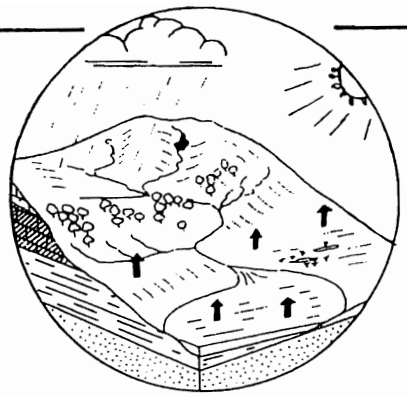
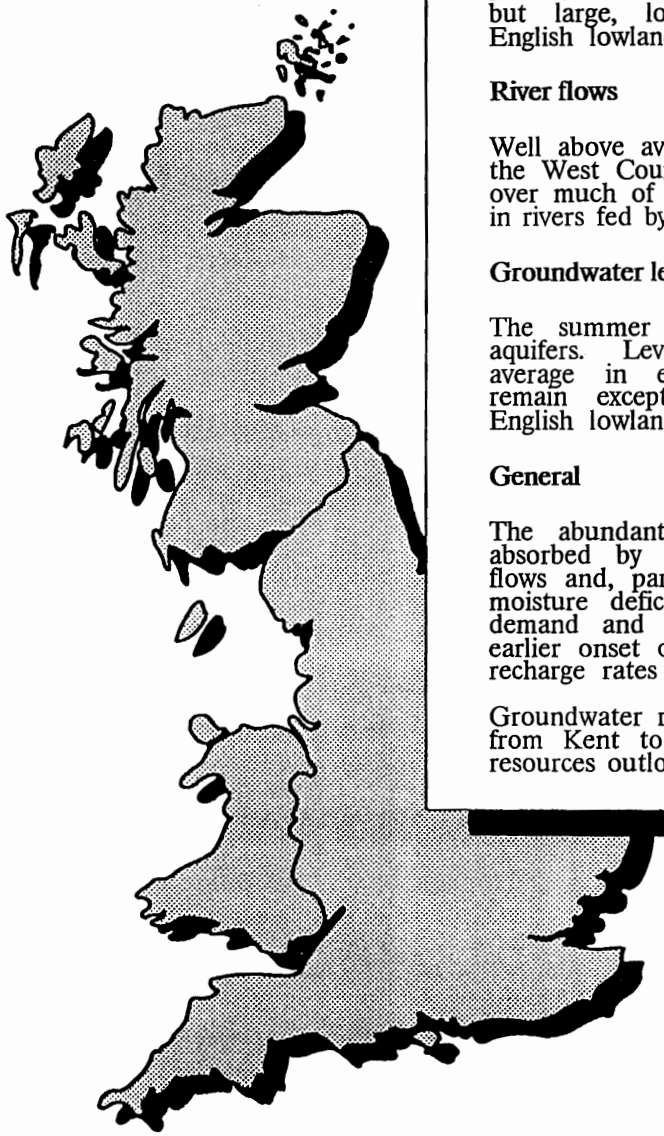
Hydrological Summary for Great Britain





JUNE 1991

Rainfall

Rainfall for Great Britain was around 160% of average; the 3rd wettest June this century. Regional rainfall totals for 1991 are within the normal range but large, long-term deficiencies remain in the English lowlands.

River flows

Well above average in parts of Scotland, Wales and the West Country. Runoff rates remain depressed over much of central and eastern England, especially in rivers fed by groundwater.

Groundwater levels

The summer recession is well established in all aquifers. Levels are generally only a little below average in eastern and northern outcrops but remain exceptionally low in the Chalk of the English lowlands.

General

The abundant June rainfall, most of which was absorbed by the soil, had little impact on river flows and, particularly, on groundwater levels. Soil moisture deficits were greatly reduced, constraining demand and increasing the likelihood of a much earlier onset of the autumn recovery in runoff and recharge rates than in the last three years.

Groundwater resources remain very fragile in a zone from Kent to Lincolnshire but generally the water resources outlook is much healthier than in July 1990.

Institute of Hydrology

British Geological Survey

HYDROLOGICAL SUMMARY FOR GREAT BRITAIN - JUNE 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 for England and Wales has been supplied by either the Water Services Companies or the NRA. 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

Like the preceding month, June was notably cool and cloudy throughout most of Great Britain. However, in contrast to the very dry May, June rainfall was abundant. Initially, showery conditions predominated thence a series of frontal systems, generally on a south-westerly airflow, brought more sustained rainfall across most regions. A few districts in the South-East and the Midlands recorded rainfall on 27, or more, days in the month. Some thundery activity produced significant precipitation, in the lowlands especially, towards month-end.

June was the wettest month of the year for Britain as a whole with parts of southern England and eastern Scotland recording well over twice the mean June rainfall. The showery - thundery in places - nature of much of the rainfall made for substantial spatial variability.

Accumulated rainfall totals on a regional basis are well within the normal range for 1991 thus far, albeit appreciably below average in parts of north-western England and East Anglia. Over the last twelve months only modest meteorological droughts can be recognised; rainfall deficiencies are less than 15 per cent in all regions with the exception of Anglian and Thames. For (selected) longer durations the rainfall deficiencies become more notable (see Table 2). Rainfall totals since the beginning of March 1990 in the English lowlands have return periods typically in the range 20-60 years; this represents a distinct amelioration compared to a month ago but for periods in excess of about 18 months large deficiencies remain.

In the 26-month timeframe (from May 1989) rainfall for the Thames catchment is similar to that registered during the prolonged droughts of 1972-74 and 1920-22 (these constitute the most severe droughts on record for the specified range of months). More significantly, for the 35-month period beginning in August 1988, the accumulated rainfall total is comparable with the minimum accumulations for any 35-month period (only the period ending in July 1944 being appreciably drier in a record extending back to 1883). Exceptionally severe long term deficiencies can also be recognised in parts of East Anglia. The very extended nature of these meteorological droughts is the key to the continuing depressed rates of runoff and groundwater levels in the English lowlands especially (see below).

Evaporation and Soil Moisture Deficits (SMDs)

Temperatures and sunshine hours were both well below average in June, particularly in southern Britain. The cool, overcast conditions resulted in notably low potential evaporation (PE) totals characterising large areas - the MORECS PE total for June in parts of eastern Wales, for instance, being the lowest in a 30-year record. For the first six months of 1991 calculated PE and AE (actual evaporation) losses - for a grass cover - were generally close to or below average.

These conditions contrast sharply with both 1989 and 1990 when over the January to June period estimates of PE and AE were up to 70 mm greater than the corresponding totals for 1991 over wide areas. Over the twelve-month timescale (June-July), PE losses in the English lowlands are still amongst the highest on record - a legacy of the exceptionally warm conditions experienced in 1990 - but substantially less than for the previous twelve months. In the same month-span 1990/91 AE losses for the lowlands were close to the lowest on record reflecting the inhibiting influence of high SMDs over an extended period.

In an average year soil moisture deficits increase briskly through June in response to warm conditions and long hours of daylight. Some modest increases in calculated SMDs were registered in June 1991, in Lincolnshire and Cambridgeshire for example, but, more generally, soils became substantially wetter during the month, especially over the last eight days. This reversal in the normal seasonal trend was most evident in southern England where, in some districts, end-of-June SMDs were over 50 mm less than for month-end in May.

Relative to the average, the late-June pattern of SMDs was somewhat complex with considerable spatial variation. Above average deficits typified much of eastern Britain from the Forth estuary to the Wash, whereas elsewhere soils were very much wetter than normal. Much of central and northern Scotland saw a return to field capacity in June, a situation finding a remarkable parallel in a few, mostly coastal, localities in Sussex where MORECS data (for the end of June) indicate the absence of any appreciable SMD for the first time in a 30-year series. In such pockets the contrast with last year achieves an extreme expression - deficits being around 100 mm lower than in early July 1990. More typically, SMDs throughout the English lowlands are 30-80 mm less than at the corresponding time last year.

The relatively modest SMDs may be expected to produce rather more tangible hydrological benefits later in the year. Given rainfall within the normal range, the autumn recovery in runoff and recharge rates should be very much earlier than in 1988, 1989 or 1990 throughout much of the English lowlands.

Runoff

Following an exceptionally dry May, river flow rates were generally depressed in early June and the dryness of the soils implied that only a remarkably wet episode would generate any large flow increases in eastern England. In the event, whilst the persistent rainfall produced only isolated spate conditions, the seasonal decline in runoff rates was moderated in most catchments and reversed in some - mostly in western and southern Britain.

In some impervious southern catchments flow rates picked up briskly, if only temporarily, from around the 23rd and seasonally high flows were often maintained until near month-end. Such catchments generally registered above average June runoff totals and in a few rivers notable mean flows were recorded; runoff for the River Wallington (Hampshire), for instance, was the second highest in 23 years for June. Similarly elevated runoff totals were registered in rivers draining from the Cairngorms and above average June flows characterised much of Wales and western England. Elsewhere, near-average mean flows were registered in a number of largely impervious catchments in eastern England but generally, flows remained below average albeit well above historical drought levels. Typically, runoff totals for June were considerably greater than those recorded in June 1990 (see Table 3).

On the basis of runoff figures, drought conditions are now largely confined to lowland rivers sustained principally from groundwater. By their nature such rivers are unresponsive to summer rainfall and a further decline in monthly runoff rates was recorded on, for instance, the rivers Lud and Little Ouse. Nonetheless, flow rates are still appreciably greater than in 1976 and often surpass those registered in the early 1970s also. Monthly runoff totals for the early summer over large parts of eastern England remained modest for the fourth successive year. This clustering of low June flows is exemplified on the Leven (a lower Tees tributary), where each of the June runoff totals since 1987 has been below any recorded over the preceding ten years. Where flow records

allow the perspective to be extended back a further 20 years, embracing the droughts of 1959, 1964/65 and those of the early and mid-1970s, the recent low flows appear far less notable.

Whilst not matching the 1976 drought in terms of intensity, the duration of the current low flow episode is remarkable and unprecedented in many eastern catchments. The rankings associated with the accumulated runoff totals listed in Table 3 emphasise the severity of the runoff drought in lowland England over a range of durations extending up to three years. A zone of maximum severity extends from Lincolnshire to the North Downs, where aquifer recharge has been limited since the spring of 1988 and the baseflow contribution to runoff has been in sustained decline. For the Lud and the Little Ouse, June 1990 was the 32nd successive month with below average flows and the 3-year accumulations are the lowest, or equivalent to the lowest, for ***any*** 36-month accumulations on record. With a few exceptions accumulated runoff deficiencies are now relatively modest in catchments away from the English lowlands. For rivers draining the Scottish Highlands three-year runoff totals are close to the highest on record - testifying to a remarkable accentuation in the normal NW-SE runoff gradient across Great Britain.

Abundant rainfall, aided by the thin soils and steep slopes, allowed small but significant replenishment of reservoir stocks in parts of western Britain (e.g. South Wales) during June. With weather conditions moderating demand, stocks in the east remained fairly stable relative to late May and, entering July, surface water resources were generally very much healthier than at the same time in 1990.

Groundwater

Groundwater levels during June were falling throughout the outcrop areas of all major aquifers. Despite the heavy rainfall in the later part of the month and the monthly totals exceeding 200 per cent in the Southern and Wessex regions, no recoveries in groundwater levels at index sites have been observed. Although soil moisture deficits had developed to a level much less than at the end of the spring in 1990, it would appear that the soils were sufficiently dry to allow only minimal infiltration. The absence of any significant decrease in groundwater levels through June at sites such as Redlands probably reflects the belated impact of spring recharge. Some evidence of meagre June recharge may be found at localities where thin soils overlay a fissured aquifer - at Ampney Crucis, for example, the rate of water-table recession had noticeably slowed by month-end.

Nowhere can groundwater levels be regarded as significantly above the June average, although water-tables in the Wessex Chalk and the Oolitic Limestone of the Cotswolds are very close to the June mean. Over much of the country, groundwater levels are either near average or rather below. A clear eastward deterioration in the groundwater situation may, however, be recognised although local differences in the magnitude of groundwater depletion remain apparent. In the Chalk aquifer, levels at the Dalton Holme site are near average, testifying to a substantial recovery in 1991. South of the Humber, the level at Little Brocklesby is well below average. Further south, at Washpit Farm, Fairfields and Redlands Hall, levels are near to minimum monthly recorded values; indeed at Fairfields (and at Redlands Hall) the 1991 levels for June are the lowest on record. At the Holt (further west) and at Little Bucket Farm (further south), the groundwater levels are somewhat above the minimum recorded for June, although not greatly so. These index boreholes help to define the region where the 1991 drought is currently most severe. Groundwater levels in parts of Cambridgeshire, Hertfordshire, the Chilterns and parts of the North Downs stand close to, or below, the minimum on record - in the last region there is a marked similarity with the 1973 recession.

Since no general recovery in groundwater levels may be expected before the onset of winter recharge, the eastern lowlands from the Humber to southern Kent may see the current recession approaching absolute minimum levels by the autumn, with parts of East Anglia south of the Wash being most at risk. In the Triassic sandstones of the Midlands, the feeble 1991 recovery at Morris Dancers appeared to terminate in June and currently the water-table is close to the seasonal minimum on record - as at Weeford Flats. Whilst the impact of abstractions on natural rest

evels implies that spatial extrapolation should be undertaken cautiously, it seems that groundwater levels generally in the Midlands are at their most depressed since 1976.

Just as fairly modest winter rainfall deficiencies combined with persistent soil moisture deficits can result in especially depressed groundwater levels in eastern England, so the modest nature of current SMDs allows the possibility of a more general recovery in the last quarter of the year similar to that registered in 1990/91 at Dalton Holme. Indeed very brisk recoveries were recorded, for example, following the droughts and of 1965 and 1976. Rainfall over the next three months will be important in determining the start - and by implication the likely duration - of the 1991/92 recharge season.

Institute of Hydrology / British Geological Survey **11 July 1991**

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

		Jun 1990	Jul	Aug	Sep	Oct	Nov	Dec	Jan 1991	Feb	Mar	Apr	May	June 1991
England and	mm	72	35	46	53	103	67	101	92	63	75	68	14	100
Wales	%	118	47	51	64	124	69	112	107	97	127	117	21	163
NRA REGIONS														
North West	mm	99	58	73	86	175	73	151	97	86	89	61	16	94
	%	119	56	58	70	148	60	126	87	106	124	79	20	114
Northumbria	mm	69	40	53	53	107	61	127	85	114	84	40	23	76
	%	113	52	52	66	143	65	169	106	173	162	73	36	124
Severn Trent	mm	63	27	37	46	93	52	87	78	41	59	66	11	74
	%	113	42	46	69	143	66	124	113	77	113	127	17	131
Yorkshire	mm	83	32	47	39	92	55	121	72	89	62	49	15	74
	%	143	46	52	54	133	62	164	94	139	117	88	24	127
Anglia	mm	45	21	31	32	51	53	47	44	39	29	44	13	76
	%	92	37	48	62	98	85	89	85	93	73	110	28	154
Thames	mm	47	17	35	34	58	34	68	80	39	45	62	14	92
	%	90	28	50	55	91	47	103	129	83	98	135	25	177
Southern	mm	61	13	33	38	105	63	65	98	40	59	56	17	115
	%	122	22	45	54	135	67	80	129	70	113	117	31	230
Wessex	mm	62	31	41	49	87	51	78	105	43	88	69	9	113
	%	115	50	50	62	106	53	87	125	73	152	128	13	210
South West	mm	99	61	59	69	128	106	124	151	82	127	99	10	127
	%	152	73	58	66	113	79	92	117	91	151	139	12	195
Welsh	mm	98	53	64	85	152	112	163	150	96	125	121	15	106
	%	120	56	54	68	118	78	112	110	100	144	141	16	130
Scotland	mm	128	75	119	149	213	102	191	146	83	128	121	43	137
	%	139	67	92	109	143	72	122	107	80	139	134	47	149
RIVER PURIFICATION BOARDS														
Highland	mm	140	93	156	234	225	147	241	173	70	141	129	67	156
	%	127	73	105	148	121	87	123	105	53	124	113	66	142
North-East	mm	110	43	75	86	136	95	97	56	77	80	59	48	152
	%	157	47	70	99	140	92	95	62	104	129	97	61	217
Tay	mm	128	38	73	68	186	63	149	164	89	117	107	22	162
	%	154	37	62	59	152	53	111	139	97	143	143	23	195
Forth	mm	125	49	83	68	194	56	143	120	84	104	90	19	107
	%	167	50	72	63	183	52	131	121	109	151	132	22	143
Tweed	mm	106	52	61	69	159	53	152	107	103	93	60	20	82
	%	156	58	54	74	181	51	169	115	149	160	98	21	121
Solway	mm	121	74	106	81	218	77	191	140	108	153	146	18	108
	%	134	67	82	54	151	53	126	100	116	168	166	17	120
Clyde	mm	138	96	151	172	301	94	226	181	88	162	181	35	128
	%	134	74	106	98	164	56	122	112	78	154	176	36	124

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 June 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.

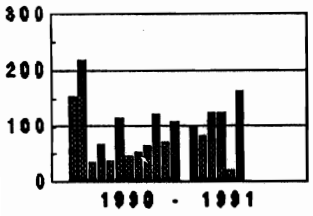
TABLE 2 RAINFALL RETURN PERIOD ESTIMATES

		JAN - JUN 91	Est Return Period, years	MAR 90 - JUN 91	Est Return Period, years	MAY 89 - JUN 91	Est Return Period, years	NOV 88 - JUN 91	Est Return Period, years
England and	mm	412		975		1749		2161	
Wales	% LTA	104	2-5	84	10-15	90	5-10	90	5-10
NRA REGIONS									
North West	mm	443		1309		2325		2959	
	% LTA	87	2-5	86	5-10	89	5-10	93	2-5
Northumbria	mm	422		1040		1657		2021	
	% LTA	112	2-5	94	2-5	88	10	88	10-15
Severn Trent	mm	329		801		1485		1814	
	% LTA	95	2-5	80	15-20	89	5-10	89	5-10
Yorkshire	mm	361		908		1550		1905	
	% LTA	98	2-5	86	5-10	87	10-15	87	10-20
Anglia	mm	245		590		1068		1315	
	% LTA	91	2-5	75	40-60	81	40-50	82	40-60
Thames	mm	332		679		1290		1574	
	% LTA	108	2-5	75	30-40	85	10-20	85	15-20
Southern	mm	385		827		1495		1802	
	% LTA	114	2-5	83	5-10	88	5-10	86	10-20
Wessex	mm	427		887		1675		2034	
	% LTA	113	2-5	80	10-20	90	5-10	88	5-10
South West	mm	596		1338		2467		3006	
	% LTA	114	2-5	89	5	97	2-5	95	2-5
Welsh	mm	613		1459		2695		3338	
	% LTA	106	2-5	87	5-10	95	2-5	94	2-5
Scotland	mm	658		2032		3378		4322	
	% LTA	109	2-5	113	10-15	111	10-20	115	60-80
RIVER PURIFICATION BOARDS									
Highland	mm	736		2571		4238		5550	
	% LTA	100	<2	119	30-40	119	40-50	122	>200
North-East	mm	472		1295		2002		2421	
	% LTA	109	2-5	100	<2	91	5-10	90	10-15
Tay	mm	661		1649		2801		3550	
	% LTA	121	5-10	104	2-5	104	2-5	107	5
Forth	mm	524		1478		2492		3136	
	% LTA	111	2-5	105	2-5	104	2-5	107	5-10
Tweed	mm	465		1246		2044		2491	
	% LTA	109	2-5	98	2-5	95	2-5	95	2-5
Solway	mm	673		1783		3046		3846	
	% LTA	113	2-5	100	<2	100	<2	103	2-5
Clyde	mm	775		2432		4084		5195	
	% LTA	114	2-5	117	15-20	116	40-50	119	60-80

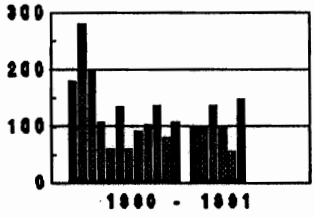
Return period assessments are based on tables provided by the Meteorological Office*. These assume a start in a given month; return periods for a start in any month may be expected to be an order of magnitude less.
The tables reflect rainfall totals over the period 1911-70 only and the estimate assumes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

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

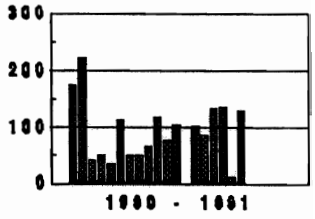
FIGURE 1 MONTHLY RAINFALL FOR 1990/91 AS A PERCENTAGE OF THE 1941-70 AVERAGE



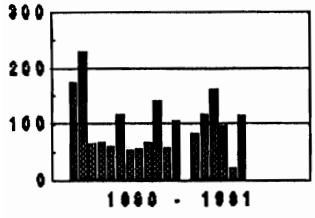
England and Wales



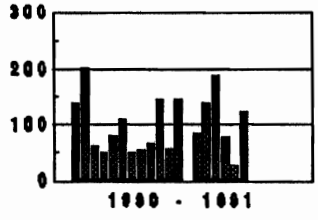
Scotland



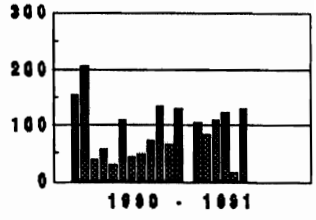
Welsh Region



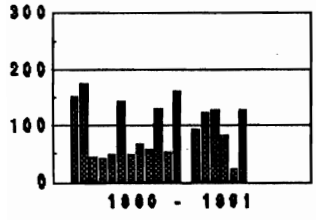
North West Region



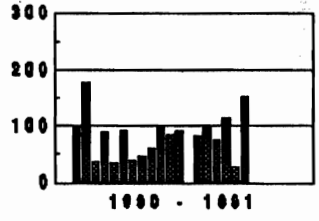
Northumbria Region



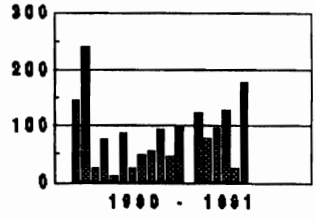
Severn-Trent Region



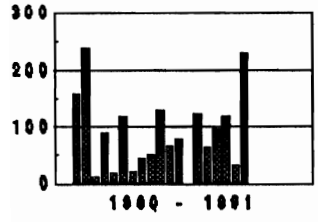
Yorkshire Region



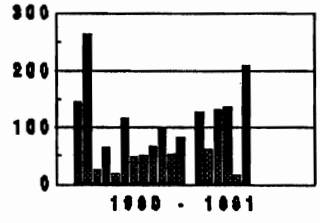
Anglian Region



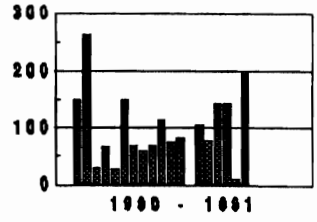
Thames Region



Southern Region

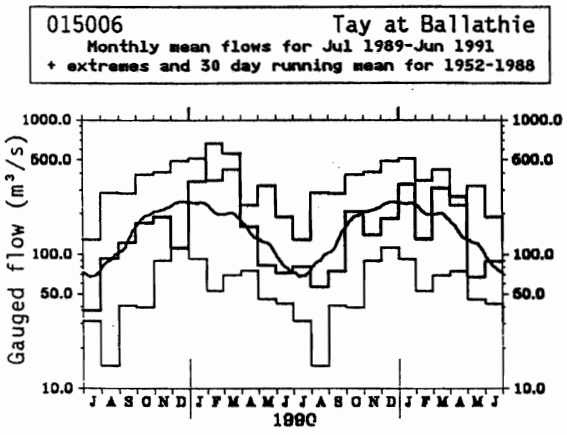


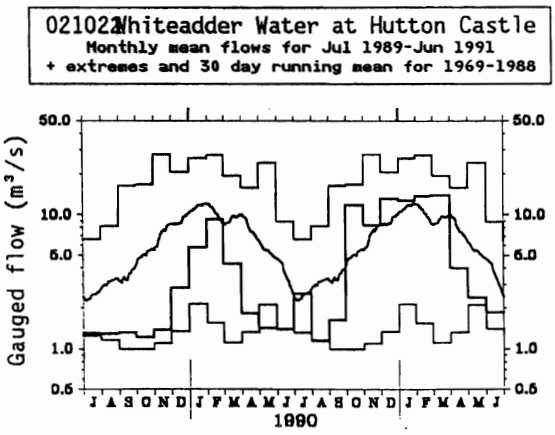
Wessex Region

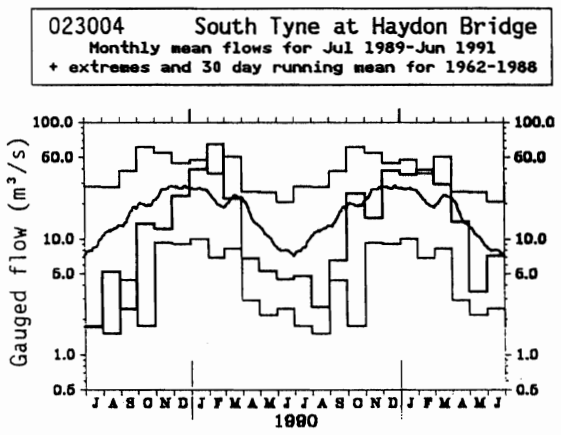


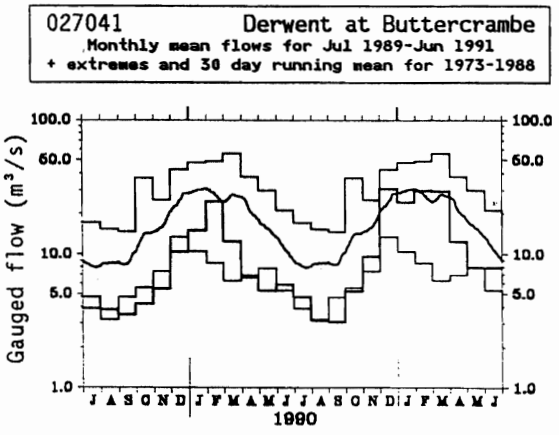
South West Region

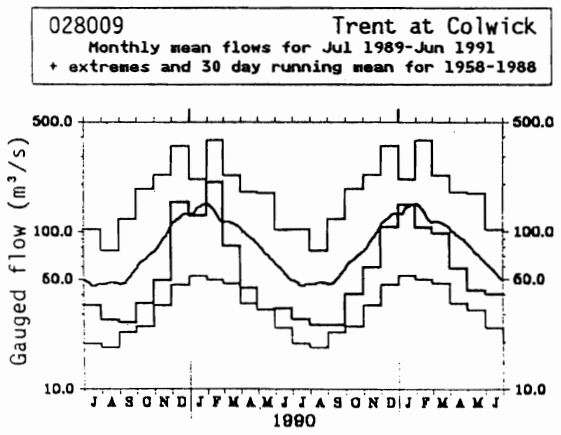
FIGURE 2 MONTHLY RIVER FLOW HYDROGRAPHS

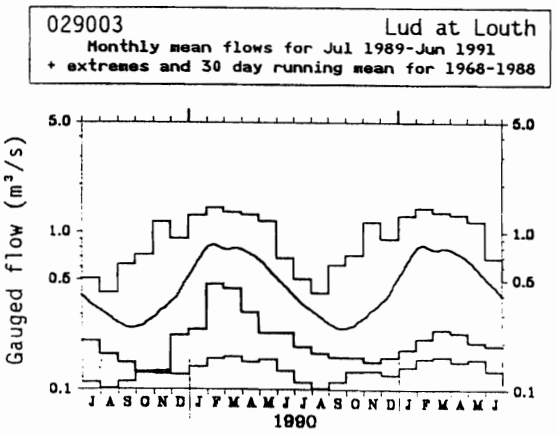


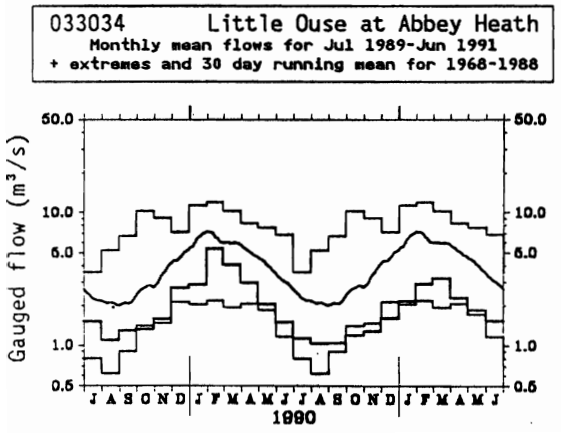


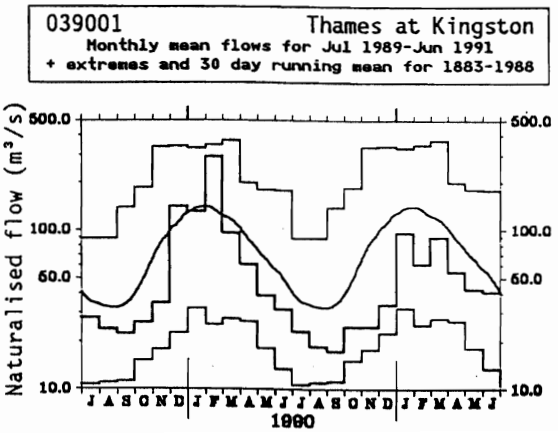






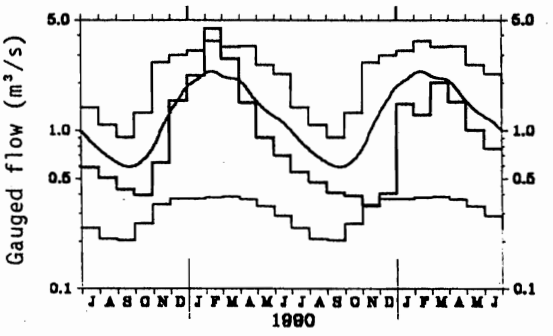






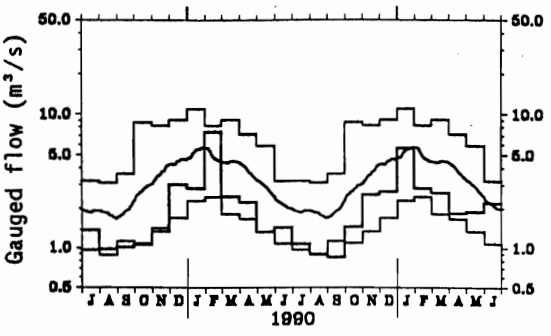
039020 Coln at Bibury

Monthly mean flows for Jul 1989-Jun 1991
+ extremes and 30 day running mean for 1963-1988



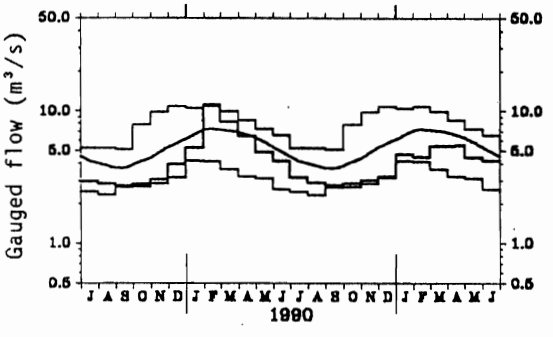
040011 Great Stour at Horton

Monthly mean flows for Jul 1989-Jun 1991
+ extremes and 30 day running mean for 1964-1988



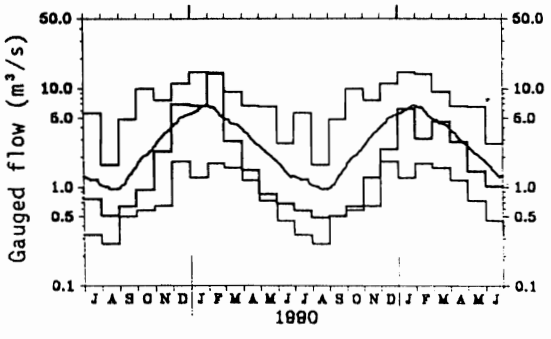
042010 Itchen at Highbridge+Allbrook

Monthly mean flows for Jul 1989-Jun 1991
+ extremes and 30 day running mean for 1958-1988



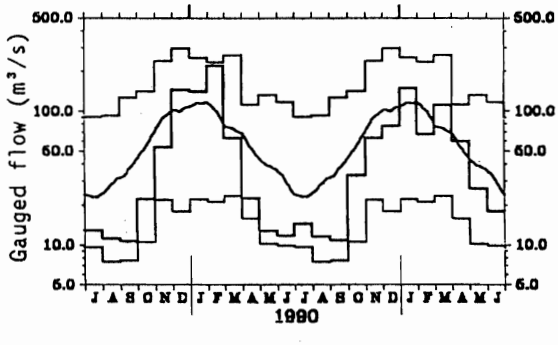
052005 Tone at Bishops Hull

Monthly mean flows for Jul 1989-Jun 1991
+ extremes and 30 day running mean for 1961-1988



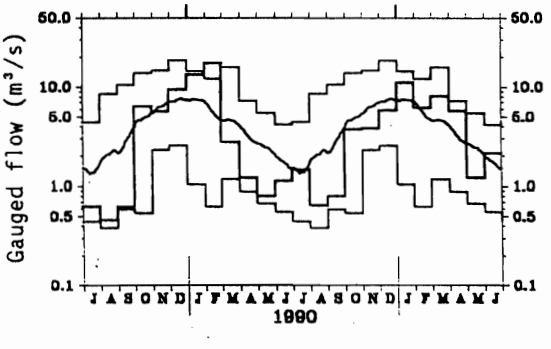
054001 Severn at Bewdley

Monthly mean flows for Jul 1989-Jun 1991
+ extremes and 30 day running mean for 1921-1988



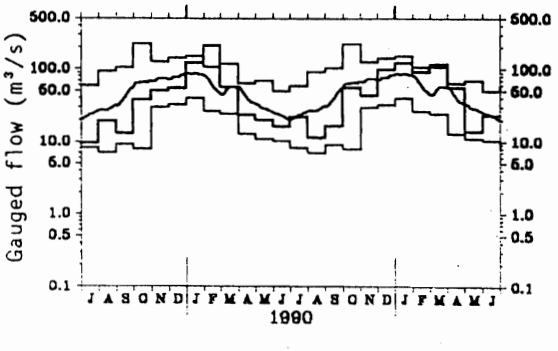
057004 Cynon at Abercynon

Monthly mean flows for Jul 1989-Jun 1991
+ extremes and 30 day running mean for 1957-1988



076007 Eden at Sheepmount

Monthly mean flows for Jul 1989-Jun 1991
+ extremes and 30 day running mean for 1967-1988



084013 Clyde at Daldowie

Monthly mean flows for Jul 1989-Jun 1991
+ extremes and 30 day running mean for 1963-1988

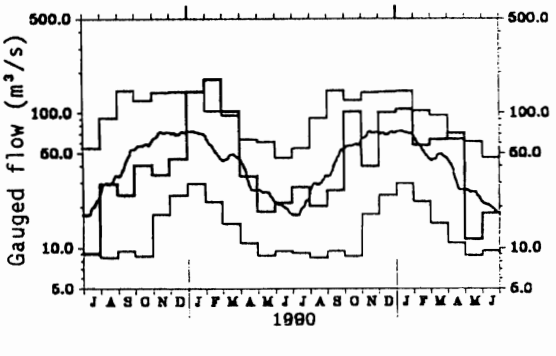


TABLE 3 RUNOFF AS MM. AND AS A PERCENTAGE OF THE PERIOD OF RECORD AVERAGE WITH SELECTED PERIODS RANKED IN THE RECORD

River/ Station name	Feb 1991	Mar	Apr	May	Jun 1991		Jun 1990		1/91 to 6/91		3/90 to 6/91		5/89 to 6/91		8/88 to 6/91	
	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	mm %LT	rank /yrs
Dee at	59	149	80	41	56	16	28	7	468	11	943	5	1432	2	2075	2
Park	79	162	104	65	153	/19	74	/19	107	/19	89	/18	84	/17	87	/16
Tay at	69	180	152	39	50	27	41	20	683	31	1612	32	2654	30	4065	35
Ballathie	60	142	183	56	111	/39	90	/39	117	/39	111	/38	112	/37	122	/36
Whiteadder Water at	65	74	21	13	10	5	7	1	249	13	499	8	645	6	894	5
Hutton Castle	134	149	57	48	57	/22	42	/22	104	/22	95	/21	77	/20	76	/19
South Tyne at	125	105	49	12	25	14	16	8	442	25	905	12	1480	9	2072	5
Haydon Bridge	172	125	91	34	93	/29	58	/29	119	/29	94	/27	93	/25	91	/23
Wharfe at	104	86	53	13	24	22	11	6	377	21	747	5	1241	2	1890	7
Flint Mill Weir	138	114	98	34	97	/36	45	/36	103	/36	82	/35	82	/34	88	/33
Derwent at	45	49	20	13	13	11	10	3	182	13	327	5	465	2	654	1
Buttercrambe	113	120	64	54	77	/30	57	/30	92	/30	74	/29	66	/28	66	/27
Trent at	34	35	20	15	14	10	11	3	172	7	340	2	599	2	847	2
Colwick	78	87	62	60	74	/33	60	/33	82	/33	72	/32	79	/31	80	/30
Lud at	9	12	11	10	9	2	11	5	59	2	164	1	272	1	406	1
Louth	26	33	34	37	44	/23	54	/23	33	/23	44	/22	49	/21	53	/21
Witham at	19	21	11	9	7	12	5	6	85	8	160	6	281	6	371	5
Claypole Mill	71	80	52	57	72	/33	52	/33	69	/32	62	/31	71	/31	68	/30
Little Ouse at	10	12	8	7	6	5	6	4	51	2	118	1	203	1	336	1
Abbey Heath	45	54	43	47	55	/24	52	/24	46	/23	50	/22	55	/22	66	/21
Colne at	10	8	5	5	5	18	4	8	42	4	86	2	179	2	285	3
Lexden	54	43	37	57	93	/32	68	/32	48	/32	47	/31	62	/30	70	/29
Thames at	15	24	14	11	11	45	8	27	101	22	199	6	401	20	554	15
Kingston (natr.)	45	77	62	63	87	/109	65	/109	66	/109	60	/108	77	/107	76	/106
Blackwater at	21	29	18	15	16	27	12	13	133	14	277	9	529	13	727	11
Swallowfield	71	98	78	78	108	/39	82	/39	88	/39	79	/38	94	/37	92	/36
Coln at	29	50	37	25	19	8	17	6	197	6	407	5	712	5	913	3
Bibury	53	92	85	75	71	/28	64	/28	75	/28	74	/27	83	/26	78	/25
Great Stour at	20	20	14	15	16	16	11	4	128	5	257	2	420	1	573	1
Horton	58	59	52	70	104	/26	69	/26	75	/25	65	/23	66	/22	65	/20
Itchen at	30	40	39	33	30	8	30	7	208	5	512	2	823	2	1084	1
Highbridge+Allbrook	61	77	83	78	86	/33	86	/33	76	/33	80	/32	82	/31	80	/30
Stour at	26	58	35	20	14	11	10	4	213	4	359	2	731	5	962	2
Throop Mill	43	112	102	85	90	/19	66	/19	87	/19	70	/18	88	/17	82	/16
Piddle at	29	53	47	28	23	13	17	4	216	6	425	4	729	4	937	2
Baggs Mill	49	93	111	88	99	/28	73	/28	82	/27	76	/26	84	/24	78	/22
Exe at	71	106	52	22	24	21	11	6	435	16	815	4	1489	8	2157	6
Thorverton	67	125	92	58	101	/36	46	/36	99	/35	79	/34	86	/34	87	/33
Tone at	37	60	36	19	13	9	9	2	247	9	402	2	847	5	1172	4
Bishops Hull	49	104	93	69	74	/31	50	/31	84	/30	66	/30	85	/29	83	/28
Severn at	37	68	35	16	11	20	7	4	259	39	454	8	837	18	1207	17
Bewdley	64	147	111	68	63	/71	40	/71	104	/70	79	/69	88	/69	90	/68
Wye at	196	171	192	34	96	27	68	19	914	21	2306	8	4095	9	5932	9
Cefn Brwyn	113	97	153	35	115	/37	81	/37	102	/36	90	/32	94	/27	97	/24
Cynon at	140	204	141	31	53	24	28	12	847	31	1401	9	2744	17	3822	15
Abercynon	101	172	189	52	131	/33	68	/36	134	/33	90	/31	105	/29	102	/27
Dee at	164	147	166	22	67	16	50	12	741	10	1852	4	3363	4	5035	6
New Inn	96	82	161	33	115	/22	85	/22	91	/22	83	/21	89	/20	93	/20
Eden at	96	126	63	16	26	13	18	8	468	20	893	11	1505	10	2164	10
Sheepmount	129	184	138	49	103	/21	73	/21	132	/21	104	/19	106	/17	107	/15
Clyde at	73	89	96	16	24	15	29	20	448	25	1133	23	1845	22	2653	22
Daldowie	96	119	232	46	91	/28	110	/28	124	/28	120	/27	116	/26	117	/25

Notes (i) Values based on gauged flow data unless flagged (natr.), when naturalised data have been used.
(ii) Values are ranked so that lowest runoff as rank 1;
(iii) %LT means percentage of long term average from the start of the record to 1990. For the long periods (at the right of this table), the end date for the long term is 1990.

TABLE 4 START-MONTH RESERVOIR STORAGES UP TO JULY 1991

Area	Reservoir (R)/ Group (G)		Capacity● (Ml)	1991 Feb (%)▲	Mar	Apr	May	Jun	Jul	[1990 Jul]
North West	Northern Command Zone[1]	(G)	133375	89	98	99	90	72	68	
	Vyrnwy	(R)	55146	91	100	99	96	88	86	61
Northumbrian	Teesdale[2]	(G)	87936	91	97	93	82	64	61	
Severn Trent	Clywedog	(R)	44922	89	96	95	97	98	99	89
	Derwent Valley[3]	(G)	39525	94	99	97	91	78	74	65
Yorkshire	Washburn[4]	(G)	22035	86	96	99	91	80	72	64
	Bradford supply[5]	(G)	41407	95	100	98	92	76	76	61
Anglian	Grafham	(R)	58707	70	76	85	91	96	96	90
	Rutland	(R)	130061	68	71	78	80	85	80	80
Thames	London[6]	(G)	206232	87	90	89	91	90	91	85
	Farmoor[7]	(G)	13843	82	64	95	100	100	100	97
Southern	Bewl	(R)	31300	56	60	68	79	69	76	57
	Ardingly	(R)	4627	100	100	100	100	100	100	96
Wessex	Clatworthy	(R)	5364*	94*	98*	100*	95*	84*	71*	67*
	Bristol WW[8]	(G)	36620	70	77	93	95	91	79	64
South West	Colliford	(R)	28540	81	85	92	94	91	89	84
	Roadford	(R)	34500	81	87	94	98	98	94	55[9]
	Wimbleball[10]	(R)	21320	68	74	82	84	81	75	70
	Stithians	(R)	5205	85	98	100	96	83	77	53
Welsh	Celyn + Brenig	(G)	131155	96	100	100	99	96	94	84
	Brianne	(R)	62140	100	100	100	97	88	93	85
	Big Five[11]	(G)	69762	83	93	95	96	87	94	63
	Elan Valley[12]	(G)	99106	99	100	99	97	91	91	76

● Live or usable capacity (unless indicated otherwise)

* Gross storage/percentage of gross storage

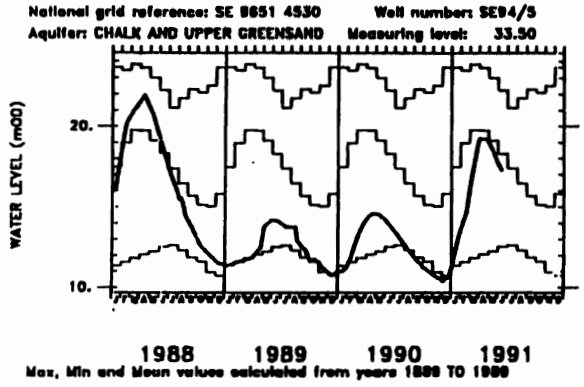
▲ Percentage of live or usable capacity in storage at or close to the beginning of the month according to data availability (unless indicated otherwise)

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.

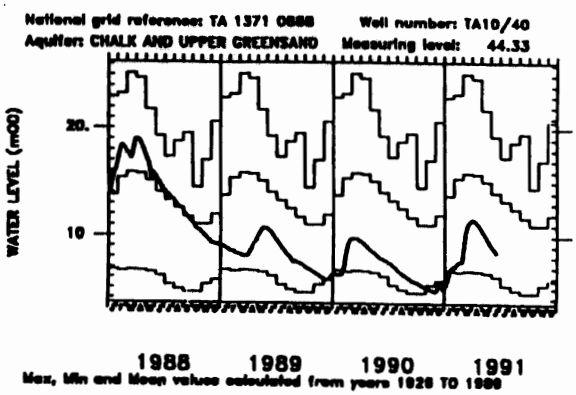
Note: Variations in storage depend on the balance between inputs (from catchment rainfall and any pumping) and outputs (to supply, compensation flow, HEP, amenity). There will be additional losses due to evaporation, especially in the summer months. Operational strategies for making the most efficient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

FIGURE 3 GROUNDWATER HYDROGRAPHS

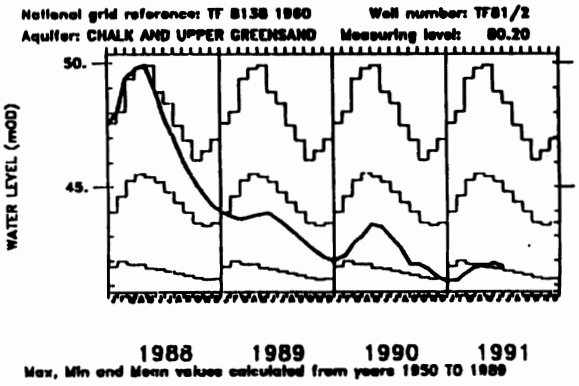
Site name: DALTON HOLME



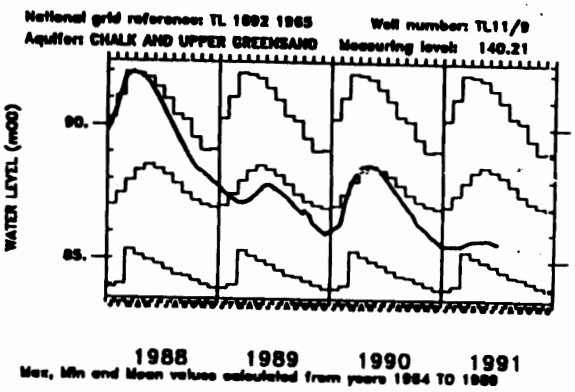
Site name: LITTLE BROCKLESBY



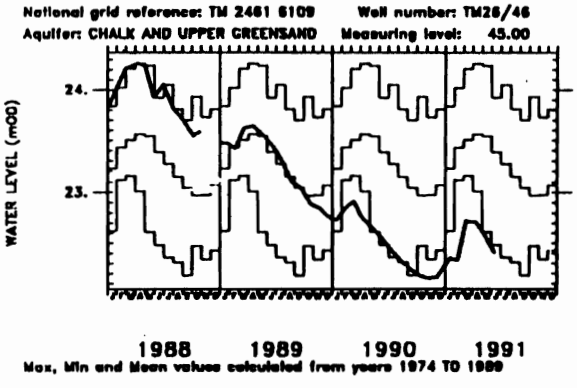
Site name: WASHPIT FARM



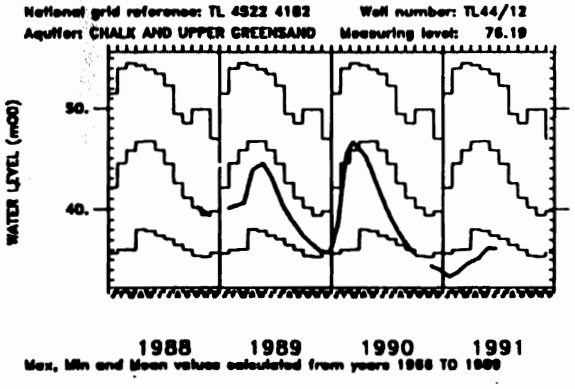
Site name: THE HOLT



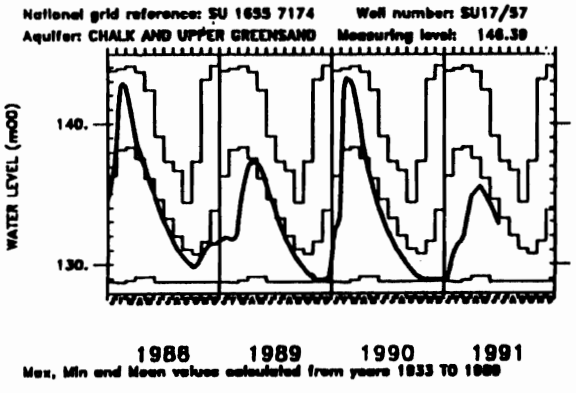
Site name: FAIRFIELDS



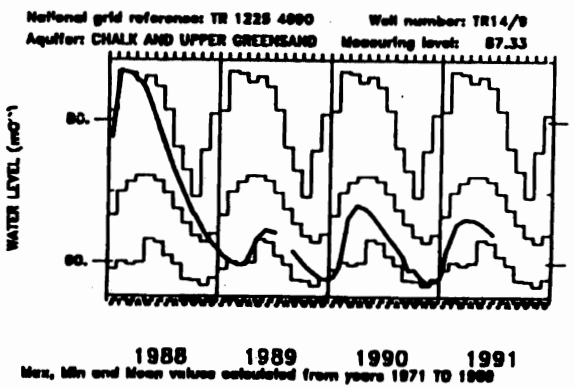
Site name: REDLANDS HALL,ICKLETON



Site name: ROCKLEY

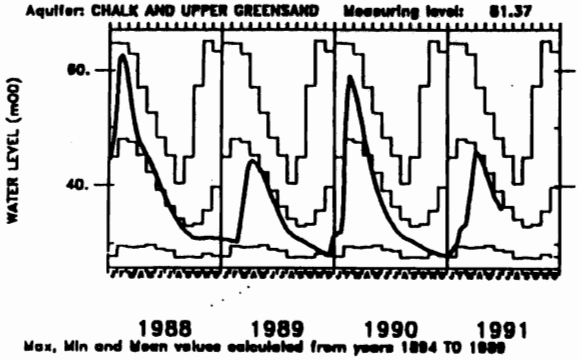


Site name: LITTLE BUCKET FARM,WALTHAM



Site name: COMPTON HOUSE

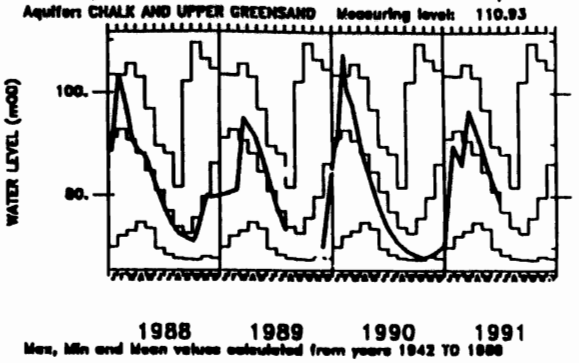
National grid reference: SU 7755 1490 Well number: SU71/23
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 81.37



Max, Min and Mean values calculated from years 1984 TO 1989

Site name: WEST WOODYATES MANOR

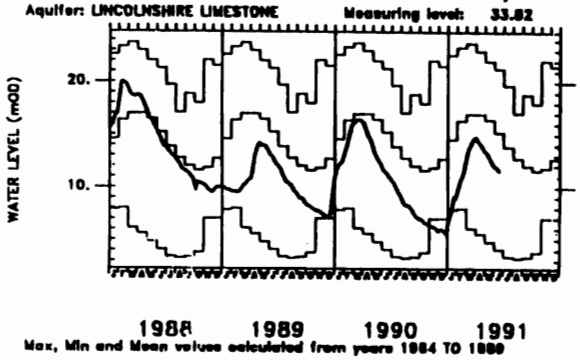
National grid reference: SU 0160 1980 Well number: SU01/58
Aquifer: CHALK AND UPPER GREENSAND Measuring level: 110.93



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

Site name: NEW RED LION

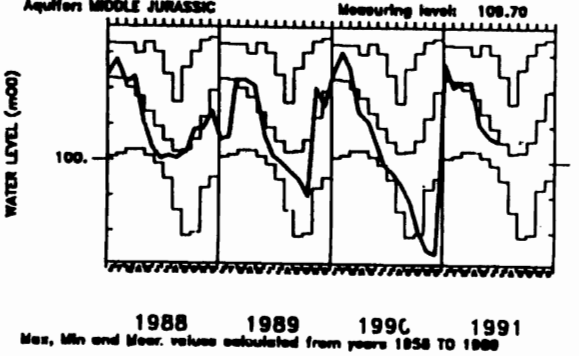
National grid reference: TF 0685 3034 Well number: TF03/37
Aquifer: LINCOLNSHIRE LIMESTONE Measuring level: 33.82



Max, Min and Mean values calculated from years 1984 TO 1989

Site name: AMPNEY CRUCIS

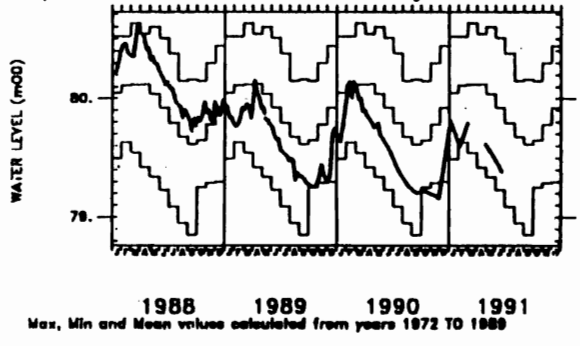
National grid reference: SP 0985 0190 Well number: SP00/62
Aquifer: MIDDLE JURASSIC Measuring level: 108.70



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

Site name: LLANFAIR DC

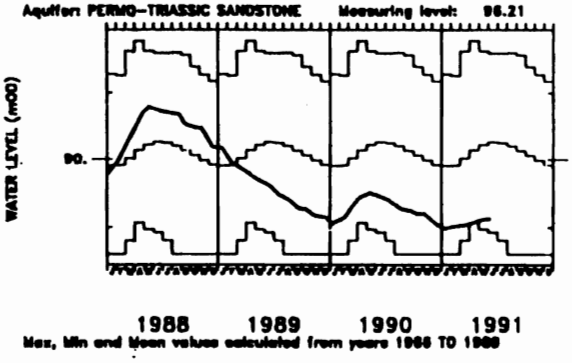
National grid reference: SJ 1374 5556 Well number: SJ15/15
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 82.00



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

Site name: WEEFORD FLAT,WEEFORD

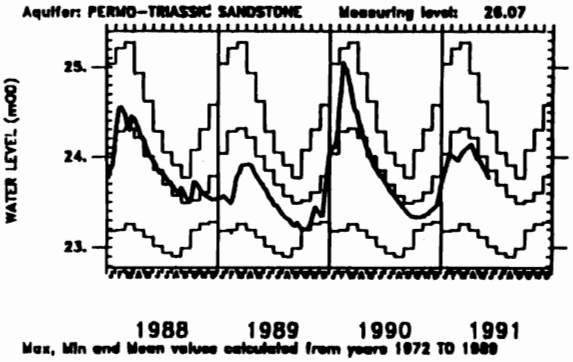
National grid reference: SK 1440 0464 Well number: SK10/9
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 96.21



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

Site name: BUSSELS NO.7A

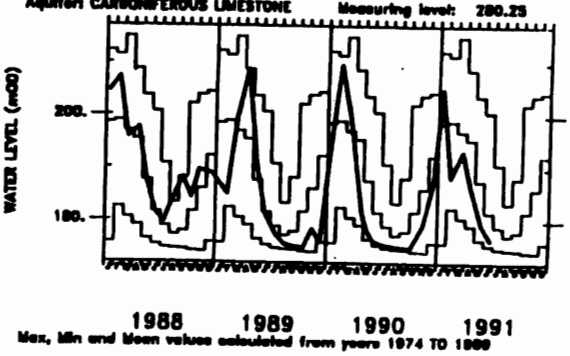
National grid reference: SX 9528 9872 Well number: SX99/379
Aquifer: PERMO-TRIASSIC SANDSTONE Measuring level: 26.07



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 JUNE GROUNDWATER LEVELS: 1991, 1976 and 1973

Borehole	Aquifer	First year of record	Av. June level	June 1973		June 1976		June/July 1991		No. of years with June levels ≤ 1991	Lowest pre-1991 level for any month
				Day	level	Day	level	Day	level		
Dalton Holme	C&UG	1889	18.31	30	13.80	26	13.69	13/06	17.25	27	10.34
L. Brocklesby	"	1926	14.07	19	6.15	04	6.23	18/06	8.42	3	4.56
Washpit Farm	"	1950	45.20	01	41.65	01	42.70	01/07	41.73	1	41.24
The Holt	"	1964	88.38	24	84.79	17	85.52	01/07	85.65	4	83.90
Fairfields	"	1974	23.39	-	-	22	22.78	11/06	22.42	0	22.15
Redlands Farm	"	1964	45.27	01	37.44	01	37.70	24/06	36.09	1	34.53
Rockley	"	1933	134.60	24	131.95	27	128.78	01/07	132.82	16	128.78 dry
L. Bucket Farm	"	1971	71.54	07	63.97	02	62.83	24/06	64.07	2	56.77
Compton House	"	1894	39.10	28	32.00	30	29.06	25/06	36.04	24	27.64
Lime Kiln Way	"	1969	125.40	04	125.14	15	124.37	19/06	124.81	1	124.09
Ashton Farm	"	1974	67.90	-	-	21	64.78	01/07	66.90	4	63.10
West Woodyates	"	1942	80.89	24	77.20	01	70.75	01/07	79.00	17	67.62
New Red Lion	L.L.	1964	15.25	24	9.62	25	4.11	18/06	11.53	4	3.29
Ampney Crucis	M.J.	1958	100.93	24	100.14	27	99.89	28/06	100.56	17	97.38
Dunmurry (N.I.)	PTS	1985	28.18	-	-	-	-	25/06	27.85	0	27.47
Llanfair D.C.	"	1972	79.92	01	79.49	01	79.23	23/06	79.38	1	78.85
Morris Dancers	"	1969	32.58	27	32.33	22	31.92	10/06	32.01	2	30.87
Weeford Flats	"	1966	90.26	29	90.18	17	88.93	06/06	89.12	1	88.61
Bussels 7A	"	1972	23.85	27	23.42	29	23.01	06/06	23.77	7	22.90
Rushyford N.E.	M.L.	1967	76.22	01	65.22	29	65.81	03/06	75.58	13	64.77
Peggy Ellerton	"	1968	34.77	29	32.62	22	31.38	11/06	33.39	5	31.10
Alstonfield	C.B.	1974	181.61	-	-	28	175.45	24/06	176.55	5	174.22

Groundwater levels are in metres above Ordnance Datum

C & U.G. Chalk and Upper Greensand;
L.L. Lincolnshire Limestone
PTS Permo-Triassic Sandstones
M.J. Middle Jurassic Limestone
C.B. Carboniferous Limestone
M.L. Magnesian Limestone

FIGURE 4 LOCATION MAP OF GAUGING STATIONS AND GROUNDWATER INDEX WELLS