



United States Department of Agriculture



Soil Science Division
Natural
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Wetland Hydrology

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1. What Makes a Wetland

2. Wetland Hydrology



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What Makes a Wetland?

- Soils
- Vegetation
- Landscape Position
- Morphology (shape of the wetland basin)
- Hydrologic Factors

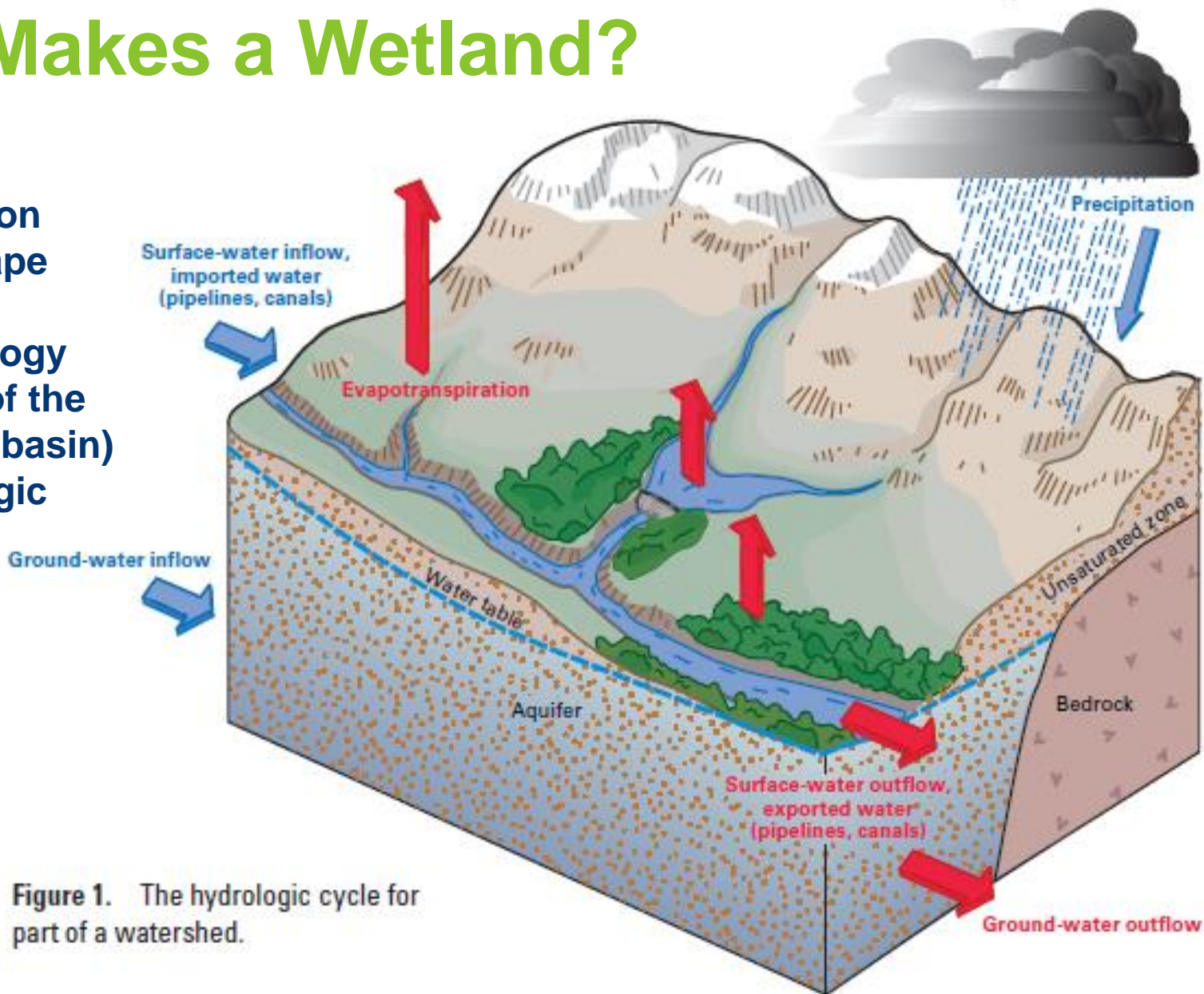
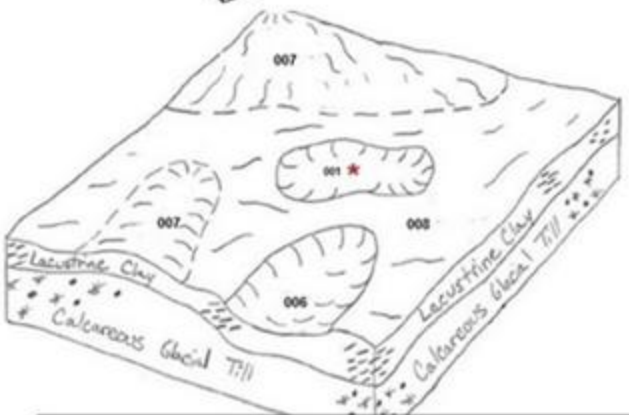
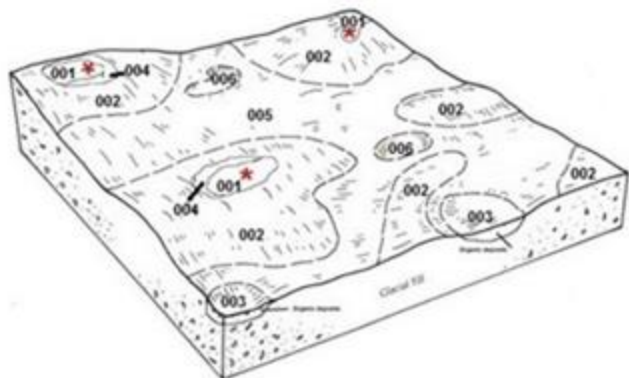


Figure 1. The hydrologic cycle for part of a watershed.

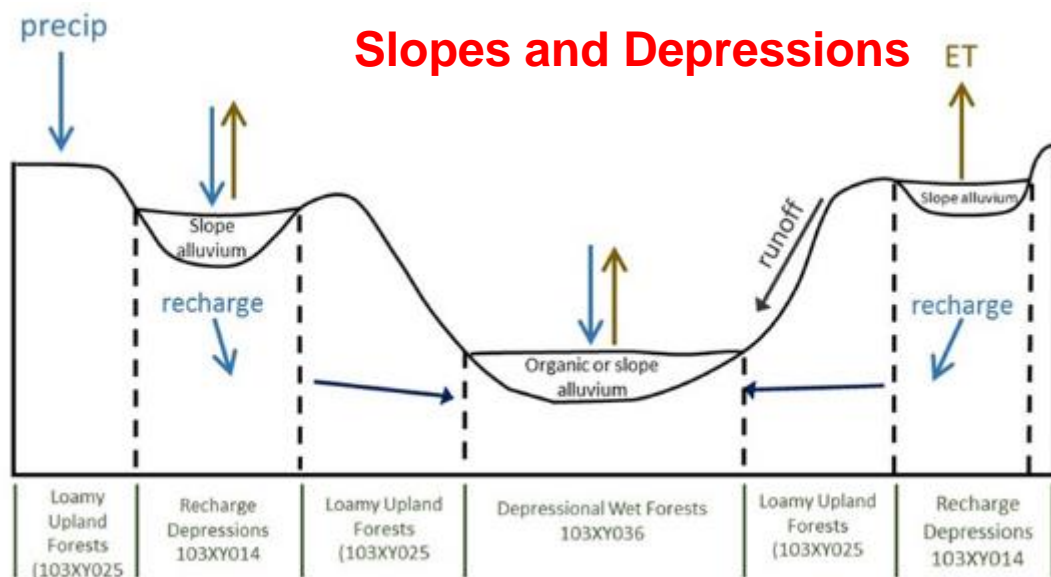


Morphology (shape of the wetland basin)

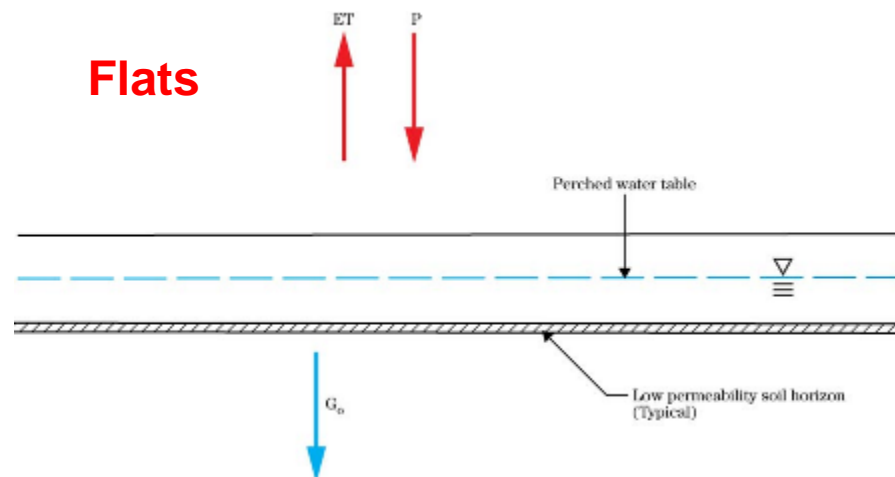
- Depth to water table
- Hydrologic Factors



Code	Ecological Site Name	Representative Soil Series
001	Recharge Depressions	Rolle, Barbert
002	Loamy Upland Forest	Lester, Le Sueur
003	Organic Wet Meadow/Carr	Muskego, Klossner
004	Wet Footslope/Drainageway Forest	Hamel, Derryrane
005	Loamy Wet Forests	Cordova, Dundas
006	Depressional Marsh	Lura, Okoboji
007	Clayey Upland Prairies	Shorewood, Collinwood
008	Clayey Wet Prairies	Brownton, Marna

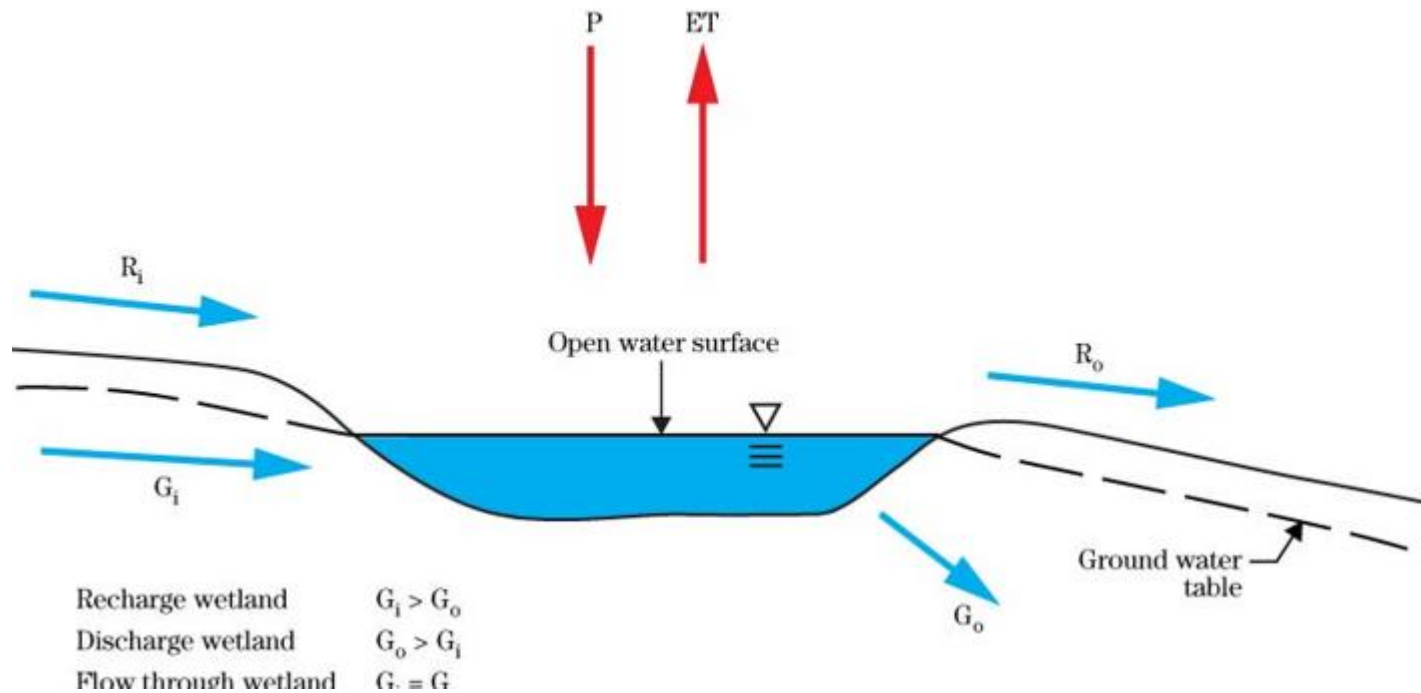


Flats



Hydrologic Factors

- **Source** of Water (Precipitation, Surface Flow, Groundwater)
- Flow **Direction** of Water
- **Amount** of Water (magnitude)
- **Duration** (residence time)
- **Timing** (season, frequency)



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Image courtesy of Richard Weber



Source of Water: Precipitation

(3 T's):

- **Type**

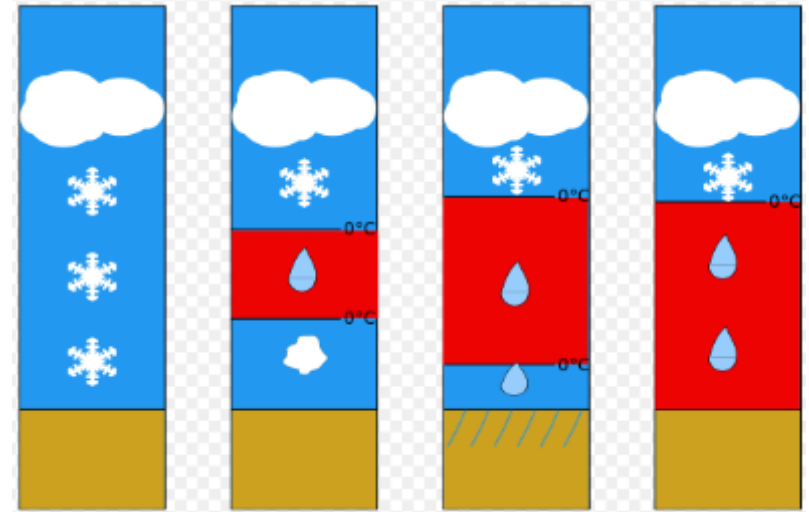
- Snow
- Snowmelt
- Ice
- Rain
- Condensation

- **Time of year (Season)**

- Presence of vegetation
- State of soil
- Runoff/Erosion

- **Timing of recurrence**

- Soil saturation
- Water table levels



Source of Water: Surface Flow

The flow of water across the surface of the land, “**Runoff**”

**Topographic
SLOPE
Wetland Plan
View**

**Concave
Landscape
Positions**

**Typical of
Stream
Headwaters**

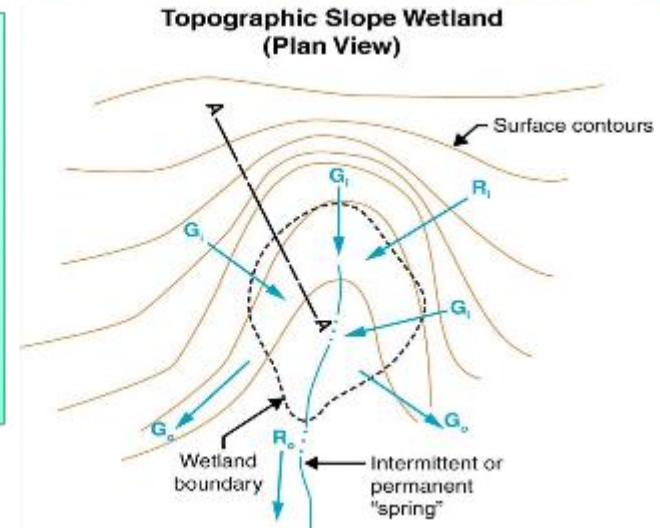
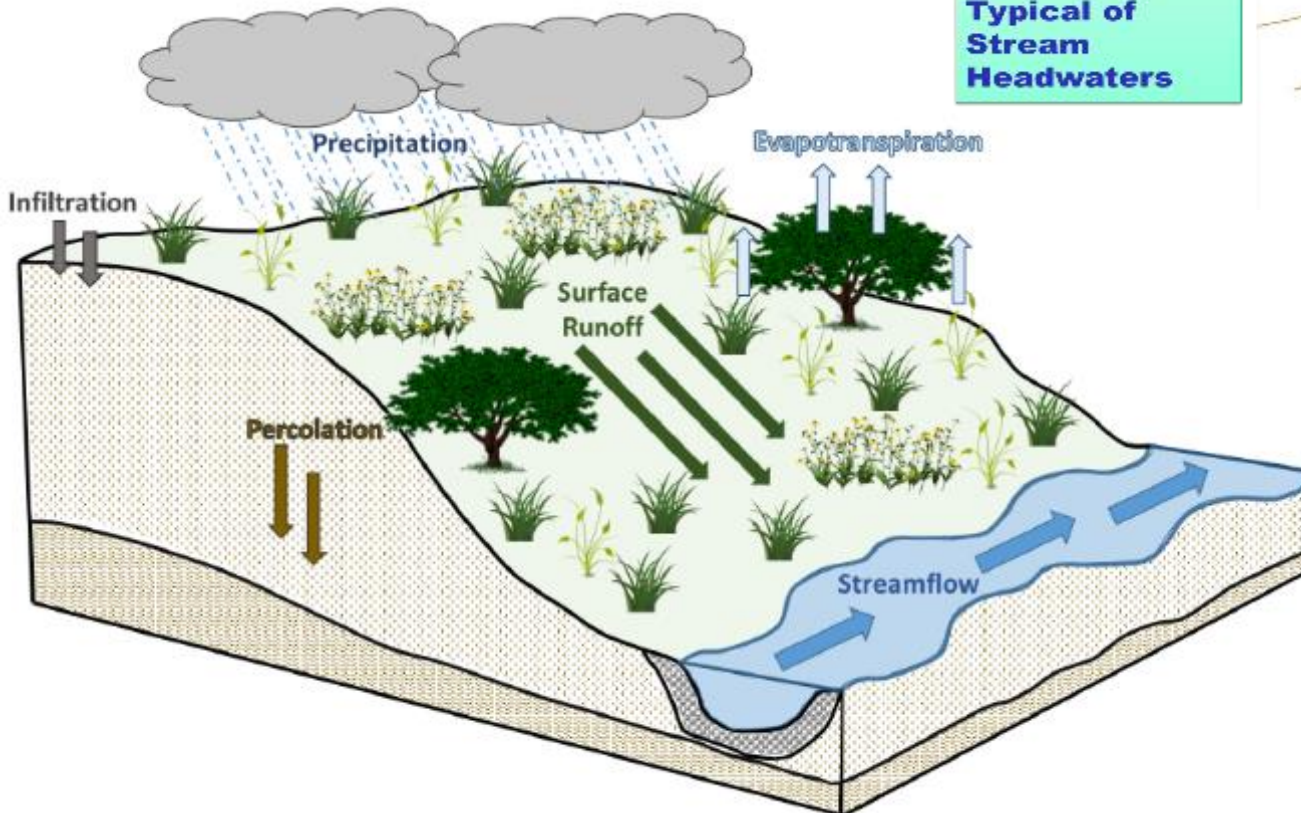


Image courtesy of Richard Weber



Source of Water: Groundwater

Water held underground

- Maintains water table level fluctuations in wetland ecosystems
- Important source of water for human use and consumption

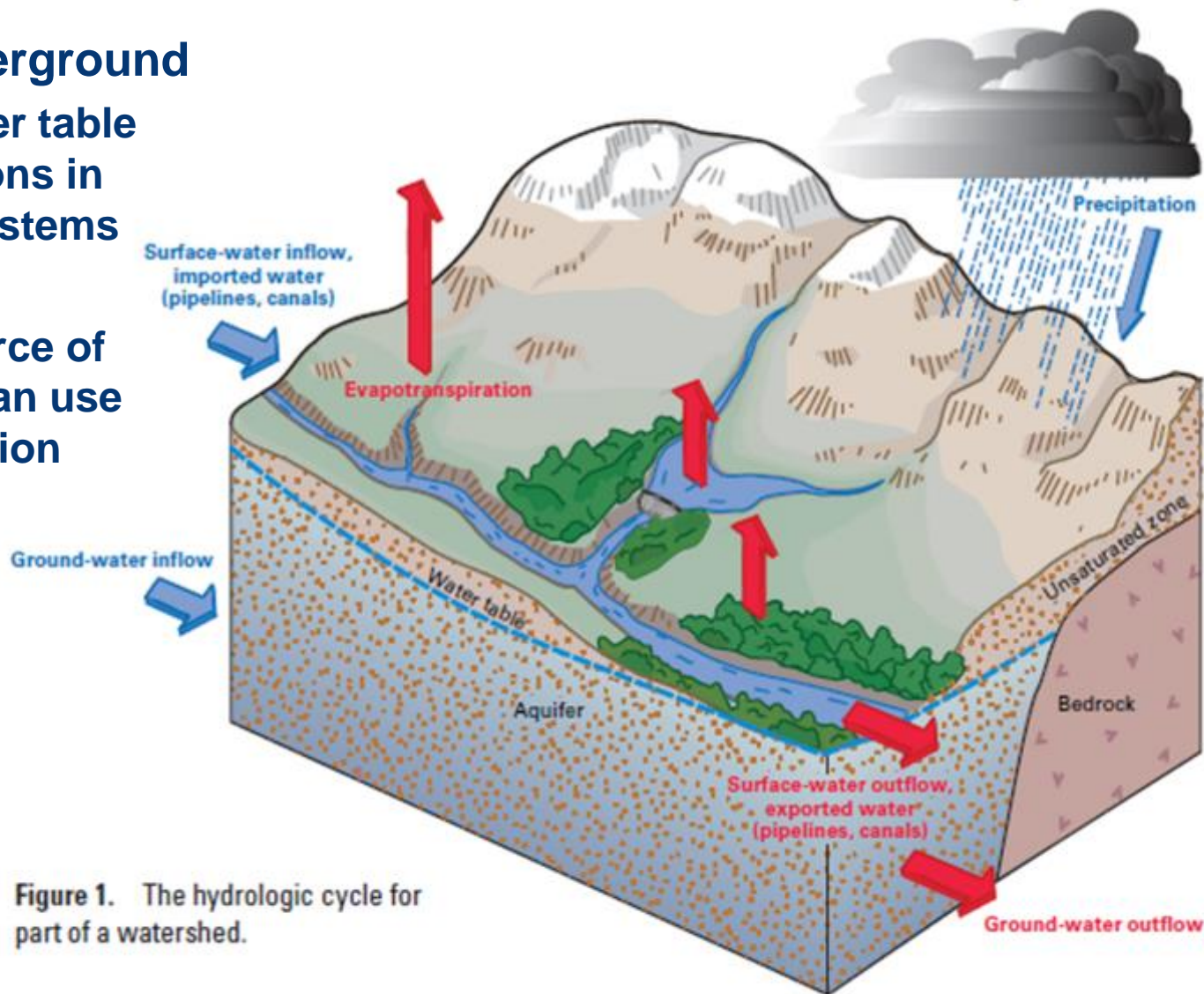


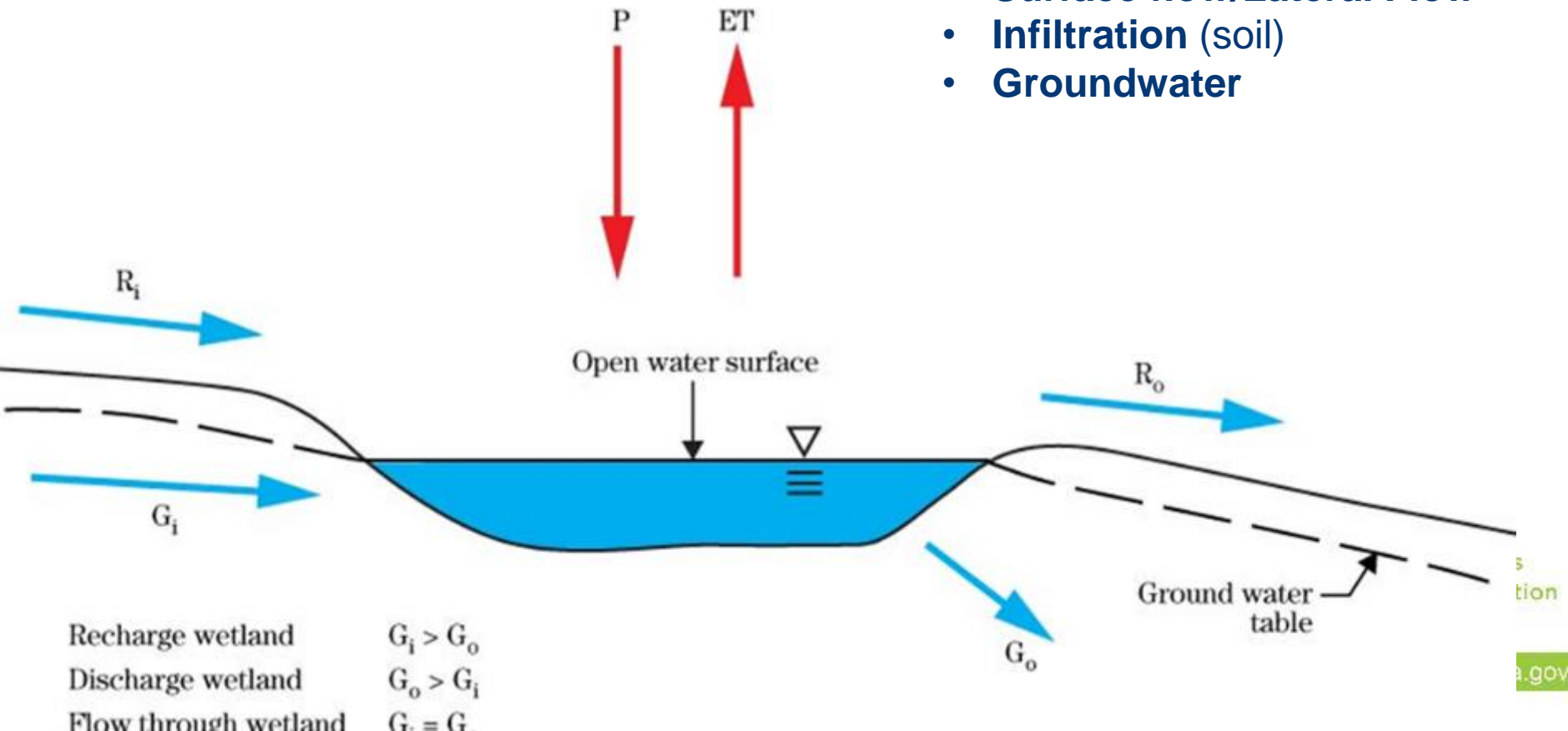
Figure 1. The hydrologic cycle for part of a watershed.



Flow Direction of Water

Water can leave the site through:

- **Evaporation** (temperature)
- **Evapotranspiration** (plants)
- **Surface flow/Lateral Flow**
- **Infiltration** (soil)
- **Groundwater**

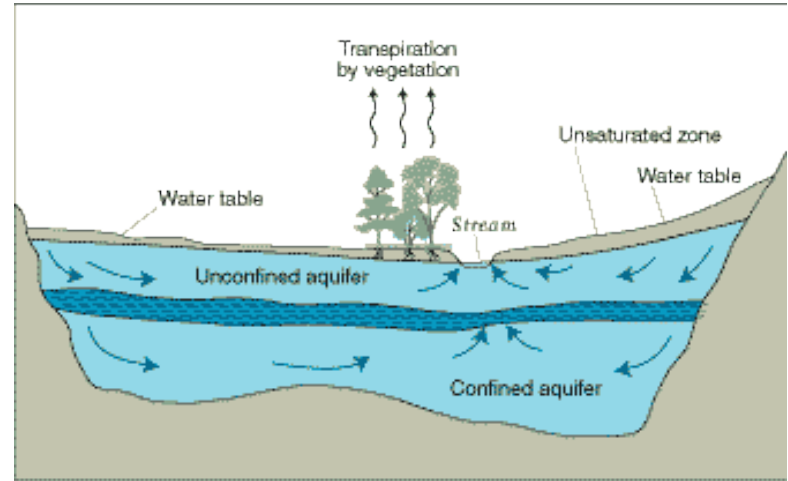
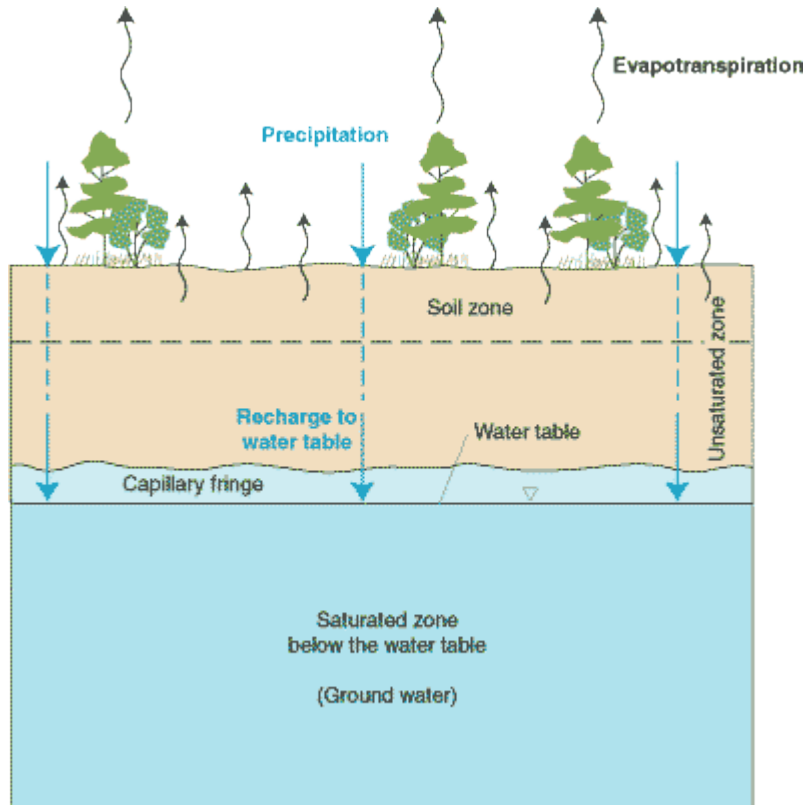


Where is the groundwater going?





Recharge

vs.

Discharge



EXPLANATION

-  High hydraulic-conductivity aquifer
-  Low hydraulic-conductivity confining unit
-  Very low hydraulic-conductivity bedrock
-  Direction of ground-water flow

Water flows out of wetland down through the soil profile and **into the aquifer/groundwater**

Water flows out of the aquifer/groundwater **into the wetland**



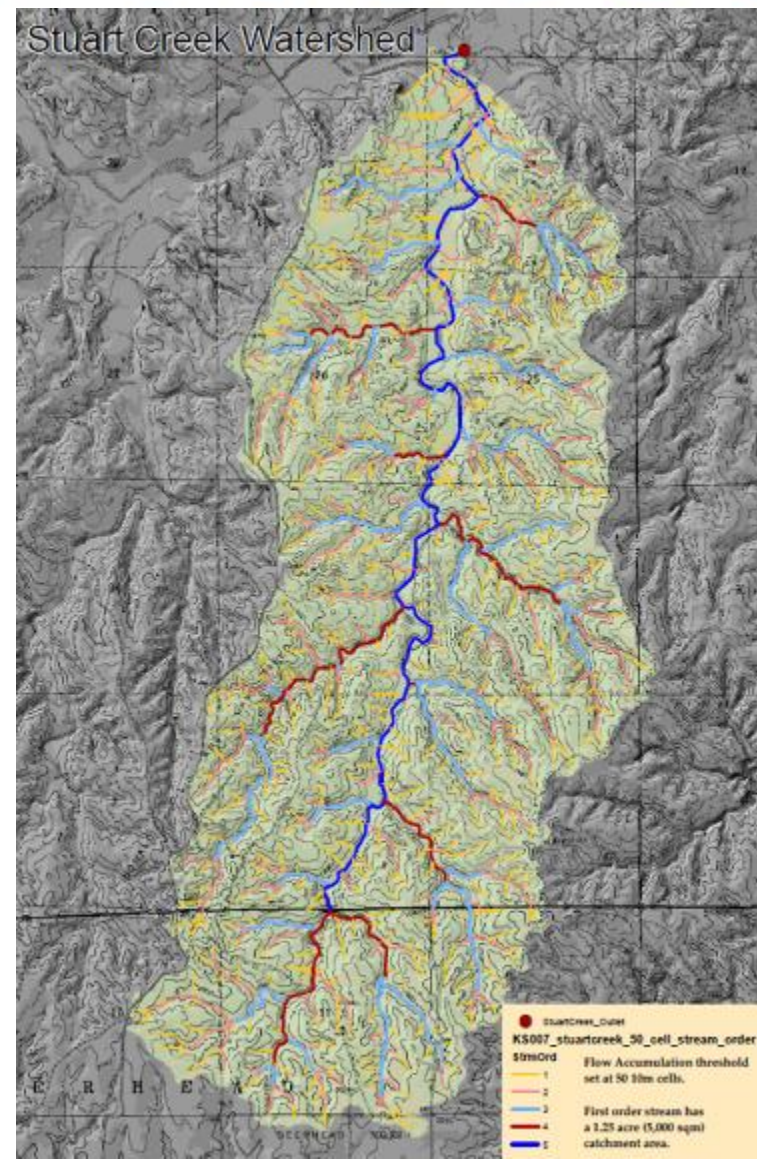
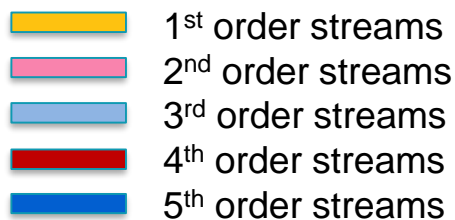
Amount of Water (magnitude)

Dependent on:

- **Source of water**
- **Size of catchment area (wetland basin)**

Flow Accumulation:

(1st order streams have a 1.25 acre catchment area)



Duration (“residence time”)

How long does water stay in a wetland?

- **Determines chemical and biotic properties of the wetland (nutrient status, plant species, etc.)**
- **Indicates how rapidly the water in the system is “replaced”**
- **Determined by:**
 - Soils
 - Climate (precipitation events, temperature)
 - Flooding
 - Landscape position
 - Catchment size
 - Land Use
 - Wetland Quality (presence of vegetation)



Photo courtesy of Capel et. al, 2018



Timing

Time of Year

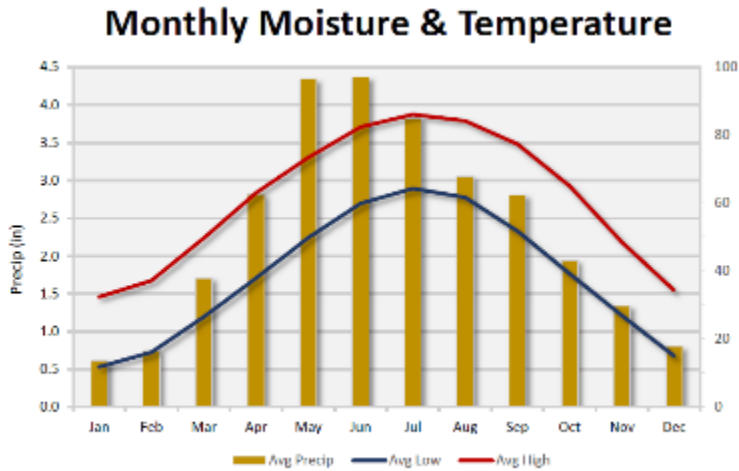
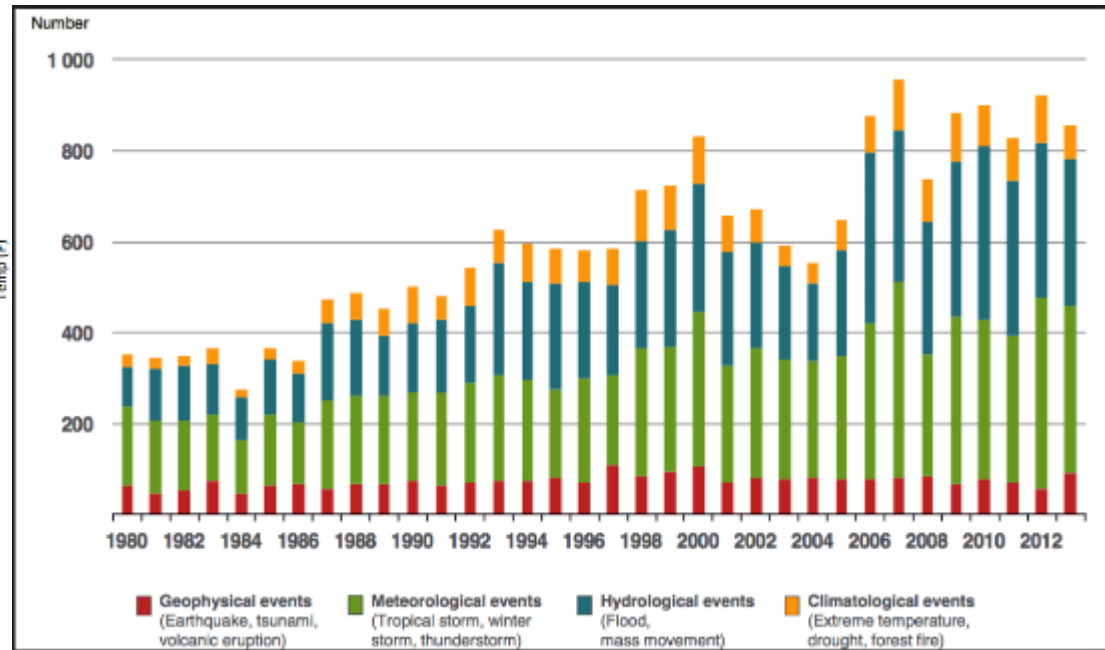


Figure 4. Calcareous Till Upland Prairie average monthly precipitation and temperature, 1981-2010.

Graphic courtesy of Lisa Kluesner. Calcareous Till Upland Prairie Ecological Site average monthly precipitation and temperature, 1981 – 2010.

Frequency of Occurrence



<https://skepticalscience.com/>

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Wetland Hydrology: Water Budgets

1. Balance between inflows and outflows of water
2. The surface contours of the landscape
3. Subsurface soil, geology, and groundwater conditions

$$P + Q_{in} = ET + \Delta S + Q_{out} \text{ (A1)}$$

where

P is precipitation,

Q_{in} is water flow into the watershed,

ET is evapotranspiration (the sum of evaporation from soils, surface-water bodies, and plants),

ΔS is change in water storage,

and

Q_{out} is water flow out of the watershed.



(Healy et al. 2007)

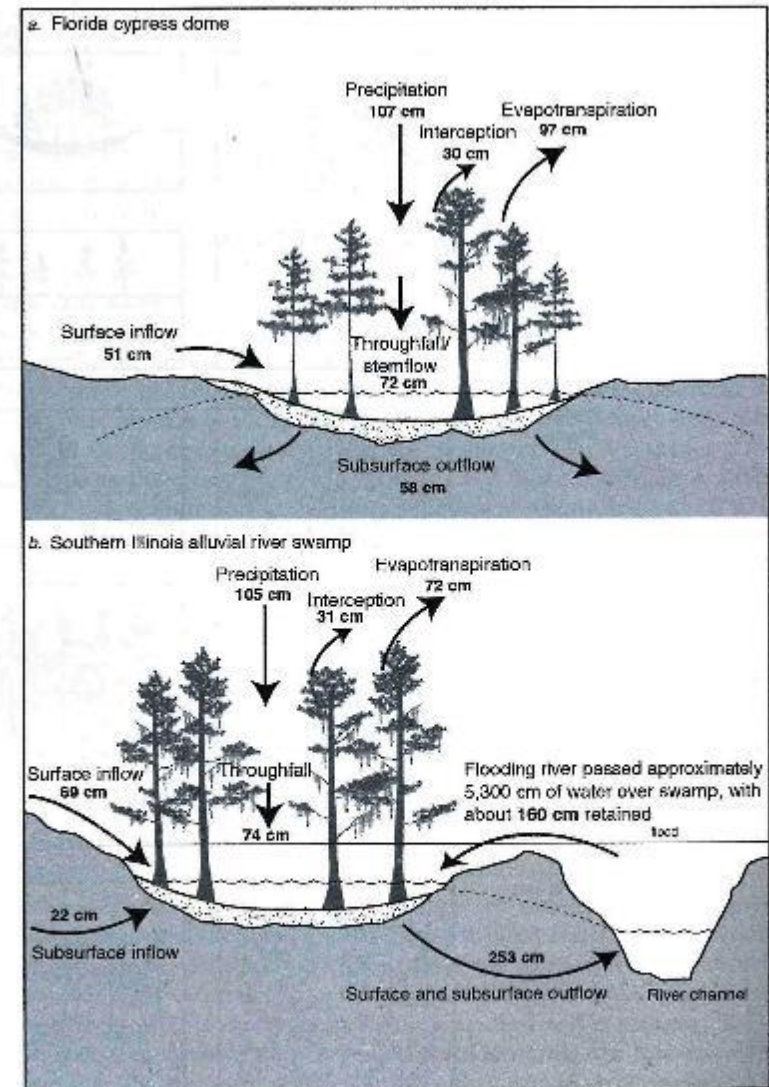


Figure 11.3 Annual water budgets for (a) Florida cypress dome and (b) southern Illinois cypress-tupelo alluvial cypress swamp. ((a) After Helmburg, 1984; (b) After Mitsch et al., 1979)

(Mitsch & Gosselink 2015)

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