APPENDIX 6

FORMULAE OF WATER BALANCE RATIOS

I. GENERAL PURPOSE RATIOS (in %): (Formulae x 100)

Surface Runoff to Rainfall Ratio = \( \left( \frac{Q_{olf}}{P} \right) = \left( \frac{\text{Surface Runoff}}{\text{Rainfall}} \right) \);

Base flow to Rainfall Ratio = \( \left( \frac{Q_{bf}}{P} \right) = \left( \frac{\text{Base flow}}{\text{Rainfall}} \right) \);

Impervious Area flow to Rainfall Ratio = \( \left( \frac{Q_{impf}}{P} \right) = \left( \frac{\text{Impervious Area flow}}{\text{Rainfall}} \right) \);

Interflow to Rainfall Ratio = \( \left( \frac{Q_{if}}{P} \right) = \left( \frac{\text{Interflow}}{\text{Rainfall}} \right) \);

Channel flow to Rainfall Ratio = \( \left( \frac{Q_{cf}}{P} \right) = \left( \frac{\text{Channel flow}}{\text{Rainfall}} \right) \);

Evaporation to Rainfall Ratio = \( \left( \frac{\sum E}{P} \right) = \left( \frac{\sum \text{Evaporation}}{\text{Rainfall}} \right) \);

Transpiration to Rainfall Ratio = \( \left( \frac{\sum T}{P} \right) = \left( \frac{\sum \text{Transpiration}}{\text{Rainfall}} \right) \);

ET to Rainfall Ratio = \( \left( \frac{E + T}{P} \right) = \left( \frac{\text{Evaporation} + \text{Transpiration}}{\text{Rainfall}} \right) \);

Interception to Rainfall Ratio = \( \left( \frac{\sum I_c}{P} \right) = \left( \frac{\sum \text{Interception}}{\text{Rainfall}} \right) \);

Interception loss to Rainfall Ratio = \( \left( \frac{\sum I_{ic}}{P} \right) = \left( \frac{\sum \text{Evaporation from Interception}}{\text{Rainfall}} \right) \);

Infiltration to Rainfall Ratio = \( \left( \frac{\sum Inf}{P} \right) = \left( \frac{\sum \text{Infiltration}}{\text{Rainfall}} \right) \);

Surface Runoff to Channel flow Ratio = \( \left( \frac{Q_{olf}}{Q_{cf}} \right) = \left( \frac{\text{Surface Runoff}}{\text{Channel flow}} \right) \);
Baseflow to Channel flow Ratio = \( \left( \frac{Q_{bf}}{Q_{cf}} \right) = \left( \frac{\text{Baseflow}}{\text{Channel flow}} \right) \);

Impervious Area flow to Channel flow Ratio = \( \left( \frac{Q_{mpf}}{Q_{cf}} \right) = \left( \frac{\text{Imp. Area flow}}{\text{Channel flow}} \right) \);

Interflow to Channel flow Ratio = \( \left( \frac{Q_{if}}{Q_{cf}} \right) = \left( \frac{\text{Interflow}}{\text{Channel flow}} \right) \);

Variable Source flow to Channel flow Ratio = \( \left( \frac{Q_{vsf}}{Q_{cf}} \right) = \left( \frac{\text{Var. Source flow}}{\text{Channel flow}} \right) \);

Macropore flow to Channel flow Ratio = \( \left( \frac{Q_{mpc}}{Q_{cf}} \right) = \left( \frac{\text{Macropore contrib. on}}{\text{Channel flow}} \right) \);

Macropore flow to Base flow Ratio = \( \left( \frac{Q_{mpc}}{Q_{bf}} \right) = \left( \frac{\text{Macropore contrib. on}}{\text{Base flow}} \right) \);

Transpiration to ET Ratio = \( \left( \frac{T}{E + T} \right) = \left( \frac{\text{Transpiration}}{\text{Evaporation} + \text{Transpiration}} \right) \);

ET Efficiency = ET to PET Ratio = \( \left( \frac{E + T}{PET} \right) = \left( \frac{\text{Actual ET}}{\text{Potential ET}} \right) \);

II. LONG TERM CLIMATE RATIOS (in fractions):

Horton's Index = \( \left( \frac{E + T}{\sum \text{Inf}} \right) = \left( \frac{\text{Evapotranspiration}}{\sum \text{Infiltration}} \right) \);

Budyko's Aridity Index = DI = \( \phi = \left( \frac{PET}{P} \right) = \left( \frac{\text{Potential ET}}{\text{Rainfall}} \right) \);

Humidity Index = Wetness Index = \( \left( \frac{P}{PET} \right) = \left( \frac{\text{Rainfall}}{\text{Potential ET}} \right) \);

L'vovich's Coefficients:

\( \text{Lv}_\text{Runoff Coefficient} = \left( \frac{Q_{cf}}{Q_{cf} + E + T} \right) = \left( \frac{\text{Channel flow}}{\text{Channel flow} + \text{Evapotranspiration}} \right) \);

\( \text{Lv}_\text{Baseflow Coefficient} = \left( \frac{Q_{bf}}{\sum \text{Inf}} \right) = \left( \frac{\text{Baseflow}}{\sum \text{Infiltration}} \right) \);

\( \text{Lv}_\text{Vaporsation Coefficient} = \left( \frac{E + T}{\sum \text{Inf}} \right) = \left( \frac{\text{Evapotranspiration}}{\sum \text{Infiltration}} \right) \);
Tomer and Schilling’s Ratios:

\[
\text{TS}_\text{Excess Rainfall (unused) Ratio} = P_{ex} = \left( \frac{P - ET}{P} \right) = \left( \frac{P - (E + T)}{P} \right);
\]

\[
\text{TS}_\text{Excess Energy (unused) Ratio} = E_{ex} = \left( \frac{PET - ET}{PET} \right) = \left( \frac{PET - (E + T)}{PET} \right);
\]

Renner’s Catchment Efficiency = \( CE = \left( \frac{E + T}{PET} + \frac{E + T}{P} \right) \)

\[= \left( \frac{\text{Evapotranspiration}}{\text{Potential Evapotranspiration}} + \frac{\text{Evapotranspiration}}{\text{Rainfall}} \right).\]

### III. ESTIMATES OF EVAPORATION RATIO (in fractions):

**Schneiber Evaporation ratio** = \( 1 - e^{-\phi} \);

**Ol’dekop Evaporation ratio** = \( \phi \cdot \tanh \left( \frac{1}{\phi} \right) \);

**Budyko Evaporation ratio** = \( \sqrt{\left( 1 - e^{-\phi} \right) \cdot \phi \cdot \tanh \left( \frac{1}{\phi} \right)} \);

**Turc Evaporation ratio** = \( \frac{1}{\sqrt{0.9 + \left( \frac{1}{\phi} \right)^2}} \);

**Turc - Pike Evaporation ratio** = \( \frac{1}{\sqrt{1.0 + \left( \frac{1}{\phi} \right)^2}} \);

**Zhang Evaporation ratio** = \( \frac{1 + w \phi}{1 + w \phi + \frac{1}{\phi}} \).

where \( \phi = \text{Budyko’s Aridity Index} \).