One result of interest is that if the discharge, Q, diminishes due to a drought, groundwater interception by pumping, or other cause, the outflow region, x_o, is reduced so that the aquifer tends to conserve the freshwater region. Also, from Eq. 8.8, it is possible to calculate the increase in elevation of the salt-freshwater interface if Q is decreased. This is relevant to a pumping field with intakes at a particular depth.

As shown in Fig. 8.5, for an unconfined aquifer, the effect of a sea level rise would be to displace the fresh-saltwater interface landward a distance dependent on the slope, δ, of the topography. Thus for a sea level increase, S, the interface would be elevated by a distance S and displaced landward a distance, Δx, where approximately

$$\Delta x = \frac{S}{\delta} \tag{8.11}$$

For a confined aquifer, which flows to the ocean under pressure, saltwater intrusion into the aquifer is not expected to present the same magnitude of problem as for the unconfined aquifer. As shown in Fig. 8.1b, the only requirement is that the piezometric head at the point of aquifer outcropping must be equal to the depth of water at this point. With an increase in sea level, the rate of outflow can decrease, thereby increasing the piezometric head at the point such that little if any intrusion will occur.

8.3.3 Oceanic Islands

Many oceanic islands are composed of relative permeable limestone with a freshwater layer overlying a saltwater layer. The freshwater layer must be maintained by rainfall or the layer thickness would diminish to zero with increasing time. Referring to Fig. 8.6, the freshwater layer must outcrop at or below the mean sea level.

Considering a circular island of radius, R, with a rainfall recharge rate, W, and employing the Dupuit and Ghyben-Herzberg relations, an approximate freshwater boundary can be determined. The distance, z, to the interface is given by

$$z^2 = \frac{W(R^2 - r^2)}{2K[1 + \frac{\Delta\rho}{\rho}][\frac{\Delta\rho}{\rho}]} \tag{8.12}$$