Example 2.4 Watershed Precipitation-runoff Units

The watershed above a particular site on a river has a drainage area of 77,700 hectares. The mean annual precipitation for this area is 812 mm. About 25 percent of the precipitation reaches the basin outlet as streamflow. Estimate the mean flow rate Q at that particular site on the river alternatively in units of m^3/yr, m^3/s, ft^3/s, and ac-ft/yr.

Solution

$$\text{Precipitation} = (77{,}700\ \text{ha})\left(10{,}000\ \frac{\text{m}^2}{\text{ha}}\right)\left(812\ \frac{\text{mm}}{\text{yr}}\right)\left(0.001\ \frac{\text{m}}{\text{mm}}\right) = 6.31 \times 10^8\ \text{m}^3/\text{yr}$$

$$Q = \left(6.31 \times 10^8\ \frac{\text{m}^3}{\text{yr}}\right)(0.25) = 1.58 \times 10^8\ \frac{\text{m}^3}{\text{yr}}$$

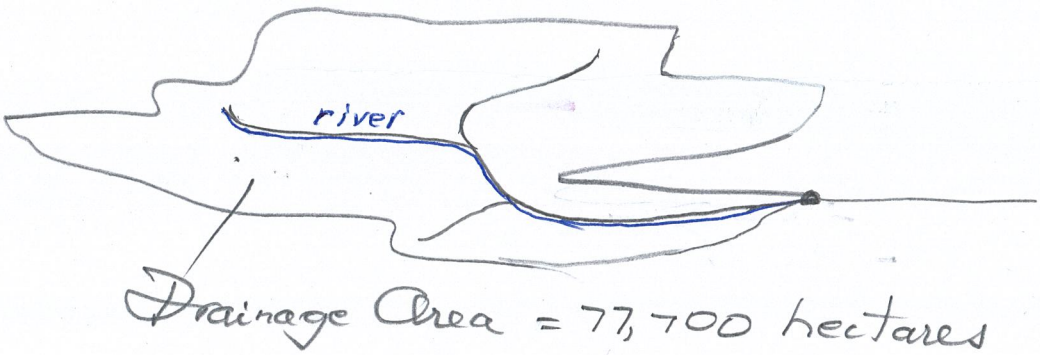
$$Q = \left(1.58 \times 10^8\ \frac{\text{m}^3}{\text{yr}}\right)\left(\frac{\text{year}}{365\ \text{days}}\right)\left(\frac{\text{day}}{86{,}400\ \text{s}}\right) = 5.00\ \text{m}^3/\text{s}$$

$$Q = \left(5.00\ \frac{\text{m}^3}{\text{s}}\right)\left(\frac{\text{ft}^3}{0.02832\ \text{m}^3}\right) = 176.6\ \text{ft}^3/\text{s}$$

$$Q = \left(176.6\ \frac{\text{ft}^3}{\text{s}}\right)\left(\frac{\text{ac-ft}}{43{,}560\ \text{ft}^3}\right)\left(86{,}400\ \frac{\text{s}}{\text{day}}\right)\left(365\ \frac{\text{days}}{\text{yr}}\right) = 127{,}900\ \text{ac-ft/yr}$$

alternatively

$$Q = (77{,}700\ \text{ha})\left(812\ \frac{\text{mm}}{\text{yr}}\right)\left(\frac{\text{acre}}{0.4047\ \text{ha}}\right)\left(\frac{\text{ft}}{304.8\ \text{mm}}\right)(0.25) = 127{,}900\ \text{ac-ft/yr}$$



Source: Wurbs & James, 2002