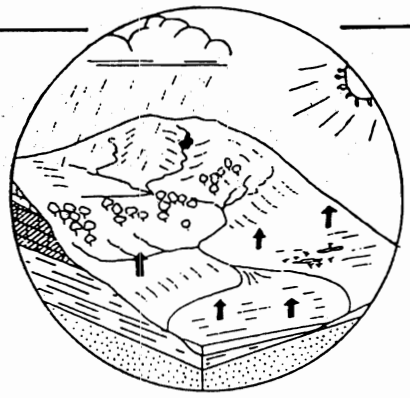
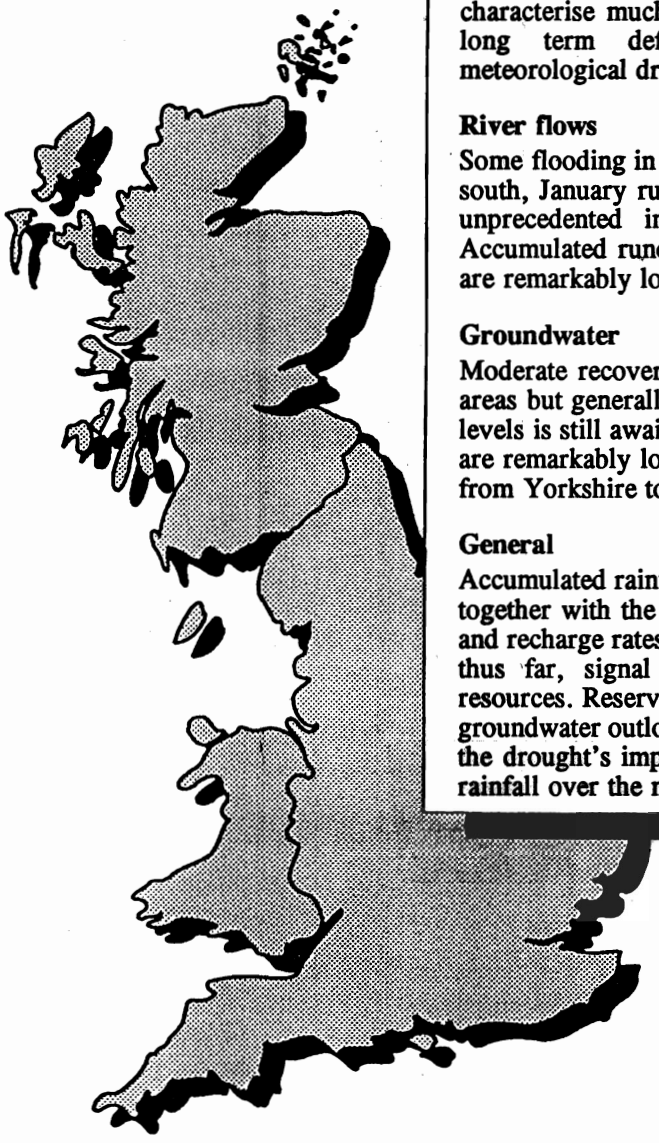
Hydrological Summary for Great Britain





JANUARY 1992

Rainfall

Around 70% of average for Britain but very dry in parts of England and Wales. The combined December/January rainfall total for England and Wales was the third lowest this century. Substantial six-month rainfall deficiencies characterise much of England and in the lowlands, where long term deficiencies are also exceptional, the meteorological drought is very severe.

River flows

Some flooding in Scotland at the turn of the year but, to the south, January runoff totals were very modest - commonly unprecedented in the English lowlands (and beyond). Accumulated runoff totals in eastern and southern England are remarkably low.

Groundwater

Moderate recoveries have begun in a few, mostly western, areas but generally the much belated upturn in groundwater levels is still awaited. Throughout the eastern Chalk, levels are remarkably low - without parallel this century in a zone from Yorkshire to Hertfordshire.

General

Accumulated rainfall deficiencies over 3-4 years (in the east) together with the failure of the seasonal recovery in runoff and recharge rates to achieve any momentum over the winter thus far, signal a difficult year in prospect for water resources. Reservoir stocks remain relatively healthy but the groundwater outlook is very fragile. The scale and scope of the drought's impact in 1992 will be heavily influenced by rainfall over the next three months.

Institute of Hydrology

British Geological Survey

HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - JANUARY 1992

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

A map (Figure 4) is provided to assist in the location of the principal monitoring sites.

Rainfall

1992 has begun with a synoptic background similar to that which over the winter of 1988/89 initiated the first severe phase of the current exceptionally protracted drought in the lowlands. High pressure centred over the UK, or over western Europe, dominated the January weather patterns producing relatively stable, dry conditions over much of Britain with substantial rainfall largely confined to a wet interlude early in the second week.

Rainfall over England and Wales in January was only a little above half the long term mean and spatial variability was considerable. Above average rainfall in parts of the Midlands and East Anglia was especially welcome but generally most of England and Wales was notably dry. Some areas in southern England and the North-East registered less than a quarter of the January average. London was exceptionally dry with one raingauge registering its lowest January rainfall total since 1838. By contrast, the Scottish Highlands were again wet, particularly around the turn of the year.

For January and December combined, the provisional England and Wales rainfall total is around 95 mm, the third driest such sequence this century after 1963/64 and 1988/89 (which was only marginally drier). The two-month rainfall deficiency is particularly notable south of a line from central Wales to Essex. For the winter half-year thus far (see Table 2), deficiencies were notable only in the South-East. However, extending the accounting period back to August 1991 reveals widespread drought conditions. Taking the last six months together, rainfall over England and Wales has been about 35 per cent below average - closely equivalent to 1933/34, the driest August-January period since 1854. In the six-month timeframe, drought conditions have been especially severe in the Thames and Southern regions (where, as in Severn-Trent, each month has been below average) and in parts of the South West.

Throughout the greater part of lowland England this two-season drought overlays a very substantial long-term rainfall deficiency. The accumulated rainfall totals presented on Table 2 point to a drought severity without modern parallel in much of eastern and southern England. For some districts in East Anglia above average rainfall has occurred in only three or four months since February 1990 and the deficiency (relative to the 1941-70 average) since the summer of 1988 is the equivalent of a full year's rainfall. Regional shortfalls of greater than 20 per cent extending beyond three years are very rare; for the Thames catchment the provisional rainfall total for the 42 months ending in January 1992 is the lowest for <u>any</u> 42-month accumulation in a 108-year record.

Whilst more intense drought episodes have been experienced, notably in 1975/76, the persistence of the current event - durations extend up to four years in some areas - is unprecedented. The impact on river flows and groundwater levels in the east is already very severe (see below). The degree to which the situation is exacerbated in 1992 will depend, in large part, on rainfall over the February to April period. Sustained rainfall is essential to generate a much belated recovery in groundwater levels.

Evaporation and Soil Moisture Deficits (SMDs)

For Great Britain as a whole January was a relatively mild and rather cloudy month but regional temperature and sunshine differences were marked. Overall, evaporation losses were close to the average; evaporation totals over the last twelve months are also well within the normal range.

Throughout most of the country, soil moisture conditions changed only modestly in January - in northern and western Britain soils remained close to, or at, field capacity through the month. Appreciable reductions (over 20 mm in some districts) in outstanding SMDs occurred during the second week in parts of East Anglia and the lower Trent basin. Unfortunately - and predictably - the most substantial remaining deficits coincide broadly with the region of maximum drought intensity; close to the Thames Estuary deficits (> 50 mm) are the highest on record (in a series from 1961).

Runoff

The year opened with moderate flooding over a large part of Scotland - flows on the Tay (at Ballathie) approached 1000 m^3s^{-1} on the 3rd and the Ness overtopped its banks. Transport disruption was considerable. A week later, heavy rainfall, augmented by appreciable snowmelt, generated spate conditions in Wales and parts of the Severn and Wye basins. Thereafter steep recessions typified most western and northern rivers as impervious catchments responded to the very meagre rainfall. In the lowlands of eastern and southern England only short-lived increases in flows were recorded early in the month and January runoff totals often fell short of the meagre December figures. Entering February, flows remained exceptionally depressed over wide areas.

For the index catchments, above average January runoff totals were confined to Scotland. As in December, gauging stations recording new minimum monthly runoff totals showed a wide distribution. Included in this category were the Eden (in a record from 1967) and the Kenwyn which has a 24-year record. Whilst flows were low in most catchments in the west and north of England, runoff totals were typically several times greater than those registered in January 1963 and 1964. By contrast, in the lowlands, and especially in rivers relying largely on groundwater, January runoff totals were exceptionally low over an extensive area and remarkably low east of a line from Yorkshire to Dorset. In the Thames basin, unprecedented January runoff totals were established on, amongst others, the Rivers Ver (Hertfordshire) and the Wey (Surrey) - both with records exceeding 35 years - the Mimram and, most notably, the Lea where the naturalised mean flow was considerably below the previous minimum (January 1934) in a record from 1883. The January mean on the Hampshire Itchen was virtually identical to the record established in 1989 whilst in East Anglia, the Little Ouse runoff total was marginally below that recorded in 1973 and, on the evidence of nearby monitoring sites, probably the lowest for more than fifty years.

A better measure of the drought's severity, and a means of establishing its areal extent, is provided by the accumulated runoff totals presented in Table 3. Runoff totals for the winter half-year (thus far) are well below average except for rivers draining the west of Scotland. In parts of eastern Britain the persistence of low flows is now remarkable. At the Abbey Heath gauging station on the Little Ouse, for instance, runoff has remained below average for 33 consecutive months - an unprecedented sequence. Over the period from May 1990 the accumulated runoff total for the Little Ouse is considerably below any 21-month accumulation in a 24-year record. Similarly, there is no lower accumulation for the Thames since the major improvement at Teddington Weir in 1951. Since May 1990, the average flow in many lowland rivers has been only around half of the long term mean. Accumulated runoff totals close to, or below, the minimum on record for a wide range of durations confirm the longevity of the drought in the east and its greater spatial extent when considered in the longest timeframes.

Relative to late-December, reservoir contents generally showed little change. Stocks in most major impoundments remain relatively healthy but the lack of substantial replenishment since mid-December has left a few reservoirs well short of capacity (e.g. Stithians in Cornwall).

Groundwater

The rather erratic spatial distribution of the January rainfall produced some significant infiltration in a few areas - for example, in the Cotswolds and parts of the Lincolnshire Limestone outcrop. Generally, however, the much belated recovery in groundwater levels is still awaited. With water-tables remarkably depressed in central, eastern and parts of southern England, the normal lag between infiltration at the surface and water-table response has been appreciably increased. Nonetheless, it is clear that in many areas the limited December and January rainfall has served only to ease the rate of recession, or at best, produce a very slight rise in levels.

The backcloth to the very depressed levels currently being registered is provided by long term recharge deficiencies which are proportionately much greater than the corresponding rainfall deficiences. Large parts of eastern and central England have registered less than half of their average recharge since the spring of 1988.

In the Chalk, the modest December recoveries in southern England (see Rockley and Little Bucket Farm) have stalled. No significant increase in levels is yet evident in the eastern Chalk where levels remain the lowest on record for January over wide areas. In a zone from Lincolnshire to Hertfordshire, the late January/early February readings were also commonly the lowest on record for any month (examples include the Washpit Farm and Redlands Hall index sites). At Therfield Rectory - a deep well in the Chalk of Hertfordshire which exhibits a two to three month lag between infiltration and response - the well was recorded as dry in January for the first time since 1923 (silting-up of the well over the intervening period implies that caution should be exercised when making direct comparisons). Rainfall figures together with levels at a few long term boreholes suggest the overall depletion in the Chalk from the Chilterns to the Yorkshire Wolds is without parallel this century. The hydrograph trace at Washpit Farm provides an illustration of the remarkable severity of the drought in groundwater terms. After three successive years with very modest recharge followed by protracted recessions, levels are now the equivalent of twice the average annual range below the mean level for the late winter.

Away from the eastern Chalk, drought conditions ameliorate but only in a few areas are groundwater levels within the normal range. The water-table at Bussels in the South-West is approaching the seasonal average (levels in other boreholes in the same region remain exceptionally low; groundwater pumping may be a factor). Levels in the Permo-Triassic of the Midlands are still very depressed, the Weeford Flats well remains dry and at Llanfair DC in north Wales the water level, although rising, remains below the seasonal minimum.

It is difficult to predict the level at which the summer recession of 1992 will start - principally this reflects the fact that the temporal distribution of the spring rainfall will be almost as important as the amount in determining the end of the recharge season. Sustained spring rainfall allowing a continuation of recharge conditions well into April (as happened in 1989) would be especially beneficial in maintaining groundwater levels at a time when, in the east, recessions have normally become established. Notable recoveries over periods of less than three months have occurred in recent years (examples include 1990, 1984 and 1976) but, in the absence of considerably above average February-April rainfall totals, the expectation must be for summer and autumn groundwater levels in the eastern Chalk to fall below any on record over very wide areas.

Institute of Hydrology/British Geological Survey 12 February 1992

Note: A short review of hydrological conditions in the UK for 1991 has been completed by the Institute of Hydrology. Copies may be obtained from: Mrs S. Black (0491 38800, Extn 2201).

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

		Jan 1991	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec 1991	Jan 1992
England and	mm	92	65	75	69	14	90	68	30	62	75	90	49	46
Wales	%	107	100	127	119	21	148	93	33	75	90	92	54	53
NRA REGIONS														
North West	mm	98	94	110	67	18	105	67	65	68	111	152	118	62
	%	88	116	153	87	22	127	65	52	55	94	126	98	55
Northumbria	mm	83	113	85	41	22	69	53	37	42	75	105	78	32
	%	104	171	163	75	34	113	69	37	53	100	112	104	40
Severn-Trent	mm	77	43	59	67	11	74	77	21	55	54	69	39	57
	%	112	81	113	129	17	132	118	26	82	83	87	56	83
Yorkshire	mm	71	88	63	49	14	73	36	21	40	63	93	61	47
	%	92	138	119	88	23	126	51	23	56	91	104	82	62
Anglian	mm	44	39	29	45	13	77	38	18	62	26	53	23	44
	%	85	93	73	113	28	157	67	28	119	50	85	44	85
Thames	mm	80	38	45	63	13	96	79	19	52	36	66	16	29
	%	129	81	98	137	23	185	132	27	84	56	90	25	47
Southern	mm	98	39	59	56	17	125	88	15	50	51	81	23	20
	%	129	68	113	117	31	250	149	21	70	65	86	28	26
Wessex	mm	108	40	81	72	10	107	73	20	70	84	71	30	36
	%	129	68	140	133	15	198	118	24	89	102	73	33	43
South West	mm	153	82	127	100	9	127	90	32	84	123	112	52	45
	%	119	91	151	141	11	195	107	32	81	109	84	39	35
Welsh	mm	151	94	127	124	15	111	97	53	85	153	138	67	71
	%	111	98	146	144	16	135	102	45	68	119	97	46	53
Scotland	mm	151	83	127	123	41	122	91	67	129	162	222	143	113
	%	110	80	138	137	45	133	81	52	94	109	156	92	83
RIVER PURIFICATION BOARDS														
Highland	mm	180	71	141	131	63	125	105	84	181	191	294	173	167
	%	110	53	124	115	61	114	83	57	115	103	174	88	102
North-East	mm	60	77	81	62	46	131	57	33	57	116	129	50	74
	%	66	104	131	102	60	187	62	31	66	120	125	49	81
Tay	mm	154	90	117	110	23	135	93	41	108	146	147	91	109
	%	131	98	143	147	24	163	91	35	94	120	124	68	92
Forth	mm	133	86	103	90	18	110	97	39	99	109	112	109	93
	%	134	112	149	132	21	147	99	34	92	103	104	100	94
Tweed	mm	110	102	93	62	21	90	65	35	66	99	120	90	61
	%	118	148	160	102	28	132	73	31	71	113	115	100	66
Solway	mm	144	108	150	148	17	122	77	69	79	175	198	157	97
	%	103	116	165	168	18	136	70	53	52	122	137	104	69
Clyde	mm	187	90	156	184	33	129	108	86	157	190	274	209	145
	%	116	80	149	179	34	125	83	61	90	104	164	112	90

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 January 1992 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.

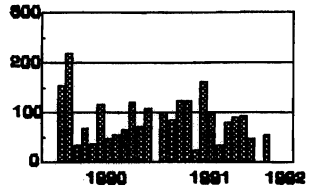
TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

		Oct 91 - Jan 92		Aug-Jan 92		Mar 90 - Jan 92		Nov 88 - Jan 92	
		Est Return Period, years		Est Return Period, years		Est Return Period, years		Est Return Period, years	
England and Wales	mm	260		353		1392		2578	
	% LTA	73	5-10	67	30-40	79	60-90	86	30-40
NRA REGIONS									
North West	mm	443		576		2001		3651	
	% LTA	94	2-5	80	5-10	85	10-20	92	5-10
Northumbria	mm	290		369		1453		2434	
	% LTA	89	2-5	73	10-20	86	10-20	84	35-50
Severn Trent	mm	219		295		1175		2188	
	% LTA	77	5-10	68	15-25	79	35-50	86	20-30
Yorkshire	mm	264		325		1266		2263	
	% LTA	86	2-5	69	15-25	79	40-60	83	60-80
Anglian	mm	146		226		856		1581	
	% LTA	67	10-20	67	20-30	73	>200	79	>200
Thames	mm	147		218		979		1874	
	% LTA	55	20-35	55	60-90	72	150-200	81	60-90
Southern	mm	175		240		1164		2139	
	% LTA	53	30-40	51	120-150	76	50-70	81	50-80
Wessex	mm	221		311		1262		2409	
	% LTA	63	10-20	61	30-40	75	70-90	84	20-40
South West	mm	332		448		1878		3546	
	% LTA	65	10-20	63	30-40	82	20-30	89	10-20
Welsh	mm	429		567		2132		4011	
	% LTA	78	5-10	71	10-20	83	20-30	91	5-10
Scotland	mm	640		836		2948		5238	
	% LTA	110	2-5	98	2-5	107	5-10	111	20-30
RIVER PURIFICATION BOARDS									
Highland	mm	833		1098		3646		6625	
	% LTA	117	5-10	108	2-5	110	5-10	116	110-150
North-East	mm	369		459		1783		2909	
	% LTA	94	2-5	78	10-20	91	5-10	87	30-40
Tay	mm	493		642		2351		4252	
	% LTA	100	<2	88	2-5	97	2-5	103	2-5
Forth	mm	423		561		2149		3807	
	% LTA	100	<2	87	2-5	100	<2	104	<2
Tweed	mm	370		471		1774		3019	
	% LTA	99	2-5	81	5-10	92	5	92	5-10
Solway	mm	627		775		2628		4691	
	% LTA	108	2-5	90	2-5	95	2-5	100	<2
Clyde	mm	818		1061		3521		6284	
	% LTA	117	5	105	2-5	109	5-10	114	30-50

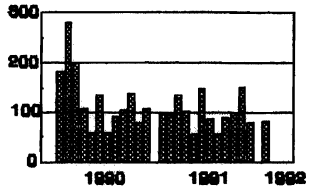
Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a specified month; return periods for a start in any month may be expected to be an order of magnitude less. "Wet" return periods underlined.
The tables reflect rainfall totals over the period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

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

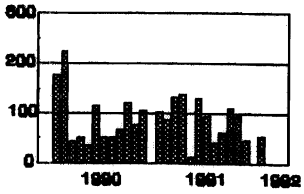
FIGURE 1. MONTHLY RAINFALL FOR 1990-1992 AS A PERCENTAGE OF THE 1941-1970 AVERAGE



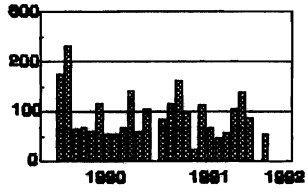
England and Wales



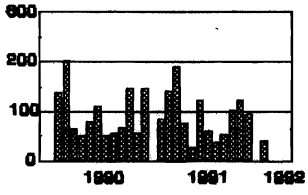
Scotland



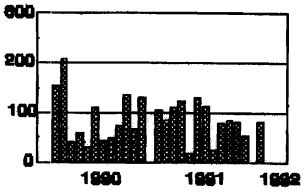
Welsh Region



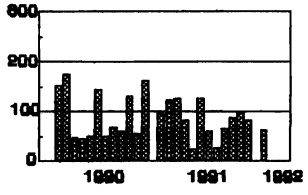
North West Region



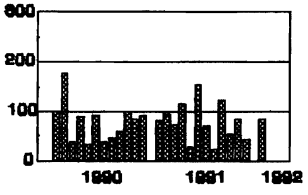
Northumbria Region



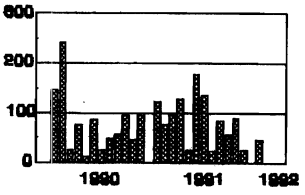
Severn-Trent Region



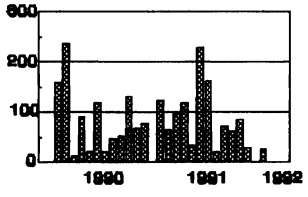
Yorkshire Region



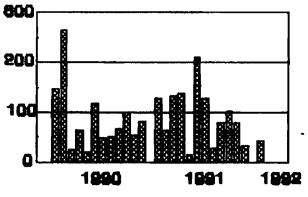
Anglian Region



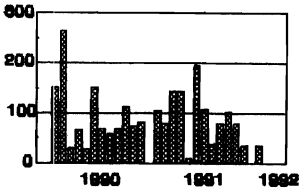
Thames Region



Southern Region



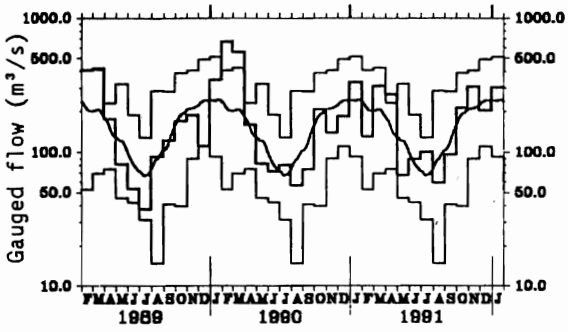
Wessex Region



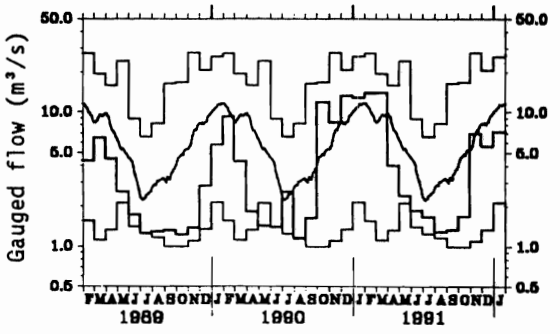
South West Region

FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

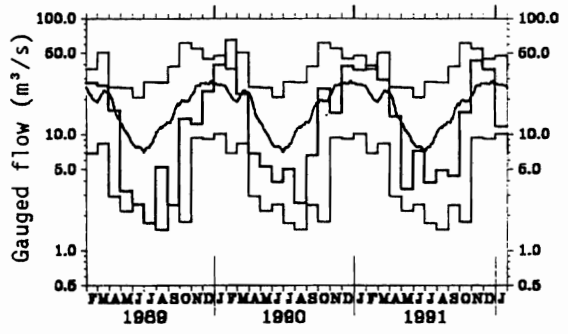
015006 Tay at Ballathie
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1952-1988



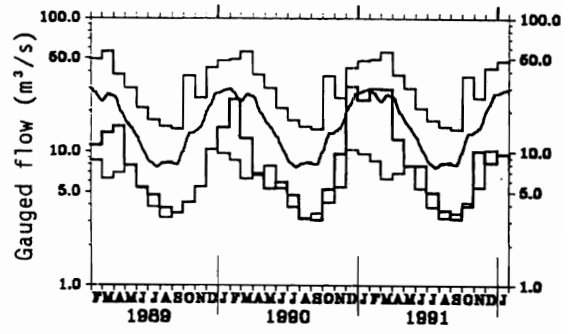
021022 Whiteadder Water at Hutton Castle
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1969-1988



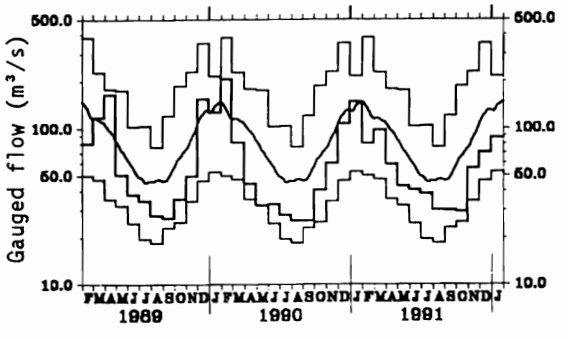
023004 South Tyne at Haydon Bridge
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1962-1988



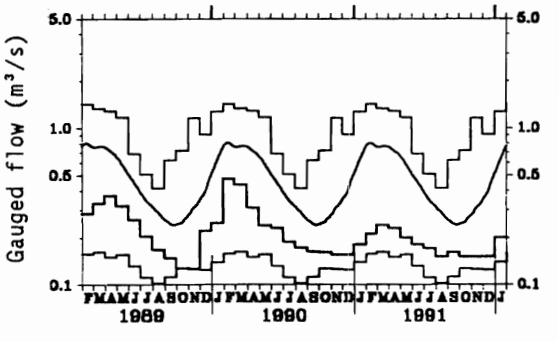
027041 Derwent at Buttercrambe
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1973-1988



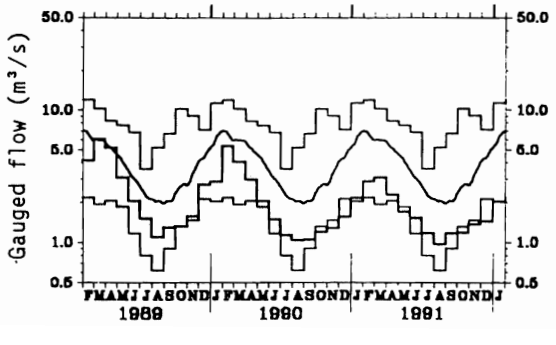
028009 Trent at Colwick
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1958-1988



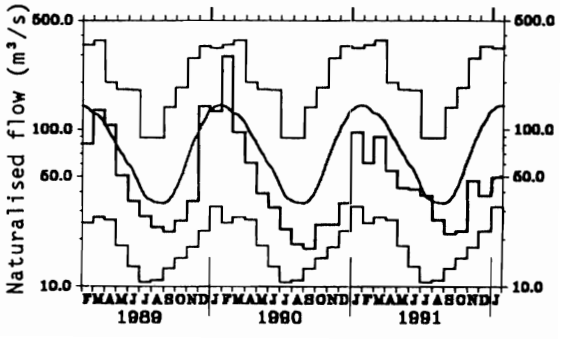
029003 Lud at Louth
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1968-1988



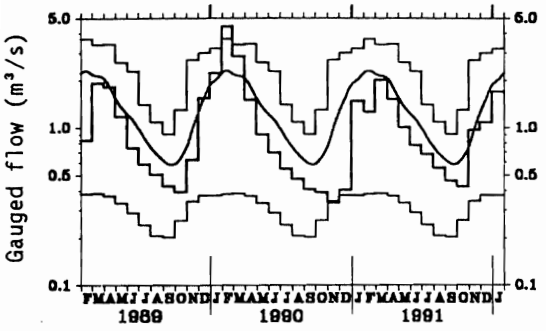
033034 Little Ouse at Abbey Heath
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1968-1988



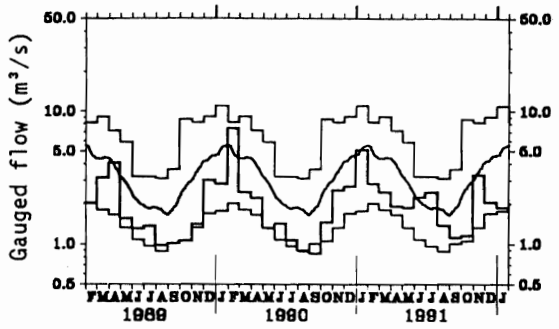
039001 Thames at Kingston
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1883-1988



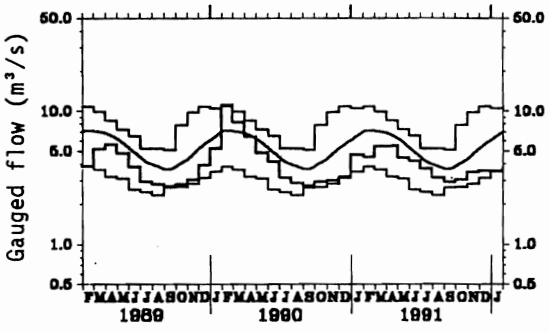
039020 Coln at Bibury
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1963-1988



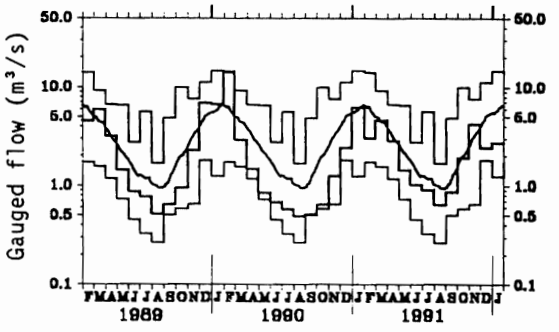
040011 Great Stour at Horton
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1964-1988



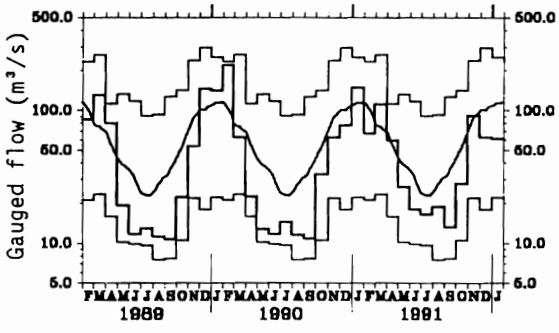
042010 Itchen at Highbridge+Allbrook
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1958-1988



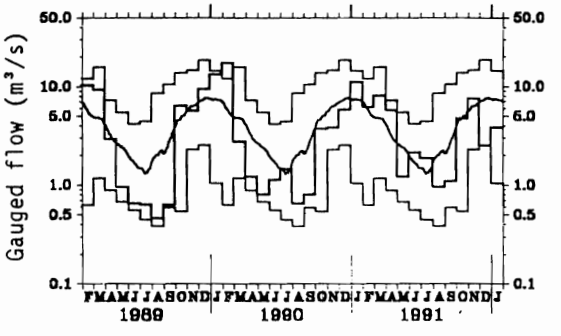
052005 Tone at Bishops Hull
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1961-1988



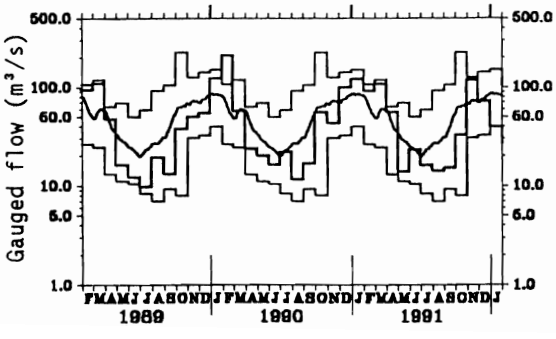
054001 Severn at Bewdley
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1921-1988



057004 Cynon at Abercynon
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1957-1988



076007 Eden at Sheepmount
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1967-1988



084013 Clyde at Daldowie
Monthly mean flows for Feb 1989-Jan 1992
+ extremes and 30 day running mean for 1963-1988

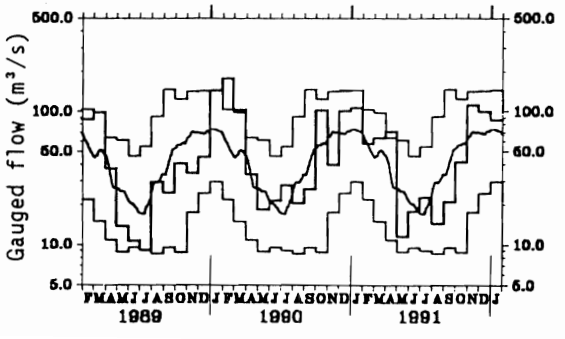


TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

River/ Station name	Sept	Oct	Nov	Dec	Jan		10/91 to 1/92		5/91 to 12/92		5/90 to 1/92		5/89 to 1/92	
	1991				1992									
	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 41	70 87	122 165	44 50	61 67	5 /20	297 88	7 /19	468 87	4 /19	1177 88	5 /18	1803 85	1 /17
Tay at Ballathie	54 77	124 111	173 145	118 84	176 124	30 /40	592 115	32 /40	828 104	27 /39	1939 101	22 /38	3393 111	29 /37
Whiteadder Water at Hutton Castle	7 44	9 32	35 94	30 66	38 65	8 /23	112 67	5 /23	157 62	4 /22	602 92	8 /21	780 74	5 /20
South Tyne at Haydon Bridge	15 29	55 79	148 165	125 128	41 42	2 /30	373 105	19 /30	456 84	19 /30	1220 93	10 /26	1897 91	6 /24
Wharfe at Flint Mill Weir	15 33	36 56	117 149	91 94	61 62	7 /37	305 90	13 /37	389 76	4 /36	1029 83	4 /35	1616 82	2 /34
Derwent at Buttercrambe	5 37	7 34	17 60	14 35	16 35	1 /31	53 40	2 /31	99 46	2 /30	368 67	3 /29	538 61	1 /28
Trent at Colwick	10 60	10 43	19 63	25 56	31 62	6 /34	86 58	2 /34	150 63	2 /33	408 68	2 /32	711 75	2 /31
Lud at Louth	8 71	7 58	7 48	7 36	10 33	3 /24	31 43	3 /24	72 47	1 /23	183 45	1 /22	326 49	1 /21
Witham at Claypole Mill	5 81	5 59	7 59	7 38	15 59	7 /33	33 52	8 /33	62 57	6 /33	171 58	5 /32	327 69	4 /31
Little Ouse at Abbey Heath	4 54	4 40	5 41	6 36	8 34	1 /24	23 38	1 /24	47 43	1 /24	126 45	1 /23	238 53	1 /22
Colne at Lexden	3 71	3 36	5 41	5 30	7 30	5 /33	20 34	3 /33	40 47	5 /32	100 46	2 /31	209 59	1 /20
Thames at Kingston (natr.)	6 67	6 45	12 56	10 33	14 38	13 /110	42 42	9 /109	87 55	14 /109	222 55	4 /108	466 71	9 /107
Blackwater at Swallowfield	11 84	12 62	19 79	14 46	14 39	2 /40	59 55	3 /40	127 71	5 /39	327 74	2 /38	626 88	10 /37
Coln at Bibury	11 78	11 69	23 96	27 70	43 84	9 /29	104 81	10 /29	189 79	7 /28	445 70	3 /27	857 83	7 /26
Great Stour at Horton	8 58	9 44	25 94	16 47	15 37	2 /28	64 53	2 /27	133 67	4 /26	319 64	2 /24	518 65	1 /22
Itchen at Highbridge+Allbrook	21 80	23 76	25 73	26 63	26 54	2 /34	100 66	1 /34	235 75	3 /33	578 75	1 /32	995 81	1 /31
Stour at Throop Mill	8 69	13 61	29 95	25 46	23 39	3 /20	90 54	3 /19	157 66	5 /18	412 64	1 /18	854 83	2 /17
Piddle at Baggs Mill	16 106	23 113	30 105	28 68	26 50	3 /28	106 76	8 /28	209 86	9 /27	485 75	4 /25	886 83	3 /23
Exe at Thorverton	14 36	56 75	128 134	75 57	48 37	3 /36	307 71	6 /36	414 72	5 /36	1111 79	4 /35	1858 83	4 /34
Tone at Bishops Hull	11 72	25 94	54 130	32 48	36 45	4 /31	147 69	7 /31	211 70	7 /31	523 68	1 /30	1025 82	2 /29
Severn at Bewdley	8 37	17 51	54 101	39 62	38 54	11 /71	148 67	8 /71	205 65	6 /71	580 76	6 /70	1014 83	11 /69
Wye at Cefn Brwyn	102 62	167 80	315 126	192 68	145 59	5 /38	819 83	12 /38	1336 85	7 /34	3315 90	6 /29	5310 92	5 /24
Cynon at Abercynon	27 40	120 99	182 120	63 33	96 50	7 /34	461 71	7 /34	642 70	3 /32	1861 86	7 /30	3304 96	14 /28
Dee at New Inn	43 32	146 72	260 107	189 76	114 47	3 /23	710 77	6 /23	959 71	2 /22	2557 81	2 /21	4233 84	1 /20
Eden at Sheepmount	17 39	38 51	132 162	83 92	46 45	1 /22	300 86	8 /21	395 79	6 /20	1151 97	8 /18	1858 99	7 /16
Clyde at Daldowie	28 49	58 70	151 160	140 143	120 114	18 /29	469 122	23 /29	589 103	17 /28	1493 111	20 /27	2394 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 FEBRUARY 1991

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1992 Sep	Oct	Nov	Dec	Jan	Feb	1991 Feb
					(%)▲					
North West	Northern Command Zone[1]	(G)	133375	43	33	41	72	79	70	89
	Vyrnwy	(R)	55146	85	71	82	85	95	86	91
Northumbria	Teesdale[2]	(G)	87936	39	31	41	68	88	88	96
	Kielder	(R)	199175*		85*	85*	96*	99*	91*	91*
Severn-Trent	Clywedog	(R)	44922	91	74	75	82	87	88	89
	Derwent Valley[3]	(G)	39525	53	35	32	46	84	94	94
Yorkshire	Washburn[4]	(G)	22035	46	36	28	48	65	77	86
	Bradford supply[5]	(G)	41407	50	38	37	70	86	90	95
Anglian	Grafham	(R)	58707	88	81	76	81	88	90	70
	Rutland	(R)	130061	70	68	63	63	63	67	68
Thames	London[6]	(G)	206232	80	66	57	71	75	81	87
	Farmoor [7]	(G)	13843	89	82	89	97	99	99	82
Southern	Bewl	(R)	28170	73	62	54	58	58	58	51
	Ardingly	(R)	4627	81	84	81	85	88	92	99
Wessex	Clatworthy	(R)	5364*	47*	40*	59*	89*	87	88*	94*
	Bristol WW [8]	(G)	36620	57	46	39	50	53	58	66
South West	Colliford	(R)	28540	86	81	79	83	83	82	81
	Roadford	(R)	34500	89	84	81	86	85	85	81
	Wimbleball[10]	(R)	21320	63	52	57	69	73	76	68
	Stithians	(R)	5205	53	40	34	34	37	38	85
Welsh	Celyn + Brenig	(G)	131155	79	68	71	84	94	93	96
	Brianne	(R)	62140	92	84	89	100	100	97	100
	Big Five[11]	(G)	69762	92	69	73	87	93	93	83
	Elan Valley[12]	(G)	99106	85	77	90	94	94	91	99
Lothian	Edinburgh/Mid Lothian	(G)	97639					95	92	
	West Lothian	(G)	5613					90	82	
	East Lothian	(G)	10206					95	98	

● Live or usable capacity (unless indicated otherwise)

* Gross storage/percentage of gross storage

▲ Percentage of live or usable capacity at or close to the beginning of the month according to data availability (unless indicated otherwise)

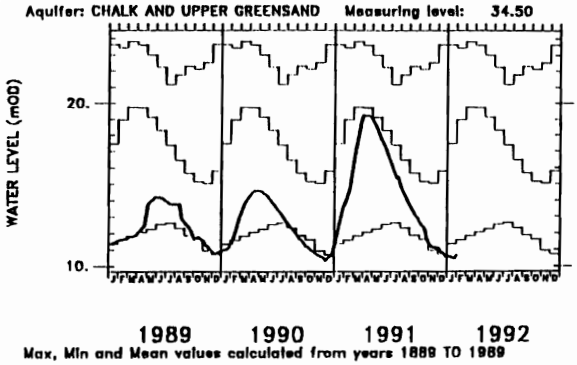
1. Includes Haweswater, Thirlmere, Stocks and Barnacre.
2. Cow Green, Selset, Grassholme, Balderhead, Blackton and Hury.
3. Howden, Derwent and Ladybower.
4. Swinsty, Fewston, Thruscross and Eccup.
5. The Nidd/Barden group (Scar House, Angram, Upper Barden, Lower Barden and Chelker) plus Grimwith.
6.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

FIGURE 3 GROUNDWATER HYDROGRAPHS

Site name: DALTON HOLME

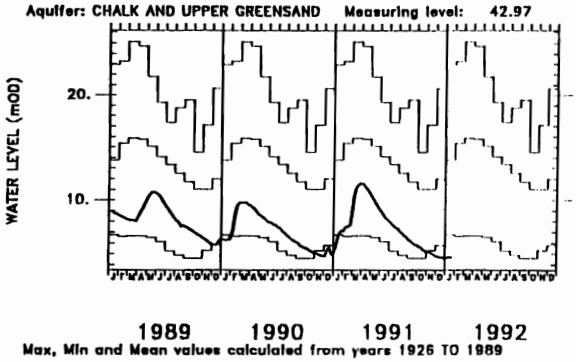
National grid reference: SE 9651 4530 Well number: SE94/5
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 34.50



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

Site name: LITTLE BROCKLESBY

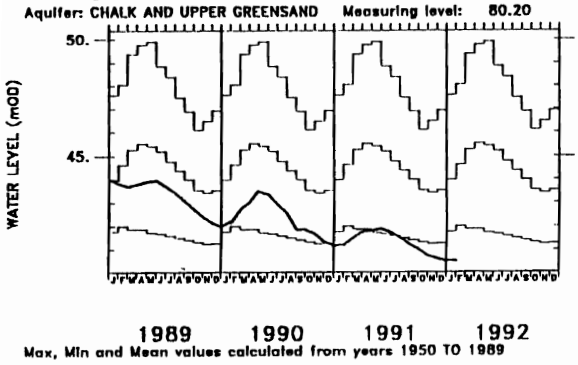
National grid reference: TA 1371 0888 Well number: TA10/40
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 42.97



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

Site name: WASHPIT FARM

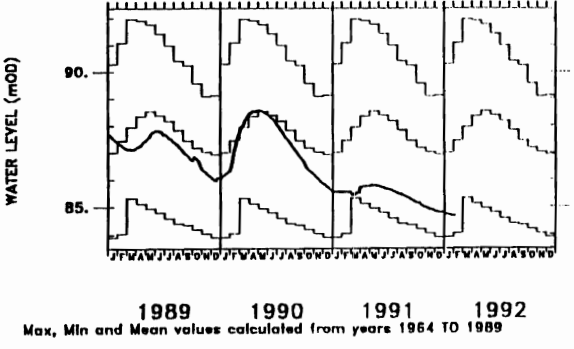
National grid reference: TF 8138 1960 Well number: TF81/2
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 80.20



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

Site name: THE HOLT

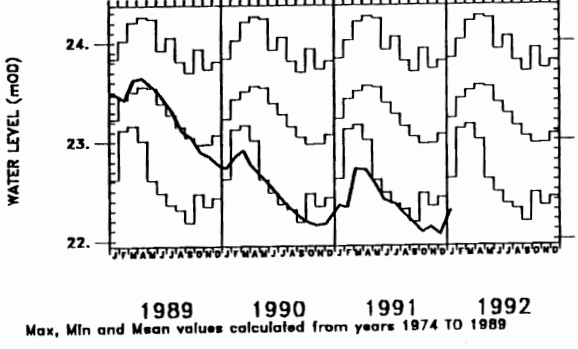
National grid reference: TL 1692 1965 Well number: TL11/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 138.17



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

Site name: FAIRFIELDS

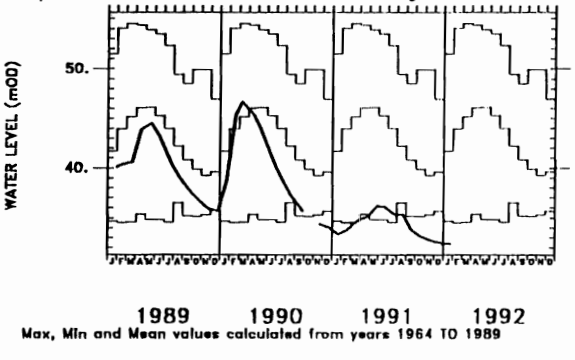
National grid reference: TM 2461 6109 Well number: TM26/46
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 45.00



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

Site name: REDLANDS HALL,ICKLETON

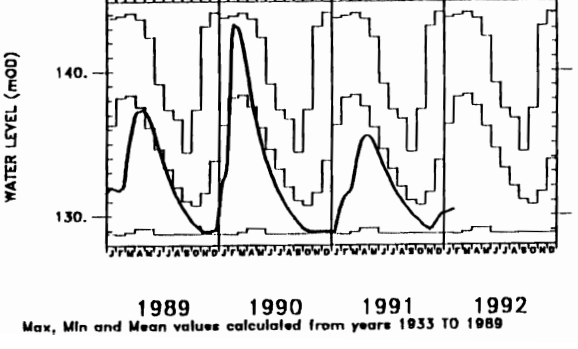
National grid reference: TL 4522 4182 Well number: TL44/12
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 76.19



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

Site name: ROCKLEY

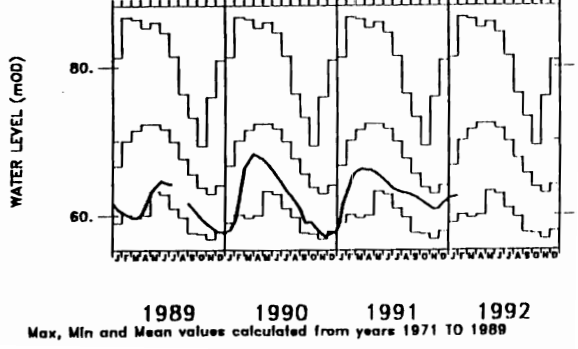
National grid reference: SU 1655 7174 Well number: SU17/57
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 146.57



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

Site name: LITTLE BUCKET FARM,WALTHAM

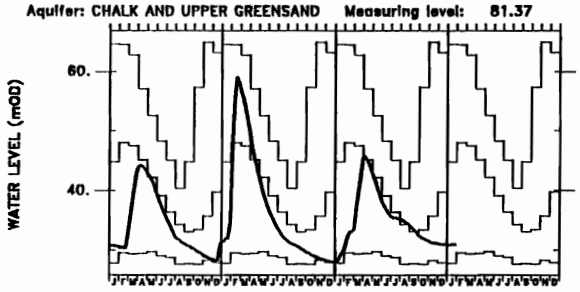
National grid reference: TR 1225 4690 Well number: TR14/9
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 87.33



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

Site name: COMPTON HOUSE

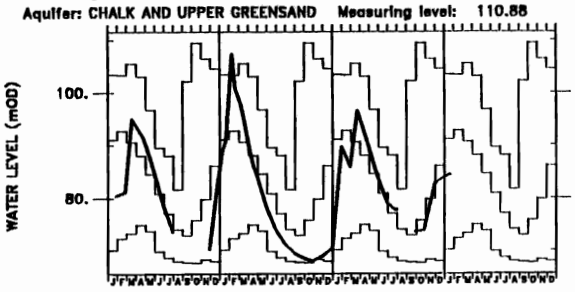
National grid reference: SU 7755 1490 Well number: SU71/23
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



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

Site name: WEST WOODYATES MANOR

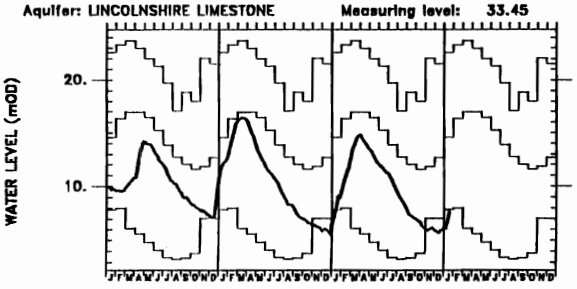
National grid reference: SU 0160 1960 Well number: SU01/5B
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 110.88



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

Site name: NEW RED LION

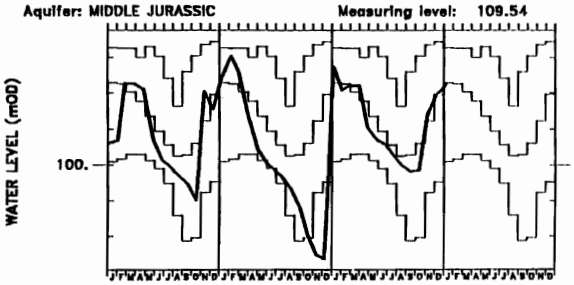
National grid reference: TF 0885 3034 Well number: TF03/37
Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.45



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

Site name: AMPNEY CRUCIS

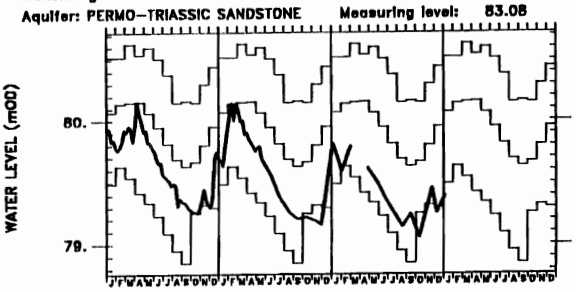
National grid reference: SP 0595 0190 Well number: SP00/62
Aquifer: MIDDLE JURASSIC Measuring level: 109.54



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

Site name: LLANFAIR DC

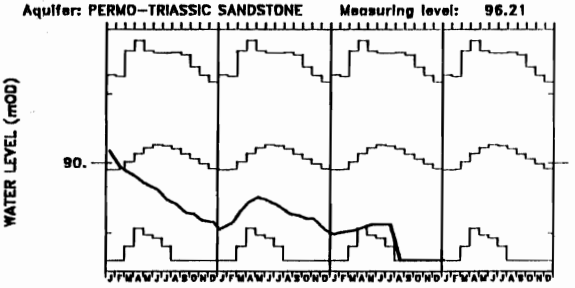
National grid reference: SJ 1374 5556 Well number: SJ15/15
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 83.08



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

Site name: WEEFORD FLATS,WEEFORD

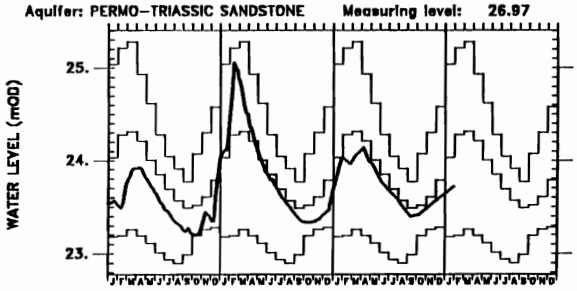
National grid reference: SK 1440 0464 Well number: SK10/9
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 96.21



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

Site name: BUSSELS NO.7A

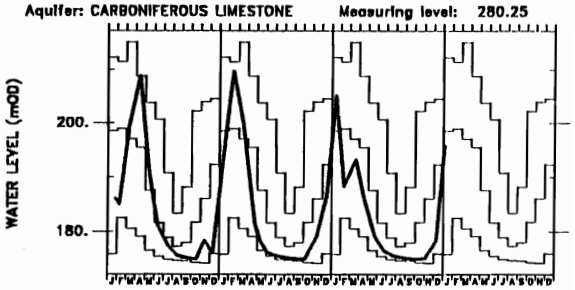
National grid reference: SX 9528 9872 Well number: SX99/37B
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.97



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 JANUARY GROUNDWATER LEVELS : 1992, 1989 AND 1976

Site	Aquifer	Records commence	Average January Level	January 1976		January 1989		January and February 1992		No of years January levels <1992	Lowest pre-1992 level (any month)
				Day	Level	Day	Level	Day	Level		
Wetwang	C & UGS	1971	24.98	7/01	19.09	31/01	19.81	22/01	17.00	0	16.84
Dalton Holme	C & UGS	1889	11.39	31/01	13.00	17/01	11.35	3/02	10.62	0	10.34
Little Brocklesby	C & UGS	1926	13.76	13/01	7.10	31/01	8.59	22/01	4.64	0	4.56
Washpit Farm	C & UGS	1950	43.98	1/01	43.50	11/01	43.93	3/02	40.51	0	41.24
The Holt	C & UGS	1964	87.01	29/01	87.02	23/01	87.46	3/02	84.65	2	83.90
Therfield Rectory	C & UGS	1883	77.98	28/01	78.47	27/01	82.45	3/02	dry	5	dry (below 71.60)
Fairfields	C & UGS	1974	23.23	27/01	23.28	25/01	23.47	13/01	22.29	0	22.15
Redlands Farm	C & UGS	1964	41.71	1/01	39.20	31/01	40.09	24/01	32.38	0	34.04
Rockley	C & UGS	1933	136.30	25/01	dry	29/01	131.84	3/02	130.39	>10	dry (below 128.94)
Little Bucket Farm	C & UGS	1971	66.68	7/01	66.62	16/01	60.91	29/01	62.52	7	56.77
Compton House	C & UGS	1894	44.87	29/01	30.38	26/01	30.62	29/01	30.86	9	27.64
Chilgrove House	C & UGS	1836	54.75	31/01	38.53	26/01	39.15	29/01	40.31	>10	33.46
West Dean No 3	C & UGS	1940	2.17	30/01	1.70	no	levels	31/01	1.38	3	1.01
Lime Kiln Way	C & UGS	1969	125.09	15/01	124.72	9/01	124.57	29/01	124.16	0	124.09
Ashton Farm	C & UGS	1974	68.90	8/01	64.82	16/01	66.30	20/01	68.10	7	63.10
West Woodyates	C & UGS	1942	91.07	10/01	67.62	27/01	80.44	20/01	84.40	>10	67.62
New Red Lion	LLst	1964	14.56	30/01	8.52	30/01	9.63	20/01	7.56	1	3.29
Ampney Crucis	Mid Jur	1958	102.30	18/01	100.35	6/01	100.60	10/01	102.23	10	97.38
Dunmurry (NI)	PTS	1985	28.77	no	levels	no	levels	27/01	28.05	1	27.47
Llanfair DC	PTS	1972	80.07	1/01	79.49	31/01	79.78	6/01	79.39	0	78.85
Morris Dancers	PTS	1969	32.62	29/01	32.01	16/01	32.54	16/01	32.07	3	30.87
Wexford Flats	PTS	1966	89.91	29/01	89.41	12/01	90.17	10/01	dry	1	dry (below 88.61)
Bussels 7A	PTS	1972	24.03	27/01	25.22	31/01	23.52	30/01	23.71	9	22.90
Rusheyford NE	MgLst	1967	76.08	27/01	65.98	30/01	75.87	13/01	74.71	>10	64.77
Peggy Ellerton	MgLst	1968	34.43	22/01	31.78	12/01	35.16	14/01	32.38	1	31.10
Alstonfield	CLst	1974	198.56	29/01	186.51	26/01	186.03	7/01	195.82	6	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