

Hydrological Summary for Great Britain

APRIL 1993

Rainfall

April was generally a warm but dull month with very unsettled weather conditions characterising the first fortnight; the 13 days ending on the 11th produced the equivalent of twice the average April rainfall in some lowland districts. The provisional rainfall total for Great Britain was around 160% of the April average; spatial variability was considerable but northern Scotland was the only region to register below average rainfall. Following two largely dry months the April rainfall returned the 1993 regional totals to within or slightly above the normal range although appreciable deficiencies can be recognised in parts of Wales, the South West and central England. On a regional basis rainfall over the last twelve months is also close to the average. Although modest compared with those registered in early 1992, long term rainfall deficiencies remain in eastern England whilst in western Scotland positive anomalies continue to build - accumulated precipitation totals are remarkably high over the post-1987 period.

River flows

Heavy early April rainfall eliminated the modest soil moisture deficits and generated a brisk recovery in runoff rates. However, by month-end recessions were again well established. April runoff totals were substantially above those for March - typically by a factor of two or three - and were well within the normal range in the great majority of catchments. There were, however, some notable exceptions. In northern Britain, the Tay, Earn and Eden were amongst those rivers which established new April maximum mean flows. Existing April maxima were also eclipsed in a few southern rivers draining impervious catchments e.g. the River Lymington in Hampshire. Conversely, flow rates were very depressed over the latter half of the month in the Shropshire Plain and parts of Cambridgeshire, Norfolk and Suffolk. In the English lowlands, April runoff was mostly below average but generally still the highest since 1989 and, commonly, twice that of April

1992. For the year thus far, runoff totals are mostly unexceptional and in the 12-month time-frame runoff exceeds 80% of average in almost all index catchments. Very long term deficiencies remain high in much of central, eastern and southern England.

Groundwater

In most aquifers the steep decline in water-tables in the early spring was moderated, or reversed, following significant recharge early in the month. With smds now appreciable throughout the lowlands, little or no further recharge may be expected to the major aquifers before the autumn. In the Chalk, the summer recessions are now well underway but, generally, they have commenced from the highest level for four years and late-April levels were well within the normal range albeit often below average. Levels in the Permo-Triassic sandstones show considerable spatial variability but water-tables remain depressed in a zone from North Wales to the lower Trent - especially where levels are significantly influenced by groundwater pumping. The need to generate water-table rises from last year's extremely low base implies that the post-drought recovery (in groundwater terms) will be protracted and, as is already evident, uneven. Nonetheless, the margin by which the April 1993 levels in the Chalk exceeded those of the spring of 1992 is very encouraging.

General

The very dry late winter/early spring threatened to precipitate a further drought episode in 1993. However, the abundant April rainfall provided a valuable boost to resources at a crucial time. Reservoir contents increased in almost all regions with a particularly notable improvement in north-eastern England. Overall, the hydrological and resources outlook is very much healthier than in the spring of 1992. Only localised difficulties are anticipated unless there is a repetition of the exceptionally dry and warm conditions experienced in the summers of 1989 and 1990.



Institute of
Hydrology

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British
Geological
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Data for this report have been provided principally by the regional divisions of the National Rivers Authority in England and Wales, the River Purification Boards in Scotland and by the Meteorological Office. Reservoir contents information has been supplied by the Water Services Companies, the NRA or, in Scotland, the Lothians Regional Council. The most recent areal rainfall figures are derived from a restricted network of raingauges (particularly in Scotland) and a proportion of the river flow data is of a provisional nature.

A map (Figure 3) is provided to assist in the location of the principal monitoring sites.

13 May 1993

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TABLE 1 1992/93 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Jan 1993	Feb	Mar	Apr
England and Wales	mm	73	49	38	83	129	92	90	135	75	98	18	27	96
	%	126	73	62	114	143	111	108	139	84	114	28	46	166
NRA REGIONS														
North West	mm	96	62	30	79	151	110	128	163	107	135	22	34	113
	%	125	76	36	77	121	89	109	135	89	120	28	47	147
Northumbria	mm	103	31	19	63	99	95	84	99	69	78	17	24	119
	%	187	48	31	82	98	120	112	105	92	98	26	46	216
Severn-Trent	mm	50	60	54	88	120	74	73	111	60	77	10	16	77
	%	96	94	96	135	148	110	113	141	85	112	19	31	149
Yorkshire	mm	66	34	33	81	99	95	80	104	67	82	22	17	107
	%	118	56	57	116	110	132	115	116	90	107	34	32	191
Anglian	mm	43	48	34	89	83	86	72	86	40	54	17	17	69
	%	108	102	69	156	130	165	138	140	75	105	40	42	172
Thames	mm	66	59	39	78	107	93	76	112	57	82	6	24	78
	%	143	105	75	130	153	150	118	153	86	132	13	53	169
Southern	mm	84	29	26	75	104	70	81	132	70	85	9	31	85
	%	175	53	52	127	143	99	103	141	87	112	16	60	176
Wessex	mm	74	25	50	64	129	85	50	149	82	120	7	40	81
	%	137	37	93	103	157	108	61	153	91	143	12	69	150
South West	mm	101	30	23	83	174	93	96	197	104	152	22	35	99
	%	142	36	35	99	173	89	85	147	77	118	25	42	139
Welsh	mm	94	70	51	93	222	114	100	196	124	168	23	31	105
	%	109	77	62	98	187	91	77	137	85	123	24	35	122
Scotland	mm	118	80	40	91	221	177	148	196	141	291	70	91	128
	%	131	88	43	81	171	129	99	138	90	212	67	98	142
RIVER PURIFICATION BOARDS														
Highland	mm	141	108	46	95	255	214	144	241	190	407	86	107	95
	%	124	105	42	75	172	135	78	143	101	248	65	94	84
North-East	mm	69	57	52	47	132	107	107	97	90	200	41	56	64
	%	113	74	74	51	123	123	110	94	88	220	55	90	105
Tay	mm	89	57	31	77	201	160	92	165	106	324	32	83	109
	%	119	60	37	75	170	139	76	153	79	274	35	102	145
Forth	mm	73	49	25	74	183	166	80	167	81	236	18	76	122
	%	107	58	33	75	158	154	75	155	74	238	24	111	180
Tweed	mm	99	49	27	61	157	118	80	123	75	139	13	42	119
	%	162	65	40	69	138	127	91	118	83	149	18	73	195
Solway	mm	148	63	30	101	215	155	114	190	119	200	22	87	158
	%	168	69	33	92	165	103	79	131	79	143	23	95	179
Clyde	mm	144	95	39	123	278	205	135	272	142	332	42	137	178
	%	140	98	38	95	196	117	74	163	76	206	37	130	173

Note: The most recent monthly rainfall figures correspond to the MORECS areal assessments derived by the Meteorological Office; the provisional figures for England and Wales and for Scotland are derived using a different raingauge network. The regional areal rainfall figures are regularly updated (normally one or two months in arrears) using figures derived from a far denser raingauge network.

TABLE 2 RAINFALL FOR SELECTED PERIODS WITH CORRESPONDING RETURN PERIOD ESTIMATES

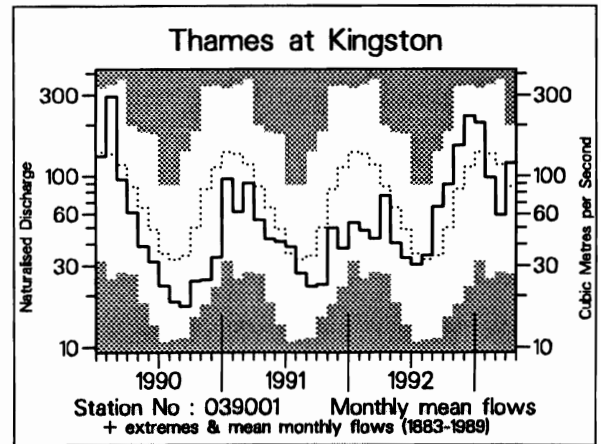
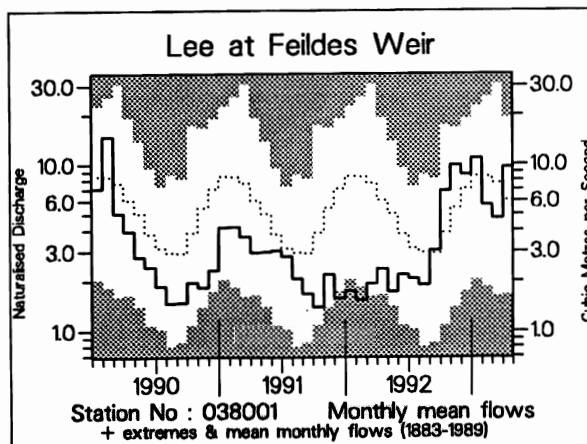
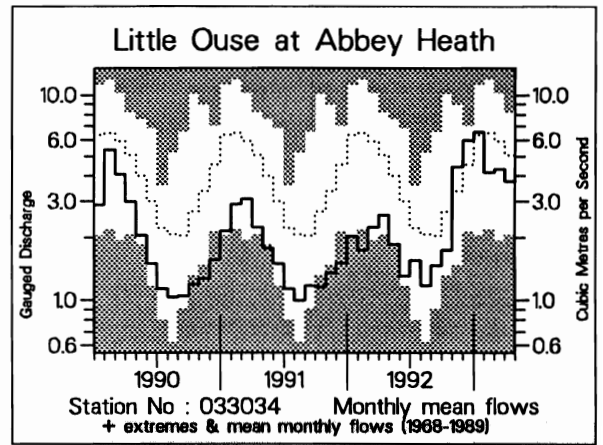
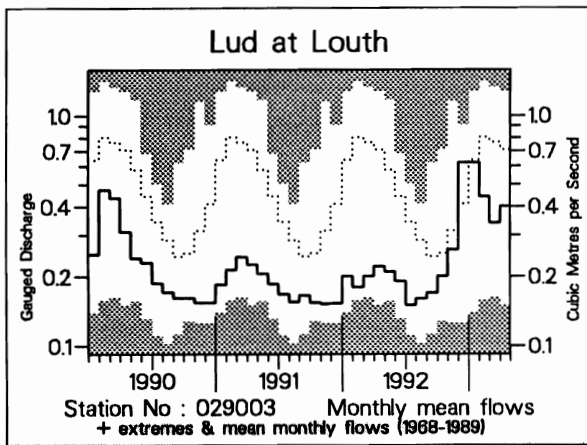
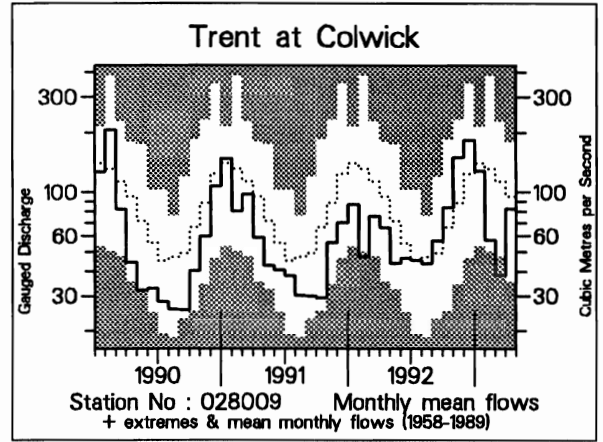
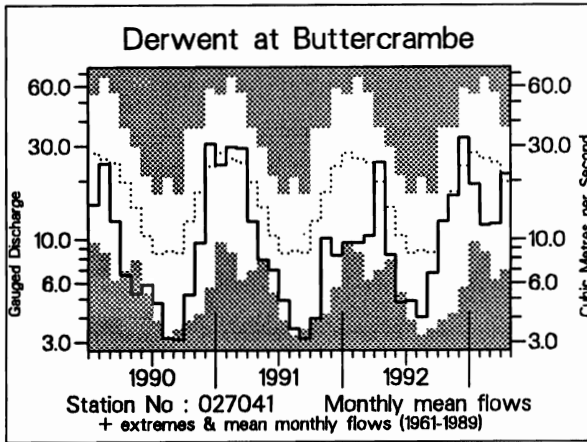
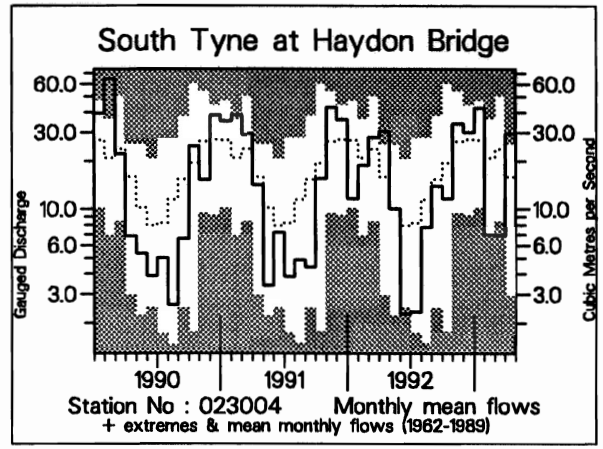
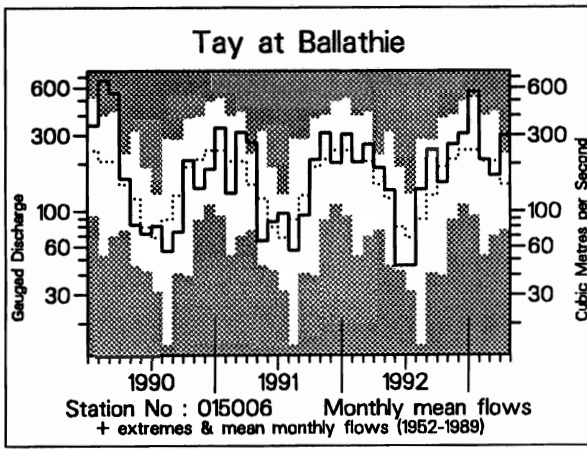
		Jan-Apr93		May92-Apr93		Mar90-Apr93		Aug88-Apr93	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales	mm% LTA	239 89	2-5	940 103	<u>2-5</u>	2546 89	10-20	3968 91	10-20
NRA REGIONS									
North West	mm% LTA	304 89	2-5	1135 93	2-5	3507 92	5-10	5533 95	2-5
Northumbria	mm % LTA	239 94	2-5	798 91	5	2510 91	5-10	3726 89	20-40
Severn-Trent	mm % LTA	181 80	5	820 106	<u>2-5</u>	2144 88	10-20	3333 91	10-20
Yorkshire	mm % LTA	228 91	2-5	820 98	2-5	2286 88	10-20	3512 88	20-40
Anglian	mm % LTA	157 90	2-5	694 114	<u>5-10</u>	1677 88	10-20	2534 87	30-50
Thames	mm % LTA	191 95	2-5	811 115	<u>5-10</u>	1931 88	10-20	2991 89	10-20
Southern	mm % LTA	210 90	2-5	797 100	<2	2136 86	15-25	3287 86	30-60
Wessex	mm % LTA	247 97	2-5	880 101	<u>2-5</u>	2312 85	20-30	3689 89	10-20
South West	mm % LTA	309 82	5	1109 93	2-5	3231 86	15-25	5236 91	5-15
Welsh	mm % LTA	326 80	5	1296 97	2-5	3737 90	5-15	5994 94	5-10
Scotland	mm % LTA	580 137	<u>40-60</u>	1683 118	<u>15-25</u>	5158 115	<u>120-170</u>	7938 116	<u>>>200</u>
RIVER PURIFICATION BOARDS									
Highland	mm % LTA	695 132	<u>15-25</u>	1988 115	<u>10-20</u>	6386 118	<u>>200</u>	9922 120	<u>>>200</u>
North-East	mm % LTA	361 125	<u>10-20</u>	1049 103	<u>2-5</u>	3083 97	2-5	4534 93	5-10
Tay	mm % LTA	548 149	<u>40-60</u>	1437 115	<u>5-10</u>	4193 107	<u>5-10</u>	6557 109	<u>10-20</u>
Forth	mm % LTA	453 145	<u>35-60</u>	1278 114	<u>5-10</u>	3811 109	<u>5-15</u>	5848 110	<u>15-25</u>
Tweed	mm % LTA	312 111	<u>2-5</u>	1002 100	<2	3119 100	<2	4640 97	2-5
Solway	mm % LTA	466 113	<u>2-5</u>	1452 102	<u>2-5</u>	4610 104	<u>2-5</u>	7189 105	<u>5</u>
Clyde	mm % LTA	689 143	<u>35-60</u>	1978 119	<u>10-20</u>	6253 120	<u>200</u>	9623 120	<u>>>200</u>

Return period assessments are based on tables provided by the Meteorological Office*. The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate. They assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less - for the longest durations the return period estimates converge. "Wet" return periods underlined.

Note: The long-term accumulated rainfall totals have been recomputed following the discovery of an error in the December 1992 report. As a result the long-term accumulations presented in Table 2 are slightly higher than those featured in recent months.

* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office.

FIGURE 1 MONTHLY RIVER FLOW HYDROGRAPHS



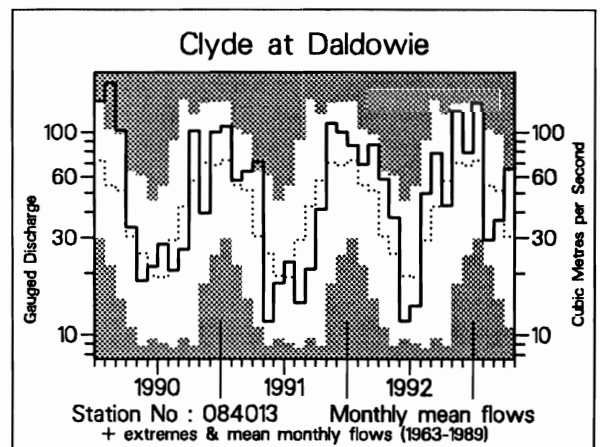
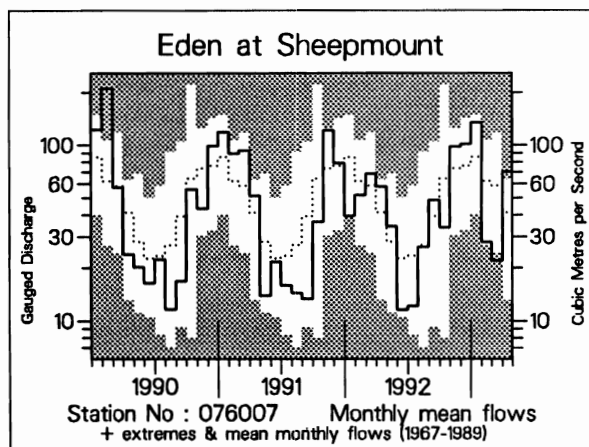
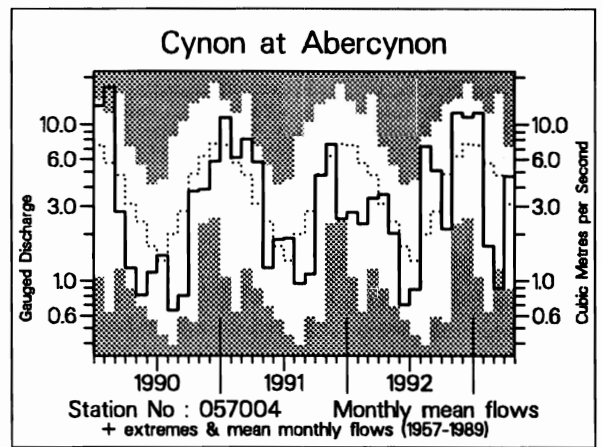
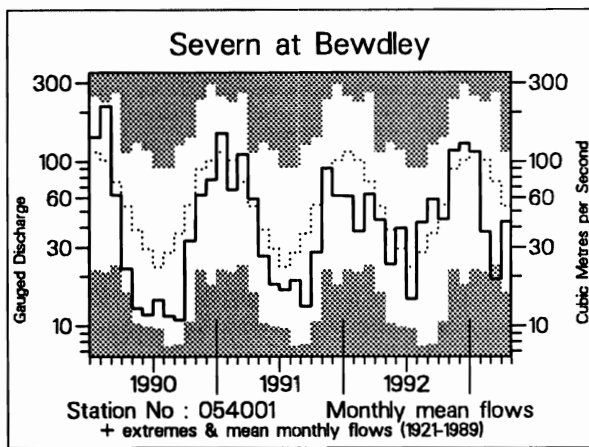
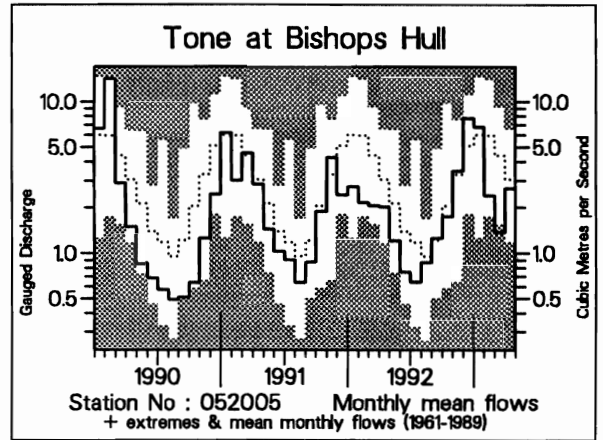
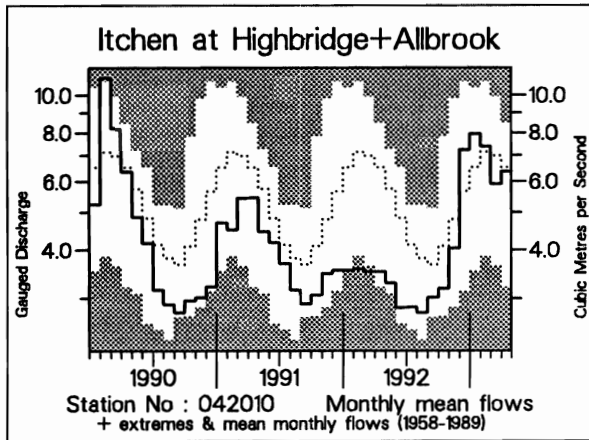
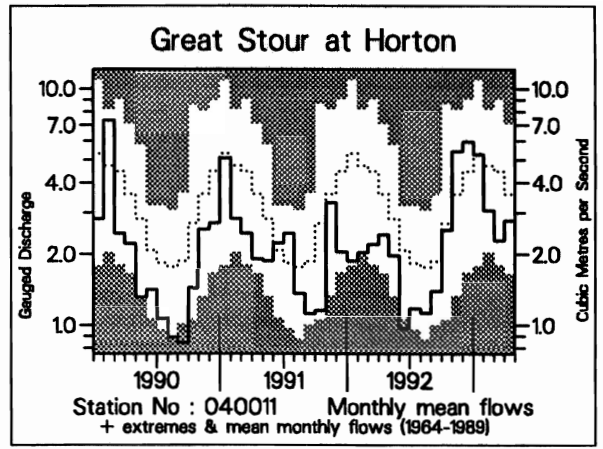
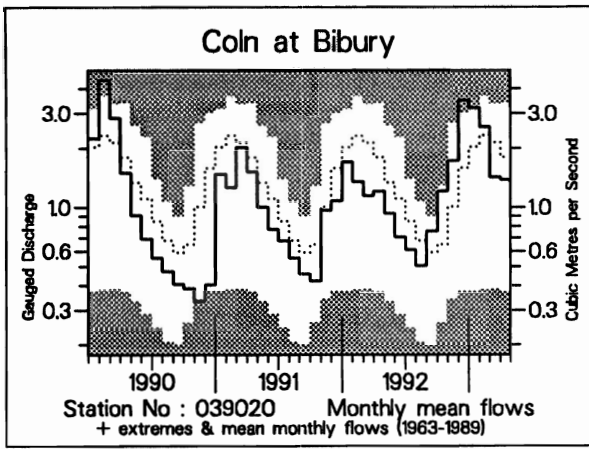


TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

River/ Station name	Dec	Jan	Feb	Mar	Apr		1/93	5/92	5/90	11/88				
	1992	1993			1993		to 4/93	to 4/93	to 4/93	to 4/93				
	mm %LT	mm %LT	mm %LT	mm %LT	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs	mm %LT	rank /yrs
Dee at Park	80 93	155 172	75 102	66 69	97 126	17 /21	392 117	17 /21	801 102	12 /20	2176 92	5 /18	3210 87	2 /17
Tay at Ballathie	179 128	327 227	111 97	97 76	168 198	41 /41	703 147	39 /41	1467 129	38 /40	3772 111	31 /38	6178 118	34 /37
Whiteadder Water at Hutton Castle	46 102	53 90	20 41	14 28	50 138	18 /24	137 71	6 /24	327 84	8 /23	1071 91	8 /21	1416 76	5 /20
South Tyne at Haydon Bridge	107 108	152 154	22 30	24 28	101 188	30 /31	300 97	11 /31	692 91	8 /29	2179 95	9 /25	3290 92	5 /23
Wharfe at Flint Mill Weir	112 116	132 134	27 35	20 26	60 111	23 /38	239 79	10 /38	608 85	8 /37	1844 85	4 /35	2878 85	2 /34
Trent at Colwick	65 149	46 92	18 42	14 35	29 90	18 /35	106 66	4 /35	336 96	17 /34	809 76	2 /32	1304 79	1 /31
Soar at Littlethorpe	49 151	40 103	11 31	9 27	24 111	15 /22	84 68	4 /22	263 108	11 /20	555 75	2 /16	896 77	2 /14
Lud at Louth	30 159	30 102	19 56	17 48	19 60	8 /25	85 68	8 /25	179 73	7 /24	391 53	2 /22	627 53	1 /21
Witham at Claypole Mill	39 214	32 127	37 140	13 50	15 72	15 /34	97 100	18 /34	224 123	24 /34	429 79	8 /32	657 76	4 /30
Little Ouse at Abbey Heath	23 140	25 109	14 64	16 73	14 78	9 /26	70 85	7 /25	143 85	8 /25	294 59	2 /23	506 65	1 /21
Colne at Lexden	26 159	29 128	9 49	8 44	11 84	16 /34	56 79	9 /34	151 112	25 /33	272 68	3 /31	469 73	1 /30
Lee at Feildes Weir (natr.)	22 122	28 129	13 66	12 61	24 160	95 /107	77 102	62 /107	169 104	61 /106	311 64	8 /102	543 72	9 /99
Thames at Kingston (natr.)	60 201	55 149	24 72	16 51	31 138	92 /111	125 102	64 /111	303 124	87 /110	571 78	16 /108	935 81	12 /106
Coln at Bibury	88 230	80 158	58 108	36 66	34 79	7 /30	207 104	14 /30	453 116	21 /29	988 84	8 /27	1558 85	4 /26
Great Stour at Horton	46 138	41 101	21 62	18 54	21 81	12 /28	101 77	7 /28	258 89	9 /27	627 72	3 /23	936 69	1 /19
Itchen at Highbridge + Allbrook	54 132	59 123	49 101	44 85	46 99	12 /35	198 103	16 /35	412 90	10 /34	1067 78	1 /32	1669 79	1 /31
Piddle at Baggs Mill	81 199	86 166	53 90	35 62	38 89	14 /30	213 103	17 /29	426 107	18 /28	990 82	4 /24	1554 81	2 /21
Tone at Bishops Hull	102 156	90 113	29 39	18 31	34 88	18 /32	170 70	6 /32	402 86	10 /32	1004 71	1 /30	1750 77	1 /28
Severn at Bewdley	79 127	71 100	21 36	12 26	26 82	29 /73	129 63	7 /72	414 92	26 /72	1080 80	7 /70	1778 84	3 /68
Cynon at Abercynon	280 151	299 154	38 27	23 19	114 149	27 /35	474 91	12 /35	1497 119	29 /33	3549 94	13 /29	5749 98	14 /27
Dee at New Inn	232 95	275 115	30 18	36 20	138 130	18 /24	479 70	2 /24	1604 90	7 /23	4638 85	1 /21	7405 87	1 /20
Eden at Sheepmount	118 131	157 151	30 40	26 37	79 171	23 /23	292 100	12 /23	713 104	12 /21	2054 100	9 /17	3233 101	7 /14
Clyde at Daldowie	111 112	197 184	37 49	52 69	89 205	29 /30	375 122	25 /30	985 126	28 /29	2769 119	26 /27	4234 118	25 /26

Notes: (i) Values based on gauged flow data unless flagged (natr.), when naturalised data have been used.
(ii) Values are ranked so that lowest runoff as rank 1.
(iii) %LT means percentage of long term average from the start of the record to 1991. For the long periods (at the right of this table), the end date for the long term is 1993.

TABLE 4 START-MONTH RESERVOIR STORAGES UP TO MAY 1993

Area	Reservoir (R)/ Group (G)	Capacity● (MI)	1992			1993			1992
			Dec	Jan	Feb	Mar	Apr	May	May
North West	Northern Command Zone ¹	(G) 133375	79	88	98	84	77	91	93
	Vyrnwy	(R) 55146	88	89	86	87	78	87	100
Northumbria	Teesdale ²	(G) 87936	95	90	98	91	83	95	97
	Kielder	(R) 199175*	77*	74*	90*	81*	81	91	91
Severn-Trent	Clywedog	(R) 44922	92	84	96	87	87	95	99
	Derwent Valley ³	(G) 39525	95	88	99	91	73	81	100
Yorkshire	Washburn ⁴	(G) 22035	89	95	99	92	83	91	99
	Bradford supply ⁵	(G) 41407	83	94	100	89	76	83	99
Anglian	Grafham	(R) 58707	94	94	96	93	92	93	96
	Rutland	(R) 130061	96	95	93	93	88	94	82
Thames	London ⁶	(G) 206232	96	96	96	93	91	95	100
	Farmoor ⁷	(G) 13843	95	96	92	96	95	99	100
Southern	Bewl	(R) 28170	72	82	91	91	91	97	70
	Ardingly	(R) 4685	100	100	100	100	100	100	100
Wessex	Clatworthy	(R) 5364*	70	100	100	94	83	86	85
	Bristol WW ⁸	(G) 38666*	63*	94*	97*	93*	85*	89*	86*
South West	Colliford	(R) 28540	73	82	88	88	83	83	82
	Roadford	(R) 34500	85	90	92	83	80	78	92
	Wimbleball ⁹	(R) 21320	71	90	100	99	91	92	79
	Stithians	(R) 5205	82	100	100	98	88	83	65
Welsh	Celyn + Brenig	(G) 131155	98	96	100	96	90	95	100
	Brienne	(R) 62140	100	99	100	96	90	99	100
	Big Five ¹⁰	(G) 69762	91	94	99	91	78	89	98
	Elan Valley ¹¹	(G) 99106	100	98	100	88	89	98	100
Lothian	Edinburgh/Mid Lothian	(G) 97639	100	98	100	95	93	99	100
	West Lothian	(G) 5613	95	98	99	91	92	100	85
	East Lothian	(G) 10206	91	100	100	99	97	100	89

● Live or usable capacity (unless indicated otherwise)

□ Kielder drawn down for ecological management

* Gross storage/percentage of gross storage

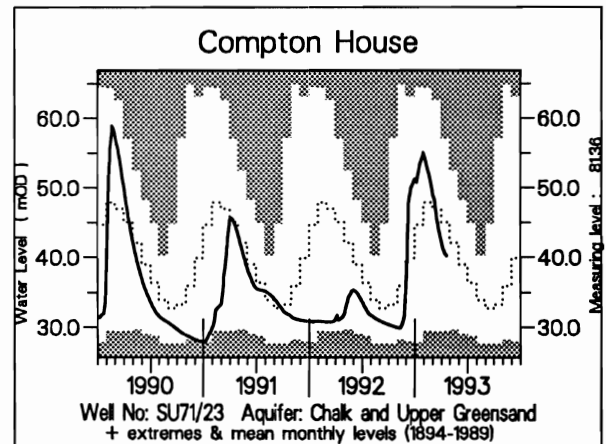
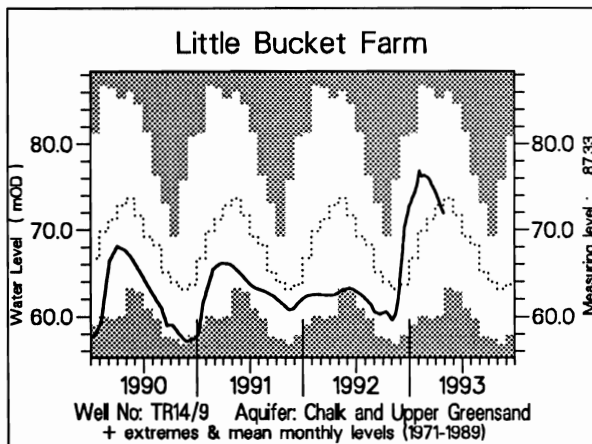
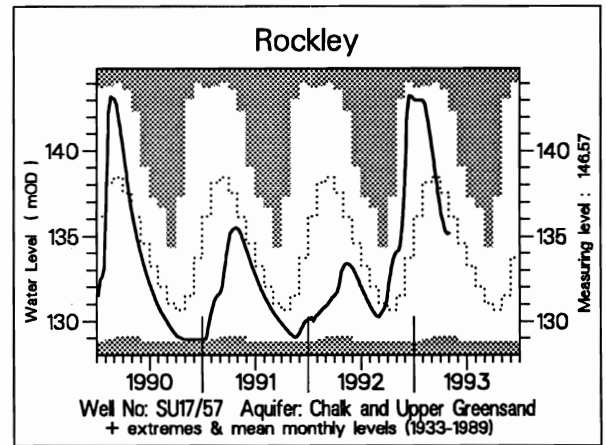
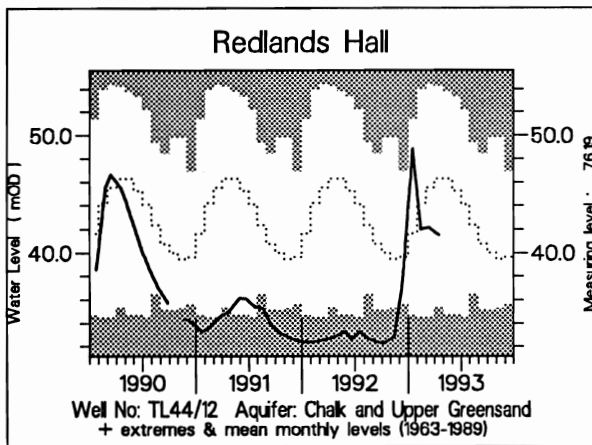
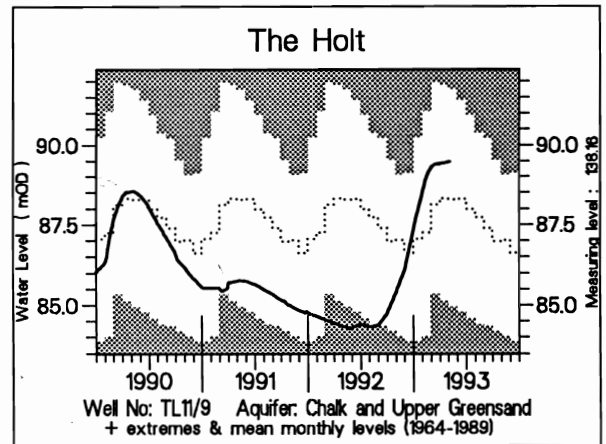
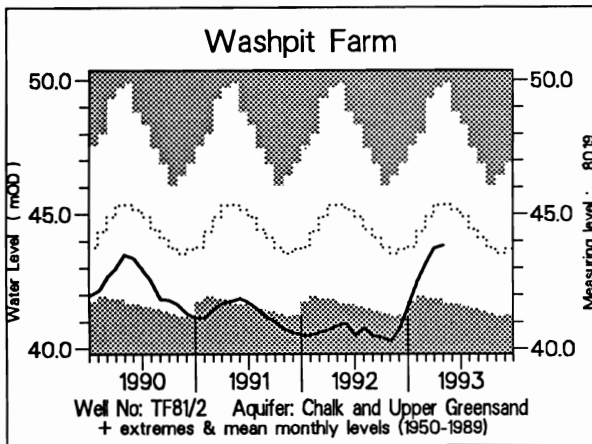
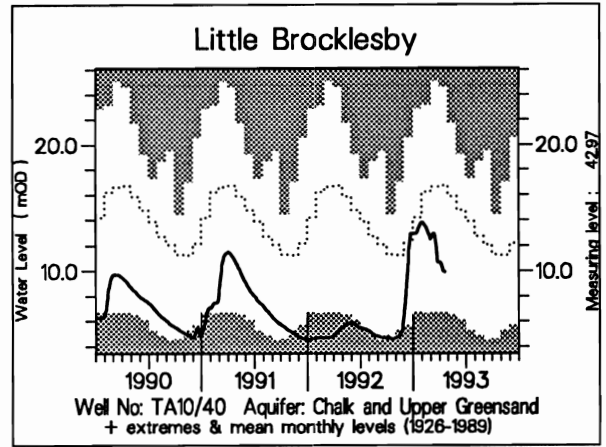
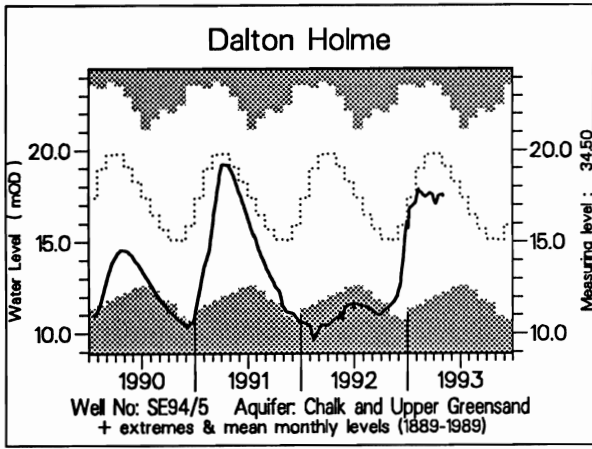
† Intake closure for engineering works caused storage to be lower than it would have been otherwise

1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. Lower Thames (includes Queen Mother, Wraysbury, Queen Mary, King George VI and Queen Elizabeth II) and Lee Valley (includes King George and William Girling) groups - pumped storages.
7. Farmoor 1 and 2 - pumped storages.
8. Blagdon, Chew Valley and others.

9. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
10. Usk, Talybont, Llandegfedd (pumped storage), Taf Fechan, Taf Fawr.
11. Claerwen, Caban Coch, Pen y Garreg and Craig Goch.

Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient use of water stocks will further affect reservoir storages. Table 4 provides a link between the hydrological conditions described elsewhere in the report and the water resources situation.

FIGURE 2 GROUNDWATER LEVEL HYDROGRAPHS



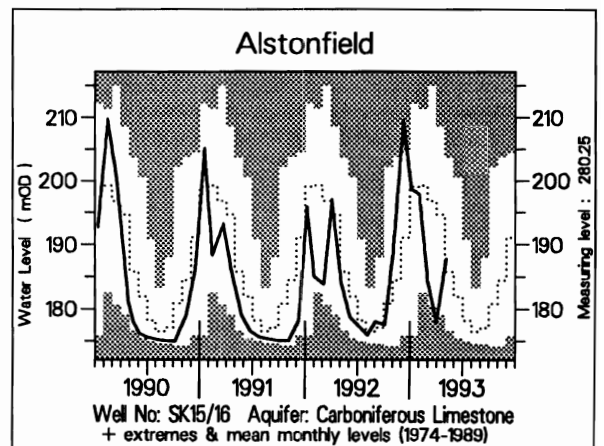
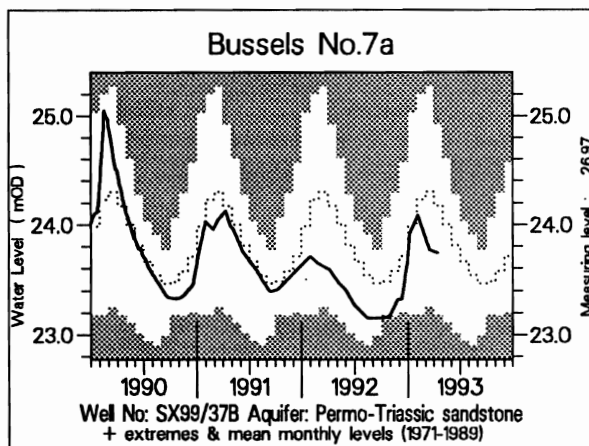
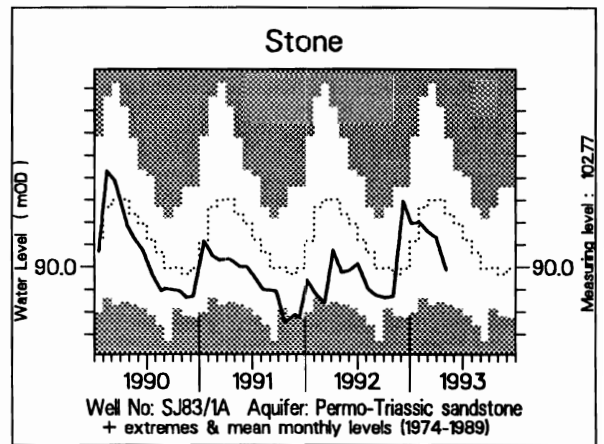
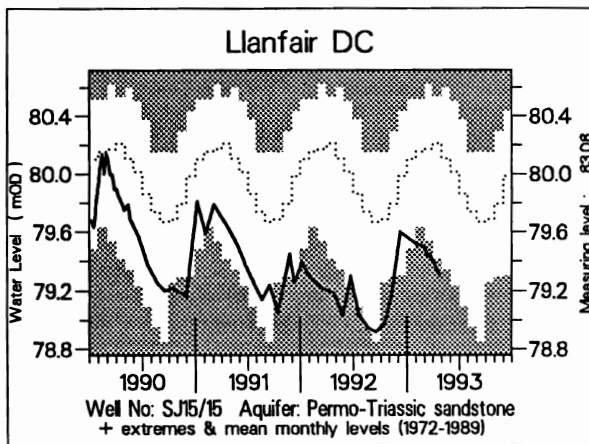
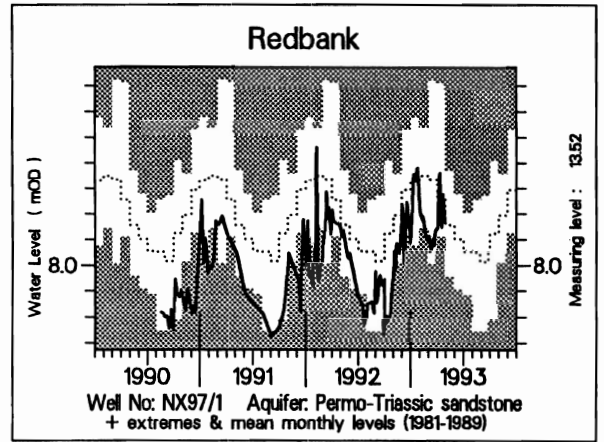
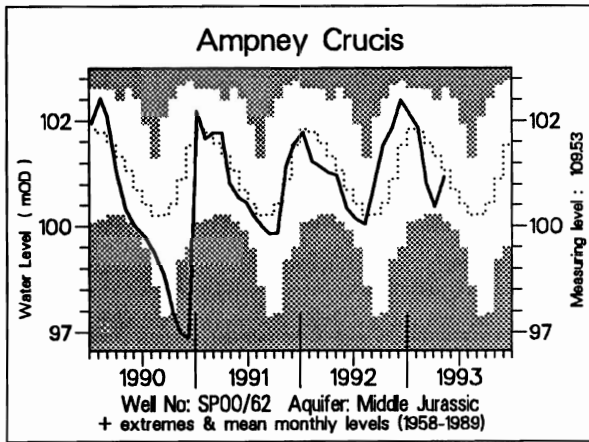
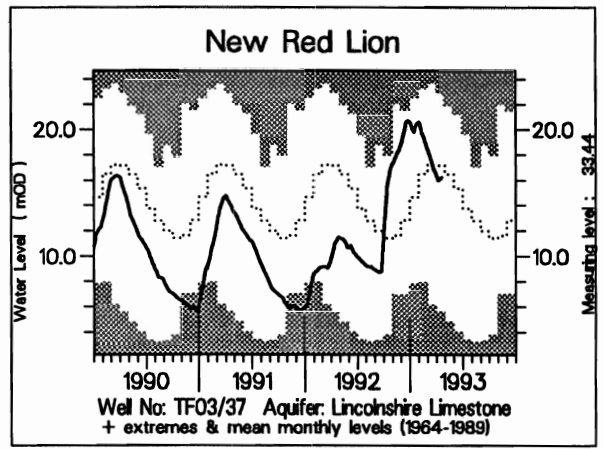
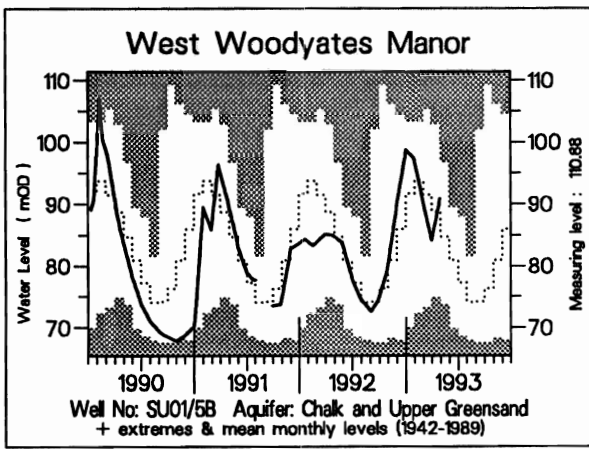


TABLE 5 A COMPARISON OF APRIL GROUNDWATER LEVELS: 1992 AND 1993

Site	Aquifer	Records commence	Average April level	April 1992		April/May 1993		No of years April level <1993	Least pre-1993 level any month
				day	level	day	level		
Wetwang	C & UGS	1971	24.99	10/04	18.42	04/05	23.30	9	16.66
Dalton Holme	C & UGS	1889	19.72	24/04	10.75	04/05	17.47	>10	9.64
Little Brocklesby	C & UGS	1926	15.33	28/04	5.50	20/04	9.91	5	4.53
Washpit Farm	C & UGS	1950	45.53	02/04	40.71	04/05	43.83	>10	40.32
The Holt	C & UGS	1964	88.07	07/04	84.35	02/05	89.47	>10	83.90
Therfield Rectory	C & UGS	1883	84.21	26/04	71.67	04/05	80.46	>10	dry <71.6
Redlands Farm	C & UGS	1964	45.18	22/04	32.85	16/04	41.50	6	32.29
Rockley	C & UGS	1933	137.44	23/04	132.86	02/05	135.19	>10	dry <128.9
Little Bucket Farm	C & UGS	1971	71.32	22/04	62.59	29/04	71.93	>10	56.77
Compton House	C & UGS	1894	46.10	29/04	31.69	20/04	40.23	>10	27.64
Chilgrove House	C & UGS	1836	53.50	29/04	41.86	20/04	48.49	>10	33.46
West Dean No 3	C & UGS	1940	2.09	24/04	1.51	30/04	1.87	>10	1.01
Lime Kiln Way	C & UGS	1969	125.49	22/04	124.00	21/04	124.42	1	123.70
Ashton Farm	C & UGS	1974	69.39	27/04	67.90	29/04	68.23	4	63.10
West Woodyates	C & UGS	1942	88.06	27/04	85.00	29/04	90.82	>10	67.62
New Red Lion	LLst	1964	16.60	28/04	11.50	20/04	16.25	>10	3.29
Ampney Crucis	Mid Jur	1958	101.78	09/04	101.27	10/05	101.17	>10	97.38
Yew Tree Farm	PTS	1973	13.58	30/04	13.39	29/04	13.62	6	8.43
Llanfair DC	PTS	1972	80.12	26/04	79.19	25/04	79.30	1	78.85
Morris Dancers	PTS	1969	32.51	06/04	32.03	16/04	31.87	1	30.87
Stone	PTS	1974	90.65	07/04	90.15	05/05	89.97	1	89.34
Skirwith	PTS	1978	130.61	30/04	130.35	28/04	130.43	3	129.44
Redbank	PTS	1981	8.45	30/04	8.30	29/04	8.33	4	7.45
Bussels 7A	PTS	1972	24.17	07/04	23.59	14/04	23.74	4	22.90
Rusheyford NE	MgLst	1967	76.25	30/04	74.86	08/04	75.09	>10	64.77
Peggy Ellerton	MgLst	1968	34.97	09/04	32.00	13/04	32.04	2	31.10
Alstonfield	CLst	1974	195.55	03/04	197.02	04/05	174.22	0	174.22

groundwater levels are in metres above Ordnance Datum

C & UGS Chalk and Upper Greensand
 LLst Lincolnshire Limestone
 PTS Permo-Triassic sandstones

Mid Jur
 MgLst
 CLst

Middle Jurassic limestones
 Magnesian Limestone
 Carboniferous Limestone

FIGURE 3 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS

