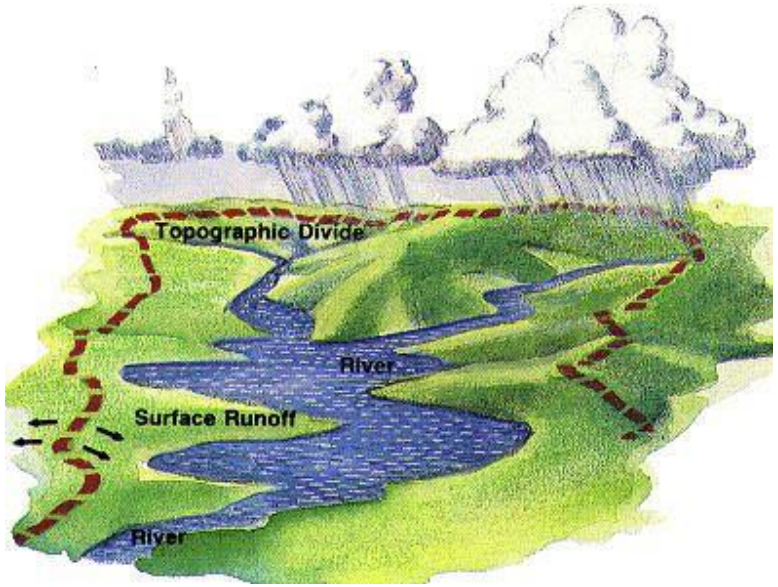
Runoff

Surface water

- Watershed – area of land draining into a stream at a given location
- Streamflow – gravity movement of water in channels
  - Surface and subsurface flow
  - Affected by climate, land cover, soil type, etc.



Perennial river

A **perennial stream** or **perennial river** is a stream or river (channel) that has continuous flow in parts of its stream bed all year round during years of normal rainfall.

A river that has water thorough out the year is called perennial river.

The ganga (Yamuna, Ram Ganga, Gomti, Chambal, bhagirati, alkanada and Ghaghara and others - tributaries), Indus (Jhelum, Chenab, Ravi, Beas and Sutlej are its tributaries) and Bramhaputra(Lohit River ,Burhidihing River ,Dihing River ,Manas River ,Sankosh ,Teesta River) are perennial river systems in India.

Ephemeral Stream

A River that has water during the rainy season only is called Ephemeral Stream.

Surface Runoff

- Water flowing on earth’s surface
- Overland flow
- Flow in rills, gullies and streams

Precipitation - Runoff

- Methods have been developed to predict characteristics of runoff as a function of precipitation characteristics
  - volume of runoff
    - Seasonal
    - Annual
    - Based on seasonal or annual total precipitation
  - peak flow
    - Annual peak flow - e.g., snowmelt peak (interior), a function of peak snow accumulation
    - Storm peaks - a function of rainfall intensity

Runoff coefficient

- Simplest form of ppt - runoff relation

  Ratio of total stream flow over total precipitation

  $$R = Q/P$$

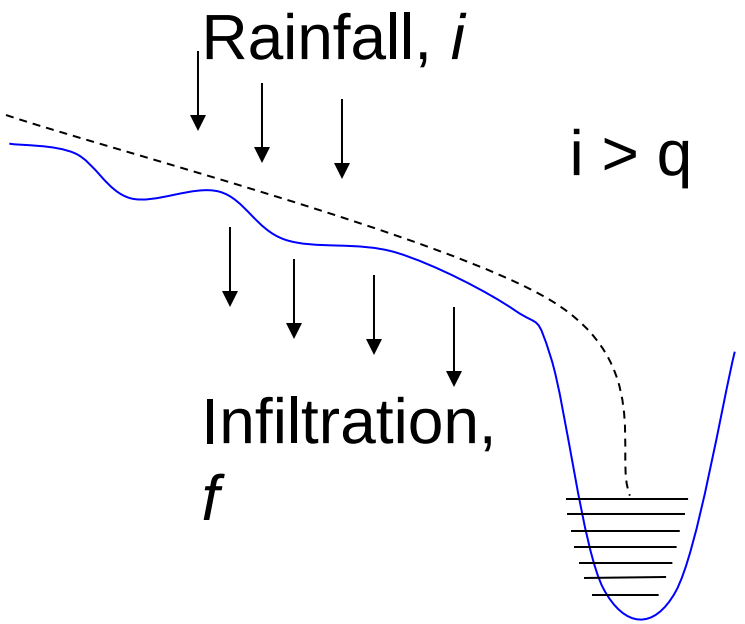
- Runoff coefficient can be assessed annually, seasonally or monthly depending on purpose

Stream Flow generation

- Stream flow is generated by three mechanisms
  1. Hortonian overland flow
  2. Subsurface flow
  3. Saturation overland flow

Hortonian Flow

- Sheet flow described by Horton in 1930s
- When $i<f$, all i is absorbed
- When $i > f$, $(i-f)$ results in rainfall excess
- Applicable in
  - ✓ impervious surfaces (urban areas)
  - ✓ Steep slopes with thin soil
  - ✓ hydrophobic or compacted soil with low infiltration



Subsurface flow

- Lateral movement of water occurring through the soil above the water table
- primary mechanism for stream flow generation when *f*>*i*
  - **Matrix/translatory flow**
    - Lateral flow of old water displaced by precipitation inputs
    - Near surface lateral conductivity is greater than overall vertical conductivity
    - Porosity and permeability higher near the ground
  - **Macropore flow**
    - Movement of water through large conduits in the soil

Saturation overland flow

- Soil is saturated from below by subsurface flow
- Any precipitation occurring over a saturated surface becomes overland flow
- Occurs mainly at the bottom of hill slopes and near stream banks

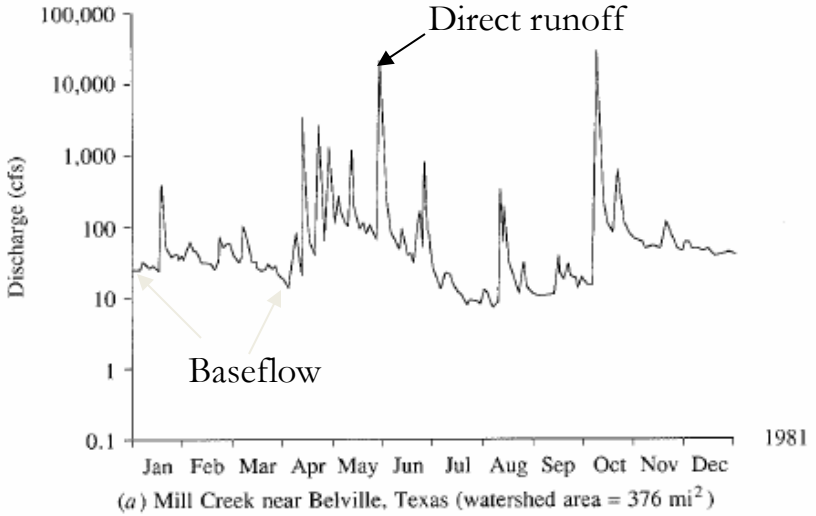
Antecedent Condition

Soil water content in the upper soil layer prior to a rain event can be an important factor affecting the relationship between rainfall and runoff.

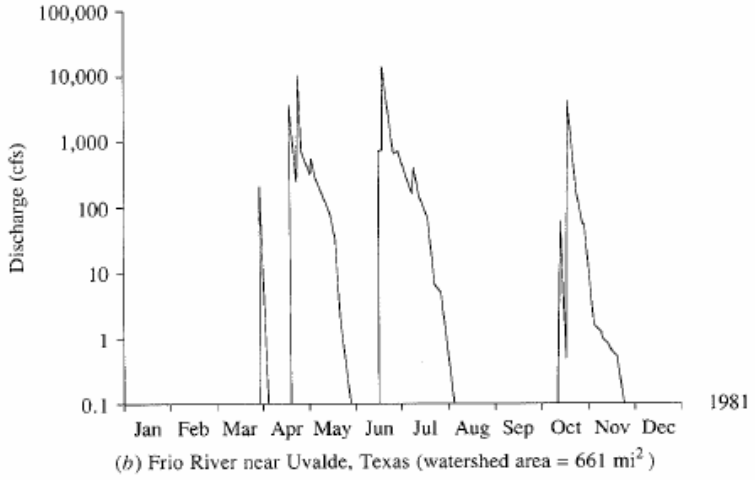
In hot semiarid and arid environments soils are often much drier in general, and the role of antecedent soil moisture can be less important.

Hydrograph

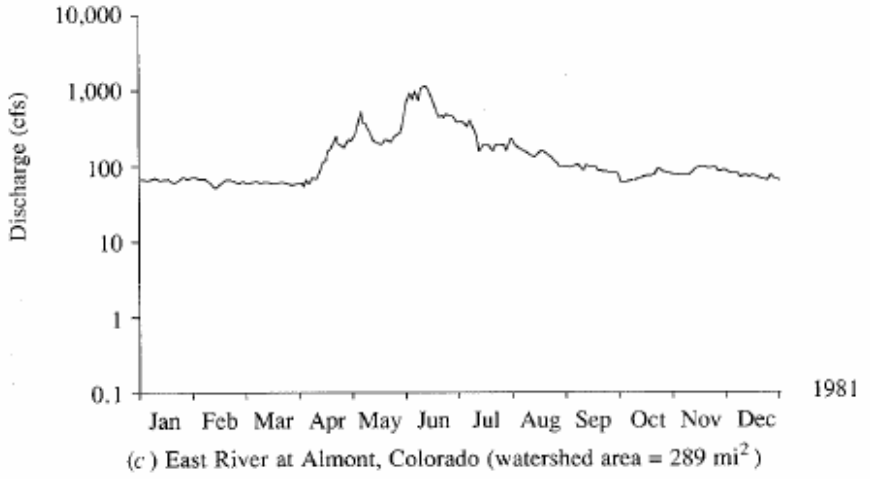
- Graph of stream discharge as a function of time at a given location on the stream



Perennial river



Ephemeral river



Snow-fed River