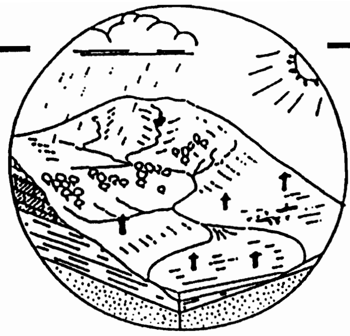
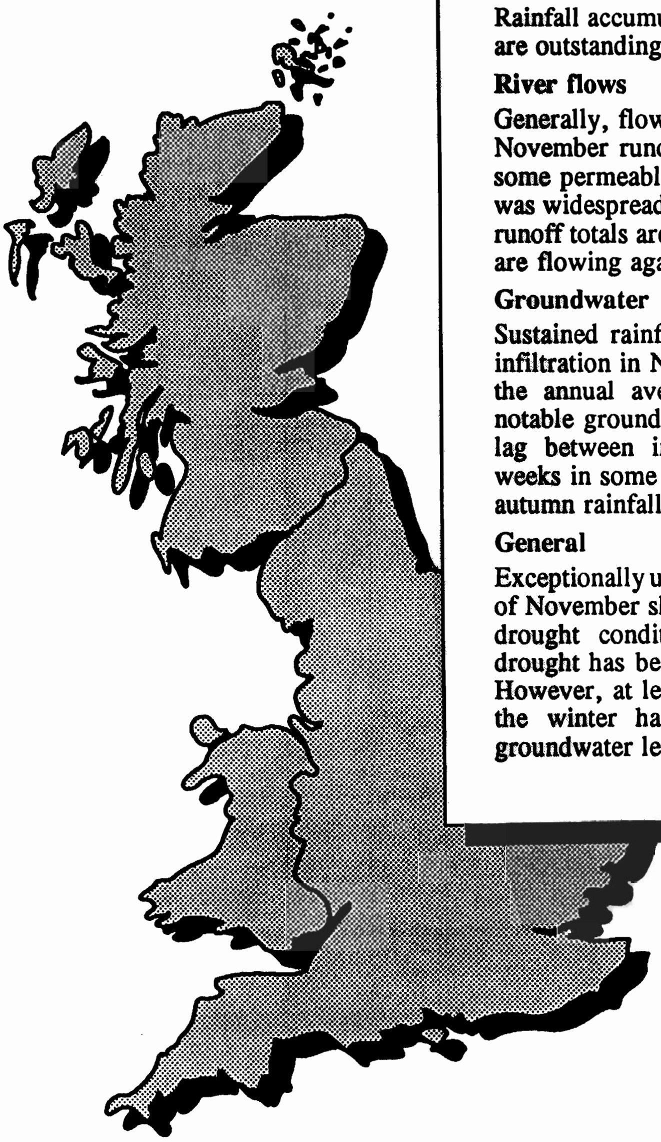
Hydrological Summary for Great Britain





NOVEMBER 1992

Rainfall

Around 140% for Britain as a whole and notably wet late in the month. A fifth successive wet month has terminated the meteorological drought in all regions. Modest long term deficiencies can still be recognised in the English lowlands. Rainfall accumulations in the longest timeframes (>2 years) are outstandingly high for western Scotland.

River flows

Generally, flows increased markedly through the month and November runoff totals were well above average except in some permeable eastern and southern catchments. Flooding was widespread in southern Britain at month-end and autumn runoff totals are notably high over wide areas. Many springs are flowing again for the first time in at least two years.

Groundwater

Sustained rainfall on saturated catchments produced heavy infiltration in November and early December - approaching the annual average recharge in some areas. Some very notable groundwater level rises have been reported but the lag between infiltration and water-table response (many weeks in some deep wells) means that the full impact of the autumn rainfall will not be evident before year-end.

General

Exceptionally unsettled weather conditions over the latter half of November shifted the focus of hydrological concern from drought conditions to floods. A remarkably protracted drought has been effectively terminated in almost all areas. However, at least average rainfall through the remainder of the winter half-year will be required to restore some groundwater levels to within the normal range.

Institute of Hydrology

British Geological Survey

Institute of Hydrology / British Geological Survey
Maclean Building
Crowmarsh Gifford
Wallingford
Oxfordshire
OX10 8BB

HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - NOVEMBER 1992

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 4) is provided to assist in the location of the principal monitoring sites.

Rainfall

November was a notably mild and very wet month in most regions. Weather patterns were dominated by a sequence of active frontal systems carried on a westerly or south-westerly airstream. The exceptionally unsettled conditions, particularly towards month-end, resulted in the focus of hydrological concern shifting from droughts to floods as saturated catchments and sustained rainfall produced widespread spate conditions.

Following a typically autumnal start to the month, November became increasingly unsettled. Some districts in southern Britain recorded rainfall on every day from the 13th and hefty totals were registered around the 14th, 25th and at month-end. Monthly rainfall totals comfortably exceeded the November average in almost all regions with parts of south-western Britain recording more than twice the 1941-70 mean. Rainfall totals exceeding 100 mm for the four days beginning on the 29th were common in the West Country and in central and southern Wales; at Tyn y Waen a fall of 109 mm on the 29th/30th was followed by 106 mm on the 1st/2nd December - return periods of 15 and 25 years respectively have been associated with the two storms. A few eastern areas from Lincolnshire to north-east Scotland, mostly where rain-shadow effects could be recognised, failed to reach the November average but the shortfalls were generally marginal. In some areas, November was the wettest month since February 1990 and amongst the half dozen wettest months in the last decade.

For England and Wales as a whole, November was the fifth successive month with above average rainfall, the longest such sequence since the summer of 1985. The July-November period was the second wettest since 1960, more importantly - in the drought context - the rainfall favoured eastern areas for much of this time. In many lowland districts, June was the only month to record below average rainfall since February. For the Thames Valley, the accumulated rainfall total over the five months to November was the fourth highest in a 110-year record (only 1960 was significantly wetter). Over much of the English lowlands provisional data suggest that the autumn rainfall exceeded that which rapidly terminated the 1984 drought and, in parts of East Anglia especially, also eclipsed the abundant rainfall which provided a dramatic conclusion to the drought of 1975/76. A particularly rapid transformation in the severity of the lowland drought was signalled by the notable storm of the 20/21st September. This marked the start of an 11-week period when rainfall in much of eastern England approached 50 per cent of the 1941-70 annual average and also approached 11-month totals registered at the height of the drought.

The accumulated rainfall totals presented in Table 1 and 2 confirm the moderation in the severity of the lowland drought since the late spring and its rapid decline in recent months. For the first time since the winter of 1989/90 notably high 'n-month' rainfall totals may now be identified in eastern England. In rarity terms, these are of minor significance compared with the remarkably abundant rainfall in western Scotland over the last four years.

Evaporation and Soil Moisture Deficits (SMDs)

Provisional data indicate that last month was the eighth warmest November this century and the warmest since 1978. For the first time in more than 10 years November was warmer than October. Potential evaporation (PE) totals for November rank very high in the MORECS series (from 1961) but losses were generally only 5-10 millimetres above average. Although autumn as a whole was cooler than average, PE totals for 1992 thus far remain substantially above average, but well short of the record totals computed for 1989 and 1990. By contrast, 1992 actual evaporation totals are much greater than for 1989 and 1990, in the lowlands especially. In some districts the relatively moist summer soil conditions have allowed AE totals to exceed the previous highest on record.

Soils were wet throughout virtually the whole of Britain by mid-November and water-logged conditions were common from around the 23rd. At the same time in the previous four years very significant lowland deficits remained. The early elimination of SMDs in 1992 has permitted the seasonal recovery in runoff and recharge rates to proceed far more briskly than in any autumn since 1987. The prospect, given average rainfall, of groundwater replenishment extending over around six months (six weeks being more typical in recent years) in the eastern lowlands is very encouraging in relation to the 1993 water resources outlook.

Runoff

The recovery in lowland river flows which generally began in late September gathered momentum in November and by month-end spate conditions characterised all but the most permeable catchments. In the West Country the steep increase in flows in late-October was followed by further increases in November culminating in widespread floodplain inundation around month-end. The River Exe recorded its highest flow for a decade but generally the flooding was notable for its areal extent rather than its magnitude. Flooding was more severe in South Wales where new peak discharge rates were recorded on the Gwili (which has a 24-year record) and Ewenny (21-year). Notable peaks were also registered on rivers draining from the Brecon Beacons. Very high flows occurred on, for example, the Taff, Rhymney and Sirhowy and significant flood damage was sustained in Tredegar and Pontypridd. An added danger was the slumping of coal tips caused by sustained heavy rainfall. Overall, the flooding was significantly less severe than in 1979 but, as elsewhere, transport disruption was considerable. Flood alerts were called on many rivers in central and southern Britain and inundation of agricultural land was widespread. An unusual feature reported from a number of Chalk catchments was localised flooding in headwater reaches. This was more a consequence of surface (or near-surface) runoff than baseflow recoveries but a further factor is the reduction in channel capacities due to vegetation growth in stream beds which - in some areas - have been dry for over two years.

November runoff totals were above average throughout almost the whole of Great Britain, notably so to the south of a line from the Wash to Cardigan Bay. In eastern England the hydrological contrast with the recent past was very notable. In some catchments runoff totals exceeded the monthly average for the first time in over four years; examples include the Little Ouse at Abbey Heath which fell below average in May 1988. The Thames recorded its highest monthly flow since significant flooding last occurred in February 1990; above Oxford the recent water levels exceeded those of 33 months ago. Although individual daily flows at the Kingston gauging station over the fortnight beginning on the 26th November were unexceptional, the accumulated gauged runoff was roughly comparable to the overall totals for the May-December period in both 1990 and 1991.

Autumn runoff totals provide clear evidence for the drought's termination, in river flow terms, throughout most of the region where drought severity was extreme in the early spring. The September to November runoff total for the Bedford gauging station (on the Ouse) was four times the average and the highest in a record from 1933; autumn flows were also amongst the highest on record for the Trent, Witham, Colne - see Table 3. Flow recoveries have been less dramatic in some of the most permeable catchments but over the last six weeks many springs have begun to flow once again and the stream network has extended further into the headwaters. Although long term accumulated runoff totals remain relatively depressed for some spring-fed rivers (e.g. the Itchen for which the January-November 1991 runoff is the lowest on record) average winter rainfall should ensure healthy flows by next spring.

Reservoir replenishment continued throughout November with a considerable number of gravity-fed upland impoundments drawn-down to provide a measure of flood alleviation storage. (Keilder storage was also reduced to provide scope for further habitat creation.) Entering December, regional storage totals were near capacity and very healthy relative to the early winter storages in each of the last three years in the lowlands.

Groundwater

Sustained and often heavy rainfall, combined with saturated soils have created ideal conditions for heavy infiltration over the last six weeks or so. Preliminary estimates suggest that autumn infiltration in much of the English lowlands exceeds the, admittedly modest, total for the entire 1991/92 recharge season and may in some areas exceed the long term annual average. For the deeper Chalk wells many weeks may elapse before surface infiltration translates into a rise in groundwater levels; this lag is a particularly important factor when recoveries need to be generated from an exceptionally low level.

Groundwater levels are now rising in all the index wells, although the rate of recovery varies greatly from area to area. Upturns in parts of the Chalk are as yet barely discernible but have begun very much earlier than in the last four years. Some very sharp increases in level have also been reported - levels at Chilgrove (not illustrated), for example, rose nine metres in the week ending on the 1st December. In the Lincolnshire Limestone, at the New Red Lion site, and the Stone site (Permo-Triassic sandstones) in the Midlands, levels are approaching the seasonal recorded maxima. The same is true of the Alstonfield borehole where levels have increased around 30 metres through the autumn. Most of the sites in central and southern England show water-tables approaching or above the seasonal means.

The relicts of the drought are still evident. In the Permo-Triassic sandstones, the Weeford Flats site remains dry, the water-table presumably not yet having risen above the bottom. At Dalton Holme and Little Brocklesby, groundwater levels remain near the seasonal minima. At Washpit Farm and Redlands Hall in East Anglia and at Llanfair DC in north Wales, levels have yet to rise above the seasonal minima (but note, that levels at the latter two sites were recorded early in November). In the South-West, levels at the Bussels site remain close to the seasonal minimum.

The recharge to the country's aquifers has already been substantial, and in all probability the intense rainfall of late November and early December has yet to register its full effect on the water-table, particularly in those regions where groundwater levels have been most severely depressed and their response to infiltration correspondingly slow. Given average rainfall over the winter and extending through to April, recharge over much of the drought affected regions should exceed about 150 per cent of the long term average. This would allow groundwater resources to recover to near, or above, mean values before the onset of the summer recession in 1993.

In the October summary, a tentative suggestion was put forward for the determination of the end of the groundwater drought; the proposed definition was for groundwater levels in relevant index wells to reach and remain at or above mean seasonal values for two successive months. Over central and southern Britain, these conditions may well be met by the end of 1992. In the deeper wells of Yorkshire, Humberside, East Anglia, north Wales and south-west England, they should be met by the end of March providing that the spring rainfall is not substantially below average. The curtain may then finally fall on a drought which, in meteorological terms, began to ameliorate in March 1992.

Institute of Hydrology/British Geological Survey
11 December 1992

TABLE 1 1991/92 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Nov	Dec 1991	Jan 1992	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov
England and	mm	95	49	48	47	85	75	49	45	87	126	103	90	135
Wales	%	98	54	56	72	144	129	73	74	119	140	124	108	139
NRA REGIONS														
North West	mm	169	119	57	100	142	89	62	31	72	137	114	128	163
	%	140	99	51	123	197	116	76	37	70	110	93	109	135
Northumbria	mm	109	78	33	45	107	103	31	19	61	104	108	84	99
	%	116	104	41	68	206	187	48	31	79	103	137	112	105
Severn-Trent	mm	68	39	59	31	67	50	59	55	87	117	72	73	111
	%	86	56	86	58	129	96	92	98	134	144	107	113	141
Yorkshire	mm	94	62	47	42	96	66	34	33	81	94	98	80	104
	%	106	84	61	66	170	118	56	57	116	104	136	115	116
Anglian	mm	54	24	45	17	63	43	48	34	89	82	92	72	86
	%	87	45	87	40	158	108	102	69	156	128	176	138	140
Thames	mm	66	16	28	25	52	65	60	39	77	107	89	76	112
	%	90	24	45	53	113	141	107	75	128	153	144	118	153
Southern	mm	81	23	18	33	59	84	30	26	75	105	73	81	132
	%	86	28	24	58	113	175	55	52	127	144	102	103	141
Wessex	mm	72	30	36	39	57	81	24	49	64	127	94	50	149
	%	74	33	43	66	98	150	35	91	103	155	119	61	153
South West	mm	112	52	44	69	75	100	31	23	83	171	100	96	197
	%	84	39	34	77	89	141	37	35	99	169	96	85	147
Welsh	mm	142	65	76	80	129	91	80	48	93	212	112	100	196
	%	99	45	56	83	148	107	88	59	98	178	89	77	137
Scotland	mm	227	141	139	167	208	123	80	52	103	217	187	148	196
	%	160	90	101	161	226	137	88	57	92	168	136	99	138
RIVER PURIFICATION BOARDS														
Highland	mm	305	166	197	229	248	138	105	46	97	250	77	144	241
	%	180	85	120	172	218	121	102	42	76	169	112	78	143
North-East	mm	133	53	67	52	113	68	57	50	48	128	113	107	97
	%	129	52	74	70	182	111	74	71	52	120	130	110	94
Tay	mm	154	97	117	111	172	90	57	30	78	197	152	92	165
	%	129	72	99	121	210	120	60	36	76	167	132	76	153
Forth	mm	124	108	110	111	164	76	45	25	67	174	156	80	167
	%	115	99	111	144	238	112	54	33	68	150	144	75	155
Tweed	mm	127	92	63	70	138	98	52	27	60	151	126	80	123
	%	122	102	68	101	238	161	68	40	67	132	135	91	118
Solway	mm	203	162	91	140	206	144	66	30	99	214	166	114	190
	%	140	107	65	151	226	164	72	33	90	165	110	79	131
Clyde	mm	274	208	170	231	267	144	93	41	123	270	195	135	272
	%	164	112	106	204	254	140	96	40	95	190	111	74	163

Note: The most recent monthly rainfall figures correspond to the MORECS areal assessments derived by the Meteorological Office. 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

		Jul - Nov92	Est Return Period, years	Jan - Nov92	Est Return Period, years	Mar90-Nov92	Est Return Period, years	Aug88-Nov92	Est Return Period, years
England and	mm	539		888		2241		3663	
Wales	% LTA	126	10	108	<5	90	5-10	92	5-10
NRA REGIONS									
North West	mm	614		1095		3072		5098	
	% LTA	104	<5	100	<2	92	5-10	95	5
Northumbria	mm	456		794		2218		3434	
	% LTA	107	<5	99	<5	92	5-10	89	15-20
Severn Trent	mm	460		781		1898		3087	
	% LTA	129	10	111	<5	89	5-10	91	5-10
Yorkshire	mm	456		768		1989		3215	
	% LTA	117	<5	101	<2	87	10-20	88	20-30
Anglian	mm	420		670		1485		2342	
	% LTA	146	40-50	120	10-15	88	10-15	88	20-30
Thames	mm	461		730		1679		2739	
	% LTA	140	15-25	114	5	87	10-15	89	10-15
Southern	mm	466		716		1861		3012	
	% LTA	124	5-10	100	<2	86	10-20	86	20-30
Wessex	mm	483		769		1995		3372	
	% LTA	120	5-10	99	<5	84	15-25	88	15-25
South West	mm	647		989		2823		4828	
	% LTA	121	5-10	93	<5	87	10-20	92	5-10
Welsh	mm	713		1217		3282		5539	
	% LTA	117	<5	102	<5	91	5-10	95	<5
Scotland	mm	851		1620		4463		7243	
	% LTA	127	15-20	127	100-150	115	75-100	115	>>200
RIVER PURIFICATION BOARDS									
Highland	mm	668		1631		5214		8750	
	% LTA	85	<10	107	<5	112	20-30	116	>200
North-East	mm	396	5-10	803		2536		3987	
	% LTA	81		87	5-10	91	5-10	89	20-50
Tay	mm	519		1095		3363		5727	
	% LTA	90	<5	98	<5	98	<5	104	3-5
Forth	mm	477		1008		3083		5120	
	% LTA	89	<5	100	<2	100	<2	104	<5
Tweed	mm	417		865		2612		4133	
	% LTA	85	<5	95	<5	95	<5	94	5-10
Solway	mm	593		1278		3843		6422	
	% LTA	87	<5	100	<2	99	<5	102	<5
Clyde	mm	723		1669		5132		8502	
	% LTA	91	<5	113	5-10	113	20-30	116	200

Return period assessments are based on tables provided by the Meteorological Office*. These 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.
The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate.

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

FIGURE 1. MONTHLY RAINFALL FOR 1990-1992 AS A PERCENTAGE OF THE 1941-1970 AVERAGE

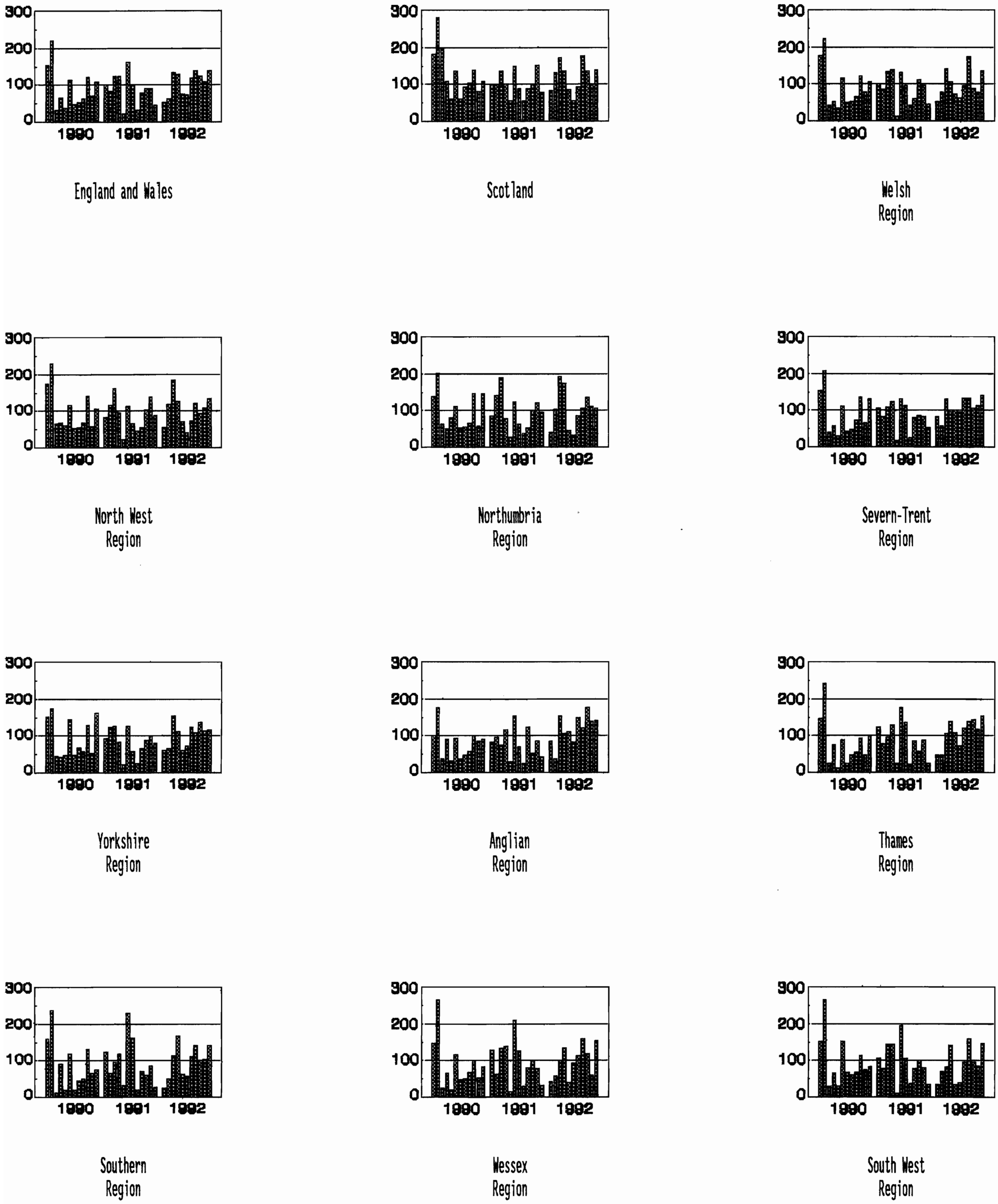
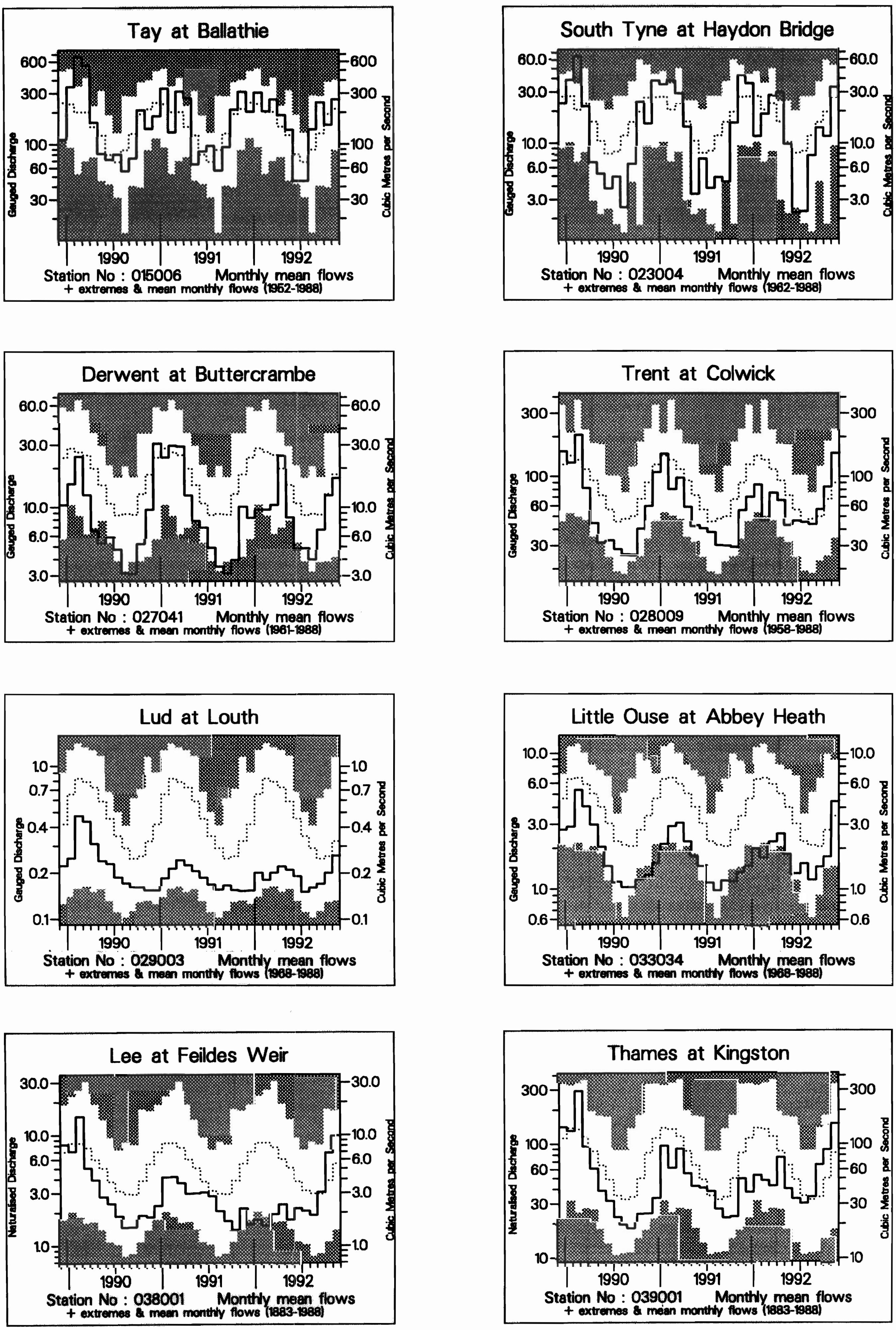
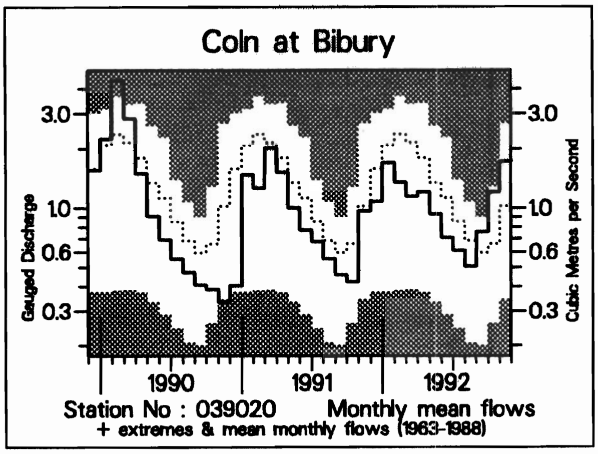
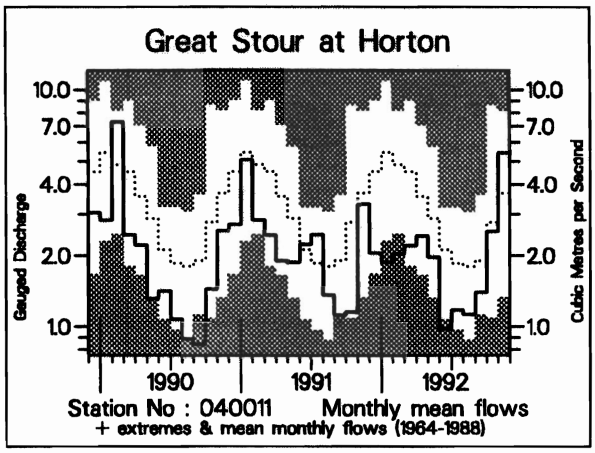
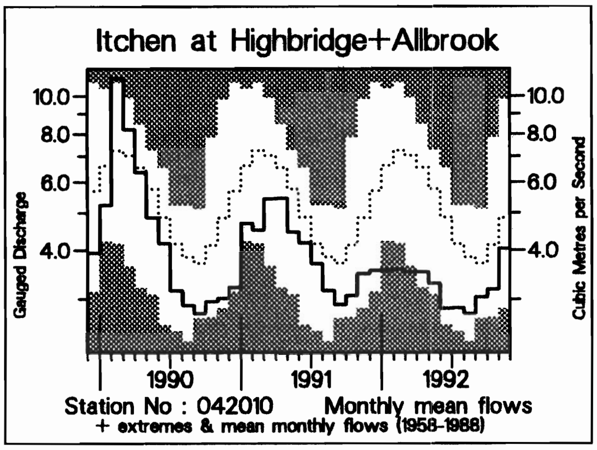


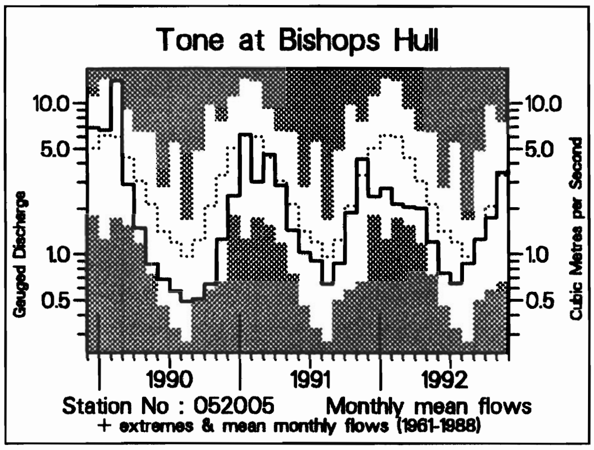
FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

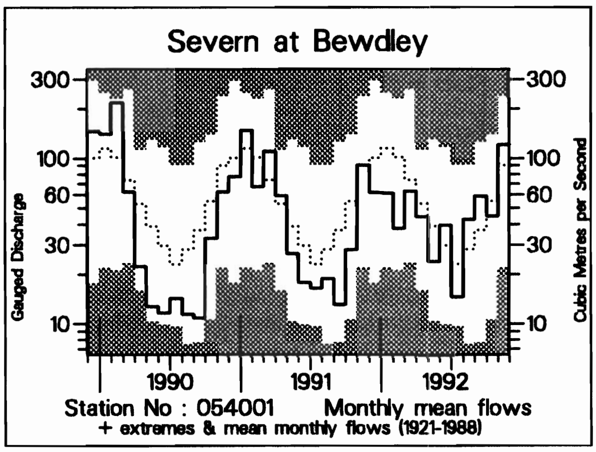


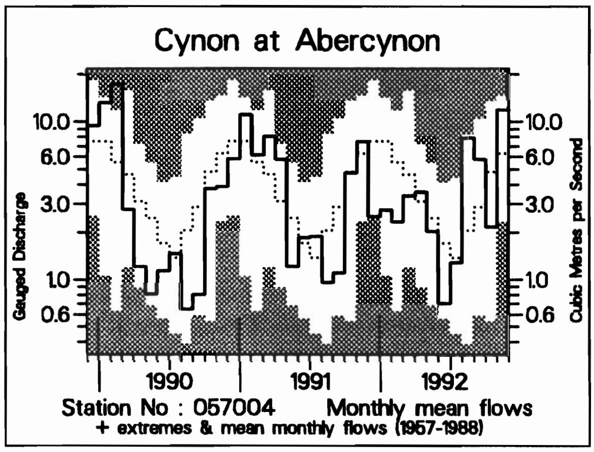

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1990
1991
1992
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

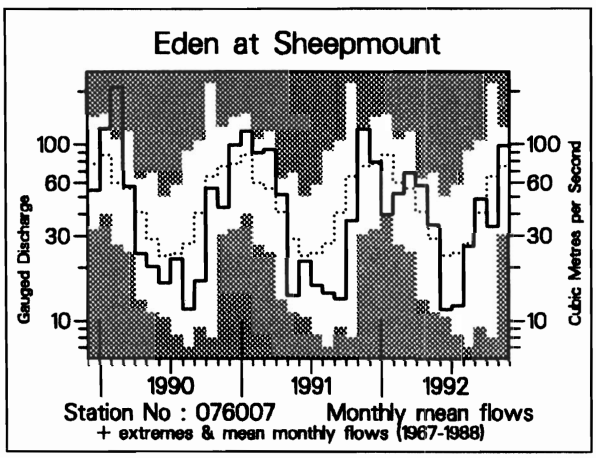

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10.0
7.0
4.0
2.0
1.0
1990
1991
1992
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1988)


Itchen at Highbridge+Allbrook
Gauged Discharge
Cubic Metres per Second
10.0
8.0
6.0
4.0
1990
1991
1992
Station No : 042010 Monthly mean flows
+ extremes & mean monthly flows (1958-1988)


Tone at Bishops Hull
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1990
1991
1992
Station No : 052005 Monthly mean flows
+ extremes & mean monthly flows (1961-1988)


Severn at Bewdley
Gauged Discharge
Cubic Metres per Second
300
100
60
30
10
1990
1991
1992
Station No : 054001 Monthly mean flows
+ extremes & mean monthly flows (1921-1988)


Cynon at Abercynon
Gauged Discharge
Cubic Metres per Second
10.0
6.0
3.0
1.0
0.6
1990
1991
1992
Station No : 057004 Monthly mean flows
+ extremes & mean monthly flows (1957-1988)


Eden at Sheepmount
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1990
1991
1992
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1988)

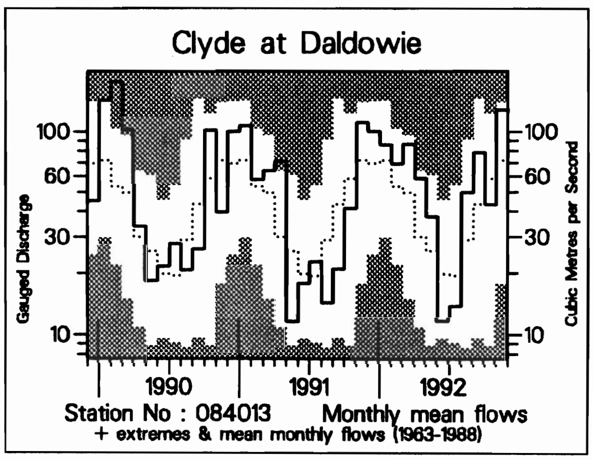

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1990
1991
1992
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1988)

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	Jul 1992	Aug 1992	Sep 1992	Oct 1992	Nov 1992	Nov 1992	9/92 to 11/92	9/92 to 11/92	1/92 to 11/92	1/92 to 11/92	5/90 to 11/92	5/90 to 11/92	11/88 to 11/92	11/88 to 11/92
	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	14	42	55	61	90	17	206	14	587	4	1704	5	2738	2
Park	49	134	137	76	118	/21	103	/20	85	/20	87	/18	84	/17
Tay at	27	80	139	88	148	29	375	32	1132	33	2890	25	5296	33
Ballathie	67	157	200	79	123	/41	123	/40	115	/40	105	/38	115	/37
Whiteadder Water at	8	12	19	32	48	18	99	16	324	11	888	9	1233	5
Hutton Castle	63	78	123	118	129	/24	123	/24	94	/23	94	/21	76	/20
South Tyne at	8	28	48	41	117	21	206	12	594	8	1772	10	2883	5
Haydon Bridge	28	72	95	59	127	/31	96	/29	91	/29	94	/25	91	/23
Wharfe at	11	26	41	40	98	25	180	19	527	8	1493	4	2527	2
Flint Mill Weir	41	65	93	63	123	/38	95	/37	85	/37	85	/35	85	/34
Derwent at	8	7	11	21	27	17	59	17	185	4	535	3	838	1
Buttercrambe	57	49	82	105	97	/32	97	/31	65	/31	68	/29	62	/28
Trent at	16	16	20	30	52	34	102	29	261	9	638	2	1133	2
Colwick	101	97	121	130	173	/35	145	/34	85	/34	75	/32	78	/31
Lud at	7	8	8	10	12	17	30	10	102	3	277	1	512	1
Louth	44	60	72	84	85	/25	81	/25	44	/24	46	/22	49	/21
Witham at	7	5	11	23	28	32	61	32	136	13	292	5	520	3
Claypole Mill	100	73	179	274	239	/34	225	/34	83	/33	68	/32	70	/30
Little Ouse at	6	4	5	7	16	19	28	18	83	3	202	1	414	1
Abbey Heath	73	53	69	72	135	/25	99	/25	55	/24	50	/23	60	/21
Colne at	4	3	9	16	28	32	54	30	96	6	190	1	387	1
Lexden	96	75	216	193	232	/34	208	/33	81	/33	61	/31	70	/30
Lee at	5	5	8	18	24	95	50	92	89	16	212	6	444	7
Feildes Weir (natr.)	62	66	111	182	178	/108	162	/107	62	/106	54	/103	67	/100
Thames at	8	9	17	24	39	101	80	100	175	34	386	7	749	7
Kingston (natr.)	84	103	191	180	182	/110	182	/110	81	/110	66	/108	74	/106
Coln at	15	13	18	30	42	28	90	27	291	8	693	2	1264	2
Bibury	72	78	128	189	176	/30	166	/29	83	/29	74	/27	79	/26
Great Stour at	9	9	11	20	41	24	71	21	176	3	480	1	790	1
Horton	63	67	81	99	154	/29	115	/28	68	/26	68	/23	66	/19
Itchen at	21	20	22	24	29	15	75	10	264	1	816	1	1417	1
Highbridge+Allbrook	69	71	84	80	86	/35	84	/34	64	/34	72	/32	76	/31
Exe at	15	47	61	63	169	34	292	30	609	11	1672	6	2857	2
Thorverton	71	169	161	85	175	/37	139	/37	88	/36	85	/35	84	/33
Tone at	8	11	16	23	45	18	84	17	244	3	731	1	1477	1
Bishops Hull	52	90	106	87	107	/32	100	/32	61	/31	67	/30	76	/28
Severn at	9	26	35	28	72	52	135	53	333	21	874	8	1573	9
Bewdley	64	152	163	84	135	/72	124	/72	86	/71	81	/70	85	/68
Wye at	44	214	204	179	368	37	175	31	1885	23	5043	13	8182	8
Cefn Brwyn	40	149	125	86	146	/40	120	/38	106	/35	97	/26	97	/20
Cynon at	32	199	140	55	291	32	485	26	1080	17	2837	11	5037	13
Abercynon	93	408	213	45	191	/35	139	/33	102	/33	94	/29	98	/27
Eden at	14	31	55	40	110	17	205	13	550	8	1644	8	2823	8
Sheepmount	52	104	132	55	131	/23	107	/22	92	/22	99	/18	102	/15
Clyde at	19	70	107	61	174	29	341	26	910	28	2282	26	3748	26
Daldowie	69	176	189	74	181	/30	145	/29	136	/29	119	/27	119	/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 1991.

TABLE 4 START-MONTH RESERVOIR STORAGES UP TO DECEMBER 1992

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1992 Jul	Aug	Sep	Oct	Nov	Dec	1991 Dec
North West	Northern Command Zone[1]	(G)	133375	66	55	60	66	64	79	72
	Vyrnwy	(R)	55146	89	80	96	93	81	88	85
Northumbria	Teesdale[2]	(G)	87936	71	58	63	68	79	95	68
	Kielder	(R)	199175*	86*	77*	84*	89*	87*	77*	96*
Severn-Trent	Clywedog	(R)	44922	93	85	87	92	86	92	82
	Derwent Valley[3]	(G)	39525	79	73	66	62	79	95	46
Yorkshire	Washburn[4]	(G)	22035	85	72	64	64	70	89	48
	Bradford supply[5]	(G)	41407	76	58	56	65	65	83	70
Anglian	Grafham	(R)	58707	95	95	94	94	95	94	81
	Rutland	(R)	130061	81	81	86	93	95	96	63
Thames	London[6]	(G)	206232	86	85	89	94	96	96	71
	Farmoor[7]	(G)	13843	98	97	99	99	99	95	97
Southern	Bewl	(R)	28170	71	64	60	68	69	72	58
	Ardingly	(R)	4685	100	88	71	79	81	100	85
Wessex	Clatworthy	(R)	5364*	65*	43*	35*	40*	49*	70	89
	Bristol WW[8]	(G)	38666*	71*	61*	58*	65*	61*	63*	50*
South West	Colliford	(R)	28540	71	66	63	65	67	73	83
	Roadford	(R)	34500	83	75	70	72	76	85	86
	Wimbleball[9]	(R)	21320	63	53	48	50	55	71	69
	Stithians	(R)	5205	61	54	53	63	69	82	34
Welsh	Celyn + Brenig	(G)	131155	99	87	89	93	96	98	84
	Brianne	(R)	62140	88	77	90	99	100	100	100
	Big Five[10]	(G)	69762	77	66	83	86	87	91	87
	Elan Valley[11]	(G)	99106	91	87	100	100	100	100	94
Lothian	Edinburgh/Mid Lothian	(G)	97639	87	79	86	92	90	100	90
	West Lothian	(G)	5613	60	49	60	82	84	95	74
	East Lothian	(G)	10206	81	72	68	78	82	91	90

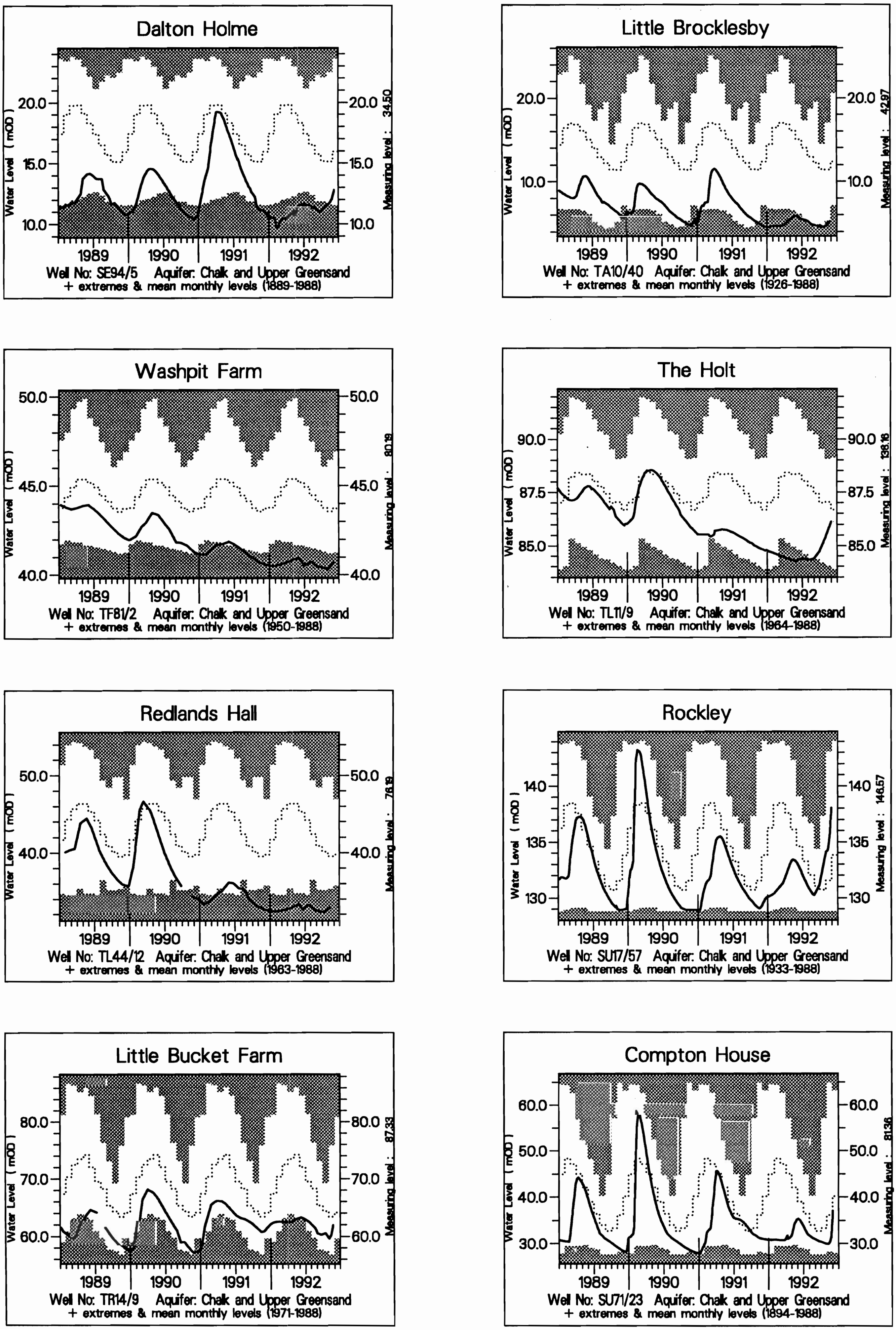
● Live or usable capacity (unless indicated otherwise)
* Gross storage/percentage of gross storage

77* Kielder drawn down for conservation purposes

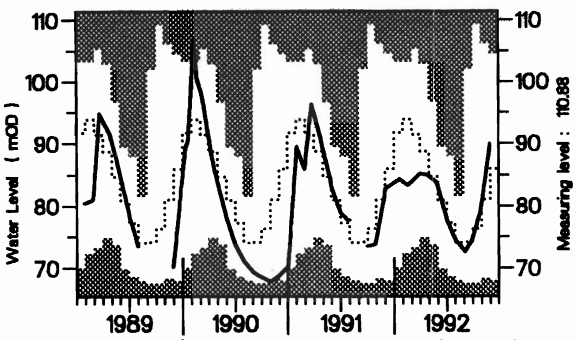
1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. 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 3 GROUNDWATER LEVEL HYDROGRAPHS

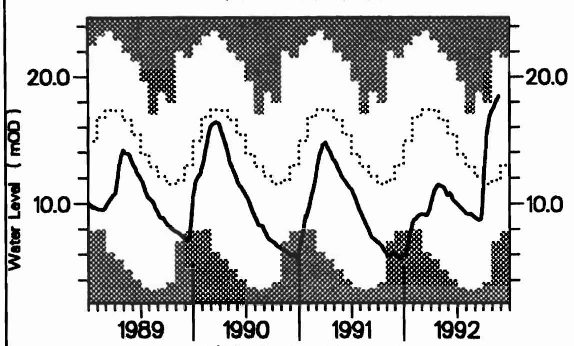


West Woodyates Manor



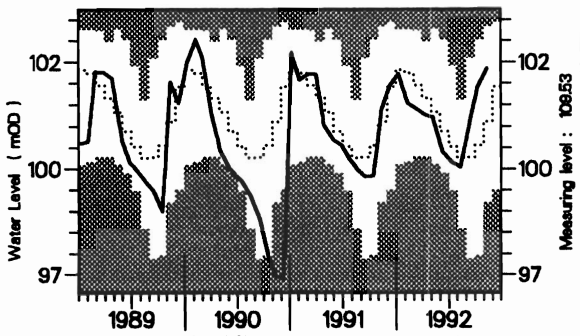
Well No: SU01/5B Aquifer: Chalk and Upper Greensand
+ extremes & mean monthly levels (1942-1988)

New Red Lion



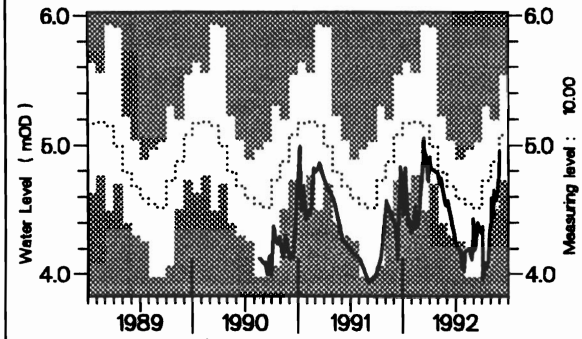
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1988)

Ampney Crucis



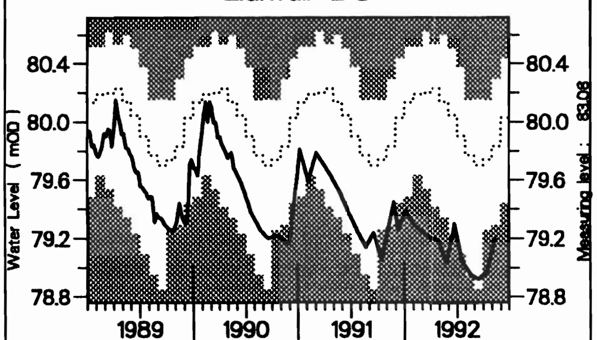
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1988)

Redbank



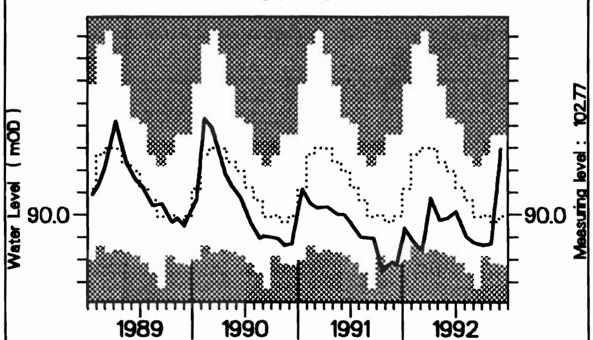
Well No: NX97/1 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1981-1988)

Llanfair DC



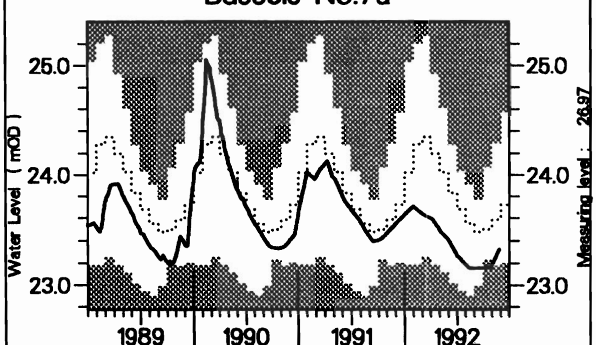
Well No: SJ15/15 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-1988)

Stone



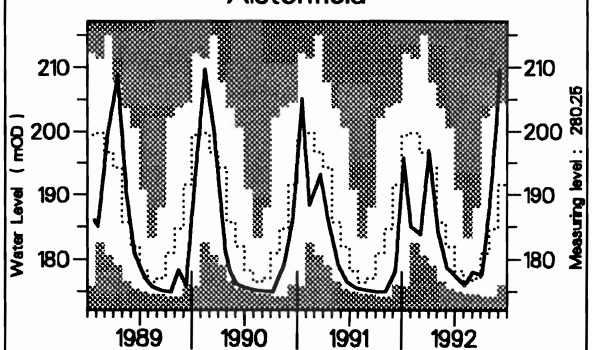
Well No: SJ83/1A Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1974-1988)

Bussels No.7a



Well No: SX99/37B Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1988)

Alstonfield



Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1988)

TABLE 5 A COMPARISON OF NOVEMBER GROUNDWATER LEVELS : 1992, 1991 AND 1976

Site	Aquifer	Records commence	Average November Level	November 1976 Day	November 1976 Level	November 1991 Day	November 1991 Level	November December 1992 Day	November December 1992 Level	No of years Nov/level <1992	Lowest pre-1992 level (any month)
Wetwang	C & UGS	1971	20.15	08/11	24.15	20/11	17.19	27/11	20.65	>10	16.84
Dalton Holme	C & UGS	1889	14.95	27/11	15.07	11/11	11.18	27/11	12.10	5	10.34
Little Brocklesby	C & UGS	1926	10.27	26/11	7.09	26/11	4.90	24/11	5.28	2	4.54
Washpit Farm	C & UGS	1950	43.43	01/11	41.50	01/11	40.75	01/12	40.70	0	40.61
The Holt	C & UGS	1964	87.03	24/11	84.16	24/11	84.88	01/12	86.13	5	83.90
Therfield Rectory	C & UGS	1883	78.24	23/11	72.55	17/11	72.43	01/12	72.23	4	dry (below 71.59)
Redlands Farm	C & UGS	1964	39.23	01/11	35.40	25/11	32.71	13/11	32.90	1	32.46
Rockley	C & UGS	1933	131.62	28/11	129.12	24/11	129.12	29/11	138.04	>10	dry (below 128.94)
Little Bucket Farm	C & UGS	1971	62.91	01/11	56.77	28/11	60.83	23/11	61.95	8	56.77
Compton House	C & UGS	1894	35.76	18/11	36.27	26/11	31.11	01/12	37.09	>10	27.64
Chilgrove House	C & UGS	1836	45.17	27/11	51.82	26/11	39.65	01/12	54.52	>10	33.46
West Dean No 3	C & UGS	1940	1.76	12/11	1.95	24/11	1.64	24/11	1.64	>10	1.01
Lime Kiln Way	C & UGS	1969	124.90	15/11	124.42	06/11	124.30	03/12	123.75	0	124.09
Ashton Farm	C & UGS	1974	65.93	25/11	68.85	29/11	68.20	30/11	66.52	>10	63.10
West Woodyates	C & UGS	1942	79.84	09/11	85.84	29/11	81.80	30/11	89.95	>10	67.62
New´Red Lion	LLst	1964	11.86	26/11	10.06	25/11	6.11	24/11	18.42	>10	3.29
Ampney Crucis	Mid Jur	1958	101.22	28/11	101.76	11/11	101.39	12/11	102.35	>10	97.38
Dunmurry (NI)	PTS	1985	28.28	no	levels	26/11	28.10	27/11	28.32	4	27.47
Redbank	PTS	1981	4.77	no	levels	04/11	4.57	02/12	4.95	10	3.93
Skirwith	PTS	1978	129.90	no	levels	30/11	130/09	30/11	129.91	5	129.44
Llanfair DC	PTS	1972	79.73	01/11	79.47	25/11	79.45	10/11	79.20	1	78.85
Morris Dancers	PTS	1969	32.60	23/11	31.81	12/11	32.11	18/11	31.88	1	30.87
Stone	PTS	1974	90.02	26/11	89.67	27/11	89.58	07/12	90.59	>10	89.34
Bussels 7A	PTS	1972	23.60	30/11	24.30	05/11	23.48	24/11	23.32	4	22.90
Rushyford NE	MgLst	1967	75.80	30/11	68.18	12/11	75.04	11/11	74.57	>10	64.77
Peggy Ellerton	MgLst	1968	34.12	22/11	32.34	11/11	32.86	07/12	32.29	1	31.10
Alstonfield	CLst	1974	186.07	25/11	182.89	06/11	175.08	07/12	209.62	>10	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 Middle Jurassic limestones
MgLst Magnesian Limestone
CLst Carboniferous Limestone

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS