The requirement for a Survey results from the Water Act 1989, which also created the National Rivers Authority. Under Section 136(1) of the above Act the National Rivers Authority has a duty to carry out from time to time, a survey of its area in relation to flood defence functions.

2.1.2 The Ministry of Agriculture, Fisheries and Food issued Guidance Notes for Water Authorities in carrying out the original Survey and, wherever possible, suggested procedures were adopted and information incorporated within the reports.

2.1.3 In carrying out the Survey the Authority was required to:

1 Consult every local authority whose area is wholly or partially included in the area of the Water Authority.

2 Have regard to structure plans and local plans under the Town and Country Planning Act 1971.

2.2 Purposes of the Survey

2.2.1 The primary purpose of the Survey is to identify and evaluate flooding problems, both for existing problems and for potential problems which may occur as a result of increased run-off from development. Information is provided which summarises the principal solutions, costs, benefits and priorities.

2.2.2 The Surveys are required by the Ministry of Agriculture, Fisheries and Food to provide a comprehensive and logical basis for long-term planning of drainage improvements and flood alleviation.

2.2.3 The Survey will be used by this Authority to ensure rational phasing of improvements on main river, and will provide a firm basis for the supervisory role exercised by the Authority over all matters relating to its flood defence functions on all watercourses throughout the region.

2.2.4 The Survey provides comprehensive information on both main river and non-main river and can, therefore, be used by all drainage authorities and drainage bodies (local authorities) for determining capital works programmes of watercourse improvements in conjunction with the Authority's own programme of works.

2.2.5 The Authority will make use of the survey in considering any changes to the main river network.

2.3 Extent of the Survey

2.3.1 The Authority exercises a general supervisory role over all matters relating to land drainage. The Survey, therefore, identifies and examines not only problems on main river but also on other watercourses having existing or potential land drainage and flood alleviation problems.

2.3.2 No limit has been fixed by the Ministry of Agriculture, Fisheries and Food for a lower order of problems which should be considered by the Survey, but it has been indicated that a "broad brush" approach is preferable to detailed investigations of a minority of large problems. This accords with the Authority's view of its own requirements and thus the lower limit has been fixed as flooding affecting a single property or inadequate arterial conditions affecting twenty hectares of agricultural land. However, where specific requests have been made to investigate problems of lesser order these have been included wherever possible.

2.3.3 The Survey has investigated those watercourses which are currently in a satisfactory condition but where future development could necessitate improvements. This has been limited to those developments which have planning permission or have been identified in Structure and Local Plans and are likely to proceed in the near future.

2.3.4 The Survey covers only those drainage inadequacies which occur on arterial watercourses. Where drainage inadequacies on agricultural land can be resolved by underdrainage alone, these have not been included within the Survey.

2.4 Procedure

2.4.1 Of the information on drainage deficiencies required for this Survey, a considerable proportion was available within this Authority. This is particularly so of the problems on main river but also applies to major problems on non-main river. There are, however, many kilometres of non-main river on which this Authority had no information and which have, in many cases, had little or no maintenance work carried out on them. In order to ensure comprehensive coverage on such watercourses, in addition to main river, all bodies having land drainage interests were asked to provide information on drainage deficiencies. These include:

1 Ministry of Agriculture, Fisheries and Food.

2 Internal Drainage Boards.

3 County Councils.

4 District Councils.

5 Parish Councils.

6 British Waterways Board.

7 National Farmers' Union.

8 Country Landowners Association.

9 British Coal.

2.4.2 In July 1978, an 'Interim Report' was circulated to local authorities and many other organisations and bodies as part of the Authority's statutory duty under Section 24 of the Water Act 1973. This Report identified all drainage deficiencies which had been notified to the Authority and provided brief details of location and type of problem.

2.4.3 The primary purpose of the Interim Report was to seek views and comments on the identified problems so that these could be taken into account in determining solutions. Provision was also made to incorporate additional problem areas in subsequent Reports to ensure their comprehensiveness. All relevant comments have, therefore, been incorporated in the problem evaluations in Appendix A1 including those of the Nature Conservancy Council, County Conservation Trusts, Countryside Commission and fisheries, navigation and many other interests, in addition to those scheduled in Section 2.4.1. Wherever possible, the costs identified for the improvement works have included the cost of making provision for all interests which have been notified.

2.4.4 Every problem identified in the Interim Report and those notified since its publication have been investigated by visiting the site and carrying out land surveys as necessary. The extent of the investigation has largely been determined by the extent of the problems and the benefits which will result. Many minor problems have, therefore, not been examined in detail because of the high cost of providing the necessary improvement works. There are also many cases where flooding cannot be attributed to inadequacies in the arterial watercourse drainage system. In these situations, the solutions to the problems are outside the scope of this Survey and have not been determined. However, an indication is given, in each case, of the cause of the problem and these have been brought to the attention of the appropriate authority (eg. Highway Authority, British Coal, etc).

2.5 Hydrological Criteria

2.5.1 The mean annual flow for all sites of major importance, for which flow records are available, have been calculated using the appropriate method formulated in the "Flood Studies Report"[2].

2.5.2 For sites of minor importance and sites having no available flow records, the mean annual flood has been calculated from catchment characteristics using the "Flood Studies Report" six parameter equation.

2.5.3 In all cases, the relationship between Q(T) (the flood of return period T) and $\bar{Q}$ (the mean annual flood) has been derived from the "Flood Studies Report" regional growth curves.

2.6 Hydraulic Criteria

2.6.1 Urban flood alleviation schemes have been designed, wherever possible, to contain the 1 in 100 years flood. It is recognised that, in the final analysis, the design frequency chosen will be that which maximises the excess of benefit over cost but, within the scope of this Survey, this has not been possible other than in schemes of the very highest priority.

2.6.2 Culverts have generally been designed for the following flood return frequencies. (These standards have varied dependent upon economic or physical constraints):

1 Flooding of property and urban areas in general – 1 in 100 years.

2 All areas of high agricultural value including horticultural areas – 1 in 100 years.

3 Other agricultural areas – 1 in 25 years.

4 A combination of flooding transport systems and agricultural areas may justify a standard of up to 1 in 50 years.

2.6.3 For the Survey purposes the following criteria have been adopted:

1 In agricultural areas the pipe outfalls for field drainage systems are designed to be 150mm above normal water level. Where there is no field drainage system an average freeboard of 1,500mm between normal water level and ground level has been used. The freeboard requirements for under-drainage purposes may result in larger channel capacities than those required purely for flood alleviation purposes.

2 For the construction of floodbanks freeboard is dependent on the confidence limits of data used for design purposes, and for major floodbanks is normally 500mm. Small freeboards have been considered in appropriate cases. In all other cases, channel capacity is the design flood discharge with no additional freeboard.

2.7 Land Potential Category

2.7.1 The successful growth of crops depends on a suitable soil environment for germination, root anchorage and plant growth. Cropping systems are dependent on soil potential and similarly drainage standards can be linked to soil profile characteristics such as structure, texture, depth, stoniness and wetness. The Ministry of Agriculture, Fisheries and Food has assessed standards for field drainage and flood protection based upon the relationship between cropping and soil or land potential as indicated in Table 4. In providing these individual assessments the Ministry has pointed out that they are subjective and will need to be verified by detailed in-field investigations before any scheme can be agreed for grant aid purposes.

Table 4 Land Potential Categories

a	Land potential low (Normally pasture land)	1 in 2 years
a5	Land potential low/medium (Normally low grade arable land)	1 in 5 years
b	Land potential medium/high (Normally high grade arable land)	1 in 5/10 years
c	Land potential very high (Very high grade arable and horticultural land)	1 in 25/100 years

2.8 Improvement Costs

2.8.1 Costs of improvement schemes have been estimated on a standard unit cost basis wherever possible and appropriate in order to ensure uniformity and comparability of all schemes. The unit cost approach has been adopted for excavation of new channels, construction of floodbanks, bridges, pumping stations, culverts, revetment work, etc. It has not been possible to use unit costing for regrading and remodelling of existing channels or for channel clearance of undergrowth and trees as these are items which vary from watercourse to watercourse.

2.8.2 All costs include for design and supervision which on average is approximately 10% of the cost of the improvement works.

2.8.3 All costs are at a price base of December 1989.

2.8.4 The cost of field drainage for existing problems has been assessed by the Ministry of Agriculture, Fisheries and Food and has been included within the total cost of the improvement works. Field drainage costs for new problems have been assessed using a nomograph produced by Silsoe College for the Authority in 1984. Ditching costs have not been included unless this constitutes a significant proportion of the overall cost.

2.8.5 Wherever possible, the total cost of the improvement works includes the cost of making provision for navigation, fisheries, conservation and other interests of which the Authority has been notified.

2.9 Benefit Assessment

2.9.1 Benefit areas for urban problems have been determined largely from local knowledge of the extent and depth of past floods. These have been extrapolated where necessary to estimate the extent of floods with return periods in excess of recorded events. The stage/damage estimates and subsequent evaluation of annual average benefits have been derived from methods formulated in the manual entitled "The Benefits of Flood Alleviation: A Manual of Assessment Techniques"[3].

2.9.2 The areas which are likely to benefit in both agricultural and urban areas are shown on the overlays to the maps in the 1980 album. The locations of small areas of urban flooding and miscellaneous minor flooding problems are shown with a dot enclosed in a circle and identified with the appropriate code number. In the case of large urban flooding problems and agricultural drainage problems, the areas shown on the overlays and identified by code numbers are the areas which will benefit from drainage improvements.

2.9.3 Areas of inland agricultural land which will derive benefit from drainage operations have been defined, for the purpose of this Survey, as follows:

i) Land within an area bounded by a line 2.4m above the highest recorded flood level as defined in the "Medway Letter"[4].

ii) Where no flooding has occurred but normal water levels restrict outfall conditions for field drains, the benefit area is the area bounded by a line 2.4m above bank top level.

2.9.4 Annual average benefits for agricultural areas have been assessed by the Ministry of Agriculture, Fisheries and Food from the land potential (see Table 4) and from the potential change in gross margin which will result from improved drainage. These assessments will require verification by detailed studies if schemes are incorporated in capital programmes.

2.9.5 The maximum benefits from most agricultural improvement schemes can be achieved only if the individual farmers carry out ditching and install field drainage following the improvement to the receiving watercourses. In practise the benefits will, therefore, be phased in as field drainage is installed and due account will be taken of this phasing when individual detailed schemes are prepared.

2.9.6 If the improvement of a watercourse is an essential pre-requisite of planning permission for any housing or industrial development, such that without the improvement planning permission would not be approved, then the benefits attributable to future development by the off-site improvement of watercourse have been assessed as a proportion of the increase in the value of the land after planning permission is granted.

2.9.7 The benefits have been assessed, for both urban and agricultural problems, using a base date of December 1989. It should be appreciated that benefits, particularly in agricultural schemes, may not follow normal inflationary trends.

2.10 Test Discount Rate

2.10.1 The test discount rate which has been used for the assessment of the net present value of future costs and benefits is the Government's recommended current rate for public investment of 6%. The life of improvement schemes, other than those involving pumping stations, has been assumed as 50 years for the purpose of the net present value analysis.

2.10.2 Maintenance costs after improvements have been carried out are assumed, on average, to be of a similar order to those before. In some cases, maintenance costs will be lower whereas in others, particularly where maintenance has been neglected in the past, costs will be higher.

2.11 Benefit/Cost Ratios

2.11.1 The comparison of benefit with cost enables an assessment to be made of the worthwhileness of any proposed improvement. For the purpose of this Survey a scheme is considered as being possibly viable if the benefit to cost ratio is greater than unity. However, if an improvement scheme progresses to a capital programme it may be necessary to compare it with benefit/cost ratios for other competing schemes to enable a choice to be made.

2.11.2 The greater the excess of benefit over cost the higher the return for capital employed and, therefore, in purely economic terms, a scheme having a high benefit/cost ratio would have a higher priority than a scheme having a lower value. However, due weight must also be given to other factors such as risk to human life, amenity and environmental considerations. These factors are intangible and require a subjective assessment, in conjunction with economic factors, to determine the overall priorities of schemes.

2.12 Priority Category

2.12.1 The Survey has made no attempt to determine priorities which take into account intangible benefits; schemes have been categorised solely on the basis of tangible benefits which can be assessed in purely economic terms. It will be the responsibility of the promoting authority to determine the weight to be given to intangible benefits and, therefore, the overall priorities to be attached to schemes in its area.

2.13 Inflation Factors

2.13.1 Costs and Benefits for problems contained in the 1986 revision have been updated to a December 1989 price base as follows:

Arterial Costs - Baxter (Regional) Index

Underdrainage Costs - Retail Price Index

Agricultural Benefit - Using information supplied by Silsoe College based on changes in weighted gross margins

Urban and Road Benefits - Retail Price Index.

CHAPTER 3

GENERAL DESCRIPTION

3.0 GENERAL DESCRIPTION

3.1 Description of the Region

3.1.1 The boundary of the Severn-Trent Region of the National Rivers Authority is formed by the watersheds of the River Trent and the River Severn. The area of 21,600 sq. km extends from the Humber estuary in the north to the Severn estuary in the south, and is bounded by the Anglian, Yorkshire, North West, Welsh, Wessex and Thames Regions of the NRA. The Severn-Trent Region is divided into eight catchments the boundaries of which are the watersheds of the major sub-catchments of the River Severn and the River Trent. These catchments and the location of the region is shown in Fig.1.

3.1.2 The Severn-Trent Region of the National Rivers Authority is responsible for the two major tidal estuaries of the River Severn and the River Trent but other than these areas it has no coast line. The River Trent is tidal as far as Cromwell Lock, about eight kilometres downstream of Newark, and the River Severn is tidal as far as Gloucester.

3.1.3 The highest part of the Trent region is the Pennines in the north west where the River Derwent rises at an altitude of 630 metres. Altitude decreases across the Trent basin to the River Trent itself and then rises in the east to a height of between 60 metres and 120 metres. In the central region the catchments of the Rivers Severn and Trent are separated at the headwaters of the River Tame and the River Stour by a ridge of between 200 metres and 270 metres high.

3.1.4 The topography of the Severn basin is dominated by the Welsh Hills in the west at a maximum elevation of 830 metres and the Cotswold Hills in the south-east at an elevation of 330 metres. A prominent feature in the south-west is the Malvern Hills which rise to a height of 430 metres.

3.1.5 The average annual rainfall over the whole of the region is 775mm and this ranges from a maximum of over 2,000mm in the Welsh Hills to approximately 600mm in the Trent Valley in the rain shadow of the Pennines. The variation is largely associated with altitude. The lowlands generally have little seasonal variation but upland areas are wetter in winter than in summer. Similarly, in the upland areas, snowfall is a significant form of precipitation.

3.1.6 The geology of the region varies from the resistant Pre-Cambrian and Palaeozoic rocks in west Shropshire to the softer clays, shales and limestone bands of the Lower Lias in east Leicestershire and Warwickshire. The Pre-Cambrian and Palaeozoic rocks are characterised by the rugged landscape of Wales, the Border Counties and the carboniferous limestone formations in Derbyshire, while the more recent formations in the east have weathered to form the rolling scarps and vales typical of Leicestershire.

3.1.7 The total population of the Region is 8.3 million people with some 2.5 million in the Severn catchment and 5.8 millions in the Trent. Approximately 2.6 million people live in the West Midlands conurbation which straddles both catchments. The other major centres of population are Nottingham (280,000), Leicester (282,000), Stoke-on-Trent (250,000) and Derby (215,000). Many of these conurbations, and particularly that of the Black Country area, are situated in the vicinity of the headwaters of major rivers and have a significant effect on the river flows throughout their lengths.

3.1.8 The National Rivers Authority assumes a direct responsibility for 3,573 km of main river on which capital improvements and maintenance are carried out as necessary. Areas which have been protected from flooding, to various standards, on this length of main river total over 1,000 sq. km. Much of this area is protected by floodbanks of which the total length is 820 km, all of which is maintained on a regular basis by the Authority.

3.2 Description of the Upper Severn Basin

3.2.1 General

The Upper Severn Basin comprises the catchment area of the River Severn to a point just north of Bewdley and covers an area of 4,310 sq.km. The major tributaries in the Basin are the Rivers Vyrnwy, Banwy, Tanat, Perry, Tern and Worfe and the major centres of populations are at Shrewsbury and Telford. There are four Internal Drainage Boards in the Catchment namely, Melverley, Powysland, Strine and Rea.

3.2.2 The geology of the upper River Severn catchment situated generally within Wales consists of impervious strata of the Lower Palaeozoic and Pre-Cambrian sediments and the river and its tributaries exhibit all the characteristics of typical upland rivers having high discharges and narrow flood plains. The River Severn between Llanidloes and Welshpool has an unstable channel and this causes problems for farmers in the area.

Further downstream the river gradient slackens and strong meander patterns develop as the river flows across the Shropshire Plain. At the confluence of the Vyrnwy and Severn approximately 50 sq. km of good quality agricultural land suffers from regular inundation although it is protected to a limited extent by embankments known as argae. In Shrewsbury, development over the years has encroached on the floodplain with the result that extensive areas are subject to flooding and 380 properties are at risk from the 1 in 100 years flood event. A feasibility study has been completed and further investigations are progressing to seek the optimum solution which will both improve the argae to give a higher standard of protection to agricultural land and reduce the height of new flood defences required to protect Shrewsbury.

The effectiveness of the winter drawdown use of the Clywedog Reservoir for flood control purposes reduces with distance downstream. The mid-Wales towns of Llanidloes and Newtown benefit from a significant reduction in flood risk but the effect is small downstream of the River Vyrnwy confluence on the English Border.

CHAPTER 4

THE NATIONAL RIVERS AUTHORITY'S SUPERVISORY ROLE

4.0 THE NATIONAL RIVERS AUTHORITY'S SUPERVISORY ROLE

4.1 Introduction

4.1.1 Section 136(1) of the Water Act 1989 states that the National Rivers Authority shall exercise a general supervision over all matters relating to flood defence. This general supervision includes all watercourses, both main and non-main, and is exercised in part by consenting to works on or in watercourses, by the enforcement of bye-laws and by liaison with Planning Authorities responsible for development control.

4.2 Land Drainage Bye-laws

4.2.1 Section 34 of the Land Drainage Act 1976 (as amended by the Water Act 1989) allows Drainage Authorities to "make such bye-laws as they consider necessary for securing the efficient working of the drainage system in their area". Consent is required in compliance with particular bye-laws covering control of certain operations in or adjacent to rivers or the floodplain of rivers (generally confined to main rivers). Such operations include erection of fences, tree planting, disposal of rubbish, excavation affecting the bed and banks of rivers, erection of jetties or walls, etc.

4.2.2 In order to eliminate minor inconsistencies in the bye-laws inherited from the Severn and Trent River Authorities, the Severn Trent Water Authority made new bye-laws which were confirmed by the Ministry of Agriculture, Fisheries and Food on the 26 April 1979. By the provisions of the Water Act 1989 these Byelaws are now enforced by the National Rivers Authority, Severn-Trent Region. All references to Severn Trent Water Authority, STWA or Water Authority should now read National Rivers Authority.

4.3 Statutory Consents

4.3.1 It is essential that a rational and consistent approach is adopted for standards not only on main rivers but also on non-main rivers, where alterations to existing conditions can seriously affect the main river system downstream. The maximum benefits can be achieved only if all works which require consent are identified, so that a consistent standard can be attained throughout the region.

4.3.2 The issue of a Land Drainage Consent implies that, if the work is carried out in accordance with the drawings and documents submitted, there will be no detriment to land drainage operations or consequential flooding. Prior to issue of a consent Local Authorities, Internal Drainage Boards, Navigation Authorities and others are consulted as necessary.

4.3.3 A Consenting Manual has been produced for the Authority's internal use which details principles to be adopted and formalises the Authority's policy on various types of development so that consistent advice can be given to planners.

4.4 Planning Liaison and Development Control

4.4.1 In addition to exercising control over drainage works by consenting procedures, the Authority also seeks to control operations likely to adversely affect drainage interests through its planning consultation with Local Authorities. The Town & Country Planning General Development Order 1988 obliges local planning authorities to consult the NRA before determining planning applications. The majority of new developments which require land drainage improvements are identified in this way and advice is given to the planners about the effects of the proposals in relation to flooding and land drainage.

4.4.2 The Department of the Environment Circular 17/82[5] issued in 1982 emphasised the need for Planning Authorities to consult the Water Authorities in respect of development and caravan and camping sites in flood risk areas, and the effects of run-off from new developments. The National Rivers Authority must now be consulted on such matters.

4.4.3 The major floodplain areas are identified on the maps which accompanied the 1980 report. In general, the areas shown envelop those areas which have been flooded by past recorded events. They do not, therefore, relate to a particular frequency flood event.

4.4.4 Many areas within floodplains have been protected by improvement schemes which will, in general terms, consist of either channel improvements or flood embankments. These areas are also identified on the maps and the level of protection is indicated.

4.4.5 In particular, Local Authorities are advised that, for developments which are likely to increase the risk of flooding, the developer should be informed that works will be required to watercourses to remedy the situation. If these works are outside the area of the application, the developer is required to show that provision has been made to carry out the works, as conditions applicable to such works cannot be applied to planning permissions. If the developer does not make arrangements for the watercourse improvement the Planning Authority can refuse the application.

4.4.6 Where works are required to a non-main watercourse to accommodate the additional run-off from developments, the developer may carry out the work, by agreement with the riparian owners, at his own expense. If agreement is not possible he may request the Local Authority to carry out the works and reimburse the authority accordingly. In the case of main river, works will normally be carried out by the National Rivers Authority with an appropriate contribution from the developer.

4.4.7 At the present time, negotiations take place between the developer(s) and the National Rivers Authority or Local Authority into the proportion of the improvement cost of the off-site watercourse which is to be met by the developer(s).

CHAPTER 5

MAIN RIVER SYSTEM

5.0 MAIN RIVER SYSTEM

5.1 Statutory Provisions

5.1.1 The main river system is the system of watercourses identified on the statutory set of main river maps held by the National Rivers Authority and the Ministry of Agriculture, Fisheries and Food (MAFF). Main river powers extend to any structure in the bed or bank of the watercourse which controls the flow of water into or out of the watercourse. Powers for carrying out work on main river are exercisable by the National Rivers Authority and by others with the Authority's consent.

5.1.2 The main river map may be altered by the Ministry of Agriculture, Fisheries and Food at the request of the National Rivers Authority. Before doing so, the Minister must give notice of his intention and this is usually carried out by advertising in local newspapers. All objections to the proposals will be considered by the Minister.

5.1.3 In relation to watercourses which are not designated as main river the Authority has certain regulatory powers but has no powers to carry out work using Flood Defence finance.

5.1.4 A 1:250,000 scale map showing the main river system within the Severn-Trent Region as at January 1990 is available.

5.2 Principles for Main River Extension

5.2.1 The following criteria are used by the National Rivers Authority, Severn-Trent Region in deciding whether to make an application to MAFF for changing the status of a watercourse from non-main to main river.

1 Main River shall be continuous from the estuary to a suitable point (eg a bridge or other structure) where:-

(a) the population in the remainder of the upstream catchment is less than 10,000

or

(b) the average width of flood plain in the remainder of the upstream catchment is less than 300 metres per kilometre of watercourse

or

(c) there is no single community greater than 3,000 persons further upstream.

Whichever is the furthest point upstream.

2 Main river shall also extend upstream to the point of discharge of:-

(a) outfalls from sewage works with an average daily flow greater than 5 megalitres

(b) untreated water reservoirs that impound more than 1,000 megalitres

(c) the downstream outfall of an internal drainage board.

3 Where balancing storage is provided as an essential part of the system of surface water drainage, consideration should be given to extending main river up to the point of intake of such balancing storage.

4 However, a flexible approach will be adopted and consideration may also be given to extension of main river in particular circumstances (eg to receive the surface water drainage from a motorway, an embanked watercourse or to be the upstream boundary of urban areas for development control and byelaw purposes).

5.3 Local Authority Improvements

5.3.1 Where non-main watercourses accord with the above policy, and improvements are carried out by Local Authorities to standards approved by this Authority, the Authority may recommend to the Ministry of Agriculture, Fisheries and Food that the watercourses should be included as part of the main river system.

CHAPTER 6

THE LAND DRAINAGE ROLE OF LOCAL AUTHORITIES

6.0 THE LAND DRAINAGE ROLE OF LOCAL AUTHORITIES

6.1 Interaction with the National Rivers Authority's role

6.1.1 The powers available to Local Authorities (both District and County Councils) under the Land Drainage Act 1976 (as amended by the Water Act 1989) for carrying out works of maintenance and improvement on non-main rivers are complementary to those of the National Rivers Authority on main river. In almost all cases the powers are permissive, but most Councils now accept the responsibility that this implies and are prepared to carry out improvement schemes in conjunction with those of the National Rivers Authority on main river. In this way, many serious impediments to the overall drainage system are gradually being eliminated.

6.2 Powers of District Councils

6.2.1 District and Metropolitan District Councils have powers under Section 98 of the Land Drainage Act 1976 (as amended by the Water Act 1989) to carry out works on non-main river for the purpose of preventing flooding or remedying or mitigating any damage caused by flooding.

6.3 Powers of County Councils

6.3.1 County Councils have powers under Section 99 of the Land Drainage Act 1976 (as amended by the Water Act 1989) to execute land drainage schemes, at the request of owners and occupiers who will benefit from the schemes.

6.3.2 Section 100 of the Land Drainage Act 1976 (as amended by the Water Act 1989) enables County Councils to execute land drainage works compulsorily for the improvement of agricultural land, and apportion any expenses among the beneficiaries.

6.3.3 County Councils may exercise Section 98 powers by agreement with, or by default of, a District Council.

6.4 Maintenance of the Flow of Watercourses

6.4.1 Where the proper flow of water in a non-main river is impeded, both District and County Councils may, under Section 18, of the Land Drainage Act 1976 (as amended by the Water Act 1989), serve notice on the person concerned to remedy the situation.

CHAPTER 7

INTERNAL DRAINAGE BOARDS

7.0 INTERNAL DRAINAGE BOARDS

7.1 Constitution

7.1.1 Many Internal Drainage Boards were first constituted in the nineteenth century by individual Acts of Parliament. However, all Internal Drainage Boards are today constituted, or continued in being, in accordance with the provisions of the Land Drainage Act 1976 (as amended by the Water Act 1989) which defines Internal Drainage Districts as such areas as will derive benefit or avoid danger as a result of drainage operations. These areas are generally located in lowland regions where special drainage problems exist and where collective benefit will be derived from drainage operations.

7.1.2 Within the Region there are 32 Internal Districts of which 24 are in the Trent catchment and eight are in the Severn catchment. In most cases a District is administered by a Board consisting of elected members but the Sow and Penk District is administered directly by this Authority.

7.1.3 The basis for the determination of Internal Drainage District boundaries was laid down by the Minister of Agriculture and Fisheries in 1933 in a decision letter known as the "Medway Letter" [4]. This letter, which is now regarded as the authoritative pronouncement for all cases which have arisen since then, identified the area of benefit or avoidance of danger by reason of drainage operations by reference to flood contours (in relation to freshwater drainage) or tide levels (in relation to sea defence and salt water inundations).

7.2 Income

7.2.1 The income of Internal Drainage Boards is derived in the main from:

i) Drainage rates levied on land and buildings within the Drainage District.
ii) Ministry of Agriculture, Fisheries and Food grant aid for capital schemes undertaken by the Boards.
iii) Contributions, in appropriate cases, from the National Rivers Authority towards the cost incurred by the Boards in handling water flowing through the District from upland areas.

7.3 Designated Watercourses

7.3.1 The Boards are empowered under Section 6 of the Land Drainage Act 1976 (as amended by the Water Act 1989) to exercise a general supervision over all matters relating to the drainage of land within their Districts, and are empowered by Section 17 of that Act to carry out work on all non-main river watercourses within their area. In practice, most Boards designate certain watercourses in their area on which they carry out regular maintenance and other minor watercourses are left to riparian owners to maintain or improve.

7.4 Maintenance of the Flow of Watercourses

7.4.1 Where the proper flow of water is impeded, an Internal Drainage Board may serve notice under Section 18, Land Drainage Act 1976 (as amended by the Water Act 1989), on the person concerned to remedy the situation. This applies to all watercourses in the Drainage District other than main river on which notice would normally be served by the National Rivers Authority.

CHAPTER 8

FLOOD DEFENCE MAINTENANCE

8.0 FLOOD DEFENCE MAINTENANCE

8.1 Objectives

The main objectives for flood defence maintenance can be summarised as follows:

- to preserve the stability, continuity and integrity of flood defences

- to ensure the satisfactory operation of pumping stations, outfalls, sluices and other flood defence structures.

- to ensure that the river systems (channels, floodplain and washland) are capable of containing and transmitting flood waters and tidal surges up to the appropriate target return period.

- in carrying out its operations to preserve and 'further' the river environment.

8.2 Responsibility for Maintenance

The Authority is given powers under Section 17, Land Drainage Act 1976 (as amended by the Water Act 1989) to maintain watercourses designated as main river. It does not have similar powers for the maintenance of non-main rivers which are normally considered the responsibility of the riparian owners although Internal Drainage Boards, District Councils and, in certain cases County Councils have permissive powers on these watercourses.

8.3 Maintenance Programmes

An Asset Management Plan is being developed which will identify maintenance expenditure profiles which will ensure an appropriate Level of Service (LOS) for Flood Defence.

This Level of Service is expressed in terms of a target flood capacity which is calculated from an analysis of the land use benefiting from flood protection.

A major survey of Flood Defence Assets will be carried-out as part of this Asset Management Plan. Many of these assets are approaching the end of their original design life, therefore, this survey will confirm whether the current maintenance practices are adequate or not.

The Asset Management Plan will determine:-

- the target Level of Service

- the existing Level of Service

- the gap or shortfall between the target and existing Level of Service

- objective maintenance programmes appraised by cost benefit techniques. These will be further refined, following full consultation, to ensure that balanced programmes are produced which accommodate environmental interests.

The Region has recently commissioned a new Rivers Information and Maintenance System (RIMS) which assists this development of objective maintenance programmes.

In addition the Region carries out Best Operational Practice Reviews to ensure that full benefit is taken of any new developments in the industry; the resultant cost savings enable our operations to extend over more of the main river network.

Furthermore, post project appraisals are carried-out to ensure that the various models and techniques which have been developed and used are valid.

The Region also funds an annual environmental enhancement programme.

CHAPTER 9

FLOOD DEFENCE AND CONSERVATION

9.0 FLOOD DEFENCE AND CONSERVATION

9.1 Introduction

9.1.1 When carrying out improvements to watercourses due regard is taken of other interests which may be affected by such improvements. Other functions of the NRA are consulted during the detailed design phase of schemes. However, in the past, conservation interests relating to watercourses have not always received their due regard and for this reason particular emphasis has been given in this Survey to these aspects. Therefore, the problem evaluations in Appendix A1 give specific information on conservation and environmental interests where these may be affected by the suggested improvements. In addition, statutory conservation sites and County Trust Reserves are delineated on the maps which accompanied the 1980 report and scheduled in Appendix A3.

9.2 Statutory Provisions for Nature Conservation

9.2.1 Section 8(1) of the Water Act 1989 states that the National Rivers Authority has a duty to "further the conservation and enhancement of natural beauty and the conservation of flora, fauna and geological and physiographical features of special interest".

9.2.2 Guidance notes on land drainage and conservation have been circulated jointly by the Department of the Environment, MAFF and the Welsh Offices to all Water Authorities and Internal Drainage Boards in relation to duties under previous legislation. These guidelines are currently being updated to take into account the Water Act 1989.

9.2.3 The relevant functions of the Nature Conservancy Council and the Countryside Commission are given in Appendix A6.

9.2.4 The Authority's standard land drainage consent form has been amended to inform applicants of the need to comply with any duties or responsibilities for the conservation or protection of the environment (including flora and fauna).

9.3 Liaison with Conservation Interests

9.3.1 The Authority attaches great importance to liaison with conservation interests for all land drainage proposals which affect watercourses. These may be summarised as:

i) Improvement schemes identified in the 5 year capital programme for flood defence.

ii) Maintenance work on watercourses.

iii) Proposals for main river variations.

iv) Water Act 1989, Section 136(1) Flooding Survey.

9.3.2 The Authority's area staff have been issued with guidelines on the consultation which is necessary between area staff and conservation/recreation staff where works involve improvement or maintenance of rivers and watercourses.

9.3.3 The principal links between the area offices and conservation and amenity bodies are the Area Conservation and Recreation Officers.

CHAPTER 10

FLOOD WARNING SYSTEM

10.0 FLOOD WARNING SYSTEM

10.1 Investigations have shown that within the Severn-Trent Region of the National Rivers Authority considerable public benefit can accrue from accurate, reliable and well disseminated flood forecasts which provide the general public with adequate warning of flood events. The warnings can provide time for items to be moved from ground floors of residential and commercial properties, for boat owners to secure their crafts, campers and caravanners to evacuate sites, etc.

10.2 The National Rivers Authority has powers to provide and operate a flood warning system by Section 32 of the Land Drainage Act, 1976 (as amended by the Water Act 1989). The main provisions of the system which operates throughout the Region are:

i) To monitor weather conditions and flows and levels in rivers and to forecast future water levels.
ii) To provide warnings of potential floods in areas likely to be affected.
iii) To provide an advice and information service to the general public.
iv) To deploy area staff and equipment as necessary.
v) To liaise with other emergency services.

10.3 The procedure for issuing warnings is normally initiated by the Meteorological Office providing forecasts of rainfall or snowmelt. This information, together with the continual assessment of the detailed catchment situation by the interrogation of the network of rainfall and river flow and level recorders, enables the Authority to forecast and monitor the progression of floods through the river basins.

10.4 When danger areas have been assessed this information has to be passed to the public in those areas. This service is normally provided by the Police who advise the public by loudspeaker, local radio broadcasts and other appropriate methods. This system, however, cannot operate in some areas where localised storms can outpace the forecasting and warning procedure. Therefore, the service is limited to those areas where more than 4 hours warning can be given.

10.5 It is particularly difficult to provide warnings for transient groups of people such as caravanners, campers and boaters. When sites for caravans and camping are being considered the Authority will always advise planning authorities against their location in areas which are subject to periodic inundation. The protection of such sites from flooding is normally difficult, expensive and contrary to Authority policy regarding the use and management of floodplains. The joint DoE/MAFF/WO Circular 17/82 highlights this special risk problem.

10.6 Although major benefits can be attributed to a reliable flood warning system, such a system cannot, in itself, be considered as a satisfactory alternative to structural improvements which will reduce the risk of flooding. The Authority's policy is to continue to provide increased flood alleviation measures, at the same time as providing an effective flood forecasting service, which will give early warning of flooding in unprotected areas and also in the event that flood defences are likely to be overtopped.

CHAPTER 11

PROGRAMMING OF FUTURE WORK

11.0 PROGRAMMING OF FUTURE WORK

11.1 This Survey has identified and evaluated a wide range of flood defence problems throughout the Region. The responsibility for resolving the problems and financing the improvement works falls initially upon the riparian owner although drainage authorities have permissive powers to undertake works.

11.2 In many cases, the necessity for improvement is often due to increased channel flows resulting from developments in the upstream catchment, which, in recent years, have been approved by planning departments of Local Authorities. Where improvements due to development are required on main river, responsibility is normally accepted by this Authority, whereas on non-main river the responsibility is normally that of the District Council in urban areas, and the County Council in agricultural areas (other than in Drainage Districts where the Internal Drainage Board has a responsibility).

11.3 Improvement works on watercourses in individual catchments need to be co-ordinated to ensure that works in one area are compatible with those in another. This Authority is the body responsible for the co-ordination and supervision of flood defence throughout the area, and publishes annually its 5 year programme. The co-ordinating role can be carried out effectively only if all drainage bodies produce programmes of work which satisfactorily integrate to provide the maximum benefit to flood defence. This Survey provides the basis for the determination of such programmes of work.

11.4 Financing of flood defence works varies, dependent on the drainage body promoting the work. Most improvements, other than those needed as a requirement of future development, are eligible for grant aid from the Ministry of Agriculture, Fisheries and Food providing the improvement can be shown to have a satisfactory benefit/cost ratio (see Section 2.11). The sources of finance generally available to drainage bodies are indicated in Appendix A5.

11.5 In the future, the Survey will be updated at intervals of approximately three years. In order to ensure this operation is kept to a minimum in terms of manpower and financial resources, the Authority wishes to be kept informed of all improvement schemes which have been completed and of any additional problems which may be identified from time to time.

APPENDIX A1

PROBLEM DESCRIPTIONS

AND EVALUATIONS

IDENTIFICATION

Problem code number(s):	1-83-110-1
Watercourse:	None
Location:	Ryton (Bridgnorth District Council)
OS Map reference:	SJ 790 030

NATURE OF PROBLEM

Two sections of unclassified road flood several times each year for up to 8 hours. There is no watercourse, but surface water goes to a soakaway which cannot cope with storm run-off.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

Road run-off should be piped 400 m to discharge to the watercourse at SJ 786 028. This is a Highway Authority problem and the evaluation is, therefore, outside the scope of this Survey.

IDENTIFICATION

Problem code number(s):	1-83-110-2
Watercourse:	Wesley Brook (non-main river)
Location:	Shifnal (Bridgnorth District Council)
OS Map reference:	SJ 743 067 to SJ 745 086

NATURE OF PROBLEM

Seven pre-1918 terrace houses in Church Street are subject to flooding, the last time in 1968, for periods up to 10 hours. The watercourse has insufficient capacity to pass even the mean annual peak discharge, and Church Street culvert forms an obstruction to major floods. The problem is exacerbated by bank slips, accumulation of debris and general inadequate maintenance.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	167,210	
	(ii)	Field drainage	£		£167,210
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	50,040	
	(iii)	Roads/Railways	£		£50,040
(c) **Benefit/cost ratio**					0.3
(d) **Priority category**					3C

IMPROVEMENT WORKS

It is necessary to regrade 1.2 km of channel and replace the Church Street culvert to provide a design capacity of 7.7 cumecs. 300 m of channel will be lined because of the steep bank slopes and high flow velocities that are necessary.

A comprehensive improvement scheme up to Haughton Bridge (SJ 744 086) involving lining 1.5 km of the channel and underpinning three bridges would cost in excess of £430,000. Such major works are difficult to justify but further deterioration of the watercourse will put a number of additional properties at risk.

Bridgnorth District Council have carried out a heavy maintenance scheme between Church Street and Victoria Road which has ameliorated the problem to a limited degree.

BENEFITS

There is little benefit from alleviating road flooding as it is not a major route and there is access from another direction.

DEVELOPMENT

Telford Development Corporation have completed a balancing lake system at Castle Farm (SJ 726 094) to control run-off from Priorslee and the design discharge takes this into account. The M54 extension surface run-off outfalls to the Wesley Brook upstream of Shifnal. This increased discharge has not been taken into account.

COMMENT

The limited improvement scheme will not have a marked effect on the amount of flood storage available and consequently will not materially affect the drainage situation downstream of Shifnal. The comprehensive scheme right through Shifnal may have a more pronounced effect which will require investigating in detail.

IDENTIFICATION

Problem code number(s):	1-83-110-3
Watercourse:	River Worfe (non-main river)
Location:	Ryton (Bridgnorth District Council)
OS Map reference:	SJ 762 023 to SJ 781 046

NATURE OF PROBLEM

35 ha of woodland and 10 ha of potentially good grazing land suffer from inadequate arterial drainage. The river channel has only the capacity to carry the mean annual peak discharge before overtopping, and 8 ha of land suffer from periodic inundation.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	2 years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	158,560	
		(ii)	Field drainage	£	15,010	£173,570
(b)	**Present value of benefits**	(i)	Agriculture	£	50,010	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£50,010
(c)	**Benefit/cost ratio**					0.3
(d)	**Priority category**					3C

IMPROVEMENT WORKS

It is suggested that a total of 2.4 km of watercourse should be regraded to provide a channel design capacity of 3 cumecs at the downstream end but freeboard criteria will, however, allow a maximum capacity of 6.6 cumecs. Approximately 700 m of the Worfe downstream of the confluence at SJ 759 029, and 300 m of the Wesley Brook above this confluence, should be improved. Two road bridges also need underpinning. A more comprehensive improvement scheme would involve the regrading of 4.7 km of watercourse but cannot be justified on economic grounds.

BENEFITS

35 ha of the benefit area is devoted to estate woodland and would probably remain as such after drainage, though it is uncertain what benefit would accrue to the woodland area following drainage.

COMMENT

There is a water abstraction works at Cosford Grange (SJ 781 046) and a sewage treatment works at SJ 812 047.

FISHERIES

There is a first class trout fishery and consultation on any scheme is essential.

IDENTIFICATION

Problem code number(s):	1-83-110-4
Watercourse:	Albrighton Brook (non-main river)
Location:	Albrighton (Bridgnorth District Council)
OS Map reference:	SJ 795 045 to SJ 814 050

NATURE OF PROBLEM

20 ha of land suffer from inadequate arterial drainage, and development within the floodplain has put 17 semi-detached houses at risk from inundation during major flood events. The development within Albrighton has exacerbated stormwater run-off problems.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in 2 years
	(ii)	Structures	1 in 25 years
(c) **Land potential category**			a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	126,850	
	(ii)	Field drainage	£	7,510	£134,360
(b) **Present value of benefits**	(i)	Agriculture	£	16,670	
	(ii)	Buildings	£	20,020	
	(iii)	Roads/Railways	£		£36,690
(c) **Benefit/cost ratio**					0.3
(d) **Priority category**					3C

IMPROVEMENT WORKS

It is suggested that the channel upstream of Albrighton Pool (SJ 810 045) should be improved to provide a maximum capacity of 3.7 cumecs (1 in 100 years discharge). The Brook is affected by the impounding level of Albrighton Pool and it will be necessary to lower the level of the Pool by 0.6 m. The channel downstream of Albrighton Pool should be regraded from SJ 795 043 to the outfall of the pool at SJ 809 046 to provide a design discharge of 0.7 cumecs. Freeboard criteria will, however, allow a maximum channel capacity of 8.3 cumecs. The road culverts at SJ 806 046 and SJ 796 044 should be replaced, whilst the access bridge to the sewage works at SJ 812 047 may need replacement. Proper maintenance of the watercourse upstream of Albrighton Pool would greatly reduce the risk of flooding.

BENEFITS

Only 7 ha of pasture land (downstream of Albrighton Pool) will benefit from drainage improvement. A large part of this benefit area is owned by the Ministry of Defence. Upstream of the Pool benefits are purely attributable to the protection of the 20 houses assumed to be at risk from flood events greater than the 1 in 20 years return period.

DEVELOPMENT

There is no record that STWA were consulted over the floodplain development at Albrighton.

CONSERVATION

Albrighton Pool is of some interest and there is an area of damp pasture alongside the stream, west of the Pool.

FISHERIES

Albrighton Pool has been a fishery which has been affected by pollution. Restocking may take place and consultations will be necessary.

IDENTIFICATION

Problem code number(s):	1-83-110-7
Watercourse:	Quatt Brook (non-main river)
Location:	Quatt Bridge (Bridgnorth District Council)
OS Map reference:	SO 754 884

NATURE OF PROBLEM

The A442 road floods for periods up to eight hours due to the blockage of Quatt Bridge by silt. The silting is caused by an abstraction structure at SO 750 884.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 25 years
	(ii)	Structures	1 in 25 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	14,410	
	(ii)	Field drainage	£		£14,410
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	7,510	£7,510
(c) **Benefit/cost ratio**					0.5
(d) **Priority category**					3E

IMPROVEMENT WORKS

It is necessary to move the abstraction structure to a satisfactory alternative site and clean out approximately 600 m of the watercourse to provide a channel capacity of 2.8 cumecs.

Shropshire County Council Highways Department have completed work at Quatt Bridge.

IDENTIFICATION

Problem code number(s):	1-83-110-8
Watercourse:	River Severn (main river)
Location:	Stanley (Bridgnorth District Council)
OS Map reference:	SO 750 831

NATURE OF PROBLEM

Six terraced houses, a public house, an old store house and a caravan flood for up to 24 hours during all major floods on the Severn. The terraced houses are affected by floods with a return period of two years or greater, and the public house floods with a return period of 25 years or greater.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in		years
	(ii)	Structures	1 in	100	years
(b) **Agricultural**	(i)	Channel	1 in		years
	(ii)	Structures	1 in		years
(c) **Land potential category**					

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	432,440	
	(ii)	Field drainage	£		£432,440
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	227,690	
	(iii)	Roads/Railways	£		£227,690
(c) **Benefit/cost ratio**					0.5
(d) **Priority category**					3C

IMPROVEMENT WORKS

The bed slope of the Severn at Stanley makes regrading impractical. A possible solution, is to construct a 3 m high steel sheet-piled wall to contain a design discharge of 977 cumecs.

CONSERVATION

The construction of a 3 m high wall will severely affect the amenity value of the site and is not recommended as such.

IDENTIFICATION

Problem code number(s):	1-83-110-9
Watercourse:	River Severn (main river)
Location:	Fort Pendlestone (Bridgnorth District Council)
OS Map reference:	SO 724 943

NATURE OF PROBLEM

Eight commercial premises and the A442 are subject to inundation by floods, of a 5 year return period or greater, for durations of approximately 24 hours.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in 100	years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	689,010	
	(ii)	Field drainage	£		£689,010
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	242,700	
	(iii)	Roads/Railways	£	2,500	£245,200
(c) **Benefit/cost ratio**					0.4
(d) **Priority category**					3B

IMPROVEMENT WORKS

The works suggested involve protection of Fort Pendlestone by a 2.3 m high wall, approximately 250 m long, to contain a design flow of 946 cumecs. The A442 will need raising for a short distance so as to tie the flood-wall into higher ground to the east. The A442 will be protected by a 1.8 m high flood bank, approximately 1.4 km long, to provide protection from floods of up to a 25 year return period (703 cumecs).

BENEFITS

Protection of Fort Pendlestone on its own will cost £406,490 giving a benefit/cost ratio of 0.6. This limited improvement work may be environementally more acceptable.

The benefits of alleviating the flooding of the A442 are small in relation to the cost of construction of the protecting flood bank.

IDENTIFICATION

Problem code number(s):	1-83-110-10
Watercourse:	River Severn (main river)
Location:	Bridgnorth (Bridgnorth District Council)
OS Map reference:	SO 723 913 to SO 720 935

NATURE OF PROBLEM

12 houses and 2 public houses flood during all major Severn floods for periods in excess of 24 hours. The maximum recorded flood has an estimated return period of 1 in 60 years. The watercourse has a poor gradient, and insufficient capacity to pass flows greater than the mean annual peak discharge without overtopping. Major floods will affect 50 houses, commercial properties, the A458 road and 2 caravan sites. The 100 years return period flood is estimated to reach a depth of 2.4 m over bank top level.

In addition, roads and 4 properties on the Wellmeadow Estate are likely to flood occasionally.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	1,983,440	
	(ii)	Field drainage	£		£1,983,440
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	975,820	
	(iii)	Roads/Railways	£	27,520	£1,003,340
(c) **Benefit/cost ratio**					0.5
(d) **Priority category**					3A

IMPROVEMENT WORKS

Construction of a flood wall high enough to contain the design flood is unrealistic on amenity grounds. Regrading of the river is also impossible as the existing bed slope is poor. The only alternative is to widen the watercourse to 60 m for 1.5 km downstream of Bridgnorth. This will have the effect of drawing the water level down by 1.5 m and provide a design capacity of almost 1,000 cumecs. The channel through Bridgnorth should also be cleaned out. These improvements will have some effect on the peak flood levels at Fort Pendlestone upstream of Bridgnorth (see 1-83-110-9). A back water computation would have to be done to check that the proposed widening of the channel will result in the desired lowering of the flood levels. There would still be a considerable restriction through Bridgnorth and the mean flow velocity would be considerably increased. The road bridge causes some afflux with flood flows at present and this will become more important as flow velocity is increased. Some protection works to the bridge and the channel invert may be necessary.

BENEFITS

Flood levels were calculated from the existing channel characteristics and related to the maximum recorded levels for the 1946 flood (60 year event).

FISHERIES

This is a prime coarse fishery and consultation will be essential if widening of the river is to proceed.

IDENTIFICATION

Problem code number(s):	1-83-110-11/12
Watercourse:	Stratford Brook and Hilton Brook (non-main river)
Location:	Worfield (Bridgnorth District Council)
OS Map reference:	SO 757 945 to SO 780 957 and SO 773 955 to SO 780 948

NATURE OF PROBLEM

80 ha of agricultural land suffer from inadequate arterial drainage. The watercourse has only the capacity to discharge the mean annual flow and 20 ha of land suffer from periodic flooding. The Hilton Brook has also insufficient freeboard for efficient field drainage and 4 houses are potentially at risk from flood events greater than the 1 in 4 years return period.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in 100 years (Hilton Brook)
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	418,020	
		(ii)	Field drainage	£	120,100	£538,120
(b)	**Present value of benefits**	(i)	Agriculture	£	719,580	
		(ii)	Buildings	£	32,530	
		(iii)	Roads/Railways	£		£752,110
(c)	**Benefit/cost ratio**					1.4
(d)	**Priority category**					2C

IMPROVEMENT WORKS

It is suggested that 5.2 km of watercourse should be regraded and enlarged to provide satisfactory freeboard for field drainage under normal flow conditions. This includes 500 m of the River Worfe downstream of the Stratford Brook confluence, and 1 km of the Hilton Brook. The improvement works will provide a design capacity of 6.8 cumecs, though freeboard criteria will allow a maximum discharge capacity of 8.7 cumecs. The Hilton Brook will, however, be enlarged to contain the 100 year event (7.2 cumecs). In addition to these channel improvements, a road bridge, two footbridges and three farm bridges will need to be replaced, and two road bridges need to be underpinned.

DEVELOPMENT

Considerable housing development in Hilton necessitates the improvement of Hilton Brook. Some properties on the left bank immediately upstream of the A454 road bridge are built within the floodplain. Gardens and boundary fences extend right to the brook, restricting access during improvement work.

FISHERIES

This is a major trout fishery and spawning ground for which consultation will be essential.

IDENTIFICATION

Problem code number(s):	1-83-110-14
Watercourse:	Mad Brook (non-main river)
Location:	Sutton Madcock (Bridgnorth District Council)
OS Map reference:	SJ 709 042 to SJ 739 022

NATURE OF PROBLEM

115 ha of agricultural land suffer from inadequate arterial drainage. Frequent flooding occurs to 15 ha of land and the B4379 road, three times each year for up to 12 hours.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in 5 years
	(ii)	Structures	1 in 25 years
(c) **Land potential category**			a – 85 ha
			b – 30 ha

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	291,170	
	(ii)	Field drainage	£	25,020	£316,190
(b) **Present value of benefits**	(i)	Agriculture	£	569,550	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	2,500	£572,050
(c) **Benefit/cost ratio**					1.8
(d) **Priority category**					2C

IMPROVEMENT WORKS

Approximately 3.8 km of watercourse should be regraded and enlarged to allow satisfactory freeboard under average flow conditions, providing a minimum design discharge of 2.8 cumecs and a maximum discharge of 8.9 cumecs. The road bridges at SJ 722 028 and SJ 716 032 and two farm bridges should be replaced.

Some improvements have been made between Brocton Bridge and Brocton Park Road by riparian owners. In 1979, the County Council made some improvements to the upper reaches.

BENEFITS

There is unlikely to be any increase in gross margin on 85 ha of the benefit area. However, a potential increase in gross margin is expected following drainage improvements on the remaining 30 ha, which will become good arable land.

DEVELOPMENT

The Telford Development Corporation made an agreement with the former Severn River Authority to release compensation water to the Mad Brook, because the developments in their area would divert some of the surface water run-off. The releases are made via a control structure at SJ 714 038 and there is a flow measurement structure at SJ 714 038.

FISHERIES

There is a trout pool at Harrington Hall and the scheme should as far as possible avoid this.

IDENTIFICATION

Problem code number(s):	1-83-110-15
Watercourse:	Burlington Brook (non-main river)
Location:	Sherrif Hales (Bridgnorth District Council)
OS Map reference:	SJ 761 113 to SJ 756 118

NATURE OF PROBLEM

The watercourse does not provide sufficient freeboard for field drainage, and 20 ha requiring under drainage suffer from these inadequate outfall conditions.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	112,430	
		(ii)	Field drainage	£	25,020	£137,450
(b)	**Present value of benefits**	(i)	Agriculture	£	205,590	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£205,590
(c)	**Benefit/cost ratio**					1.5
(d)	**Priority category**					2C

IMPROVEMENT WORKS

Improvements have been limited by the road bridge at SJ 761 113 which has a hard invert with a 0.8 m drop at the exit. It is suggested, however, that this road bridge should be replaced, the invert level lowered and about 1.2 km of watercourse regraded to provide a channel design capacity of 2.9 cumecs. However, the maximum discharge capacity to allow satisfactory freeboard for land drainage under average flow conditions will be 7.2 cumecs. Two farm bridges also need to be replaced. If the road bridge at SJ 759 113 needs underpinning the cost would increase.

There are areas near the upstream ends of Burlington and Crackleybank Pools which suffer from poor drainage, and the watercourse in these areas is in need of maintenance.

BENEFITS

The change from the present poor grazing to a cereals/grass system is possible following drainage, resulting in an increase in gross margin over 20 ha within the area of improvement.

IDENTIFICATION

Problem code number(s):	2-83-110-1
Watercourse:	River Corve (non-main river)
Location:	Woodhousefield Gorse to Broadstone Mill (Bridgnorth District Council)
OS Map reference:	SO 547 901 to SO 609 951

NATURE OF PROBLEM

218 ha of agricultural land within the Medway Line suffer from inadequate arterial drainage and localised flooding (August 1976 and December 1972).

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 5 years
		(ii)	Structures	1 in 50 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	172,970	
		(ii)	Field drainage	£	217,680	£390,650
(b)	**Present value of benefits**	(i)	Agriculture	£	1,989,260	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£1,989,260
(c)	**Benefit/cost ratio**					5.1
(d)	**Priority category**					1C

IMPROVEMENT WORKS

The disused weir at approximately SO 554 904 has caused much deposition over the whole of the upstream portion of the problem reach. The weir needs breaking out with considerable excavation upstream to rectify the problem to provide a channel capacity of 8.8 cumecs at Broadstone Mill and allow satisfactory freeboard under normal flow conditions. Three bridges may require underpinning.

BENEFITS

With improved drainage an increase in gross margin is expected. Already some land adjoining the river at Woodhouse, Brockton and Shipton is under arable cultivation as a result of riparian owners maintaining and improving the watercourse thereby obtaining sufficient freeboard to allow underdrainage.

CONSERVATION

There is little conservation interest at this site. There are several different marginal and emergent plants present, but few aquatic plants.

FISHERIES

Consultation is essential before improvement works are commenced, particularly with regard to the weir removal, as this is an important fishery.

IDENTIFICATION

Problem code number(s):	2-83-110-2
Watercourse:	River Rea (non-main river)
Location:	Oreton (Bridgnorth District Council)
OS Map reference:	SO 662 804

NATURE OF PROBLEM

Agricultural land adjacent to the watercourse suffers from flooding several times per year.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

Improvement of the channel to enable the conveyance of a 1 in 5 year flow within bank would be costly. The area of benefit is small and there is already sufficient freeboard for field drainage outfall, were it to be installed. No works are therefore proposed.

Repair of erosion damage to footbridge abutment is probably the responsibility of the County Council.

IDENTIFICATION

Problem code number(s):	2-83-110-3
Watercourse:	Un-named (non-main river)
Location:	Ditton Priors (Bridgnorth District Council)
OS Map reference:	SO 604 888 and SO 609 890

NATURE OF PROBLEM

Two minor roads in the village are liable to flooding after very heavy rainfall.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£____
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£____
(c) **Benefit/cost ratio**				
(d) **Priority category**				

IMPROVEMENT WORKS

The road culvert at SO 609 890 is adequate for Q_{25} flows. The road flooding at this location is therefore due to inadequacies in the road gullies/grips etc. leading to the watercourse or culvert. The flooding at SO 604 888 is due mainly to an inadequate culvert. However, as replacement costs would be high in relation to the low benefits of alleviating the infrequent road flooding, no works are proposed. Maintenance work or additional gullies/grips are required at both locations.

IDENTIFICATION

Problem code number(s):	1-83-210-3
Watercourse:	River Roden and Back Brook (main river)
Location:	Wem (North Shropshire District Council)
OS Map reference:	SJ 511 285 to SJ 483 292

NATURE OF PROBLEM

The Roden is a highland carrier upstream of Wem Mill and there are leakage problems from a 3 km long embankment section. The lowland drain (Back Brook) does not provide sufficient freeboard for drainage, causing inadequate drainage to 200 ha of agricultural land. The Roden overtops its banks in major floods. The embankment section of the River Roden has a discharge capacity of slightly less than the mean annual peak discharge. Wem Mill weir controls the level of the Roden.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			B

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	844,690	
		(ii)	Field drainage	£	235,200	£1,079,890
(b)	**Present value of benefits**	(i)	Agriculture	£	5,570,490	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£5,570,490
(c)	**Benefit/cost ratio**					5.2
(d)	**Priority category**					1B

IMPROVEMENT WORKS

The recommended works require the River Roden to be lowered, Wem Mill weir removed and the channel regraded over 4.8 km. The Back Brook should be regraded over 2.7 km, the road bridge at SJ 512 286 replaced and the sewer built into the main mill weir lowered, and possibly a pumping station installed.

The improved channel will provide a design capacity of 15.2 cumecs at the downstream end allowing satisfactory freeboard under normal flow conditions.

The improvement of the Roden at Wem could well worsen the situation downstream and could necessitate improvement of a further length of the River Roden (see 1-83-210-10 at Stanton Mill).

Maintenance to the embankments has reduced the leakage, giving some improvement.

BENEFITS

With improved drainage there is potential for a significant change from medium dairy stock and support crops and medium cereals, to high class arable (sugar beet/potatoes) and dairy farming.

DEVELOPMENT

The NRA are currently objecting to development in Wem due to inadequate watercourse capacity. The objections could be withdrawn if improvement works are carried out.

CONSERVATION

The River Roden has probably the richest aquatic flora of all the main Shropshire lowland rivers and the stretch implicated in this scheme contains most of the characteristic plant species of the whole river. However, careful channel improvement should not damage these plant communities permanently.

The most important site is at SJ 495 280, which has very interesting wet grassland with several uncommon species such as marsh orchid, bottle sedge and the rare meadow-rue.

FISHERIES

There is a specific fishery interest in the area adjacent to Wem Mill and consultations will be necessary with the local fishing club.

IDENTIFICATION

Problem code number(s):	1-83-210-4
Watercourse:	War Brook (non-main river)
Location:	Baschurch (North Shropshire District Council)
OS Map reference:	SJ 432 206 to SJ 430 235

NATURE OF PROBLEM

The watercourse does not provide adequate freeboard for field drainage and 250 ha of land suffer from these inadequate outfall conditions.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	660,180	
	(ii)	Field drainage	£	312,760	£972,940
(b) **Present value of benefits**	(i)	Agriculture	£	1,400,260	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£1,400,260
(c) **Benefit/cost ratio**					1.4
(d) **Priority category**					2B

IMPROVEMENT WORKS

The level of Walford Pool should be dropped by 0.6 m, to enable the regrading and enlarging of the watercourse to provide satisfactory freeboard under average flow conditions. These improvements will provide a design capacity of 3.1 cumecs, though freeboard criteria will allow a maximum capacity of 5.2 cumecs at the downstream end. If the full area is to benefit, 8.3 km of watercourse should be improved and the levels of Fenemere, Birchgrove Pool, Marton Pool and Berth Pool should be lowered by 1m. The road culverts at SJ 448 223 and SJ 437 236, as well as the railway culvert at SJ 443 213, will have to be replaced.

In 1984, Shropshire County Council carried out an improvement scheme from Walford up to the railway line.

BENEFITS

With improved drainage there is potential for a change from the present poor grazing system to a mixed beef and cereals system.

CONSERVATION

Fenmere is a designated SSSI. The Nature Conservancy Council would oppose the lowering of the pool levels and would prefer the proposals to be abandoned. It would be possible to carry out an improvement scheme up to the road culvert at SJ 448 223 without affecting the SSSI. 4.4 km of watercourse would then need regrading to benefit 104 ha.

FISHERIES

Any lowering of the pools would seriously affect the fishing and would be opposed.

IDENTIFICATION

Problem code number(s):	1-83-210-5
Watercourse:	Sleap Brook (non-main river)
Location:	Loppington (North Shropshire District Council)
OS Map reference:	SJ 472 271 to SJ 446 285

NATURE OF PROBLEM

The arterial drainage of 274 ha of agricultural land is inadequate.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 10	years
	(ii)	Structures	1 in 25	years
(c) **Land potential category**			b	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£

(c) **Benefit/cost ratio**

(d) **Priority category**

IMPROVEMENT WORKS

Regrading and enlarging of 3.5 km of watercourse are required to provide satisfactory freeboard, and the road culvert (SJ 459 273) should be replaced at a lower level. The channel will have a design capacity of 2.6 cumecs but freeboard criteria will, however, allow a maximum capacity of 5.7 cumecs.

Shropshire County Council have completed an improvement scheme for the area east of Burlton.

BENEFITS

The area is peat with a high water table seriously limiting grain production. With drainage, an intensive cereals/potatoes system could be adopted in the benefit area.

IDENTIFICATION

Problem code number(s):	1-83-210-6
Watercourse:	River Roden (non-main river)
Location:	Bettisfield (North Shropshire District Council)
OS Map reference:	SJ 462 334 to SJ 489 381

NATURE OF PROBLEM

420 ha of land suffer from inadequate arterial drainage, though 120 ha of this is a woodland conservation area. In the upper reaches on Fenn's Moss there is no proper watercourse.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	423,790	
	(ii)	Field drainage	£	525,440	£949,230
(b) **Present value of benefits**	(i)	Agriculture	£	7,501,410	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£7,501,410
(c) **Benefit/cost ratio**					7.9
(d) **Priority category**					1C

IMPROVEMENT WORKS

It is suggested that 7.2 km of watercourse should be regraded and enlarged to provide satisfactory freeboard under average flow conditions. Improvements will provide a design capacity of 3.9 cumecs, though freeboard criteria will allow a maximum design capacity of 6.4 cumecs at the downstream end. The disused gauging station near Blackhurstford Bridge should be removed. The road and the road culvert at SJ 471 352, the canal culvert at SJ 472 357 and five farm bridges should be replaced.

BENEFITS

Drainage improvements will increase the versatility of cropping producing a marked change in productivity.

CONSERVATION

Fenn's, Whixall, Bettisfield and Wem Moss have SSSI status. Wem Moss is managed as a nature reserve by the Shropshire Conservation Trust and is considered to be a nationally important raised bog. Whixall Moss and Fenn's Moss are wetland sites, whose value would decline with drainage improvements. It is possible to carry out a limited improvement scheme not affecting these sites. This would go as far as Bettisfield Canal and would have a benefit area of 117 ha, omitting the woodland area to the south of the canal. Approximately 3.5 km of watercourse would have to be regraded and enlarged for this limited scheme.

IDENTIFICATION

Problem code number(s):	1-83-210-7
Watercourse:	Wolverley Brook (non-main river)
Location:	Whixall (North Shropshire District Council)
OS Map reference:	SJ 472 306 to SJ 495 365

NATURE OF PROBLEM

625 ha of agricultural land suffer from inadequate arterial drainage. The Wolverley Brook, downstream of Whixall Moss, has a poor bed-slope and any improvements are limited by the levels of a number of road culverts.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	1,078,200	
	(ii)	Field drainage	£	1,095,920	£2,174,120
(b) **Present value of benefits**	(i)	Agriculture	£	15,627,940	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£15,627,940
(c) **Benefit/cost ratio**					7.2
(d) **Priority category**					1A

IMPROVEMENT WORKS

It is recommended that 13.9 km of watercourse are regraded and enlarged to provide satisfactory freeboard under average flow conditions. These improvements will provide a channel design discharge of 6.3 cumecs at the downstream end. Road bridges at SJ 477 317 and SJ 490 333, the canal culverts at SJ 489 352 and SJ 491 349, and the road culverts at SJ 491 345 and SJ 494 352 should be replaced.

Shropshire County Council carried out improvements in 1985/86 on the lower section of the Brook from the River Roden to Ossage Bridge. This will not benefit the majority of the problem area.

BENEFITS

With improved drainage, the land has potential to change from poor grazing to good grass and supporting crops for dairy cows, with an increased versatility for cropping if the farm structure enabled this to develop.

CONSERVATION

Whixall's Moss, Fenn's Moss and the Shropshire Union Canal at this point are of SSSI status and any lowering of the water table within the SSSI would most likely be opposed. Worldsend Moss to the south of the canal is also an important conservation site.

IDENTIFICATION

Problem code number(s):	1-83-210-9
Watercourse:	Wemsbrook (non-main river)
Location:	Wem (North Shropshire District Council)
OS Map reference:	SJ 509 286 to SJ 509 300

NATURE OF PROBLEM

13 houses and some farm buildings are potentially liable to flooding following urban development. The Brook has only the capacity to pass the mean annual peak discharge. Adjacent agricultural land also suffers from localised flooding and inadequate arterial drainage.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in 100 years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	170,090	
		(ii)	Field drainage	£		£170,090
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£	67,560	
		(iii)	Roads/Railways	£		£67,560
(c)	**Benefit/cost ratio**					0.4
(d)	**Priority category**					3C

IMPROVEMENT WORKS

It is recommended that culverts should be designed to provide a capacity of 3.6 cumecs. To achieve this a 1.8 m diameter culvert is required, costing in the order of £1m. Alternative solutions include the construction of a balancing lake upstream of the urban area to reduce peak flows or allowing the culvert to surcharge and containing the flow upstream of the culvert in a walled channel.

The existing culvert has trash screens at the inlet and outlet, which collect a considerable amount of debris, and affect the discharge capacity. Clearly the balancing lake alternative would not be prone to blockage problems.

BENEFITS

No improvements to the agricultural drainage will result from either of the two possible schemes.

IDENTIFICATION

Problem code number(s):	1-83-210-10
Watercourse:	River Roden (main river)
Location:	Stanton (North Shropshire District Council)
OS Map reference:	SJ 565 240 to SJ 558 247

NATURE OF PROBLEM

15 ha of agricultural land and three unclassified roads flood frequently for durations of up to 24 hours. The channel has insufficient capacity to pass even the mean annual discharge. 28 ha of agricultural land suffer from inadequate arterial drainage caused, in part, by two weirs which used to feed mill streams (now disused).

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	541,990	
	(ii)	Field drainage	£	35,030	£577,020
(b) **Present value of benefits**	(i)	Agriculture	£	700,130	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£700,130
(c) **Benefit/cost ratio**					1.2
(d) **Priority category**					2B

IMPROVEMENT WORKS

It is necessary to demolish the weirs at SJ 556 252 and SJ 566 241, regrade and enlarge 3.7 km of watercourse, replace the road bridge at SJ 559 246 and underpin the road bridges at SJ 566 241 and SJ 555 258. The channel improvement will provide satisfactory freeboard under normal flow conditions and have a design capacity of 27 cumecs.

The road to Harcourt Mill has access to only one property. If a standard farm bridge is acceptable on this road, the cost of the scheme would be reduced by £43,240.

The low bed gradient may necessitate combining this problem with 1-83-210-3.

BENEFITS

Following drainage improvement it is expected that the present summer grazing and poor cereal farming will be replaced by intensive production of potatoes and cereals.

The benefits attributable to the alleviation of road flooding are negligible and have not been estimated.

FISHERIES

This is a trout fishery and detailed consultation will be required with regard to any lowering or removal of weirs.

IDENTIFICATION

Problem code number(s):	1-83-210-11
Watercourse:	Hawk Lake Brook (non-main river)
Location:	Weston (North Shropshire District Council)
OS Map reference:	SJ 552 291 to SJ 574 313

NATURE OF PROBLEM

The arterial drainage of 90 ha of agricultural land is inadequate. The situation has deteriorated since 1980.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	219,100	
		(ii)	Field drainage	£	135,110	£354,210
(b)	**Present value of benefits**	(i)	Agriculture	£	2,210,730	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£2,210,730
(c)	**Benefit/cost ratio**					6.2
(d)	**Priority category**					1C

IMPROVEMENT WORKS

It is necessary to regrade and enlarge the Brook over a length of 3 km, dropping the channel invert by 1 m maximum. The road culverts at SJ 554 296 and SJ 561 300 are set too high and need to be replaced. The improved channel will carry a design discharge of 1.7 cumecs.

BENEFITS

With improved drainage, a change from rough grazing to good pasture and support crops for dairy cows is possible, with a further potential for arable farming.

COMMENT

The River Roden affects a short length of the Brook and needs to be investigated with a view to improving the channel.

There is little support for an improvement scheme.

IDENTIFICATION

Problem code number(s):	1-83-210-12
Watercourse:	Sundorne Brook (non-main river)
Location:	Astley (North Shropshire District Council)
OS Map reference:	SJ 536 174 to SJ 515 220

NATURE OF PROBLEM

Flooding occurs more than once per year, for periods up to 4 hours, to three unclassified roads and 10 ha of agricultural land. 150 ha of agricultural land suffer from poor arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	415,140	
	(ii)	Field drainage	£	187,660	£602,800
(b) **Present value of benefits**	(i)	Agriculture	£	608,450	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£608,450
(c) **Benefit/cost ratio**					1.0
(d) **Priority category**					2C

IMPROVEMENT WORKS

It is suggested that the level of Sunderton Pool is lowered by 0.5 m, and 7 km of channel regraded to provide satisfactory freeboard under average flow conditions. In addition, five culverts need to be replaced because they are inadequate or set too high.

The channel design capacity will be 5.5 cumecs, but freeboard criteria will, however, allow a maximum capacity of 6.9 cumecs at the downstream end. The dam at Sunderton Pool is in a poor state, but only minor works have been allowed for in the cost estimate, although extensive works could be required to make it safe.

BENEFITS

No change in the current farming system is envisaged. Benefits to road traffic are negligible.

CONSERVATION

An interesting wetland stretch which includes patches of Salix Carr at SJ 532 168 is of value for conservation. Any drainage improvements should attempt to avoid disturbance to the lake and surrounding woodlands.

IDENTIFICATION

Problem code number(s):	1-83-210-13
Watercourse:	Steel Brook (non-main river)
Location:	Whitchurch (North Shropshire District Council)
OS Map reference:	SJ 553 358 to SJ 536 371

NATURE OF PROBLEM

50 ha of agricultural land suffer from inadequate arterial drainage. The situation has deteriorated since 1980.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	164,330	
		(ii)	Field drainage	£	57,550	£221,880
(b)	**Present value of benefits**	(i)	Agriculture	£	1,200,230	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£1,200,230
(c)	**Benefit/cost ratio**					5.4
(d)	**Priority category**					1C

IMPROVEMENT WORKS

The channel should be regraded and enlarged for 2.4 km within the area of benefit from 500 m downstream of the confluence with Soulton Brook (main river). It will also be necessary to replace road culverts at SJ 550 366 and SJ 544 368, and a farm bridge.

The proposed improvements will provide a design capacity of 1.7 cumecs, but freeboard criteria will, however, allow a maximum capacity of 2.1 cumecs at the downstream end.

If it is necessary to underpin the railway bridge at SJ 548 366 the cost of the scheme would increase.

BENEFITS

A major change in the farming system from pasture and poor cereals to high value root crop production will be possible following drainage works.

CONSERVATION

There are several stretches of interesting aquatic and marshland plant species along the banks of the watercourse.

IDENTIFICATION

Problem code number(s):	1-83-210-14
Watercourse:	Sandford Brook (non-main river)
Location:	Sandford (North Shropshire District Council)
OS Map reference:	SJ 581 341 to SJ 583 369

NATURE OF PROBLEM

The arterial drainage of 160 ha of agricultural land is inadequate. Sandford Pool is silting up and the situation has deteriorated.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in 10	years
		(ii)	Structures	1 in 25	years
(c)	**Land potential category**			b	

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£ 325,770	
		(ii)	Field drainage	£ 177,650	£503,420
(b)	**Present value of benefits**	(i)	Agriculture	£ 1,633,640	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£1,633,640
(c)	**Benefit/cost ratio**				3.2
(d)	**Priority category**				1C

IMPROVEMENT WORKS

It is necessary to lower the level of Sandford Pool by 0.5 to 0.8 m to allow the regrading of 5.6 km of watercourse upstream. Millenheath Bridge (SJ 378 349) and the new road culvert at SJ 590 358 should be replaced. The channel is designed to have a maximum capacity of 5.7 cumecs allowing for freeboard criteria.

BENEFITS

A significant change from rough pasture and poor cereals to an arable crop rotation (including potatoes) will be possible with improved drainage.

COMMENT

It may prove difficult to get agreement to the lowering of Sandford Pool, in which case the alternative of a pumping scheme(s) could prove expensive.

IDENTIFICATION

Problem code number(s):	1-83-210-15
Watercourse:	Darliston Brook (non-main river)
Location:	Darliston (North Shropshire District Council)
OS Map reference:	SJ 586 331 to SJ 565 345

NATURE OF PROBLEM

The arterial drainage of 60 ha of agricultural land is inadequate. The situation has deteriorated since 1980.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 10	years
	(ii)	Structures	1 in 25	years
(c) **Land potential category**			b	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£ 259,460		
	(ii)	Field drainage	£ 67,560	£327,020	
(b) **Present value of benefits**	(i)	Agriculture	£ 1,500,280		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	£1,500,280	
(c) **Benefit/cost ratio**				4.6	
(d) **Priority category**				1C	

IMPROVEMENT WORKS

It is necessary to regrade and enlarge 1 km of the Bailey Brook and 2.7 km of the Darliston Brook to provide satisfactory freeboard under average flow conditions. Darliston Brook should be lowered by an average 0.7 m and the road culverts at SJ 586 331, SJ 586 334 and SJ 574 336 should be replaced as they are too high. The suggested improvements would provide a design capacity of 0.6 cumecs but freeboard criteria would, however, allow a maxium capacity of 5.4 cumecs at the downstream end.

BENEFITS

Improving the drainage will produce a significant change from rough pasture and poor root/cereals, to first class dairy and support crops with some potatoes and sugar beet.

CONSERVATION

The RSPB and BTO have identified this site as being of ornithological interest.

COMMENT

The Bailey Brook also affects problems 1-83-210-14 and 1-83-210-20 and it may be advantageous to combine all of these problems to justify a major improvement of the Brook.

IDENTIFICATION

Problem code number(s):	1-83-210-16
Watercourse:	Sidley Moor Brook (non-main river)
Location:	Preesgreen (North Shropshire District Council)
OS Map reference:	SJ 555 308 to SJ 597 320

NATURE OF PROBLEM

The arterial drainage of 100 ha of agricultural land is inadequate.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in 10 years
	(ii)	Structures	1 in 25 years
(c) **Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	299,820	
	(ii)	Field drainage	£	125,110	£424,930
(b) **Present value of benefits**	(i)	Agriculture	£	2,450,460	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£2,450,460
(c) **Benefit/cost ratio**					5.8
(d) **Priority category**					1C

IMPROVEMENT WORKS

It is necessary to regrade and lower the Brook by an average of 0.7 m over a 4.3 km reach. Six road culverts need to be either replaced or modified to provide the required design standard.

The channel improvements will provide a design capacity of 1.5 cumecs but freeboard criteria will, however, allow a maximum capacity of 1.8 cumecs at the downstream end.

The County Council completed an improvement scheme in 1983 to the lower reaches of the Brook, from the main river to the A49.

IDENTIFICATION

Problem code number(s):	1-83-210-17
Watercourse:	River Tern (main river)
Location:	Peplow (North Shropshire District Council)
OS Map reference:	SJ 642 242 to SJ 637 278

NATURE OF PROBLEM

The Peplow mill pool is impounded at too high a level and results in the inadequate arterial drainage of 160 ha of agricultural land, with occasional flooding of approximately 70 ha. The River Tern, in this reach, is a highland carrier with a complex system of lowland drains.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 10	years
	(ii)	Structures	1 in	years
(c) **Land potential category**			b	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£ 380,540	
	(ii)	Field drainage	£ 175,150	£555,690
(b) **Present value of benefits**	(i)	Agriculture	£ 4,500,850	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£4,500,850
(c) **Benefit/cost ratio**				8.1
(d) **Priority category**				1C

IMPROVEMENT WORKS

It is necessary to lower the mill pool by 0.6 m, and enlarge the main channel over a 3.4 km reach, to permit a design channel capacity of 22.5 cumecs. In order to provide satisfactory freeboard under average winter flow conditions, it is also necessary to improve the lowland drains over a distance of 4 km.

BENEFITS

A significant change from the present rough pasture and poor cereals system, to a cereals/potatoes/sugar beet rotation, will be possible following the proposed arterial works.

CONSERVATION

The mill pond is used for rearing waterfowl. Lowering the pool may have a deleterious effect on the wildlife habitat.

COMMENT

It may prove possible to extend the suggested improvement scheme upstream to Tern Hill (SJ 638 318). The reach between Stoke-upon-Tern and Tern Hill suffers from frequent flooding and partial unsatisfactory drainage.

IDENTIFICATION

Problem code number(s):	1-83-210-18
Watercourse:	Platt Brook (non-main river)
Location:	Ellerdine Heath (North Shropshire District Council)
OS Map reference:	SJ 631 227 to SJ 600 233

NATURE OF PROBLEM

The arterial drainage of 140 ha of agricultural land is inadequate. There is a Shropshire Groundwater Scheme discharge point at SJ 604 242.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	285,410	
		(ii)	Field drainage	£	175,150	£460,560
(b)	**Present value of benefits**	(i)	Agriculture	£	1,294,690	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£1,294,690
(c)	**Benefit/cost ratio**					2.8
(d)	**Priority category**					1C

IMPROVEMENT WORKS

The suggested works involve regrading and enlarging 5.6 km of the Brook, together with the replacement of the road culvert at SJ 620 226 and the railway culvert at SJ 627 227 at a lower level, to provide a channel design standard of 1.1 cumecs. The improvement of the Platt Brook is dependent on the improvement of the Potford Brook (1-83-210-19).

BENEFITS

A change from permanent pasture and cereals to an intensive arable system, including potatoes and sugar beet, is possible following drainage improvements.

CONSERVATION

Platt Brook and its adjacent damp woodland and meadows are important reservoirs for wildlife in an area of widespread intensive arable farming.

COMMENT

The railway is disused and it may be possible to reduce the cost of lowering the railway culvert by having an open cut through the embankment.

IDENTIFICATION

Problem code number(s):	1-83-210-19
Watercourse:	Potford Brook (part main river)
Location:	Hodnet (North Shropshire District Council)
OS Map reference:	SJ 635 222 to SJ 614 262

NATURE OF PROBLEM

The arterial drainage of 150 ha of agricultural land is inadequate. There is a Shropshire Groundwater Scheme discharge point at SJ 615 261.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	429,550	
		(ii)	Field drainage	£	187,660	£617,210
(b)	**Present value of benefits**	(i)	Agriculture	£	1,672,540	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£1,672,540
(c)	**Benefit/cost ratio**					2.7
(d)	**Priority category**					1C

IMPROVEMENT WORKS

It is necessary to regrade and enlarge 6.4 km of watercourse to provide satisfactory freeboard under normal flow conditions. The road culverts at SJ 635 222 and SJ 623 244 and the railway culvert at SJ 625 243 should be replaced. The railway is disused and the culvert could be replaced with an open cut.

The channel improvement will provide a design capacity of 1.8 cumecs but freeboard criteria will, however, allow a maximum capacity of 4.7 cumecs.

The improvement of Platt Brook (1-83-210-18) is dependent on the lowering of the Potford brook.

The County Council promoted an improvement scheme (financed by STWA) in 1983/84, from the Tern confluence to Sandyford Bridge.

BENEFITS

A significant change from permanent pasture and part cereals, to an intensive arable system including potatoes and sugar beet, is possible with improved drainage.

CONSERVATION

Potford Brook and adjacent meadows and damp woodland provide important habitats for wildlife. At SJ 620 227 there are water meadows and old pasture with patches of marsh vegetation, including spotted orchids.

IDENTIFICATION

Problem code number(s):	1-83-210-20
Watercourse:	Smythemoor Brook (non-main river)
Location:	Bletchley (North Shropshire District Council)
OS Map reference:	SJ 630 328 to SJ 637 340

NATURE OF PROBLEM

The arterial drainage of 48 ha of agricultural land is inadequate.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	167,210	
		(ii)	Field drainage	£	52,540	£219,750
(b)	**Present value of benefits**	(i)	Agriculture	£	964,070	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£964,070
(c)	**Benefit/cost ratio**					4.4
(d)	**Priority category**					1C

IMPROVEMENT WORKS

It is necessary to lower the channel invert by 0.6 m over a 1.6 km reach to provide satisfactory freeboard under average flow conditions. The main road culvert at SJ 630 328 is to be replaced as it is too high. The channel improvement will provide a maximum design capacity of 0.25 cumecs.

It may be necessary to regrade a short length of the Bailey Brook in order to lower Smythemoor Brook (see 1-83-210-15).

Some maintenance has been carried out by riparian owners which has reduced the problem.

BENEFITS

A significant change from summer grazing to a cereal/sugar beet/potato rotation will be possible following the suggested works.

CONSERVATION

This area supports a rich flora and insect population contrasting with the intensive agriculture of adjacent land.

COMMENT

There is an existing pipe drainage system for the area which discharges to the River Tern at SJ 629 315. This is not providing satisfactory drainage and a comprehensive scheme should be undertaken to investigate this aspect.

IDENTIFICATION

Problem code number(s):	1-83-210-21
Watercourse:	River Tern (non-main river)
Location:	Norton-in-Hales (North Shropshire District Council)
OS Map reference:	SJ 698 368

NATURE OF PROBLEM

Flooding of 15 ha is caused as a result of silting of the channel. This is due to sandwashing and the deposition of heavy silt loads produced from the very sandy soil of the catchment area.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

Periodic heavy flooding clears out much of the silt deposits and it is not proposed to carry out remedial works. The Willoughbridge sandworks should not be discharging to the river as their washing water is said to be recirculated (See 1-83-210-23).

IDENTIFICATION

Problem code number(s):	1-83-210-22
Watercourse:	Sambrook (non-main river)
Location:	Cheswardine (North Shropshire District Council)
OS Map reference:	SJ 714 260 to SJ 705 294

NATURE OF PROBLEM

Flooding occurs more than once a year, for periods up to 4 hours, to 10 ha of agricultural land and 2 unclassified roads. 100 ha of agricultural land suffer from inadequate arterial drainage. The situation has deteriorated since 1980.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	259,460	
	(ii)	Field drainage	£	112,590	£372,050
(b) **Present value of benefits**	(i)	Agriculture	£	2,039,270	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£2,039,270
(c) **Benefit/cost ratio**					5.5
(d) **Priority category**					1C

IMPROVEMENT WORKS

To provide satisfactory freeboard under average flow conditions, it is necessary to lower Ellerton Pool by 0.5 m, regrade and enlarge the channel for 3.1 km and replace the road culverts at SJ 712 281 and SJ 711 287. The suggested improvements will provide a maximum design capacity of 2.2 cumecs but freeboard criteria will, however, allow a maximum channel capacity of 9.3 cumecs.

BENEFITS

Improving the arterial drainage will allow a significant change from permanent rough pasture with some poor cereals to arable farming.

The benefits from alleviating road flooding are negligible and have not been calculated.

CONSERVATION

At SJ 716 267 there is a rich marsh with interesting flora and a rich associated insect fauna.

IDENTIFICATION

Problem code number(s):	1-83-210-23
Watercourse:	River Tern (non-main river)
Location:	Market Drayton (North Shropshire District Council)
OS Map reference:	SJ 672 336 to SJ 726 389

NATURE OF PROBLEM

150 ha of agricultural land suffer from inadequate arterial drainage and the watercourse is in poor condition. The situation has deteriorated since 1980.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	1,081,090	
		(ii)	Field drainage	£	187,660	£1,268,750
(b)	**Present value of benefits**	(i)	Agriculture	£	3,300,620	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£3,300,620
(c)	**Benefit/cost ratio**					2.6
(d)	**Priority category**					1A

IMPROVEMENT WORKS

To provide satisfactory freeboard under average flow conditions it is necessary to regrade and enlarge 10.4 km of the watercourse. The works also include removing the old mill impounding at SJ 677 338 and lowering Oakley Pool by up to 1.0 m at SJ 700 369.

Major structural work to 5 road bridges and a canal bridge will also be necessary to give a design capacity of 13 cumecs.

BENEFITS

Improvement of the arterial drainage will enable improved grass production for dairy cattle. The area has potential for arable farming where management allows.

CONSERVATION

There are strong conservation interests opposed to a major improvement scheme which would change the nature of the river. However, if the Coal Brook (see 1-99-510-1) is to be improved effectively, the minor improvement of 34 ha of agricultural land below the canal bridge (SJ 684 344) is essential.

A marsh at SJ 699 369 contains a variety of important plant species including ragged robin, marsh marigold, spotted orchid, square St. John's wort and brooklime. Otters are present in the vicinity of Bearstone Mill, and there are a number of interesting water meadows and marshes, particularly between Broomhall Grange and Betton.

IDENTIFICATION

Problem code number(s):	1-83-210-24
Watercourse:	Houlston Brook (non-main river)
Location:	Sleap Airfield (North Shropshire District Council)
OS Map reference:	SJ 485 264 to SJ 483 213

NATURE OF PROBLEM

262 ha of agricultural land suffer from poor drainage due to the outfall pipe under Sleap Airfield being too high. In addition, 16 ha of land flood annually.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b - 121 ha
				a - 141 ha

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	651,540	
		(ii)	Field drainage	£	170,140	£821,680
(b)	**Present value of benefits**	(i)	Agriculture	£	2,772,740	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£2,772,740
(c)	**Benefit/cost ratio**					3.4
(d)	**Priority category**					1B

IMPROVEMENT WORKS

The suggested works involve the replacement of the airfield culvert by 0.75 km of open channel, and the regrading and enlarging of 5.3 km of watercourse to carry a maximum design capacity of 1.5 cumecs, although freeboard criteria will allow a channel capacity of up to 5.7 cumecs. There are 5 road culverts which need to be replaced as they are too high.

Riparian owners have cleared the Brook around Webscott and some improvement has been gained.

BENEFITS

Improvement of the drainage will allow 121 ha to change from grain to intensive arable farming. However, 141 ha in the north of the benefit area will remain largely grassland, with moderate increases in productivity.

IDENTIFICATION

Problem code number(s):	1-83-210-25
Watercourse:	Un-named tributary of the River Tern (non-main river)
Location:	Woore (North Shropshire District Council)
OS Map reference:	SJ 736 418 to SJ 716 427

NATURE OF PROBLEM

10 ha of agricultural land suffer from frequent flooding and inadequate arterial drainage. This is caused by a 100 m long culvert of inadequate capacity which drains Gravenhunger Moss. North Shropshire District Council have occasionally replaced sections of the pipe and they are possibly going to replace the whole culverted length.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	60,540	
	(ii)	Field drainage	£	12,510	£73,050
(b) **Present value of benefits**	(i)	Agriculture	£	238,930	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£238,930
(c) **Benefit/cost ratio**					3.3
(d) **Priority category**					1D

IMPROVEMENT WORKS

It is necessary to regrade and enlarge 900 m of watercourse to provide satisfactory freeboard under average flow conditions. The culverted length of the eastern drainage channel from the A525 to the main watercourse should be replaced by an open cut, and the road culvert will also require replacing. The channel improvement will provide a design capacity of 1 cumec, but freeboard criteria will, however, allow a maximum channel capacity of 6.5 cumecs.

If the construction of an open cut was not permissible, the replacement of a larger culvert would increase costs.

Some improvements have been carried out by riparian owners which have reduced the problem.

BENEFITS

A major change in the farming system from rough pasture and poor cereals to an intensive dairy/cereal rotation will be possible following drainage improvement.

There is a small area of land to the south of the A525 which will benefit from the above improvement works to some extent. This has not been taken into account in the benefit assessment.

CONSERVATION

Only one field remains of Gravenhunger Moss, with limited conservation interest, but it is of local value and disturbance by improving drainage in the area should be avoided.

IDENTIFICATION

Problem code number(s):	1-83-210-26
Watercourse:	Un-named tributary of the Soulton Brook (non-main river)
Location:	Wem (North Shropshire District Council)
OS Map reference:	SJ 540 298 to SJ 524 318

NATURE OF PROBLEM

176 ha of agricultural land suffer from inadequate arterial drainage. Shropshire County Council have improved the watercourse up to the road culvert at SJ 535 303.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	308,470	
	(ii)	Field drainage	£	220,180	£528,650
(b) **Present value of benefits**	(i)	Agriculture	£	4,311,920	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£4,311,920
(c) **Benefit/cost ratio**					8.2
(d) **Priority category**					1C

IMPROVEMENT WORKS

5 km of watercourse require regrading to provide a channel design capacity of 1.0 cumec. Freeboard criteria will, however, allow a maximum capacity of 4.9 cumecs under normal flow conditions. The road culvert at SJ 535 303, and the railway culverts at SJ 527 313 and SJ 526 310, should be replaced.

BENEFITS

It is assumed that the land has the same potential as that in the Sidleymoor Brook area (1-83-210-16).

IDENTIFICATION

Problem code number(s):	1-83-210-27
Watercourse:	Muckleton Brook (non-main river)
Location:	Shawbury (North Shropshire District Council)
OS Map reference:	SJ 602 201 to SJ 592 221

NATURE OF PROBLEM

140 ha of agricultural land suffer from inadequate arterial drainage and 10 ha suffer from annual flooding (at SJ 600 220).

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 2	years
	(ii)	Structures	1 in 25	years
(c) **Land potential category**			a	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£____
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£____

(c) **Benefit/cost ratio**
(d) **Priority category**

IMPROVEMENT WORKS

It is recommended that 3.5 km of watercourse are regraded to allow satisfactory freeboard under average flow conditions, providing a channel design capacity of 0.2 cumecs. Freeboard criteria will, however, allow a maximum capacity of 0.5 cumecs. The works will involve deepening the Brook by up to 2 m, replacing the road culvert at SJ 603 204 and 4 farm culverts.

It may be necessary to improve part of the Lakemoor Brook downstream of the Muckleton Brook confluence so as to obtain the full lowering of the affected reach. There has been trouble with maintenance of the existing channel due to running sand in the bed and banks. This could raise the cost of any scheme considerably.

In 1980/81 the County Council completed an improvement scheme, but channel depths in the upper reaches are still unsatisfactory.

BENEFITS

An improvement in the productivity of the present farming system (cereals, beef and dairy) is possible with better drainage.

IDENTIFICATION

Problem code number(s):	1-83-210-28
Watercourse:	River Tern (to Victoria Mill - SJ 671 333) (main river)
Location:	Market Drayton (North Shropshire District Council)
OS Map reference:	SJ 628 315 to SJ 672 334

NATURE OF PROBLEM

98 ha of agricultural land suffer from inadequate arterial drainage, and frequent flooding of 40 ha for periods up to 24 hours. The watercourse does not have sufficient freeboard for field drainage and is of insufficient capacity for even the mean annual discharge.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	665,950	
		(ii)	Field drainage	£	122,600	£788,550
(b)	**Present value of benefits**	(i)	Agriculture	£	2,155,960	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£2,155,960
(c)	**Benefit/cost ratio**					2.7
(d)	**Priority category**					1B

IMPROVEMENT WORKS

Approximately 7.1 km of watercourse require enlarging and regrading to provide a design capacity of 15.7 cumecs and allow satisfactory freeboard under normal flow conditions. The scheme would start at the Tern gauging station (SJ 628 315) and the channel bed would be lowered by approximately 0.7 m. The Tern passes through the road embankment at SJ 639 319 in an Armco culvert which appears to be set too high. It is possible that the culvert has a false wall built in to allow for lowering the invert, but it has been assumed that a new pipe jacked culvert will be necessary at a low level.

IDENTIFICATION

Problem code number(s):	1-83-310-1
Watercourse:	Woolston Brook (non-main river)
Location:	West Felton (Oswestry Borough Council)
OS Map reference:	SJ 318 243 to SJ 329 270

NATURE OF PROBLEM

140 ha of agricultural land suffer from inadequate arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£____
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£____

(c) **Benefit/cost ratio**

(d) **Priority category**

IMPROVEMENT WORKS

Approximately 3 km of main channel and 2 km of feeder channels should be regraded to allow satisfactory freeboard under average flow conditions. These channel improvements will provide a channel design capacity of 2.1 cumecs, although freeboard criteria will, however, allow a maximum capacity of 2.6 cumecs. If drainage to the north of the canal is to be effective, the siphon under the canal at Aston Lock (SJ 325 251) should be replaced by a deep, straight-through culvert. In addition, 5 farm bridges and culverts require replacing. The County Council have completed an improvement scheme, but it has not provided sufficient lowering of the watercourse for the canal culvert to be replaced. The canal is closed at present but, if re-opened, the replacement of this culvert would be a priority.

CONSERVATION

The length of canal at Aston Locks is of interest for aquatic plants, and there are interesting meadows at Cupid's Ramble which could be affected by improved drainage.

IDENTIFICATION

Problem code number(s):	1-83-310-2
Watercourse:	River Morda (part main river)
Location:	Maesbury to Oswestry (Oswestry Borough Council)
OS Map reference:	SJ 305 245 to SJ 288 281

NATURE OF PROBLEM

Five houses in Weston, a house and farm buildings in Pentre Coed, and fields in the Newbridge area are subject to flooding for periods up to eight hours. 28 ha of agricultural land around Newbridge and Ball also suffer because there is insufficent freeboard for field drainage. Oswestry Borough Council have constructed a new stormwater system for Oswestry, including new outfalls to the Morda, changing the mean annual peak discharge from 9.9 cumecs to 11.3 cumecs at Pentre Coed.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in 2 years
	(ii)	Structures	1 in years
(c) **Land potential category**			a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£

(c) **Benefit/cost ratio**
(d) **Priority category**

IMPROVEMENT WORKS

The hard invert of the ford at SJ 306 248 limits the improvement of the watercourse in the Newbridge area. To provide adequate freeboard for field drainage would require lowering the ford, regrading 1.2 km of watercourse and structural works to the inverted siphon under the canal at SJ 307 249. The Borough Council's proposals will give the watercourse upstream of Newbridge the capacity to pass the 10 year return period peak discharge. The proposals include lowering Ball Mill weir by 0.5 m and resectioning the channel to a minimum 1.2 m depth. However, to obtain the satisfactory freeboard of 1.5 m would necessitate a further lowering of Ball Mill weir by 0.5 m, and 800 m of watercourse would have to be regraded. It is not possible to provide adequate arterial drainage without lowering the weir. If this is not possible, the weir crest will have to be lengthened and the channel upstream enlarged.

To provide the recommended protection for residential property (1 in 100 years, or 23 cumecs peak discharge) the channel at Pentre Coed could be enlarged and, if the weir is not lowered, a 1 m high flood bank some 300 m long would be required on the right bank. At Weston, the Borough Council's proposals will raise the standard of protection up to the 50 years return period, though this can be increased to the 100 year standard by either widening the channel or constructing a 0.5 m high flood wall some 170 m long.

The suggested improvements between Newbridge and Morda have been partially completed. The channel regrading works were carried out, but no structures were replaced. Only limited benefits have been achieved.

IDENTIFICATION

Problem code number(s):	1-83-310-3
Watercourse:	Frankton Brook (non-main river)
Location:	Frankton (Oswestry Borough Council)
OS Map reference:	SJ 365 299 to SJ 337 325

NATURE OF PROBLEM

Shropshire County Council completed a scheme in 1978 on the lower reaches of the Brook. However, the scheme was limited by the level of the River Perry and the invert level of the canal culvert at SJ 369 310. 200 ha of agricultural land could still benefit from improved drainage.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	291,170	
		(ii)	Field drainage	£	80,070	£371,240
(b)	**Present value of benefits**	(i)	Agriculture	£	4,000,750	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£4,000,750
(c)	**Benefit/cost ratio**					10.8
(d)	**Priority category**					1C

IMPROVEMENT WORKS

It is necessary to regrade and enlarge the watercourse for 5 km from its confluence with the River Perry, and replace the canal culvert at SJ 367 310 and the road culvert at SJ 351 325, as they are set too high. The channel improvements will provide a design capacity of 4.7 cumecs but freeboard criteria will, however, allow a maximum capacity of 5.8 cumecs at the downstream end.

The County Council carried out some improvements to the upstream end of the watercourse which included lowering the invert of the road bridge. The remainder of the improvement scheme was dependent on lowering the water level in the River Perry which has now been completed.

IDENTIFICATION

Problem code number(s):	1-83-310-4
Watercourse:	Tributary of River Perry (non-main river)
Location:	Fernhill (Oswestry Borough Council)
OS Map reference:	SJ 315 329 to SJ 302 327

NATURE OF PROBLEM

Unsatisfactory freeboard for field drainage results in the inadequate drainage of 60 ha of agricultural land. Inadequate road and railway culverts cause frequent flooding to 10 ha of agricultural land for periods up to 8 hours.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			a

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	383,430	
		(ii)	Field drainage	£		£383,430
(b)	**Present value of benefits**	(i)	Agriculture	£	150,030	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£150,030
(c)	**Benefit/cost ratio**					0.4
(d)	**Priority category**					3C

IMPROVEMENT WORKS

The necessary works involve replacing the road culverts at SJ 312 327 and SJ 303 327 and the railway culvert at SJ 307 327, and lowering the invert level of the railway culvert at SJ 305 327.

The channel should be deepened and enlarged over 1.7 km to provide satisfactory freeboard with a maximum design capacity of 3.3 cumecs. Freeboard criteria will, however, allow a maximum capacity of 7 cumecs.

The culvert at SJ 307 327 is an inverted siphon, and it may be possible to increase its capacity by changing the inlet and outlet characteristics.

BENEFITS

The enhancement of agricultural productivity is expected to be low as, apart from a small area, the benefit area is already used to its full potential.

IDENTIFICATION

Problem code number(s):	1-83-310-5
Watercourse:	Tributary of River Perry (non-main river)
Location:	Park Hall (Oswestry Borough Council)
OS Map reference:	SJ 312 315 to SJ 303 315

NATURE OF PROBLEM

Frequent flooding for periods up to 6 hours occurs to 12 ha of agricultural land, 8 ha of amenity land and a private road. The land also suffers from perpetual inadequate drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	320,000	
	(ii)	Field drainage	£		£320,000
(b) **Present value of benefits**	(i)	Agriculture	£	119,470	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£119,470
(c) **Benefit/cost ratio**					0.4
(d) **Priority category**					3C

IMPROVEMENT WORKS

The watercourse discharges into a pool at SJ 312 315 from which there is no obvious outfall. It will be necessary to install a new outfall culvert to discharge to the Whittington watercourse at SJ 322 313. The existing watercourse should be improved for 0.8 km.

BENEFITS

There is negligible benefit from alleviating the road flooding.

DEVELOPMENT

Shropshire County Council are proposing the Park Hall disused army camp as a mixed commercial/residential development. The above improvement to the arterial watercourse is essential before development can commence.

CONSERVATION

It is possible that this section could affect a marsh of some interest.

IDENTIFICATION

Problem code number(s):	1-83-310-6/9
Watercourse:	River Perry (main river to SJ 314 335)
Location:	Whittington (Oswestry Borough Council)
OS Map reference:	SJ 347 303 to SJ 305 342

NATURE OF PROBLEM

350 ha of agricultural land suffer from inadequate arterial drainage and occasional localised flooding. A petrol filling station on the A5 at Gobowen (SJ 335 320) floods occasionally because of an inadequate culvert just upstream of the road culvert.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 2 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			a

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	472,800	
		(ii)	Field drainage	£	125,110	£597,910
(b)	**Present value of benefits**	(i)	Agriculture	£	858,490	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£858,490
(c)	**Benefit/cost ratio**					1.4
(d)	**Priority category**					2C

IMPROVEMENT WORKS

Any improvement works are limited by the levels of Perry Farm weir and Halston weir, which both need to be lowered by 0.6 m. It is then necessary to regrade 5.8 km of main channel and 4.0 km of tributary channels to provide a channel design capacity of 2.4 cumecs, but freeboard criteria will allow a maximum channel capacity of 7.8 cumecs. The road culvert at SJ 318 334, two farm bridges on the main channel and four farm culverts on the tributary channels, should be replaced.

It has been assumed that no structural works will be necessary for the road bridge at SJ 335 320 or the remnants of the railway bridge at SJ 332 325.

Although this was part of the major Perry Improvement Scheme, this section upstream of Perry Farm is not being pursued. This is principally because of the conservation interest below, and because the benefit area is small.

The culvert causing flooding to the petrol filling station is in a very poor condition, apparently serving no purpose. It is suggested that the riparian owner demolishes it and cleans the channel.

CONSERVATION

The Nature Conservancy Council have recognised some interesting sites in the benefit area associated with extensive areas of semi-natural habitat. These including wet woodland, lakes and damp, unimproved pastures. They would prefer the improvement scheme not to take place.

COMMENT

The County Council has completed a Survey on the Halston Brook (tributary of the Perry). Halston weir is to be removed.

IDENTIFICATION

Problem code number(s):	1-83-310-7
Watercourse:	Common Brook (non-main river)
Location:	Whittington (Oswestry Borough Council)
OS Map reference:	SJ 337 308 to SJ 318 301

NATURE OF PROBLEM

The watercourse does not provide sufficient freeboard for field drainage, resulting in the inadequate arterial drainage of 80 ha of agricultural land and frequent localised flooding. The situation may be worsened by the stormwater outfall from Orenewydd Sewage Works (SJ 317 304).

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 2 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			a

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	196,040	
		(ii)	Field drainage	£	100,080	£296,120
(b)	**Present value of benefits**	(i)	Agriculture	£	300,060	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£300,060
(c)	**Benefit/cost ratio**					1.0
(d)	**Priority category**					2C

IMPROVEMENT WORKS

It is recommended that 2 km of watercourse should be regraded and enlarged to allow satisfactory freeboard under average flow conditions. The improvement works will provide a design capacity of 2.2 cumecs, but freeboard criteria will allow a maximum capacity of 4.2 cumecs. The road culvert at SJ 330 307 and five farm culverts will be replaced. The railway culvert at SJ 327 304 may need some structural or underpinning works to allow the invert to be lowered, which could increase the cost considerably.

BENEFITS

Some improvement in the productivity of the present farming system is possible with better drainage.

CONSERVATION

The stream has a fairly rich flora, including numerous marshland species along its edge.

IDENTIFICATION

Problem code number(s):	1-83-310-8
Watercourse:	Hindford Brook (non-main river)
Location:	Whittington (Oswestry Borough Council)
OS Map reference:	SJ 332 326 to SJ 320 355

NATURE OF PROBLEM

180 ha of agricultural land suffer from inadequate drainage. In addition, there is frequent flooding for periods of up to six hours to 20 ha of agricultural land.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 10	years
	(ii)	Structures	1 in 25	years
(c) **Land potential category**			b	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£ 389,190		
	(ii)	Field drainage	£ 225,190	£614,380	
(b) **Present value of benefits**	(i)	Agriculture	£ 2,700,510		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	£2,700,510	
(c) **Benefit/cost ratio**				4.4	
(d) **Priority category**				1C	

IMPROVEMENT WORKS

It is necessary to regrade and enlarge 3.4 km of watercourse to provide satisfactory freeboard under average flow conditions. The road culvert at SJ 332 330 and the canal culverts at SJ 329 347 and SJ 328 349 should be replaced as they are set too high.

The channel improvements will provide a design capacity of 3.1 cumecs.

Regrading is dependent on the lowering of the River Perry and it should be noted that regrading of the Perry will not now be pursued. The upstream end of the benefit area may have received some relief from the work on the Frankton watercourse.

BENEFITS

The benefit area is mostly peat with a relatively high potential.

CONSERVATION

There are wet meadows and botanically interesting drainage ditches in this area.

IDENTIFICATION

Problem code number(s):	1-83-310-10
Watercourse:	Un-named tributary of the River Perry (non-main river)
Location:	Rednal (Oswestry Borough Council)
OS Map reference:	SJ 360 297 to SJ 337 276

NATURE OF PROBLEM

170 ha of agricultural land suffer from inadequate arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	325,770	
	(ii)	Field drainage	£	50,040	£375,810
(b) **Present value of benefits**	(i)	Agriculture	£	511,210	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£511,210
(c) **Benefit/cost ratio**					1.4
(d) **Priority category**					2C

IMPROVEMENT WORKS

It is recommended that approximately 5.5 km of watercourse should be deepened by 1 m to allow satisfactory freeboard under average flow conditions. The improvement works will provide a design capacity of 0.8 cumecs, but freeboard criteria will allow a maximum capacity of 1.7 cumecs. A gravity drainage scheme would now be possible as the River Perry has been lowered. The railway culvert at SJ 345 284 and six farm culverts need to be replaced.

There are already three pumped drainage schemes in this area which have changed the land use. Difficulties have been experienced in laying pipes because of artesian groundwater.

BENEFITS

Only a marginal increase in the productivity of the present farming system is possible with improved drainage.

CONSERVATION

Some lengths of the canal in this area are of interest to aquatic plants.

IDENTIFICATION

Problem code number(s):	1-83-410-2
Watercourse:	Worthen Brook (non-main river)
Location:	Brockton (South Shropshire District Council)
OS Map reference:	SJ 318 043

NATURE OF PROBLEM

There is annual shallow flooding of the B4499 and 20 ha of agricultural land for durations up to four hours. Downstream of SJ 319 042 the freeboard is insufficient for agricultural drainage.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

This problem, together with an urban flooding problem at Worthen, is considered in problem No. 1-83-410-4.

IDENTIFICATION

Problem code number(s):	1-83-410-4
Watercourse:	Worthen Brook (non-main river)
Location:	Worthen (South Shropshire District Council)
OS Map reference:	SJ 334 042 to SJ 318 045

NATURE OF PROBLEM

Annual flooding affects up to 9 houses, the B4499 road near Brockton and unclassified roads in Worthen. There is also insufficient freeboard for land drainage from SJ 328 046 to SJ 318 045, which affects 20 ha of agricultural land. Limited improvements to the section between Worthen and the confluence with the River Rea were carried out by STWA in 1978.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in 30 years
	(ii)	Structures	1 in [b] years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	167,210	
	(ii)	Field drainage	£	25,020	£192,230
(b) **Present value of benefits**	(i)	Agriculture	£	325,060	
	(ii)	Buildings	£	45,040	
	(iii)	Roads/Railways	£		£370,100
(c) **Benefit/cost ratio**					1.9
(d) **Priority category**					2C

IMPROVEMENT WORKS

There are two alternatives for solving the problem:

i) A new channel should be cut from SJ 323 041 to SJ 326 036 to take all flood flows (100 years standard), and approximately 1 km of existing channel upstream should be regraded and enlarged to provide the necessary freeboard under average flow conditions. The design capacity of the new channel is 12.8 cumecs, and only a sweetening flow will be maintained downstream in the existing channel.

ii) The watercourse should be regraded and enlarged from its confluence with the Rea Brook to SJ 318 045. The invert level of the ford in Worthen will need to be lowered by 0.8 m. The design capacity of the channel from the confluence with the Rea Brook to SJ 326 044 will be 1 in 100 years (12.8 cumecs), and upstream will be 1 in 30 years (7.4 cumecs). Two farm bridges and one footbridge will require replacing to provide lower inverts and increased capacities.

BENEFITS

The agricultural land, currently poor grazing, has a potential for a mixed cereal/dairy/farming system. The benefits attributable to traffic disruption are negligible, as traffic volumes are low and delays short.

COMMENT

Scheme (i) is cheaper than scheme (ii) and almost completely removes the risk of flooding in Worthen. However, there could be problems in purchasing land for the new channel required for scheme (i), and as some difficulty could be experienced in maintaining a sweetening flow down the old channel, it may be necessary to fill this in up to the ford in Worthen.

Shropshire County Council have improved a storm culvert which discharges the run-off from a small catchment through Worthen and into the Worthen Brook at SJ 329 045. No account has been taken within the schemes for discharge from this culvert.

IDENTIFICATION

Problem code number(s):	1-83-410-5
Watercourse:	River Camlad (main river)
Location:	Chirbury (South Shropshire District Council)
OS Map reference:	SO 249 997

NATURE OF PROBLEM

The A490 floods frequently for durations of about 12 hours where it crosses the floodplain. The road bridge has insufficient capacity, as does the channel.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	198,920	
		(ii)	Field drainage	£		£198,920
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£	2,500	£2,500
(c)	**Benefit/cost ratio**					0
(d)	**Priority category**					3C

IMPROVEMENT WORKS

It is necessary to replace the existing road bridge and raise the road by 1.2 m over 250 m, to provide a design capacity of 56.5 cumecs.

It may be possible to underpin the existing bridge and increase the flow area, thus reducing the cost. This will have little effect in providing a satisfactory benefit/cost ratio.

IDENTIFICATION

Problem code number(s):	1-83-410-6
Watercourse:	Cound Brook (non-main river)
Location:	All Stretton (South Shropshire District Council)
OS Map reference:	SO 461 953 to SO 463 950

NATURE OF PROBLEM

Two bungalows flood frequently for durations of up to six hours and adjacent land suffers from flooding and inadequate arterial drainage.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

The Shropshire County Council scheme is limited by the invert levels of the road culvert at SO 461 953 and the railway culvert at SO 463 950, and does not increase the freeboard to the recommended 1.5 m. The scheme consists of regrading the channel between the road culvert at SO 461 953 and the railway culvert at SO 463 950, as well as replacing the farm culvert at SO 461 951. The new culvert is designed for the 1 in 50 years return period discharge and added protection is given to the bungalows by a 0.7 m high bank.

The improvement scheme proposed in 1-83-510-17 would replace the road culvert and railway culvert, and allow improvement of the channel to the full standard, providing a design capacity of 7 cumecs.

The County Council have completed an improvement scheme. One bungalow still floods but is is hoped that a flapped land drain will solve this.

BENEFITS

Benefits to agricultural land following arterial improvement are included in 1-83-510-17.

IDENTIFICATION

Problem code number(s):	1-83-410-7
Watercourse:	Cardingmill Stream (non-main river)
Location:	Church Stretton (South Shropshire District Council)
OS Map reference:	SO 454 941 to SO 443 946

NATURE OF PROBLEM

In 1976, the culvert at SO 443 946 was blocked by gravel, causing the stream to break its banks, flooding a block of flats and a cafe. Downstream of SO 446 944 a semi-detached house and a detached house were flooded.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	230,630	
	(ii)	Field drainage	£		£230,630
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	37,530	
	(iii)	Roads/Railways	£		£37,530
(c) **Benefit/cost ratio**					0.2
(d) **Priority category**					3C

IMPROVEMENT WORKS

It is suggested that 2 km of watercourse should be improved to provide a maximum channel capacity of 4.8 cumecs. To overcome erosion and subsequent deposition of quantities of gravel and silt during floods, it will be necessary to install a gravel trap upstream of the culvert at SO 459 946 and to have energy dissipators at intervals along the watercourse. The culvert at SO 443 946 and the railway culvert at SO 459 940 should be replaced. The replacement of the latter is included in 1-83-510-17 and would result in a saving to the cost of this scheme. The costs, however, do not include adjustments to the number of bridges and footbridges downstream of SO 446 944.

It is thought that these proposed improvement works would have little effect on the flooding in All Stretton (1-83-410-6).

BENEFITS

The calculation of benefits assumes that flooding depths remain constant irrespective of the magnitude of the flood.

CONSERVATION

The proposed improvement is within the Long Mynd SSSI and early consultation would be appreciated by the Nature Conservancy Council. The site consists of moorland with flushes and steep-sided valleys and is of high botanical, geological and ornithological interest.

IDENTIFICATION

Problem code number(s):	1-83-410-8
Watercourse:	Tributary of the Aylesford Brook (non-main river)
Location:	Chirbury (South Shropshire District Council)
OS Map reference:	SJ 274 014 to SJ 270 016

NATURE OF PROBLEM

20 ha of agricultural land suffer from inadequate arterial drainage and frequent flooding.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£____
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£____

(c) **Benefit/cost ratio**
(d) **Priority category**

IMPROVEMENT WORKS

The road culvert at SJ 274 014 should be replaced, and approximately 700 m of watercourse regraded and enlarged, to provide satisfactory freeboard under average flow conditions. Channel improvements will allow a design capacity of 0.5 cumecs.

The Brook is a Powysland IDB maintained watercourse.

Some deepening of the watercourse has been carried out upstream of the Chirbury/Shrewsbury road culvert permitting some underdrainage to be carried out.

BENEFITS

Following drainage improvements, the land presently used for stock rearing has the potential for dairying.

IDENTIFICATION

Problem code number(s):	1-83-410-9
Watercourse:	Crankwell Brook (non-main river)
Location:	Chirbury (South Shropshire District Council)
OS Map reference:	SO 221 990 to SO 240 989

NATURE OF PROBLEM

The arterial drainage of 30 ha of agricultural land is inadequate. Powysland IDB have cleaned out the watercourse from SO 226 990 to SO 233 990, but the gradient available has stopped further improvement.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	184,510	
	(ii)	Field drainage	£	37,530	£222,040
(b) **Present value of benefits**	(i)	Agriculture	£	300,060	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£300,060
(c) **Benefit/cost ratio**					1.4
(d) **Priority category**					2C

IMPROVEMENT WORKS

To provide the satisfactory freeboard under average flow conditions, it is necessary to regrade the watercourse from SO 221 990 to SO 240 989, replace the road culvert at SO 226 990 and three farm culverts. The channel improvement will provide a design capacity of 1.9 cumecs but freeboard criteria will, however, allow a maximum capacity of 4 cumecs at the downstream end.

BENEFITS

With improved drainage, the existing arable system could be intensified.

IDENTIFICATION

Problem code number(s):	1-83-410-10
Watercourse:	Aylesford Brook (non-main river) Rea Brook (main river)
Location:	Marton (South Shropshire District Council)
OS Map reference:	SJ 277 015 to SJ 293 026

NATURE OF PROBLEM

The watercourses do not provide for sufficient freeboard for field drainage. The Rea Brook has been improved already and there is little scope for further improvement. It is thought that water levels in the Rea Brook are closely associated with the level of Marton Pool, which has a winter level some 0.6 m above its summer level. At present, the Aylesford Brook does not form an outlet for Marton Pool. Some 308 ha suffer from inadequate drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 5	years
	(ii)	Structures	1 in 25	years
(c) **Land potential category**			a	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£ 232,410	
	(ii)	Field drainage	£ 346,390	£578,800
(b) **Present value of benefits**	(i)	Agriculture	£ 656,340	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£656,340
(c) **Benefit/cost ratio**				1.1
(d) **Priority category**				2C

IMPROVEMENT WORKS

The necessary works involve regrading and enlarging the Aylesford Brook to form a new outlet from Marton Pool. A control structure is required to maintain the level of Marton Pool. Approximately 2.8 km of watercourse need to be improved to provide a design capacity of 3 cumecs. However, freeboard criteria will provide for a maximum capacity of 6.8 cumecs at the downstream end of Aylesford Brook. The road bridge at SJ 280 016 requires underpinning and the road culvert at SJ 287 021 needs replacing.

CONSERVATION

Consultation with the Nature Conservancy Council is required at an early stage to assess the effect of any drainage improvements on Marton Pool.

IDENTIFICATION

Problem code number(s):	2-83-410-1
Watercourse:	Brockton Brook (non-main river)
Location:	Brockton (South Shropshire District Council)
OS Map reference:	SO 327 858

NATURE OF PROBLEM

Roads and fields adjacent to the brook suffer from periodic flooding (December 1965 and September 1976). 17 ha of agricultural land would benefit from improved drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	5,770	
	(ii)	Field drainage	£	3,750	£9,520
(b) **Present value of benefits**	(i)	Agriculture	£	22,230	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£22,230
(c) **Benefit/cost ratio**					2.3
(d) **Priority category**					1F

IMPROVEMENT WORKS

Some desilting and channel clearance is required for 400m downstream of the footbridge (SO 328 857) to provide a channel design capacity of 7.9 cumecs and allow satisfactory freeboard for field drainage under normal flow conditions.

IDENTIFICATION

Problem code number(s):	2-83-410-2/15
Watercourse:	River Clun (non-main river)
Location:	Clun to Broadward Hall (South Shropshire District Council)
OS Map reference:	SO 396 758 to SO 303 808

NATURE OF PROBLEM

Annual flooding for periods greater than 12 hours affects agricultural land particularly in the Broadward Hall area. 245 ha of agricultural land within the Medway Line also suffer from inadequate arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	294,060	
	(ii)	Field drainage	£	337,780	£631,840
(b) **Present value of benefits**	(i)	Agriculture	£	2,236,530	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£2,236,530
(c) **Benefit/cost ratio**					3.5
(d) **Priority category**					1C

IMPROVEMENT WORKS

For about 70% of its length the River Clun, from Clun to the Broadward Hall Farm area, requires some excavation and tree clearance to provide a downstream channel design capacity of 65.7 cumecs and allow satisfactory freeboard for field drainage under normal flow conditions. Purslow New Bridge (SO 361 804) will require underpinning and the weir and one bridge abutment at Beckjay Mill (SO 396 778) require breaking out.

BENEFITS

An increase in gross margin is expected following drainage improvements. All the land is potentially suitable for a cereal/grass rotation.

CONSERVATION

The River Clun is one of the most important Shropshire rivers, largely unpolluted and supporting a very wide range of wildlife. The Clun is one of Englands few rivers suitable for otters.

FISHERIES

This is a good trout fishery site which presents an excellent opportunity for fishery improvement. There has already been extensive tree clearance. As this stretch of river is important, excavation work may seriously affect fishery interest and consultation is absolutely essential.

IDENTIFICATION

Problem code number(s):	2-83-410-3
Watercourse:	River Corve (main river)
Location:	Stanton Lacy (South Shropshire District Council)
OS Map reference:	SO 494 790 to SO 496 785

NATURE OF PROBLEM

Roads and fields adjacent to the river near Stanton Lacy Bridge suffer from flooding, most recently in December 1965, September and December 1976, January/February 1977 and January/February 1990.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	54,780	
	(ii)	Field drainage	£		£54,780
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£
(c) **Benefit/cost ratio**					0
(d) **Priority category**					3D

IMPROVEMENT WORKS

Channel excavation is required to provide a design discharge of 28 cumecs at Stanton Lacy and allow satisfactory freeboard under normal flow conditions.

BENEFITS

MAFF consider that there are no worthwhile benefits within the Medway Line.

CONSERVATION

The Lower Corve is of moderate conservation interest with a variety of bed and bank conditions.

IDENTIFICATION

Problem code number(s):	2-83-410-4/10
Watercourse:	Town Brook and Marsh Brook (non-main river)
Location:	Church Stretton and Little Stretton (South Shropshire District Council)
OS Map reference:	SO 454 933 to SO 441 906

NATURE OF PROBLEM

Roads and gardens in Stretton House housing estate flooded in 1976 where Town Brook emerges from its underground culvert downstream of SO 455 935. Fields close to the brooks, especially near SO 450 932, flooded most recently in 1965, 1971, 1975 and 1976.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in 5 years
	(ii)	Structures	1 in years
(c) **Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£ 322,880	
	(ii)	Field drainage	£ 92,580	£415,460
(b) **Present value of benefits**	(i)	Agriculture	£ 894,610	
	(ii)	Buildings	£ negligible	
	(iii)	Roads/Railways	£	£894,610
(c) **Benefit/cost ratio**				2.2
(d) **Priority category**				1C

IMPROVEMENT WORKS

The Stretton House housing estate problem has already been resolved by realignment of the brook by the local council. It is recommended, however, that six small drop structures are constructed in this first 300m length of brook as it emerges from the culvert to lose excessive head. To alleviate flooding downstream and provide satisfactory freeboard for field drainage under normal flow conditions, channel excavation is required to allow a design discharge of 2.7 cumecs at the downstream end. This work will necessitate the replacement of four substantial culverts - under the gasholder near SO 450 932, under the road near SO 449 932, under the road near SO 445 917 and under the railway near SO 445 917 - and 25 house access crossings.

This work should resolve the flooding at Little Stretton. The flooding of the crossroads (SO 443 916) may have been caused by some temporary obstruction as the channel downstream of Ashes Hollow Brook is capable of carrying a 1 in 100 year flow.

IDENTIFICATION

Problem code number(s):	2-83-410-7
Watercourse:	Tributary of Brockton Brook (non-main river)
Location:	Colebatch (South Shropshire District Council)
OS Map reference:	SO 319 873

NATURE OF PROBLEM

A road and fields adjacent to the Brook flood. This is a Highway Authority problem and is outside the scope of this Survey.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IDENTIFICATION

Problem code number(s):	2-83-410-11
Watercourse:	River Kemp (non-main river)
Location:	Kempton to Lydbury North (South Shropshire District Council)
OS Map reference:	SO 335 857 to SO 382 815

NATURE OF PROBLEM

254 ha of agricultural land suffer from localised flooding and inadequate arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	311,350	
	(ii)	Field drainage	£	335,280	£646,630
(b) **Present value of benefits**	(i)	Agriculture	£	2,217,080	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£2,217,080
(c) **Benefit/cost ratio**					3.4
(d) **Priority category**					1C

IMPROVEMENT WORKS

Extensive excavation is required to provide a channel design capacity of 18 cumecs and allow satisfactory freeboard for field drainage under normal flow conditions. The costs assume the replacement of the bridge at SO 361 843 but as this structure could be of historic interest a diversion of the river at this point, adding £60,580 to the costs, should be considered.

CONSERVATION

This is a valuable stretch of the River Kemp. Disturbance to the main river and/or the wooded banks would considerably detract from the nature conservation interest of the area as a whole.

FISHERIES

Whilst this is not a particularly important fishery, consultation is required. Walcot Pool (SO 346 854) is leased to Birmingham Anglers' Association who will maintain a high water level with a recently constructed weir at the outlet.

IDENTIFICATION

Problem code number(s):	2-83-410-12
Watercourse:	River Redlake (non-main river)
Location:	Bucknell (South Shropshire District Council)
OS Map reference:	SO 373 743 to SO 340 753

NATURE OF PROBLEM

The flooding of 7 to 8 properties in Bucknell occurred regularly until the 1947 flood demolished and by-passed several weirs downstream of the village. No significant property flooding has occurred since although two properties appear to be risk and 60 ha of agricultural land suffer from inadequate arterial drainage. Some properties were flooded in January/February 1990.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 5	years
	(ii)	Structures	1 in 25/50	years
(c) **Land potential category**			b	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	80,720	
	(ii)	Field drainage	£	75,060	£155,780
(b) **Present value of benefits**	(i)	Agriculture	£	502,870	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£502,870
(c) **Benefit/cost ratio**					3.2
(d) **Priority category**					10

IMPROVEMENT WORKS

The poor land drainage and minor flooding will be solved by clearing and resectioning the watercourse throughout to provide a channel design discharge of 10.3 cumecs and allow satisfactory freeboard for field drainage under normal flow conditions.

CONSERVATION

The river, particularly from SO 340 753 to SO 342 750, is important to aquatic fauna.

FISHERIES

This site is of minor importance as a fishery, but consultation is required before any works are commenced.

IDENTIFICATION

Problem code number(s):	2-83-410-13
Watercourse:	River Redlake (non-main river)
Location:	Chapel Lawn (South Shropshire District Council)
OS Map reference:	SO 315 765 to SO 319 762

NATURE OF PROBLEM

The main road through the village and several farm outbuildings flood for periods less than 12 hours. In addition 9 ha of agricultural land suffer from inadequate arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	11,530	
	(ii)	Field drainage	£	12,510	£24,040
(b) **Present value of benefits**	(i)	Agriculture	£	83,350	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£83,350
(c) **Benefit/cost ratio**					3.5
(d) **Priority category**					1E

IMPROVEMENT WORKS

The river channel requires resectioning through the village to alleviate flooding and improve the land drainage. These works should provide a channel design capacity of 7.7 cumecs and allow satisfactory freeboard under normal flow conditions. The culverts and bridges in the village are adequate for Q_{25} flows.

CONSERVATION

The small size of the improvement area means loss of habitat will be minimal.

IDENTIFICATION

Problem code number(s):	2-83-410-14, 2-86-310-6 and 2-87-110-7/9
Watercourse:	River Teme (main river - part)
Location:	Knighton to Burrington (South Shropshire, Radnor and Leominster District Councils)
OS Map reference:	SO 300 724 to SO 432 717

NATURE OF PROBLEM

720 ha of agricultural land are prone to flooding (March 1955, January 1960, January 1968, February 1974) and suffer from inadequate arterial drainage. For the majority of this 16 km length the Teme flows in a meandering unstable channel. A continuous, often rapid, process of erosion and accretion occurs, the channel often changing considerably with the passage of each flood. The overall flood plain is well defined, but the actual areas of flood plain taken up by flood flows change with each major flood and the whole floodplain of the Teme is never filled by a flood. The passage of a flood down the Teme is hindered by inadequate bridges and their approach embankments where they cross the flood flow area. Flow is also hindered by the remains of several impounding structures.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£ not estimated	
		(ii)	Field drainage	£ 372,810	£372,810
(b)	**Present value of benefits**	(i)	Agriculture	£ 3,458,980	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£3,458,980
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

For the full agricultural benefits to be realised it would be necessary to carry out considerable works on the river. A two stage normal flow/flood flow channel (possibly embanked) would be required. This would be either expensive to construct or expensive to maintain. It is therefore anticipated that the Teme will have to remain in its present state with future works being restricted to maintenance, to control to some degree, the unstable nature of the river.

It may be possible to solve the property flooding around Leintwardine by localised channel works and embankments.

CONSERVATION

The River Teme is an important river for the otter.

FISHERIES

Any improvement works in this area will affect one of STWA's best trout fisheries.

IDENTIFICATION

Problem code number(s):	2-83-410-16 and 2-87-110-16
Watercourse:	Ledwyche Brook (non-main river)
Location:	Caynham (South Shropshire District Council and Leominster District Council)
OS Map reference:	SO 540 764 to SO 567 700

NATURE OF PROBLEM

Agricultural land between SO 556 707 and 567 700 is subject to flooding for periods up to 12 hours every few years and 28 ha of agricultural land within the Medway Line suffer from inadequate arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	5 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	25,950	
	(ii)	Field drainage	£	42,540	£68,490
(b) **Present value of benefits**	(i)	Agriculture	£	255,600	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£255,600
(c) **Benefit/cost ratio**					3.7
(d) **Priority category**					1E

IMPROVEMENT WORKS

General clearance and desilting of the brook in the last 2km of the problem reach are required to provide a channel design discharge of 17.2 cumecs and allow satisfactory freeboard for field drainage under normal flow conditions.

CONSERVATION

This watercourse has a wide range of aquatic and associated wildlife habitats. There is an interesting bank flora including the rare Monkshood. Otters have also been reported on this watercourse.

IDENTIFICATION

Problem code number(s):	2-83-410-17
Watercourse:	Tributary of Mill Brook (non-main river)
Location:	Hopton Wafers (South Shropshire District Council)
OS Map reference:	SO 635 767 to SO 638 763

NATURE OF PROBLEM

The only flooding that occurs sporadically is on the road between the church and school and is partly due to inadequate road drainage and partly to inadequate land drainage. Benefits are small and no remedial works have been proposed.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IDENTIFICATION

Problem code number(s):	2-83-410-18
Watercourse:	River Corve (main and non-main river)
Location:	Broadstone to Culmington (South Shropshire District Council)
OS Map reference:	SO 555 907 to SO 491 800

NATURE OF PROBLEM

82 ha of agricultural land from Broadstone to Beambridge suffer from localised flooding and inadequate arterial drainage.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 5 years
		(ii)	Structures	1 in 100 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	152,790	
		(ii)	Field drainage	£	112,590	£265,380
(b)	**Present value of benefits**	(i)	Agriculture	£	1,027,970	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£1,027,970
(c)	**Benefit/cost ratio**					3.9
(d)	**Priority category**					1C

IMPROVEMENT WORKS

Phased resectioning, in sympathy with the conservation note below, is required to provide capacity for Q_5 discharges and satisfactory freeboard for field drainage under normal flow conditions.

CONSERVATION

The Corve is a lowland stream in a reasonably natural state supporting a variety of aquatic and marginal plants including emergent vegetation such as bar-reed and great willowherb.

FISHERIES

Consultation is required before works are commenced.

IDENTIFICATION

Problem code number(s):	2-83-410-19
Watercourse:	Pye Brook (non-main river)
Location:	Corve Dale (South Shropshire District Council)
OS Map reference:	SO 537 847 to SO 498 817

NATURE OF PROBLEM

Agricultural land adjacent to the brook suffers from occasional flooding

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 5 years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	57,660	
		(ii)	Field drainage	£		£57,660
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£negligible
(c)	**Benefit/cost ratio**					0
(d)	**Priority category**					30

IMPROVEMENT WORKS

Some light pioneering work over 50 percent of the affected length of the Pye Brook together with some enlarging of the brook cross-section would improve its capacity and allow a channel discharge of 6.8 cumecs.

BENEFITS

MAFF consider the solution to this problem to have no worthwhile benefits.

IDENTIFICATION

Problem code number(s):	2-83-410-20
Watercourse:	Clee Brook (non-main river)
Location:	Clee St. Margaret (South Shropshire District Council)
OS Map reference:	SO 560 843 and SO 563 843

NATURE OF PROBLEM

At SO 563 843 occasional flooding of the road occurs due to the culvert being unable to take mean annual flows. At SO 560 843 occasional flooding of the road is caused by the blocking with debris of an inadequate gully.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in 100 years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	25,950	
		(ii)	Field drainage	£		£25,950
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£negligible
(c)	**Benefit/cost ratio**					0
(d)	**Priority category**					3E

IMPROVEMENT WORKS

The culvert should be replaced to provide a design flow of 1.3 cumecs and the inadequate gully replaced.

IDENTIFICATION

Problem code number(s):	2-83-410-22
Watercourse:	River Teme (main river)
Location:	Barrett's Mill (South Shropshire District Council)
OS Map reference:	SO 523 693

NATURE OF PROBLEM

Major flooding of part of the residential area of the mill buildings occurred in 1960, 0.6m of water entering the main living room. Some flooding re-occurred in 1975.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

It is not economic nor practical to defend the property against flooding by building embankments or floodwalls. Water would still enter via the substrata, drains and old mill orifices and therefore no works are proposed.

IDENTIFICATION

Problem code number(s):	2-83-410-23 and 2-86-310-2
Watercourse:	River Teme (non-main river)
Location:	Llanfair Waterdine to Knighton (South Shropshire District Council and Radnor District Council)
OS Map reference:	SO 245 760 to SO 288 725

NATURE OF PROBLEM

155 ha of agricultural land suffer from frequent flooding for durations in excess of 12 hours, most serious in March 1955, January 1960, January 1968 and February 1974. For most of this 6 km reach the Teme flows in a meandering unstable channel. A continuous, often rapid process of erosion and accretion occurs, the channel often changing considerably following each flood. Although the overall floodplain is well defined, the actual areas of floodplain taken up by flood flows changes with each event, and the whole floodplain of the Teme is never filled by one flood. The passage of a flood down the Teme is hindered by the inadequate bridges and their approach embankments where they cross the floodplain.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**			b	

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£ not estimated	
		(ii)	Field drainage	£ 212,680	£212,680
(b)	**Present value of benefits**	(i)	Agriculture	£ 1,805,900	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£1,805,900
(c)	**Benefit/cost ratio**				8.5
(d)	**Priority category**				1F

IMPROVEMENT WORKS

To release areas of the floodplain for agricultural improvement a two stage normal flow/flood flow channel (possibly embanked) would be required. This would be very expensive to construct and/or maintain. It is therefore anticipated that the Teme will have to remain in its present state with future works being restricted to maintenance to control, to some degree, the unstable nature of the river.

Due to a reassessment of priorities, it is unlikely that any improvements will be carried out.

CONSERVATION

The Teme is an important otter river and consultation is requested if any river bank work is envisaged.

FISHERIES

This is an important trout fishery. Consultation is essential.

IDENTIFICATION

Problem code number(s):	2-83-410-24 and 2-87-110-1
Watercourse:	Gosford, Orleton, Brimfield Brooks (non-main river)
Location:	Orleton to Gosford (South Shropshire and Leominster District Councils)
OS Map reference:	SO 486 669 to SO 537 688

NATURE OF PROBLEM

347 ha of agricultural land suffer from inadequate arterial drainage and 80 ha require underdrainage. A short length of the watercourse has been resectioned by Hereford and Worcestershire County Council.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 5 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			a5

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	100,900	
		(ii)	Field drainage	£	75,060	£175,960
(b)	**Present value of benefits**	(i)	Agriculture	£	791,820	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£791,820
(c)	**Benefit/cost ratio**					4.5
(d)	**Priority category**					1C

IMPROVEMENT WORKS

The watercourses require light tree clearance and channel resectioning together with clearance of all culverts and bridges to provide a channel design capacity of 6.4 cumecs at the downstream end and allow satisfactory freeboard for field drainage under normal flow conditions.

CONSERVATION

Orleton Brook and Brimfield Brook are of moderate biological interest.

IDENTIFICATION

Problem code number(s):	2-83-410-25 and 2-87-110-4
Watercourse:	River Teme (main river)
Location:	Tenbury Wells (South Shropshire and Leominster District Councils)
OS Map reference:	SO 592 683 and SO 600 685

NATURE OF PROBLEM

Upwards of 200 properties could be affected in the 1 in 100 years flood event. The last significant event occurred in 1960. The flooding problem at Tenbury Wells has been studied at length by the NRA.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	75 years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	1,294,420	
	(ii)	Field drainage	£		£1,294,420
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£1,211,020
(c) **Benefit/cost ratio**					0.9
(d) **Priority category**					3A

IMPROVEMENT WORKS

Detailed investigations at Tenbury Wells have concentrated on schemes combining limited bank raising in the town and channel improvements in the reach through the town from the Kyre Brook to the church with channel improvements downstream of the town to provide a design discharge of 374 cumecs. The latter comprise various combinations of improvements to the existing river channel and construction of a normally dry second-stage flood channel at mid-bank height.

The proposed scheme was not accepted locally on environmental grounds and non appreciation of the flood risk.

The scheme has been deleted from the capital programme.

FISHERIES

Consultation is already taking place over the fisheries interest within the Tenbury Wells investigations.

IDENTIFICATION

Problem code number(s):	2-83-410-26 and 2-87-110-5
Watercourse:	Corn Brook (non-main river)
Location:	Near Tenbury Wells (South Shropshire and Leominster District Councils)
OS Map reference:	SO 617 685

NATURE OF PROBLEM

Approximately 4 ha of agricultural land suffer from flooding and inadequate arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 5	years
	(ii)	Structures	1 in	years
(c) **Land potential category**			a	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	3,170	
	(ii)	Field drainage	£	4,000	£7,170
(b) **Present value of benefits**	(i)	Agriculture	£	2,780	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£2,780
(c) **Benefit/cost ratio**					0.4
(d) **Priority category**					3f

IMPROVEMENT WORKS

The channel section is adequate for flows in excess of Q_{25} but requires clearance of trees, debris and obstructions.

IDENTIFICATION

Problem code number(s):	2-83-410-27
Watercourse:	River Redlake (non-main river)
Location:	Pentre and New Invention (South Shropshire District Council)
OS Map reference:	SO 302 767 to SO 311 765

NATURE OF PROBLEM

74 ha of agricultural land suffer from inadequate arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	86,490	
	(ii)	Field drainage	£	102,590	£189.080
(b) **Present value of benefits**	(i)	Agriculture	£	666,790	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£666.790
(c) **Benefit/cost ratio**					3.5
(d) **Priority category**					1D

IMPROVEMENT WORKS

The watercourse requires clearing and resectioning to provide channel design capacity of 7.7 cumecs on the lower reach and allow satisfactory freeboard for field drainage under normal flow conditions.

IDENTIFICATION

Problem code number(s):	2-83-410-28 and 2-87-110-17
Watercourse:	Ledwyche Brook (non-main river)
Location:	Burford (South Shropshire and Leominster District Councils)
OS Map reference:	SO 567 700 to SO 573 686

NATURE OF PROBLEM

24 ha of agricultural land suffer from flooding, annual in the lower reaches, and inadequate arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	25,950	
	(ii)	Field drainage	£	35,030	£60.980
(b) **Present value of benefits**	(i)	Agriculture	£	219,490	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£219,490
(c) **Benefit/cost ratio**					3.6
(d) **Priority category**					1E

IMPROVEMENT WORKS

The suggested solution requires the lowering of the weir at SO 573 686 together with tree clearance and desilting of the whole problem reach to provide a channel design capacity of 17.2 cumecs and allow satisfactory freeboard under normal flow conditions.

FISHERIES

The fishery aspect of the river should be considerably improved by the careful execution of this work.

IDENTIFICATION

Problem code number(s):	2-83-410-29
Watercourse:	Tributary of Brockton Brook (non-main river)
Location:	Colebatch (South Shropshire District Council)
OS Map reference:	SO 321 870

NATURE OF PROBLEM

The watercourse downstream of Lagden Lane is held at high level to provide cattle watering facilities. Water levels are such that a small rise causes flooding of the lane.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 5 years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	3,100	
		(ii)	Field drainage	£		£3,100
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£ Not estimated
(c)	**Benefit/cost ratio**					
(d)	**Priority category**					

IMPROVEMENT WORKS

The watercourse requires resectioning at a lower level for some 200 to 300m downstream of Lagden Lane. New cattle drinking places at the lower level would be required. The road culvert at Lagden Lane would benefit from clearing out.

IDENTIFICATION

Problem code number(s):	2-83-410-30 and 2-83-410-31
Watercourse:	Un-named tributaries of Brockton Brook (non-main river)
Location:	Bishops Castle (South Shropshire District Council)
OS Map reference:	SO 324 885

NATURE OF PROBLEM

Road flooding in the town occurs near Church Lane SO 323 884, Union Street, Church Street junction SO 323 886, near Six Bells Inn SO 323 884, and at the main road junction near the High School SO 326 883.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£ Not Assessed
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£ Not Assessed
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

No major works are proposed. Flooding appears to be caused by inadequacies in the highway drainage system. The flooding may be aggravated by deficiencies, in terms of size or gradient, of the culverted watercourse along Church Lane/Church Street/Stank Lane. The grill to the upstream end of the culvert is prone to blockage. The open watercourse downstream of the culverting requires further maintenance.

BENEFITS

There appears to be no property flooding and as road flooding is of short duration the benefits of alleviating the flooding are low.

IDENTIFICATION

Problem code number(s):	2-83-410-32
Watercourse:	Colly Brook (non-main river)
Location:	Hope Bagot (South Shropshire District Council)
OS Map reference:	SO 58 73

NATURE OF PROBLEM

Inadequate watercourse capacity and road drainage facilities cause flooding of the access road to the Elan Aqueduct and the minor road through Hope Bagot.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£		
		(ii)	Field drainage	£		£ ____
(b)	**Present value of benefits**	(i)	Agriculture	£	low	
		(ii)	Buildings	£	low/nil	
		(iii)	Roads/Railways	£	low	£ low
(c)	**Benefit/cost ratio**					
(d)	**Priority category**					

IMPROVEMENT WORKS

Drainage facilities are required for the access to the Aqueduct. Colly Brook from the Aqueduct to downstream of the village requires proper maintenance. The various culverts on the Brook though inconsistent and theoretically inadequate do not require more than proper maintenance to prevent flooding of roads and gardens.

IDENTIFICATION

Problem code number(s):	2-83-410-33
Watercourse:	River Clun (non-main river)
Location:	Clun (South Shropshire District Council)
OS Map reference:	SO 304 807

NATURE OF PROBLEM

5 properties and 1 shop are subject to flooding due to the silting up of the bridge arch.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£_____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£_____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IDENTIFICATION

Problem code number(s):	1-83-510-1
Watercourse:	Minsterley Brook (non-main river)
Location:	Minsterley (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 384 066 to SJ 374 047

NATURE OF PROBLEM

A terraced house, two small shops, a post office, a public house and 20 ha of agricultural land are subject to flooding for periods up to six hours - most recently in 1970 and 1976. In addition, 50 ha of agricultural land suffer from inadequate arterial drainage. The lower end of the Brook is affected by flooding from the Rea Brook (main river)

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 10 years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(c) **Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	210,450	
	(ii)	Field drainage	£	62,550	£273,000
(b) **Present value of benefits**	(i)	Agriculture	£	625,120	
	(ii)	Buildings	£	162,640	
	(iii)	Roads/Railways	£		£787,760
(c) **Benefit/cost ratio**					2.9
(d) **Priority category**					1C

IMPROVEMENT WORKS

It is necessary to regrade and enlarge 2.7 km of watercourse, including 500 m of the Rea Brook downstream of the Minsterley Brook confluence. In addition, a farm bridge would need to be replaced and the road bridge at SJ 374 051 would have to be underpinned. The improved channel will provide a design capacity of 15.4 cumecs through Minsterley and 8.9 cumecs downstream between SJ 984 064 and SJ 374 051. However, freeboard criteria will allow a maximum capacity of 15.5 cumecs at the downstream end.

The Brook has been diverted in the past from its original northerly course from SJ 374 054. It may, however, be necessary to revert back to this original course to get the maximum land drainage improvement with the least amount of channel works. If the present course is retained, it may be necessary to improve a further 1.7 km of IDB watercourse.

BENEFITS

With improved drainage, the existing cereal/dairy farming will be substantially increased.

CONSERVATION

The pool-and-shallow nature of the brook bed provides valuable fish habitat allowing recreational use.

COMMENT

In 1979/80, Shrewsbury and Atcham District Council raised the left bank of the Brook, upstream of the road bridge at SJ 374 051, so as to alleviate the flooding in Minsterley. This has provided some protection to properties in Minsterley, but is not considered to be a completely satisfactory solution.

IDENTIFICATION

Problem code number(s):	1-83-510-2
Watercourse:	America Brook (non-main river)
Location:	Shrawardine (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 375 154 to SJ 377 170

NATURE OF PROBLEM

100 ha of agricultural land suffer from inadequate arterial drainage. A large part of the area is also subject to frequent flooding from the River Severn.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	66,310	
	(ii)	Field drainage	£	85,070	£151,380
(b) **Present value of benefits**	(i)	Agriculture	£	238,930	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£238,930
(c) **Benefit/cost ratio**					1.6
(d) **Priority category**					2D

IMPROVEMENT WORKS

It is suggested that 1.5 km of watercourse is regraded to provide a design capacity of 0.6 cumecs, although freeboard criteria will allow a maximum capacity of 1.3 cumecs. It will also be necessary to replace a road culvert at SJ 375 162 and a farm culvert upstream.

BENEFITS

40 ha of the benefit area is Severn floodplain. In addition, most of the land is owned by the Ministry of Defence and used as a training ground, although some is let off for grazing and a ploughing licence. Due to ownership and use, little improvement will be seen on at least 40 ha. 60 ha away from the floodplain will benefit, but additional works in the Ministry of Defence area will be required and these may not be forthcoming. However, lowering the road culvert would offer a substantial improvement on its own.

CONSERVATION

Conservation interest is mainly limited to areas of woodland and scrub on the Army Ranges near Shrawardine and disturbance to these areas should be avoided.

IDENTIFICATION

Problem code number(s):	1-83-510-3
Watercourse:	Pontesford Brook (non-main river)
Location:	Pontesford (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 408 076 to SJ 411 065

NATURE OF PROBLEM

5 ha of agricultural land are subject to frequent flooding and 20 ha suffer from inadequate arterial drainage. This is within the Rea Internal Drainage District and the channel is poorly maintained. The Rea Brook affects the level in the lower reaches of Pontesford Brook and flooding can occur from either watercourse.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	129,730	
		(ii)	Field drainage	£	30,030	£159,760
(b)	**Present value of benefits**	(i)	Agriculture	£	150,030	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£150,030
(c)	**Benefit/cost ratio**					0.9
(d)	**Priority category**					3C

IMPROVEMENT WORKS

It is necessary to regrade and enlarge 1.1 km of the Pontesford Brook from its confluence with Rea Brook, and 400 m of the Rea Brook (main river). In addition, the weir at SJ 407 068 should be lowered by 0.6 m and the farm bridge at SJ 407 075 replaced. The channel improvements will provide a design capacity of 7.4 cumecs, but freeboard criteria will, however, allow a maximum capacity of 9.7 cumecs at the downstream end. Rock is exposed in the watercourse in places and the amount of rock encountered will have a significant effect on the cost and, therefore, the viability of the scheme.

BENEFITS

Following drainage improvement, it is expected that the existing system of poor pasture could be converted to a regular cereals system.

CONSERVATION

Pontesford Brook is an unspoilt, well wooded stream supporting a rich flora. The Brook is well oxygenated with a stony bed, affording a valuable habitat for fish and insects. Any disturbance would be severely detrimental to the ecology of this reach.

IDENTIFICATION

Problem code number(s):	1-83-510-4
Watercourse:	Habberley Brook (non-main river)
Location:	Pontesbury (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 403 037

NATURE OF PROBLEM

Habberley Mill and the old mill cottage suffer from flooding for durations up to 5 hours. The mill is no longer in use. The watercourse has a maximum discharge capacity equivalent to a 4 years return period peak discharge.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	8,650	
	(ii)	Field drainage	£		£8,650
(b) **Present value of benefits**	(i)	Agriculture	£	13,890	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£13,890
(c) **Benefit/cost ratio**					1.6
(d) **Priority category**					2F

IMPROVEMENT WORKS

It is suggested that 300 m of watercourse should be enlarged to protect the mill cottage from flood discharges up to 9.2 cumecs. Alternatively it would be possible to protect the cottage by constructing a 1 m high flood wall for 40 m. This would be slightly more expensive than improving the channel.

BENEFITS

Damages were estimated assuming the house was occupied, as it was being renovated at the time of the site survey.

IDENTIFICATION

Problem code number(s):	1-83-510-7
Watercourse:	Rea Brook (main river)
Location:	Cruckton (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 433 098

NATURE OF PROBLEM

An unclassified road is subject to flooding from events greater than the 1 in 6 years return period. There is also annual flooding of land in the Rea Brook floodplain. The road bridge forms a partial obstruction to flood flows. The main problem is the angle at which the Cruckton Brook joins the Rea Brook immediately upstream of the bridge. The north span of the bridge is almost completely obscured.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	25 years
	(ii)	Structures	1 in	years

(c) **Land potential category**

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£

(c) **Benefit/cost ratio**

(d) **Priority category**

IMPROVEMENT WORKS

The Cruckton Brook needs to be straightened so as to pass through the north span of the bridge. The watercourse should be improved to contain a design discharge of 43.6 cumecs, or the road level raised by about 0.4 m over a distance of 100 m. The cost of raising the road is approximately the same as the channel improvement.

The Cruckton Brook requires regrading to allow adequate field drainage (see 1-83-510-9). In order to improve the Cruckton Brook to the full desired standard, it is necessary to regrade the Rea Brook from Hanwood to the Cruckton Brook confluence. This improvement will also alleviate the road problem and further works will not be required.

The Rea IDB cleaned out the north span of the bridge and diverted the river through it, in addition to regrading a short length downstream as part of the Cruckton Brook Improvement Scheme. The bridge is still liable to flooding.

BENEFITS

No traffic figures are available for this road, so an average 16 hour total of 500 vehicles was assumed.

IDENTIFICATION

Problem code number(s):	1-83-510-8
Watercourse:	Un-named tributary of the Cruckton Brook (non-main river)
Location:	Pontesbury (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 412 095

NATURE OF PROBLEM

An unclassified road floods more than once a year for durations up to four hours. An overflow drain from Polemere Pool crosses the road at this point before discharging to the Cruckton Brook at SJ 409 103. It is an old stone drain, without a solid invert, which is prone to silting and blockage. During heavy rain the drain surcharges.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 25	years
	(ii)	Structures	1 in	years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	51,890	
	(ii)	Field drainage	£		£51,890
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£negligible
(c) **Benefit/cost ratio**					0
(d) **Priority category**					3D

IMPROVEMENT WORKS

A new open channel from south-east of Polemere Pool to the Rea Brook (SJ 419 086) should be constructed to take local drainage. If the outfall were piped, the cost would increase threefold.

BENEFITS

Although benefits are negligible due to the very low volume of traffic using the road, a serious accident has ocurred as a result of the flood hazard.

CONSERVATION

Any lowering of Polemere Pool would probably have a detrimental effect on wildlife, and it is essential that the suggested channel improvement does not interfere with this important site.

IDENTIFICATION

Problem code number(s):	1-83-510-9
Watercourse:	Cruckton Brook (non-main river)
Location:	Cruckton (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 433 097 to SJ 411 102

NATURE OF PROBLEM

This reach of the Brook has a poor gradient, the channel has little freeboard and is choked with weeds. Hence, flooding is frequent and prolonged and there is inadequate drainage to 80 ha of agricultural land. The Brook is within the Rea Internal Drainage District.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 10	years
	(ii)	Structures	1 in 25	years
(c) **Land potential category**			b	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£
(c) **Benefit/cost ratio**				
(d) **Priority category**				

IMPROVEMENT WORKS

In 1980, the Rea Internal Drainage Board carried out an improvement scheme on Cruckton New Cut and Cruckton Brook, between its confluence with the Rea Brook and Nox Bridge. A significant improvement has been achieved.

BENEFITS

With improved drainage, the existing system of rough pasture and grazing has the potential for first class dairy farming.

IDENTIFICATION

Problem code number(s):	1-83-510-10
Watercourse:	Bagley Brook (non-main river)
Location:	Shrewsbury (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 493 131 to SJ 494 150

NATURE OF PROBLEM

20 ha of waste ground are subject to frequent flooding and poor drainage. Flooding of property at the lower end of the Brook is caused by the Severn which is considered in Problem No. 1-83-510-16.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 2 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	204,690	
		(ii)	Field drainage	£	52,540	£257,230
(b)	**Present value of benefits**	(i)	Agriculture	£	94,460	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£94,460
(c)	**Benefit/cost ratio**					0.4
(d)	**Priority category**					3C

IMPROVEMENT WORKS

The watercourse is culverted for 100 m before its confluence with the Severn and the outfall to the river is flapped. It is necessary to replace this culvert with a 1.2 m diameter culvert, with the invert set 1 m lower, and to regrade 2.2 km of watercourse upstream to provide a design capacity of 0.6 cumecs.

The new culvert would have to be at a depth of 5m through a strip of high ground. This area is built up and considerable difficulties in construction are anticipated.

A developer has replaced the downstream 48 m of culvert under the Gateway Centre, but this has had no material effect on the flooding problems.

BENEFITS

At present the benefit area is wasteland and is agriculturally non-productive. Following drainage, some grazing of beef cattle may be possible.

CONSERVATION

The benefit area has a high environemental and amenity potential if the watercourse were improved. This intangible benefit has not been included in the benefit/cost appraisal. The old channel of the Severn, north of Shrewsbury is an SSSI and is of interest botanically and also as a historic and physiographic feature.

IDENTIFICATION

Problem code number(s):	1-83-510-11
Watercourse:	Tributary of the Rea Brook (non-main river)
Location:	Nobold (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 481 099 to SJ 474 110

NATURE OF PROBLEM

The arterial drainage of 20 ha of agricultural land is inadequate. 10 ha suffer from frequent flooding and a cottage is at risk. The channel is ill-defined upstream of the railway culvert at SJ 477 102 and there are large marshy areas.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 2	years
	(ii)	Structures	1 in 100	years
(c) **Land potential category**			a	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	210,450	
	(ii)	Field drainage	£	17,510	£227,960
(b) **Present value of benefits**	(i)	Agriculture	£	27,780	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£27,780
(c) **Benefit/cost ratio**					0.1
(d) **Priority category**					3C

IMPROVEMENT WORKS

The watercourse is culverted from SJ 477 102 to SJ 478 100 passing under a housing estate. It is necessary to re-lay this culvert at a greater depth, regrade and enlarge 1.1 km of watercourse, lower the invert of the railway culvert at SJ 477 102 and replace the road culvert at SJ 476 104. The channel improvements will provide a design capacity of only 0.5 cumecs but freeboard criteria will, however, allow a maximum channel capacity of 1.4 cumecs.

An alternative to constructing a new culvert would be pumping, but the cost of a pumping station makes this prohibitive.

BENEFITS

Limited improvements in productivity to 20 ha of land will be possible with better drainage.

IDENTIFICATION

Problem code number(s):	1-83-510-12
Watercourse:	River Perry (main river)
Location:	Fitz (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 440 174 to SJ 443 184

NATURE OF PROBLEM

8 ha of agricultural land suffer from inadequate arterial drainage. The mill weir at Mytton Mill (SJ 440 176) controls the river level and is set too high at present.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	years
(c) **Land potential category**			a	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£

(c) **Benefit/cost ratio**
(d) **Priority category**

IMPROVEMENT WORKS

The impounding level at Mytton Mill should be lowered by 0.5 m and 1.1 km of watercourse deepened to provide satisfactory freeboard under average flow conditions. The improved channel will allow a maximum channel capacity equal to the design capacity (14 cumecs). The road bridge at SJ 444 181 needs underpinning to allow for the invert level to be lowered.

CONSERVATION

This section of the river is clear and clean with shingle beds, some deep pools and developing inlets which provide a variety of wildlife habitats. Any watercourse improvements may affect the ornithological interest of the area as identified by the RSPB and BTO.

FISHERIES

Although in favour of lowering of the mill weir, the pool riffle system should be retained.

COMMENT

Due to a reassessment of priorities it is unlikely that any works will be carried out.

IDENTIFICATION

Problem code number(s):	1-83-510-13
Watercourse:	Cob Brook (non-main river)
Location:	Bomere Heath (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 481 192 to SJ 477 194

NATURE OF PROBLEM

A cottage and an unclassified road flooded in 1976. The road floods annually. The watercourse in Bomere Heath has been culverted from SJ 474 199 to SJ 475 197. This culvert was inadequate and caused flooding in Cob Grove and Brook Road. The installation of a larger pipe has solved the problem, but downstream the poor condition of the watercourse results in flooding of Brook Cottage and puts Brook House at risk. The adjacent land does not have adequate freeboard for land drainage.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in 100 years
		(ii)	Structures	1 in 100 years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£ 8,650	
		(ii)	Field drainage	£	£8,650
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£ 17,510	
		(iii)	Roads/Railways	£ negligible	£17,510
(c)	**Benefit/cost ratio**				2.0
(d)	**Priority category**				2F

IMPROVEMENT WORKS

It is suggested that 500 m of watercourse should be desilted and cleared of debris. It may also be necessary to replace two farm culverts. The improvement works would provide a design capacity of 0.7 cumecs.

DEVELOPMENT

Urban development in Bomere Heath has increased flows in the Brook.

BENEFITS

The frequency and depth of flooding are difficult to estimate as the problems are caused by debris blockages in the watercourse.

There is no benefit from improving the field drainage downstream of Bomere Heath, as there would only be a minor increase in productivity, and an expensive field drainage system would be required to achieve full potential.

IDENTIFICATION

Problem code number(s):	1-83-510-14
Watercourse:	Cot Brook (non-main river)
Location:	Shrewsbury (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 489 134 to SJ 475 198

NATURE OF PROBLEM

The lower end of the watercourse follows the old course of the River Severn, and 50 ha of agricultural land are subject to prolonged and frequent flooding during Severn floods. 150 ha of land suffer from inadequate arterial drainage.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 2 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			a

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	435,320	
		(ii)	Field drainage	£	225,190	£660,510
(b)	**Present value of benefits**	(i)	Agriculture	£	202,820	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£202,820
(c)	**Benefit/cost ratio**					0.3
(d)	**Priority category**					3C

IMPROVEMENT WORKS

7.5 km of watercourse require regrading and enlarging to provide satisfactory freeboard under average flow conditions. Nine culverts need either to be replaced or to have their inverts lowered. The improvements will provide a design capacity of 0.9 cumecs but freeboard criteria will allow a maximum capacity of 2 cumecs.

The northern section of the Brook, upstream of Alkmondpark Pool could be improved in conjunction with the problem at Bomere Heath (1-83-510-13).

Some cleansing and regrading has been undertaken by Berwick Estates, but this has had little effect.

BENEFITS

A marginal increase in gross margins to two-thirds of the benefit area will be possible following arterial improvement.

CONSERVATION

The old channel of the Severn, north of Shrewsbury, is of interest botanically and also as a historic and physiographic feature. Alkmondpark Pool is of interest as one of a series of lakes in North Shropshire and is believed to be of considerable value for wildlife. Its scientific interest depends on the maintenance of water levels.

COMMENT

The part of the Brook which follows the old course of the River Severn will still remain liable to frequent, prolonged flooding from the River Severn after completion of the improvement works.

IDENTIFICATION

Problem code number(s):	1-83-510-16
Watercourse:	River Severn (main river)
Location:	Shrewsbury (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 505 140 to SJ 475 136

NATURE OF PROBLEM

Up to 191 residential and 195 commercial properties suffer from frequent flooding. Flooding of property starts with peak flows of 2.5 years return period. Flood durations have exceeded six days and flood depths of greater than 1.5 m have been reached. Major traffic routes through the town are cut by major floods.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in 100+	years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£ 3,458,210		
	(ii)	Field drainage	£		£3,458,210
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£ 9,724,390		
	(iii)	Roads/Railways	£ 226,370		£9,950,760
(c) **Benefit/cost ratio**					2.9
(d) **Priority category**					1A

IMPROVEMENT WORKS

A system of flood walls and embankments is proposed to protect the four areas of Shrewsbury which are liable to flooding. The system will be designed to contain at least the 100 years return period. There are investigations proceeding into improving the Severn-Vyrnwy confluence (1-86-210-31). It is possible that works in the Severn-Vyrnwy confluence area to control flood storage may reduce flood levels and, hence, defence levels, in Shrewsbury.

BENEFITS

Benefits include an estimate for loss of trading profit. The estimated cost of traffic disruption was based on a one-day traffic census conducted by the County Council in 1974. A generalised assessment was made for a major flood, and this figure used for each flood stage, with no attempt to assess reduced costs for lower stage floods.

COMMENT

The information on costs and benefits was taken from the Shrewsbury Flood Alleviation Working Party Report. A liaison group with representatives from the Borough and County Councils recognised the visual impact of such a scheme. However, it did appear that it would be possible to mitigate some of the environmental effects with careful scheme design.

IDENTIFICATION

Problem code number(s):	1-83-510-17
Watercourse:	Cound Brook (non-main river)
Location:	Cressage to Church Stretton (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 567 062 to SO 453 941

NATURE OF PROBLEM

195 ha of agricultural land suffer from inadequate arterial drainage. Upstream of Dorrington (SJ 483 034) the watercourse does not provide sufficient freeboard for land drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 10	years
	(ii)	Structures	1 in 25	years
(c) **Land potential category**			b	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	700,540	
	(ii)	Field drainage	£	267,720	£968,260
(b) **Present value of benefits**	(i)	Agriculture	£	1,219,670	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£1,219,670
(c) **Benefit/cost ratio**					1.3
(d) **Priority category**					2B

IMPROVEMENT WORKS

It is recommended that the weir at SJ 487 006 should be removed and 8.4 km of watercourse upstream from the weir, regraded and enlarged to provide satisfactory freeboard under average flow conditions. The works will provide a design capacity of 22 cumecs at the downstream end. In addition to channel improvements, three road bridges and two railway culverts need replacing, and a road bridge and a railway bridge require underpinning. The improvements necessary to provide satisfactory land drainage would also allow for a better standard of protection to be provided to the properties in All Stretton.

The riparian owner may wish to maintain the weir. In this case, 300 m of watercourse downstream of the weir will be regraded and the existing weir replaced at a lower level. This would increase the cost.

Shropshire County Council have improved the Cound Brook at All Stretton.

BENEFITS

With improved drainage, an increase in gross margin is expected. North of Longnor, the area is already farmed with semi-intensive arable/grass rotations.

CONSERVATION

Cound Brook is a natural watercourse of great interest for its physiographic features, and plants and animals associated with it. The Nature Conservancy Council expect to be consulted before any improvement works take place.

FISHERIES

The whole length of the reach from Cressage to the weir at SJ 487 006 is an important trout fishery. Consultation is essential.

IDENTIFICATION

Problem code number(s):	1-83-510-18
Watercourse:	Cound Brook (non-main river)
Location:	Coundarbour (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 558 057 to SJ 554 051

NATURE OF PROBLEM

An unclassified road, four houses and a derelict mill building flood to some depth, for periods up to 8 hours, during flood events greater than the 1 in 7 years return period. Flooding was more frequent when the weirs at SJ 557 056 and SJ 555 053 were at their full height.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	98,020	
	(ii)	Field drainage	£		£98,020
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	52,540	
	(iii)	Roads/Railways	£	negligible	£52,540
(c) **Benefit/cost ratio**					0.5
(d) **Priority category**					3D

IMPROVEMENT WORKS

It is recommended that the weir at SJ 557 056 should be lowered by 0.6 m, so that 700 m of the channel upstream can be improved to contain a design discharge of 77 cumecs. The road bridge at SJ 555 053 will need to be underpinned so that the invert level can be lowered. Bed protection will also be necessary for the invert to the bridge because of the high flow velocities. The lower end of the Cound Brook, below the weir at SJ 557 056, is affected by peak flood levels in the River Severn. If the channel below the weir had to be improved the cost would increase.

CONSERVATION AND AMENITY

The road bridge at SJ 555 053 is an 18th Century iron bridge which may need special preservation works. The whole of the Cound Brook is of very high conservation interest. Improvement, even of this small stretch, would detract from the overall value of the whole brook.

FISHERIES

This is an important trout fishery and consultation is essential.

IDENTIFICATION

Problem code number(s):	1-83-510-19
Watercourse:	River Severn (main river)
Location:	Cressage (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 594 045

NATURE OF PROBLEM

The B4380 road has flooded seven times since 1946, for periods in excess of 24 hours, most recently in 1990. The road becomes impassable during flood events greater than the 1 in 4 years return period. The existing channel cannot pass the mean annual peak discharge without overtopping.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	144,150	
	(ii)	Field drainage	£		£144,150
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	5,000	£5,000
(c) **Benefit/cost ratio**					0
(d) **Priority category**					3C

IMPROVEMENT WORKS

The construction of a total of 1 km of flood banks, on average 1.5 m high, on either side of the road, would solve the road flooding. The flood banks will, in effect, form an obstruction to out-of-bank floods, thus raising the upstream flood levels. This would have to be investigated and, if necessary, flood arches incorporated in the approach ramps to the bridge. Raising the road as an alternative would increase the cost to £268,100.

IDENTIFICATION

Problem code number(s):	1-83-510-21
Watercourse:	Rea Brook (main river)
Location:	Meole Brace (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 489 107

NATURE OF PROBLEM

Four pre-1918 terraced houses are at risk from floods of greater than a 1 in 30 years return period. The gardens of the houses (which partly occupy a filled-in mill race) flood almost annually and suffer from persistent waterlogging, but the ground floor level of the houses is 0.6 m higher than this garden level.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in 100 years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	11,530	
		(ii)	Field drainage	£		£11,530
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£	5,000	
		(iii)	Roads/Railways	£		£5,000
(c)	**Benefit/cost ratio**					0.4
(d)	**Priority category**					3E

IMPROVEMENT WORKS

The cheapest way to alleviate flooding involves the construction of a floodbank, 1.3 m high and 60 m long, around the gardens providing a design capacity of 69.2 cumecs. This bank should tie into the level of the Brooklands Hotel car park at one end and into the hillside at the other end. There is sufficient freeboard at the Brook for a land drain to be installed to drain the gardens and this is included in the scheme costs.

A sewer outfall runs alongside the Rea Brook at Meole Brace and consideration is being given to an overflow to discharge into the Brook, which will make the identified flood problem worse.

IDENTIFICATION

Problem code number(s):	1-83-510-22
Watercourse:	Rea Brook (main river)
Location:	Meole Brace, Shrewsbury (Shrewsbury and Atcham Borough Council)
OS Map reference:	SJ 482 100 to SJ 485 101

NATURE OF PROBLEM

Three new detached houses flooded for two hours in March 1980. These three houses, and three others, have been built in the floodplain near the line of a mill race channel which was filled-in in 1975.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	52,680	
	(ii)	Field drainage	£		£52,680
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	114,950	
	(iii)	Roads/Railways	£		£114,950
(c) **Benefit/cost ratio**					2.2
(d) **Priority category**					1D

IMPROVEMENT WORKS

A flood bank, approximately 220 m long and 1.4 m high, would protect the properties against the design standard flood of 69.1 cumecs. However, a flood bank would restrict flood flows and could not be recommended without a detailed investigation of its effects. A scheme to straighten and enlarge the Rea Brook would cost £441,580 and worsen flooding downstream.

DEVELOPMENT

The houses were built in the floodplain without the consent of the National Rivers Authority.

COMMENT

Some amelioration of the flooding could be achieved by better maintenance of the floodplain and removal of a close-barred iron railing which crosses the floodplain.

IDENTIFICATION

Problem code number(s):	1-83-710-1
Watercourse:	River Severn (main river)
Location:	Ironbridge (Wrekin District Council)
OS Map reference:	SJ 672 034 to SJ 666 037

NATURE OF PROBLEM

16 residential, and 14 commercial, properties on The Wharfage are subject to flooding from discharges greater than the 10 years return period. Flooding can be of considerable depth (2.5 m) with durations in excess of 24 hours. Recent flooding has occurred in 1946, 1947, 1948, 1960, 1965, 1968 and 1990, the most serious event estimated to have a 65 year return period.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	3,263,440	
	(ii)	Field drainage	£		£3,263,440
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	108,090	
	(iii)	Roads/Railways	£	7,510	£715,600
(c) **Benefit/cost ratio**					0.2
(d) **Priority category**					3A

IMPROVEMENT WORKS

To protect Ironbridge from floods of up to the 100 year return period, it is necessary to regrade and enlarge the Severn for 2 km through the gorge and construct a 900 mm high flood wall for 750 m along the frontage, giving a design capacity of 938 cumecs.

CONSERVATION AND AMENITY ASPECTS

Ironbridge Gorge is an area of great conservation interest. The Iron Bridge and Gothic Warehouse are sites of historic and archaeological interest. A major improvement scheme would considerably change the character of Ironbridge Gorge.

Enlarging and regrading the river channel will be highly impractical if the Iron Bridge is to be retained in its present form. Minor improvements such as a single flood wall will only give marginal protection if they are to be unobtrusive.

FISHERIES

Any improvement in this area is of concern as it is a major coarse fishery.

IDENTIFICATION

Problem code number(s):	1-83-710-2
Watercourse:	River Severn (main river)
Location:	Coalport (Wrekin District Council)
OS Map reference:	SJ 694 025 to SJ 690 028

NATURE OF PROBLEM

Nine terraced houses, one detached house and two public houses flood to depths up to 4 m for durations longer than 24 hours. Recent flooding has occurred in 1946, 1947, 1948, 1960, 1965 and 1968, the most serious event estimated to have a 65 year return period. One public house was flooded in 1990.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in 100 years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	337,300	
		(ii)	Field drainage	£		£337,300
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£	893,250	
		(iii)	Roads/Railways	£		£893,250
(c)	**Benefit/cost ratio**					2.6
(d)	**Priority category**					1C

IMPROVEMENT WORKS

It is impractical to improve the channel or construct a balancing lake to reduce peak flows. A 5 m high flood wall is required to protect all properties at risk and contain a maximum discharge of 938 cumecs. By excluding "The Boat Inn" from the scheme, the flood wall can be reduced to 3 m high and this is the option that has been costed.

CONSERVATION

There are strong conservation interests in the area of the Severn Gorge. Any improvement proposals in this area need to take account of local interest. The flood wall could be dropped by 0.5 m, if the design standard was reduced to 1 in 50 years, or by 1.5 m, if reduced to 1 in 25 years.

IDENTIFICATION

Problem code number(s):	1-83-710-3
Watercourse:	Coal Brook (non-main river)
Location:	Ironbridge (Wrekin District Council)
OS Map reference:	SJ 667 038

NATURE OF PROBLEM

Flooding occurs to a cottage, a police station, a garage and a shop due to the backing-up of the Coal Brook by the River Severn. The most recent flooding was in 1976 and 1977.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

The limited storage capacity in the Coal Brook channel makes it impossible to separate this problem from the major flooding problem in Ironbridge. The necessary improvements have been considered within Problem No. 1-83-710-1.

IDENTIFICATION

Problem code number(s):	1-83-710-4
Watercourse:	Coal Brook (non-main river)
Location:	Ironbridge (Wrekin District Council)
OS Map reference:	SJ 668 040

NATURE OF PROBLEM

The Brook takes run-off from a steep, partially developed catchment and has a high discharge. There is a short culverted reach just upstream of a cottage which has flooded frequently for periods up to 2 hours. The channel is then embanked above the valley floor for a distance of 300 m to where it enters a road culvert at SJ 6668 0376. The level of the River Severn can affect the level in the road culvert during major floods.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	46,130	
	(ii)	Field drainage	£		£46,130
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	27,520	£27,520
(c) **Benefit/cost ratio**					0.6
(d) **Priority category**					3E

IMPROVEMENT WORKS

The embanked section of the watercourse requires to be cleared and deepened by at least 300 mm to provide a maximum capacity of 12.4 cumecs. In addition, the left bank of the channel should be raised by 300 mm (mostly in stone walling) together with the raising of six access bridges (mostly footbridges) across the channel.

It would be possible to reduce the cost of the scheme by limiting the work to the raising of the left bank for a short distance near the affected house. This could, however, worsen the situation downstream and is not recommended.

Telford Development Corporation are thought to be investigating a third option of constructing balancing lakes to reduce peak flows in the Brook.

COMMENT

There is also some concern about the pool higher up the hillside which would put the cottage in great danger if the pool was to overtop and breach its banks. The pool collects water from hillside springs and has been very close to overtopping on a number of occasions.

IDENTIFICATION

Problem code number(s):	1-83-710-5
Watercourse:	Un-named feeder brook to Horsehay Pool (non-main river)
Location:	Horsehay (Wrekin District Council)
OS Map reference:	SJ 673 075

NATURE OF PROBLEM

Very frequent flooding occurs to two semi-detached houses and a small area of agricultural land for durations up to four hours. The last 30 m of the Brook is culverted before it reaches the Pool. Upstream, the watercourse has been realigned and, behind the houses, does not follow the valley bottom. During floods the Brook overtops its banks behind the houses, misses the culvert intake and is held back by the road.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	20,180	
	(ii)	Field drainage	£		£20,180
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	17,510	
	(iii)	Roads/Railways	£		£17,510
(c) **Benefit/cost ratio**					0.9
(d) **Priority category**					3E

IMPROVEMENT WORKS

The twin 18" pipes forming the 30 m long culvert require replacing with a single 700 mm diameter culvert. The Brook should then be deepened and enlarged over a length of 300 m.

The cost could be reduced if the works are limited to channel improvement and improvement to the inlet to the twin culverts, but this will reduce the standard of protection.

BENEFITS

The frequent flooding causes constant worry to the residents, and it is considered that such intangible benefits could give this scheme a higher priority than that obtained from a economic viewpoint alone.

COMMENT

A number of attempts have been made by the Local Authority to solve this problem, but without success.

Opencast mining is likely to take place upstream of Horsehay Pool in the future.

IDENTIFICATION

Problem code number(s):	1-83-710-8
Watercourse:	Un-named tributary of the Ketley Brook (non-main river)
Location:	Ketley (Wrekin District Council)
OS Map reference:	SJ 675 105

NATURE OF PROBLEM

Six houses and an unclassified road flood to some depth and for long durations when a culvert intake becomes blocked with debris. The watercourse is culverted from a pool at SJ 675 105 to a pool near the Glynwed foundry at SJ 672 109. Run-off from a considerable built-up area discharges to the former pool.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

A surface water sewerage scheme has been designed which should alleviate this problem. The scheme is dependent upon financial input from a developer. It is hoped that construction will take place in 1990/91.

IDENTIFICATION

Problem code number(s):	1-83-710-9
Watercourse:	River Strine, Red Strine and Commission Drain (main river)
Location:	Kynnersley (Wrekin District Council)
OS Map reference:	SJ 640 150 to SJ 720 200

NATURE OF PROBLEM

The area covered by these watercourses is within the Strine Internal Drainage District and has 2,215 ha of agricultural land affected by inadequate drainage. Previous improvement schemes on the watercourses in this area have provided the capacity for passing peak flood flows and for satisfactory drainage of land adjacent to the channels. A higher standard is required to provide benefit to the whole area and a detailed survey is essential.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 10	years
	(ii)	Structures	1 in 25	years
(c) **Land potential category**			b	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£ 2,859,840		
	(ii)	Field drainage	£ 2,326,950	£5,186,790	
(b) **Present value of benefits**	(i)	Agriculture	£ 13,363,620		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	£13,363,620	
(c) **Benefit/cost ratio**				2.6	
(d) **Priority category**				1A	

IMPROVEMENT WORKS

The suggested works require enlargement of the Commission Drain to form a combined highland and lowland carrier taking all the run-off from the area. The flow of the Strine Brook requires diverting into the Red Strine which would then follow the line of Parsons Oak Ditch to the Commission Drain. These modifications will enable the main drainage channels to be lowered by about 1.2 m. It will be necessary to remove Allscott Mill impounding and regrade the Tern channel for 1.9 km so that the Commission Drain outfall can be lowered. In all, a total of 22.8 km of watercourse should be improved and eight road bridges replaced. The channel improvements will provide a maximum design capacity of 21 cumecs although freeboard criteria will allow a maximum capacity of 26.4 cumecs.

It may prove necessary to lower the outfall of the Commission Drain more than would be made possible by removal of Allscott Mill impounding. In this case, it would be possible to reduce the impounding level at Walcot Mill and regrade 4.5 km of the River Tern, but this would add £317,120 to the cost.

The former STWA and Strine Internal Drainage Board carried out limited improvements upstream of Buttery Farm on the River Strine, but this only affects a very small part of the benefit area.

DEVELOPMENT

Telford Development Corporation have plans to construct a flood meadow on the Crow Brook to reduce discharges resulting from development in Telford. The improved Commission Drain/Red Strine will eliminate the need for such a scheme and a contribution could, therefore, be expected to the Commission Drain Improvement Scheme from Telford Development Corporation.

BENEFITS

With arterial drainage improvements, the present dairy/cereals/sugar beet/potatoes system could be intensified, resulting in increased gross margins.

COMMENT

i) There are a number of water supply boreholes along the Strine and the possible effects of any improvement scheme on these should be investigated as regards the protection of the aquifer.

ii) It will be necessary to investigate the effects of the scheme on the licensed abstractions on the watercourses involved.

iii) There are areas where artesian water in the underlying sandstone leads to very high groundwater levels. Intensive drainage systems will be necessary in such areas.

The Pipe Strine is a tributary of the River Strine. The outfall of the Pipe Strine to the River Strine has been improved, but work on the Pipe Strine was discontinued a short distance upstream of the outfall after a bad bank slip occurred. The slip was caused by artesian pressure.

FISHERIES

Although these watercourses have in the past been polluted, there could be some interest in developing a fishery in the future.

IDENTIFICATION

Problem code number(s):	1-83-710-11
Watercourse:	Strine Brook (main river)
Location:	Newport (Wrekin District Council)
OS Map reference:	SJ 719 184 to SJ 772 182

NATURE OF PROBLEM

The arterial drainage of 230 ha of agricultural land is inadequate, and frequent flooding of 20 ha for periods up to six hours occurs.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in 10	years
	(ii)	Structures	1 in 50	years
(c) **Land potential category**			180	ha - b
			50	ha - a5

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£
(c) **Benefit/cost ratio**				
(d) **Priority category**				

IMPROVEMENT WORKS

Improvement works were carried out by Strine IDB prior to maining.

FISHERIES

In the future there could be some interest in developing a fishery in this area.

IDENTIFICATION

Problem code number(s):	1-83-710-12
Watercourse:	Hurley Brook (main river)
Location:	Eyton upon the Weald (Wrekin District Council)
OS Map reference:	SJ 645 156

NATURE OF PROBLEM

Flooding occurs to 12 ha of agricultural land. The Brook takes the overflow from the Northern Interceptor Sewer and, in places, is embanked above field level before it discharges to the Commission Drain. At SJ 638 157, the embankment has been broken through and some water flows northward out of the channel.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

The Brook cannot be properly improved unless the Commission Drain is lowered. The benefit area for this problem forms part of that used in Problem No. 1-83-710-9.

COMMENT

The overflow from the Northern Interceptor is designed to operate with peak discharges of greater than 20 years return period once the whole balancing lake system has been installed. In the meantime, however, it is possible that it operates more frequently, although the planned expansion of Telford has not taken place.

IDENTIFICATION

Problem code number(s):	1-83-710-13
Watercourse:	Wrockwardine Brook (non-main river)
Location:	Wrockwardine (Wrekin District Council)
OS Map reference:	SJ 639 121 to SJ 622 107

NATURE OF PROBLEM

5 ha of agricultural land adjacent to the watercourse flood frequently for periods up to four hours. 30 ha of agricultural land suffer from poor drainage as a result of inadequate culverting along 70 m of watercourse at SJ 639 121.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	83,600	
		(ii)	Field drainage	£	37,530	£121,130
(b)	**Present value of benefits**	(i)	Agriculture	£	208,370	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£208,370
(c)	**Benefit/cost ratio**					1.7
(d)	**Priority category**					20

IMPROVEMENT WORKS

It is proposed to remove the culvert and regrade and enlarge the watercourse over 2 km, to provide a design capacity of 4.2 cumecs. In addition, the road culvert at SJ 639 120 and the railway culverts at SJ 639 120 and SJ 639 121 are to be cleaned out.

If the road and railway culverts need underpinning to lower their inverts, in order to provide the capacity required, the cost of works will increase considerably.

Some improvements have been carried out by the riparian owner upstream of Drummery Lane.

BENEFITS

The present root/cereal farming system will be much improved following drainage improvements.

COMMENT

The Brook was culverted without the Authority's consent and is on land owned by Telford Development Corporation.

IDENTIFICATION

Problem code number(s):	1-83-710-14
Watercourse:	Un-named tributary of Hurley Brook (non-main river)
Location:	Old Hall Close, Wellington (Wrekin District Council)
OS Map reference:	SJ 659 109

NATURE OF PROBLEM

6 semi-detached houses flood, approximately every 2 years, due to an inadequate culvert which was built without a land drainage consent.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

The existing twin 600 mm diameter culvert was prone to blockage. Wrekin District Council have installed a grille at the inlet and improved the inlet conditions, which has helped to some extent. A replacement 1.5 m diameter culvert would completely alleviate the problem.

IDENTIFICATION

Problem code number(s): 1-83-710-15
Watercourse: Moorfield Brook (non-main river)
Location: Newport (Wrekin District Council)
OS Map reference: SJ 735 192

NATURE OF PROBLEM

An inadequate sized culvert causes backing up of the watercourse.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in			years
	(ii)	Structures	1 in			years
(b) **Agricultural**	(i)	Channel	1 in	10		years
	(ii)	Structures	1 in	25		years
(c) **Land potential category**				b		

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£		
	(ii)	Field drainage	£		£_____
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£_____
(c) **Benefit/cost ratio**					
(d) **Priority category**					

IMPROVEMENT WORKS

It is hoped that this problem can be resolved in 1990/91 or 1991/92 by the riparian owners and/or Wrekin District Council.

CONSERVATION

The site is near Newport Canal SSSI.

IDENTIFICATION

Problem code number(s):	1-84-110-1
Watercourse:	River Tanat (main river)
Location:	Llangedwyn (Glyndwr District Council)
OS Map reference:	SJ 150 240 to SJ 185 240

NATURE OF PROBLEM

Flooding occurs to an unclassified road and 200 ha of agricultural land for periods up to eight hours. Henblas Farm (SJ 179 238) is flooded infrequently and 305 ha of agricultural land suffer from inadequate drainage. The River Tanat is an upland river, but in this reach the gradient slackens and quantities of gravel and silt are deposited. The river changes course frequently and causes land to be unproductive and waterlogged.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years

(c) **Land potential category**

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£

(c) **Benefit/cost ratio**

(d) **Priority category**

IMPROVEMENT WORKS

It is not economically viable to carry out river training works, as the agricultural land has only low potential. Such works could only be recommended if erosion was endangering structures and flood embankments. STWA carried out limited pioneer improvements to reduce future maintenance problems, but this has not affected the present problems of the river changing course.

BENEFITS

Due to low traffic flows, the benefits from alleviating road flooding are negligible.

CONSERVATION

The Tanat is regarded by RSPB/SPNC as a high grade river and much of the interest is determined by the nature of the river banks and associated vegetation. There are strong interests in preserving the present nature of the river and the proposed improvements will take these interests into account.

FISHERIES

This is probably the best trout and salmon river in the area, and it will be essential to consult on any improvements.

IDENTIFICATION

Problem code number(s):	1-86-210-1
Watercourse:	Tributary of River Banwy (non-main river)
Location:	Wern (Montgomery District Council)
OS Map reference:	SH 965 125

NATURE OF PROBLEM

Annual flooding affects a small area of agricultural land and the A458(T) road, for periods up to three hours, due to inadequate channel capacity and an inadequate culvert. The level of the Banwy could have a significant effect on the road flooding.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in 25 years
	(ii)	Structures	1 in 25 years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	43,240	
	(ii)	Field drainage	£		£43,240
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	10,010	£10,010
(c) **Benefit/cost ratio**					0.2
(d) **Priority category**					3E

IMPROVEMENT WORKS

It is necessary to replace the existing twin culverts with a single culvert and improve the watercourse for 150 m to the confluence of the Banwy, to provide a design capacity of 3.3 cumecs.

The District Council has installed a grille at the culvert inlet which will provide some degree of alleviation.

BENEFITS

Benefits to agricultural land are negligible and have been ignored.

IDENTIFICATION

Problem code number(s):	1-86-210-3
Watercourse:	River Banwy (non-main river)
Location:	Neuadd (Montgomery District Council)
OS Map reference:	SJ 083 077

NATURE OF PROBLEM

A caravan site is inundated by floods of greater than the 5 year return period event for durations up to 12 hours. The lower part of the site is restricted to touring caravans only, although major floods will affect almost the whole site.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in 100 years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	126,850	
		(ii)	Field drainage	£		£126,850
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£	140,120	
		(iii)	Roads/Railways	£		£140,120
(c)	**Benefit/cost ratio**					1.1
(d)	**Priority category**					2C

IMPROVEMENT WORKS

It is necessary to construct a flood bank 2.1 m high to contain the design flood of 262 cumecs.

BENEFITS

The benefits will be less if warning is provided to evacuate the touring caravans in the lowest positions.

CONSERVATION AND AMENITY

A flood bank 2.1 m high would affect the amenity of the site as a holiday caravan park. The River Banwy is regarded by RSPB/SPNC as a high grade river, particularly important for otters. Much of the interest is determined by the nature of the river banks and associated vegetation.

COMMENT

An alternative to the above scheme would be the improvement of a considerable length of the river to increase its capacity. This will be expensive and will not be economically viable.

IDENTIFICATION

Problem code number(s):	1-86-210-4
Watercourse:	River Vyrnwy (non-main river)
Location:	Dolanog (Montgomery District Council)
OS Map reference:	SJ 069 127

NATURE OF PROBLEM

The B4382 road floods several times per year for periods up to 10 hours.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	37,480	
		(ii)	Field drainage	£		£37,480
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£	1,250	£ 1,250
(c)	**Benefit/cost ratio**					0
(d)	**Priority category**					3E

IMPROVEMENT WORKS

It is necessary to raise the road levels by 1 m over a distance of 50 m. The road is adjacent to the river bank and it will be necessary to include 50 m of sheet pile revetment as bank support work.

A private road bridge to the Dolanog estate is also subject to flooding. The cost of replacement would be £115,320.

IDENTIFICATION

Problem code number(s):	1-86-210-5
Watercourse:	Wig Brook (non-main river)
Location:	Dolanog (Montgomery District Council)
OS Map reference:	SJ 076 128 to SJ 087 117

NATURE OF PROBLEM

40 ha of agricultural land suffer from almost permanent waterlogging as the channel does not provide adequate freeboard for field drainage. It is in very poor condition and does not have the capacity to contain even the annual peak discharge. 20 ha of land suffer from frequent flooding.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	123,960	
	(ii)	Field drainage	£	12,510	£136,470
(b) **Present value of benefits**	(i)	Agriculture	£	100,020	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£100,020
(c) **Benefit/cost ratio**					0.7
(d) **Priority category**					3C

IMPROVEMENT WORKS

The road culvert at SJ 076 126 should be replaced, and approximately 1.6 km of watercourse regraded to provide a design capacity of 1 cumec. However, freeboard criteria will allow a maximum channel capacity of 7.2 cumecs. Two farm bridges also require replacement. There is rock exposed in the bed of the Brook just downstream of the road culvert. An allowance has been made in the cost estimate for some excavation in rock but this could be inadequate.

BENEFITS

At present the area is used for poor summer grazing. With improved drainage conditions, an increase in gross margin is anticipated.

CONSERVATION

There is some ornithological interest.

IDENTIFICATION

Problem code number(s):	1-86-210-7
Watercourse:	River Banwy (non-main river)
Location:	Castle Caereinion (Montgomery District Council)
OS Map reference:	SJ 134 082

NATURE OF PROBLEM

The old mill house, a cottage, the A458(T) road and approximately 30 ha of agricultural land are subject to frequent flooding for up to eight hours. Flooding occurred in August 1974, and was estimated to be a 1 in 25 year event.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in 100 years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	210,450	
		(ii)	Field drainage	£		£210,450
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£	61,300	
		(iii)	Roads/Railways	£	3,750	£65,050
(c)	**Benefit/cost ratio**					0.3
(d)	**Priority category**					3C

IMPROVEMENT WORKS

It is recommended to construct a flood bank between the road bridge and high ground, enclosing the two residential properties. This involves the construction of 600 m of flood bank at an average of 1.5 m high, 600 m at an average of 2.5 m high and 300 m of steel sheet-piled wall at an average of 1.5 m high, based on a design discharge of 247 cumecs.

The old mill house, SJ 132 079, is in a difficult position to protect.

BENEFITS

Benefits to agricultural land are negligible and have not been assessed.

IDENTIFICATION

Problem code number(s):	1-86-210-8
Watercourse:	Luggy Brook (non-main river)
Location:	Brithdir (Montgomery District Council)
OS Map reference:	SJ 199 022

NATURE OF PROBLEM

The A483(T) road floods frequently for periods of up to four hours due to an inadequate culvert and an old impounding at SJ 201 021. In addition, there is flooding and inadequate arterial drainage to 10 ha of agricultural land. The level of the Severn may affect this part of the Brook in major flood events.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	129,730	
	(ii)	Field drainage	£	12,510	£142,240
(b) **Present value of benefits**	(i)	Agriculture	£	50,010	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	5,000	£55,010
(c) **Benefit/cost ratio**					0.4
(d) **Priority category**					3C

IMPROVEMENT WORKS

The recommended works include demolishing the impounding structure and regrading the watercourse over 300 m. The road culvert at SJ 199 022 has an inadequate section and a hard invert which is too high and should be replaced. The channel improvement will provide a design capacity of 9.3 cumecs, but freeboard criteria will, however, allow a maximum capacity of 11.7 cumecs at the downstream end.

In 1984, Powysland Internal Drainage Board cleaned out the Brook up to the road culvert and then regraded the Brook to the limit of the Board's area, thus partly alleviating the problem.

FISHERIES

Salmon rearing experiments are taking place on this reach and the removal of the weir could be of benefit.

IDENTIFICATION

Problem code number(s):	1-86-210-9
Watercourse:	River Vyrnwy (main river)
Location:	New Bridge, Meifod (Montgomery District Council)
OS Map reference:	SJ 142 115

NATURE OF PROBLEM

The A495 (and large areas of the Vyrnwy floodplain) is subject to frequent flooding over a length of 500 m for periods up to 16 hours.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	49,010	
	(ii)	Field drainage	£		£49,010
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	20,020	£20,020
(c) **Benefit/cost ratio**					0.4
(d) **Priority category**					3E

IMPROVEMENT WORKS

Replacement of the road bridge and raising of the A495 across the floodplain will partly solve the problem. However, containing the Vyrnwy upstream of New Bridge is not sufficient, as the river downstream has a bank top capacity of only 75 cumecs and will back up enough to flood the road. It is necessary, therefore, to construct a floodbank 1.5 m high at either side of the road which will tie into high ground and provide for a design discharge of 144 cumecs.

Any improvement here may cut off an important flood route and worsen the situation upstream. A detailed investigation of this aspect is essential, but has not been possible within the scope of this Survey.

IDENTIFICATION

Problem code number(s):	1-86-210-10
Watercourse:	The Brogan (non-main river)
Location:	Meifod (Montgomery District Council)
OS Map reference:	SJ 143 168 to SJ 173 179

NATURE OF PROBLEM

The arterial drainage of 100 ha of agricultural land is inadequate.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	363,250	
	(ii)	Field drainage	£	75,060	£438,310
(b) **Present value of benefits**	(i)	Agriculture	£	250,050	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£250,050
(c) **Benefit/cost ratio**					0.6
(d) **Priority category**					3C

IMPROVEMENT WORKS

It is recommended to regrade and enlarge the watercourse over a minimum length of 4.5 km and lower the bed by 0.8 m to provide a design capacity of 5.0 cumecs. The new road bridge at SJ 173 179 should be replaced.

The cost of the arterial works will be reduced if the bridge invert can be lowered by underpinning, and the side slopes on the improved channel made steeper.

BENEFITS

A significant increase in productivity is possible with better drainage. However, the value of the improvement to pasture land in an upland area remains low.

IDENTIFICATION

Problem code number(s):	1-86-210-11
Watercourse:	River Vyrnwy (main river)
Location:	Meifod (Montgomery District Council)
OS Map reference:	SJ 160 129

NATURE OF PROBLEM

An unclassified road is subject to frequent flooding for durations up to 18 hours. The floodplain has already been restricted by the flood bank system protecting Meifod.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 25 years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	340,180	
		(ii)	Field drainage	£		£340,180
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£	3,500	£3,500
(c)	**Benefit/cost ratio**					0
(d)	**Priority category**					3C

IMPROVEMENT WORKS

The construction of a floodbank system, although the cheapest way to alleviate flooding, would worsen flooding upstream and reduce the level of protection of Meifod. It is recommended, therefore, to raise 250 m of the road and incorporate two 15 m twin-span flood arches in the embankment. This scheme will provide a design capacity of 387 cumecs.

IDENTIFICATION

Problem code number(s):	1-86-210-12
Watercourse:	Afon Cain (non-main river)
Location:	Talwrn (Montgomery District Council)
OS Map reference:	SJ 175 193

NATURE OF PROBLEM

The B4393 and an unclassified road are frequently flooded for periods up to six hours where they cross the floodplain of the Cain.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	100,900	
		(ii)	Field drainage	£		£100,900
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£	500	£ 500
(c)	**Benefit/cost ratio**					0
(d)	**Priority category**					3C

IMPROVEMENT WORKS

It is necessary to raise 350 m of roadway by 1 m to eliminate road flooding from peak discharges up to 37 cumecs.

The flooding situation could be alleviated to some extent by carrying out a pioneering scheme of minor improvements to the watercourse.

FISHERIES

This is a salmon spawning ground and any channel works could have detrimental effects.

IDENTIFICATION

Problem code number(s):	1-86-210-13
Watercourse:	Afon Cain (non-main river)
Location:	Llanfechain (Montgomery District Council)
OS Map reference:	SJ 192 208 to SJ 185 203

NATURE OF PROBLEM

One chapel, 11 residential properties and an unclassified road are subject to flooding for periods up to two hours, notably in August 1973. The channel has insufficient capacity and the road bridge forms a partial obstruction to peak flows.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	201,800	
	(ii)	Field drainage	£		£201,800
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	207,670	
	(iii)	Roads/Railways	£		£207,670
(c) **Benefit/cost ratio**					1.0
(d) **Priority category**					2C

IMPROVEMENT WORKS

A scheme was prepared by STWA on behalf of Montgomery District Council in November 1976. It proposed to regrade and enlarge the channel over 850 m through the village, replace the road bridge and construct low flood banks, to provide a design capacity of 74 cumecs.

The scheme costs include the replacement of the bridge. Underpinning would reduce the costs, although it is desirable to replace the bridge.

BENEFITS

The benefits to road traffic are negligible and have not been estimated.

FISHERIES

This is a salmon spawning ground and any channel works could have detrimental effects.

IDENTIFICATION

Problem code number(s):	1-86-210-14
Watercourse:	River Severn (main river)
Location:	Cil-Cewydd (Montgomery District Council)
OS Map reference:	SJ 229 040 to SJ 221 049

NATURE OF PROBLEM

The A490 suffers from frequent flooding. Glan Hafren farm and caravan site are also at risk from flooding.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in 25 years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	1,205,050	
		(ii)	Field drainage	£		£1,205,050
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£	42,540	£42,540
(c)	**Benefit/cost ratio**					0
(d)	**Priority category**					3A

IMPROVEMENT WORKS

A flood bank system to protect the road would form a considerable obstruction to flood flows, worsening the situation upstream. It is suggested, therefore, to raise 1.1 km of roadway by 2.3 m and incorporate a new 10 m span bridge over the Nern Llwyd to provide a design capacity of 561 cumecs.

It is not feasible to protect the farm and caravan site because of the excessive cost of resiting the railway arches.

IDENTIFICATION

Problem code number(s):	1-86-210-15
Watercourse:	Coed-y-Dinas (non-main river)
Location:	Welshpool (Montgomery District Council)
OS Map reference:	SJ 229 066

NATURE OF PROBLEM

28 ha of agricultural land suffer from poor drainage. This left bank tributary of the River Severn does not provide sufficient freeboard for field drainage under normal conditions and has insufficient capacity for rapid evacuation of Severn flood water. In addition, the culvert on a stream between SJ 227 067 and SJ 227 065 is inadequate causing waterlogging and frequent flooding of part of some council playing fields.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 2 years
		(ii)	Structures	1 in years
(c)	**Land potential category**			a

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£ 118,200	southern tributary
				£ 109,160	playing field tributary
		(ii)	Field drainage	£	£227,360
(b)	**Present value of benefits**	(i)	Agriculture	£ 28,080	southern tributary
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£28,080
(c)	**Benefit/cost ratio**				0.1
(d)	**Priority category**				3C

IMPROVEMENT WORKS

1.9 km of the southern tributary should be regraded to provide the recommended freeboard under average flow conditions. Two farm bridges would have to be replaced and the railway culvert at SJ 227 057 would need some form of structural works. There is little gradient on the main watercourse to allow for the regrading of the southern tributary and it may be necessary to construct a new outfall to the Severn in the region of SJ 234 060.

The playing field culvert should be replaced by a 1 m diameter culvert with a proper intake structure. Replacement by an open channel would be difficult and expensive as the culvert passes through a ridge of high ground.

BENEFITS

Without further information, the improvement in gross margin was assumed to be the same as for Problem 1-86-210-52, which covers the watercourse to the south of Coed-y-Dinas. No value was put on the benefit of alleviating the playing field problem.

DEVELOPMENT

The playing field watercourse is in the line of a proposed by-pass road for Welshpool. It may be possible to improve the watercourse in conjunction with the new road.

CONSERVATION

This is an important wintering area for Siberian White-fronted Geese.

IDENTIFICATION

Problem code number(s):	1-86-210-16
Watercourse:	Un-named tributary of the River Severn (non-main river)
Location:	Welshpool (Montgomery District Council)
OS Map reference:	SJ 230 048 to SJ 236 044

NATURE OF PROBLEM

A road and 12 ha of agricultural land suffer from frequent flooding because of an inadequately culverted watercourse at SJ 233 046 and SJ 236 044.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 2 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			a

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	83,600	
		(ii)	Field drainage	£		£83,600
(b)	**Present value of benefits**	(i)	Agriculture	£	30,560	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£	negligible	£30,560
(c)	**Benefit/cost ratio**					0.4
(d)	**Priority category**					3D

IMPROVEMENT WORKS

There were originally two ornamental lakes on the watercourse and the outfall from the lower lake at SJ 233 046 is culverted for 400 m to the River Severn. The lakes have silted up completely and the flow control structures are in a very poor condition. The culvert has broken in a number of places and the escaping water has eroded channels. The earth dam for the lower lake has been overtopped and eroded.

The culverted lengths of the Brook should be replaced by 1.6 km of open channel of adequate depth for field drainage, providing a design discharge of 1.8 cumecs. Freeboard criteria will, however, allow a maximum channel capacity of 6.6 cumecs at the downstream end. In addition, the road culvert at SJ 236 044 should be replaced.

BENEFITS

The main benefit is derived from the alleviation of flooding as the land generally has a good gradient for natural drainage.

CONSERVATION

This is an important wintering area for Siberian White-fronted Geese.

IDENTIFICATION

Problem code number(s):	1-86-210-17
Watercourse:	River Severn (main river)
Location:	Lower Trehelig (Montgomery District Council)
OS Map reference:	SJ 219 030

NATURE OF PROBLEM

Lower Trehelig farmhouse and farm buildings are subject to inundation by floods of ten years or more return period. Cil-Cewydd weir was lowered in 1974 and has reduced the frequent flooding. Further lowering of the weir will not have any major effect during flood flows as the weir drowns out.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in 100	years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	98,020	
	(ii)	Field drainage	£		£98,020
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	17,510	
	(iii)	Roads/Railways	£		£17,510
(c) **Benefit/cost ratio**					0.2
(d) **Priority category**					3D

IMPROVEMENT WORKS

It is necessary to construct a 1.5 m high flood bank for 600 m around the property to protect it from a design flood of 771 cumecs.

IDENTIFICATION

Problem code number(s):	1-86-210-18
Watercourse:	River Severn (main river)
Location:	Buttington (Montgomery District Council)
OS Map reference:	SJ 245 095

NATURE OF PROBLEM

The A483(T) road is frequently flooded for periods up to 24 hours where it encroaches on the floodplain.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	164,330	
		(ii)	Field drainage	£		£164,330
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£	50,040	£50,040
(c)	**Benefit/cost ratio**					0.3
(d)	**Priority category**					3C

IMPROVEMENT WORKS

It is necessary to build a 3 m high flood bank over a length of 500 m to eliminate road flooding from peak discharges up to 524 cumecs.

Any works in the Severn-Vyrnwy confluence area may have an effect on the flood levels.

IDENTIFICATION

Problem code number(s):	1-86-210-19
Watercourse:	River Severn (main river)
Location:	Buttington (Montgomery District Council)
OS Map reference:	SJ 245 089

NATURE OF PROBLEM

The A458(T) road is subject to flooding for periods up to 12 hours during floods with a return period of approximately 1 in 5 years. Flood arches are already built into the existing road and adjacent railway embankments. In addition, 2 properties are liable to more frequent flooding.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	236,400	
	(ii)	Field drainage	£		£236,400
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	25,020	£25,020
(c) **Benefit/cost ratio**					0.1
(d) **Priority category**					3C

IMPROVEMENT WORKS

It is necessary to raise the road by 1.2 m over a distance of 350 m, to alleviate road flooding from peak discharges up to 524 cumecs. Flood banks could be built as an alternative, for similar costs.

COMMENT

The railway line forms a potential gap in the protection system where it crosses the road.

IDENTIFICATION

Problem code number(s):	1-86-210-20
Watercourse:	River Severn (main river)
Location:	Leighton (Montgomery District Council)
OS Map reference:	SJ 236 069

NATURE OF PROBLEM

The B4381 road floods frequently for up to 24 hours. Flood arches are built into the embankment on the left bank.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in 25 years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	322,880	
	(ii)	Field drainage	£		£322,880
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	12,510	£12,510
(c) **Benefit/cost ratio**					0
(d) **Priority category**					3C

IMPROVEMENT WORKS

Approximately 900 m of flood banks, on average 3 m high, must be built to alleviate road flooding from peak discharges up to the 1 in 25 year event (524 cumecs).

The proposed flood bank system may obstruct flood flows and worsen the situation upstream. A comprehensive investigation of this aspect is thus required and is outside the scope of this Survey.

IDENTIFICATION

Problem code number(s):	1-86-210-21
Watercourse:	Lledan Brook (non-main river)
Location:	Welshpool (Montgomery District Council)
OS Map reference:	SJ 225 076 to SJ 217 075

NATURE OF PROBLEM

Property and roads within Welshpool are subject to frequent flooding, which is particularly severe in Raven Square and the junction of Brook and Union Street. A report by Wallace Evans and Partners in May 1975 proposed replacing the existing culvert, installing new culverts to by-pass the Smithfield Market and printing works, and regrading and enlarging the open channel sections of the Brook.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

The first phase involves improvements to the sewerage system for the north-east of the town to allow further development, but this is likely to exacerbate flooding in the vicinity of the printing works. This is because the lower section of Bull Dingle Brook will be improved under the first phase and a new storm sewer will discharge to Bull Dingle Brook just upstream of the printing works.

The planned road scheme is not going ahead and therefore, the improvement scheme is unlikely to be carried out.

IDENTIFICATION

Problem code number(s):	1-86-210-22
Watercourse:	Hem Brook (non-main river)
Location:	Hem Moor (Montgomery District Council)
OS Map reference:	SJ 241 995 to SJ 237 003

NATURE OF PROBLEM

The arterial drainage of 40 ha of agricultural land is inadequate.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	95,140	
		(ii)	Field drainage	£	12,510	£107,650
(b)	**Present value of benefits**	(i)	Agriculture	£	200,040	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£200,040
(c)	**Benefit/cost ratio**					1.9
(d)	**Priority category**					2D

IMPROVEMENT WORKS

It is recommended to regrade 1.6 km of the watercourse, lowering the bed by 1.2 m, providing a design capacity of 1.0 cumec. Freeboard criteria will, however, allow a maximum capacity of 4.4 cumecs. The channel has been cut through a spur of high ground which makes further improvement difficult and expensive. The level of the Camlad may limit the deepening of the Brook.

Riparian improvements have achieved some alleviation of the problem.

BENEFITS

Improvement of the drainage will allow a significant increase in productivity.

COMMENT

The River Camlad itself does not provide adequate drainage in the Salt Bridge area and downstream. There is, however, very little available fall between Salt Bridge and the confluence of the Camlad and the Severn, making an improvement scheme unecomonic.

IDENTIFICATION

Problem code number(s):	1-86-210-23
Watercourse:	Bull Dingle Brook (non-main river)
Location:	Welshpool (Montgomery District Council)
OS Map reference:	SJ 227 077

NATURE OF PROBLEM

The A483 road and property in Welshpool, mainly north of Victoria Memorial Hospital and in the Salop road area near Dawes Garage, flooded in 1974. This has frequently occurred in the past. The Brook is culverted for a considerable distance through Welshpool and, although the culverting varies in size, it is generally inadequate. There is an overflow pipe from the existing foul sewer, which results in sewage being discharged to the Brook even under normal flow conditions.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

Wallace Evans and Partners carried out a study of the drainage situation in Welshpool for Montgomery District Council, for which a report was produced in 1975. The report proposed replacing the existing culverted sections of the Brook and separating the foul sewers from the surface water sewers. Phase 1 of the works allows for improvement of the sewerage system for the north-east part of the town to allow for future development. The Bull Dingle culvert from Salop Road to the canal is to be replaced in this first phase. There is no indication of when this scheme will commence. It is considered that the first phase works would exacerbate the problems with the Lledan Brook where it is culverted under the printing works.

IDENTIFICATION

Problem code number(s):	1-86-210-24
Watercourse:	Pwll Trewern (non-main river)
Location:	Middletown (Montgomery District Council)
OS Map reference:	SJ 266 115 to SJ 275 107

NATURE OF PROBLEM

40 ha of agricultural land are subject to flooding several times per year for periods up to 24 hours, and 80 ha suffer from inadequate arterial drainage.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	10 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£____
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£____

(c) **Benefit/cost ratio**
(d) **Priority category**

IMPROVEMENT WORKS

It is necessary to clean out the lower 500 m of the watercourse, and regrade and enlarge the remaining 1 km, to provide a maximum capacity of 4 cumecs. Freeboard criteria will, however, allow a maximum capacity of 7.7 cumecs at the downstream end. The weir at SJ 270 109 holds the upstream water level too high for satisfactory field drainage and should be lowered by 1 m.

The level of the Severn has a marked influence on the lower reach of the Pwll Trewern and, during major floods, inundates a large proportion of the area.

A scheme carried out by Powysland IDB in 1979 has improved the situation.

BENEFITS

Improved drainage will result in a longer grass growing season.

IDENTIFICATION

Problem code number(s):	1-86-210-25
Watercourse:	River Severn (main river)
Location:	Pool Quay (Montgomery District Council)
OS Map reference:	SJ 261 145

NATURE OF PROBLEM

The A483(T) flooded in 1946, 1947, 1960 and 1964 for periods up to 12 hours, though it is protected by an argae system from floods up to the five year return period. Agricultural land within the floodplain is also subject to frequent flooding.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	908,110	
		(ii)	Field drainage	£		£908,110
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£	7,510	£7,510
(c)	**Benefit/cost ratio**					0
(d)	**Priority category**					3B

IMPROVEMENT WORKS

The cheapest solution is to raise the roadway by 1 m over a length of 1.8 km to provide protection from flooding for discharges up to 561 cumecs. This road is near the Severn-Vyrnwy confluence and would be affected by any works there (see 1-86-210-31).

Although a large area of agricultural land would benefit, the existing argae system should not be raised, as flooding in other areas would be worsened. This aspect is being investigated in the Severn-Vyrnwy Confluence studies.

IDENTIFICATION

Problem code number(s):	1-86-210-26
Watercourse:	River Severn (main river)
Location:	Llandrinio (Montgomery District Council)
OS Map reference:	SJ 299 169

NATURE OF PROBLEM

The B4393 suffers from frequent flooding often for periods greater than 24 hours. 400 m of road is at risk within the argae system from minor floods and 2 km outside the argae system can be inundated by major floods.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£_____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£_____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

To protect the road from flood discharges up to 561 cumecs, it is proposed to raise 2 km of roadway by 2 m and incorporate flood arches in the embankment. This problem falls within the Severn-Vyrnwy Confluence area (see 1-86-210-31) and will be affected by any proposals for the Confluence area.

IDENTIFICATION

Problem code number(s):	1-86-210-27
Watercourse:	Bele Brook (non-main river)
Location:	Guilsfield (Montgomery District Council)
OS Map reference:	SJ 274 157 to SJ 254 137

NATURE OF PROBLEM

595 ha of agricultural land suffer from inadequate arterial drainage. From Trederwen to Wern (Severn floodplain) the area is protected from floods of less than the 5 years return period by the argae system. The outfall of the Bele Brook to the new cut is flapped, but there is frequent flooding of large areas of land during periods of high Severn levels because the Bele Brook backs up and the channel itself has little storage capacity.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a - 180 ha
				b - 415 ha

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£

(c) **Benefit/cost ratio**

(d) **Priority category**

IMPROVEMENT WORKS

Powysland Internal Drainage Board have implemented a pumped drainage system which deals with the inadequate drainage problem and flooding from the internal catchment. The area is still liable to flooding from overtopping of the Severn argae system.

FISHERIES

More detailed consultation than normal will be required on this reach.

IDENTIFICATION

Problem code number(s):	1-86-210-28
Watercourse:	River Vyrnwy (main river)
Location:	Godor, Llansantffraid Deytheur (Montgomery District Council)
OS Map reference:	SJ 203 179

NATURE OF PROBLEM

The A495 floods frequently for durations up to 12 hours, notably in 1974.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	66,310	
		(ii)	Field drainage	£		£66,310
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£	1,000	£ 1,000
(c)	**Benefit/cost ratio**					0
(d)	**Priority category**					3D

IMPROVEMENT WORKS

There is insufficient room between the road and the river bank for the construction of a flood bank. It is recommended that the road should either be raised by 1.1 m or a flood wall constructed to prevent inundation of the road. A steel sheet-piled wall, with concrete facing, forms the cheapest option and causes least disruption to road traffic.

The bank between the south edge of the road and field level is quite steep and may need stabilising. If this is the case, the cost of the scheme will rise considerably.

IDENTIFICATION

Problem code number(s):	1-86-210-29
Watercourse:	Tributary of River Vyrnwy (non-main river)
Location:	Llansantffraid Deytheur (Montgomery District Council)
OS Map reference:	SJ 209 181 to SJ 215 174

NATURE OF PROBLEM

The arterial drainage of 25 ha of agricultural land is inadequate.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in 2	years
		(ii)	Structures	1 in 25	years
(c)	**Land potential category**			a	

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	118,200	
		(ii)	Field drainage	£	7,510	£125,710
(b)	**Present value of benefits**	(i)	Agriculture	£	138,920	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£138,920
(c)	**Benefit/cost ratio**					1.1
(d)	**Priority category**					2C

IMPROVEMENT WORKS

The suggested works include the regrading and enlarging of the watercourse over a length of 1.3 km, to provide satisfactory freeboard under average flow conditions with a capacity of 0.8 cumecs. The road culvert at SJ 209 179 is set too high and should be replaced.

The level of the Vyrnwy affects the watercourse downstream of the road culvert.

BENEFITS

Drainage will allow intensification of stocking, plus better feed value from grassland.

CONSERVATION

The Vyrnwy is regarded by RSPB/SPNC as a high grade river and much of the interest is determined by the nature of the river banks and associated vegetation.

IDENTIFICATION

Problem code number(s):	1-86-210-30
Watercourse:	River Vyrnwy (main river)
Location:	Llansantffraid-ym-Mechain (Montgomery District Council)
OS Map reference:	SJ 227 204 to SJ 228 199

NATURE OF PROBLEM

An engineering workshop, a garage/storeroom, two pre-1918 detached houses, two inter-war cottages, a farmhouse and outbuildings and a water pumping station are affected by floods with a 10 years recurrence interval, although the lowest property is inundated by floods of only 2 years return period. The B4393 also suffers from flooding which can reach 2 m depth in the village and last for up to 24 hours. During floods, the river overtops its banks and some of the flow takes a direct route across the meander. The most notable flooding was in December 1965.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	397,840	
	(ii)	Field drainage	£		£397,840
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	181,150	
	(iii)	Roads/Railways	£	4,000	£185,150
(c) **Benefit/cost ratio**					0.5
(d) **Priority category**					3C

IMPROVEMENT WORKS

The course of the Vyrnwy should be straightened as much as possible, and a flood bank constructed around the vulnerable properties based on a design flow of 625 cumecs. Approximately 350 m of new channel would have to be excavated and 920 m of flood bank, on average 2 m high, constructed. The proposed scheme is dependent on sealing off the old mill channel. An alleviation scheme becomes much more difficult, and expensive, if the mill rights are continued.

BENEFITS

There is an electricity sub-station next to the pumping station which could be affected by flooding, and cause considerable local inconvenience. Benefits have not been assessed for this utility nor for the small sewage treatment works at SJ 225 203, which will be affected by major floods. The old, detached house at SJ 226 198 is empty and could be excluded from the protection scheme because of its isolated position.

AMENITY

There is a large caravan site at SJ 245 195, the lower part of which is subject to flooding from the Vyrnwy. The site is too far away to be included in the proposed alleviation works and would need its own protection works.

FISHERIES

Any straightening of the channel will reduce the length available for fishing and would be opposed.

IDENTIFICATION

Problem code number(s):	1-86-210-31
Watercourse:	Rivers Severn and Vyrnwy (main river)
Location:	Llandrinio, Melverley (Montgomery District Council)
OS Map reference:	SJ 411 145 to SJ 259 115 and SJ 225 206

NATURE OF PROBLEM

7,080 ha of land suffer from inadequate arterial drainage and frequent flooding for periods in excess of 24 hours. A number of roads and 30 properties are also affected by flooding. There is an embankment system providing protection up to the 1 in 3 years return period and locally up to the 1 in 5 years return period, but there are many places where the local watercourses are inadequate leading to early flooding and/or persistent poor drainage. There are also places where the embankment system is defective or poorly maintained.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 15 years	
	(ii)	Structures	1 in years	
(b) **Agricultural**	(i)	Channel	1 in 15 years	
	(ii)	Structures	1 in years	
(c) **Land potential category**			a/b	

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£ 13,959,000	
	(ii)	Field drainage	£ 7,638,910	£21,597,910
(b) **Present value of benefits**	(i)	Agriculture	£ 53,340,580	
	(ii)	Buildings	£ 500,420	
	(iii)	Roads/Railways	£ not estimated	£53,841,000
(c) **Benefit/cost ratio**				2.5
(d) **Priority category**				1A

MODEL STUDIES

The NRA is currently investigating methods of alleviating the flooding by improving the argae system. A new mathematical model was produced in 1990 to establish the effect of improving the embankment system on flood levels in Shrewsbury (see 1-83-510-16). This model supersedes the earlier STWA model of 1979.

IMPROVEMENT WORKS

The economic evaluation above is based on the STWA mathematical model which looked at the effects of improving the embankment system to provide protection from 1 in 7, 1 in 10 and 1 in 15 years floods. The MAFF benefit assessment shows the greatest benefits as coming from the latter standard of protection and would necessitate works on a total of 83.8 km of embankments. The cost of these improvements is based on raising the embankment system by an average of 1 m. The Bele, Guilsfield and Acre Brooks suffer from inadequate drainage as well as flooding from the Severn (see 1-86-210-27, 53 and 51 respectively) and costs for these subsidiary improvements are included in the total costs herein. Costs were estimated assuming that fill for the embankments would be won from unprotected areas within the embankments. If imported fill is necessary, the costs increase by £7M. The local improvements for the Bele, Guilsfield and Acre Brooks could be carried out independently.

BENEFITS

The MAFF benefit assessment covered only that part of the benefit area within Shropshire. An improvement in gross margin of £420/ha per annum was assumed for that part of the benefit area within Powys.

566 ha is used by the army as a training ground and its potential is very limited. Although an item has been included for field drainage and ditching this would probably not be undertaken under present use.

The properties liable to flooding within the confluence area are scattered and would need individual works to provide the usual 100 years protection (which would obviously increase costs). Therefore, only the benefits from improving the general standard of protection to 1 in 15 years were assumed. No assessment has been made of the benefits from alleviating road flooding. Agricultural benefits for Bele, Guilsfield and Acre Brook are included in this assessment.

COMMENT

Investigations using the 1990 model indicate that flood storage in the confluence area has a major impact on flood hydrographs downstream, giving the possibility of achieving substantial benefits downstream by controlled, as opposed to uncontrolled, use of that storage. The links with the Shrewsbury Flood Alleviation Scheme have been established and both schemes are currently being further investigated together.

FISHERIES

A general interest in the whole of the area has been expressed and channel improvements will require consultations.

IDENTIFICATION

Problem code number(s):	1-86-210-32
Watercourse:	Afon Cerist (main river)
Location:	Van (Montgomery District Council)
OS Map reference:	SN 965 881 to SN 951 874

NATURE OF PROBLEM

The arterial drainage of 25 ha of agricultural land is inadequate. In addition, the flooding of four fields is caused by inadequate maintenance.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	219,100	
	(ii)	Field drainage	£		£219,100
(b) **Present value of benefits**	(i)	Agriculture	£	19,450	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£19,450
(c) **Benefit/cost ratio**					0.1
(d) **Priority category**					3C

IMPROVEMENT WORKS

The necessary works include regrading the watercourse over a distance of 2 km, to provide satisfactory freeboard under average flow conditions and a design capacity of 3.3 cumecs. In addition, the road culverts at SN 965 881 and SN 963 879 will be replaced as their inverts are set too high. Freeboard criteria will allow a maximum capacity of 7 cumecs at the downstream end. The former road culvert is the main cause of the silting and, as benefits are minimal, work on lowering the level of this culvert along with a minor silting-out exercise could be sufficient to alleviate the problem.

BENEFITS

There will be a marginal increase in productivity as a result of drainage.

IDENTIFICATION

Problem code number(s):	1-86-210-34
Watercourse:	River Trannon, Gleiniant Brook (non-main river)
Location:	Trefeglwys (Montgomery District Council)
OS Map reference:	SN 970 905

NATURE OF PROBLEM

Ten houses, two commercial properties (including a garage) and a caravan site are subject to flooding for up to 12 hours. Flooding from the Trannon occurred in 1961, 1964 and 1974 and from the Gleiniant Brook in 1971. Flooding was also caused by inadequate road drains at the junction of Llawr-y-glyn road and the main road through Trefeglwys. Partial remedial works have alleviated much of the flooding in the village.

There will be some spillage at the drop weir at SN 974 912, with flows greater than the mean annual peak discharge, because of limited freeboard immediately upstream of the weir. The channel upstream has a discharge capacity greater than the 1 in 100 years flood event, whilst the channel downstream has a 1 in 50 years design capacity.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

STWA completed an improvement scheme on the Trannon downstream of Pont Brynllwyn in 1979, and when Powys County Council replace Pont Brynllwyn flooding from this source will be alleviated.

The renewal of road drains and the provision of an overflow from storm flows, by Powys County Council in 1974, has alleviated surface water flooding in the village.

Although Powys County Council repaired the road bridge at SN 973 911 on the Gleiniant Brook after flood damage in 1971, the channel is still liable to overtopping at a new drop-structure upstream of the bridge by floods of large magnitude.

IDENTIFICATION

Problem code number(s):	1-86-210-35
Watercourse:	Afon Garno (non-main river)
Location:	Carno (Montgomery District Council)
OS Map reference:	SN 957 978 to SN 936 992

NATURE OF PROBLEM

The arterial drainage of 65 ha of agricultural land is inadequate and 15 ha of land adjacent to the watercourse suffer from frequent flooding.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a5

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	314,240	
	(ii)	Field drainage	£	22,520	£336,760
(b) **Present value of benefits**	(i)	Agriculture	£	614,000	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£614,000
(c) **Benefit/cost ratio**					1.8
(d) **Priority category**					2C

IMPROVEMENT WORKS

The railway embankment divides the area into two:

1 To the east, the channel should be regraded and enlarged for 2.3 km.

2 To the west, the channel should be regraded and enlarged for 0.6 km.

The inverts of the railway bridges at SN 954 977 and SN 949 980 will need to be lowered, the road bridge at SN 954 977 underpinned and five farm access road culverts replaced. The channel improvement will provide a design capacity of 7.1 cumecs at the downstream end, but freeboard criteria will, however, allow a maximum capacity of 10.8 cumecs.

BENEFITS

With improved arterial drainage, a major improvement in agricultural productivity is possible.

CONSERVATION

This area has considerable botanical and ornithological interest.

FISHERIES

This is a salmon spawning ground and trout stream and consultation is essential on any works.

IDENTIFICATION

Problem code number(s):	1-86-210-36
Watercourse:	Colwyn Brook and tributary (non-main river)
Location:	Park, Caersws (Montgomery District Council)
OS Map reference:	SO 010 910 to SO 005 919

NATURE OF PROBLEM

The arterial drainage of 25 ha of agricultural land is inadequate. There has been considerable silting in the past caused by flooding from the River Trannon, but STWA has completed a scheme on the River Trannon which has alleviated this problem.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	112,430	
	(ii)	Field drainage	£		£112,430
(b) **Present value of benefits**	(i)	Agriculture	£	75,010	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£75,010
(c) **Benefit/cost ratio**					0.7
(d) **Priority category**					3C

IMPROVEMENT WORKS

The recommended works involve regrading and enlarging the channel over a length of 1.2 km. The channel improvement will provide a design capacity of 5.3 cumecs at the downstream end, but freeboard criteria will, however, allow a maximum capacity of 9.1 cumecs.

Removal of exposed bedrock in parts of the watercourse could seriously increase scheme costs.

BENEFITS

No change in the current farming practice (intensive dairy holdings) is envisaged, though improved arterial drainage will increase gross margins.

CONSERVATION

This is an important watercourse for otters.

IDENTIFICATION

Problem code number(s):	1-86-210-37
Watercourse:	Manthrigg Brook (non-main river)
Location:	Caersws (Montgomery District Council)
OS Map reference:	SO 037 922 to SO 020 935

NATURE OF PROBLEM

The arterial drainage of 100 ha of agricultural land is inadequate. Land, 3/4 properties and a minor road adjacent to the lower section of the Brook, are subject to frequent flooding from a combination of high flows in the River Severn and Manthrigg Brook.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£

(c) **Benefit/cost ratio**
(d) **Priority category**

IMPROVEMENT WORKS

It is proposed to regrade the watercourse from its confluence with the Severn to a point 3 km upstream, and to replace the box culvert under the road at SO 034 921. The design capacity is 2.1 cumecs, but freeboard criteria will, however, allow a maximum capacity of 4.4 cumecs.

During major floods, the Severn floods some properties to the west of the main road. There will be insufficient storage capacity in the improved channel to allow for a flapped outfall to the Severn, and flood defences would also be necessary to protect the properties.

BENEFITS

Following arterial drainage, it is expected that 15 ha of rough grazing would become arable and earlier spring grazing would improve the existing gross margins.

IDENTIFICATION

Problem code number(s):	1-86-210-39
Watercourse:	Bechan Brook (non-main river)
Location:	Bettws Cedewain (Montgomery District Council)
OS Map reference:	SO 144 935 to SO 121 968

NATURE OF PROBLEM

14 houses, a shop and a public house, have flooded three times in 14 years for periods up to 10 hours. The watercourse has insufficient capacity to contain even the mean annual discharge and is in a very poor state of repair.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	109,550	
	(ii)	Field drainage	£		£109,550
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	135,110	
	(iii)	Roads/Railways	£		£135,110
(c) **Benefit/cost ratio**					1.2
(d) **Priority category**					2C

IMPROVEMENT WORKS

The suggested works involve regrading and enlarging 500 m of the channel to provide a design discharge of 43.3 cumecs. In addition, the invert to Bettws bridge will be lowered by 0.8 m and the bridge underpinned. The scheme costs could increase as the work involves a considerable amount of rock excavation in the bed and channel sides.

BENEFITS

The costs attributable to road traffic disruption are negligible.

FISHERIES

This is a salmon spawning and trout stream and consultation is necessary.

IDENTIFICATION

Problem code number(s):	1-86-210-40
Watercourse:	Lliffior Brook (non-main river)
Location:	Garthmyl (Montgomery District Council)
OS Map reference:	SO 190 987

NATURE OF PROBLEM

The A483(T) floods frequently for periods up to eight hours. 200 m downstream of the road, the Brook is culverted under a disused canal. The culvert has collapsed and the flow is maintained in the canal by piping across the gap caused by the collapsed culvert.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in 25 years
	(ii)	Structures	1 in 25 years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	80,720	
	(ii)	Field drainage	£		£80,720
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	5,000	
	(iii)	Roads/Railways	£		£5,000
(c) **Benefit/cost ratio**					0.1
(d) **Priority category**					3D

IMPROVEMENT WORKS

It is recommended to regrade and enlarge the watercourse over a distance of 450 m, replace the canal culvert and install an additional culvert under the road to increase the capacity to 14.1 cumecs.

The culvert under the A483(T) was replaced in 1978, though Powys County Council did not apply for consent from STWA.

BENEFITS

No benefits to the small area of agricultural land have been calculated as the improvement potential of the land is low.

FISHERIES

Experiments are taking place for salmon rearing, and close consultation will be necessary.

IDENTIFICATION

Problem code number(s):	1-86-210-41
Watercourse:	Llandyssil Brook (non-main river)
Location:	Llandyssil (Montgomery District Council)
OS Map reference:	SO 198 952

NATURE OF PROBLEM

Eight houses and a small area of agricultural land suffer from frequent flooding. In the past Montgomery D.C. have removed an old farm culvert and improved the watercourse behind the houses. This improved the situation although the problem still remains.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£_____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£_____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IDENTIFICATION

Problem code number(s):	1-86-210-42
Watercourse:	Sarn Brook (non-main river)
Location:	Kerry (Montgomery District Council)
OS Map reference:	SO 187 911 to SO 195 910

NATURE OF PROBLEM

The arterial drainage of 10 ha of agricultural land is inadequate over a 2 km length from the confluence with the Mule. The Pen-y-gelli mill pools affect the drainage in the lower reach.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	43,240	
	(ii)	Field drainage	£	7,510	£50,750
(b) **Present value of benefits**	(i)	Agriculture	£	50,010	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£50,010
(c) **Benefit/cost ratio**					1.0
(d) **Priority category**					3E

IMPROVEMENT WORKS

It is recommended to lower the impounding level of the upper mill pool by 0.9 m and direct the flow from an inadequate deep level drain through the pool. In addition, the watercourse should be regraded and enlarged over 900 m to provide a design capacity of 1.0 cumec. Freeboard criteria will, however, allow a maximum capacity of 11.9 cumecs at the downstream end.

IDENTIFICATION

Problem code number(s):	1-86-210-43
Watercourse:	River Severn (main river)
Location:	Rhydwhyman, Montgomery (Montgomery District Council)
OS Map reference:	SO 208 983

NATURE OF PROBLEM

An unclassified road suffers from frequent flooding for periods up to 24 hours. The channel here has insufficient capacity to contain the mean annual peak discharge. Also, approximately 36 ha in the low lying area adjacent to the railway line, known as The Floss, suffer from occasional flooding.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	years
	(ii)	Structures	1 in 25	years
(c) **Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	63,420	
	(ii)	Field drainage	£		£63.420
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	7,510	£7,510
(c) **Benefit/cost ratio**					0.1
(d) **Priority category**					3D

IMPROVEMENT WORKS

It is necessary to construct a flood bank between the road and the Severn to contain a design discharge of up to 449 cumecs.

Flapped outfalls on the two Powysland IDB watercourses from The Floss would help to relieve flooding.

CONSERVATION AND AMENITY

Construction of a flood bank would necessitate the clearance of an area of woodland between the road and the river. As the bank would be 2.5 m high, the scheme may be environmentally unacceptable. There is some omithological interest.

IDENTIFICATION

Problem code number(s):	1-86-210-44
Watercourse:	River Caebitra (non-main river)
Location:	Church Stoke (Montgomery District Council)
OS Map reference:	SO 244 929 to SO 242 928

NATURE OF PROBLEM

Bacheldre Mill, the mill house and an unclassified road suffer from frequent flooding for periods up to 10 hours. The watercourse has insufficient capacity to pass even the mean annual peak discharge without overtopping. Brompton Mill Weir (SO 244 929) has a drop of 1.5 m and is disused, the mill stream having been filled up. There are considerable accumulations of debris in the watercourse which cause blockages.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	63,420	
	(ii)	Field drainage	£		£63,420
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	32,530	
	(iii)	Roads/Railways	£		£32,530
(c) **Benefit/cost ratio**					0.5
(d) **Priority category**					3D

IMPROVEMENT WORKS

The suggested scheme involves lowering Brompton Mill weir by 1 m and regrading and enlarging the watercourse for 300 m upstream. To increase the flow area at the road bridge at SO 243 929, the invert of the bridge should be lowered by 1 m. The mill race culvert should be replaced by a new larger culvert and a provision made for a portion of the main channel flow to be diverted into the mill race during high flows. The design capacity of the scheme will be 31.3 cumecs.

The high velocities during major floods may necessitate underpinning the road bridge and the provision of bed and bank protection and could raise the scheme costs.

CONSERVATION AND AMENITY

The mill is in working order and used for exhibition purposes.

FISHERIES

The reach is used for salmon rearing experiments and close consultations will be required.

IDENTIFICATION

Problem code number(s):	1-86-210-45
Watercourse:	Un-named tributary of the River Camlad (non-main river)
Location:	Church Stoke (Montgomery District Council)
OS Map reference:	SO 273 937 to SO 265 923

NATURE OF PROBLEM

An unclassified road and 60 ha of agricultural land suffer from flooding several times a year. This is a result of accumulations of gravel brought down from a steep catchment to the south, choking the flow in the grossly inadequate channel below SO 265 923.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	270,990	
	(ii)	Field drainage	£		£270,990
(b) **Present value of benefits**	(i)	Agriculture	£	88,910	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£	negligible	£88,910
(c) **Benefit/cost ratio**					0.3
(d) **Priority category**					3C

IMPROVEMENT WORKS

It is suggested that 1.7 km of watercourse should be regraded and enlarged, and the road culverts at SO 270 953 and SO 266 925 and two farm culverts be replaced. The channel improvement works will provide a design discharge of 6.4 cumecs, although freeboard criteria will allow a maximum channel capacity of 11.7 cumecs at the downstream end. The improved channel would require regular maintenance to remove gravel and silt deposits.

Existing (and future) underdrainage systems drain directly into the River Camlad. Thus, the proposed channel improvements could be reduced, as the satisfactory freeboard for field drainage under average flow conditions would not be required, but the difference in cost is minimal.

BENEFITS

A small improvement in the productivity of the land is possible with improved drainage.

CONSERVATION

The River Camlad supports a population of otters, and consultation is necessary if river bank work is included around SO 274 936.

IDENTIFICATION

Problem code number(s):	1-86-210-47
Watercourse:	Afon Garno (part main river)
Location:	Caersws (Montgomery District Council)
OS Map reference:	SO 025 917 to SO 009 938

NATURE OF PROBLEM

The arterial drainage of 60 ha of agricultural land is inadequate. 10 ha of this land and the B4569 are subject to frequent flooding for durations up to 12 hours. It is possible that a house has also been flooded.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 2 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			a

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	190,270	
		(ii)	Field drainage	£		£190,270
(b)	**Present value of benefits**	(i)	Agriculture	£	13,890	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£13,890
(c)	**Benefit/cost ratio**					0.1
(d)	**Priority category**					3C

IMPROVEMENT WORKS

It is necessary to straighten the channel over a length of 2.7 km, and deepen the channel by an average of 0.4 m, to provide a design channel capacity of 33.7 cumecs. The road bridges at SO 027 908 and SO 016 926 need underpinning.

BENEFITS

The character of farming (dairying) in much of the benefit area is unlikely to change. There will be a minor improvement in the productivity of the land with better drainage.

CONSERVATION

The Garno is a high grade river and much of the interest is determined by the nature of the river banks and associated vegetation. There is some omithological interest.

COMMENT

High maintenance costs would be associated with any major improvement. As there is little benefit to be derived from a major scheme, some shoal and silt removal to clear the drainage outfalls would suffice. At this location, the watercourse is highly mobile and therefore the pattern of flooding is changing rapidly.

FISHERIES

This is a salmon spawning and trout stream and consultations are essential.

IDENTIFICATION

Problem code number(s):	1-86-210-48
Watercourse:	River Severn (non-main river)
Location:	Near Llanidloes (Montgomery District Council)
OS Map reference:	SN 912 845 to SN 908 845

NATURE OF PROBLEM

Three terraced cottages and a chapel flood frequently. The Severn has insufficient capacity to pass the mean annual peak discharge.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	89,370	
	(ii)	Field drainage	£		£89,370
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	30,030	
	(iii)	Roads/Railways	£		£30,030
(c) **Benefit/cost ratio**					0.3
(d) **Priority category**					3D

IMPROVEMENT WORKS

It is necessary to clear and regrade the Severn over a length of 400 m, lowering the bed level adjacent to the cottages by 0.5 m to give a design capacity of 95.1 cumecs. Maintenance work would help to alleviate flooding.

BENEFITS

Only one of the cottages is occupied, the other two being in very poor condition and the benefits to these have not been assessed.

COMMENT

There is rock exposed in the bed and banks of the existing watercourse and the cost estimate has assumed all excavation to be in rock. The nature of the rock could cause a great variation in the final cost of the scheme.

FISHERIES

This is a salmon spawning area and consultation will be required, although the proposed works could be of benefit.

IDENTIFICATION

Problem code number(s):	1-86-210-50
Watercourse:	River Camlad (main river)
Location:	Church Stoke (Montgomery District Council)
OS Map reference:	SO 273 947 to SO 320 928

NATURE OF PROBLEM

290 ha of agricultural land suffer from frequent flooding and inadequate arterial drainage. The channel capacity is considerably less than the mean annual peak discharge.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	423,790	
	(ii)	Field drainage	£	45,040	£468,830
(b) **Present value of benefits**	(i)	Agriculture	£	1,089,090	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£1,089,090
(c) **Benefit/cost ratio**					2.3
(d) **Priority category**					1C

IMPROVEMENT WORKS

It is suggested that 6 km of the watercourse should be improved. The lower 3 km above Church Stoke should be enlarged, the next 1.5 km cleaned out and the worst meanders removed. The top 1.5 km should be regraded so as to provide satisfactory freeboard under average conditions. These works will provide a channel design capacity of about 20 cumecs at the downstream end. The ford at SO 314 920 should be replaced by a bridge and, although the road bridge at SO 320 918 forms an obstruction to flows and should also be replaced, it is at the upper end of the benefit area and little benefit will accrue from replacing it. Costs of replacing this bridge are included in the estimate.

BENEFITS

An improvement in the productivity of the present farming system is possible with better drainage and flood alleviation.

COMMENT

The proposed scheme removes a lot of flood storage capacity for the low magnitude floods. This could make some difference to the flood levels downstream. It may be necessary to carry out a field level survey to ensure that the Camlad is providing adequate freeboard for drainage under average flow conditions.

FISHERIES

This is an important trout fishery and detailed consultation will be essential.

IDENTIFICATION

Problem code number(s):	1-86-210-51
Watercourse:	Acre Brook (non-main river)
Location:	Bausley (Montgomery District Council)
OS Map reference:	SJ 315 160 to SJ 280 140

NATURE OF PROBLEM

460 ha of agricultural land suffer from inadequate arterial drainage, in addition to a further 20 ha within Bellam Farm Drain. The benefit area forms part of the Severn floodplain, but is protected from floods of less than five years return period by the argae system. However, the outfall to the Acre Brook is flapped, and the channel of the brook has insufficient storage capacity for run-off during the long periods when the outfall to the Severn is closed.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 5 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£ 1,207,940	
		(ii)	Field drainage	£ 25,020	£1,232,960
(b)	**Present value of benefits**	(i)	Agriculture	£ 2,300,430	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£2,300,430
(c)	**Benefit/cost ratio**				1.9
(d)	**Priority category**				2A

IMPROVEMENT WORKS

It is suggested that 8.6 km of watercourse should be regraded and enlarged, to provide satisfactory freeboard and maximum channel capacities of 5.9 cumecs on the Acre Brook, and 4.2 cumecs on the Newtown Brook. The improved channel would only have limited storage and a pumping scheme would be necessary to improve the standard of protection up to that nominally provided by the argae. In addition, the level of the flapped outfall should be lowered and six culverts replaced, including the road culvert at SJ 305 162. The road bridge at SJ 308 158 will need to be underpinned. The costs include for the pumping station running and maintenance costs.

The area to the west of the Criggion Hall access road has been drained to a new outfall to the Severn, thus reducing the amount of deepening on the main Acre Brook.

This is part of the Severn-Vyrnwy confluence area (1-86-210-31), and will be affected by any works proposed for the Confluence Scheme.

Powysland Internal Drainage Board have constructed a new outfall from Acre Brook to the River Severn.

BENEFITS

The improvement of the Acre Brook and its tributaries would make the existing underdrainage far more effective.

IDENTIFICATION

Problem code number(s):	1-86-210-52
Watercourse:	Wern Llwyd (non-main river)
Location:	Welshpool (Montgomery District Council)
OS Map reference:	SJ 230 054 to SJ 204 028

NATURE OF PROBLEM

280 ha of agricultural land suffer from inadequate arterial drainage. A large proportion of the benefit area is within the Severn floodplain and suffers from frequent flooding. In addition, the A483 and one bungalow are liable to flooding from the Severn.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	2 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	213,330	
	(ii)	Field drainage	£	20,020	£233,350
(b) **Present value of benefits**	(i)	Agriculture	£	280,610	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£280,610
(c) **Benefit/cost ratio**					1.2
(d) **Priority category**					2C

IMPROVEMENT WORKS

Approximately 4 km of watercourse should be regraded and enlarged to provide satisfactory freeboard under average flow conditions. The channel improvements will provide a channel design capacity of 0.4 cumecs, although freeboard criteria will allow a maximum channel capacity of 4.2 cumecs. The road culverts at SJ 221 048 and SJ 208 034 should be replaced as their inverts are too high. Two farm bridges will have to be replaced and the channel through the railway bridge at SJ 227 055 will have to be lined. The road culverts should be oversized to allow for the rapid evacuation of flood water. The area will still suffer from frequent flooding from the Severn, but evacuation of flood water will be faster if the proposed improvements are carried out.

The A490 road flooding covered in 1-86-210-14 included provision for replacing the road culvert at SH 221 048. The cost of replacing this road culvert is also included in this assessment.

In 1985, Powysland Internal Drainage Board carried out extensive improvement works including the replacement of 2 road culverts and are now investigating possible improvements to the lower section of the watercourse.

BENEFITS

An increase in gross margin is possible to the present farming system if drainage is improved. Improvements to watercourses and tributary ditches will allow existing underdrainage to function efficiently.

CONSERVATION

There is some ormithological interest.

IDENTIFICATION

Problem code number(s):	1-86-210-53
Watercourse:	Guilsfield Brook (main river to SJ 236 126)
Location:	Guilsfield (Without) (Montgomery District Council)
OS Map reference:	SJ 274 156 to SJ 226 123

NATURE OF PROBLEM

278 ha of agricultural land suffer from inadequate arterial drainage and 200 ha of land suffer from frequent flooding. 10 properties and a number of unclassified roads flood during major events. Downstream of Wern, the Brook is greatly affected by the River Severn level and flooding often emanates from the Severn. Downstream of Sarn Bridge (SJ 224 121) the channel has a grossly inadequate discharge capacity.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 50 years
	(ii)	Structures	1 in years
(b) **Agricultural**	(i)	Channel	1 in 5 years
	(ii)	Structures	1 in years
(c) **Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£ 1,219,470	
	(ii)	Field drainage	£ 347,790	£1,567,260
(b) **Present value of benefits**	(i)	Agriculture	£ 1,389,150	
	(ii)	Buildings	£ 217,680	
	(iii)	Roads/Railways	£ negligible	£1,606,830
(c) **Benefit/cost ratio**				1.0
(d) **Priority category**				2A

IMPROVEMENT WORKS

The watercourse has been diverted at SJ 254 136 and now flows northwards along the New Cut. The old course (Bele Brook - see 1-86-210-27) forms an overspill from the New Cut. There are a number of catch weirs on the New Cut giving scope for the channel to be regraded. It is proposed to regrade the New Cut from the Severn to the outfall of the Bele Brook as part of 1-86-210-27. This should be extended upstream. The main channel should be regraded and enlarged for 6.6 km upstream of SJ 274 156, in addition to 3.9 km of tributaries, to provide a design discharge of 20.9 cumecs at the downstream end. Freeboard criteria will, however, allow a maximum capacity of 37.4 cumecs (giving a 1 in 50 year protection to property). It will be necessary to underpin eight bridges and replace one road bridge at SJ 257 147.

BENEFITS

Some benefit from alleviating flooding of properties to the north-east of Wern Bridge was assumed, although these properties could still be flooded from the Severn.

FISHERIES

Close consultations with fisheries will be necessary.

IDENTIFICATION

Problem code number(s):	1-86-210-54
Watercourse:	River Severn (main river)
Location:	Fron, near Abermule (Montgomery District Council)
OS Map reference:	SO 180 955

NATURE OF PROBLEM

Some nine properties and the A483 road, built on the edge of the River Severn floodplain, are subject to frequent and long duration flooding. Flooding occurred in 1960, 1964 and February 1981.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	133,250	
		(ii)	Field drainage	£		£133,250
(b)	**Present value of benefits**	(i)	Agriculture	£	)	
		(ii)	Buildings	£	125,680)	
		(iii)	Roads/Railways	£	)	£125,680
(c)	**Benefit/cost ratio**					0.9
(d)	**Priority category**					3C

IMPROVEMENT WORKS

The cheapest, simplest means of protecting the properties at risk is the construction of flood banks. Approximately 1,300 m of embankment, an average of 1.2 m high, is necessary to provide a design capacity of 600 cumecs. Some 200 m of the embankment will have to be in steel sheet piling and 100 m of embankment is necessary to give Wern Farm individual protection. The local roads will have to be raised to pass over the embankments.

BENEFITS

Flooding commences at the two year return period event and little additional benefit accrues from protecting to the 100 year standard.

COMMENT

The embankment to protect the road and properties on the north bank does not protrude significantly onto the floodplain. The embankment to protect Wern Farm would, however, form more of an obstruction to flood flows and may not be permissible.

IDENTIFICATION

Problem code number(s):	1-86-210-55
Watercourse:	Tributary of Sarn Wen Brook (non-main river)
Location:	Rhos Common (Montgomery District Council)
OS Map reference:	SJ 283 183

NATURE OF PROBLEM

Approximately 24 ha suffer from inadequate drainage freeboard.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£_____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£_____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

Powysland Internal Drainage Board have carried out a grant aided improvement scheme.

CONSERVATION

There is some omithological interest.

IDENTIFICATION

Problem code number(s):	1-86-210-56
Watercourse:	Tributary of Gwyfer Brook (non-main river)
Location:	Rhos Royal (Montgomery District Council)
OS Map reference:	SJ 279 172

NATURE OF PROBLEM

Approximately 32 ha of agricultural land suffer from inadequate drainage freeboard.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

Powysland Internal Drainage Board have carried out a grant aided improvement scheme on Gwyfer Brook.

IDENTIFICATION

Problem code number(s):	1-86-210-57
Watercourse:	Sarn Wen Brook (non-main river)
Location:	Gornal (Montgomery District Council)
OS Map reference:	SJ 268 184

NATURE OF PROBLEM

More than 20 ha suffers from inadequate drainage freeboard. In addition, the high water table reduces the effectiveness of a number of septic tank soakaways.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

The lowering of the culvert under the farmyards at Gornal and Greenfields, together with the lowering of the main road culvert outside Powysland Internal Drainage Board's area, would partly resolve the problem. A scheme has been prepared, sponsored by the Powys County Council Land Agent, but it has not progressed through lack of contributions from beneficiaries.

IDENTIFICATION

Problem code number(s): 1-86-210-58
Watercourse: Un-named ditch (non-main river)
Location: The Haim (Montgomery District Council)
OS Map reference: SJ 327 160

NATURE OF PROBLEM

81 ha of agricultural land suffer from inadequate drainage freebord.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in		years
	(ii)	Structures	1 in		years
(b) **Agricultural**	(i)	Channel	1 in		years
	(ii)	Structures	1 in		years

(c) **Land potential category**

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£		
	(ii)	Field drainage	£		£
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£

(c) **Benefit/cost ratio**
(d) **Priority category**

IMPROVEMENT WORKS

STWA re-built the ditch outfall to a lower level. Improved freeboard would be achieved if the ditch was regraded.

IDENTIFICATION

Problem code number(s):	1-86-210-59
Watercourse:	River Vyrnwy (main river)
Location:	Llandysillo (Montgomery District Council)
OS Map reference:	SJ 269 198

NATURE OF PROBLEM

The A483 road floods from the River Vyrnwy and the road becomes impassable, most notably in 1974.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IDENTIFICATION

Problem code number(s):	1-86-210-60
Watercourse:	River Severn (main river)
Location:	Long Length, Caersws (Montgomery District Council)
OS Map reference:	SO 040 915

NATURE OF PROBLEM

The A492 road and 2 houses flood every 2/3 years. Another house and a hotel suffer from flooding approximately every 5 years and 25 years respectively.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IDENTIFICATION

Problem code number(s):	1-86-210-61
Watercourse:	Afon Cain (non-main river)
Location:	Llanfyllin (Montgomery District Council)
OS Map reference:	SJ 143 196

NATURE OF PROBLEM

Two properties are subject to flooding due to a build up of shingle downstream of the road bridge.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IDENTIFICATION

Problem code number(s):	2-86-310-1
Watercourse:	River Teme (non-main river)
Location:	Knighton (Radnor District Council)
OS Map reference:	SO 288 726 to SO 300 724

NATURE OF PROBLEM

Considerable property flooding occurs during floods of 1 in 5 years magnitude or greater. 16 houses and 14 commercial properties are affected including the Tyre Works and the Teme Mill complex. Major flooding occurred in 1947, 1955, 1960 and 1974 but mainly lasts for less than 12 hours. The main street leading to the bridge becomes impassable and during floods of Q_{20} magnitude floodwater passes down the railway line, bypassing the bridge and flowing through the station causing much damage to the track and formation. Road and property flooding also occurs in Knighton from the Wylcwm (Wilcombe) Brook (2-86-310-5).

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	100	years
	(ii)	Structures	1 in	100	years
(b) **Agricultural**	(i)	Channel	1 in		years
	(ii)	Structures	1 in		years
(c) **Land potential category**					

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	331,530	
	(ii)	Field drainage	£		£331,530
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£	620,520	
	(iii)	Roads/Railways	£		£620,520
(c) **Benefit/cost ratio**					1.9
(d) **Priority category**					2C

IMPROVEMENT WORKS

The recommended solution is to carry out a channel improvement scheme rationalising the channel cross-section throughout and deepening by about 1m to provide a design capacity of 87 cumecs. Underpinning the main road bridge and considerable stone revetment works to stabilise the channel will be required.

CONSERVATION

The Teme is an important river for otters and if any river bank work is envisaged on either of the schemes in the vicinity of Knighton, consultation with the various conservation groups is important.

FISHERIES

Consultation is required before works are commenced.

COMMENT

A feasibility study has been commissioned with a view to the resolution of this problem. Further level and velocity guaging is being carried out.

IDENTIFICATION

Problem code number(s):	2-86-310-3
Watercourse:	Ffrwdwen Brook (non-main river)
Location:	Knucklas (Radnor District Council)
OS Map reference:	SO 225 745 to SO 257 743

NATURE OF PROBLEM

34 ha of land adjacent to the watercourse and minor roads are prone to flooding for durations usually less than 12 hours.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 5 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			a

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	80,720	
		(ii)	Field drainage	£	25,020	£105,740
(b)	**Present value of benefits**	(i)	Agriculture	£	16,670	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£16,670
(c)	**Benefit/cost ratio**					0.2
(d)	**Priority category**					3D

IMPROVEMENT WORKS

The watercourse requires clearance and resectioning together with the replacement of two culverts.

BENEFITS

Following arterial improvements only a minimal increase in gross margin is likely. Drainage has been carried out in the past and farmers are unlikely to take advantage of any arterial improvements.

IDENTIFICATION

Problem code number(s):	2-86-310-4
Watercourse:	Warren Brook (non-main river)
Location:	Pant-y-Caregl, Beguildy (Radnor District Council)
OS Map reference:	SO 199 793 to SO 202 793

NATURE OF PROBLEM

Minor road flooding occurs occasionally but the road is never impassable.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£_____
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£_____
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IMPROVEMENT WORKS

The road bridge at Pant-y-Caregl is adequate for flows in excess of Q_{50}. The minor road flooding problem at this location is due to inadequacies in the highway drainage system and is outside the scope of this Survey.

IDENTIFICATION

Problem code number(s):	2-86-310-5
Watercourse:	Wylcwm (Wilcombe) Brook (non-main river)
Location:	Knighton (Radnor District Council)
OS Map reference:	SO 278 718 to SO 290 724

NATURE OF PROBLEM

Domestic and commercial property in Station Road flooded in 1947, 1955, 1960 and 1974 for periods normally less than 12 hours. The response of the brook to storm intensity rainfall is very rapid. Flooding may be due solely to the Wylcwm Brook flows, or more usually, to a combination of these with Teme floodflows.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in 100 years
	(ii)	Structures	1 in 100 years
(b) **Agricultural**	(i)	Channel	1 in years
	(ii)	Structures	1 in years
(c) **Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	98,020	
	(ii)	Field drainage	£		£98,020
(b) **Present value of benefits**	(i)	Agriculture	£		
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£ not estimated
(c) **Benefit/cost ratio**					0
(d) **Priority category**					3D

IMPROVEMENT WORKS

The complete solution to this problem requires improvements to the Teme at the confluence (2-86-310-1). However, relief from flooding, due solely to the brook can be achieved by clearing and resectioning the channel from Broad Street to the Teme confluence together with major structural works around Station Road. These include lowering the weir immediately upstream of the road and replacement of the culvert beneath the road and will provide a design discharge of 11.3 cumecs.

The works to replace and realign the culvert under Station Road together with the lowering of the weir have been carried out by Powys County Council. The remainder of the recommendations have not as yet been carried out.

BENEFITS

The benefits to be gained from alleviation of the flooding from the brook above do not justify the works outlined above. They are only justifiable economically if carried out in conjunction with the improvement works necessary for the solution of 2-86-310-1. No separate benefits have therefore been estimated in this solution.

IDENTIFICATION

Problem code number(s):	2-86-310-7
Watercourse:	Cil Owen Brook (non-main river)
Location:	Felindre (Radnor District Council)
OS Map reference:	SO 167 810 to SO 170 811

NATURE OF PROBLEM

Flooding around the road bridge takes place when a combination of Cil Owen Brook and the Teme floods occur. The road is not usually impassable but a modernised cottage immediately downstream of the bridge at Teme confluence is liable to flooding. In 1975 the property flooded for a short duration. Floodwater either enters the property via the eroded bank of the Cil Owen Brook or from the Teme itself.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in 100 years
(b)	**Agricultural**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(c)	**Land potential category**			

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	8,650	
		(ii)	Field drainage	£		£8,650
(b)	**Present value of benefits**	(i)	Agriculture	£		
		(ii)	Buildings	£	12,510	
		(iii)	Roads/Railways	£		£12,510
(c)	**Benefit/cost ratio**					1.4
(d)	**Priority category**					2F

IMPROVEMENT WORKS

The road bridge has been renovated and widened. Although river training walls were constructed as part of the works they have been curtailed at an insufficient distance downstream of the bridge and erosion is taking place.

Remedial works are required to the river training walls downstream of the bridge and a floodbank/floodwall is required alongside and to the rear of the property to provide protection against discharge of 6.4 cumecs. Care will be required to ensure effective sealing of the cottage surface water drains from backing-up effects.

IDENTIFICATION

Problem code number(s):	1-87-910-1
Watercourse:	River Severn (main river)
Location:	Trimpley, Nr Bewdley (Wyre Forest District Council)
OS Map reference:	SO 779 765 to SO 775 782

NATURE OF PROBLEM

38 holiday chalets are liable to flood, the lowest chalet with a frequency of 1 in 5 years.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(b)	**Agricultural**	(i)	Channel	1 in	years
		(ii)	Structures	1 in	years
(c)	**Land potential category**				

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	
		(ii)	Field drainage	£	£
(b)	**Present value of benefits**	(i)	Agriculture	£	
		(ii)	Buildings	£	
		(iii)	Roads/Railways	£	£
(c)	**Benefit/cost ratio**				
(d)	**Priority category**				

IDENTIFICATION

Problem code number(s):	1-99-510-1
Watercourse:	Coal Brook (non-main river)
Location:	Sutton-upon-Tern (Newcastle-under-Lyme Borough Council)
OS Map reference:	SJ 685 341 to SJ 726 323

NATURE OF PROBLEM

120 ha of agricultural land suffer from poor drainage with some flooding.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	354,600	
		(ii)	Field drainage	£	132,610	£487,210
(b)	**Present value of benefits**	(i)	Agriculture	£	388,960	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£388,960
(c)	**Benefit/cost ratio**					0.8
(d)	**Priority category**					3C

IMPROVEMENT WORKS

It is necessary to regrade and enlarge the watercourse over a length of 4.9 km, lower the channel invert by a maximum of 1.3 m and replace three road culverts at SJ 688 340, SJ 701 337 and SJ 715 328. The culvert under the Shropshire Union Canal at SJ 685 341 needs underpinning so that the invert can be lowered. The channel improvement will provide a design capacity of 5.4 cumecs, but freeboard criteria will, however, allow a maximum capacity of 6.3 cumecs.

Providing satisfactory freeboard for drainage by lowering the Coal Brook is only possible if the River Tern is improved. This scheme and 1-83-210-23 should be considered together.

The County Council have been asked to prepare a scheme for the Coal Brook from Goldenhill Farm to the Chipnall - The Lloyd Road.

FISHERIES

This is a minor trout stream, but it supports a trout farm.

IDENTIFICATION

Problem code number(s):	1-99-510-2
Watercourse:	River Tern (non-main river)
Location:	Mucklestone to Ashley (Newcastle-under-Lyme Borough Council)
OS Map reference:	SJ 726 390 to SJ 787 385

NATURE OF PROBLEM

190 ha of agricultural land suffer from inadequate arterial drainage. The impounding at Bearstone Mill is too high for satisfactory drainage upstream.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	5 years
	(ii)	Structures	1 in	25 years
(c) **Land potential category**				a5

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	484,330	
	(ii)	Field drainage	£	175,150	£659,480
(b) **Present value of benefits**	(i)	Agriculture	£	616,780	
	(ii)	Buildings	£		
	(iii)	Roads/Railways	£		£616,780
(c) **Benefit/cost ratio**					0.9
(d) **Priority category**					3C

IMPROVEMENT WORKS

It is suggested that the level of Bearstone Mill Pool should be lowered by 0.8 m, and 6.5 km of watercourse regraded and enlarged to provide satisfactory freeboard under average flow conditions. The proposed improvement works will provide a design capacity of 4.7 cumecs at the downstream end, though freeboard criteria will allow a slightly larger maximum channel capacity. In addition, five road culverts need replacing.

BENEFITS

Only a minor improvement in the productivity of the present farming system will be possible, with improved drainage.

CONSERVATION

Maer Pool (SJ 789 384) is an SSSI. It is possible to terminate an improvement scheme downstream of the pool so as not to affect the site. There would be only a marginal decrease in the benefit area. At this location the River Tern is a clean, unpolluted stream with varied aquatic flora and fauna and interesting marginal vegetation. It is possibly an otter habitat.

FISHERIES

Trout rearing takes place at Willoughbridge Wells, and the watercourse is a possible trout fishery.

IDENTIFICATION

Problem code number(s):	1-99-710-1
Watercourse:	Back Brook (non-main river)
Location:	Woodcote (Stafford Borough Council)
OS Map reference:	SJ 779 200 to SJ 788 151

NATURE OF PROBLEM

144 ha of agricultural land suffer from poor drainage. Lynn Mill Cottage (SJ 788 151) is also prone to frequent flooding for up to four hours, caused by an inadequate culvert.

DESIGN STANDARDS

(a)	**Urban**	(i)	Channel	1 in years
		(ii)	Structures	1 in years
(b)	**Agricultural**	(i)	Channel	1 in 10 years
		(ii)	Structures	1 in 25 years
(c)	**Land potential category**			b

ECONOMIC EVALUATION (December 1989 price base)

(a)	**Costs**	(i)	Arterial works	£	412,250	
		(ii)	Field drainage	£	180,150	£592,400
(b)	**Present value of benefits**	(i)	Agriculture	£	2,472,690	
		(ii)	Buildings	£		
		(iii)	Roads/Railways	£		£2,472,690
(c)	**Benefit/cost ratio**					4.2
(d)	**Priority category**					1C

IMPROVEMENT WORKS

It is recommended to regrade and enlarge the watercourse over a length of 5.2 km, replace the road culverts at SJ 781 194 and SJ 784 168, as well as the railway culvert at SJ 780 184 and the culvert under the access road to Lynn Mill Cottage. The proposed channel improvement will provide a design capacity of 5.4 cumecs, but freeboard criteria will, however, allow a maximum capacity of 6.4 cumecs.

Some improvements have been carried out, but further work is necessary before land drainage near Lynn can be implemented, which Shropshire County Council are investigating.

BENEFITS

A major change from poor pasture to a mixed cereals system is possible following drainage improvements.

The benefits derived from protecting the cottage have not been assessed.

CONSERVATION

This area has a moderate botanical and ornithological interest and the proposed improvements would be undesirable from a conservation point of view.

IDENTIFICATION

Problem code number(s):	1-99-710-2/3
Watercourse:	River Meese and Lonco Brook (main river)
Location:	Forton (Stafford Borough Council)
OS Map reference:	SJ 731 222 to SJ 765 207

NATURE OF PROBLEM

60 ha of agricultural land close to Aqualate Mere suffer from frequent flooding, and 352 ha are inadequately drained.

DESIGN STANDARDS

(a) **Urban**	(i)	Channel	1 in	years
	(ii)	Structures	1 in	years
(b) **Agricultural**	(i)	Channel	1 in	10 years
	(ii)	Structures	1 in	10 years
(c) **Land potential category**				b

ECONOMIC EVALUATION (December 1989 price base)

(a) **Costs**	(i)	Arterial works	£	
	(ii)	Field drainage	£	£
(b) **Present value of benefits**	(i)	Agriculture	£	
	(ii)	Buildings	£	
	(iii)	Roads/Railways	£	£

(c) **Benefit/cost ratio**
(d) **Priority category**

IMPROVEMENT WORKS

The River Meese is to be regraded and enlarged from SJ 731 222 to SJ 765 207 to provide satisfactory freeboard for land drainage. A control structure will be constructed near SJ 765 207 to regulate the level of Aqualate Mere with flows up to a design capacity of 8 cumecs. 1.4 km of Lonco Brook from SJ 741 206 to SJ 749 209 will be regraded. The level of Aqualate Mere will have an effect on Back Brook.

STWA completed a scheme downstream of Forton Bridge in 1983/84. The Forton Bridge has been replaced which would allow regrading to continue upstream. Further work to Aqualate Mere has been suspended because of conservation problems.

BENEFITS

The land has a high potential. The present rough grazing system will be converted to an intensive cereal/potato/sugar beet rotation following improved drainage.

CONSERVATION

The Aqualate Mere SSSI could be seriously affected by these proposals and the lowering of the water table would seriously affect the interest of the site.

APPENDIX A2

SCHEDULE OF MAIN RIVER

SCHEDULE OF MAIN RIVERS IN THE UPPER SEVERN AREA - JANUARY 1990

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
ACRE BROOK	R Severn confluence to upstream face of outfall structure	SJ 316 160	SJ 315 159	0.28	1
ADFORTON BROOK	Wigmore Main Drain confluence to a point upstream of Green Lane Bridge, Adforton	SO 420 706	SO 415 704	0.48	2
ALLCOCKS BROOK	Wigmore Main Drain confluence to Allcocks Bridge	SO 420 706	SO 425 693	1.45	2
BACK BROOK	R Roden confluence to Stang's Plantation	SJ 514 286	SJ 484 291	3.70	1
BAILEY BROOK	R Tern confluence to Hoarstone Lane Bridge	SJ 629 315	SJ 610 337	4.67	1
BELE BROOK	R Severn confluence to Wern Bridge	SJ 283 158	SJ 253 137	4.14	1
BLACK BROOK	Smestow Brook confluence to the A454 road bridge	SO 839 959	SO 836 967	1.00	2
BROMLEY BROOK	R Perry confluence to Bagley-Shade Oak road bridge	SJ 399 252	SJ 410 274	3.70	1
BUCKLEY FARM BROOK	R Severn confluence to upstream face of Buckley Farm outfall	SJ 363 166	SJ 364 167	0.20	1
RIVER CAMLAD	R Severn confluence to Snead Bridge	SJ 209 006	SO 320 918	29.23	1
RIVER CERIST	R Severn confluence to Van road bridge (B4518)	SO 025 915	SN 915 874	9.50	1
RIVER CLYWEDOG	R Severn confluence to Clywedog Dam	SN 954 848	SN 913 869	5.31	1
COMMISSION DRAIN	R Tern confluence to Kynnersley road bridge	SJ 615 149	SJ 650 176	5.25	1
RIVER CORVE	R Teme confluence to Beam Bridge	SO 506 750	SO 532 882	22.85	2
CRIGGION BROOK	R Severn confluence to upstream face of outfall structure	SJ 314 161	SJ 313 161	0.04	1
CRUCKTON BROOK	Rea Brook confluence to upstream of confluence with right bank tributary	SJ 432 098	SJ 428 102	0.70	1
DUNKETT BROOK	R Severn confluence to upstream face of Dunkett outfall	SJ 356 170	SJ 357 174	0.40	1
RIVER EIRTH	R Tanat confluence to 250m upstream of B4391 bridge at Llangynog	SJ 055 260	SJ 051 263	0.56	1
ELMBRIDGE BROOK	R Salwarpe confluence to road bridge near Cooksey Green	SO 885 629	SO 894 696	8.69	2
RIVER GARNO	R Severn confluence to Wig Bridge	SO 027 917	SO 017 926	1.50	1
GUILSFIELD BROOK	Bele Brook confluence to Lower Varchoel Farm	SJ 253 137	SJ 236 126	2.30	1
GWYFER BROOK	R Severn confluence to upstream face of outfall structure	SJ 292 166	SJ 291 166	0.07	1
HADLEY BROOK	R Salwarpe confluence to the B4192 road bridge	SO 869 620	SO 869 713	14.64	2
HEN AFON	R Vyrnwy confluence to outfall structure	SJ 155 127	SJ 153 128	0.26	1
HOO BROOK	R Stour confluence to A448	SO 829 746	SO 847 755	2.25	2
HURLEY BROOK	Commission Drain confluence to overflow structure on Northern Interceptor sewer	SJ 641 159	SJ 653 151	1.17	1
KYRE BROOK	R Tame confluence to confluence with a minor watercourse downstream of Splash Bridge	SO 599 685	SO 602 672	1.88	2
LAUGHERN BROOK	R Teme confluence to the Worcester - Martley road bridge near Kenswick Manor	SO 834 526	SO 796 580	12.71	2
LONCO BROOK	R Meese confluence to Whitleyford Bridge	SJ 737 217	SJ 746 238	4.83	1
RIVER MEESE	R Tern confluence to Aqualate Mere	SJ 638 208	SJ 765 208	22.60	1
RIVER MORDA	R Vyrnwy confluence to Newbridge road bridge	SJ 293 207	SJ 304 254	14.80	1
RIVER ONNY	R Teme confluence to confluence of Quinny Brook	SO 485 766	SO 436 843	12.34	2
OSWESTRY BROOK	R Morda confluence to the major surface water outfalls at Oswestry	SJ 316 238	(SJ 302 290) (SJ 300 284)	7.40	1

SCHEDULE OF MAIN RIVERS IN THE UPPER SEVERN AREA (CONTINUED)

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
PENTRE BROOK	R Vyrnwy confluence to downstream face of road culvert at Pentre	SJ 166 137	SJ 151 135	1.74	1
RIVER PERRY	R Severn confluence to Hillyards Plantation	SJ 440 166	SJ 315 334	30.09	1
POTFORD BROOK	R Tern confluence to the downstream face of A442 culvert	SJ 638 208	SJ 634 223	2.30	1
REA BROOK	R Severn confluence to Marton Pool	SJ 496 123	SJ 298 028	37.65	1
RIVER REA	R Teme confluence to the A4117 road bridge at Cleobury Mortimer	SO 636 686	SO 680 763	18.02	2
RIVER RED STRINE	R Strine confluence to Humber Brook confluence	SJ 644 174	SJ 685 165	5.31	1
RIVER RODEN	R Tern confluence to Blackhurstford Bridge	SJ 593 124	SJ 462 334	43.44	1
RIVER SALWARPE	R Severn confleunce to Upton Warren Bridge	SO 841 601	SO 933 674	23.01	2
RIVER SEVERN	R Teme confluence to R Clywedog confluence	SO 850 521	SN 954 848	218.00	1 + 2
SLEAP BROOK	R Roden confluence to bridge on minor road from Brandwood to Noneley	SJ 505 281	SJ 471 271	4.30	1
SMESTOW BROOK	R Stour confluence to the upstream face of the canal culvert	SO 863 855	SJ 898 006	25.27	2
SOULTON BROOK	R Roden confluence to Creamery Bridge	SJ 545 294	SJ 541 337	5.15	1
RIVER STOUR	R Severn confluence to the downstream end of Overend Tunnel, Cradley	SO 812 708	SO 949 851	41.79	2
STRINE BROOK	Soulton Brook confluence to road bridge at Steel Heath	SJ 550 308	SJ 554 363	6.35	1
RIVER STRINE	R Tern confluence to downstream face of canal culvert	SJ 629 176	SJ 752 200	15.00	1
RIVER TANAT	R Vyrnwy confluence to 300m downstream of Llangynog bridge	SJ 243 207	SJ 055 260	26.00	1
RIVER TEME	R Severn confluence to sewage works outfall at Knighton	SO 850 521	SO 301 724	107.07	2
RIVER TERN	R Severn confluence to Walkmill Bridge, Market Drayton	SJ 553 091	SJ 672 335	45.21	1
TETCHILL AND NEWNES BROOK	R Perry confluence to upstream face of culvert at Dudleston Heath	SJ 380 296	SJ 365 363	10.70	1
RIVER TRANNON	R Cerist confluence to the B4569 road bridge at Trefeglwys	SO 012 910	SN 969 903	5.52	1
RIVER VYRNWY	R Severn confluence to downstream end of the Vyrnwy dam spillway	SJ 328 159	SJ 019 192	66.06	1
WALL BROOK	R Strine confluence to syphon at junction of Kynnersley Drive and Shropshire Union Canal	SJ 675 181	SJ 687 165	2.14	1
WEIR BROOK	R Severn confluence to upstream face of outfall structure	SJ 345 169	SJ 344 169	0.05	1
WEIR BROOK (new cut)	R Severn confluence to upstream face of outfall structure	SJ 345 171	SJ 344 171	0.04	1
WERN-DDU BROOK	R Vyrnwy confluence to the Melverley IDB outfall on the B4398	SJ 283 202	SJ 282 206	0.56	1
WIGMORE MAIN DRAIN	R Teme confluence to the head of the drain	SO 431 717	SO 415 696	3.22	2
RIVER WORFE	R Severn confluence to Broad Bridge, Stapleford	SO 725 952	SO 762 982	15.14	1
WORTHEN BROOK	Rea brook confluence to the Ford at Worthen	SJ 334 042	SJ 327 045	0.80	1
TOTAL				960.83	

SCHEDULE OF MAIN RIVERS IN THE LOWER SEVERN AREA - JANUARY 1990

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
RIVER ALNE	R Arrow confluence to Botley Mill Farm Bridge	SP 093 573	SP 144 684	22.69	3
RIVER ARROW	R Avon confluence to Coventry Highway Bridge, Redditch	SP 083 507	SO 055 680	25.00	3
RIVER AVON	R Severn confluence to road bridge at Welford	SO 888 331	SP 645 808	180.94	3
BADSEY BROOK	R Avon confluence to A44 road bridge, Wickhamford	SP 050 454	SP 065 413	6.27	3
BIRDINGBURY BROOK	R Leam confluence to upstream face of culvert on Birdingbury-Offchurch Road	SP 418 685	SP 427 677	1.40	3
BOW BROOK	R Avon confluence to Shell Ford, Himbleton	SP 919 426	SO 951 596	25.90	3
BRETFORTON BROOK	Badsey Brook confluence to Stoneford Barn	SP 066 443	SP 097 426	4.32	3
RIVER CAM	Gloucester and Sharpness Canal to Lower Cam	SO 739 051	SO 752 002	7.15	2
CAPEHALL BROOK	Wicksters Brook confluence to upstream face of M5 Motorway culvert	SO 756 048	SO 762 038	1.45	2
CAREYS BROOK	R Severn confluence to upstream face of A4021 road bridge	SO 849 506	SO 834 507	2.50	2
CARRANT BROOK	R Avon confluence to Aston on Carrant road bridge	SO 895 334	(SO 940 349) (SO 940 348)	8.10	3
RIVER CHELT	R Severn confluence to railway bridge, Cheltenham	SO 848 262	SO 936 232	14.81	2
CLAYCOTON BROOK	R Avon confluence to unnamed tributary flowing from Elkington	SP 564 778	SP 607 754	8.20	3
CLIFTON BROOK	R Avon confluence to Clifton road bridge	SP 515 775	SP 521 759	0.90	3
COLLIERS BROOK	R Leadon confluence to upstream face of the A417 road bridge	SO 776 235	SO 799 260	4.00	2
DEAN BROOK	R Swilgate confluence to the A435 road bridge	SO 911 283	SO 955 286	4.83	2
DEERHURST PARISH DRAIN	R Severn confluence to the drain head	SO 846 264	SO 878 271	3.22	2
RIVER DENE	R Avon confluence to Wellesbourne Mill	SP 258 563	SP 284 544	4.83	3
DIMORE BROOK	R Severn confluence to upstream face of the A38 road bridge	SO 794 150	SO 807 131	2.94	2
DOVERTE BROOK	R Little Avon confluence to upstream face of the B4509 road bridge at Berkeley	ST 677 992	ST 684 990	0.84	2
ELL BROOK	R Leadon confluence to upstream face of Ell Bridge, Newent	SO 774 245	SO 721 264	6.80	2
RIVER FROME	R Severn confluence to bridge on Frampton Mansell - Trillis road	SO 751 106	SO 929 030	34.59	2
GLYNCH BROOK	R Leadon confluence to upstream face of Berry Bridge, Staunton	SO 771 275	SO 783 294	4.00	2
HASFIELD DRAIN	R Severn confluence to upstream face of B4213 road culvert	SO 844 270	SO 842 281	1.58	2
HATHERLEY BROOK	R Severn confluence to upstream face of Arle Bridge	SO 826 210	SO 914 218	11.53	2
HORSBERE BROOK	R Severn confluence to upstream face of Brockworth road bridge	SO 828 209	SO 892 169	9.84	2
RIVER ISBOURNE	R Avon confluence to Wormington Bridge	SP 031 431	SP 037 364	9.07	3
RIVER ITCHEN	R Leam confluence to R Stowe confluence	SP 406 690	SP 406 620	12.55	3
RIVER LEADON	R Severn confluence to England's Bridge near Bosbury	SO 817 199	SO 692 440	39.00	2
RIVER LEAM	R Avon confluence to road bridge on Grandborough-Woolscott road	SP 301 657	SP 495 672	39.09	3
LEIGH BROOK	R Chelt confluence to Knight's Bridge	SO 853 259	SO 893 268	5.40	2

SCHEDULE OF MAIN RIVERS IN THE LOWER SEVERN AREA - (CONTINUED)

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
LEIGH PARISH DRAIN	R Chelt confluence to approx 300m downstream of footbridge on Coombe Hill Canal (disused)	SO 851 261	SO 877 270	3.38	2
RIVER LITTLE AVON	R Severn confluence to upstream face of railway bridge	SO 661 006	ST 728 902	20.04	2
LITTLETON BROOK	Bretforton Brook confluence to tributary upstream of North Littleton	SP 073 443	SP 084 478	4.34	3
LONGDON BROOK	R Severn confluence to confluence with Berry Meadow Brook	SO 868 362	SO 810 335	9.87	2
MARCHFONT BROOK	R Avon confluence to Clifford Chambers - Long Marston road bridge	SP 159 521	SP 169 513	1.61	3
MILL AVON	R Severn confluence to downstream face of Abbey Mill sluice	SO 879 317	SO 892 330	1.80	2
MILLHOLME BROOK	R Leam confluence to downstream side of bridge on road running SW from Grandborough	SP 460 681	SP 483 659	4.02	3
MYTHE BROOK	R Severn confluence to upstream face of Bow Bridge	SO 886 342	SO 879 364	2.69	2
NOLEHAM BROOK	R Avon confluence to access bridge at Pitchell Farm, south of Broad Marston	SP 117 514	SP 145 454	9.81	3
NORMANS BROOK	Hatherley Brook confluence to railway bridge at Churchdown	SO 874 222	SO 895 204	3.38	2
PIDDLE BROOK	R Avon confluence to the A442 at Grafton Flyford	SO 954 465	SO 964 555	14.48	3
RED BROOK	R Leadon confluence to upstream face of road bridge at Taynton	SO 776 222	SO 751 231	4.12	2
RIVER SEVERN	Avonmouth (East bank) and Beachley Point (West Bank) to R Teme confluence	(ST 513 798) (ST 550 903)	SO 850 521	130.00	1 + 2
SHELL BROOK	Shell Ford to Brandon Brook confluence	SO 951 596	SO 006 602	6.40	3
RIVER SHERBOURNE	R Sowe confluence to Whitley Bridge	SP 346 757	SP 349 771	2.74	3
SHORN BROOK	Gloucester and Sharpness Canal to minor road at Hardwicke	SO 791 128	SO 794 125	0.40	2
SHOTTERY BROOK	R Avon confluence to upstream face of culvert under the Stratford-on-Avon canal	SP 184 535	SP 187 560	3.00	3
RIVER SOWE	R Avon confluence to Longford Bridge (A444)	SP 324 724	SP 349 832	24.94	3
STOCK GREEN BROOK	Shell Brook confluence to downstream face of road culvert in Stock Green	SO 956 599	SO 981 587	3.15	3
RIVER STOUR	R Avon confluence to Mitford Bridge	SP 183 534	SP 263 371	36.42	3
RIVER STOWE	R Itchen confluence to Daventry road bridge, Southam	SP 406 620	SP 423 619	2.48	3
STROUD WATER	R Frome confluence to Wall Bridge culvert, Stroud	SO 831 047	SO 848 051	1.77	2
RIVER SWIFT	R Avon confluence to Lutterworth water reclamation works outfall	SP 505 768	SP 541 835	11.50	3
RIVER SWILGATE	Mill Avon confluence to Stoke Orchard Bridge	SO 887 323	SO 914 281	7.00	2
TIBBERTON BROOK	Red Brook confluence to upstream face of Wynford Bridge	SO 756 231	SO 752 226	0.68	2
TIRLE BROOK	R Swilgate confluence to Aston Cross Bridge	SO 897 325	SO 942 336	5.95	2
WHADDON BROOK	Gloucester and Sharpness Canal to downstream end of culvert, Lower Tuffley	SO 815 157	SO 824 146	1.40	2
WHITSUN BROOK	Piddle Brook confluence to Bishampton - Abberton road bridge	SO 962 510	SO 991 522	4.40	3

SCHEDULE OF MAIN RIVERS IN THE LOWER SEVERN AREA - (CONTINUED)

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
WICKSTERS BROOK	R Cam confluence to upstream face of M5 Motorway culvert	SO 742 049	SO 766 049	2.85	2
WITHY BROOK	R Sowe confluence to B4029	SP 385 802	SP 410 827	4.00	3
WOTTON BROOK	Horsbere Brook confluence to Cole Bridge, Gloucester	SO 833 210	SO 847 191	2.57	2
TOTAL				834.93	

SCHEDULE OF MAIN RIVERS IN THE UPPER TRENT AREA - JANUARY 1990

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
RIVER ANKER	R Tame confluence to Stretton Baskerville Brook confluence	SK 206 038	SP 403 909	38.34	8
BELL BROOK	R Penk confluence to Pillaton Bridge	SJ 923 145	SJ 940 130	2.41	7
BENTLEY (BRADBOURNE) BROOK	R Dove confluence to Woodeaves Mill Bridge	SK 160 462	SK 185 503	6.44	6
RIVER BLITHE	R Trent confluence to north of Blythe Bridge	SK 114 176	SJ 951 416	39.00	7
RIVER BLYTHE	R Tame confluence to Earlswood Reservoir	SP 212 916	SP 114 742	40.47	8
BOURNE BROOK	R Tame confluence to Footherley Brook confluence	(SK 210 017) (SK 209 016)	SK 108 051	18.83	8
RIVER BOURNE	R Tame confluence to Furnace End Bridge	SP 216 916	SP 248 912	4.10	8
BRAMCOTE BROOK	R Anker confluence to downstream face of M42 culverts	SK 264 040	(SK 276 056) (SK 279 061)	3.85	8
CHURCH EATON BROOK	R Penk confluence to Mitton Manor Farm	SJ 916 142	SJ 889 148	3.68	7
RIVER CHURNET	R Dove confluence to Tittesworth Reservoir	SK 102 375	SJ 994 586	40.50	6
RIVER COLE	R Blythe confluence to Cole Ford, near Shard End	SP 212 912	SP 143 885	14.11	8
COLESHILL HALL BROOK	R Cole confluence to the M42 outfall	SP 190 882	SP 195 877	1.00	8
COMBERFORD BROOK	R Tame confluence to field boundary upstream of footbridge north-west of Wigginton	SK 190 075	SK 204 072	1.80	8
CURBOROUGH BROOK	R Trent confluence to Curborough reclamation works outfall	SK 166 155	SK 127 129	5.70	7
DARLASTON BROOK	R Tame confluence to downstream face of Murdoch Road culvert	SO 981 982	SO 961 967	2.85	8
DOLEY BROOK	Church Eaton Brook confluence to Norbury Park, north-west of Gnossall	SJ 892 150	SJ 808 225	13.68	7
RIVER DOVE	R Trent confluence to Okeover Bridge	SK 280 261	SK 164 481	54.86	6
ENDON BROOK	R Churnet confluence to flood wall 40m above railway culvert	SJ 968 534	SJ 928 531	5.82	6
FEATHERSTONE BROOK	R Penk confluence to Cat and Kittens Lane, Featherstone	SJ 905 066	SJ 923 050	2.90	7
FOOTHERLEY BROOK	Bourne Brook confluence to Blake Street Culvert	SK 108 051	SK 105 008	5.95	8
FORS BROOK	R Blithe confleunce to downstream face of the footbridge, Forsbrook	SJ 960 406	SJ 965 417	1.36	7
FOSTON BROOK	R Dove confluence to Boylestone	SK 195 299	SK 179 359	8.45	6
GILWISKAW BROOK	R Meese confluence to near Nook Farm, Ashby-de-la-Zouch	SK 336 101	SK 359 155	6.91	7
GROVELAND BROOK	R Tame confluence to manhole 80m north of Tividale Road	SO 974 916	SO 964 908	1.50	8
HARROW BROOK	R Anker confluence to downstream face of Brodick Road Bridge	SP 389 911	SP 409 938	4.15	8
HATCHFORD BROOK	Kingshurst Brook confluence to the downstream face of Eastern Bridge	SP 167 860	SP 166 860	0.60	8
HENMORE BROOK	R Dove confluence to Carsington Reservoir	SK 160 447	SK 244 504	13.53	6
HILTON BROOK	R Dove confluence to Longford	SK 265 274	SK 219 369	13.52	6
HOLLYWELL BROOK	R Blythe confluence to M42 outfall	SP 214 839	SP 199 836	1.75	8
HORTON BROOK	Endon Brook confluence to A53 road bridge	SJ 936 540	SJ 934 541	0.41	6
KINGSHURST BROOK	R Cole confluence to Hatchford Brook confluence	SP 179 874	SP 167 860	1.50	8
KINGSTON BROOK	R Penk confluence to upstream face of A513 road bridge	SJ 946 229	SJ 939 242	1.45	7
LEASOW BROOK	R Tame confluence to Birmingham & Fazeley Canal	SK 189 082	SK 178 077	1.30	8

SCHEDULE OF MAIN RIVERS IN THE UPPER TRENT AREA - (CONTINUED)

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
LONGNOR BROOK	Wheaton Aston Brook confluence to Station Road, Wheaton Aston	SJ 869 141	SJ 855 124	2.05	7
LOW BROOK	Kingshurst Brook confluence to downstream face of railway culvert	SP 172 864	SP 179 846	2.00	8
MARE BROOK	R Tame confluence to upstream face of A38(T) road culvert	SK 174 115	SK 141 096	4.80	8
MARSTON BROOK	Wheaton Aston Brook confluence to Birchmoor Lane	SJ 845 141	SJ 827 143	1.98	7
RIVER MEASE	R Trent confluence to Gilwiskaw Brook confluence	SK 196 147	SK 336 101	25.57	7
MEECE BROOK	R Sow confluence to Swinchurch Brook confluence	SJ 874 282	SJ 823 363	16.94	7
MOAT BROOK	R Penk confluence to 200m above Wood Road, Codsall	SJ 890 037	SJ 859 037	4.30	7
MOTTY MEADOWS BROOK	Wheaton Aston Brook confluence to Wrestlers Wood	SJ 845 141	SJ 825 133	1.60	7
NUNEATON FLOOD RELIEF CHANNEL	R Anker confluence to inlet from the R Anker	SP 365 927	SP 379 917	1.80	8
OTHERTON BROOK	R Penk confluence to railway bridge near Lyne Hill	SJ 922 144	SJ 923 129	1.61	7
RIVER PENK	R Sow confluence to Pendeford Mill Lane bridge	SJ 946 229	SJ 891 036	26.87	7
PICKNALL BROOK	R Dove confluence to confluence 260m downstream of Loxley Lane	SJ 116 319	SK 066 326	6.31	6
RAVENSHAW BROOK	R Blythe confluence to M42 outfall	SP 178 792	SP 173 789	0.80	8
RISING BROOK	R Penk confluence to A449 culvert	SJ 936 212	SJ 920 214	2.60	7
ROLLESTON BROOK	Tutbury Mill Fleam confluence to 200m upstream of Bushton Bridge	SK 242 282	SK 206 262	4.41	6
SAREDON BROOK	R Penk confluence to Golly Brook confluence	SJ 903 075	SJ 972 087	8.35	7
SCOTCH BROOK	R Trent confluence to downstream face of canal culvert	SJ 902 334	SJ 902 337	0.26	7
SENCE BROOK	R Sence confluence to confluence of R Tweed and Stapleton Brook	SP 326 999	SP 409 989	12.47	8
RIVER SENCE	R Anker confluence to B591 at Heather	SP 315 991	SK 394 109	20.33	8
SHADOW BROOK	R Blythe confluence to M42 outfall	SP 216 825	SP 192 809	3.00	8
SKETCHLEY BROOK	Harrow Brook confluence to downstream face of Brookfield Road Bridge	SP 392 916	SP 421 928	3.50	8
RIVER SOW	R Trent confluence to Pershall	SJ 995 226	SJ 818 297	28.83	7
SWAN BROOK	Tipton Brook confluence to downstream face of manhole adjacent Birmingham New Road	SO 963 927	SO 947 918	3.00	8
RIVER TAME	R Trent confluence to Ashes Road, Oldbury and downstream face of James Bridge, Willenhall	SK 192 149	(SO 985 875) (SO 976 987)	87.72	8
TATENHILL BROOK	R Trent confluence to SK 220 203	SK 227 209	SK 220 203	1.00	7
RIVER TEAN	R Dove confluence to footbridge near Noah's Ark Farm	(SK 102 355) (SK 106 344)	SK 062 360	7.80	6
TIPTON BROOK	R Tame confluence to Swan Brook confluence	SO 979 935	SO 963 927	1.90	8
RIVER TRENT	R Dove confluence to footbridge at Stoke-on-Trent	SK 280 261	SJ 901 513	87.00	5 + 7
TUTBURY MILL FLEAM	R Dove confluence to sluice at Dove confluence	SK 249 284	SK 204 294	6.40	6
WHEATON ASTON BROOK	Church Eaton Brook confluence to Motty Meadows Brook confluence	SJ 889 148	SJ 845 141	4.30	7

SCHEDULE OF MAIN RIVERS IN THE UPPER TRENT AREA - (CONTINUED)

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
WITHERLEY BROOK	R Anker confluence to upstream face of Chapel Lane road bridge	SP 323 981	SP 328 976	0.80	8
WYRLEY BROOK	Golly Brook confluence to Charrington Drive	SJ 972 087	SJ 986 078	1.85	7
TOTAL				744.87	

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SCHEDULE OF MAIN RIVERS IN THE LOWER TRENT AREA (CONTINUED)

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
RATCLIFFE-ON-SOAR POWER STATION DRAIN	R Soar confluence to upstream face of railway culvert	SK 491 298	SK 497 296	0.70	4
RATCLIFFE-ON-SOAR VILLAGE DRAIN	R Soar confluence to upstream face of railway culvert	SK 493 289	SK 497 285	1.29	4
REPTON BROOK	R Trent confluence to Lawn Bridge	SK 317 285	SK 313 252	4.50	7
ROTHLEY BROOK	R Soar confluence to the A50	SK 592 132	SK 542 070	11.26	4
RIVER RYTON	R Idle confluence to Bracebridge, Worksop	SK 658 921	SK 585 790	28.96	5
SAUNDBY BECK	R Trent confluence to Laneham IDD boundary	SK 807 881	SK 790 879	1.74	5
RIVER SENCE	R Soar confluence to Great Glen	SP 552 985	SP 656 981	19.31	4
SILEBY BROOK	R Soar confluence to Sileby Village	SK 591 148	SK 602 150	1.00	4
SNOW SEWER	R Trent confluence to Snow Sewer pumping station	SK 813 994	SK 731 986	9.01	5
RIVER SOAR	R Trent confluence to footbridge upstream of Sharnford	SK 494 309	SP 463 909	75.73	4
SODBRIDGE DRAIN	Middle Beck confluence to upstream face of railway culvert	SK 805 508	SK 816 528	2.53	5
SOUTH LEVEL ENGINE DRAIN	Keadby pumping station to Bull Hassocks pumping station	SE 835 113	SE 731 017	17.25	5
SOUTH LEVEL ENGINE SOAK DRAIN	South Idle Drain to north of Aucklands Farm	SE 735 040	SE 738 034	2.00	5
SOUTH SOAK DRAIN	Keadby pumping station to Thorne	SE 835 113	SE 681 132	16.57	5
RIVER TORNE	R Trent confluence to the A60 at Styrrup Carr	SE 836 113	SE 588 906	39.42	5
RIVER TORNE SOAK DRAIN (CANDY FARM)	Ring Drain confluence to Blaxton Banks	SE 704 037	SE 673 028	3.94	5
RIVER TORNE SOAK DRAIN (TUNNEL PITS)	Southern side of Syphon under R Torne into Tunnel Pits pumping station to Wroot Common	SE 735 040	SE 717 040	2.20	5
RIVER TRENT	R Humber confluence to R Dove confluence	SE 863 235	SK 280 261	193.00	5 + 7
TUNNEL PITS SUCTION DRAIN	Tunnel Pits pumping station to North Idle Drain at East Ring Drain	SE 735 040	SE 736 044	0.55	5
TWYFORD BROOK	Queniborough Brook confluence to the Dairy Farm	SK 643 131	SK 736 094	15.89	4
WATERTON DRAIN	Woodhouse Sewer confluence to Diggin Dyke confluence	SE 662 066	SE 662 064	0.21	5
WENSLEY BROOK	R Derwent confluence to upstream face of Oldfield Lane Bridge	SK 270 621	SK 269 619	0.13	6
WHETSTONE BROOK	R Soar confluence to Bottom End Bridge, Countesthorpe	SP 548 974	SP 558 969	1.34	4
WILNE DRAIN	R Derwent outfall to 230m north-east of Beech cottage	SK 452 314	SK 440 307	1.59	6
WOODCARR SUCTION DRAIN	Woodcarr pumping station to junction with Woodcarr Small Drain	SE 753 088	SE 754 088	0.06	5
WOODHOUSE SEWER	Hatfield Waste Drain to Green Lane, Waterton Carr	SE 685 082	SE 660 066	3.22	5
RIVER WREAKE	R Soar confluence to Stapleford Park	SK 596 127	SK 815 187	40.42	4
RIVER WYE	R Derwent confluence to the A6 upstream of Ashford-in-the-Water	SK 260 655	SK 179 698	17.29	6
TOTAL				1,032.40	

SCHEDULE OF MAIN RIVERS IN THE LOWER TRENT AREA - JANUARY 1990

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
ALFRETON BROOK	R Amber confluence to Fordbridge Lane	SK 387 564	SK 440 577	6.84	6
RIVER AMBER	R Derwent confluence to Ogston Reservoir	SK 347 515	SK 380 598	16.03	6
BAR BROOK	R Derwent confluence to tributary confluence 60m upstream of Derwent Valley Aqueduct, near Baslow	SK 256 712	SK 262 725	1.77	6
BARROW DRAIN	Main Drain confluence to SK 350 302	SK 368 303	SK 350 302	1.80	6
BENTLEY BROOK	R Derwent confluence to stilling pond south of Lumsdale	SK 300 598	SK 312 605	1.78	6
RIVER BIAM	Downstream confluence with R Soar to upstream confluence with R Soar	SK 579 028	SK 577 024	0.48	4
BLACK BROOK	R Soar confluence to Grace Dieu Brook	SK 521 220	SK 487 209	5.15	4
BOTTESFORD BECK	R Trent confluence to Emanuel Bridge	SE 837 061	SE 925 084	9.98	5
BOTTLE BROOK	R Derwent confluence to Smithy Houses (North) & Bottlebrook Houses (South)	SK 359 407	(SK 386 471) (SK 389 460)	9.00	6
BROUGHTON ASTLEY BROOK	R Soar confluence to surface water outlet from Harborough DC housing development	SP 520 963	SP 528 923	5.00	4
BURTON BROOK	R Sence confluence to Burton Overy	SP 654 974	SP 675 980	2.41	4
CANDY FARM SUCTION DRAIN	Candy Farm pumping station to Hatfield Chase IDB Boundary	SE 698 031	SE 698 037	0.60	5
CASTLE DONINGTON BROOK	R Trent confluence to outfall of surface water sewer	SK 455 300	(SK 449 284) (SK 448 277)	3.33	7
CHADDESDEN BROOK	R Derwent confluence to Lees Brook confluence	SK 375 358	SK 384 372	1.83	6
COSBY BROOK	R Soar confluence to Cambridge Road, Cosby	SP 536 970	SP 547 952	3.22	4
CUTTLE BROOK	R Trent confluence to Sinfin Moor	SK 377 281	SK 370 302	2.41	6
RIVER DERWENT	R Trent confluence to outfall from Ladybower Reservoir	SK 459 308	SK 199 853	88.78	6
RIVER DEVON	R Trent confluence to Knipton reservoir	SK 790 533	SK 818 309	32.94	5
DIGGIN DYKE	Waterton Drain confluence to balancing area	SE 662 064	SE 657 050	2.03	5
DOVER BECK	R Trent confluence to Lowdham Mill (downstream limit of control structures)	SK 695 451	(SK 666 474) (SK 666 473)	5.20	5
RIVER EAU	R Trent confluence to Dunstall Beck	SE 837 033	SK 891 940	16.41	5
RIVER ECCLESBOURNE	R Derwent confluence to weir upstream of Windley Bridge	SK 350 432	SK 319 447	5.28	6
EGGINTON BROOK	R Trent confluence to Radbourne Brook, Etwall	SK 285 269	SK 264 336	9.36	6
EMINSONS DYKE	R Eau confluence to Messingham Catchwater Drain confluence	SE 879 026	SE 884 027	0.50	5
RIVER EREWASH	R Trent confluence to downstream face of B6018 road bridge, Kirkby-in-Ashfield	SK 514 330	SK 485 548	39.66	5
FAIRHAM BROOK	R Trent confluence to surface water outfall from new development on left bank	SK 560 366	SK 556 328	4.60	5
FOSSE DYKE	R Trent confluence to Torksey road bridge	SK 834 781	SK 838 781	0.32	5
GRASSTHORPE BECK	R Trent confluence to downstream end of control structure at Grassthorpe Mill	SK 816 673	SK 792 676	3.12	5
GREAT CATCHWATER DRAIN	Ravensfleet pumping station to the A159 at Wharton	SK 800 960	SK 839 934	6.40	5
RIVER GREET	R Trent confluence to outfall at Lower Kirklington Road, Southwell	SK 743 515	SK 705 547	6.80	5
GREYTHORNE DYKE	R Trent confluence to upstream of Wilford Road	SK 575 375	SK 572 368	0.81	5
MALLOUGHTON DUMBLE DRAIN	Marlock Dyke confluence to Southwell reclamation works	SK 737 523	SK 726 526	1.37	5

SCHEDULE OF MAIN RIVERS IN THE LOWER TRENT AREA – (CONTINUED)

WATERCOURSE	LOCATION	FROM NGR	TO NGR	LENGTH (KM)	CATCHMENT NO
HARWORTH DYKE	R Torne confluence to major surface water outfall from Harworth	SK 606 926	SK 614 916	1.50	5
HATFIELD WASTE DRAIN	Keadby pumping station to Woodhouse Sewer, Hatfield Woodhouse	SE 835 113	SE 685 082	17.70	5
HERMITAGE BROOK	R Soar confluence to railway and Moor Lane	SE 544 215	(SK 553 196) (SK 551 194)	3.30	4
RIVER IDLE	R Trent confluence to Twyford Bridge, Gamston	SK 790 947	SK 699 752	48.75	5
KILBY BROOK	R Sence confluence to downstream face of Kilby Road culvert	SP 616 963	SP 618 955	1.00	4
LANEHAM BECK	R Trent confluence to Askham Drain	SK 815 770	SK 774 740	5.60	5
LEAS BROOK	R Meden confluence to surface water outfall at Mansfield Woodhouse	SK 555 672	SK 547 642	3.60	5
RIVER LEEN	R Trent confluence to Linby Mill, Papplewick	SK 566 381	SK 546 510	17.52	5
LEES BROOK	Chaddesden Brook confluence to minor watercourse confluence	SK 384 372	SK 387 373	0.35	6
LOW BANK SUCTION) DRAIN/ANCHOR DRAIN)	Low Bank pumping station to the M180	SE 739 086	SE 729 090	1.06	5
LUBBESTHORPE BROOK	R Soar confluence to downstream face of Meridian Park culvert	SK 564 007	SK 552 008	1.43	4
MAIN DRAIN	Osmaston Drain confluence to outfall from balancing pond, Sinfin Moor	SJ 370 302	SK 348 309	2.30	6
MARLOCK DYKE	R Greet confluence to Halloughton Dumble Drain confluence	SK 741 518	SK 737 523	0.76	5
RIVER MAUN	R Idle confluence to King's Mill reservoir	SK 701 754	SK 519 597	32.61	5
MEADOW DRAIN	Osmaston Drain confluence to southern boundary of golf course, Sinfin	SK 363 312	SK 356 315	0.95	6
RIVER MEDEN	R Maun confluence to Newbound Mill Bridge, Pleasley	SK 703 751	SK 496 633	29.50	5
MESSINGHAM CATCHWATER DRAIN	Bottesford Beck confluence to the Messingham IDD boundary	SE 878 060	SE 884 027	3.50	5
MIDDLE BECK	R Devon confluence to upstream face of railway culvert	SK 785 514	SK 805 508	2.27	5
MILTON BROOK	R Trent confluence to overspill weir at Foremark reservoir	SK 340 273	SK 329 245	4.80	7
NETHERGATE BROOK	Fairham Brook confluence to downstream face of A453 culvert	SK 564 345	SK 548 348	1.70	5
NORTH ENGINE DRAIN	Keadby pumping station to Dirtness pumping station	SE 835 113	SE 747 096	9.01	5
NORTH SOAK DRAIN	Keadby pumping station to Wike Well Bridge, Thorne	SE 835 113	SE 696 121	13.68	5
OCK BROOK	R Derwent confluence to upstream face of Hawthorn Avenue bridge, Borrowash	SK 420 338	SK 422 349	1.44	6
OLDCOATES DYKE	R Ryton confluence to the A60 at Oldcoates	SK 630 872	(SK 588 885) (SK 588 884)	5.79	5
OSMASTON DRAIN	Cuttle brook confluence to culvert under disused railway line	SK 370 302	SK 364 316	1.66	6
OUSE DYKE	R Trent confluence to downstream end of Netherfield railway culvert	SK 648 420	SK 629 411	3.50	5
RIVER POULTER	R Idle confluence to weir upstream of the A614	SK 699 752	SK 646 754	7.24	5
QUENIBOROUGH BROOK	R Wreake confluence to St Mary's Church Bridge	SK 628 133	SK 653 120	3.56	4

SUMMARY OF MAIN RIVER - JANUARY 1990

AREA	LENGTH (KM)
Upper Severn	960.83
Lower Severn	834.93
Upper Trent	744.87
Lower Trent	1,032.40
TOTAL	3,573.03

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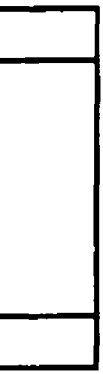

APPENDIX A3

CONSERVATION SITES

SSSI - Site of Special Scientific Interest
NNR - National Nature Reserve
LNR - Local Nature Reserve
CTR - County Trust Reserve

CONSERVATION SITES IN THE UPPER SEVERN CATCHMENT, SHROPSHIRE AND POWYS AT APRIL 1990

SITE NAME	STATUS	NATIONAL GRID REFERENCE	DESCRIPTION
Allscott Settling Ponds	SSSI	SJ 598 128	An important feeding ground for birds.
Alveley Grindstone Quarry	SSSI	SO 758 848	Geological interest.
Aqualate Mere	SSSI	SJ 770 205	Woodland and marshland, important for wildfowl and a heronry.
Berrington Pool	SSSI	SJ 525 072	A deep mere containing a rich aquatic flora.
Berwyn	SSSI	SJ 125 418	Nationally important site for vegetation and upland birds. RSPB reserve.
Besom Farm Quarry	SSSI	SO 607 819	Important geological site.
Betton Dingle & Gulley Green	SSSI/CTR	SJ 316 017	Example of ash/elm woodland and unimproved grassland.
Blodwell Marsh	SSSI	SJ 264 234	A small exceptionally rich area of fen pasture.
Bomere, Shomere and Betton Pools	SSSI	SJ 504 078	Eutrophic meres and a small drained bog surrounded by woodland.
Breidden Hill	SSSI	SJ 294 145	A site of geological interest, noted for some rare plant species.
Bron-y-Buckley Wood	SSSI	SJ 221 080	An important geological site of fossiliferous interest.
Brownheath Moss	SSSI	SJ 460 300	Area of peatland with uncommon plant species.
Brown Moss	SSSI	SJ 562 395	Dry heathland important for its rich flora.
Buildwas River Section	SSSI	SJ 640 045	Nationally important geological site.
Burnt Wood	SSSI/CTR	SJ 735 350	Entomological interest.
Bush Wood and High Wood	SSSI	SO 708 825	Woodland with ornithological interest.
Buttington Brickworks	SSSI	SJ 266 101	Site of geological importance.
Catherton Common	SSSI	SO 635 785	Dry heath with areas of wet heath and valley mires.
Chorley Covert and Deserts Wood	SSSI	SO 705 840	Woodland important for butterflies.
Clarepool Moss	NNR/SSSI	SJ 433 342	An undisturbed wetland site of exceptional interest.
Claverley Road Cutting	SSSI	SO 794 939	Geological interest.
Coed Byrwydd	SSSI	SJ 162 042	Woodland.
Coed Craig-Iar	SSSI	SN 991 798	Woodland.
Coed Hafod-Fraith	SSSI	SO 007 814	Good example of sessile oak woodland.
Coed Mawr	SSSI	SN 944 811	Wet woodland.
Coed Pentre	SSSI	SO 285 917	Woodland with diverse flora.
Coed Ty-Mawr	SSSI	SJ 130 099	Good example of mixed deciduous woodland.
Coed Y Allt	SSSI	SJ 127 211	Mixed deciduous woodland.
Coedydd Lawr-Y-Glyn	SSSI	SN 918 913	Sessile oak woodland.
Coedydd Y Beili, Malgwyn A Cribin	SSSI	SN 900 839	Outstanding example of sessile oak woodland.
Coed Y Lawnt A Coed Oli	SSSI	SJ 047 131	Good example of wet hillside.
Cole Mere	SSSI	SJ 433 332	Large mere with diverse aquatic invertebrate fauna.
Comley Quarry	SSSI/CTR	SO 484 962	Important geological site.
Cornbrook Dingle	SSSI	SO 602 757	Geological interest.
Cors Lawnt	SSSI	SJ 047 122	Site of rich and diverse flora.
Cors Llanllugan	SSSI	SJ 063 030	Excellent example of undisturbed basin mire.

SITE NAME	STATUS	NATIONAL GRID REFERENCE	DESCRIPTION
Cors Llyn Coethlyn	SSSI	SJ 023 148	A valley mire system.
Cors Ty-Gwyn	SSSI	SJ 103 111	Good example of a basin mire system.
Coston Farm Quarries	SSSI	SO 391 804	Geological interest.
Coundmoor Brook	SSSI	SJ 558 037	A nationally important geological site.
Craig Sychtyn	SSSI	SJ 232 258	A carboniferous limestone crag with a rich flora.
Crofts Mill Pasture	SSSI	SJ 305 246	A particularly rich example of damp peaty pasture, noted for uncommon species.
Cuckoopen Coppice	SSSI	SO 538 800	Mixed woodland of botanical and geological interest.
Derrington Meadow	SSSI	SO 608 908	Unimproved, traditionally managed hayfield.
Devils Hole	SSSI	SO 672 929	Geological interest.
Earls Hill and Habberley Valley	SSSI	SJ 411 048	Important geological and botanical site.
Eaton Track	SSSI	SO 501 900	Geological interest.
Edge Wood	SSSI	SJ 615 010	Woodland of botanical interest.
Farley Dingle	SSSI	SJ 637 026	Important geological site.
Fenmere	SSSI	SJ 445 228	Eutrophic mere rich in plant and invertebrate animal species.
Fenn's, Whixall & Bettisfield Mosses	SSSI	SJ 490 365	Extensive raised bog.
Fernhill Pastures	SSSI	SJ 321 328	A site of botanical interest.
Flat Coppice	SSSI	SO 394 868	Woodland.
Granham's Moor Quarry	SSSI	SJ 390 037	Important geological site.
Great Wood	SSSI	SO 082 976	An excellent example of a wood-pasture with a rich lichen flora.
Grinshill Quarries	SSSI	SJ 525 238	Site yielding excellent fossils.
Gungrog Flash	SSSI	SJ 234 084	Fine example of a transitional fen community.
Gwaun Cilgwyn	SSSI	SN 950 796	Site of unimproved upland acid pasture.
Gwaun Cwm Cownwy	SSSI	SH 992 182	An area of damp unimproved pasture of botanical interest.
Gwaun Llechwedd-Newydd	SSSI	SH 960 127	Interesting example of semi-natural grassland.
Gwern-y-Brain Dingle	SSSI	SJ 218 127	A highly fossiliferous site.
Gweunydd Dyfnant	SSSI	SH 998 157	Unimproved acid pasture.
Gweunydd Penstrowed	SSSI	SO 067 906	Botanical interest.
Gweunydd Pen-Y-Coed	SSSI	SH 976 142	Species rich unimproved acid wet pasture.
Hencott Pool	SSSI	SJ 490 160	A site of botanical interest.
Hillend Quarry	SSSI	SO 396 876	Geological interest.
Hillington Pasture	SSSI	SO 318 971	An area of damp unimproved acid pasture.
Hodnet Heath	SSSI	SJ 620 262	Small remnant of N. Shropshire heathland.
Hope Bowdler Outcrops	SSSI	SO 475 925	An important geological site.
Hope Valley	SSSI	SJ 342 015	An important geological site with rich flora.
Hughley Brook	SSSI	SO 566 984	Important geological site.
Lin Can Moss	SSSI	SJ 375 211	A small quaking bog.

SITE NAME	STATUS	NATIONAL GRID REFERENCE	DESCRIPTION
Lincoln Hill	SSSI	SJ 669 038	Site yielding excellent fossils.
Llanymynech and Llynclys Hills	SSSI/CTR	SJ 267 227	A site of varied habitats, all rich in flora.
Long Mynd	NNR/SSSI	SO 420 950	Dry moorland site of botanical, hydrobiological and ornithological interest.
Longville to Stanway Road Section	SSSI	SO 539 927	Important geological site.
Lower Garth Meadows	SSSI	SJ 217 103	Unimproved, herb-rich grassland.
Loynton Moss	SSSI/CTR	SJ 788 244	Interesting flora and rare fauna. Also important for birds.
Lydebrook Dingle	SSSI	SJ 661 060	An ancient woodland site.
Lyn Mawr	SSSI/CTR	SO 008 971	Oligotrophic upland lake.
Maer Pool	SSSI	SJ 789 384	A valuable ornithological habitat.
Marsh Wood Quarry	SSSI	SO 444 890	Important geological site.
Marton Pool, Chirbury	SSSI	SJ 296 027	An interesting site for birds.
Mawnog Gwaunynog	SSSI	SJ 075 113	Carr woodland developed on deep peat.
Meadowtown Quarry	SSSI	SJ 311 012	Geological interest.
Mochdre Dingles	SSSI	SO 080 878	Outstanding example of mixed deciduous woodland in Montgomery.
Moel Y Golfa	SSSI	SJ 290 122	Large area of semi-natural woodland noted for flora and fauna.
Montgomery Canal Aston Locks	SSSI	SJ 328 257	Variety of aquatic flora.
Montgomery Canal (Guilsfield Arm)	SSSI	SO 169 967	A canal containing exceptionally rich and varied aquatic flora.
Morton Pool and Pasture	SSSI	SJ 301 239	An area exceptionally rich in flowering plants.
Muxton Marsh	SSSI	SJ 716 134	Site forms part of a complex of habitats.
New Hadley Brickpit	SSSI	SJ 682 117	Geological interest.
Newport Canal	SSSI	SJ 734 192	A disused canal with exceptional aquatic flora.
Oak Dingle	SSSI	SO 565 871	Geological interest.
Old River Bed, Shrewsbury	SSSI	SJ 497 148	A site of botanical interest.
Onny River Section	SSSI	SO 425 854	A site of geological interest.
Pen-Dugwm Woods	SSSI/CTR	SJ 107 140	Oak wood set in valley of geological interest.
Pennerley Meadows	SSSI	SO 357 991	Unimproved grassland site.
Penstrowed Quarry	SSSI	SO 068 910	Site of geological importance.
Prescott Corner	SSSI	SO 663 811	Geological interest.
Press Branch Canal	SSSI/CTR	SJ 497 337	Disused canal with rich fauna and flora.
Pumlumon (Plynlimon)	SSSI/CTR	SN 790 870	Upland area important for vegetation and bird fauna.
Redwith Canal	SSSI	SJ 304 247	A disused stretch of canal, unusually rich in plant and invertebrate animal species.
Roundton Hill	SSSI	SO 294 949	Important grass heath habitat.
Ruewood Pastures	SSSI	SJ 496 280	Low-lying damp pasture of botanical interest.
Sheinton Brook	SSSI	SJ 607 040	Important fossiliferous site.
Shelve Church Section	SSSI	SO 337 990	Important fossiliferous site.
Shelve Pool	SSSI	SO 335 979	A man-made pool showing varied vegetation zones.
Shrawardine Pool	SSSI	SJ 398 162	A shallow mere of botanical interest.
Soudley Quarry	SSSI	SO 477 918	Geological interest.

SITE NAME	STATUS	NATIONAL GRID REFERENCE	DESCRIPTION
Spywood and Aldress Dingle	SSSI	SO 279 959	Sites of physiographic and geological interest and some floral rarities.
Sweat Mere and Crose Mere	SSSI	SJ 434 304	Two important eutrophic meres.
Sweeney Fen	SSSI/CTR	SJ 275 250	An area of base-rich marsh and fen.
Thatchers Wood and Westwood Covert	SSSI	SO 703 904	Woodland of botanical interest.
The Lump, Priestweston	SSSI	SO 291 982	Grassland with an exceptionally rich flora.
The Stiperstones and the Hollies	SSSI/NNR	SJ 370 000	Site of geological and botanical interest.
The Wrekin and the Ercall	SSSI	SJ 630 082	An area of rough grassland, heath and woodlands.
Tick Wood and Benthall Edge	SSSI	SJ 650 030	A site of geological interest noted for its rich woodland.
Titterstone Clee	SSSI	SO 595 780	Site of geological and botanical interest.
Trefonen Marshes	SSSI	SJ 246 265	A series of base-rich marshes containing an exceptionally rich flora.
Trewern Brook	SSSI	SJ 304 116	Geological interest.
Tyrley Canal Cutting	SSSI	SO 697 307	Geological interest.
Upper Millichope Stream Section	SSSI	SO 519 897	Geological interest.
View Edge Quarries	SSSI	SO 426 807	Geological interest.
Wem Moss	SSSI/CTR	SJ 473 343	A relatively undisturbed bog with rich flora and notable entomological interest.
Wenlock Edge	SSSI	SO 610 003	Interesting geological site.
White Mere	SSSI	SJ 414 330	A mere rich in flora and fauna.
Whitewell Coppice	SSSI	SJ 620 020	Outstanding woodland with important geological exposures.
Whixall Moss and Fenns Moss	SSSI	SJ 493 370	A bog with rich flora and insect fauna and of educational value.
Wyre Forest	SSSI/NNR/CTR	SO 730 760	Site regarded as one of the most important woodland areas in Britain.

APPENDIX A4

CODING SYSTEM

CODING SYSTEM

	x	xx	xxx	xx
	CATCHMENT	COUNTY	DISTRICT	NUMBER
eg	6	98	510	23
	Derwent	Derbyshire	High Peak	Problem No.

CATCHMENT	Code
UPPER SEVERN	1
LOWER SEVERN	2
AVON	3
SOAR	4
LOWER TRENT	5
DERWENT	6
UPPER TRENT	7
TAME	8

County/District Councils	County Code	District Code
AVON COUNTY COUNCIL		
Bristol	82	310
Northavon	82	410
SHROPSHIRE COUNTY COUNCIL		
Bridgnorth	83	110
North Shropshire	83	210
Oswestry	83	310
South Shropshire	83	410
Shrewsbury and Atcham	83	510
Telford Development Corporation	83	610
Wrekin	83	710
CLWYD COUNTY COUNCIL		
Glyndwr	84	110
Wrexham Maelor	84	210
GWYNEDD COUNTY COUNCIL		
Meirionnydd	85	110
POWYS COUNTY COUNCIL		
Mid Wales Development Corporation	86	110
Montgomery	86	210
Radnor	86	310

HEREFORD AND WORCESTER COUNTY COUNCIL		
Leominster	87	110
Bromsgrove	87	210
Malvern Hills	87	310
Redditch	87	410
Redditch Development Corporation	87	510
South Herefordshire	87	610
Worcester	87	710
Wychavon	87	810
Wyre Forest	87	910
GLOUCESTERSHIRE COUNTY COUNCIL		
Cheltenham	88	110
Forest of Dean	88	210
Gloucester	88	310
Stroud	88	410
Tewkesbury	88	510
Cotswold	88	610
OXFORDSHIRE COUNTY COUNCIL		
Cherwell	89	110
NORTHAMPTONSHIRE COUNTY COUNCIL		
Daventry	90	110
WARWICKSHIRE COUNTY COUNCIL		
Nuneaton & Bedworth	91	110
Rugby	91	210
Stratford-upon-Avon	91	310
Warwick	91	410
North Warwickshire	91	510
WEST MIDLANDS		
Coventry	92	110
Birmingham	92	210
Dudley	92	310
Sandwell	92	410
Solihull	92	510
Walsall	92	610
Wolverhampton	92	710
LEICESTERSHIRE COUNTY COUNCIL		
Blaby	93	110
Hinckley and Bosworth	93	210
Charnwood	93	310
Harborough	93	410
Leicester	93	510
Melton	93	610
North West Leicestershire	93	710
Oadby and Wigston	93	810
Rutland	93	910

NOTTINGHAMSHIRE COUNTY COUNCIL		
Ashfield	94	110
Bassetlaw	94	210
Broxtowe	94	310
Gedling	94	410
Mansfield	94	510
Newark and Sherwood	94	610
Nottingham	94	710
Rushcliffe	94	810
LINCOLNSHIRE COUNTY COUNCIL		
North Kesteven	95	110
South Kesteven	95	210
West Lindsey	95	310
HUMBERSIDE COUNTY COUNCIL		
Boothferry	96	110
Glanford	96	210
Scunthorpe	96	310
SOUTH YORKSHIRE		
Doncaster	97	110
Rotherham	97	210
Sheffield	97	310
DERBYSHIRE COUNTY COUNCIL		
Bolsover	98	110
Erewash	98	210
Amber Valley	98	310
Derby	98	410
High Peak	98	510
North East Derbyshire	98	610
Derbyshire Dales	98	710
South Derbyshire	98	810
Chesterfield	98	910
STAFFORDSHIRE COUNTY COUNCIL		
Staffordshire Moorlands	99	110
Cannock Chase	99	210
East Staffordshire	99	310
Lichfield	99	410
Newcastle under Lyme	99	510
South Staffordshire	99	610
Stafford	99	710
Stoke on Trent	99	810
Tamworth	99	910

APPENDIX A5

SOURCES OF FINANCE

1 Levy on County Councils, Metropolitan District Councils and Internal Drainage Boards

The Authority's flood defence and land drainage revenue income derives in the main from contributions from County Councils, Metropolitan District Councils and Internal Drainage Boards collected by a regional levy. The total amount required to be collected is apportioned between the Councils on the basis of relevant population (for Community Charge purposes) after taking into account the amounts to be raised from Internal Drainage Boards. The amount paid by Councils for flood defence levies is reimbursed in full by the Department of the Environment the following year through the revenue support grant for local authorities. Internal Drainage Boards' contributions to the National Rivers Authority expenditure are assessed on the basis of the benefit which the Boards derive as a result of the Authority's operations.

2 Loans

The Authority's flood defence capital expenditure is self-financed and loans will be sought in exceptional circumstances only, to deal with unforeseen emergencies.

3 General and Special Drainage Charges

General drainage charges are a means by which revenue, to meet land drainage expenditure, can be raised on agricultural land which lies outside Internal Drainage Districts. The Land Drainage Act (as amended by the Water Act 1989) prescribes a procedure designed to secure that the amount of the charge shall be as near as practicable equivalent to what would be paid in respect of the chargeable land if the land were rated.

Special drainage charges can be levied on specified areas outside Internal Drainage Districts where it appears to the Authority that drainage works on any watercourses in that area should be carried out in the interests of agriculture.

Because of the limits which are statutorily imposed, General and Special charges would provide only a small addition to current income. The Authority has, therefore, decided that, in view of the high adminstrative costs, such charges would not be justified at present.

4 Grant Aid to the National Rivers Authority

(a) Section 90 of the Land Drainage Act 1976 (as amended by the Water Act 1989) enables grants to be paid by the Ministry of Agriculture, Fisheries and Food in respect of approved land drainage schemes for the improvement of existing works or the construction of new works. In the Severn-Trent Region grant is currently paid at 15% of qualifying expenditure. A supplement of 20% may also be payable for tidal defence schemes.

(b) Grants are available under Section 92 of the Land Drainage Act 1976 (as amended by the Water Act 1989) for providing apparatus for carrying out engineering operations for the installation of flood warning systems.

5 Grant Aid to Local Authorities and Internal Drainage Boards

By virtue of Section 91, Land Drainage Act 1976 (as amended by the Water Act 1989) grants are payable by the Ministry of Agriculture, Fisheries and Food to Internal Drainage Boards and County, Metropolitan and District Councils in respect of expenditure incurred on drainage schemes carried out under Sections 17, 22, 98, 99

and 100 of the Land Drainage Act 1976 (as amended by the Water Act 1989). Such grants are available in respect of expenditure on approved land drainage schemes for the improvement of existing works and for the construction of new works, and, in the case of Internal Drainage Boards, on works (other than routine maintenance) on the rebuilding or repair of any bridge maintained by a Board.

The Authority must be consulted, as required by Section 98(8) of the Land Drainage Act 1976 (as amended by the Water Act 1989), before such schemes are submitted to the Ministry.

Grant aid is currently payable up to a maximum of 26% of the cost of the scheme for Internal Drainage Boards and Local Authorities. A supplement of 20% may also be payable for tidal defence schemes.

6 European Regional Development Fund

Certain areas within the region, principally the West Midlands, have been designated as intermediate areas and schemes which are designed to serve those areas by the provision of infrastructure for industry/commerce may be eligible for grant aid from the European Regional Development Fund.

APPENDIX A6

CONSERVATION

1 **CONSERVATION DUTIES UNDER THE WATER ACT 1989**

The following excerpts from the Water Act 1989 define the NRA's statutory conservation duties, as relating to flood defence/land drainage operations.

8. (1) It shall be the duty of each of the following, that is to say, the Secretary of State, the Minister, the Director and every relevant body, in formulating or considering any proposals relating to the functions of any relevant body or, as the case may be, that body:-

a) so far as may be consistent with the purposes of any enactment relating to the functions of that body and, in the case of the Secretary of State and the Director, with their duties under section 7 above, so to exercise any power conferred on him or it with respect to the proposals as to further the conservation and enhancement of natural beauty and the conservation of flora, fauna and geological and physiographical features of special interest;

b) to have regard to the desirability of protecting and conserving buildings, sites and objects of archaeological, architectural or historic interest; and

c) to take into account any effect which the proposals would have on the beauty or amenity of any rural or urban area or on any such flora, fauna, features, buildings, sites or objects.

(2) Subject to subsection (1) above, it shall be the duty of each of the following, that is to say, the Secretary of State, the Minister, the Director and every relevant body, in formulating or considering any proposals relating to the functions of a relevant body or, as the case may be, that body:-

a) to have regard to the desirability of preserving for the public any freedom of access to areas of woodland, mountains, moor, heath, down, cliff or foreshore and other places of natural beauty;

b) to have regard to the desirability of maintaining the availability to the public of any facility for visiting or inspecting any building, site or object of archaeological, architectural or historic interest; and

c) to take into account any effect which the proposals would have on any such freedom of access or on the availability of any such facility.

9. (1) Where the Nature Conservancy Council are of the opinion that any area of land:-

a) is of special interest by reason of its flora, fauna or geological or physiographical features; and

b) may at any time be affected by schemes, works, operations or activities of a relevant body or by an authorisation given by the Authority,

the Council shall notify the fact that the land is of special interest for that reason to every relevant body whose works, operations or activities may affect the land or, as the case may be, to the Authority.

(2) Where a National Park authority or the Broads Authority is of the opinion that any area of land in a National Park or in the Broads:-

a) is land in relation to which the matters for the purposes of which section 8 above has effect are of particular importance; and

b) may at any time be affected by schemes, works, operations or activities of a relevant body or by an authorisation given by the Authority, the National Park authority or Broads Authority shall notify the fact that land is such land, and the reasons why those matters are of particular importance in relation to the land, to every relevant body whose works, operations or activities may affect the land or, as the case may be, to the Authority.

(3) Where a relevant body has received a notification under subsection (1) or (2) above with respect to any land, that body shall consult the notifying body before carrying out, or (in the case of the Authority) carrying out or authorising, any works, operations or activities which appear to that relevant body to be likely:-

a) to destroy or damage any of the flora, fauna, or geological or physiographical features by reason of which the land is of special interest; or

b) significantly to prejudice anything the importance of which is one of the reasons why the matters mentioned in subsection (2) above are of particular importance in relation to that land.

(4) Subsection (3) above shall not apply in relation to anything done in an emergency where particulars of what is done and of the emergency are notified to the Nature Conservancy Council, the National Park authority in question or, as the case may be, the Broads Authority as soon as practicable after that thing is done.

2 RELEVANT FUNCTIONS OF THE NATURE CONSERVANCY COUNCIL

1 The Nature Conservancy Council was established by the Nature Conservancy Council Act 1973 for the purposes of nature conservation and fostering the understanding thereof. The major functions prescribed by the Act are:-

i) the establishment, maintenance and management of nature reserves in Great Britain;

ii) the provision of advice to Ministers on the development and implementation of policies for or affecting nature conservation in Great Britain;

iii) the provision of advice and dissemination of knowledge about nature conservation;

iv) the commissioning or support of relevant research.

2 The NCC also inherited a number of powers and duties formerly exercised by the Nature Conservancy among which are:-

i) a duty to notify land of special interest (SSSIs) to local planning authorities (Section 23 of the National Park and Access to the Countryside Act 1949 now superseded by Section 28 of the Wildlife and Countryside Act 1981 - see below);

ii) power to enter into agreements to conserve SSSIs (Section 15 of the Countryside Act 1968);

iii) powers of entry for survey in connection with acquisition of land (Section 108 of the 1949 Act).

3 The Town and Country Planning General Development Order 1977 obliges local planning authorities to consult the NCC before granting planning permission for development in an SSSI.

4 The Wildlife and Countryside Act 1981 placed a number of additional duties on the NCC, some of which replace similar duties in earlier legislation, including:

i) duty to notify internal drainage boards and the NRA of land of special interest and to advise those bodies when consulted on their proposals affecting such sites. (Section 48);

ii) duty to notify land of special interest (SSSIs) not only to local planning authorities but also to every owner or occupier and to the Secretary of State, specifying the nature of the scientific interest and any operations likely to damage the interest (Section 28);

iii) duty to offer a management agreement where the NCC has objected to a farm capital grant and it is subsequently refused by agriculture ministers on nature conservation grounds (Section 32).

3 RELEVANT FUNCTIONS OF COUNTRYSIDE COMMISSION

1 Under Section 2 of the Countryside Act 1968, the Countryside Commission has the statutory duty of keeping under review all matters relating to the provision and improvement of facilities for the enjoyment of the countryside, the conservation and enhancement of the natural beauty and amenity of the countryside, and the need to secure public access to the countryside for the purposes of open-air recreation. It is required to consult with such local planning authorities and other bodies as appear to the Commission to have an interest in those matters, and to encourage, assist, concert or promote the implementation of any proposals with respect to those matters made by any person or body, being proposals which the Commission consider to be suitable. The Commission is also required to advise any Minister having functions under the Countryside Act 1968, or any other Minister or any public body, on such matters relating to the countryside as he or they may refer to the Commission, or as the Commission may think fit.

2 Under Section 9 of the Local Government Act, 1974, the Commission, in accordance with arrangements approved by the Secretary of State and the Treasury, may give financial assistance by way of grant or loan, to any person in respect of expenditure incurred by him in doing anything which, in the opinion of the Commission, is conducive to the attainment of any of the purposes of the Countryside Act 1968 or the National Parks and Access to the Countryside Act 1949.

NRA

National Rivers Authority
Severn-Trent Region