

6. (a) Fluxes into the lake are: Precipitation (P), inlet stream discharge (S_i), overland flow (OF), interflow (IF), and groundwater inflow (G_i). Fluxes out of the lake are: Evaporation (E), outlet stream discharge (S_o), and groundwater outflow (G_o).
- (b) Precipitation's contribution during June is 1.63 inches times the area of the lake (285 acres). With appropriate unit conversions this works out to $P = 1.69 \times 10^6 \text{ ft}^3$. Evaporation is calculated in a similar manner: $E = 3.58 \times 10^6 \text{ ft}^3$. The amount of storage lost from the lake is also calculated as the change in level times the area of the lake, which works out to $dV = -4.45 \times 10^6 \text{ ft}^3$. The hydrologic balance equation for this situation is

$$P + S_i + OF + IF + G_i - E - S_o - G_o = dV$$

The unknown terms are OF , IF , G_i , and G_o . Solving for the sum of these unknowns gives:

$$OF + IF + G_i - G_o = dV - P - S_i + E + S_o = 9.4 \times 10^5 \text{ ft}^3$$

- (c) The net of the four unknown fluxes is positive (into the lake). If we assume that overland flow and interflow are negligible, then $G_i - G_o \approx 9.4 \times 10^5 \text{ ft}^3$, and there is more groundwater inflow than outflow at the lake bottom. So, with these assumptions, the lake is spring-fed to some degree. The net groundwater inflow is smaller than the contribution from precipitation and much smaller than the contribution of the inlet stream.
- (d) Possibilities include:
- Install shallow wells around lakeshore – where well levels exceed the lake level, flow is into the lake from the groundwater.
 - Measure water temperatures along the bottom of the lake. Where spring discharge is high, the temperature may be anomalous. Summer would be better for this survey, because cold spring discharge will be denser and stay on the bottom.
 - Repeat the measurements at a time when OF , E , and P are known to be low (winter in a cool climate would be good).

7. (a) The equation for baseflow is derived by substituting

$$Q_q = Q_s - Q_b$$

into

$$Q_s c_s = Q_b c_c + Q_q c_q$$

and solving for Q_b , with the result:

$$Q_b = Q_s \left(\frac{c_s - c_q}{c_b - c_q} \right)$$

The quantity in parentheses above is dimensionless, so the units of Q_b are the same as the units of Q_s , $[\text{L}^3/\text{T}]$.

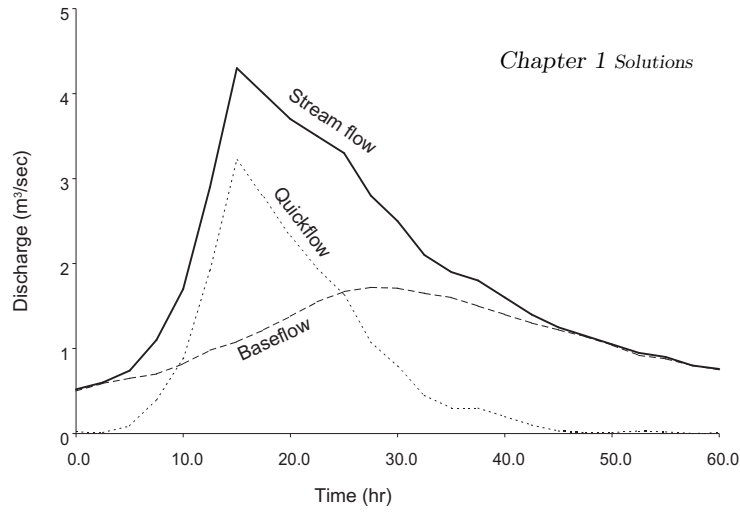


Figure 1: Problem 7.

- (b) The graph shown in Figure 1 was created with a spreadsheet using the above equation for each time step.
8. (a) The hydrologic balance equation in this case is

$$P + S_i + G - E - S_o = dV/dt$$

where P is precipitation, S_i and S_o are the inlet and outlet stream discharges, G is net groundwater inflow, E is evaporation, and dV/dt is the rate of change in reservoir volume.

- (b) A spreadsheet of the solution is shown in Table 1 and the graph is shown in Figure 2.