It is not only 'natural' parameters such as stream network or soil characteristics that have to be considered, but in a densely populated a country like Britain, human impacts such as urbanisation and impoundment are included in statistical estimation.

Such exercises are useful in elucidating the catchment variables affecting flood behaviour useful in ungauged catchment. A well-known example (NERC, 1975) is:

$$\overline{Q} = C\left[AREA^{0.94}STMFRQ^{0.27}SOIL^{1.23}RSMD^{1.03}S1085^{0.16}(1+LAKE)^{-0.85}\right]$$

where $\overline{Q}$ is the mean annual discharge (m^3 s^{-1}); AREA is catchment area (km^2); STMFRQ is stream frequency (junctions.km^{-2}); SOIL is a soil index derived from catchment soil maps, a measure of infiltration capacity and runoff potential (see section 2.2); RSMD is the net one-day rainfall of five years return period less the soil water deficit; LAKE is the fraction of the catchment draining through a lake or reservoir; S1085 is the stream slope (m.km^{-1}) measured between points at 10% and 85% of stream length; and C is a regional coefficient.

All of these variables, if increased, will increase the value of $\overline{Q}$, except LAKE, a measure of surface storage, which will reduce it by virtue of increasing the surface storage volume in a catchment and reducing the intensity of flooding e.g., m^3 s^{-1}. There are other equations derived for urbanised catchments (the proportion of urban land will also increase the catchment value of $\overline{Q}$) and small catchments, generally less than 20 km^2 (Wilson, 1983, ch. 9) that is especially prominent in areas that have been urbanised. In the 'Essex, Lee and Thames areas', which are dominated by urbanised catchments in and around London, a different equation was derived:

$$\overline{Q} = 0.373AREA^{0.70}STMFRQ^{0.52}(1+URBAN)^{2.5}$$

where URBAN is the urban fraction of the catchment. Note the strength of the exponent on the new term, an increase in the strength of the term STMFRQ (presumably reflecting the importance of engineered channels), and a corresponding absence of terms SOIL and RSMD which are characteristic of non-urban areas where soil and vegetation systems dominate catchment behaviour. In urban areas, covered and impermeable surfaces dramatically reduce the effect of soil drainage and soil water deficit. Subsequent studies for rural areas have suggested simpler forms than the first, six-term, equation may be employed (Wilson, 1983, p. 226), but the original form remains preferred.

As more information becomes available (Defra, 2009a), better modelling and statistical estimation techniques evolve and input parameters including scenarios of climate change have to be considered (Chapter 5). The possible outputs describing flood behaviour modelling become greater. Catchment descriptors can be developed that incorporate more variables; in theory, improving estimates for flood peaks in ungauged catchments. The Flood Estimation Handbook –FEH (Bayliss, 1999) replaced the Flood Studies Report, and while the latter is complicated due to the use of both statistical and hydrological process models able to make predictions of many catchment variables, it includes an estimation of median annual flood (QMED). QMED has an annual exceedance probability of 0.5, and a return period of two years.

For rural catchments, using catchment descriptors (Robson and Reed, 1999, p. 100–101):

$$QMED_{rural} = 1.72AREA^{AE}(1000/SAAR)^{1.560}FARL^{2.642}(SPRHOST$$

Where:

AREA is the catchment area (km^2)
SAAR is the standard average annual rainfall based on measurements from 1961–1990 (mm)
FARL is an index of flood attenuation due to reservoirs and lakes
SPRHOST standard percentage runoff derived from HOST soils data (page 48)
SPRHOST = BFIHOST + 1.30(SPRHOST/100) – 0.987
RESHOST residual soils term linked to soil responsiveness
BFIHOST is baseflow index derived from HOST data
AE is the area exponent = 1–0.015 ln(AREA/0.5)

The r^2 compared with measured data is 0.916.

To stress the developing nature of flood estimation, a subsequent development for rural catchments, one subsequently developed equation is example developed has been:

$$QMED_{rural} = 8.3062AREA^{0.8510}0.1536^{(1000/SAAR)}FARL^{3.4451}0.046$$

where BFIHOST2 is the squared baseflow index derived from HOST soil data.

This model is analytically more simple because it uses only four catchment descriptors, where originally six were used in the QMED model reported in the FEH (Bayliss, 1999).

Using the 'Revitalised Flood Hydrograph (ReFH)' model (Kjeldsen, 2007) design flood hydrographs are generated for a specified initial soil water content, base flow from groundwater and a design rainfall event for a required return period. Soil water content rainfall must be specified on a seasonal basis, depending on the degree of urbanisation of the catchment under consider-