of Kozeny(16) for the steady flow of a homogeneous fluid into a well that partially penetrates an aquifer having isotrophic permeability,

$$Q_{max} = \frac{2\pi kDS_w}{[\log(r_e/r_w) - \beta]} \, [1 + 7(r_w/2D)^{\frac{1}{2}} \cos(\pi D/2m)]$$

Kozeny's formulation has been slightly modified by inclusion of a term β, to take into account the fact that in an extensive well field of the type under consideration most, if not all, of the recharge-water pumped by a well enters through the ground surface within the effective radius, r_e, of the well. If all the recharges enter this way, $\beta = \frac{1}{2}$; in the case of an isolated well where practically all the recharge enters the field through the cylindrical surface $2\pi\ r_e m$, $\beta = 0$.

By substitution of the value for S_w given by the first equation in the second, the following equation is obtained.

$$Q_{max} = 2\pi\ km[(\rho_s - \rho_f)/\rho_f]m(1-\alpha)\alpha[\log_e(r_e/r_w) - \beta]^{-1}[1+7(r_w/2\alpha m)^{\frac{1}{2}} \cos(\pi\alpha/2)]$$

where $\alpha = D/m$ is the degree of penetration by the well of the fresh water layer.

In Figure 7.14 values of Q_{max} are plotted against the degree of penetration, α, for the following set of parameters: r_w = 2.25 ft; m = 500 ft; kD = 200,000 gallons per day per foot (k = 19,500 feet per year); ρ_s = 1.0167 (for 20,000 milligrams per liter of salinity); ρ_f = 1.00075 (for 900 milligrams per liter of salinity); and for β = 0. Figure 7.14 shows that values of Q_{max} increase with a decrease of the degree of penetration until α reaches a value of about 50 percent. At lower degrees of penetration the value of discharge decreases and approaches zero. For the values of the parameters assumed the maximum production of the well is about 250 gpm. Physically the results may be explained by noting that when the bottom of the well is near the original level of the interface, only a small discharge with a small drawdown will cause the salt cone to rise to the well-bottom and a slight increase in discharge will cause salt water to enter the well. On the other hand, when the degree of penetration is small, the flow rate is limited by the build-up of hydraulic friction in the fresh water as it converges into the small entrance area of the well.

The skimming well equation was solved for twenty-four cases (See Table 7.2) with different sets of the soil, aquifer, and well parameters (k, m, ρ_s, ρ_f, r_w). In each case the optimal value of $\alpha = D/m$ was determined with $\beta = \frac{1}{2}$, and with an average ground water recharge rate of 0.72 acre foot per