Environmental Water Quality
BAE 452/552

Session 17

Loads in Irrigation Return Flows

Salt Loads in Irrigation Return Flows

- Pollution of surface waters by salty irrigation drainage water is a problem in many arid regions
- Portions of diverted water are lost from the diversion canal through seepage and evaporation, the remaining is for crops
- The applied water is split into ET and return flow through drainage
- Drainage water has higher salinity than irrigated water

Salt Loads in Irrigation Return Flows

Return flow salinity found from mass balance:

- $s_o I = sR$

where

- s_o, and s = salinity (mg L^{-1}) of irrigation and return flow, respectively
- I is irrigation application (m^3 day^{-1})
- R = return flow (m^3 day^{-1})

Thus, $s = s_o I/R$

Concentration Units

Salt concentration:

- as dissolved salts (mg L^{-1})
- as electrical conductivity (mmho cm^{-1})
- 1 mmho cm^{-1} = 640 mg L^{-1}

River Concentration

- When the irrigation diversion is taken from a river, the river salinity (s_o') after the return flow is:

$$s_o' = \frac{s_o(Q - D) + sR}{Q - D + R}$$

where

- Q = river flow before diversion (m^3 day^{-1})
- D = irrigation diversion (m^3 day^{-1})

Note: $s_o' > s_o$, so river gets saltier

Estimation of Return Flow

Several relationships are needed:

- $I = E_d D$, where E_d is delivery efficiency
- $LF = (I - ET)/I$, to prevent salt build-up (LF=Leaching Fraction)
- $R = I - ET$
- $R = (LF)E_d D$
- $s = s_o/LF$

Estimation of ET

- If local estimations are not available, can find Potential ET as 70% of pan evaporation data
- We must then assume that all annual PET occurs in growing season
- Growing season PET can be estimated using a variety of equations
- Actual ET = k_cPET

Estimating PET

- Growing season PET using Hamon's eqn:

$$PET = \frac{(0.021H^2p)}{T + 273}$$

- where
- PET = potential ET (cm/day)
- H = mean number of daylight hrs per day during period of interest (Table III-18 in EPA document)
- T = mean air temperature during the period (°C)
- p = saturation vapor pressure at temperature T (mbars) (see Table III-19 in EPA document)

Example III-7 (EPA document)

- Irrigation Return Flows