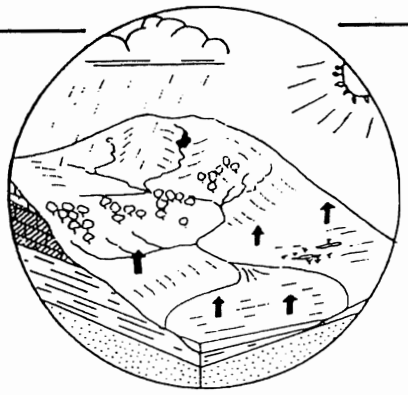
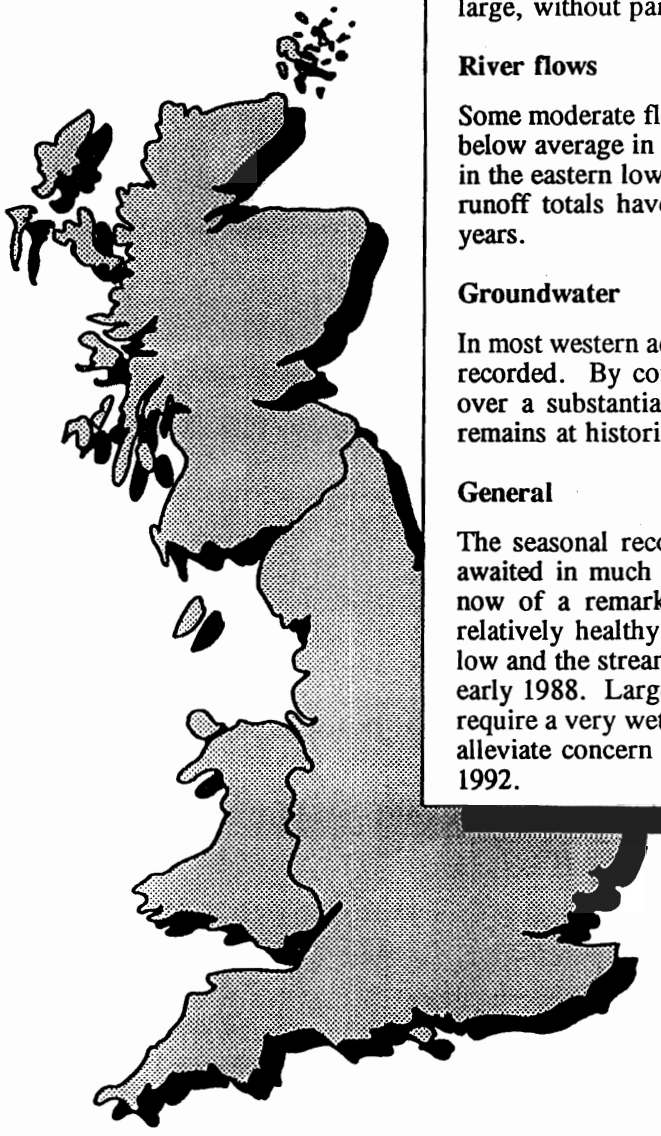
Hydrological Summary for Great Britain





DECEMBER 1991

Rainfall

Countrywide, only a little over 60% of average and notably dry in much of southern Britain. The latter half of 1991 witnessed a re-intensification of the drought in lowland England. Long term rainfall deficiencies are remarkably large, without parallel this century in parts of East Anglia.

River flows

Some moderate flooding in mid-month but runoff totals were below average in almost all areas. Flows are very depressed in the eastern lowlands where, in some catchments, monthly runoff totals have remained below average for over three years.

Groundwater

In most western aquifers some modest increases in level were recorded. By contrast, recessions continue in the east and over a substantial proportion of the Chalk the water-table remains at historical depressed levels.

General

The seasonal recovery in runoff and recharge rates is still awaited in much of lowland England where the drought is now of a remarkable duration. Reservoir stocks remain relatively healthy but groundwater levels are exceptionally low and the stream network has contracted appreciably since early 1988. Large parts of eastern and central England now require a very wet episode, extending well into the spring, to alleviate concern for water resources over the latter half of 1992.

Institute of Hydrology

British Geological Survey

HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - DECEMBER 1991

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 and, 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

December was a cool, and generally dry month throughout much of Britain. Media attention tended to focus on the wet interludes in mid-month and around year-end when flooding was reported from a number of regions; weather conditions were especially boisterous in northern Scotland. Of greater hydrological significance was the dominance of anticyclonic conditions in southern Britain which produced a notable rainless episode - beginning in the third week of November and extending over 25 days or more in some districts - and a further largely dry spell over the last ten days of December. This resulted in a re-intensification of the drought at a time when recoveries in runoff and recharge rates are normally gathering momentum.

Above average rainfall totals in December were largely confined to parts of western and central Scotland and the southern Peninnes. Exceptionally low totals characterised much of southern Britain - south of a line from the Wash to Cardigan many localities registered less than 30 per cent of the December average and for some districts it was the second driest December in the last 30 years. Generally, over the first half of 1991 the large long term rainfall deficiencies in eastern England were moderated. However, the drought reasserted itself from early August and is once again severe over much of the English lowlands. Provisional data indicate that only in 1947 and 1933 have lower August-December rainfall totals been recorded this century for England and Wales as a whole. More importantly, the five-month rainfall deficiencies tend to be greatest in those areas suffering the most severe long term drought.

Countrywide annual rainfall totals were within the normal range but 1991 totals were well below average throughout much of the English lowlands - extending as far west as the Cheshire Plain. Near to the Wash, some annual totals were closely comparable with those for 1990 - itself the second driest year this century (after 1921). With above average rainfall in such areas restricted to eight or nine individual months since the summer of 1988, accumulated rainfall deficiencies are of an unprecedented magnitude. Similarly in the Thames Valley, the catchment rainfall totals over very long durations (for instance, in the 30-46 months range) are the lowest, or close to the lowest (irrespective of start month) in a catchment rainfall record from 1883. Figures presented in Table 2 confirm the remarkable duration of the drought in parts of eastern and southern England and its exceptional magnitude in the Anglian and Thames regions, and in adjacent areas.

Long-term accumulated rainfall totals for western Scotland remain notably high and the remarkably sustained accentuation in the normal north-west to south-east rainfall gradient across Britain provides the backcloth for the depressed runoff and recharge rates in the English lowlands (see below). Very substantial rainfall will be required over the next four months to avoid a further episode of extremely low groundwater levels and contracting river networks in 1992.

Evaporation and Soil Moisture Deficits (SMDs)

Temperatures were appreciably below average throughout much of the South-East in December but above average in northern Scotland. Total sunshine hours generally displayed an opposing pattern although spatial variability was large. Evaporation losses in December were modest and well within the normal range for early winter. For the year as a whole, potential evaporation losses were also fairly typical albeit generally below average, notably so in central Wales. 1991 stands in marked contrast to the remarkable evaporation conditions experienced over the previous two years when annual losses were 100-150 mm greater over wide areas. Except for parts of the English lowlands AE losses were also below those of 1990 but still within the normal range in most regions.

By late December, significant soil moisture deficits were largely confined to the English lowlands, a few appreciable SMDs persist along Britain's north-eastern seaboard. A zone with substantially above average SMDs encompasses eastern Yorkshire, much of the Midlands, large parts of East Anglia and the lower Thames Valley. This region, where SMDs remain at least 30 mm above average, effectively delineates the area of maximum drought severity. In some districts (e.g. Cambridgeshire), remaining deficits are around 50 mm above average and equivalent to about five weeks average winter rainfall. This emphasises the critical importance of late winter/early spring precipitation in 1992 in determining the future of an already remarkably sustained drought (particularly in relation to groundwater storage).

Runoff

Large spatial variations in rainfall together with regional differences in soil moisture conditions produced wide variations in runoff rates during December. Around the 20-22nd, heavy rainfall - well over 75 mm in places - in the southern Pennines, produced flooding and widespread washland inundation in the Dove and Derwent Valleys and in South Yorkshire. New record peak river levels were recorded on the Dove (Derbyshire) and the neighbouring River Manifold; return periods exceeding 100 years were ascribed to flow rates in some reaches. Also on the 22nd, the River Clyde (at Daldowie) registered its second highest flow in a 28-year record. Subsequently, spate conditions became increasingly widespread in Scotland heralding significant flooding early in 1992.

Such notable runoff events were atypical of December, especially in lowland Britain. There was no general consolidation of the improvement in runoff rates experienced in November. Most rivers were in recession throughout much of December and, with few exceptions, monthly runoff totals were appreciably below those for November and greatly below the seasonal average. Rivers registering new minimum December mean flows showed a wide distribution. Examples include the Soar (Leicestershire), the Kennet (Berkshire), the Kenwyn (Cornwall), the Cynon, the Little Ouse and, notably, the Lea at Feilds Weir (Hertfordshire) where the naturalised December runoff was the lowest in a 108-year record. Elsewhere in the lowlands, flows were often similar to those experienced in 1975 or 1964; more recently runoff rates were also depressed in December 1988.

One measure of the persistence of the runoff drought is the sequence of low December flows recorded on the Itchen: four of the five lowest December runoff totals in a 30-year record have been registered since 1987. The accumulated runoff totals presented in Table 3 confirm the singular nature of the drought over large parts of eastern and southern Britain. Apart from some rivers draining upland catchments in Scotland and in the northern Pennines, runoff totals for 1991 are well below average - in East Anglia less than half the average is typical. The full magnitude of the runoff deficiency becomes evident over durations of 20 months or more. Flows on the River Lud, for instance, have been below average for 38 successive months and for durations greater than about 18 months (beginning in any month) accumulated runoff totals are without recorded precedent; a similar picture emerges from analyses of runoff series for the Little Ouse and some other eastern rivers.

Following healthy replenishments in November, natural inflows to reservoirs were generally much reduced in December and in eastern and southern England stocks registered only a modest improvement over the month. By contrast, relatively dramatic increases were reported for some Pennine impoundments; in the Derwent Valley system, for example, stocks rose by almost 40 per cent over the month. Overall, reservoir contents are appreciably greater than a year ago and the outlook for surface water resources, given rainfall within the normal range, remains reasonably healthy - in sharp contrast to the groundwater picture in the lowlands (see below).

Groundwater

The modest upturn in levels noted for some western aquifers last month has been followed by further limited rises in December (see, for instance, the hydrograph traces for Bussels and West Woodyates). However, the situation deteriorates in an easterly direction. Water-tables remain in recession throughout the greater part of the Chalk and the Permo-Triassic sandstones of the Midlands.

Evidence of the unprecedented magnitude of the current drought in groundwater terms is provided by the current levels at a number of long term index wells. Levels at Dalton Holme have declined to below any registered before 1990 (in a 103-year record). At Little Brocklesby, levels are closely comparable with the minimum in a series from 1926 and at Therfield - a deep well near Royston (Herts) - groundwater levels have declined over 20 metres since the spring of 1988 and now stand at their lowest level since the borehole was last dry in 1923. Levels at Washpit Farm and Redlands are unprecedented in records of 42 and 28 years respectively. Taking into consideration the inordinate nature of the long term rainfall deficiencies in a broad zone from north of the Humber estuary to Hertfordshire, it appears probable that the scale of the groundwater depletion in the Chalk of this region is without parallel this century. Away from this area, drought conditions ameliorate but groundwater levels remain well below average throughout most of the Chalk, in Kent especially. Levels in the Lincolnshire Limestone remain depressed also - at the New Red Lion borehole the December minimum established in 1990 was closely approached in December 1991.

In the Middle Jurassic of the Cotswolds (Ampney Crucis) levels are close to the seasonal average, a picture repeated in the Chalk and the Permo-Triassic sandstones of the West Country. Reports suggest a similar situation in the Permo-Triassic aquifers of north-west England but the situation in the Midlands and North Wales is more difficult to interpret. The Weeford Flats well remains dry (it was also dry in 1976) and at Llanfair DC the dry December halted the recovery in levels and by mid-month the pre-1990 monthly minimum had been eclipsed. The hydrographs for these latter sites confirm the existence of a second zone of substantially depressed groundwater levels extending across much of the Midlands and the Cheshire Plain.

Sustained rainfall - well above average - will be required over the remainder of the winter to generate a substantial recovery in groundwater levels in the English lowlands. A wet spring will also be essential to delay the onset of the 1992 groundwater level recession, in order for there to be any realistic hope of levels returning within the normal range during 1992. Average rainfall in the east will serve only to herald a fourth (in some districts, a fifth) successive year with notably low summer and autumn groundwater levels - and very limited baseflow to support spring-fed rivers through the latter half of the year.

Institute of Hydrology/British Geological Survey
13 January 1992

TABLE 1 1990/91 RAINFALL AS A PERCENTAGE OF THE 1941-70 AVERAGE

		Dec 1990	Jan 1991	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec 1991
England and	mm	101	92	65	75	69	14	90	69	30	62	75	90	41
Wales	%	112	107	100	127	119	21	148	95	33	75	90	92	45
NRA REGIONS														
North West	mm	151	98	94	110	67	18	105	65	65	68	111	152	105
	%	126	88	116	153	87	22	127	63	52	55	94	126	88
Northumbria	mm	127	83	113	85	41	22	69	55	37	42	75	105	71
	%	169	104	171	163	75	34	113	71	37	53	100	112	95
Severn-Trent	mm	87	77	43	59	67	11	74	77	21	55	54	69	38
	%	124	112	81	113	129	17	132	118	26	82	83	87	54
Yorkshire	mm	121	71	88	63	49	14	73	37	21	40	63	93	60
	%	164	92	138	119	88	23	126	53	23	56	91	104	81
Anglian	mm	47	44	39	29	45	13	77	38	18	62	26	53	23
	%	89	85	93	73	113	28	157	67	28	119	50	85	44
Thames	mm	68	80	38	45	63	13	96	79	19	52	36	66	16
	%	103	129	81	98	137	23	185	132	27	84	56	90	25
Southern	mm	65	98	39	59	56	17	125	87	15	50	51	81	23
	%	80	129	68	113	117	31	250	147	21	70	65	86	28
Wessex	mm	78	108	40	81	72	10	107	73	20	70	84	71	31
	%	87	129	68	140	133	15	198	118	24	89	102	73	34
South West	mm	124	153	82	127	100	9	127	91	32	84	123	112	47
	%	92	119	91	151	141	11	195	108	32	81	109	84	35
Welsh	mm	163	151	94	127	124	15	111	98	53	85	153	138	66
	%	112	111	98	146	144	16	135	103	45	68	119	97	45
Scotland	mm	191	151	83	127	123	41	122	92	67	129	162	222	123
	%	122	110	80	138	137	45	133	82	52	94	109	156	79
RIVER PURIFICATION BOARDS														
Highland	mm	241	180	71	141	131	63	125	108	84	181	191	294	161
	%	123	110	53	124	115	61	114	85	57	115	103	174	82
North-East	mm	97	60	77	81	62	46	131	57	33	57	116	129	52
	%	95	66	104	131	102	60	187	62	31	66	120	125	51
Tay	mm	149	154	90	117	110	23	135	91	41	108	146	147	103
	%	111	131	98	143	147	24	163	89	35	94	120	124	77
Forth	mm	143	133	86	103	90	18	110	96	39	99	109	112	92
	%	131	134	112	149	132	21	147	98	34	92	103	104	84
Tweed	mm	152	110	102	93	62	21	90	65	35	66	99	120	75
	%	169	118	148	160	102	28	132	73	31	71	113	115	83
Solway	mm	191	144	108	150	148	17	122	77	69	79	175	198	136
	%	126	103	116	165	168	18	136	70	53	52	122	137	90
Clyde	mm	226	187	90	156	184	33	129	110	86	157	190	274	190
	%	122	116	80	149	179	34	125	85	61	90	104	164	102

Note: The most recent monthly rainfall figures for England and Wales correspond to the MORECS areal assessments derived by the Meteorological Office; for the Scottish RPBs the December 1991 totals were estimated from the isohyetal map provided with the MORECS bulletin. The regional areal rainfall figures are regularly updated (normally one or two months in arrears) using figures derived from a far denser raingauge network.

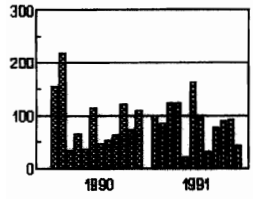
TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

		Aug-Dec 91		Jan-Dec 91		Mar 90 - Dec 91		Nov 88 - Dec 91	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales	mm	299		776		1153		2525	
	% LTA	67	20-30	85	5-10	80	40-60	86	30-40
NRA REGIONS									
North West	mm	501		1058		1924		3574	
	% LTA	83	2-5	87	5-10	86	5-15	92	5-10
Northumbria	mm	330		798		1416		2397	
	% LTA	78	5-10	91	2-5	88	5-10	85	30-40
Severn Trent	mm	237		645		1117		2130	
	% LTA	65	15-25	83	5-10	78	40-60	86	20-30
Yorkshire	mm	277		672		1219		2216	
	% LTA	70	10-20	81	10-20	80	30-45	83	50-70
Anglian	mm	182		467		812		1537	
	% LTA	64	20-30	77	15-25	72	>200	79	>200
Thames	mm	189		603		950		1845	
	% LTA	56	40-50	86	5-10	73	100-140	82	40-60
Southern	mm	220		701		1143		2118	
	% LTA	55	40-50	88	2-5	79	30-40	83	35-50
Wessex	mm	276		767		1226		2374	
	% LTA	64	10-20	88	2-5	77	40-60	85	20-30
South West	mm	398		1087		1829		3497	
	% LTA	68	10-20	91	2-5	84	10-20	91	5-10
Welsh	mm	495		1215		2061		3940	
	% LTA	75	5-10	91	2-5	85	10-20	92	5-10
Scotland	mm	703		1442		2816		5106	
	% LTA	99	<2	101	2-5	107	5-10	111	20-30
RIVER PURIFICATION BOARDS									
Highland	mm	911		1730		3462		6441	
	% LTA	106	2-5	100	<2	109	5-10	116	100-140
North-East	mm	387		901		1711		2837	
	% LTA	78	5-10	88	5-10	91	5-10	87	30-40
Tay	mm	545		1265		2252		4153	
	% LTA	90	2-5	101	2-5	98	2-5	103	2-5
Forth	mm	451		1087		2038		3696	
	% LTA	82	5-10	97	2-5	99	<2	104	2-5
Tweed	mm	395		938		1698		2943	
	% LTA	81	5-10	94	2-5	93	2-5	92	5-10
Solway	mm	657		1423		2510		4573	
	% LTA	91	2-5	100	<2	96	2-5	100	<2
Clyde	mm	897		1786		3359		6122	
	% LTA	105	2-5	107	2-5	109	5-10	114	40-50

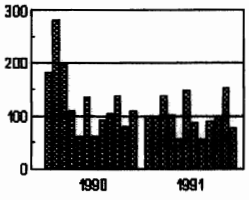
Return period assessments are based on tables provided by the Meteorological Office* and are tabulated for guidance only. These assume a start in a specified month; return periods for a start in any month may be expected to be about an order of magnitude less - for the longest durations the return period 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).

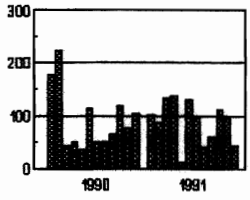
FIGURE 1. MONTHLY RAINFALL FOR 1990-1991 AS A PERCENTAGE OF THE 1941-1970 AVERAGE



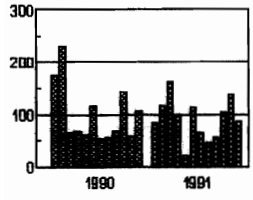
England and Wales



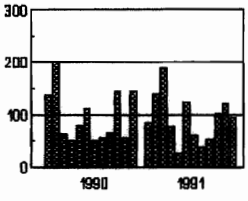
Scotland



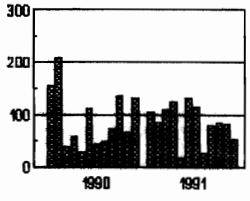
Welsh Region



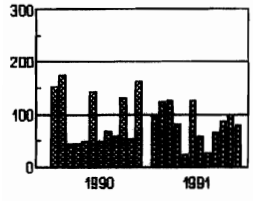
North West Region



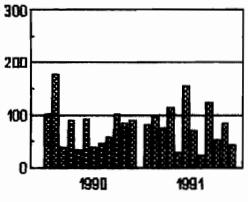
Northumbria Region



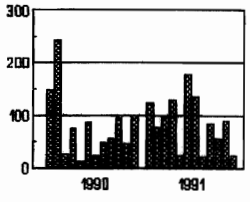
Severn-Trent Region



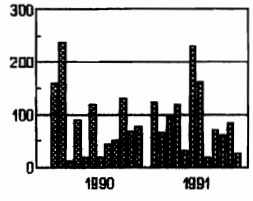
Yorkshire Region



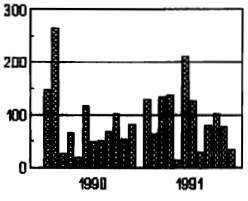
Anglian Region



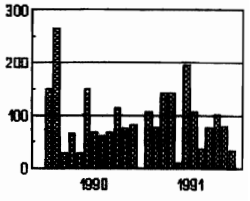
Thames Region



Southern Region

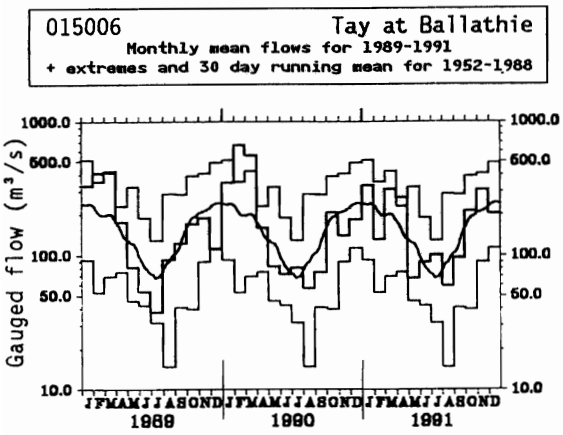


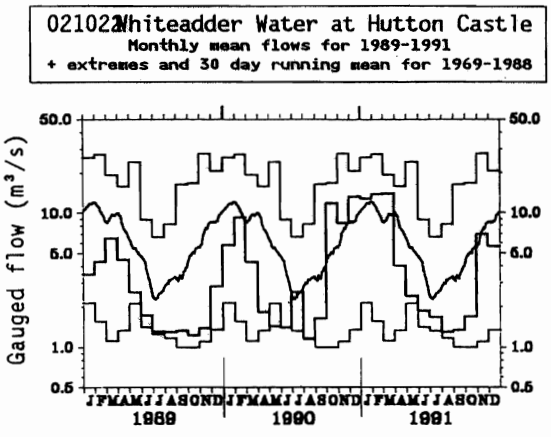
Wessex Region

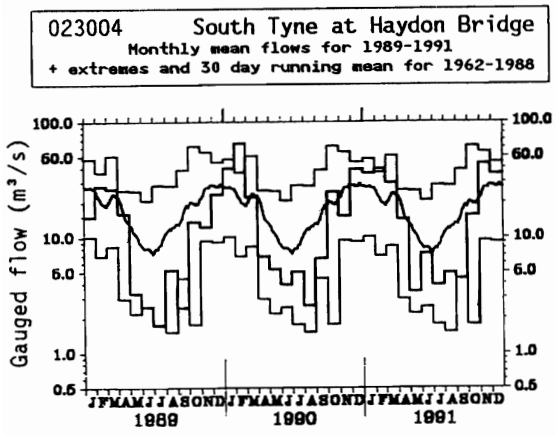


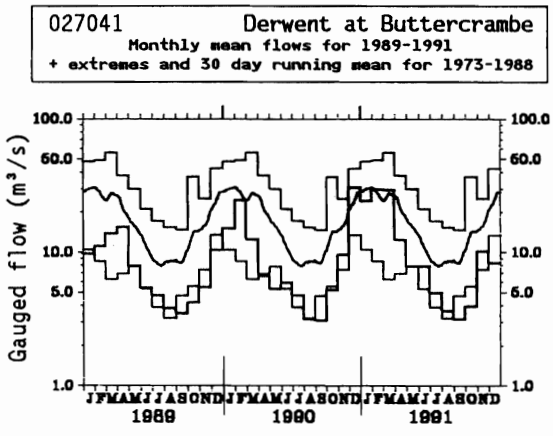
South West Region

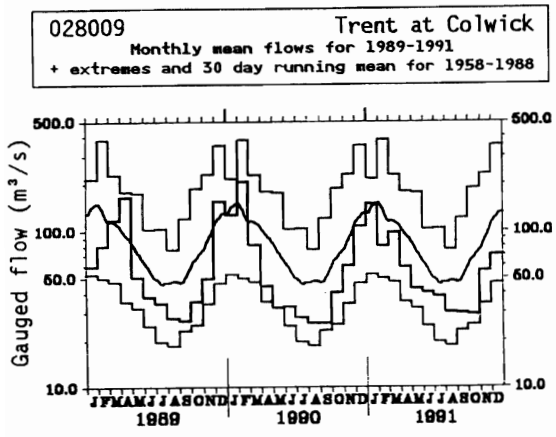
FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

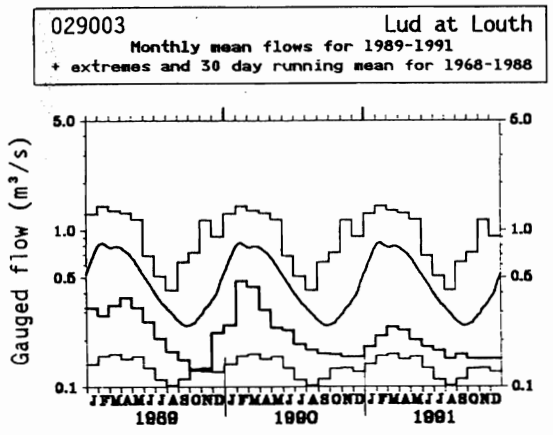


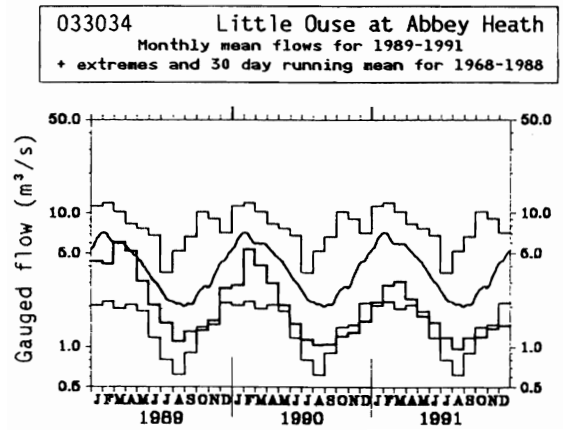


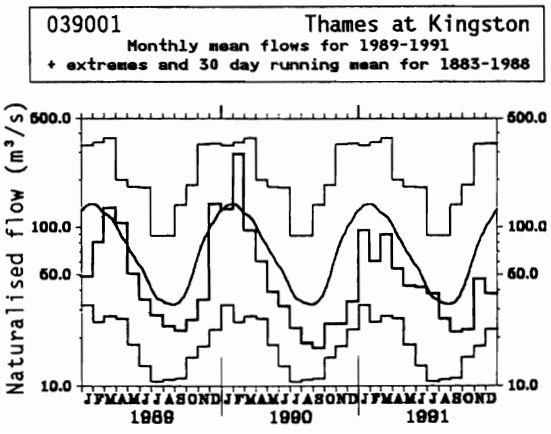




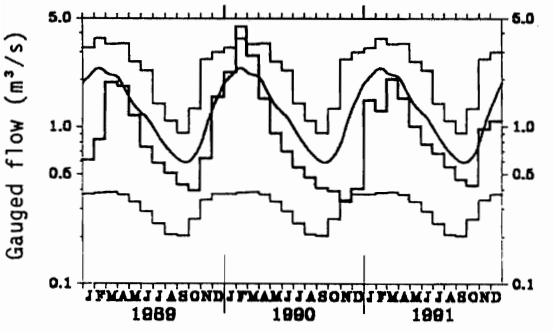




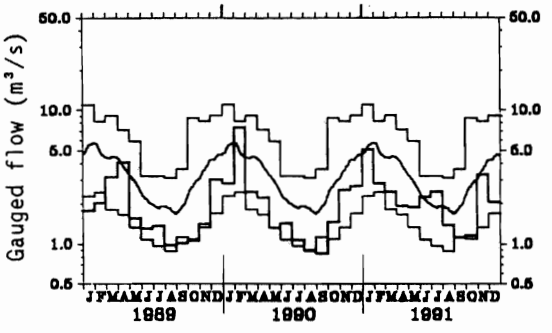




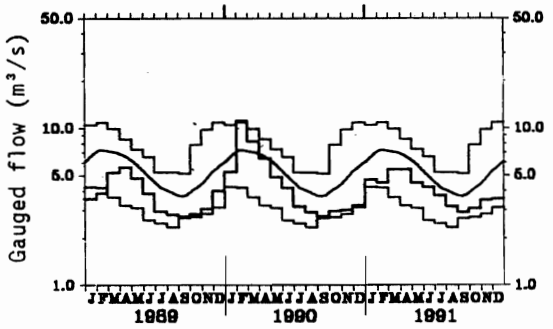
039020 Coln at Bibury
Monthly mean flows for 1989-1991
+ extremes and 30 day running mean for 1963-1988



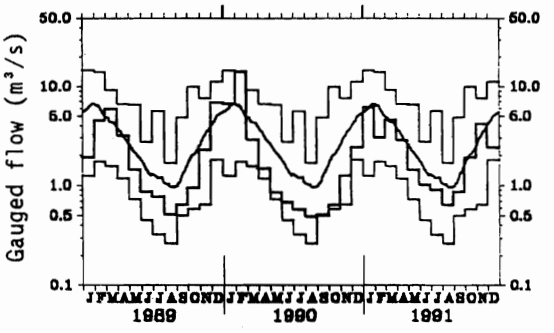
040011 Great Stour at Horton
Monthly mean flows for 1989-1991
+ extremes and 30 day running mean for 1964-1988



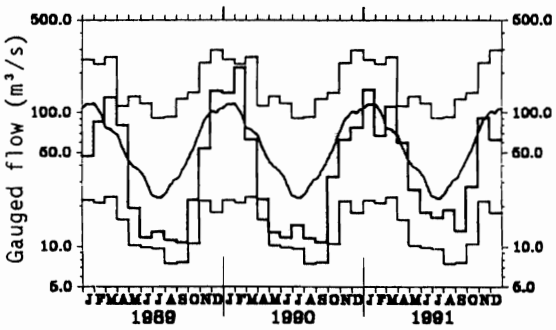
042010 Itchen at Highbridge+Allbrook
Monthly mean flows for 1989-1991
+ extremes and 30 day running mean for 1958-1988



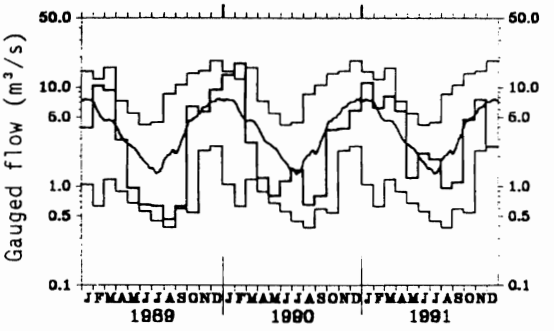
052005 Tone at Bishops Hull
Monthly mean flows for 1989-1991
+ extremes and 30 day running mean for 1961-1988



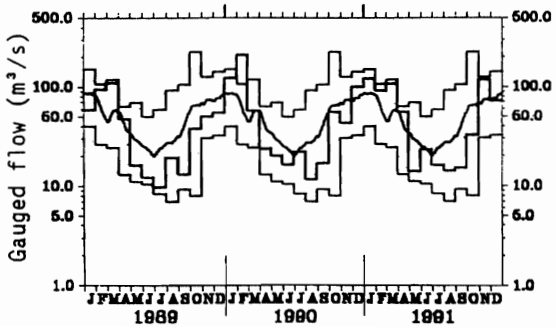
054001 Severn at Bewdley
Monthly mean flows for 1989-1991
+ extremes and 30 day running mean for 1921-1988



057004 Cynon at Abercynon
Monthly mean flows for 1989-1991
+ extremes and 30 day running mean for 1957-1988



076007 Eden at Sheepmount
Monthly mean flows for 1989-1991
+ extremes and 30 day running mean for 1967-1988



084013 Clyde at Daldowie
Monthly mean flows for 1989-1991
+ extremes and 30 day running mean for 1963-1988

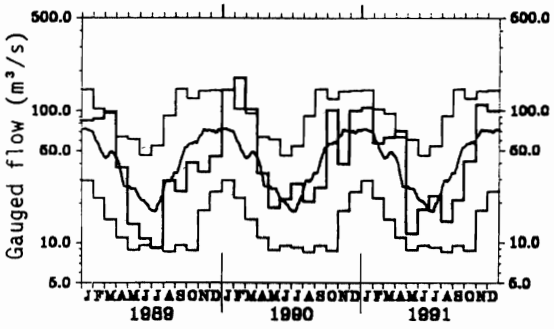


TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

River/ Station name	Aug	Sept	Oct	Nov	Dec		6/91 to 12/91		1/91 to 12/91		5/90 to 12/91		5/89 to 12/91	
	1991				1991									
	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	17 53	17 41	70 87	122 165	44 50	2 /20	367 96	9 /19	779 100	9 /19	1116 90	5 /18	1742 85	2 /17
Tay at Ballathie	34 66	54 77	124 111	173 145	118 84	19 /40	613 105	26 /39	1246 111	29 /39	1763 99	19 /38	3217 111	28 /37
Whiteadder Water at Hutton Castle	7 45	7 44	9 32	35 94	30 66	6 /23	106 62	5 /22	346 88	8 /22	564 95	9 /21	742 75	5 /20
South Tyne at Haydon Bridge	17 43	15 29	55 79	148 165	125 128	21 /30	399 98	13 /28	817 108	20 /28	1175 97	14 /26	1853 93	8 /24
Wharfe at Flint Mill Weir	15 37	15 33	36 56	117 149	91 94	19 /37	315 83	10 /36	668 93	13 /36	968 85	7 /35	1555 83	3 /34
Derwent at Buttercrambe	6 42	5 37	7 34	17 60	14 35	2 /31	69 48	3 /30	238 73	6 /30	351 70	3 /29	522 63	1 /28
Trent at Colwick	11 66	10 60	10 43	19 63	25 56	4 /34	103 63	3 /33	252 71	3 /33	377 69	2 /32	680 75	2 /31
Lud at Louth	7 51	8 71	7 58	7 48	7 36	2 /24	53 53	1 /23	103 40	2 /23	173 45	1 /22	317 50	1 /21
Witham at Claypole Mill	4 57	5 81	5 59	7 59	7 38	5 /33	38 56	9 /33	116 63	6 /32	156 58	6 /32	312 69	4 /31
Little Ouse at Abbey Heath	4 52	4 54	4 40	5 41	6 36	1 /24	33 46	2 /24	78 46	1 /23	119 46	1 /23	230 54	1 /22
Colne at Lexden	3 74	3 71	3 36	5 41	5 30	2 /33	29 52	4 /32	65 48	3 /32	94 47	2 /31	202 61	1 /30
Thames at Kingston (natr.)	7 80	6 67	6 45	12 56	10 33	8 /109	62 59	19 /109	152 62	11 /109	208 57	6 /108	452 74	11 /107
Blackwater at Swallowfield	11 96	11 84	12 62	19 79	14 46	2 /40	99 80	10 /39	216 83	10 /39	313 77	6 /38	612 91	11 /37
Coln at Bibury	14 83	11 78	11 69	23 96	27 70	9 /29	122 79	9 /28	300 77	5 /28	402 69	3 /27	815 83	6 /26
Great Stour at Horton	11 82	8 58	9 44	25 94	16 47	3 /27	104 76	5 /26	211 72	4 /25	304 67	3 /24	503 67	1 /22
Itchen at Highbridge+Allbrook	23 82	21 80	23 76	25 73	26 63	3 /34	176 79	4 /33	354 77	4 /33	552 76	1 /32	969 81	1 /31
Stour at Throop Mill	9 88	8 69	13 61	29 95	25 46	5 /19	114 75	5 /19	312 82	4 /19	389 68	1 /18	831 86	4 /17
Piddle at Baggs Mill	15 97	16 106	23 113	30 105	28 68	9 /29	155 96	15 /28	348 87	6 /27	459 77	4 /26	861 85	4 /24
Exe at Thorverton	15 53	14 36	56 75	128 134	75 57	7 /36	345 84	12 /36	755 91	12 /35	1063 83	7 /35	1809 86	5 /34
Tone at Bishops Hull	8 65	11 72	25 94	54 130	32 48	5 /31	156 80	10 /31	389 82	6 /30	487 70	2 /30	989 84	5 /29
Severn at Bewdley	12 70	8 37	17 51	54 101	39 62	13 /71	150 69	10 /71	399 88	19 /70	542 78	7 /70	976 85	11 /69
Wye at Cefn Brwyn	178 125	102 62	167 80	315 126	192 68	9 /39	1157 93	14 /35	1976 96	13 /34	3170 92	9 /30	5165 94	6 /25
Cynon at Abercynon	24 48	27 40	120 99	182 120	63 33	1 /34	516 78	8 /32	1310 105	17 /32	1764 90	8 /30	3208 99	15 /28
Dee at New Inn	54 59	43 32	146 72	260 107	189 76	7 /23	823 78	5 /22	1497 83	5 /22	2443 83	3 /21	4119 86	2 /20
Eden at Sheepmount	16 52	17 39	38 51	132 162	83 92	11 /22	332 92	10 /21	775 112	14 /21	1105 103	12 /19	1811 103	10 /17
Clyde at Daldowie	20 49	28 49	58 70	151 160	140 143	25 /29	453 106	15 /28	877 115	23 /28	1372 111	20 /27	2274 114	22 /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 JANUARY 1991

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	Aug	Sep	Oct	Nov	Dec	1992 Jan	1991 Jan
					(%)▲					
North West	Northern Command Zone[1]	(G)	133375	55	43	33	41	72	79	69
	Vyrnwy	(R)	55146	83	85	71	82	85	95	87
Northumbria	Teesdale[2]	(G)	87936	52	39	31	41	68	88	96
	Kielder	(R)	199175*			85*	85*	96*	99*	92*
Severn-Trent	Clywedog	(R)	44922	94	91	74	75	82	87	91
	Derwent Valley[3]	(G)	39525	66	53	35	32	46	84	100
Yorkshire	Washburn[4]	(G)	22035	59	46	36	28	48	65	64
	Bradford supply[5]	(G)	41407	65	50	38	37	70	86	89
Anglian	Grafham	(R)	58707	95	88	81	76	81	88	61
	Rutland	(R)	130061	81	70	68	63	63	63	60
Thames	London[6]	(G)	206232	90	80	66	57	71	75	60
	Farmoor [7]	(G)	13843	100	89	82	89	97	99	71
Southern	Bewl	(R)	28170	75	73	62	54	58	58	38
	Ardingly	(R)	4627	100	81	84	81	85	88	68
Wessex	Clatworthy	(R)	5364*	59*	47*	40*	59	89	87	66
	Bristol WW [8]	(G)	36620	71	57	46	39	50	53	38
South West	Colliford	(R)	28540	90	86	81	79	83	83	73
	Roadford	(R)	34500	95	89	84	81	86	85	68[9]
	Wimbleball[10]	(R)	21320	73	63	52	57	69	73	48
	Stithians	(R)	5205	66	53	40	34	34	37	49
Welsh	Celyn + Brenig	(G)	131155	89	79	68	71	84	94	92
	Brianne	(R)	62140	93	92	84	89	100	100	100
	Big Five[11]	(G)	69762	92	92	69	73	87	93	71
	Elan Valley[12]	(G)	99106	87	85	77	90	94	94	100
Lothian	Edinburgh/Mid Lothian	(G)	97639						95	
	West Lothian	(G)	5613						90	
	East Lothian	(G)	10206						95	

● Live or usable capacity (unless indicated otherwise)

* Gross storage/percentage of gross storage

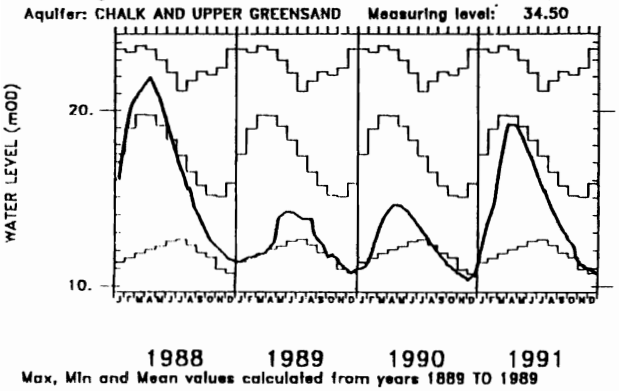
1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6. 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. The new Roadford reservoir was still filling after impounding.
10. Shared between South West (river regulation for abstraction) and Wessex (direct supply).
11. Usk, Talybont, Llandegfedd (pumped storage), Taf Fechan, Taf Fawr.
12. 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 elsehwere in the report and the water resources situation.

FIGURE 3 GROUNDWATER HYDROGRAPHS

Site name: DALTON HOLME

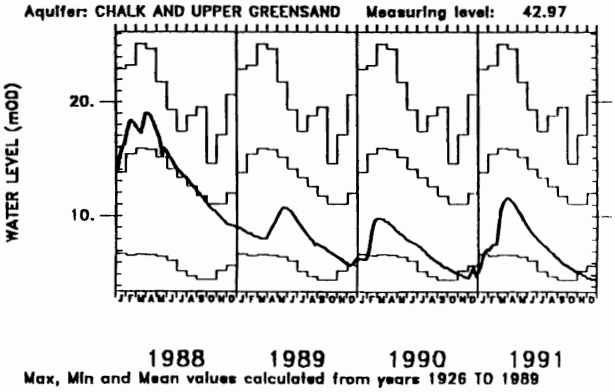
National grid reference: SE 9651 4530 Well number: SE94/5
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 34.50



Max, Min and Mean values calculated from years 1889 TO 1989

Site name: LITTLE BROCKLESBY

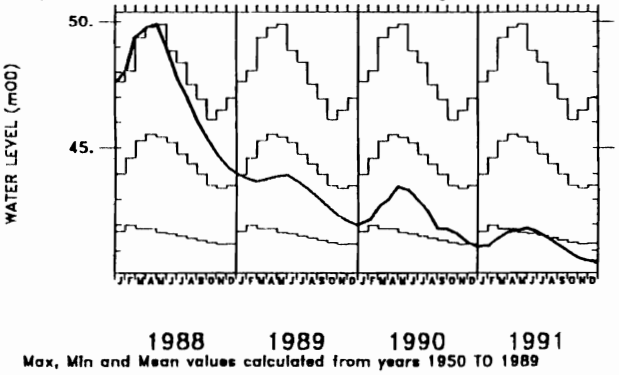
National grid reference: TA 1371 0888 Well number: TA10/40
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 42.97



Max, Min and Mean values calculated from years 1926 TO 1989

Site name: WASHPIT FARM

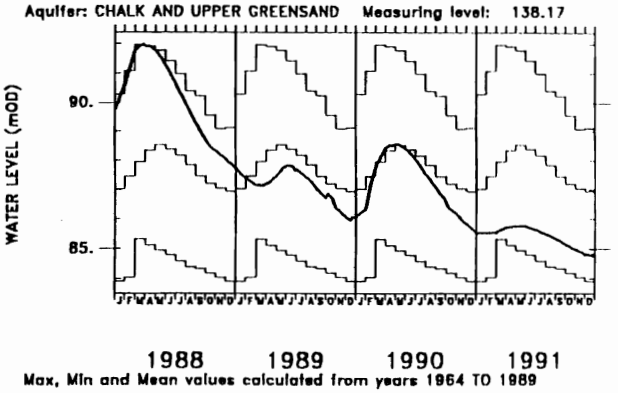
National grid reference: TF 8138 1960 Well number: TF81/2
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 80.20



Max, Min and Mean values calculated from years 1950 TO 1989

Site name: THE HOLT

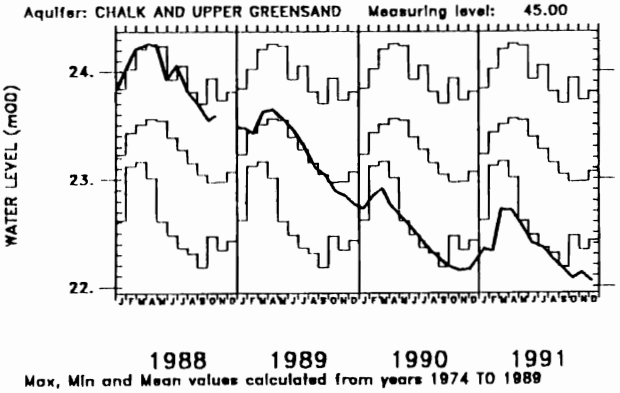
National grid reference: TL 1692 1965 Well number: TL11/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 138.17



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: FAIRFIELDS

National grid reference: TM 2461 6109 Well number: TM26/46
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 45.00

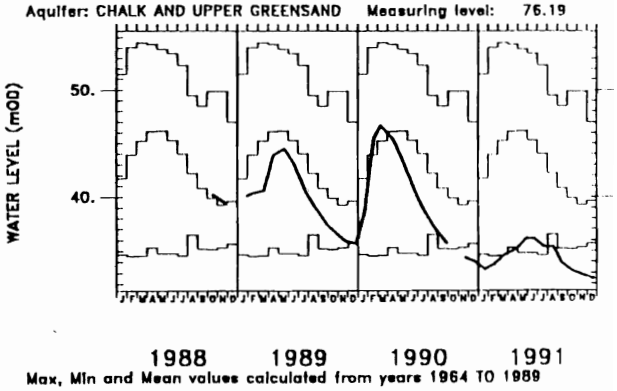


Max, Min and Mean values calculated from years 1974 TO 1989

A break in the data line indicates a recording interval of greater than 8 weeks

Site name: REDLANDS HALL,ICKLETON

National grid reference: TL 4522 4182 Well number: TL44/12
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 76.19

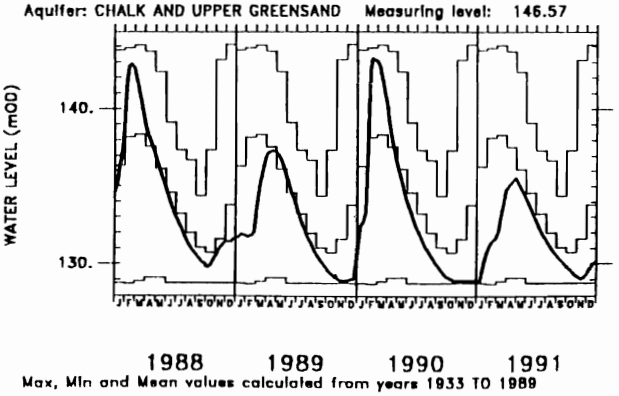


Max, Min and Mean values calculated from years 1964 TO 1989

A break in the data line indicates a recording interval of greater than 8 weeks

Site name: ROCKLEY

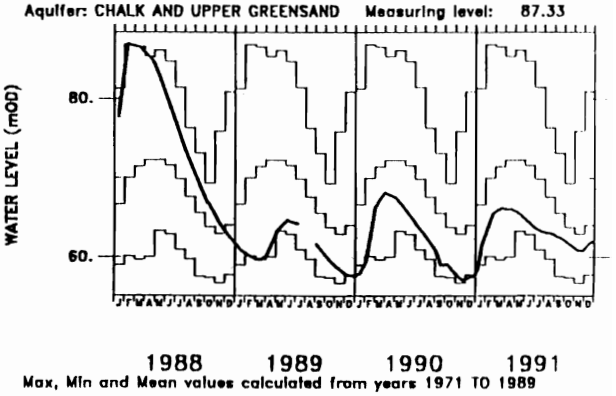
National grid reference: SU 1655 7174 Well number: SU17/57
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.57



Max, Min and Mean values calculated from years 1933 TO 1989

Site name: LITTLE BUCKET FARM,WALTHAM

National grid reference: TR 1225 4690 Well number: TR14/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 87.33

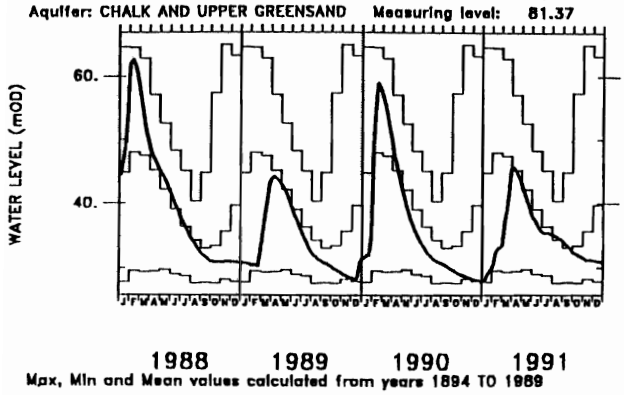


Max, Min and Mean values calculated from years 1971 TO 1989

A break in the data line indicates a recording interval of greater than 8 weeks

Site name: COMPTON HOUSE

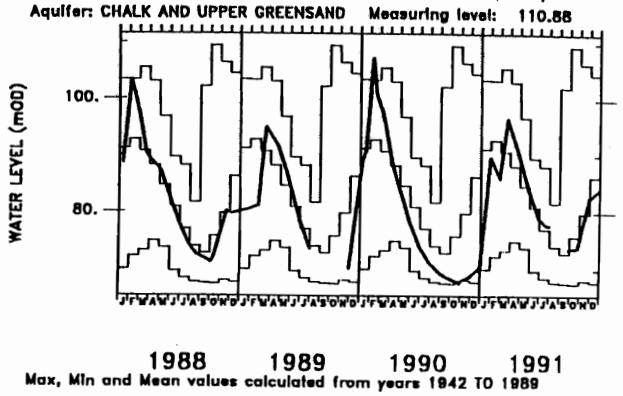
National grid reference: SU 7755 1490 Well number: SU71/23
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



Max, Min and Mean values calculated from years 1894 TO 1989

Site name: WEST WOODYATES MANOR

National grid reference: SU 0160 1960 Well number: SU01/58
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 110.88

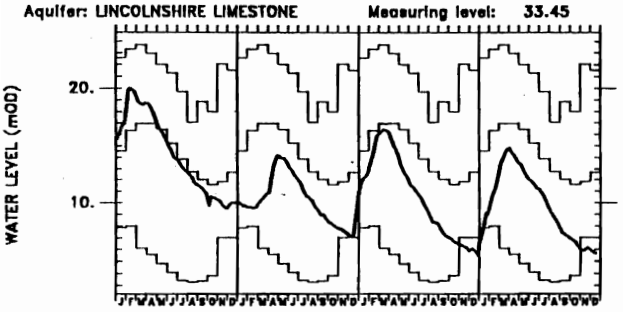


Max, Min and Mean values calculated from years 1942 TO 1989

A break in the data line indicates a recording interval of greater than 8 weeks

Site name: NEW RED LION

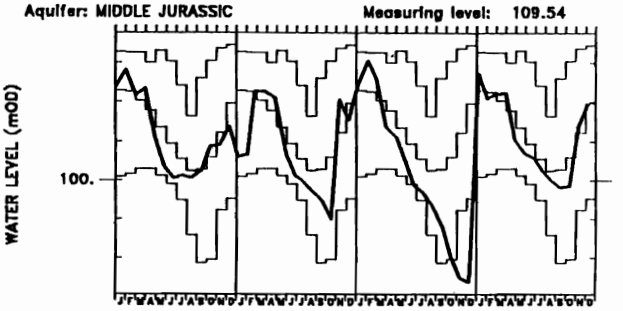
National grid reference: TF 0885 3034 Well number: TF03/37
Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.45



Max, Min and Mean values calculated from years 1964 TO 1989

Site name: AMPNEY CRUCIS

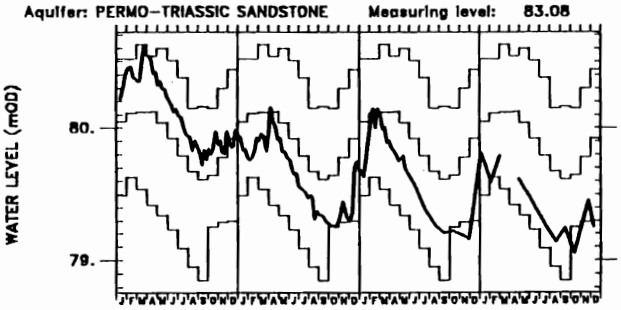
National grid reference: SP 0595 0190 Well number: SP00/62
Aquifer: MIDDLE JURASSIC Measuring level: 109.54



Max, Min and Mean values calculated from years 1958 TO 1989

Site name: LLANFAIR DC

National grid reference: SJ 1374 5556 Well number: SJ15/15
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 83.08

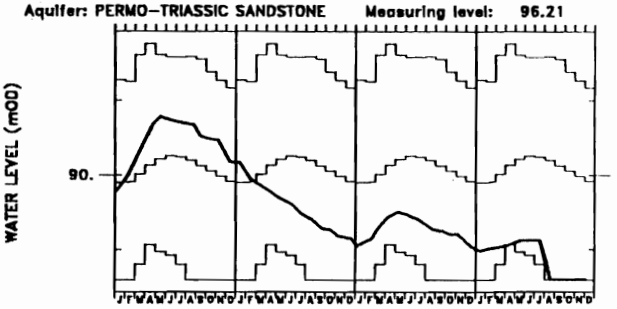


Max, Min and Mean values calculated from years 1972 TO 1989

A break in the data line indicates a recording interval of greater than 8 weeks

Site name: WEEFORD FLATS,WEEFORD

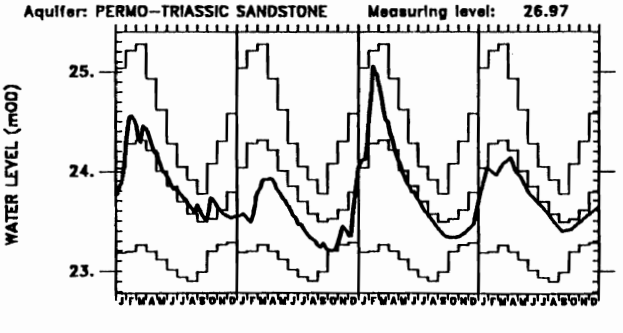
National grid reference: SK 1440 0464 Well number: SK10/9
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 96.21



Max, Min and Mean values calculated from years 1966 TO 1989

Site name: BUSSELS NO.7A

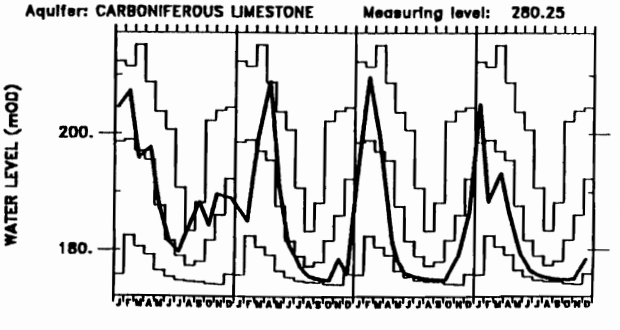
National grid reference: SX 9528 9872 Well number: SX99/37B
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.97



Max, Min and Mean values calculated from years 1972 TO 1989

Site name: ALSTONFIELD

National grid reference: SK 1292 5547 Well number: SK15/16
Aquifer: CARBONIFEROUS LIMESTONE Measuring level: 280.25



Max, Min and Mean values calculated from years 1974 TO 1989

TABLE 5 A COMPARISON OF DECEMBER GROUNDWATER LEVELS : 1991, 1990 AND 1989

Site	Aquifer	Records commence	Average December Level	December 1989		December 1990		December and January 1991-92		No of years December levels <1991	Lowest pre-1991 level (any month)
				Day	Level	Day	Level	Day	Level		
Dalton Holme	C & UGS	1889	15.79	28/12	10.89	06/12	10.34	3/01	10.62	1	10.34
Little Brocklesby	C & UGS	1926	11.85	29/12	6.31	27.12	4.86	27/12	4.60	0	4.56
Washpit Farm	C & UGS	1950	43.40	4/12	42.13	4/12	41.31	6/01	40.51	0	41.24
The Holt	C & UGS	1964	86.79	21/12	86.04	6/12	85.81	5/01	84.74	2	83.90
Fairfields	C & UGS	1974	23.01	18/12	22.77	6/12	22.16	10/12	22.05	0	22.15
Redlands Farm	C & UGS	1964	39.36	27/12	35.68	21/12	34.04	24/12	32.46	0	34.04
Rockley	C & UGS	1933	133.82	31/12	130.10	31/12	128.94 dry	5/01	130.11	>10	dry (below 128.94)
Little Bucket Farm	C & UGS	1971	64.05	6/12	57.81	31/12	57.63	27/12	61.97	7	56.77
Compton House	C & UGS	1894	39.77	29/12	31.02	28/12	27.96	2/01	30.87	>10	27.64
West Dean	C & UGS	1940	1.97	29/12	1.68	28/12	1.39	24/12	1.72	>10	1.01
Lime Kiln Way	C & UGS	1969	124.92	9/12	124.27	5/12	124.69	2/01	124.18	0	124.09
Ashton Farm	C & UGS	1974	67.15	15/12	63.80	5/12	63.20	30/12	68.60	9	63.10
West Woodyates	C & UGS	1942	86.19	27/12	83.10	3/12	68.90	2/01	83.80	>10	67.62
New Red Lion	LLst	1964	12.70	18/12	7.20	31/12	5.49	17/12	5.68	1	3.29
Ampney Crucis	Mid Jur	1958	101.97	10/12	101.54	10/12	97.38	9/12	101.94	>10	97.38
Dunmurry (NI)	PTS	1985	28.24	30/12	27.79	31/12	28.53	19/12	28.02	2	27.47
Llanfair DC	PTS	1972	79.92	26/12	79.74	1/12	79.16	10/12	79.25	1	78.85
Morris Dancers	PTS	1969	32.61	11/12	32.20	28/12	32.11	19/12	32.11	3	30.87
Weeford Flats	PTS	1966	89.92	19/12	89.15	17/12	89.05	06/12	88.61 dry	1	(dry) (below 88.61)
Bussels 7A	PTS	1972	23.79	17/12	23.60	19/12	23.46	31/12	23.63	>10	22.90
Rusheyford NE	MgLst	1967	75.84	15/12	74.99	17/12	74.37	6/12	74.80	>10	64.77
Peggy Ellerton	MgLst	1968	34.14	11/12	33.15	06/12	32.40	10/12	32.71	2	31.10
Alstonfield	CLst	1974	192.33	12/12	175.96	18/11	186.64	10/12	178.23	2	174.22

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 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS