Hydrological Summary for Great Britain

DECEMBER 1995

Rainfall

December provided a very atypical end to the third warmest year (provisionally) in the 336-year Central England Temperature series. The ingress of continental air around the 4th heralded persistent wintry conditions; very depressed temperatures characterised much of the latter half of December. Although high pressure dominated northern Britain, complex synoptic patterns resulted in spatially very variable rainfall totals throughout England and Wales - many localities experienced the full spectrum of precipitation types, from fog-drip to hail and snow accumulations were significant on many northern hills. An especially unsettled interlude beginning around the 19th boosted December precipitation totals to well above the monthly average in large parts of eastern and southern England. Despite severe blizzards over Christmas in northern Scotland - the Shetlands were particularly badly affected - provisional December precipitation totals were very modest in much of northern Britain. This was of particular water resources significance in the North-West NRA region: following the notably wet winter of 1994/95, below average rainfall has now been recorded in every month since March; over the last 9 months many areas have registered less than half the average rainfall. The accumulated total is without precedent *(for any start month)* for many raingauges some with records extending back over 100 years, e.g. Barnacre in the headwaters of the River Wyre; the exceptional severity of the drought is reflected in the corresponding return period (Table 2). The focus of the regional rainfall deficiency is clearly now in the north-west and the Pennines. In other regions the drought moderated in December and regional rainfall totals for 1995 mostly fall well within the normal range; as with other recent years (e.g. 1990) the temporal distribution was, however, very unusual.

River Flow

Remaining soil moisture deficits were mostly eliminated during December but rainfall patterns - and contrasting catchment geology - produced very wide temporal and spatial variations in runoff. Generalising broadly, in southern Britain early December flows were notably depressed but a brisk recovery began in mid-month and near-bankfull flows were widely reported following storms on the 19-21st (snowmelt was a minor factor in some areas). As a consequence, monthly runoff totals were generally within the normal range in southern England but still well below average in many central catchments; the Trent, Dove and Lud each recorded their second lowest December runoff on record. To the north, flows generally declined relative to the modest November mean and catchments registering new December minimum runoff totals showed a wide distribution; examples include the Welsh Dee, the Wharfe, the Clyde and the Ewe. Flows were especially depressed in north-west England where the December mean flow for the Lune was only around half that for the previous minima (in a 33-year series). In the 6-month timeframe (July-December) average flows are close to record minima over a much wider area but annual runoff totals are mostly unexceptional - although a few spring-fed streams, including the Hampshire Avon, established new maxima.

Groundwater

Significant infiltration occurred during December in all but a few eastern outcrop areas and brisk groundwater recoveries were recorded in some responsive aquifer units in southern England - notably in the Jurassic Limestone where early January levels were well above the seasonal average. Generally however there has, as yet, been little water-table response to the recent rainfall and the seasonal upturn is exceptionally delayed in many northern aquifers. Late December levels in the Chalk were mostly in the normal range in the more westerly outcrops but low, or exceptionally low, to the east. Recoveries, over what will now be a foreshortened winter recharge season, will also need to be generated from a very low base in much of the Lincolnshire Limestone, the northern Permo-triassic sandstones and the Carboniferous Limestone - the December level for Alstonfield was the lowest, for the month, on record.

General

In many catchments the mild, wet beginning to 1996 has shifted the focus of immediate hydrological concern to the risk of flooding. However, although the general resources outlook has improved appreciably over the last four weeks, reservoir levels declined in parts of northern England during December and overall stocks for early January were still below the corresponding totals for the 1988-92 drought; a number of reservoirs - mostly in the Pennines and the Lake District - may not fill over the winter. Groundwater level recoveries will need to gather momentum during January and February if the 1996 spring peaks are not to fall substantially short of the seasonal mean. Rainfall over the next 8-10 weeks should prove pivotal in relation to the prospects for the summer of 1996. A repeat of the early 1992 rainfall patterns would make for a very fragile water resources outlook.

Institute of Hydrology

British Geological Survey

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. 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 NRA or, in Scotland, the Lothian and Strathclyde Regional Councils. 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 and the National Rivers Authority.

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

* For reasons of consistency and to provide greater spatial discrimination, the original ten regional divisions of the NRA have been retained for use in the Hydrological Summaries.

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 rain-gauge sites.

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

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 12 January 1996

TABLE 1 1994/95 RAINFALL AS A PERCENTAGE OF THE 1961-90 AVERAGE

		Dec 1994	Jan 1995	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
England and Wales	mm	142	161	115	67	27	49	23	39	13	112	54	80	114
	%	151	183	183	93	45	77	35	63	17	145	64	89	121
NRA REGIONS														
North West	mm	207	208	165	107	28	65	39	63	19	94	86	65	54
	%	167	172	212	113	39	87	48	74	18	82	67	53	44
Northumbrian	mm	124	121	108	59	38	53	30	29	11	111	56	112	79
	%	153	144	183	84	68	85	50	45	14	152	74	130	97
Severn Trent	mm	115	131	89	51	20	49	13	36	9	93	38	64	74
	%	149	187	165	84	36	83	22	68	13	145	59	90	95
Yorkshire	mm	123	133	100	65	27	44	23	29	9	97	29	61	83
	%	148	168	172	96	46	73	38	49	12	143	40	76	100
Anglian	mm	59	98	62	51	16	30	25	26	8	101	16	42	86
	%	107	196	168	109	35	63	49	53	15	206	31	72	157
Thames	mm	93	137	82	51	18	37	16	32	4	114	35	64	99
	%	133	214	182	91	36	66	29	65	7	193	56	98	141
Southern	mm	123	163	112	59	18	23	20	31	5	140	34	63	110
	%	150	204	207	94	34	43	37	65	9	203	43	74	134
Wessex	mm	139	184	111	57	35	53	14	26	9	143	69	123	101
	%	149	211	171	81	66	87	25	50	14	199	87	148	108
South West	mm	214	233	165	93	50	55	19	45	16	135	104	132	138
	%	154	169	163	94	72	76	28	65	19	145	90	106	99
Welsh	mm	255	238	182	88	37	77	27	67	33	125	110	129	101
	%	167	166	188	82	46	94	34	87	33	109	80	91	66
Scotland	mm	245	227	205	143	67	84	43	85	35	195	228	125	47
	%	162	150	201	114	88	98	50	90	30	137	146	83	31
RIVER PURIFICATION BOARDS														
Highland	mm	304	299	271	177	97	89	47	99	47	245	249	161	28
	%	154	159	213	109	107	97	48	93	37	143	126	79	14
North East	mm	93	134	83	74	68	80	53	46	28	293	104	99	56
	%	100	135	128	95	113	116	80	63	32	337	107	100	60
Tay	mm	196	184	185	110	39	96	32	69	20	180	217	116	84
	%	154	128	195	101	63	116	44	90	21	158	167	96	66
Forth	mm	210	154	171	92	35	71	31	69	21	135	197	90	52
	%	191	131	216	98	59	96	45	92	22	123	171	80	47
Tweed	mm	173	129	109	75	36	65	35	43	22	122	134	97	61
	%	186	129	163	95	63	92	54	59	25	137	141	104	66
Solway	mm	246	222	173	145	40	84	44	77	23	102	251	111	44
	%	166	142	171	124	52	99	52	86	19	71	160	77	30
Clyde	mm	322	257	251	196	66	83	44	124	41	137	319	118	42
	%	180	136	213	133	79	91	47	114	31	77	165	66	23

Note: The monthly rainfall figures for the NRA regions for December 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 RPB regions (and for Scotland) for December 1995 were derived by IH in collaboration with the RPBs. 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 RETURN PERIOD ESTIMATES

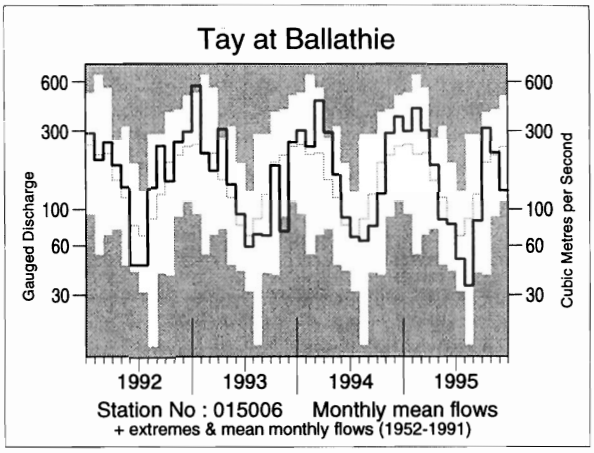
		Oct 95-Dec 95		Apr 95-Dec 95		Jan 95-Dec 95		Sep 94-Dec 95	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales	mm	248		511		854		1285	
	% LTA	92	2-5	76	15-25	95	2-5	103	2-5
NRA REGIONS									
North West	mm	205		513		993		1572	
	% LTA	55	25-40	56	>>200	83	5-15	93	2-5
Northumbria	mm	247		519		807		1176	
	% LTA	102	2-5	81	5-10	95	2-5	101	2-5
Severn Trent	mm	176		396		667		1050	
	% LTA	83	2-5	70	30-45	88	2-5	102	2-5
Yorkshire	mm	173		402		700		1086	
	% LTA	73	5-10	65	60-90	85	5-10	97	2-5
Anglian	mm	144		350		561		811	
	% LTA	88	2-5	76	10-20	94	2-5	100	<2
Thames	mm	198		419		689		994	
	% LTA	100	<2	80	5-10	100	<2	105	2-5
Southern	mm	207		444		778		1175	
	% LTA	84	2-5	76	10-15	100	<2	107	2-5
Wessex	mm	293		573		925		1374	
	% LTA	115	2-5	93	2-5	110	2-5	118	5-15
South West	mm	374		694		1185		1797	
	% LTA	98	2-5	83	5-10	101	2-5	109	2-5
Welsh	mm	340		706		1214		1876	
	% LTA	79	2-5	73	20-30	92	2-5	101	2-5
Scotland	mm	400		909		1484		2098	
	% LTA	87	2-5	86	5-10	103	2-5	103	2-5
RIVER PURIFICATION BOARDS									
Highland	mm	438		1062		1809		2551	
	% LTA	73	5-10	83	5-15	103	2-5	101	2-5
North East	mm	259		827		1118		1476	
	% LTA	90	2-5	113	5-10	115	5-10	109	5-10
Tay	mm	417		853		1332		1853	
	% LTA	110	2-5	97	2-5	108	2-5	108	2-5
Forth	mm	339		701		1118		1608	
	% LTA	101	2-5	86	5-10	101	2-5	103	2-5
Tweed	mm	292		615		928		1356	
	% LTA	104	2-5	85	5-10	96	2-5	101	2-5
Solway	mm	406		776		1316		1939	
	% LTA	90	2-5	74	25-40	93	2-5	96	2-5
Clyde	mm	479		974		1678		2415	
	% LTA	87	2-5	78	15-25	99	2-5	100	<2

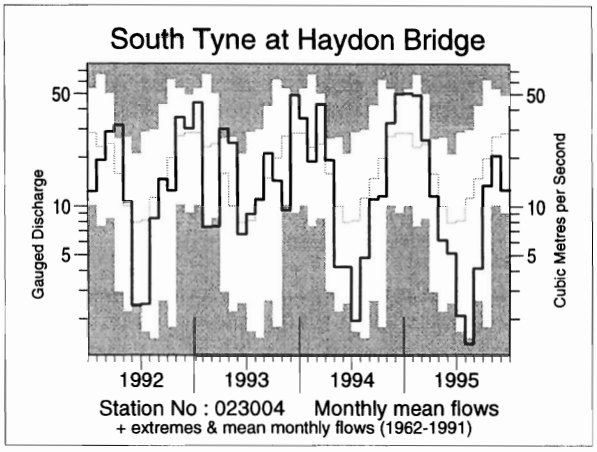
LTA refers to the period 1961-90.

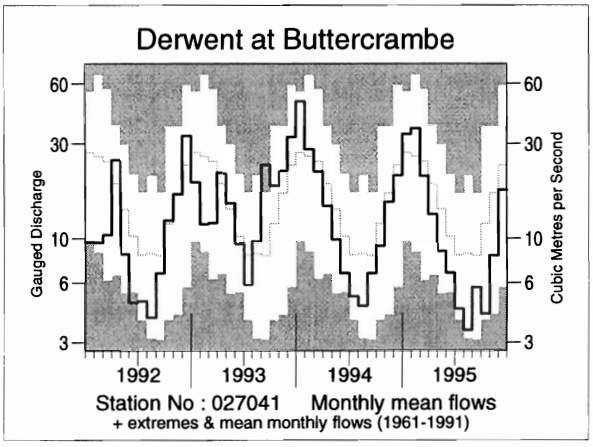
Return period assessments are based on tables provided by the Meteorological Office*. The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes a sensibly stable climate. They assume a start in a specified month; return periods for a start in any month may be expected to 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.

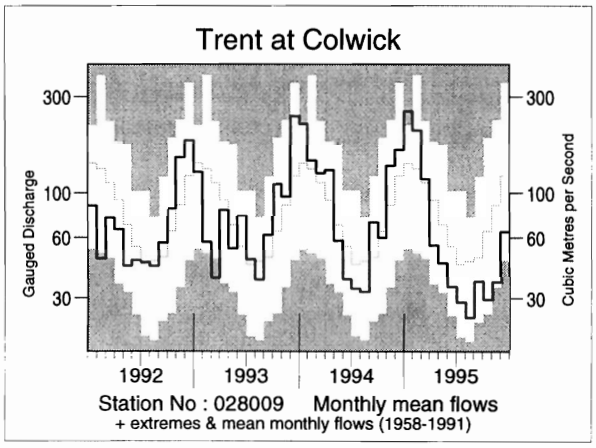
* Tabony, R.C., 1977, The Variability of long duration rainfall over Great Britain, Scientific Paper No. 37, Meteorological Office.

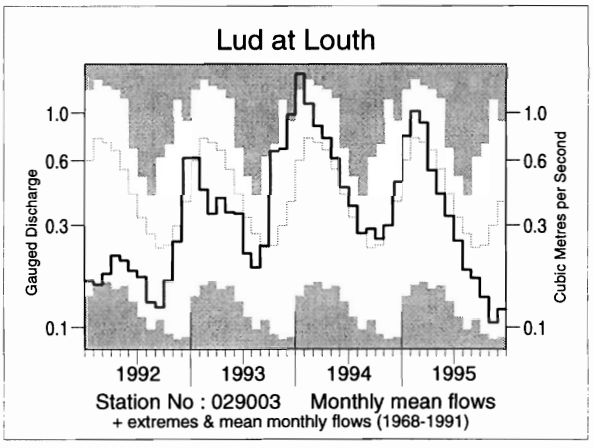
FIGURE 1 MONTHLY RIVER FLOW HYDROGRAPHS

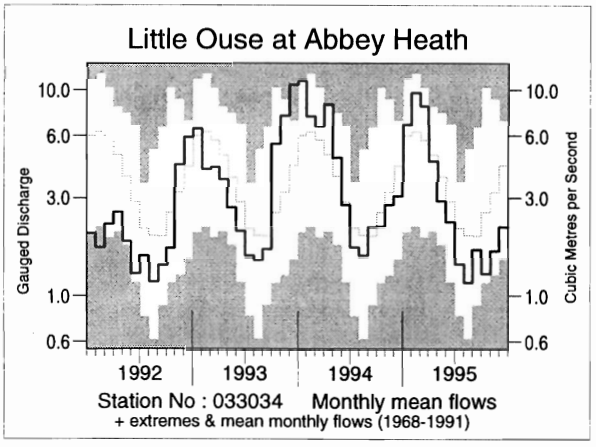


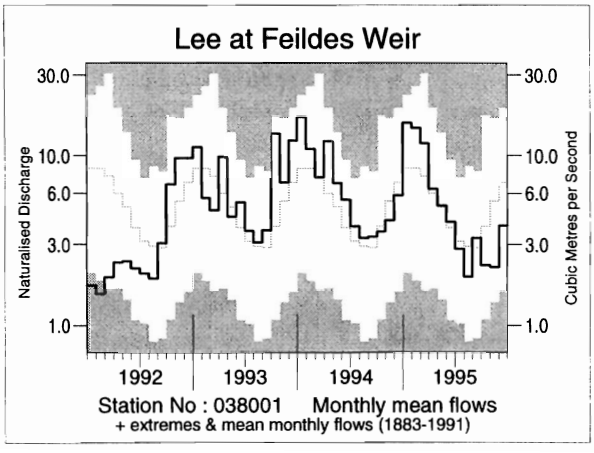


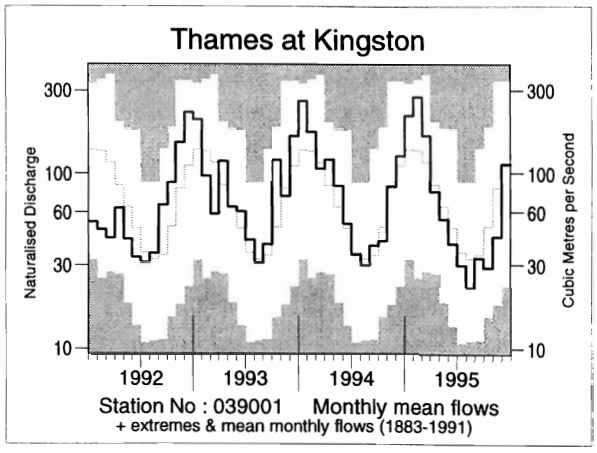


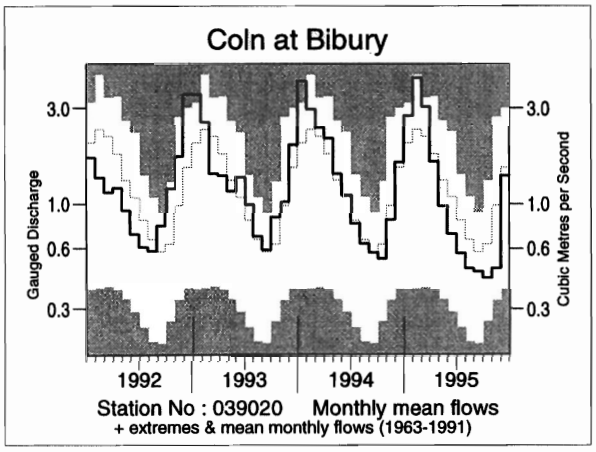


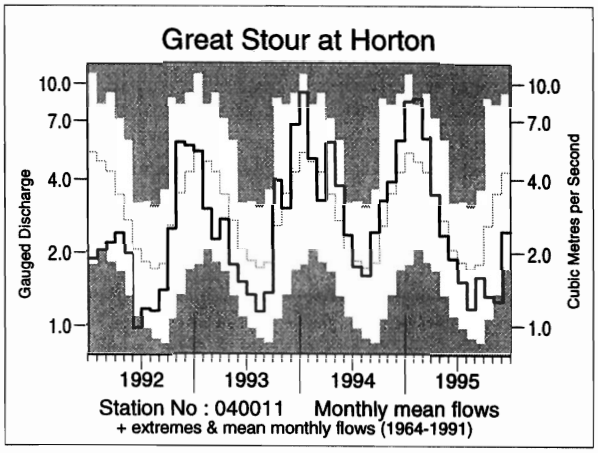


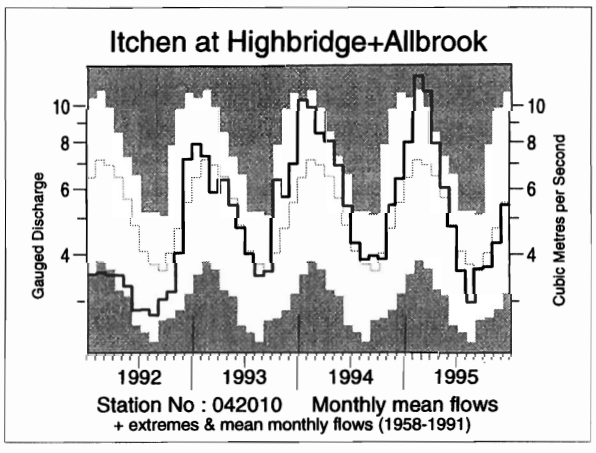


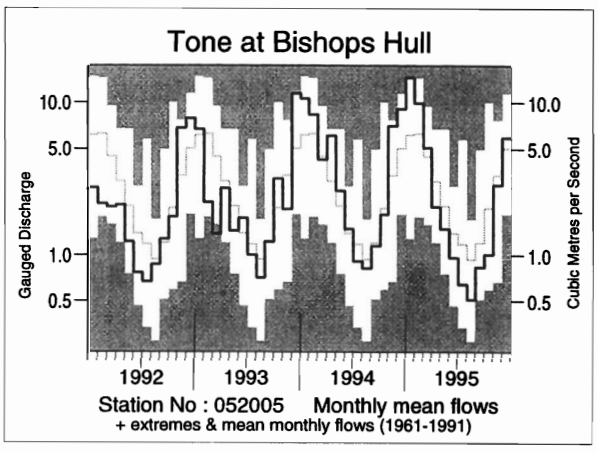


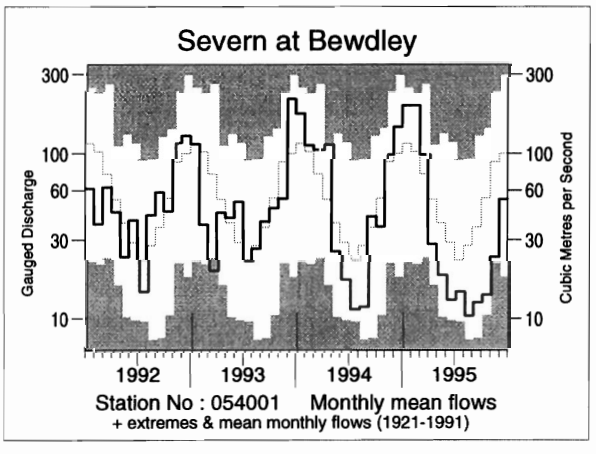


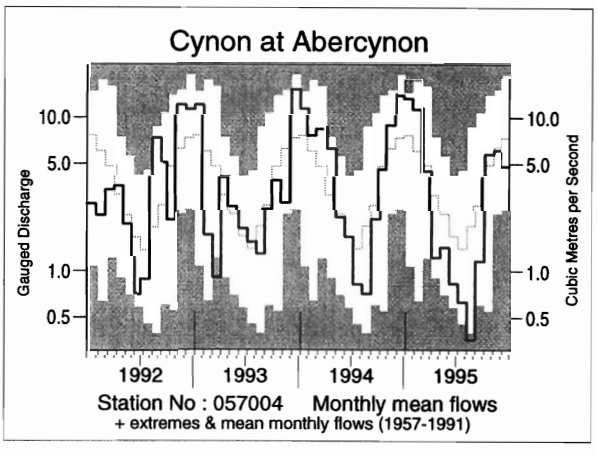

Coln at Bibury
Gauged Discharge
Cubic Metres per Second
3.0
1.0
0.6
0.3
1992
1993
1994
1995
Station No : 039020 Monthly mean flows
+ extremes & mean monthly flows (1963-1991)

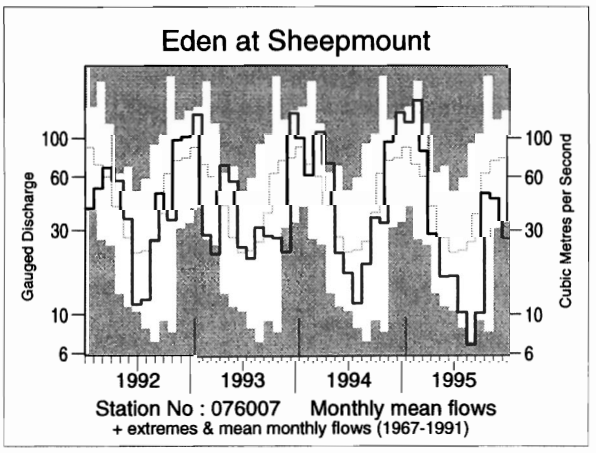

Great Stour at Horton
Gauged Discharge
Cubic Metres per Second
10.0
7.0
4.0
2.0
1.0
1992
1993
1994
1995
Station No : 040011 Monthly mean flows
+ extremes & mean monthly flows (1964-1991)


Itchen at Highbridge+Allbrook
Gauged Discharge
Cubic Metres per Second
10
8
6
4
1992
1993
1994
1995
Station No : 042010 Monthly mean flows
+ extremes & mean monthly flows (1958-1991)


Tone at Bishops Hull
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1992
1993
1994
1995
Station No : 052005 Monthly mean flows
+ extremes & mean monthly flows (1961-1991)


Severn at Bewdley
Gauged Discharge
Cubic Metres per Second
300
100
60
30
10
1992
1993
1994
1995
Station No : 054001 Monthly mean flows
+ extremes & mean monthly flows (1921-1991)


Cynon at Abercynon
Gauged Discharge
Cubic Metres per Second
10.0
5.0
1.0
0.5
1992
1993
1994
1995
Station No : 057004 Monthly mean flows
+ extremes & mean monthly flows (1957-1991)


Eden at Sheepmount
Gauged Discharge
Cubic Metres per Second
100
60
30
10
6
1992
1993
1994
1995
Station No : 076007 Monthly mean flows
+ extremes & mean monthly flows (1967-1991)

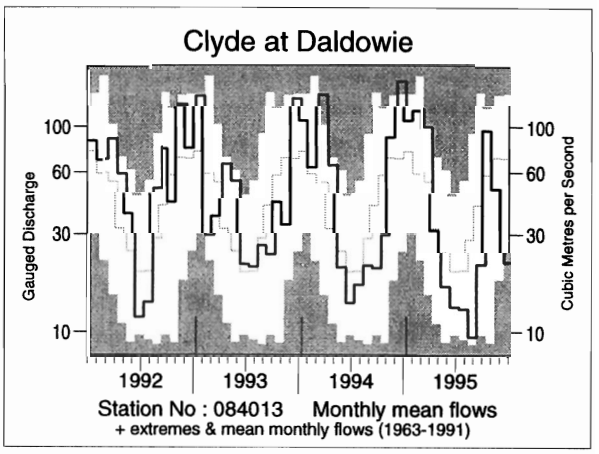

Clyde at Daldowie
Gauged Discharge
Cubic Metres per Second
100
60
30
10
1992
1993
1994
1995
Station No : 084013 Monthly mean flows
+ extremes & mean monthly flows (1963-1991)

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 1995	Sep	Oct	Nov	Dec 1995		10/95 to 12/95		7/95 to 12/95		1/95 to 12/95		1/94 to 12/95	
	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	9	136	98	105	73	11	276	19	436	20	875	17	1719	16
Park	28	332	120	138	86	/24	112	/23	125	/23	111	/23	108	/22
Tay at	20	48	183	125	76	5	384	24	481	13	1249	30	2698	38
Ballathie	39	69	166	104	53	/44	103	/44	90	/43	110	/43	118	/42
Tweed at	10	23	107	82	42	2	231	10	277	8	755	17	1692	28
Boleside	26	48	149	94	42	/35	89	/35	75	/35	99	/35	111	/34
Whiteadder Water at	5	11	10	38	47	17	95	10	118	8	279	3	641	7
Hutton Castle	36	70	34	104	100	/27	85	/27	77	/26	72	/26	82	/25
South Tyne at	5	14	48	71	45	3	164	2	191	1	702	8	1536	13
Haydon Bridge	13	28	70	76	42	/34	62	/34	49	/32	91	/32	98	/30
Wharfe at	7	11	16	22	17	1	56	1	84	1	532	4	1340	17
Flint Mill Weir	17	25	26	28	17	/41	23	/41	24	/40	74	/40	93	/39
Derwent at	6	9	7	13	30	10	50	5	73	4	266	8	583	12
Buttercrambe	42	66	35	48	73	/35	57	/35	57	/34	83	/34	90	/33
Trent at	9	13	11	13	23	2	46	2	78	2	324	12	748	20
Colwick	54	74	45	40	50	/38	46	/38	53	/37	91	/37	105	/36
Lud at	9	8	7	5	6	2	18	2	47	2	234	11	580	17
Louth	70	73	54	34	29	/28	38	/28	57	/27	92	/27	115	/26
Witham at	3	5	4	6	7	8	17	9	29	6	175	17	443	28
Claypole Mill	51	69	45	43	35	/37	40	/37	46	/37	93	/36	119	/35
Little Ouse at	4	6	5	6	8	4	19	4	35	3	163	11	367	16
Abbey Heath	62	95	52	50	49	/27	51	/27	60	/27	97	/27	110	/26
Mimram at	9	10	8	7	9	16	24	15	53	20	159	35	358	41
Panshanger Park	98	119	99	83	86	/44	90	/43	99	/43	126	/43	142	/42
Lee at	5	8	6	6	10	32	21	23	42	24	186	71	398	87
Feildes Weir (natr.)	67	114	58	41	55	/111	51	/111	65	/110	114	/109	122	/107
Thames at	6	9	8	11	30	62	49	41	72	40	286	82	590	88
Kingston (natr.)	68	95	57	52	100	/113	76	/113	78	/113	116	/113	120	/112
Coln at	12	11	11	12	35	12	57	11	95	8	418	19	886	23
Bibury	72	79	66	48	86	/33	71	/33	73	/32	106	/32	112	/31
Great Stour at	9	12	10	9	19	5	38	1	71	2	301	16	666	20
Horton	69	87	49	34	55	/31	47	/31	58	/31	103	/29	113	/27
Itchen at	22	26	28	31	40	21	99	20	174	14	531	30	1092	35
Highbridge+Allbrook	79	101	91	91	97	/38	93	/38	92	/37	115	/37	118	/36
Stour at	4	9	12	37	56	12	105	14	124	12	488	18	1044	22
Throop Mill	45	75	51	112	96	/23	92	/23	85	/23	124	/23	131	/22
Exe at	6	15	35	72	124	21	231	12	261	6	833	20	2015	36
Thorverton	22	39	47	73	90	/40	75	/40	66	/40	100	/39	121	/38
Taw at	3	6	17	52	99	13	168	5	181	4	658	19	1666	32
Umberleigh	15	25	27	56	82	/38	62	/38	55	/37	95	/37	119	/36
Tone at	7	10	13	36	77	21	126	14	152	12	581	31	1270	33
Bishops Hull	55	69	49	82	108	/35	89	/35	83	/35	121	/34	132	/33
Severn at	6	7	9	14	33	9	56	3	79	3	406	26	945	42
Bewdley	38	34	26	27	51	/75	37	/75	39	/75	90	/74	105	/73
Teme at	2	3	3	13	40	8	56	5	63	3	352	12	810	20
Knightsford Bridge	19	28	14	39	69	/26	51	/26	48	/26	96	/25	111	/24
Cynon at	9	28	143	146	121	12	411	12	463	8	1249	14	2942	30
Abercynon	17	41	120	94	61	/38	87	/38	73	/36	99	/36	117	/34
Dee at	9	37	105	119	82	1	307	1	421	1	1361	3	3482	12
New Inn	9	29	56	50	31	/27	45	/27	44	/27	76	/26	97	/25
Lune at	6	17	70	56	27	1	153	1	193	1	884	5	2275	18
Caton	9	20	60	41	17	/33	38	/33	32	/33	79	/33	101	/31
Eden at	8	12	57	51	31	1	139	3	171	1	655	8	1471	16
Sheepmount	26	28	82	61	32	/26	57	/26	51	/25	94	/25	107	/23
Clyde at	13	28	135	68	30	1	233	9	292	6	818	19	1862	27
Daldowie	33	50	170	69	28	/33	82	/33	72	/32	104	/32	118	/31
Ewe at	33	145	315	236	86	1	637	6	877	4	2290	19	4551	16
Poolewe	29	77	146	90	30	/25	84	/25	77	/25	107	/25	106	/24

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 1994. For the long periods (at the right of this table), the end date for the long term is 1995.

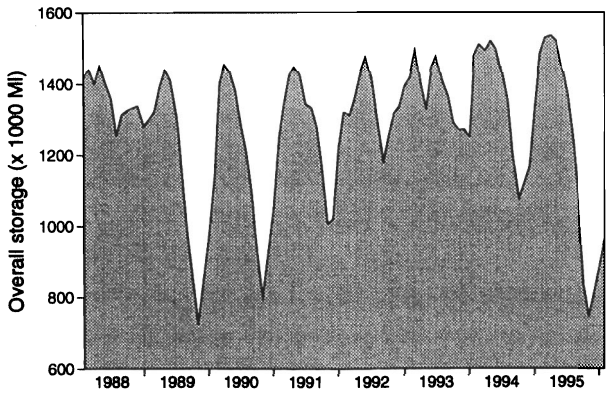
TABLE 4 START-MONTH RESERVOIR STORAGES UP TO JANUARY 1996

Area	Reservoir (R)/ Group (G)		Capacity ● (Ml)	1995 Aug	Sep	Oct	Nov	Dec	1996 Jan	1995 Jan
North West	N.Command Zone[1]	(G)	133375	44	24	13	44	57	51	91
	Vyrnwy	(R)	55146	59	36	26	25	33	35	100
Northumbria	Teesdale[2]	(G)	87936	59	38	31	33	39	41	97
	Kielder	(R)	199175*	87*	85*	82*	88*	91*	89*	100*
Severn-Trent	Clywedog	(R)	44922	73	48	43	44	49	58	100
	Derwent Valley[3]	(G)	39525	59	44	36	28	23	23	100
Yorkshire	Washburn[4]	(G)	22035	50	34	24	15	16	23	92
	Bradford supply[5]	(G)	41407	38	21	15	16	20	22	88
Anglian	Grafham	(R)	58707	88	71	72	72	72	83	93
	Rutland	(R)	130061	74	66	61	59	57	61	95
Thames	London[6]	(G)	206399	82	62	66	67	71	82	92
	Farmoor [7]	(G)	13843	86	64	76	87	98	89	95
Southern	Bewl	(R)	28170	81	72	69	65	60	65	89
	Ardingly	(R)	4685	66	48	46	47	45	67	93
Wessex	Clatworthy	(R)	5364	44	31	30	35	63	92	100
	Bristol W[8]	(G)	38666*	67*	48*	44*	37*	43*	60*	88*
South West	Colliford	(R)	28540	70	54	47	45	42	46	81
	Roadford[9]	(R)	34500	60	40	26	18	19	23	79
	Wimbleball[10]	(R)	21320	59	40	30	26	34	46	100
	Stithians	(R)	5205	45	31	27	26	31	54	77
Welsh	Celyn + Brenig	(G)	131155	79	57	48	49	50	54	100
	Brianne	(R)	62140	67	55	48	57	72	76	100
	Big Five[11]	(G)	69762	49	29	19	41	56	67	92
	Elan Valley[12]	(G)	99106	65	46	34	37	47	56	100
Lothian	Edin./Mid Lothian[13]	(G)	97639	79	69	64	85	91	91	95
	East Lothian[14]	(G)	10206	84	71	72	74	95	99	91
Strathclyde	Loch Katrine	(G)	111363	69	50	43	92	95	80	98
	Daer	(R)	22412	62	41	32	83	93	83	100
	Loch Thom	(G)	11840	72	59	56	100	97	93	99

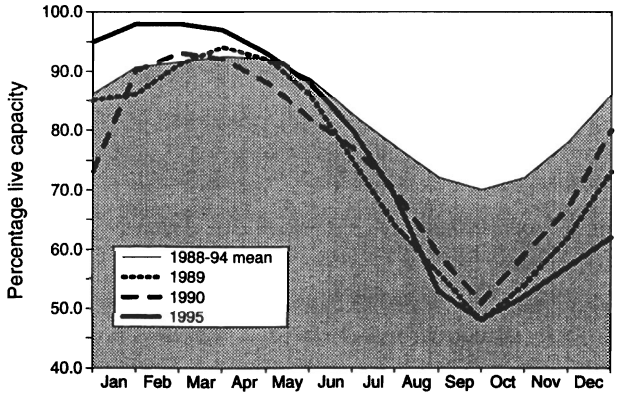
● Live or usable capacity (unless indicated otherwise) * Gross storage/percentage of gross storage

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



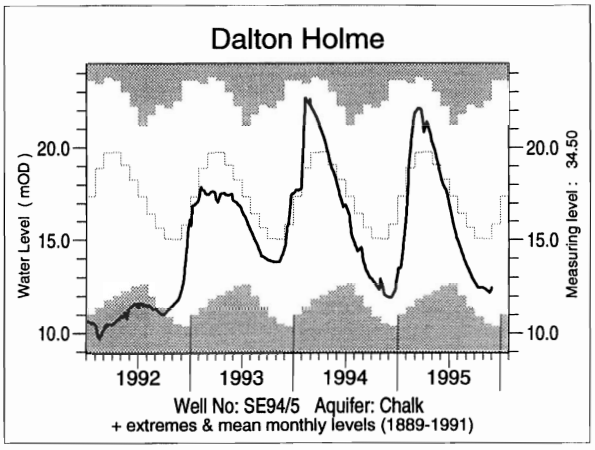
A COMPARISON BETWEEN OVERALL RESERVOIR STOCKS IN RECENT DROUGHT YEARS

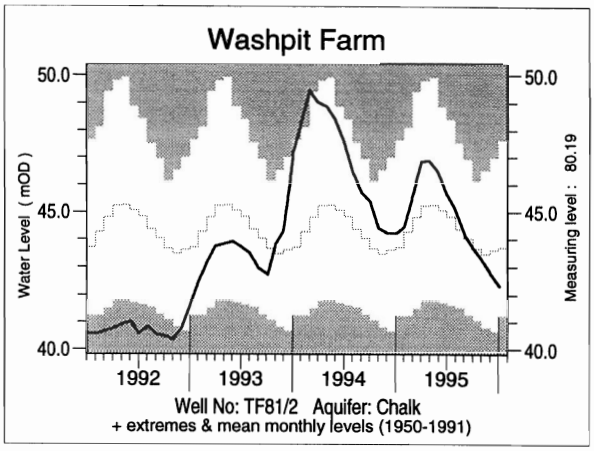


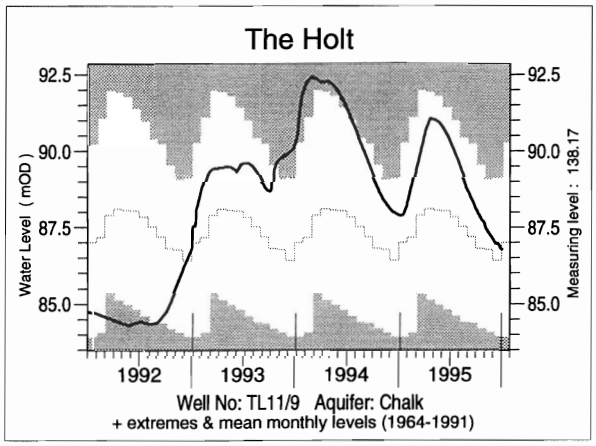
These plots are based on the reservoirs featured in Table 4 only

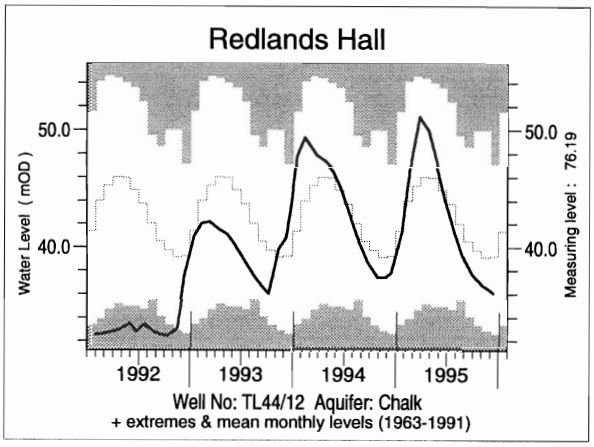
Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient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

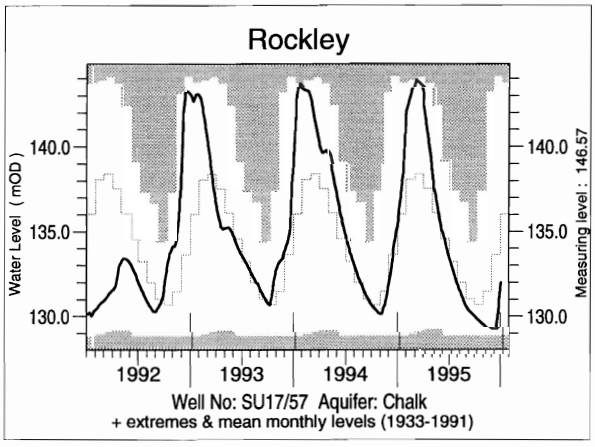
FIGURE 2 GROUNDWATER LEVEL HYDROGRAPHS

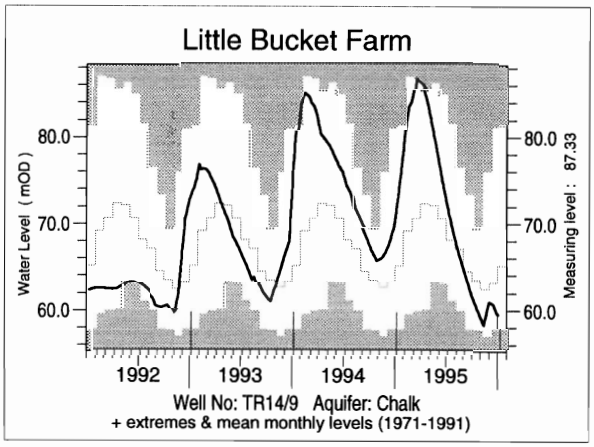


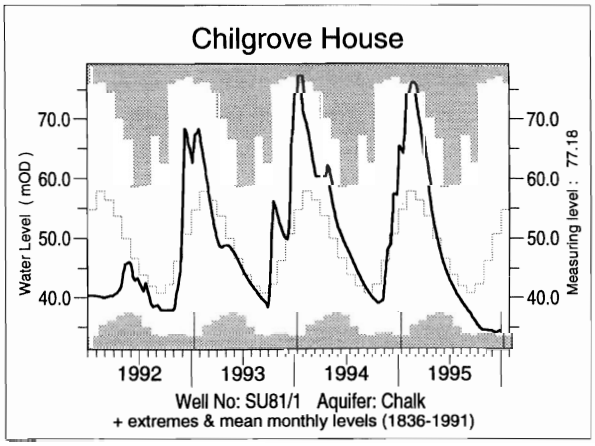


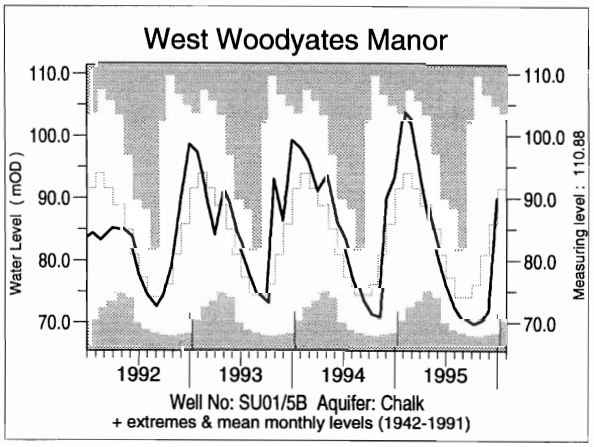


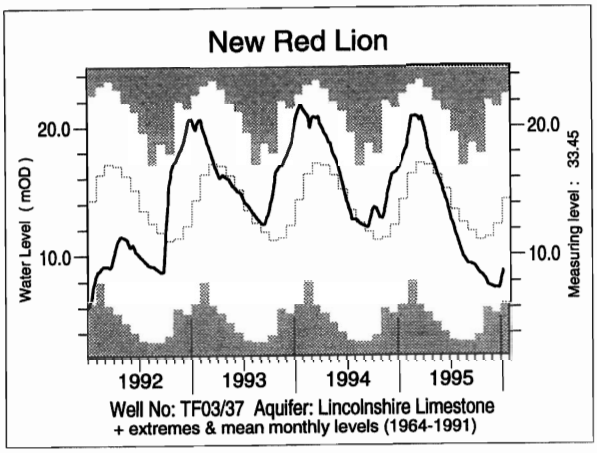


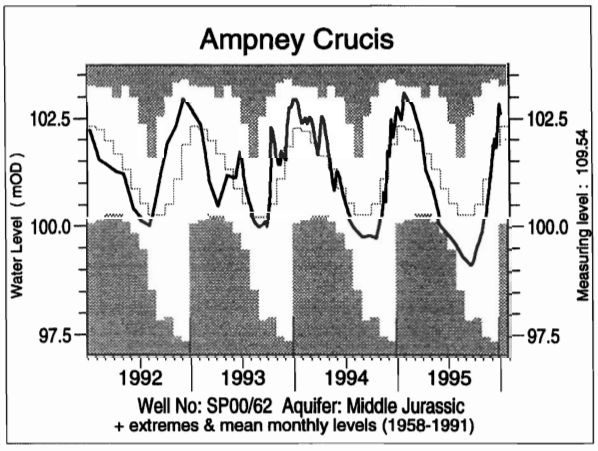


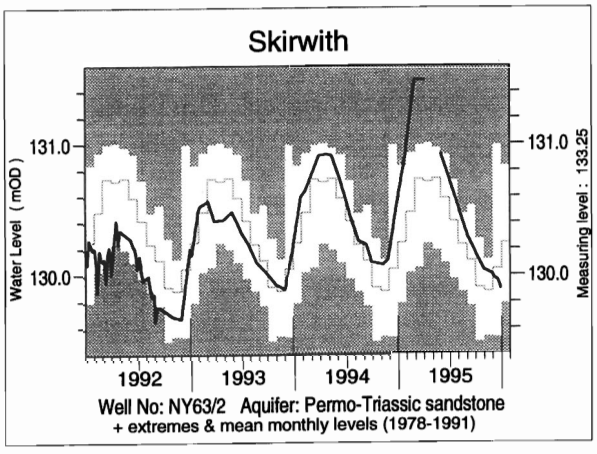


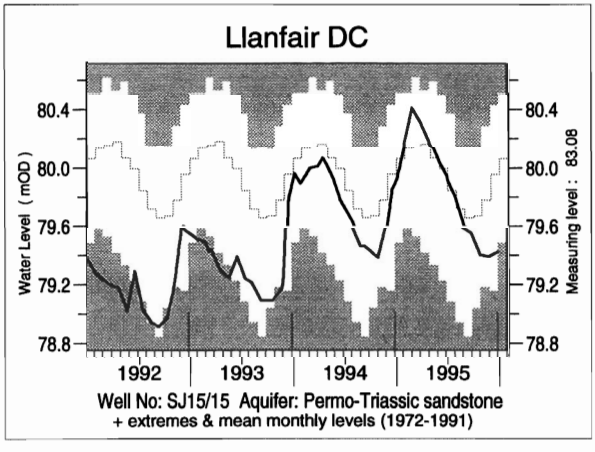


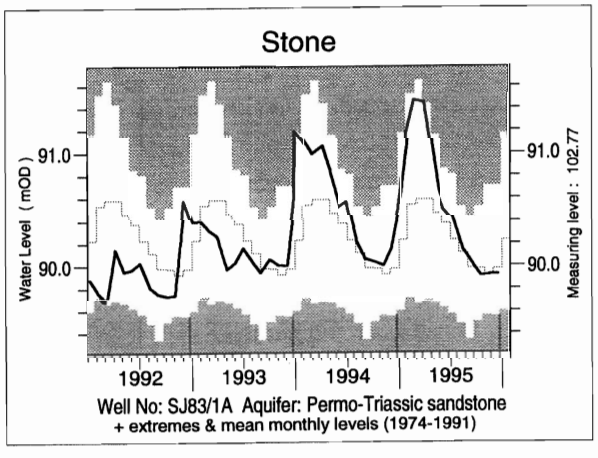


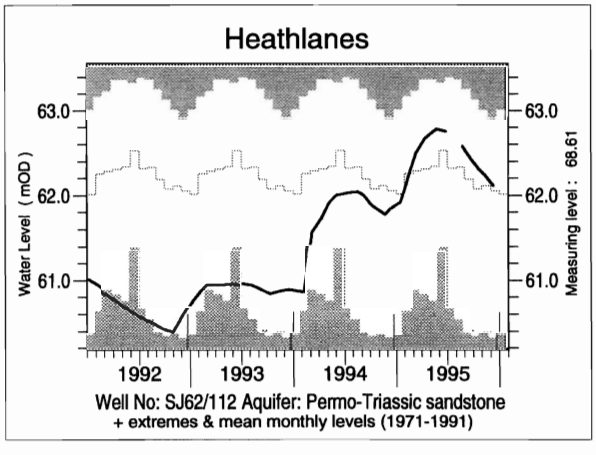

New Red Lion
Water Level (mOD)
20.0
10.0
Measuring level : 33.45
1992
1993
1994
1995
Well No: TF03/37 Aquifer: Lincolnshire Limestone
+ extremes & mean monthly levels (1964-1991)

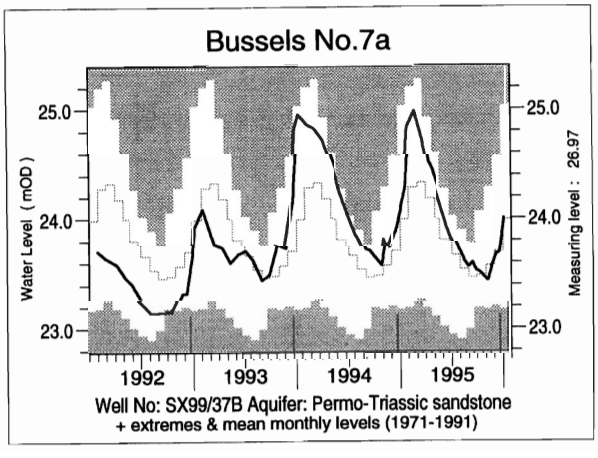

Ampney Crucis
Water Level (mOD)
102.5
100.0
97.5
Measuring level : 109.54
1992
1993
1994
1995
Well No: SP00/62 Aquifer: Middle Jurassic
+ extremes & mean monthly levels (1958-1991)


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


Llanfair DC
Water Level (mOD)
80.4
80.0
79.6
79.2
78.8
Measuring level : 83.08
1992
1993
1994
1995
Well No: SJ15/15 Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1972-1991)


Stone
Water Level (mOD)
91.0
90.0
Measuring level : 102.77
1992
1993
1994
1995
Well No: SJ83/1A Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1974-1991)


Heathlanes
Water Level (mOD)
63.0
62.0
61.0
Measuring level : 68.61
1992
1993
1994
1995
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
Well No: SX99/37B Aquifer: Permo-Triassic sandstone
+ extremes & mean monthly levels (1971-1991)

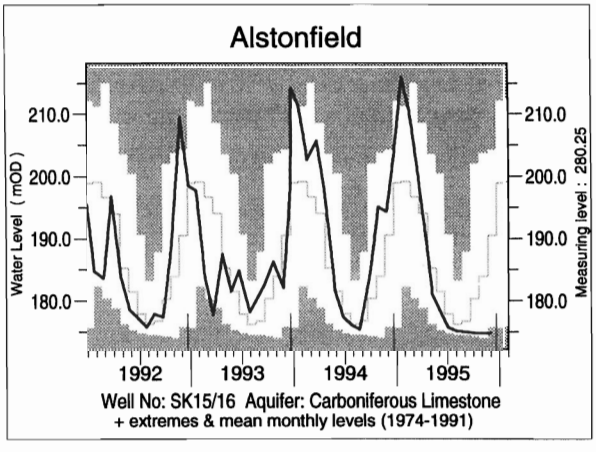

Alstonfield
Water Level (mOD)
210.0
200.0
190.0
180.0
Measuring level : 280.25
1992
1993
1994
1995
Well No: SK15/16 Aquifer: Carboniferous Limestone
+ extremes & mean monthly levels (1974-1991)

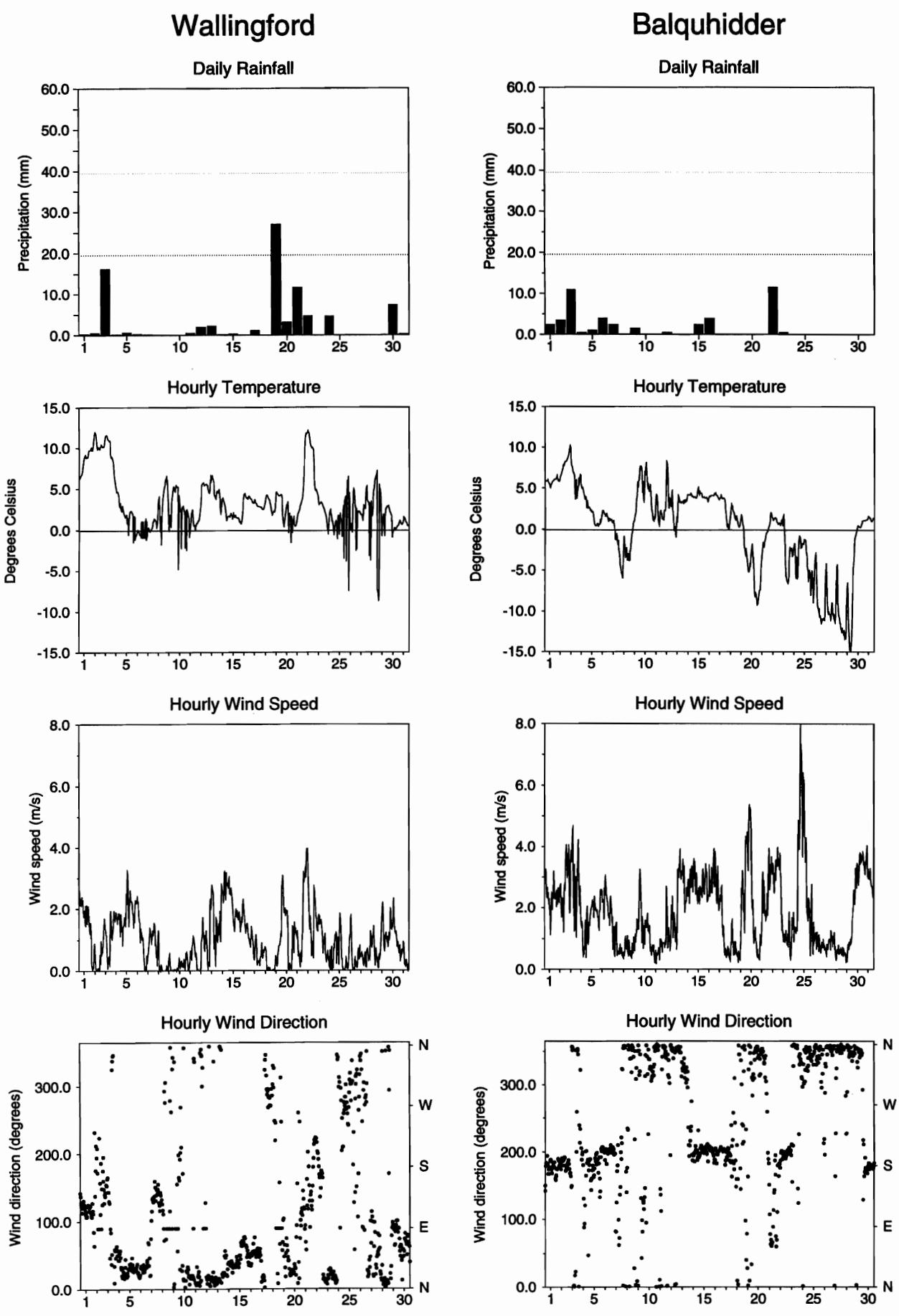
TABLE 5 DECEMBER GROUNDWATER LEVELS 1995

Site	Aquifer	Records commence	Minimum Dec <1995	Average Dec <1995	Maximum Dec <1995	No. of years Dec/Jan level <1995	Dec/Jan 1995/6 day	Dec/Jan 1995/6 level
Dalton Holme	C & UGS	1889	10.34	15.69	23.64	4	02/01	11.54
Wetwang	C & UGS	1971	16.84	21.09	28.63	5	02/01	18.81
Keelby Grange	C & UGS	1980	4.57	9.44	14.40	4	29/12	8.00
Washpit Farm	C & UGS	1950	40.61	43.30	46.94	9	04/01	42.31
The Holt	C & UGS	1964	83.90	86.85	90.11	>10	02/01	86.78
Therfield Rectory	C & UGS	1883	dry <71.6	77.81	96.32	>10	18/12	77.58
Redlands Hall	C & UGS	1964	32.46	38.88	46.97	5	14/12	36.09
Rockley	C & UGS	1933	dry <128.44	133.75	144.11	>10	02/01	131.98
Little Bucket Farm	C & UGS	1971	57.63	64.19	80.94	2	03/01	59.47
Compton House	C & UGS	1984	27.92	41.12	63.20	3	12/12	28.74
Chilgrove House	C & UGS	1836	33.46	51.76	77.11	3	27/12	34.48
Westdean No.3	C & UGS	1940	1.16	1.97	4.92	>10	29/12	1.41
Lime Kiln Way	C & UGS	1969	123.75	124.85	125.55	>10	28/12	125.58
Ashton Farm	C & UGS	1974	63.20	67.50	71.48	9	28/12	67.21
West Woodyates Manor	C & UGS	1942	67.95	86.51	104.53	>10	28/12	89.95
Killyglen (NI)	C & UGS	1985	114.06	115.97	119.27	5	13/12	115.42
New Red Lion	LLst	1964	5.49	12.70	21.51	6	03/01	8.79
Ampney Crucis	Mid Jur	1958	97.38	101.86	103.45	>10	02/01	102 .62
Redbank	PTS	1981	7.63	8.37	9.07	5	08/01	8.09
Skirwith	PTS	1978	129.54	130.22	131.00	4	27/12	129.91
Yew Tree Farm	PTS	1973	12.19	13.48	13.97	3	10/01	13.44
Llanfair D.C	PTS	1972	79.16	79.81	80.44	4	31/12	79.43
Stone	PTS	1974	89.55	90.07	90.72	7	19/12	89.92
Heathlanes	PTS	1971	60.33	61.90	62.94	>10	11/12	62.11
Bussels No.7A	PTS	1972	23.20	23.73	24.58	>10	03/01	24.00
Rushyford NE	MgLst	1967	64.77	72.26	76.65	>10	19/12	75.94
Peggy Ellerton	MgLst	1968	31.86	33.90	36.40	>10	15/12	33.64
Alstonfield	CLst	1974	175.96	192.00	209.62	0	12/12	174.96

groundwater levels are in metres above Ordnance Datum

C & UGS	Chalk and Upper Greensand	Mid Jur	Middle Jurassic limestones
LLst	Lincolnshire Limestone	MgLst	Magnesian Limestone
PTS	Permo-Triassic sandstones	CLst	Carboniferous Limestone

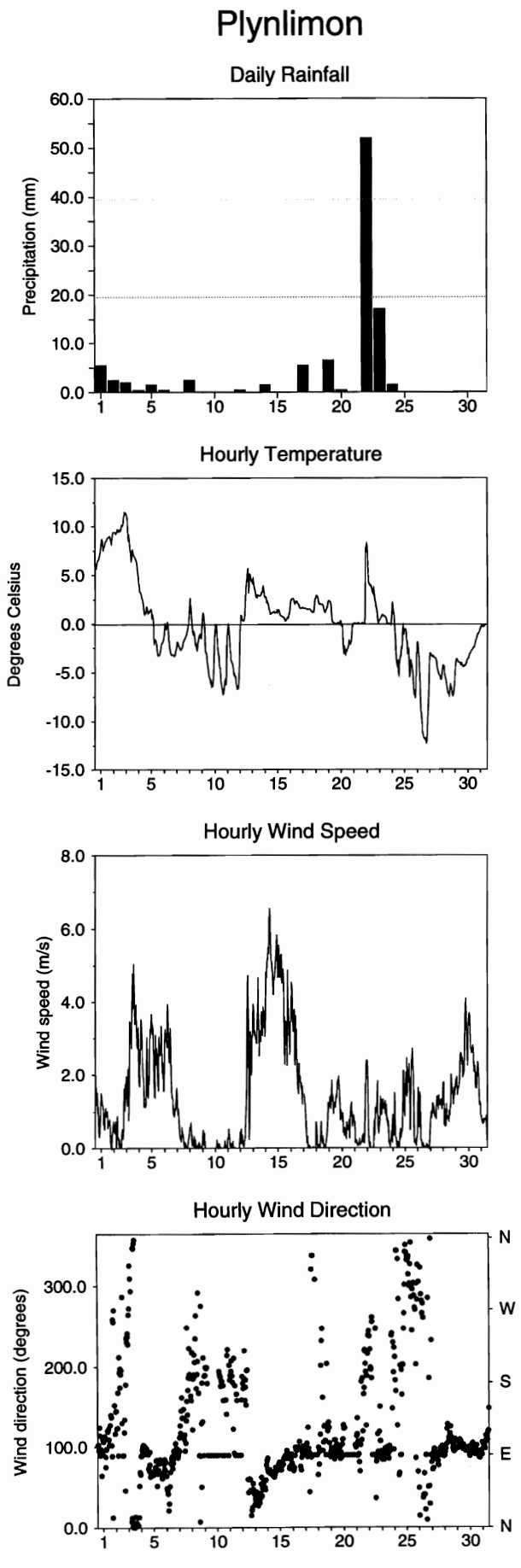
FIGURE 3 METEOROLOGICAL SUMMARY - DECEMBER 1995



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

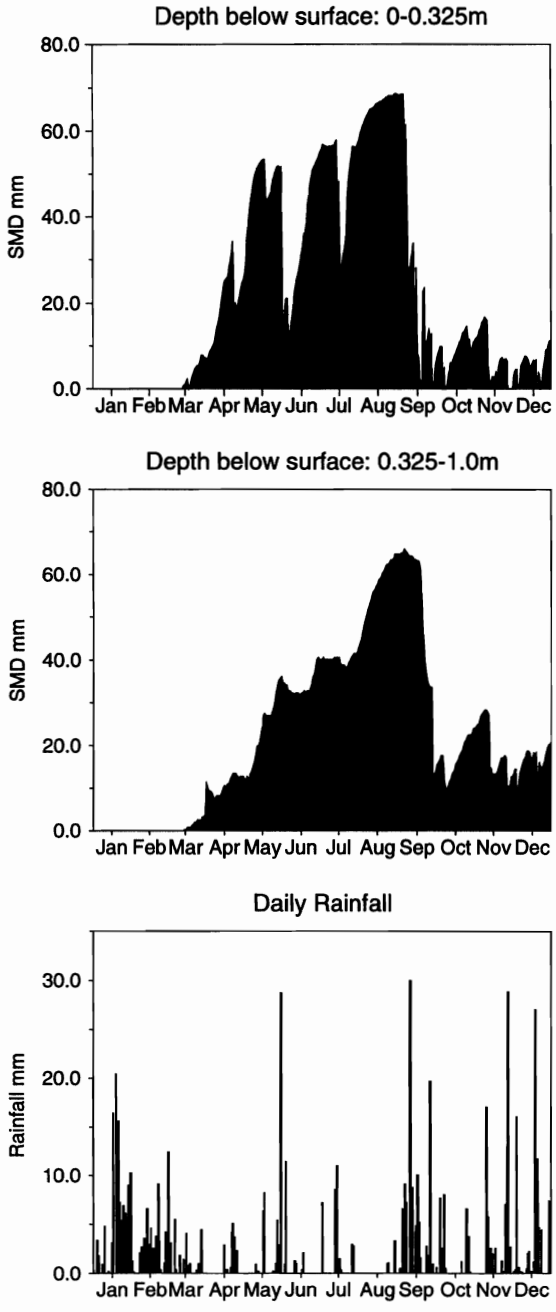
The Lower Kirkton automatic weather station (Balquhidder) occupies a relatively sheltered position at the mouth of the SSE trending Kirkton Glen. Station elevation is 270m aOD and average annual rainfall exceeds 2000mm; snow cover is expected for 10-30 days a year.

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 270m aOD and average annual rainfall exceeds 2300mm.

FIGURE 3a. WALLINGFORD SMD DATA 1995



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. The data presented here are calculated from readings taken at the two automatic soil water stations (ASWSs) at Wallingford. They employ capacitance soil water sensors installed at depths of 5, 15 and 50 cm. 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; slight discontinuities in the SMD trace can occur when switching between the ASWSs. The data presented give a good representative picture of soil moisture variations - avoiding the short term changes that can be dominant close to the surface.

Daily rainfall from the Wallingford meteorological station from the start of 1995 is presented.

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS