UK Hydrological Bulletin: November 2011 – January 2012

In climatic terms, 2011 was a remarkable year: provisionally it was the second warmest in the UK temperature record (in a series from 1910*) and the annual rainfall totals reflected an exceptional exaggeration in the normal north–west to south–east rainfall gradient across the UK. Provisionally, Scotland registered its wettest year on record but, with most rain-bearing Atlantic low pressure systems following tracks remote from the English Lowlands, rainfall deficiencies continued to increase in large parts of eastern, central and southern England.

Regional contrasts in rainfall patterns were particularly stark during the autumn. Whilst Northern Ireland recorded its second wettest autumn and western Scotland was also very wet, England recorded its second driest autumn since 1985. The dry autumn contributed to very notable rainfall deficiencies across a range of timeframes. Considering the March–November period for the Midlands, the lowest rainfall on record (established during the 1995 drought) was clearly eclipsed in 2011when extreme rainfall deficiencies also extended into Cambridgeshire, Bedfordshire and Northants. Importantly, in a water resources context, the lack of rainfall now extends across three winters: for England & Wales as a whole, the 24 months beginning in December 2009 were the driest (for accumulations ending in November) since 1974–76. For many central areas this period is vying with 1932–34 as the driest in a 101-year series.

In much of southern Britain river flow recessions continued through the autumn. As a result rivers registering new minimum November mean flows showed a wide distribution across the English Lowlands and beyond. The Little Ouse (Norfolk) and Dove (Derbyshire) were among those index rivers reporting new Spring–Autumn runoff minima and, with declining baseflows in many southern catchments, the stream network had contracted substantially — with an associated temporary loss of aquatic habitat. Figure 1 confirms that the runoff from the English Lowlands in 2011 was the third lowest in a 60-year series. By contrast, sustained high flows with widespread flood alerts were a feature of runoff patterns in northern Britain during the late autumn and early winter. In December, the mild conditions and associated rapid melting of snow accumulations in upland headwaters contributed to an increased flood risk, in Scotland particularly. Provisional runoff figures for 2011 suggest that outflows from Scotland established a new maximum (see Figure 2).

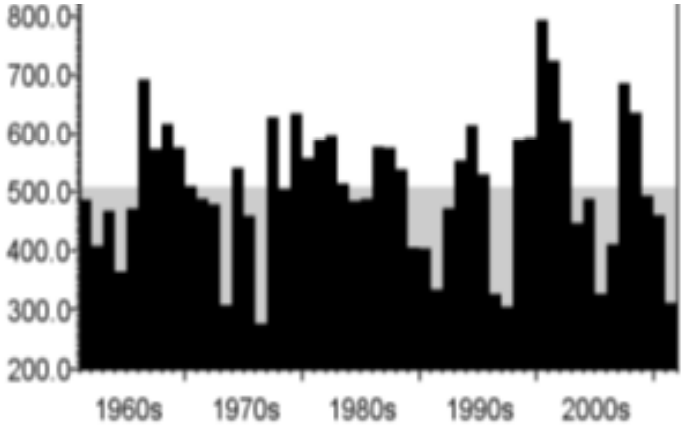

Fig 1 *Estimated annual runoff from the English Lowlands (in m^3s^{-1}); the grey infill indicates the long term average*

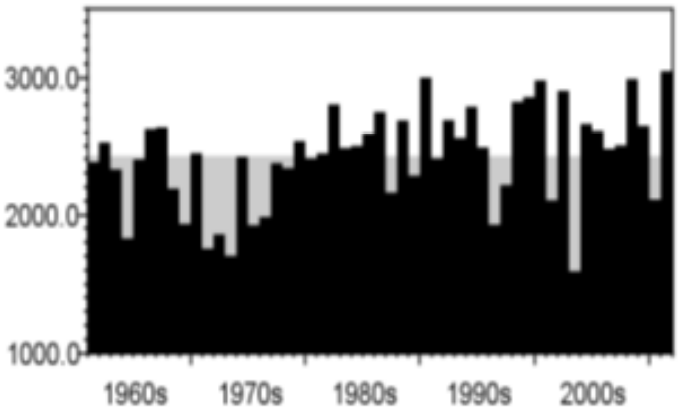

Fig 2 *Estimated annual runoff from Scotlanf (in m^3s^{-1}); the grey infill indicates the long term average*

The December rainfall ensured that reservoir stocks were approaching capacity in most upland reservoirs in northern Britain, Wales and northern Ireland but elsewhere residual soil moisture deficits limited the improvement in water resources. The normal late-autumn decline in soil moisture deficits failed to materialise in much of eastern and central England, causing continuing problems for farmers and substantially delaying the seasonal recovery in river flows and groundwater levels over wide areas. Averaged across the Chalk outcrop, modelled soil moisture deficits for the end of November were the lowest since 1978 (see Figure 3) and the equivalent of around two months of effective winter rainfall.

In southern England, reservoir stocks were particularly depressed at Bewl and Ardingly (where stocks fell below 15% of capacity in December). Of

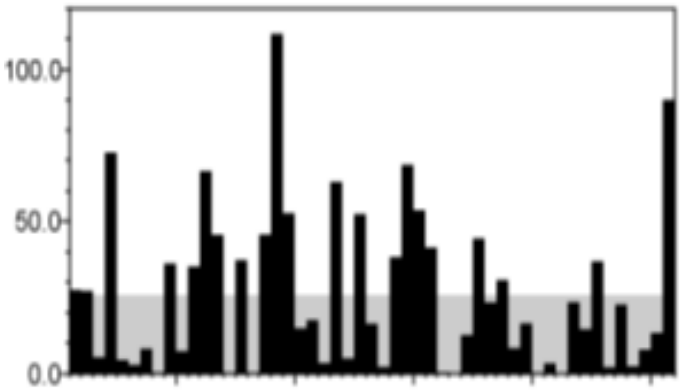

Fig 3 *Modelled end-of-November soil moisture deficits across the Chalk outcrop (in mm). Data source: MORECS*

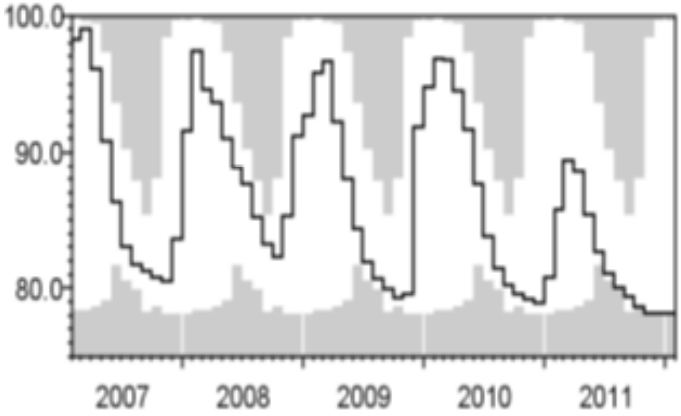

Fig 4 *Monthly groundwater level hydrograph for the Tilshead borehole in the Chalk; the shaded areas indicated the long term monthly maximum and minimum levels*

wider concern was the continuing decline in groundwater levels across much of southern Britain. The very sustained recessions, together with below average recharge through the winter 2010/11 resulted in depressed water-tables throughout much of the Chalk outcrop, with natural base levels being approached in some areas (e.g. the south-western Chalk where the Tilshead borehole was dry for the first time since 1976 — see Figure 4. Based on an index incorporating levels from seven widely-distributed index wells and boreholes, total groundwater storage in the Chalk was the fourth lowest for December (in a 62-year series) — only during the sustained droughts of the 1970s and 1990s was storage lower for the early winter.

The sustained drought conditions and depressed stream flows (often accompanied by low oxygen levels) necessitated many fish rescues. Flow augmentation schemes, together with abstraction restrictions, were brought into operation to help maintain flow rates in drought-affected rivers and the need to protect the environment was also a factor in a number of appeals for water demand to be moderated. Early January was very unsettled, bringing welcome rainfall to many of the drought-affected areas, but thereafter a familiar synoptic pattern was re-established — low pressure systems again being deflected away from the South East. As a consequence, January rainfall totals were well below average over wide areas. With the window of opportunity narrowing for further substantial aquifer recharge and replenishment to gravity–fed reservoirs in the English Lowlands, it is now almost inevitable that some degree of drought stress will be experienced in 2012. The magnitude of that stress, and its spatial extent, will be heavily influenced by rainfall over the late winter and early spring, before evaporative demands rob the rainfall of much of its hydrological effectiveness.

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Note: unless otherwise stated the climatological data series referenced in the Hydrological Bulletins are those managed by the National Climate Information Centre at the Met Office.

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