Hydrological Summary for Great Britain

DECEMBER 1996

Rainfall

December was a relatively dry and sunny month with notably low temperatures towards month-end heralding an exceptionally cold interlude. A succession of Atlantic frontal systems produced significant rainfall early in the month in most regions. Thereafter, an anticyclone centred generally to the north of Britain dominated weather patterns. Easterly and north-easterly airflows produced freezing conditions and spatially very variable snowfalls - blizzards in northern and eastern Britain, and the Midlands, but mere snow flurries in much of central southern England. December rainfall estimates exceeded the average in parts of north-eastern Britain but most regions registered less than 65% of the mean and a few parts of southern England reported less than 25%. For England and Wales, the December precipitation was only a little over 50% and, after moderating through the late autumn, rainfall deficiencies increased once more. The 1996 phase of the drought is most notable in the English lowlands, the Thames basin expecially, but the most extreme deficiencies continue to relate to the period beginning in April 1995. The ensuing 21-month sequence is the driest (in that timeframe) in the entire England and Wales rainfall series (from 1767) and, considering *any* start month, drier 21-month periods in the last 200 years are confined to the droughts of 1975/76, 1933/34 and, marginally, 1802/03. Over the drought's full compass the rainfall deficiencies are greatest in eastern, central and northern England - for some districts in the North-West, the shortfall is equivalent to over six months average rainfall (deficiencies equivalent to more than four months are very widespread).

River Flow

The seasonal recovery in runoff rates continued into early December - modest spate conditions were widespread in the first week - but then stalled in most regions. Further spates were reported on the 18/19th - triggering minor flood alerts (e.g., in the Midlands) and flood drawdown releases in a few western reservoirs - but generally rivers were in recession for most of the month and very low winter runoff rates were reported from frozen catchments at the turn of the year. Parts of southern Scotland aside, December runoff totals were below average but mostly well above drought minima. In southern England - parts of Wales and the North-West also - runoff totals declined relative to November and many fell within the lowest quartile for December. Naturalised flows on the Thames were the second lowest (after 1990) for December in the last 50 years. Elsewhere flows were less notably depressed - generally exceeding the corresponding monthly flows for 1991 (or 1990), and 1988. However, longer term runoff accumulations testify to a protracted and spatially extensive drought. Rivers establishing new minimum annual runoff totals for 1996 show a wide distribution - from the Carron (Highland Region) to the Great Stour (Kent); runoff totals for the period since April 1995 are also unprecedented in a significant minority of index catchments, falling below 50% of the long term average for a few eastern catchments.

Groundwater

Given the near saturated late autumn soils, average December rainfall would have generated substantial groundwater level recoveries in most outcrop areas. In the event, modest recharge early in the month was followed by little further infiltration. Levels are now depressed throughout most of the Chalk and close to record minima in parts of eastern England. Preliminary analysis indicates that overall stocks in the Chalk for around year-end were similar to 1991/92 and rank about fourth lowest since 1950. In the Lincolnshire Limestone, a new December minimum was registered at the New Red Lion borehole. Resource depletion in the Permo-Triassic sandstones is very spatially variable but particularly depressed levels still typify most of the more northerly outcrops. The very weak 1996/97 recovery thus far reinforces the changing character of the drought: in 1995 its impact was principally on surface waters; the 1997 outlook is most fragile in relation to groundwater (but groundwater resources are potentially very large and their resilience as major supply sources has been well demonstrated in the recent past).

General

Overall reservoir stocks increased slightly in December - but are appreciably below average (although much healthier in most of northern England than last year). Stocks remain well below capacity in much of southern, central and of eastern England. There is still plenty of scope for further reservoir refill but the window of opportunity for aquifer recharge is becoming narrow in the east. Water supply prospects will be heavily influenced by the timing of the onset of reservoir drawdown and the length of the 1996/97 recharge season. Substantial rainfall over the next two-three months is needed to avoid the likelihood of very depressed groundwater levels in the summer (with much contracted headwater stream networks and exceptionally low late summer runoff rates).

Institute of Hydrology

British Geological Survey

Data for this report have been provided principally by the regional divisions of the newly formed Environment Agency (England and Wales) and the Scottish Environment Protection Agency. For reasons of consistency and to provide greater spatial discrimination, the original regional divisions of the precursor organisations have been retained for use in the Hydrological Summaries. The majority of the areal rainfall figures have been provided by the Meteorological Office. Figure 3 is based on weather data collected by the Institute of Hydrology at Wallingford, Balquhidder (Central Region, Scotland) and Plynlimon. Reservoir contents information has been supplied by the Water Services Companies, the Environment Agency and, in Scotland, West of Scotland Water Authority and East of Scotland Water.

The most recent areal rainfall figures are derived from a restricted network of raingauges 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.

Financial support towards the production of the Hydrological Summaries is given by the Department of the Environment, the Environment Agency, the Scottish Environment Protection Agency and the Office of Water Services (OFWAT).

The Hydrological Summaries are available on annual subscription at a current cost of £48 per year - enquiries should be directed to the National Water Archive Office at the address below. No charge is made to those organisations providing data for the Summaries. The text of the monthly report, together with details of other National Water Archive facilities, is available on the World Wide Web: http://www.nwl.ac.uk:80/~nrfadata/nwa.html

MORECS

Most of the recent monthly regional rainfall data featured in the Hydrological Summaries are MORECS assessments. MORECS is the generic name for The Meteorological Office services involving the calculation of evaporation and soil moisture routinely for Great Britain. Products include a weekly issue of maps and tables of potential and actual evaporation, soil moisture deficits, effective rainfall and the hydrometeorological variables used to calculate them. The data are used to provide values for 40 km squares - or larger areas - and various sets of maps and tables are available according to user requirements. Options include a day-by-day retrospective calculation of soil moisture at any of 4000 raingauge sites.

Further information about MORECS services may be obtained from: The Meteorological Office, Sutton House, London Road, Bracknell, RG12 2SY

Tel: 01344 856858 Fax: 01344 854024

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

14 January 1997

TABLE 1 1995/96 RAINFALL AS A PERCENTAGE OF THE 1961-90 AVERAGE

		Dec 1995	Jan 1996	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
England and	mm	84	63	83	43	51	57	29	40	79	32	89	128	49
Wales	%	89	72	132	60	85	89	45	65	104	42	105	142	52
North West	mm	42	53	105	36	77	62	45	58	84	52	149	146	70
	%	34	44	135	38	108	83	56	68	79	45	116	119	57
Northumbrian	mm	79	46	89	31	63	53	22	52	76	30	68	94	85
	%	98	55	151	44	113	85	37	80	94	41	89	110	104
Severn Trent	mm	81	44	67	41	50	48	30	33	68	20	71	91	48
	%	105	63	124	67	91	81	51	62	101	31	111	127	63
Yorkshire	mm	70	46	78	31	41	52	35	41	74	31	57	114	95
	%	84	58	134	46	69	87	58	69	100	46	78	143	114
Anglian	mm	69	33	50	20	15	23	18	41	75	16	46	92	41
	%	125	66	135	43	33	48	35	84	136	33	90	158	74
Thames	mm	96	50	64	35	36	35	15	38	60	20	47	103	23
	%	137	78	142	63	72	63	27	78	103	34	76	158	32
Southern	mm	95	67	68	40	23	51	16	31	78	33	57	137	33
	%	116	84	126	63	43	94	30	65	137	48	71	161	40
Wessex	mm	104	76	85	68	58	60	30	27	86	31	83	130	31
	%	112	87	131	97	109	98	53	52	130	43	105	157	34
South West	mm	126	156	119	72	79	100	35	31	97	49	134	183	50
	%	91	113	118	73	114	139	51	45	115	53	116	146	36
Welsh	mm	103	102	127	73	87	106	47	46	100	58	173	162	53
	%	67	71	131	68	109	129	59	60	99	50	126	114	35
Scotland	mm	55	89	141	60	108	78	65	77	69	62	229	205	96
	%	36	59	138	48	142	91	76	82	59	44	147	136	63
Highland	mm	48	58	152	55	111	84	83	91	78	80	266	309	116
	%	24	31	120	34	122	91	85	86	61	47	134	152	59
North East	mm	70	69	114	59	63	67	32	66	64	32	139	97	84
	%	75	70	175	76	105	97	48	90	74	37	143	98	90
Tay	mm	68	136	116	76	103	67	41	52	64	50	195	147	72
	%	54	94	122	70	166	81	56	68	68	44	150	121	57
Forth	mm	54	72	86	53	86	68	43	55	62	46	186	126	71
	%	49	61	109	56	146	92	62	73	66	42	162	113	65
Tweed	mm	64	68	103	30	79	63	31	53	64	29	134	111	110
	%	69	68	154	38	139	89	48	73	73	33	141	119	118
Solway	mm	52	135	160	74	133	80	75	70	68	56	265	165	99
	%	35	87	158	63	173	94	89	78	57	39	169	115	67
Clyde	mm	47	119	180	62	142	90	88	97	65	79	282	229	87
	%	26	63	153	42	169	99	95	89	49	44	146	127	49

Note: The monthly regional rainfall figures for England and Wales for November & December 1996 correspond to the MORECS areal assessments derived by the Meteorological Office. In northern England these initial assessments may have a particularly wide error band associated with them, especially when snow is a significant component in the precipitation total. The figures for the Scottish regions (and also for Scotland) for November & December 1996 were derived by IH in collaboration with the SEPA regions. The provisional figures for England and Wales and for Scotland are derived using a different raingauge network. 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 ACCUMULATIONS AND RETURN PERIOD ESTIMATES

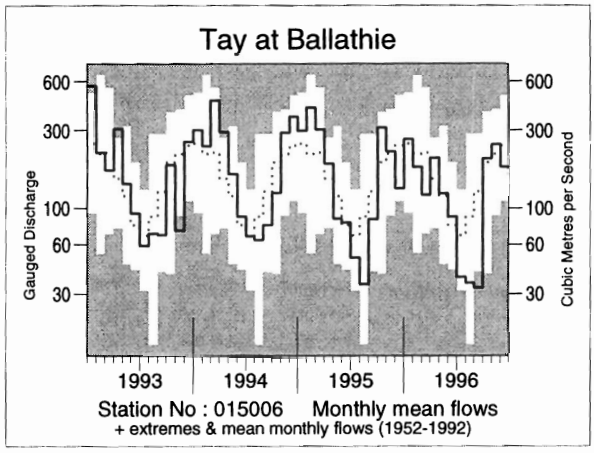
		Oct 96-Dec 96		Mar 96-Dec 96		Jan 96-Dec 96		Apr 95-Dec 96	
			Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years
England and Wales	mm	266		597		743		1230	
	% LTA	99	2-5	80	10-15	83	5-15	78	50-80
North West	mm	366		780		938		1473	
	% LTA	97	2-5	78	10-20	78	15-25	70	>>200
Northumbria	mm	247		574		709		1236	
	% LTA	102	2-5	81	5-15	83	5-15	83	15-25
Severn Trent	mm	210		500		611		1016	
	% LTA	99	2-5	79	5-15	81	5-15	77	40-60
Yorkshire	mm	266		571		695		1087	
	% LTA	113	2-5	83	5-10	85	5-10	76	70-100
Anglian	mm	178		386		469		800	
	% LTA	109	2-5	76	10-20	79	10-20	76	70-100
Thames	mm	173		412		526		943	
	% LTA	88	2-5	71	20-35	76	10-20	78	30-50
Southern	mm	227		499		634		1064	
	% LTA	92	2-5	77	10-15	81	5-15	78	30-45
Wessex	mm	245		605		766		1344	
	% LTA	96	2-5	88	2-5	91	2-5	92	2-5
South West	mm	367		830		1105		1792	
	% LTA	97	2-5	89	2-5	94	2-5	89	5-10
Welsh	mm	388		905		1134		1834	
	% LTA	90	2-5	84	5-10	86	5-10	80	30-40
Scotland	mm	530		1049		1279		2200	
	% LTA	116	2-5	89	5-10	89	5-10	88	10-20
Highland	mm	691		1273		1483		2567	
	% LTA	116	2-5	88	5-10	84	10-15	84	25-40
North East	mm	320		703		886		1729	
	% LTA	111	2-5	87	5-10	91	2-5	101	2-5
Tay	mm	414		867		1119		1959	
	% LTA	110	2-5	88	2-5	91	2-5	93	2-5
Forth	mm	383		796		954		1661	
	% LTA	114	2-5	87	5-10	86	5-10	86	10-20
Tweed	mm	355		704		875		1495	
	% LTA	126	5-10	88	2-5	90	2-5	88	5-10
Solway	mm	529		1085		1380		2166	
	% LTA	118	2-5	93	2-5	97	2-5	88	5-15
Clyde	mm	598		1221		1520		2506	
	% LTA	108	2-5	88	5-10	90	5-10	85	15-25

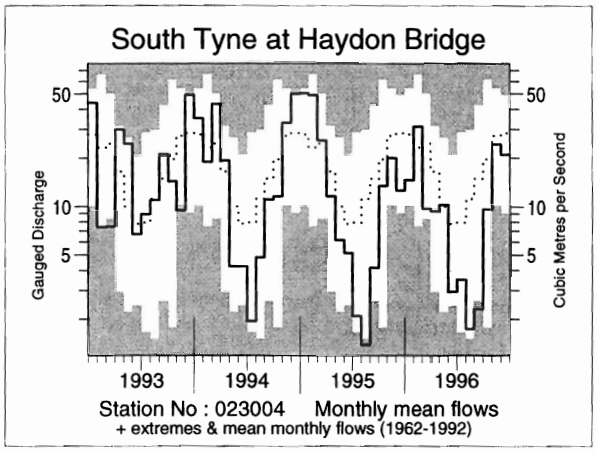
LTA refers to the period 1961-90.

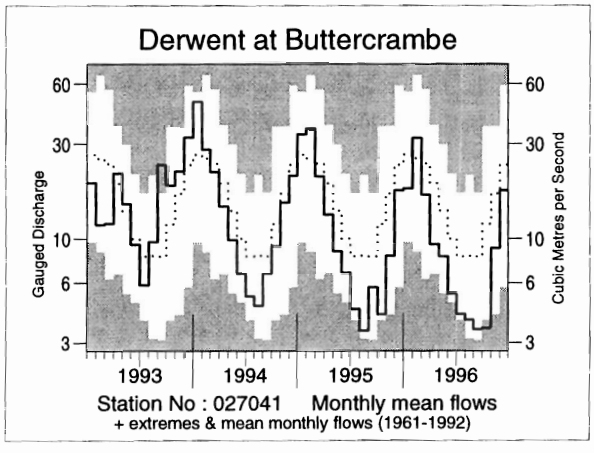
Return period assessments are based on tables provided by the Meteorological Office*. The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate. They assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less - for the longest durations the return period estimates converge. "Wet" return periods underlined. The ranking of accumulated rainfall totals for England & Wales and for Scotland can be affected by artifacts in the historical series - on balance these tend to exaggerate the relative wetness of the recent past.

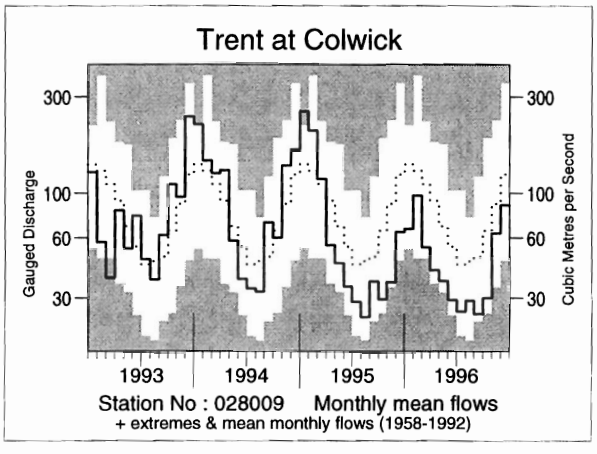
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office.

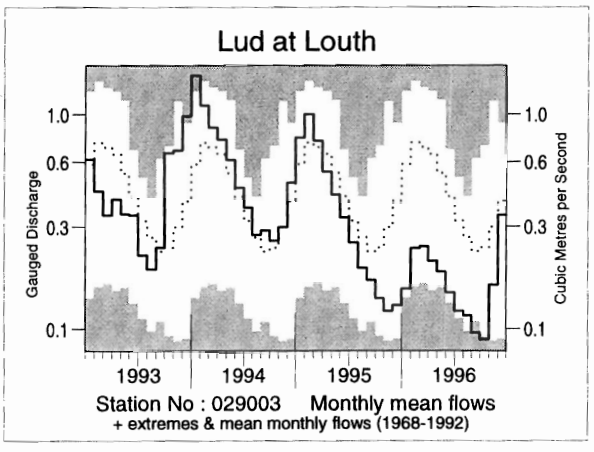
FIGURE 1 MONTHLY RIVER FLOW HYDROGRAPHS

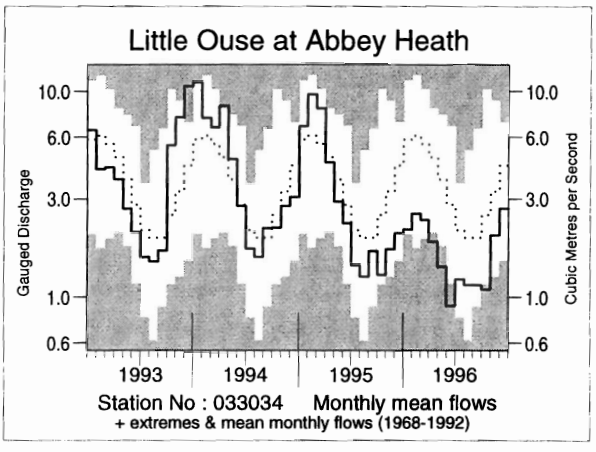


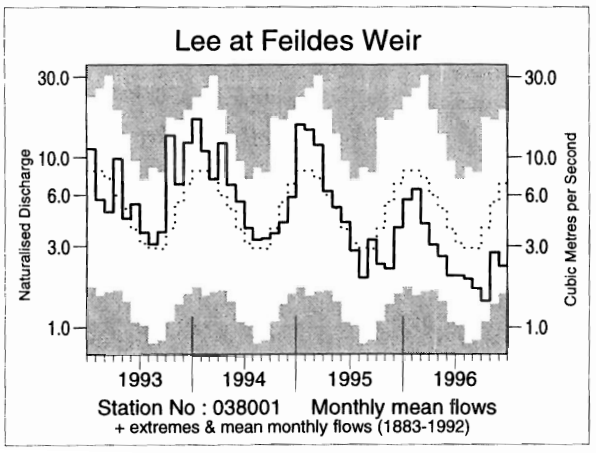


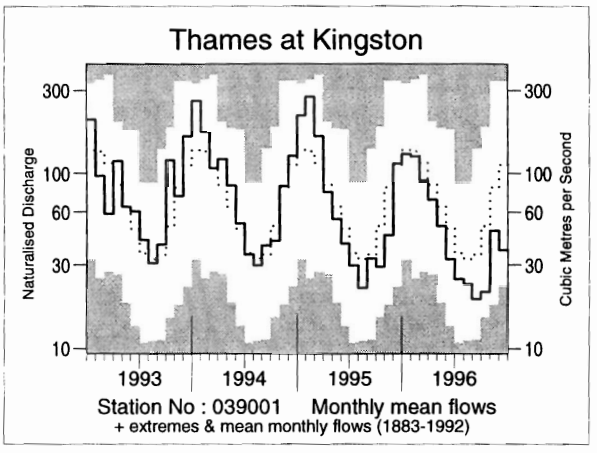


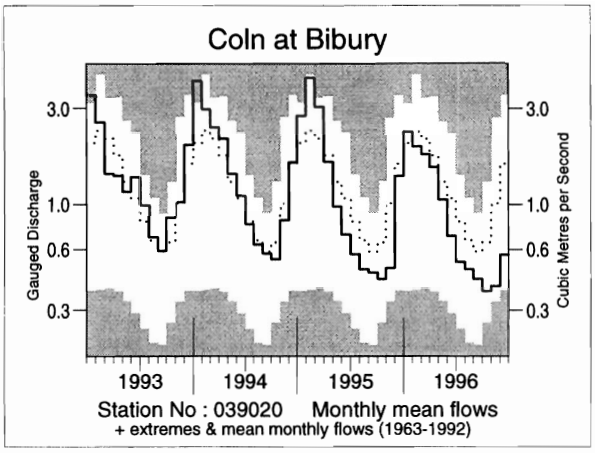


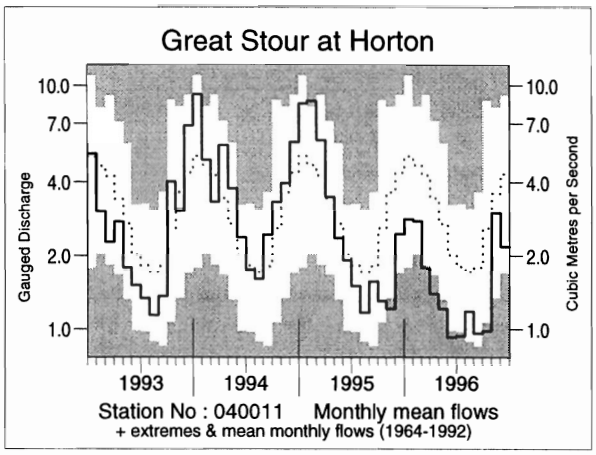


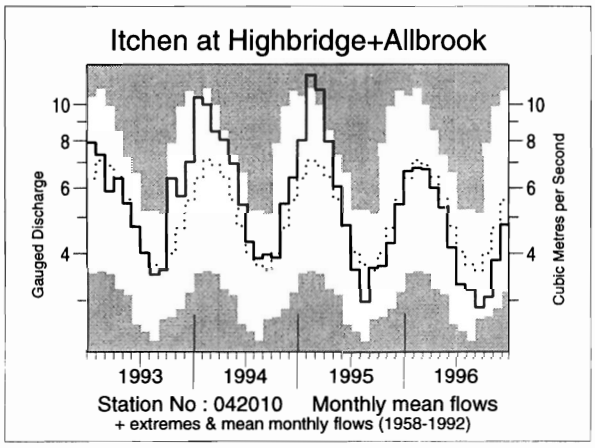


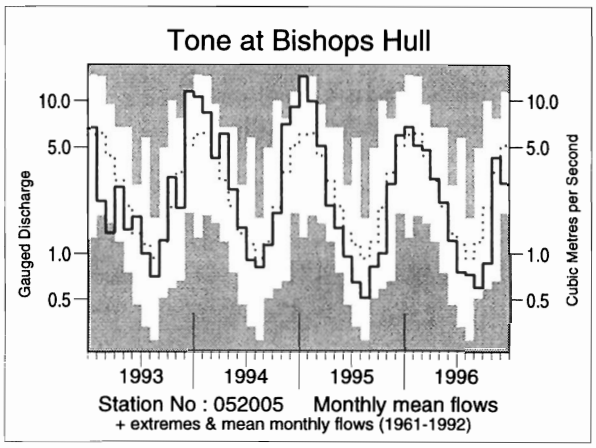


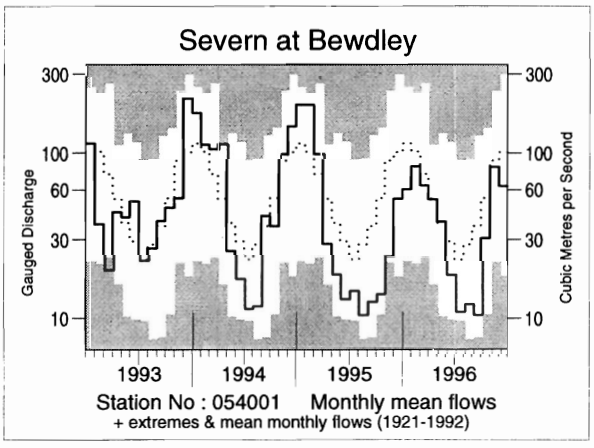


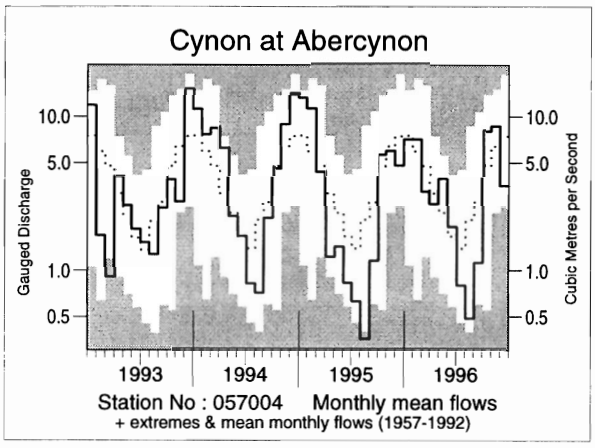

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1993
1994
1995
1996
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1992)

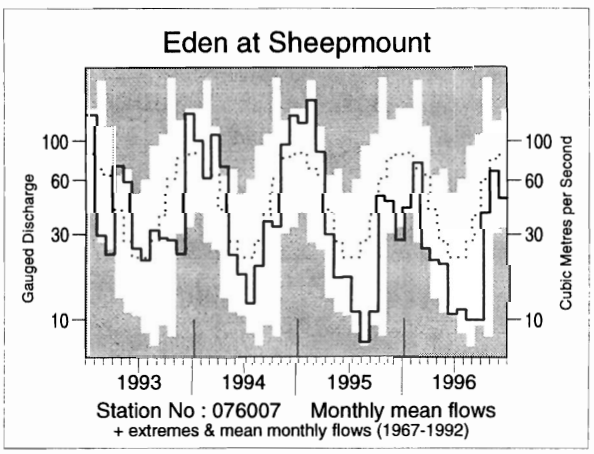

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10.0
7.0
4.0
2.0
1.0
1993
1994
1995
1996
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1992)


Itchen at Highbridge+Allbrook
Gauged Discharge
Cubic Metres per Second
10
8
6
4
1993
1994
1995
1996
Station No : 042010 Monthly mean flows
+ extremes & mean monthly flows (1958-1992)


Tone at Bishops Hull
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1993
1994
1995
1996
Station No : 052005 Monthly mean flows
+ extremes & mean monthly flows (1961-1992)


Severn at Bewdley
Gauged Discharge
Cubic Metres per Second
300
100
60
30
10
1993
1994
1995
1996
Station No : 054001 Monthly mean flows
+ extremes & mean monthly flows (1921-1992)


Cynon at Abercynon
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1993
1994
1995
1996
Station No : 057004 Monthly mean flows
+ extremes & mean monthly flows (1957-1992)


Eden at Sheepmount
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1993
1994
1995
1996
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1992)

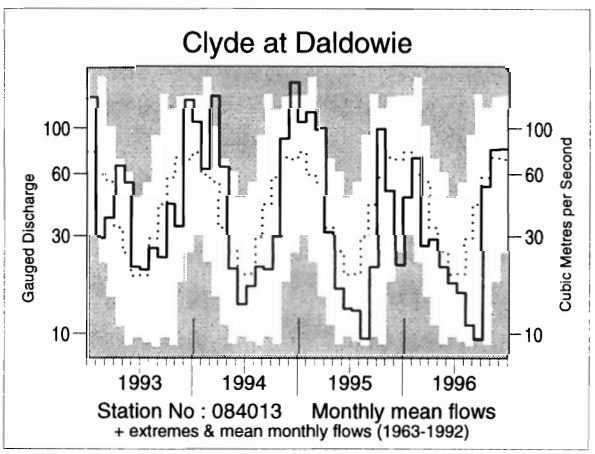

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1993
1994
1995
1996
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1992)

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	Aug 1996	Sep	Oct	Nov	Dec 1996		10/96 to 12/96		4/96 to 12/96		1/96 to 12/96		5/95 to 12/96	
	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	13 44	12 27	58 70	63 82	77 91	12 /25	198 81	6 /24	434 83	5 /24	761 97	10 /24	1298 104	11 /23
Tay at Ballathie	20 41	19 27	118 105	139 115	105 74	13 /45	361 97	21 /45	659 89	12 /44	984 87	10 /44	1563 87	8 /43
Tweed at Boleside	13 35	11 23	67 93	103 118	126 127	27 /36	296 114	25 /36	444 90	12 /36	688 91	11 /36	1002 84	6 /35
Whiteadder Water at Hutton Castle	7 47	6 38	8 27	29 79	102 217	27 /28	138 123	20 /28	220 94	11 /27	374 97	15 /27	518 89	11 /26
South Tyne at Haydon Bridge	6 16	8 16	34 50	84 91	75 72	10 /35	193 73	8 /35	299 60	3 /33	490 64	1 /33	719 59	1 /31
Wharfe at Flint Mill Weir	22 58	18 41	39 64	79 102	77 79	16 /42	195 83	12 /42	310 68	4 /41	435 61	1 /41	542 49	1 /40
Derwent at Buttercrambe	7 49	6 41	6 30	15 54	30 74	11 /36	50 58	6 /36	107 55	4 /35	217 68	5 /35	315 65	2 /34
Trent at Colwick	10 66	9 51	11 46	22 71	31 69	10 /39	64 65	6 /39	130 59	2 /38	206 59	2 /38	311 57	2 /37
Lud at Louth	6 44	5 42	4 35	8 53	17 83	13 /29	28 62	10 /29	70 46	2 /28	100 40	2 /28	184 50	3 /27
Witham at Claypole Mill	3 49	3 39	4 37	6 47	9 43	12 /38	18 43	11 /38	50 46	2 /37	95 52	2 /37	141 52	2 /37
Little Ouse at Abbey Heath	4 61	4 60	4 42	7 60	10 61	7 /29	22 57	7 /29	51 50	2 /29	77 47	1 /28	132 53	2 /28
Colne at Lexden	3 77	2 56	3 33	7 58	7 40	6 /37	17 45	7 /37	36 48	3 /36	71 53	4 /36	107 55	3 /34
Lee at Feildes Weir (natr.)	5 66	4 58	4 36	7 51	6 33	9 /112	16 40	13 /112	50 50	9 /110	91 56	12 /110	156 63	16 /109
Thames at Kingston (natr.)	6 72	5 55	6 42	12 57	10 33	8 /114	28 43	14 /114	86 60	16 /114	177 72	22 /114	275 75	23 /113
Coln at Bibury	12 73	10 74	9 58	10 40	14 35	5 /34	33 42	4 /34	149 65	4 /33	298 76	5 /33	434 75	5 /32
Great Stour at Horton	9 71	7 53	8 37	23 85	17 49	5 /32	47 58	7 /32	97 54	1 /30	153 53	1 /30	256 57	1 /29
Itchen at Highbridge+Allbrook	24 86	21 79	23 75	28 81	36 85	14 /39	86 81	10 /39	267 86	8 /38	414 90	9 /38	666 92	10 /37
Stour at Throop Mill	8 78	6 54	8 36	33 98	30 52	7 /24	71 63	8 /24	159 73	5 /24	339 86	9 /24	490 84	6 /23
Exe at Thorverton	12 46	9 24	53 72	133 135	71 52	6 /41	256 84	16 /41	406 80	11 /40	666 80	6 /40	958 75	2 /40
Taw at Umberleigh	6 31	4 18	28 46	134 146	62 52	6 /39	224 82	15 /39	325 77	11 /38	528 76	5 /38	726 68	2 /37
Tone at Bishops Hull	9 79	8 50	11 43	54 123	38 54	11 /36	103 74	11 /36	213 81	11 /36	425 89	11 /35	609 87	10 /35
Severn at Bewdley	7 44	6 29	19 58	49 93	39 62	15 /76	107 72	20 /76	194 71	9 /76	319 71	6 /75	417 60	3 /75
Teme at Knightsford Bridge	4 43	2 25	3 17	23 68	28 50	6 /27	54 51	5 /27	135 69	5 /27	298 82	6 /26	380 72	4 /26
Cynon at Abercynon	12 24	27 41	203 170	211 135	90 46	7 /39	504 107	23 /39	772 96	16 /37	1200 95	11 /37	1718 86	8 /35
Dee at New Inn	41 46	69 55	255 138	282 121	94 37	3 /28	630 94	12 /28	997 83	7 /27	1373 77	3 /27	1882 66	1 /26
Eden at Sheepmount	12 38	11 27	46 68	77 88	56 56	5 /30	179 71	6 /30	275 62	3 /29	435 62	2 /29	650 59	1 /28
Clyde at Daldowie	15 39	13 23	74 91	107 111	112 107	22 /34	293 104	19 /34	435 85	10 /33	632 81	8 /33	970 77	4 /32
Carron at New Kelso	83 53	112 45	371 148	362 130	162 49	4 /18	895 104	11 /18	1441 85	4 /18	1709 68	1 /18	2739 68	1 /17
Ewe at Poolewe	61 56	59 32	272 124	314 121	167 61	8 /27	754 100	12 /26	1245 86	5 /26	1509 71	2 /26	2563 74	1 /25

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 is rank 1.
(iii) %LT means percentage of long term average from the start of the record to 1995. For the long periods (at the right of thistable), the end date for the long term is 1996.

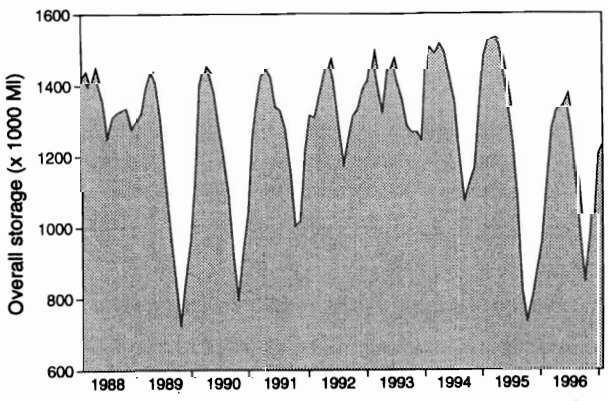
TABLE 4 START-MONTH RESERVOIR STORAGES UP TO JANUARY 1997

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1996 Aug	Sep	Oct	Nov	Dec	1997 Jan	*1996 Jan*
North West	N.Command Zone[1]	(G)	133375	64	45	36	69	84	77	*51*
	Vyrnwy	(R)	55146	56	43	35	65	86	81	*35*
Northumbria	Teesdale[2]	(G)	87936	62	42	34	35	61	78	*41*
	Kielder	(R)	199175*	89	83	81	86	93	88	*89*
Severn-Trent	Clywedog	(R)	44922	81	67	46	66	80	81	*54*
	Derwent Valley[3]	(G)	39525	43	36	27	30	93	98	*10*
Yorkshire	Washburn[4]	(G)	22035	75	69	62	64	86	97	*23*
	Bradford supply[5]	(G)	41407	56	55	48	59	84	90	*22*
Anglian	Grafham	(R)	58707	83	78	71	67	68	69	*83*
	Rutland	(R)	130061	83	78	72	70	70	71	*61*
Thames	London[6]	(G)	206399	77	67	54	46	59	70	*82*
	Farmoor [7]	(G)	13843	95	97	91	92	100	99	*89*
Southern	Bewl	(R)	28170	72	65	58	52	59	60	*65*
	Ardingly	(R)	4685	68	47	37	33	55	64	*67*
Wessex	Clatworthy	(R)	5364	70	62	48	44	88	96	*92*
	Bristol W [8]	(G)	38666*	76	66	57	59	77	80	*60*
South West	Colliford	(R)	28540	59	52	43	42	50	53	*46*
	Roadford[9]	(R)	34500	46	42	38	40	51	54	*23*
	Wimbleball[10]	(R)	21320	64	53	43	42	60	64	*46*
	Stithians	(R)	5205	79	68	57	50	71	88	*54*
Welsh	Celyn + Brenig	(G)	131155	66	55	48	63	75	82	*54*
	Brianne	(R)	62140	85	77	63	87	100	93	*76*
	Big Five[11]	(G)	69762	73	54	46	64	77	75	*67*
	Elan Valley[12]	(G)	99106	81	67	57	82	99	92	*56*
East of Scotland	Edin./Mid Lothian[13]	(G)	97639	89	77	68	74	89	93	*91*
	East Lothian[14]	(G)	10206	86	76	67	63	79	100	*99*
West of Scotland	Loch Katrine	(G)	111363	76	62	56	90	97	89	*80*
	Daer	(R)	22412	85	66	53	89	100	98	*83*
	Loch Thom	(G)	11840	82	70	59	88	100	99	*93*

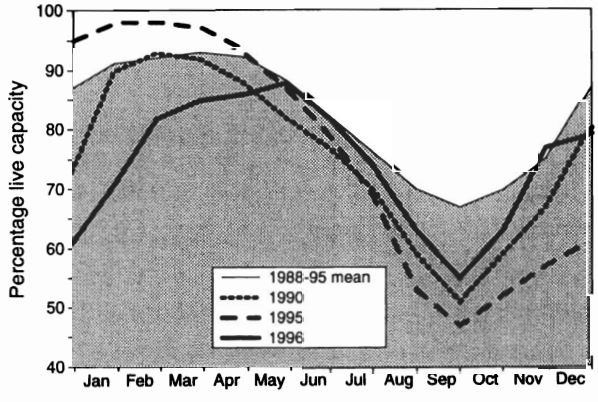
● Live or usable capacity (unless indicated otherwise) * Gross storage/percentage of gross storage

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. Roadford began filling in November 1989.
10. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
11. Usk, Talybont, Llandegfedd (pumped stroage), Taf Fechan, Taf Fawr.
12. Claerwen, Caban Coch, Pen-y-garreg and Craig Goch.
13. Megget, Talla, Fruid, Gladhouse, Torduff, Clubbiedean, Glencorse, Loganlea and Morton (upper and lower).
14. Thorters, Donolly, Stobshiel, Lammerloch, Hopes and Whiteadder

A GUIDE TO THE VARIATION IN OVERALL RESERVOIR STOCKS FOR ENGLAND AND WALES



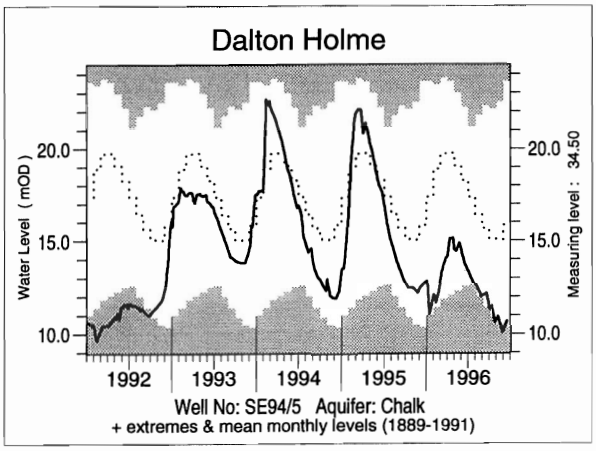
A COMPARISON BETWEEN OVERALL RESERVOIR STOCKS FOR ENGLAND AND WALES IN RECENT YEARS

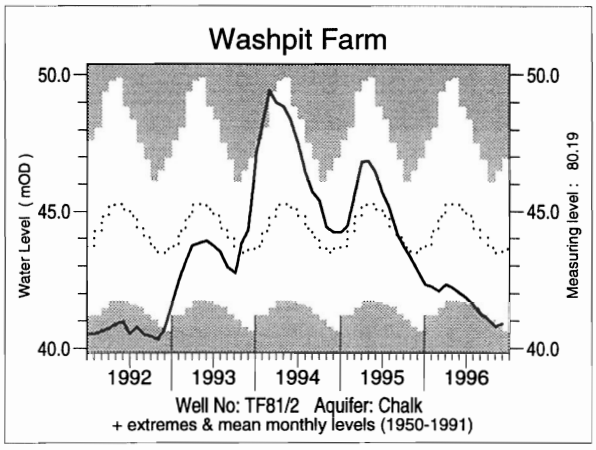


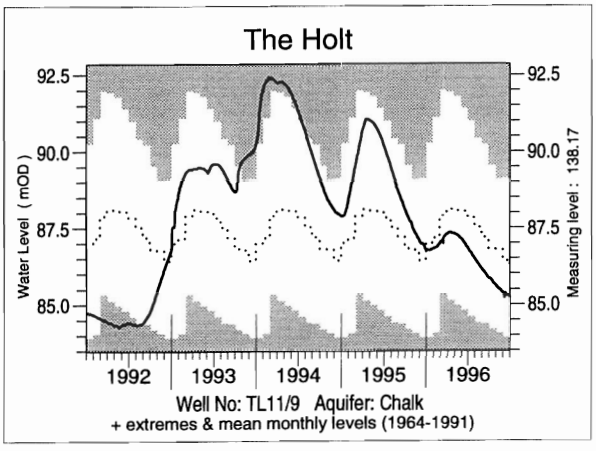
These plots are based on the reservoirs featured in Table 4 only

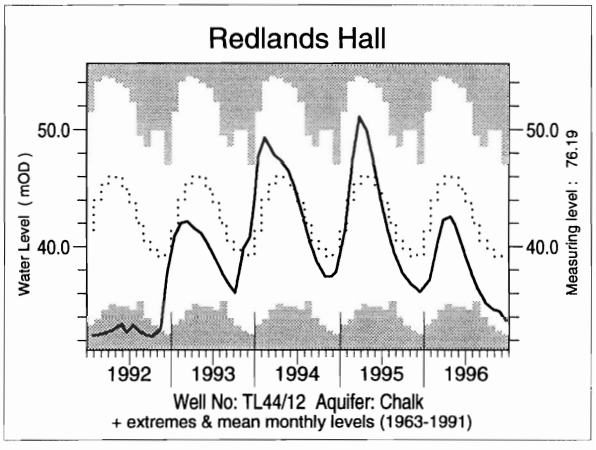
Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient use of water stocks will further affect reservoir storages. Table 4 is intended to provide a link between the hydrological conditions described elsewhere in the report and the water resources situation. The reservoirs featured may not be representative of storage conditions across the individual regions; this can be particularly important during drought conditions (eg, in the Severn-Trent region during 1995/96).

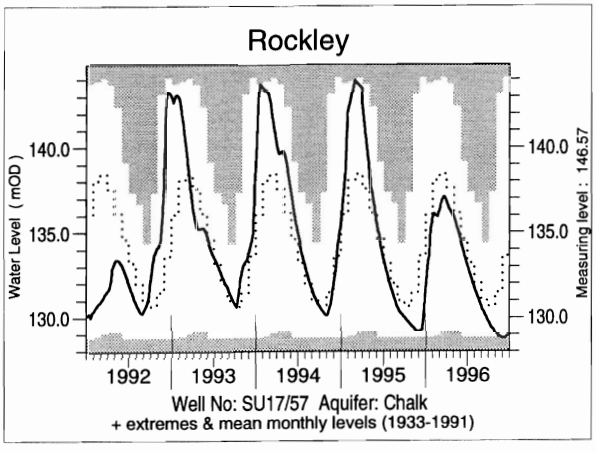
FIGURE 2 GROUNDWATER LEVEL HYDROGRAPHS

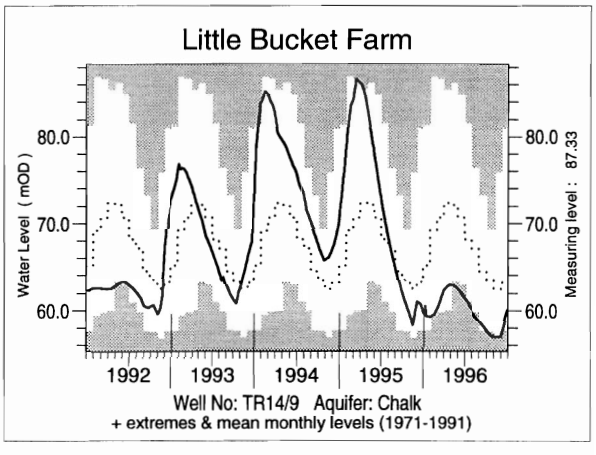


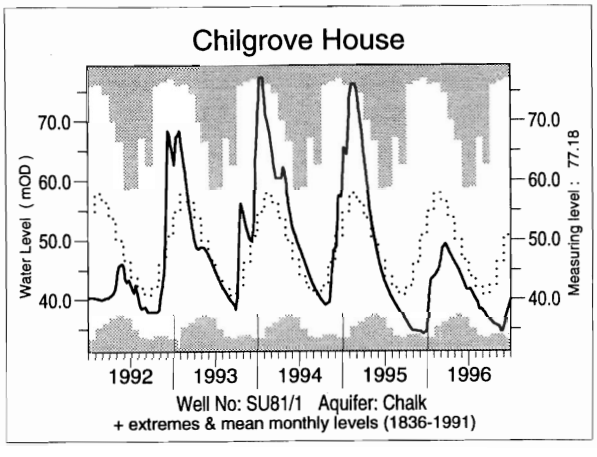


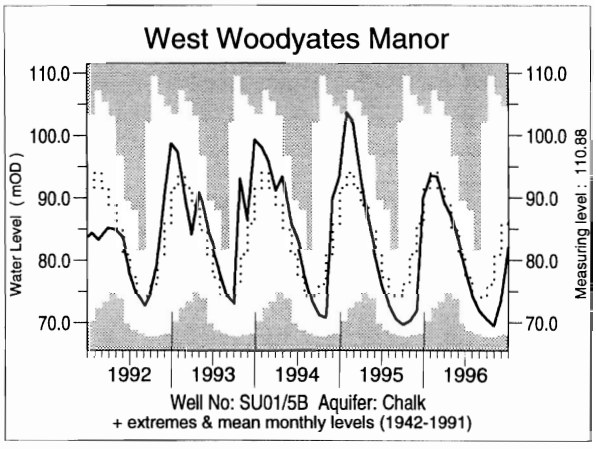


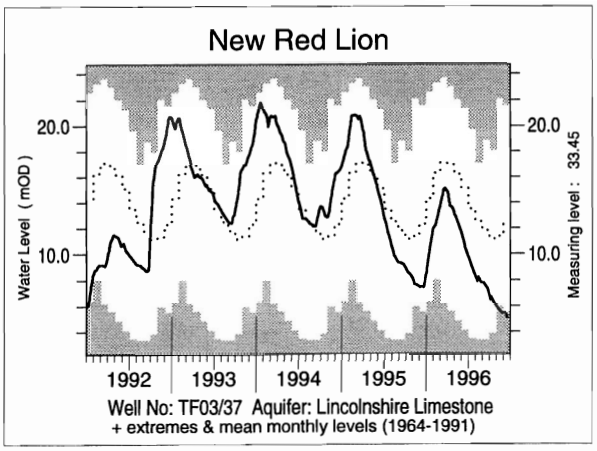


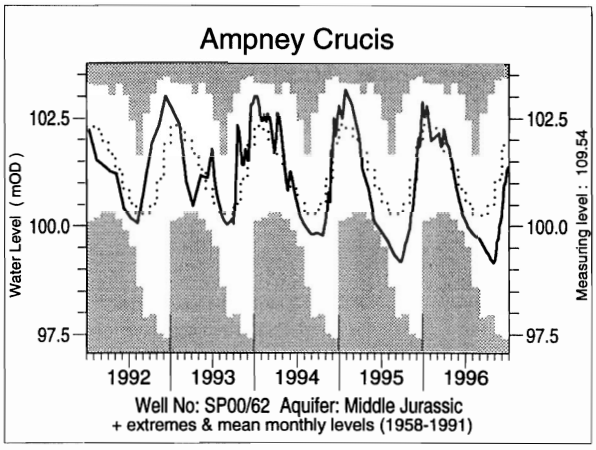


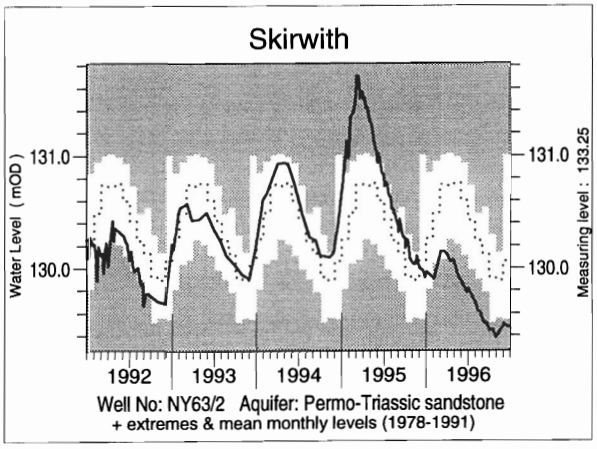


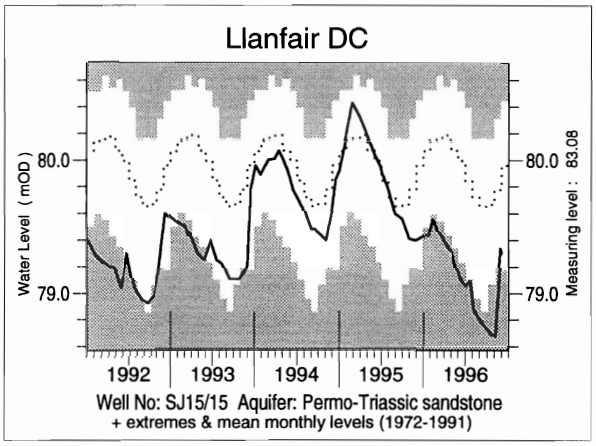


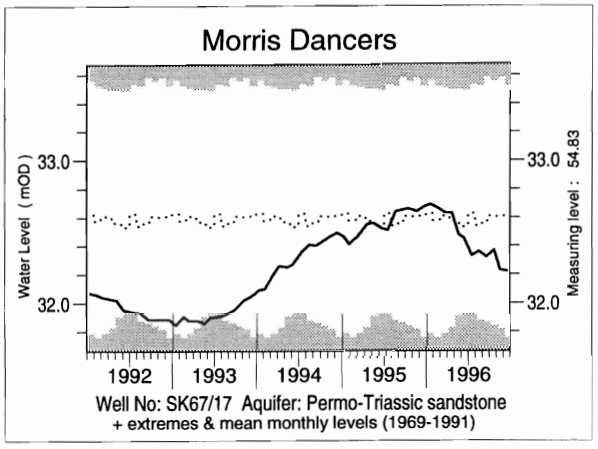


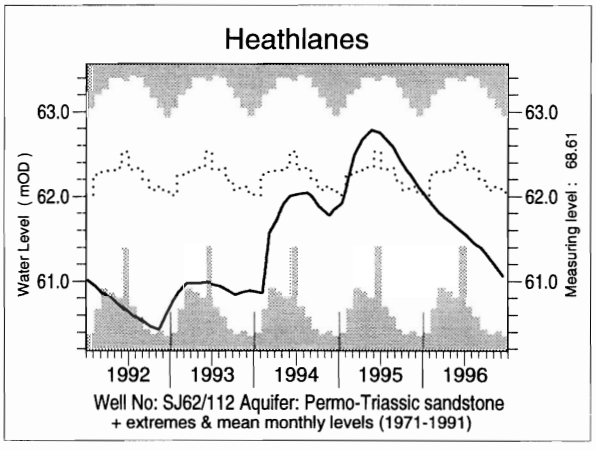

New Red Lion
Water Level (mOD)
20.0
10.0
Measuring level : 33.45
1992
1993
1994
1995
1996
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1991)

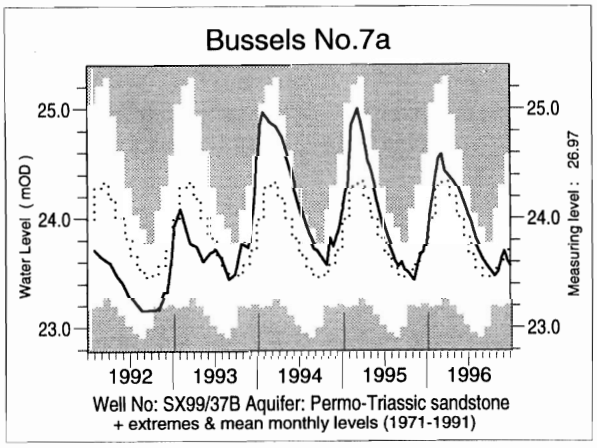

Ampney Crucis
Water Level (mOD)
102.5
100.0
97.5
Measuring level : 109.54
1992
1993
1994
1995
1996
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1991)


Skirwith
Water Level (mOD)
131.0
130.0
Measuring level : 133.25
1992
1993
1994
1995
1996
Well No: NY63/2 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1978-1991)


Llanfair DC
Water Level (mOD)
80.0
79.0
Measuring level : 83.08
1992
1993
1994
1995
1996
Well No: SJ15/15 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-1991)


Morris Dancers
Water Level (mOD)
33.0
32.0
Measuring level : 54.83
1992
1993
1994
1995
1996
Well No: SK67/17 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1969-1991)


Heathlanes
Water Level (mOD)
63.0
62.0
61.0
Measuring level : 68.61
1992
1993
1994
1995
1996
Well No: SJ62/112 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1991)


Bussels No.7a
Water Level (mOD)
25.0
24.0
23.0
Measuring level : 26.97
1992
1993
1994
1995
1996
Well No: SX99/37B Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1991)

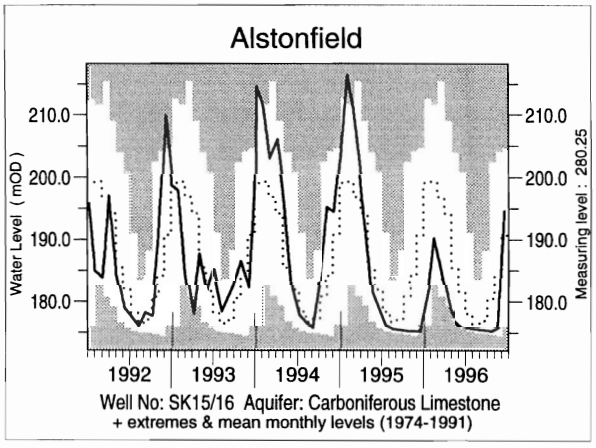

Alstonfield
Water Level (mOD)
210.0
200.0
190.0
180.0
Measuring level : 280.25
1992
1993
1994
1995
1996
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1991)

TABLE 5 DECEMBER GROUNDWATER LEVELS 1996

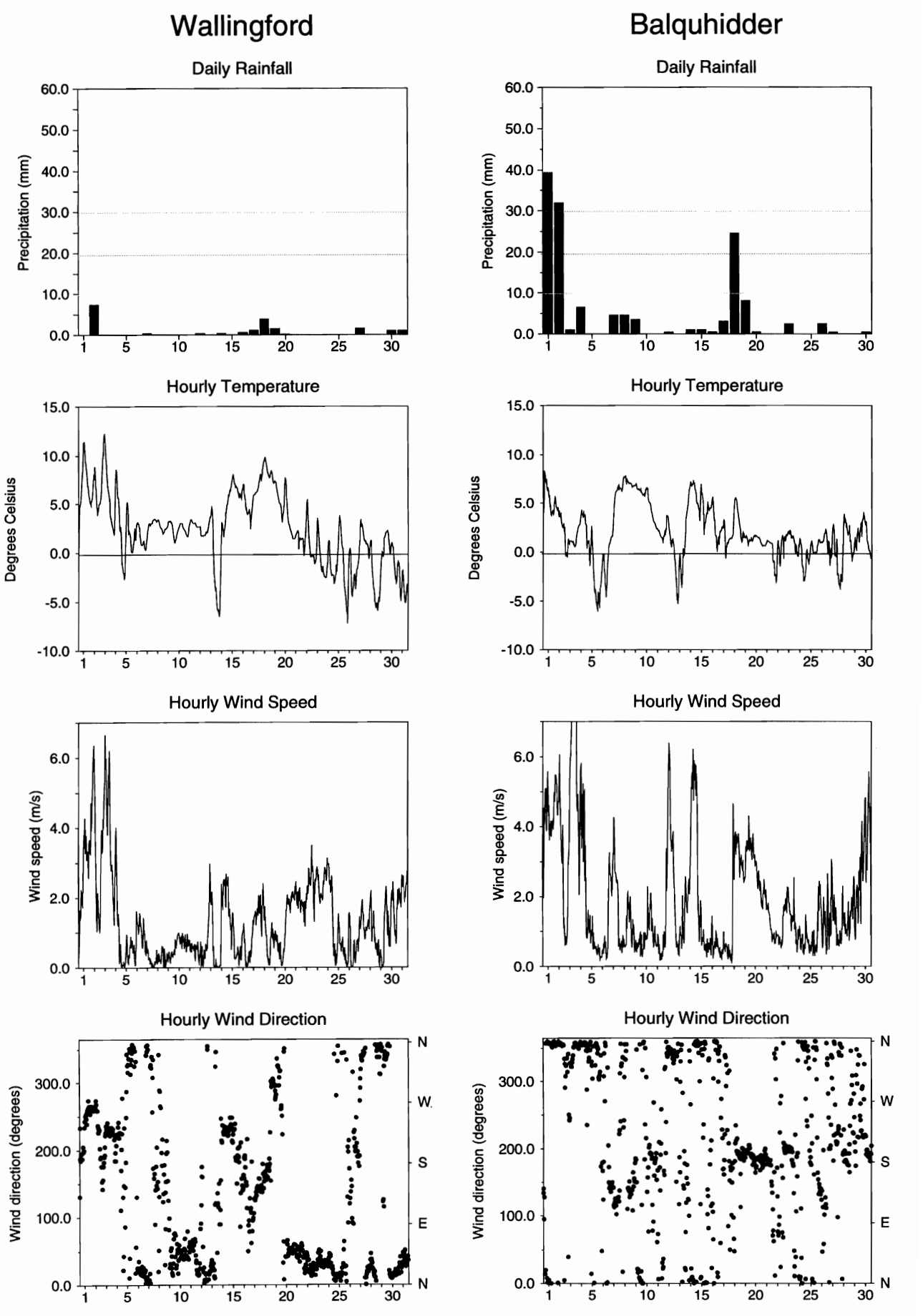
Site	Aquifer	Records commence	Minimum Dec	Average Dec	Maximum Dec	No. of years Dec/Jan*	Dec/Jan 1996/97	
			<1996	<1996	<1996	level<1996	day	level
Dalton Holme	Ck	1889	10.34	15.78	23.64	0	16/12	10.7
Wetwang	Ck	1971	16.84	22.08	28.63	0	16/12	17.49
Keelby Grange	Ck	1980	4.57	9.31	14.40	1	23/12	4.40
Washpit Farm	Ck	1950	40.61	43.63	46.94	4	06/1/97	41.78
The Holt	Ck	1964	83.90	86.77	90.11	3	30/12	85.22
Therfield Rectory	Ck	1883	70.72	77.82	96.32	7	06/1/97	73.17
Redlands Hall	Ck	1964	32.46	39.27	46.97	1	17/12	33.63
Rockley	Ck	1933	128.78	133.73	144.11	0	06/1/97	129.04
Little Bucket Farm	Ck	1971	57.63	64.34	80.94	1	30/12	60.03
Compton House	Ck	1894	27.92	39.89	63.20	0	30/12	30.48
Chilgrove House	Ck	1836	33.46	50.99	77.11	4	31/12	40.06
Westdean No.3	Ck	1940	1.15	1.96	4.92	3	27/12	1.39
Lime Kiln Way	Ck	1969	123.75	124.96	125.58	>10	23/12	125.45
Ashton Farm	Ck	1974	63.20	67.75	71.48	8	31/12	67.37
West Woodyates Manor	Ck	1942	67.95	85.99	104.53	>10	31/12	82.05
Killyglen (NI)	Ck	1985	114.06	116.03	119.27	>10	04/12	117.52
New Red Lion	LLst	1964	5.49	12.85	21.51	0	17/12	5.09
Ampney Crucis	Mid Jur	1958	97.38	1001.92	103.45	>10	06/1/97	101.14
Redbank	PTS	1981	7.63	8.35	9.07	1	01/1/97	7.72
Yew Tree Farm	PTS	1973	12.19	13.43	13.97	8	07/1/97	13.44
Skirwith	PTS	1978	129.54	130.07	131.00	0	31/12	129.46
Llanfair D.C	PTS	1972	79.16	79.91	80.44	-	02/12	79.30
Morris Dancers	PTS	1969	31.75	32.58	33.52	8	17/12	32.22
Heathlanes	PTS	1971	60.33	61.94	62.94	3	09/12	61.06
Bussels No.7A	PTS	1972	23.20	23.70	24.58	5	31/12	23.56
Rushyford NE	MgLst	1967	64.77	73.47	76.65	>10	18/12	75.86
Peggy Ellerton	MgLst	1968	31.86	33.86	36.40	3	18/12	32.09
Alstonfield	CLst	1974	174.96	190.85	209.62	>10	13/12	194.56

groundwater levels are in metres above Ordnance Datum

Ck	Chalk	Mid Jur	Middle Jurassic limestones
LLst	Lincolnshire Limestone	MgLst	Magnesian Limestone
PTS	Permo-Triassic sandstones	CLst	Carboniferous Limestone

* Average December levels for previous years are compared to the level at month end

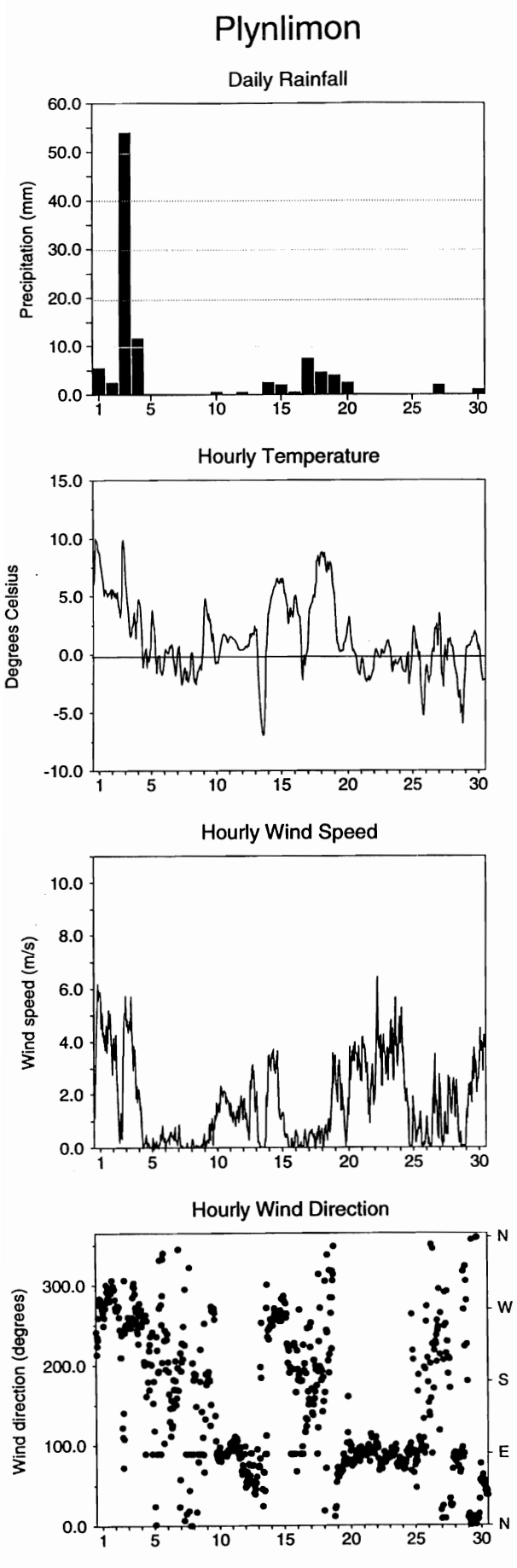
FIGURE 3 METEOROLOGICAL SUMMARY - DECEMBER 1996



The Institute of Hydrology Meteorological Station occupies a relatively open site on the Thames floodplain about 5km NW of the Chilterns escarpment. Station elevation is 48m

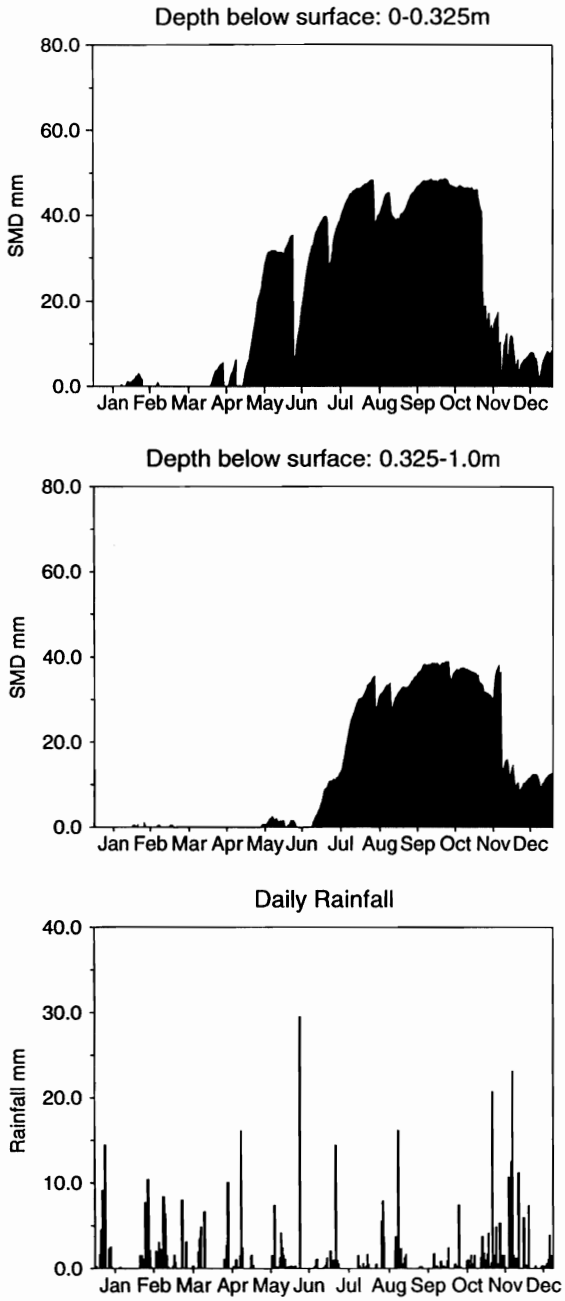
The Lower Kirkton automatic weather station (Balquhidder) occupies a relatively sheltered position at the mouth of the SSE trending Kirkton Glen. Station elevation is 270m aOD and average annual rainfall exceeds 2000mm; snow cover is expected for 10-30 days a year.

FIGURE 3 (continued)



The Dolydd automatic weather station at Plynlimon is sited in an exposed field with a forested area to the south. Surrounding land reaches a peak height of around 400m. Station elevation is 300m aOD and average annual rainfall exceeds 2300mm.

FIGURE 3a. WALLINGFORD SMD DATA 1996.



Note

Soil moisture deficit is defined as the amount by which the water stored in the soil is below the quantity held at field capacity. Two automatic soil water stations (ASWSs) deployed at Wallingford, which use capacitance soil water sensors installed at depths of 5,15 and 50 cm, are the sources of the data. Figure 3a shows deficits calculated from one of the stations for the depth ranges 0-0.325m (15cm probe) and 0.325-1.0m (50cm probe) at 0100 GMT on each day. At the end of January 1996, field capacity was re-estimated using recent data and the soil moisture deficit values for the previous months were recalculated accordingly.

Daily rainfall from the Wallingford met station from January 1996 is presented.

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS