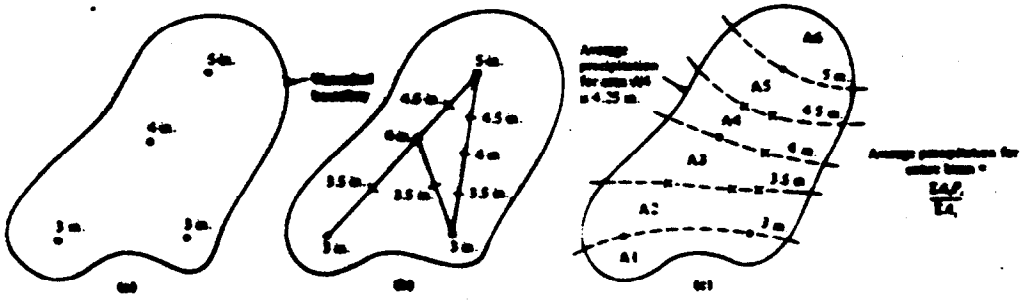
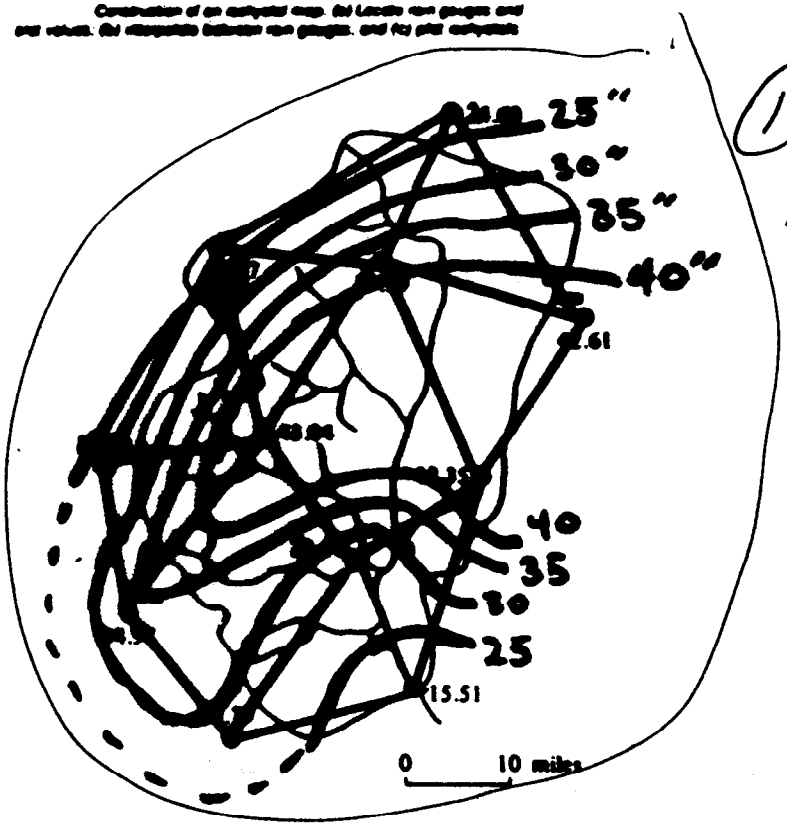
Solutions

CIVE 6361 Groundwater Hydrology

Exercise #1. Compute the mean annual effective precipitation over the watershed depicted in the figure below. The precipitation values shown are in inches. Use the following method (See the example included with this exercise).

1) Interpolate between all gages selected rainfall increments (e.g. 40.00 inches, 35.00 inches, etc.).
2) Join identical depths from each interpolation to form isohyets (lines of equal rainfall).
3) Identify the basin area between each isohyet, and assign to this area the average rainfall of the two bounding isohyets. The panel rainfall volume is the product of this average rainfall and the panel area.
4) Compute the total volume as the sum of the panel volumes. The total effective annual depth is the ratio of total volume and total basin area.





1) Construct Isohyet map

Exercise #2. Directly underneath the watershed is a groundwater reservoir (aquifer), that has a storage coefficient of 50%, that is half of the aquifer's volume is occupied by solid space and the remainder is available to store water. The fraction of precipitation that recharges to the aquifer is 2%. Estimate the time it will take for the average water level in the aquifer to increase 6-inches in the absence of any outflows.

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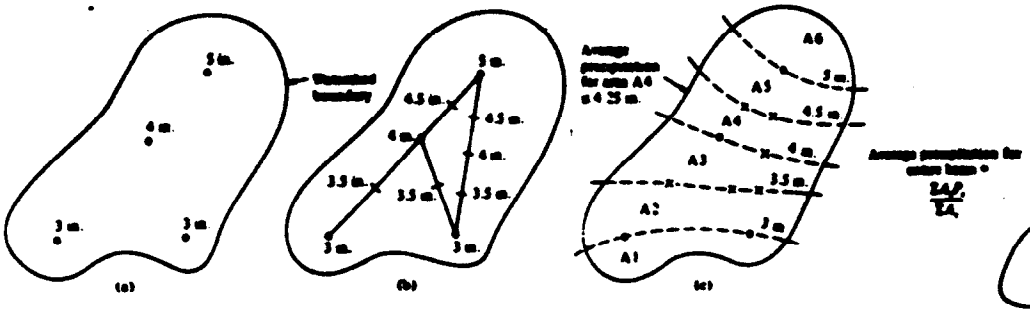
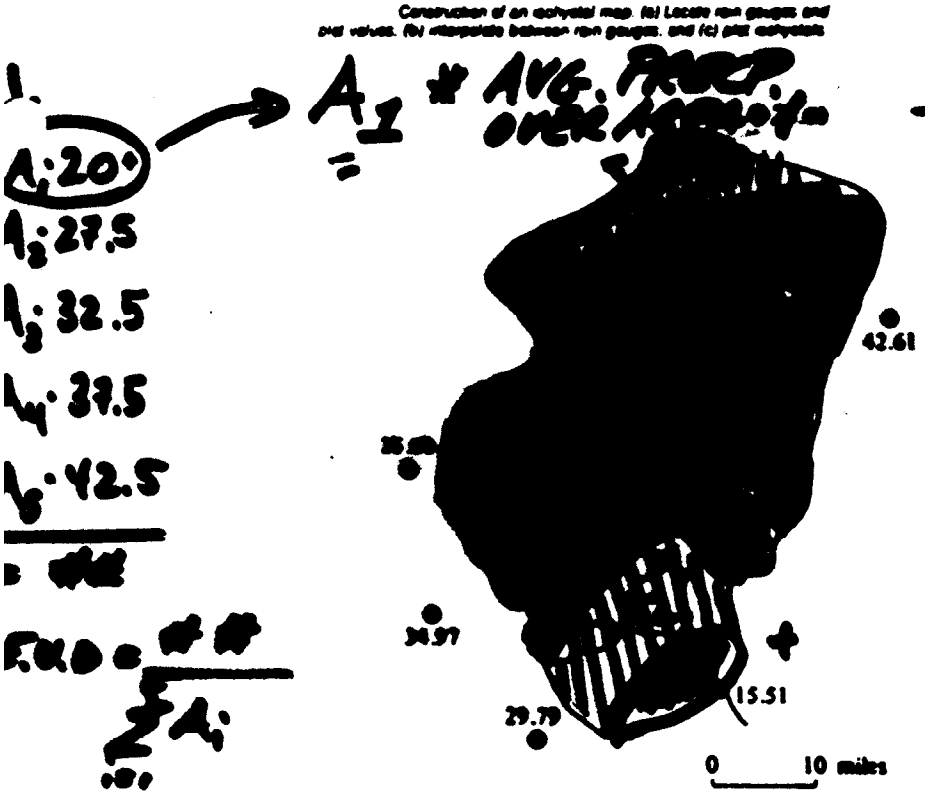


Construction of an isohyetal map. (a) Locate rain gauges and plot values. (b) Interpolate between rain gauges, and (c) plot isohyets.



(2) Identify basin sub-areas (panels)

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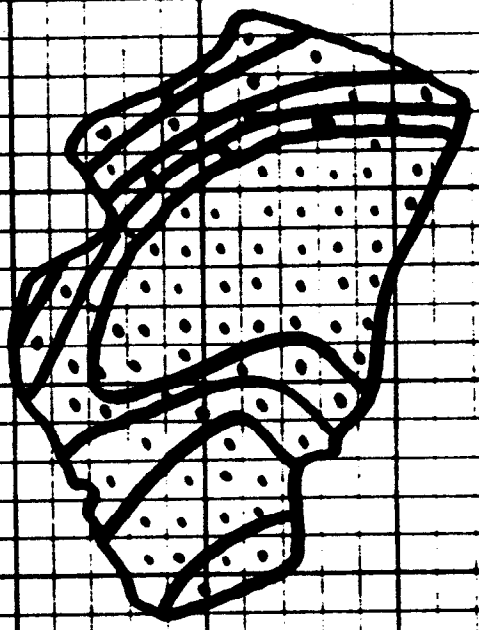
TO DETERMINE $A_1 - A_5$ OVERLAY MAP ONTO GRID AND COUNT SQUARES OR APPROXIMATE AS RECTANGLES & TRIANGLES

(3) Calculate

EUR & basin area

(2) DRAW BASIN OUTLINE

(3) COMPUTE EACH SUBAREA AS # BLOCKS * BLOCK AREA



A5 = 37 blocks

A4 = 12 blocks

A3 = 11 blocks

A2 = 14 blocks

A1 = 6 blocks

$\Sigma A = 82$ blocks

EUR = $\frac{6(20)+14(22.5)+11(32.5)+12(38.6)+37(42.5)}{82}$ = 36.2"

Total Area = 1156.2 mi²

(1) USE MAP SCALE TO FIND AREA OF EACH BLOCK

■ = 14.1 mi²

30 miles

EACH BLOCK

Exercise #1

Total Area ≈ 1156 sq. mi.

EUD ≈ 36.2"

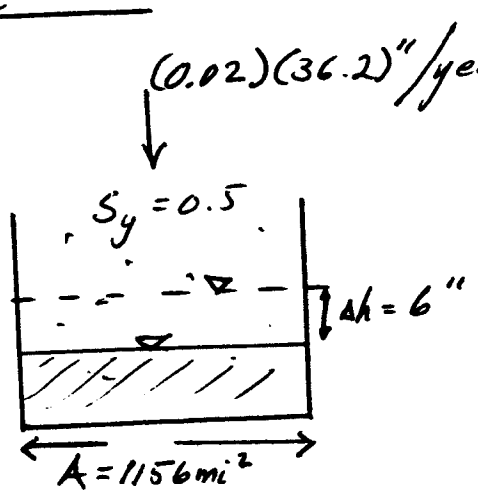
Total Volume on area

$$36.2'' * 1156\ mi^2 * \left(\frac{1\ ft}{12''}\right) * \left(\frac{5280\ Ft}{1\ mi}\right)^2 = 9.7 \cdot 10^{10}\ ft^3$$

$$9.7 \cdot 10^{10}\ ft^3 * \frac{acre\text{-}ft}{43560\ ft^3} = 2.22 \cdot 10^6\ acre \cdot ft$$

(A lot of water!)

Exercise #2



Water Balance

$$\dot{S} = \dot{I} - \dot{O}^{\nearrow 0}$$

$$\frac{S_y \Delta h \cancel{A}}{\Delta t} = \frac{(0.02)(36.2'')\cancel{A}}{year}$$

$$\frac{S_y \Delta h}{(0.02)(36.2'')} = \Delta t\ (years)$$

$$\frac{(0.5)(6'')}{(0.02)(36.2'')} = 4.14\ years$$