Problems 2 Watershed Hidrology

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Problem 1

1. Clear Lake has surface area of 708,000 m2 (70.8 ha). For a given month, the lake has an inflow of 1.5 m3/s and an outflow of 1.25 m3/s. A +1.0-m storage change, or increase in lake level was recorded. If a precipitation gage recorded a total of 24 cm for this month, determine the evaporation loss (in cm) for the lake. Assume that seepage (deep drainage) loss is negligible. (10 pts)

```
Area_m2 <- 708000 #m2
Area_ha <- 70.8 #ha
inflow <- 1.5 #m3/s
outlow <- 1.25 #m3/s
Storage_change <- 1 #m
Storage_change_cm <- Storage_change*100 #m
Precip <- 24 #cm

#determine evaporation loss (in cm) for the lake
#Assume that deep drainage loss is negligible

#Area to cm2
Area_cm2 <- Area_m2 * 10000

#Volume of precipitation
P_volume_cm3months <- Area_m2 * 1000 * Precip

#Runoff
RO_m_s<- (inflow - outlow)/Area_m2 #m/second
RO_m_s #runoff m/s
```

```
## [1] 3.531073e-07
```

```
#Turn to month
RO_cm_month <- RO_m_s * 2.628e+8 #conversion from m/sec to cm/month
RO_cm_month #runoff cm/month
```

```
## [1] 92.79661
```

```
#Meters to cm
```

Solving for et we will have

$$et(t) = p(t) + R0 - S$$

Solving

```
et <- Precip + RO_cm_month - Storage_change_cm

et
```

```
## [1] 16.79661
```

```
#Et is 16.7 cm/month
```

Problem 2

3. A small swimming pool (15 ft wide x 20 ft long x 4 ft deep) is suspected of having a leak out of the bottom. Measurements of rainfall, evaporation, and water level are taken daily for 10 days as shown in the table of "givens" below. First, convert the rainfall in inches to rainfall in millimeters. Draw a picture of the scenario. Define your inputs and your outputs for this control volume. Estimate the average daily leakage out of the swimming pool in m3 day-1 for this 10 day period. Knowing that there are about 7.5 gallons of water in a cubic foot, do you think this is a significant amount of water lost to leakage? (15 pts) Boxes in gray should not be filled in. Be careful of the units!

ï..Day	Evaporation_mm	Rain_in	Rain_mm	Water.Level.in.Pool_mm
1	12.70	NA	NA	1219.2
2	2.54	0.8	20.32	NA
3	12.70	NA	NA	NA
4	2.54	2.8	71.12	NA
5	12.70	NA	NA	NA
6	12.70	NA	NA	NA
7	2.54	2.4	60.96	NA
8	12.70	NA	NA	NA
9	12.70	NA	NA	NA
10	12.70	NA	NA	1041.4

```
#Area of Water
Area_pool_ft2 <- 20 * 15
Area_pool_m2 <- Area_pool_ft2 / 10.764

#Volume of Water
Volume_pool_ft3 <- 20 * 15 * 4
Volume_pool_m3 <- Volume_pool_ft3 / 35.315


#Total Evaporation (mm/10day)
EVt <-  12.7 + 2.54 + 12.7 + 2.54 + 12.7 + 12.7 + 2.54 + 12.7 + 12.7 + 12.7
Evt_m <- EVt/1000
#Ev in m3/10day
Evt_m3 <- Evt_m * Area_pool_m2

#Total Rain (mm/10day)
```

```
Pt <- 20.32 + 71.12 + 60.96
Pt_m <- Pt/1000
#Rain in m3/10day
Pt_m3 <- Pt_m * Area_pool_m2

#Water level change (mm/10day)
Wc <- 1219.2 - 1041.4
Wc_m <- Pt_m/1000
#Water level charge in (m3/10day)
Wc_m3 <- Wc_m * Area_pool_m2
```

Considering the variables, the equation should look like this

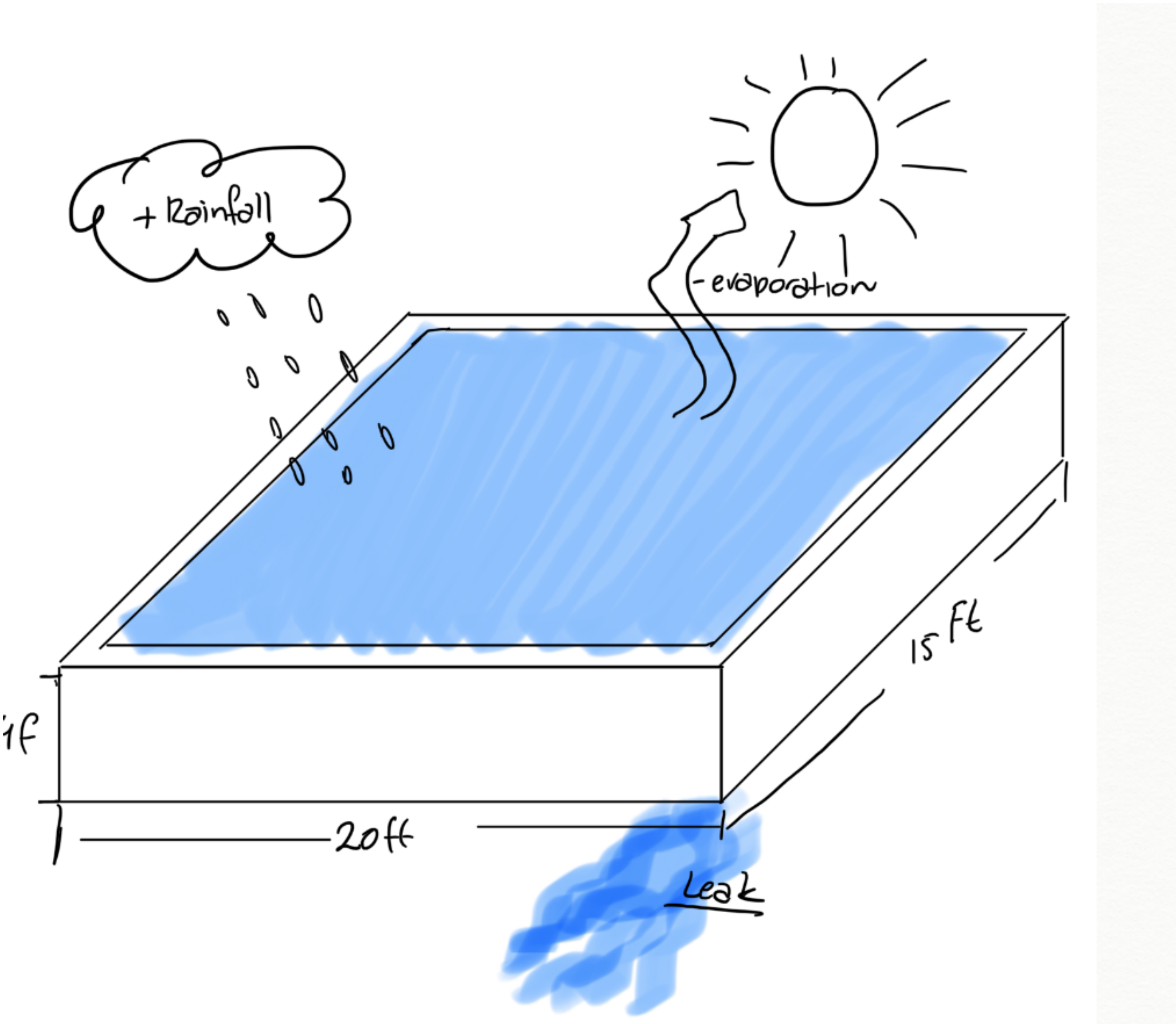

Figure 1: Pool

$$P - (R + G + E + T) = S$$

Precipitation, runoff from ground (leak) and evaporation are the main inputs and outputs.

$$P - (G + E) = S$$

Solving for G (leak)

$$G = P - E - S$$

```r
#Solving

Leak_10day <- Pt_m3 - Evt_m3 - Wc_m3
Leak_1day <- Leak_10day/10

Leak_1day #in m3/day, no significant amount.
```

```
## [1] 0.1553166
```