Water Balance Evaluation of Non-Federal Reservoir

DPL Hogan (Hogan dam):

Location details:

County: Philips, KS.

Longitude: 99.533^0

Latitude: 39.931^0

Nearest rainfall station: Long Island (24807)

Evaporation: From nearest station Scandia

Reservoir details:

Surface area at minimum water level (0.63 ft) = 0.08 acre

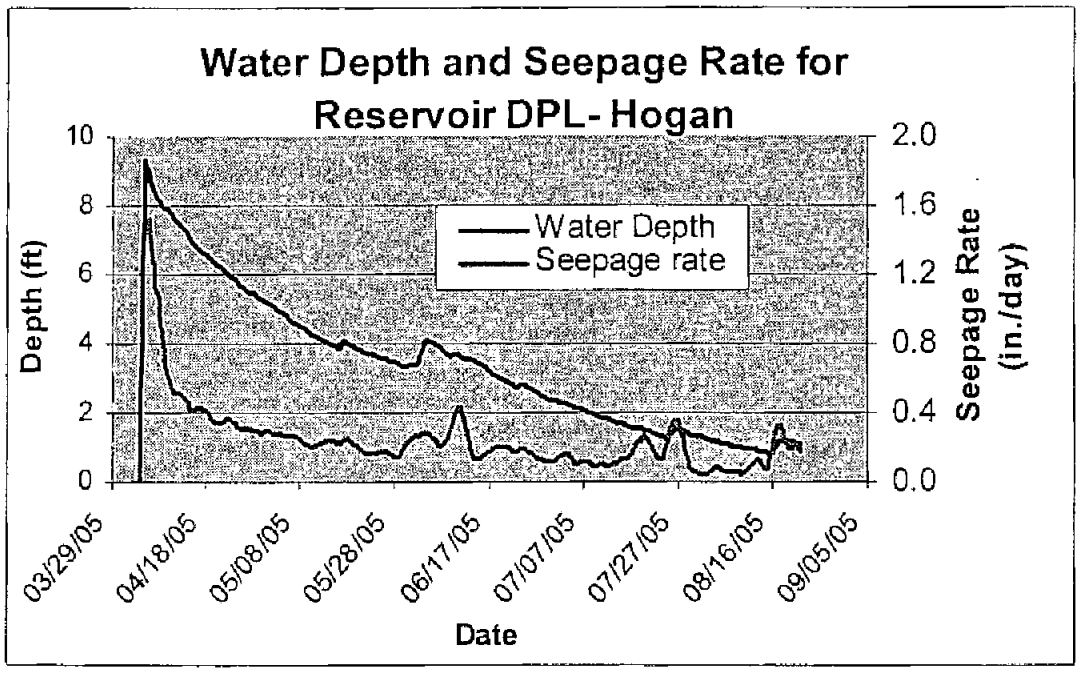
Surface area at maximum water level (9.29 ft) = 1.08 acres

Drainage area = 81.7 acres

DPL-Hogan has been analyzed for non federal reservoir water balance study. Hourly sensor data of water level obtained from Kansas Division of Water Resources was used for the study. Water balance sheet by volume was set up with required columns of change in storage volume ΔS, Rainfall, Evaporation, Runoff, Overflow and Seepage. Hourly sensor data was extracted to obtain the water level at midnight to facilitate the daily balance. Depth versus water storage relationship provided was used to develop stage-storage-area relationship for the purpose. Rainfall data from the nearest rainfall station Long Island and reference ET_0 of Scandia were used for the calculation. Seepage was determined by adding rainfall on the reservoir surface, runoff from the drainage area and deducting evaporation from the reservoir and the change in water storage. Net runoff water from the catchment was estimated for days when it occurred by inspection so that seepage versus time was reasonably consistent.Reservoir rainfall, evaporation and seepage

were expressed both in depth (in.) and in volume (acre inch).

It was observed from the data that, some of the values are not as exact as we would like and more measurement data to complete water balance would be an improvement. Particularly, runoff, overflow, and seepage are all unknown, so the partitioning between them is uncertain. Also, rainfall at the pond would be helpful too.



Seepage = Rain fall + Runoff – Evaporation – Overflow ± ΔS

Rainfall was from nearest station (Long Island, KS)

Evaporation = ET_0 from nearest station (Scandia, KS)

Overflow = Estimated from stage and Spillway characteristics

ΔS = f (depth change and area (volume) table, stage storage table)

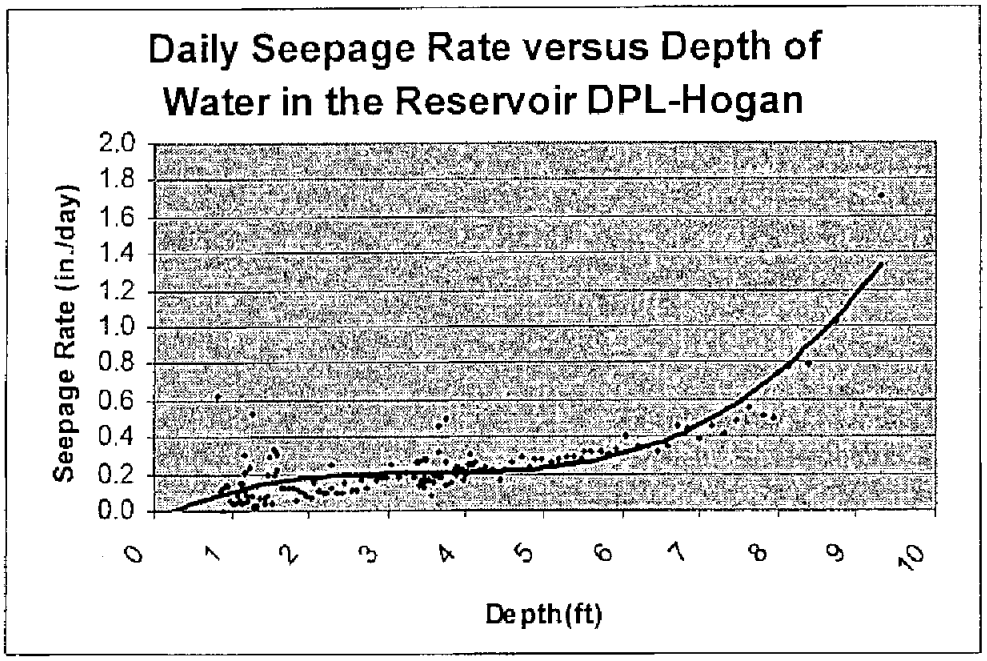
Runoff volume must be estimated to adjust seepage to a reasonable amount each day. There will be uncertainty about runoff but it occurs only occasionally, whereas seepage is continuous when water is present.

Outline of approach:

Example: Overall balance for Hogan, acre-inches.

Seepage = Ran fall + Runoff – Evaporation – Overflow ± ΔS

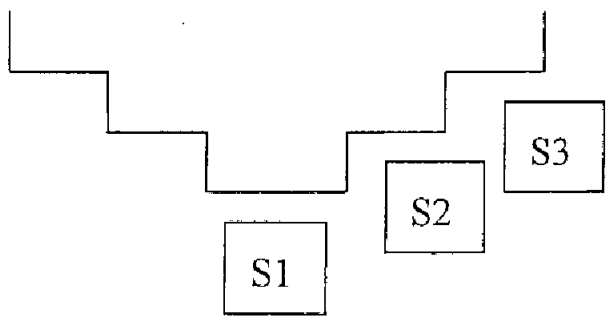
57.24 = 4.23 + 67.20 – 6.23 -7.0 – 0.96



Average seepage rate versus depth:

Seepage rate is greater for areas higher above the reservoir bottom.

S1<S2<S3



Seepage at 0 – 3 feet depth S1 = 0.15 in. /day

Seepage at 3 to 6 feet depth S1+S2 = S1 x A1 + S2 x A2

$0.25 = (0.15 \times 0.25) + (S2 \times 0.32)$

$$S2 = \left(\frac{0.85 \times 0.25}{0.32}\right)$$

S2 = 0.66 in. / day

Seepage at 6 to 8 feet depth S1+S2+S3 = (S1x A1) + (S2xA2) + (S3xA3)

0.50 = (0.15x0.25) + (0.66x0.32) + (S3x0.25)

S3= (0.50-(0.15x0.25)-(0.66x0.32))/ 0.25

S3=1.01 in. /day

Area between 0 and 3 feet depth, A1 = 0.25 ac

Area between 3 and 6 feet depth, A2 = 0.32 ac

Area between 6 and 8 feet depth, A3 = 0.25 ac