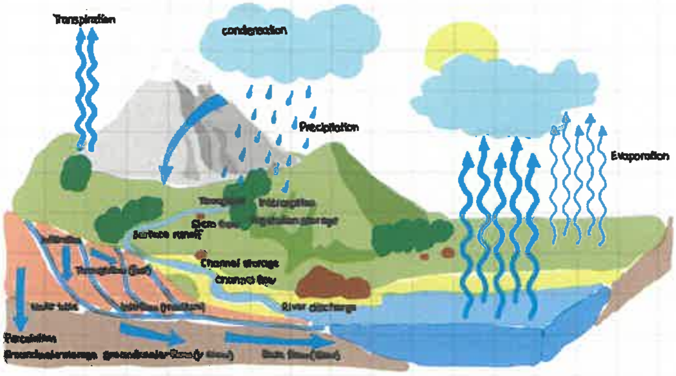
REVIEW:

31.01.2023

1. Drainage basin hydrology & geomorphology

How physical processes influence drainage basin systems and landforms:



The drainage basin is an open system with inputs (precipitation of varying type and intensity), outputs (evaporation and transpiration), flows (infiltration, throughflow, overland flow and base flow), and stores (including vegetation, soil, aquifers and the cryosphere)

Hydrological cycle (water cycle):

The continuous movement of water on the land, in the atmosphere and in the oceans. The hydrological cycle is a closed system, water can be found in different states in different locations.

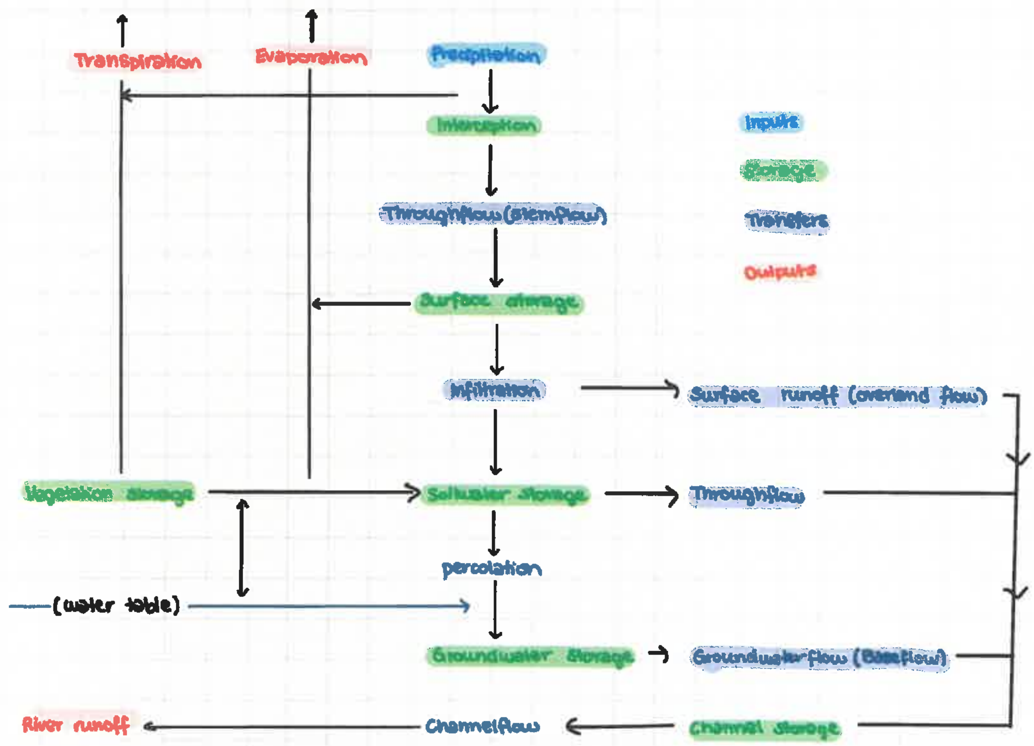
inputs (precipitation of varying type and intensity)

outputs (evaporation and transpiration)

flows (infiltration, throughflow, overland flow and base flow)

stores (including vegetation, soil, aquifers and the cryosphere)

Hydrogen cycle:



Inputs:

Precipitation: The transfer of moisture from atmosphere to the earth's surface

Main types: Rain Snow Hail Frog

Interbasin transfer: Water that either naturally (due to the alignment of the rock) or with human involvement (pumps/pipes) moves from one drainage basin to another

Outputs:

Evaporation:

- The process of water turning from a liquid into a vapour
- Only takes place from a body of water
  - Examples: Lake, puddle, sea

Evapotranspiration:

- The combined action of evaporation and transpiration

River discharge via channelflow:

- Water entering the sea and leaving a drainage basin
- A very small amount of water also enters the sea via throughflow and groundwaterflow (baseflow)

REVIEW:

21.01.2023

Outputs:

Transpiration:

The evaporation of water from vegetation

Interbasin transfer:

- Water that either naturally (due to alignment of the rock) or with human involvement (pumps/pipes) moves from one drainage basin to another.

Transfer (flows):

Stemflow:

- When intercepted water runs down the trunks and stems of vegetation

Throughfall:

- Precipitation that falls directly through vegetation

Infiltration:

- Water that moves from the surface of the earth into the soil

Percolation:

- Water that travels from unsaturated into saturated ground

Groundwaterflow (baseflow):

- Water that travels through saturated ground

Channelflow:

- Water that travels in a river

Surface run-off (overland flow):

- When water travels across the surface of the earth e.g. down a hill

Stores:

Interception:

- When water is caught and held by vegetation or man-made structures

Soil moisture Store:

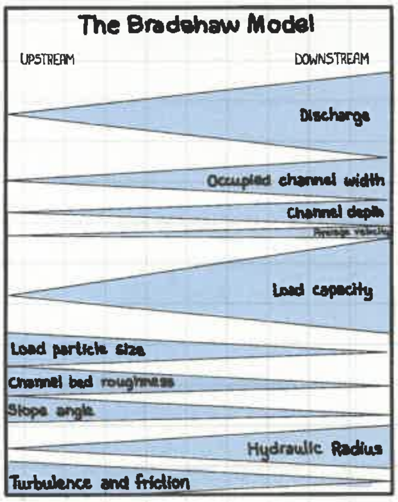
- When water is held in unsaturated soil

Groundwater Storage:

- When water is held in saturated ground.

Surface store:

- When water is held in the surface of the earth (puddle, lake)



Equation for river discharge:

RD = Velocity · depth · width

RD = V · D · W

Equation for Hydraulic radius:

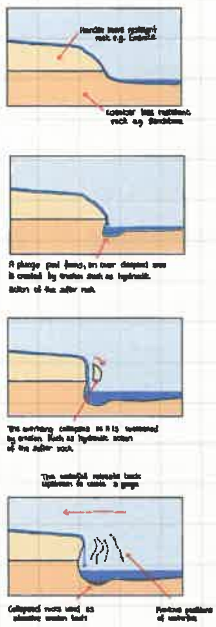
$$\frac{\text{cross-sectional area}}{\text{wetted perimeter}}$$

CHANNEL CHARACTERISTICS:

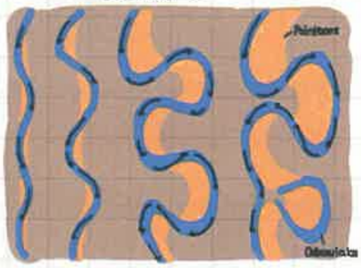
River discharge and it's relationship to stream flow, channel characteristics & Hydraulic radius.

The formation of typical river landforms, including waterfalls, floodplains, meanders, levees & deltas.

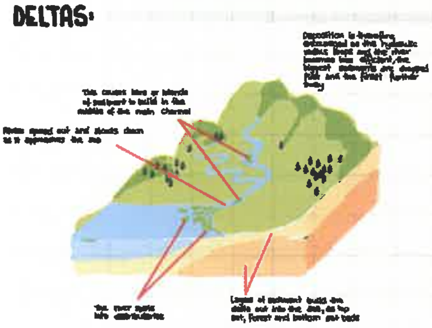
WATERFALLS:



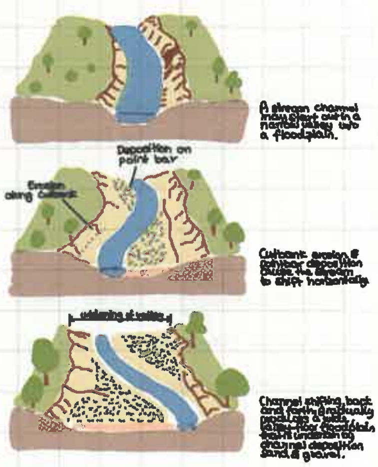
MEANDERS:



DELTAS:



FLOODPLAINS:



LEVEES:

REVIEW:

River processes of erosion, transportation and deposition and spatial and temporal factors influencing their operation, including channel characteristics and seasonality:

Channel processes:

Erosion: Wearing away of bed, bank & load of a river.
Attrition: Wearing away of load creating smaller, rounder particles
Hydraulic action: Forces of air & water on riverbed, bank & cracks
Solution (Corrosion): Removal of chemical ions (e.g. calcium) => causes rocks to dissolve
Abrasion (Corrasion): Wearing away of bed & bank by the load.

Factors affecting erosion:

Base level: Lowest level that a river can erode (sea level/artificial bed)
Load: Heavier & sharper increases erosion
Velocity & discharge: increase greater erosion potential
Gradient: increase greater erosion potential

Transportation types & deposition:

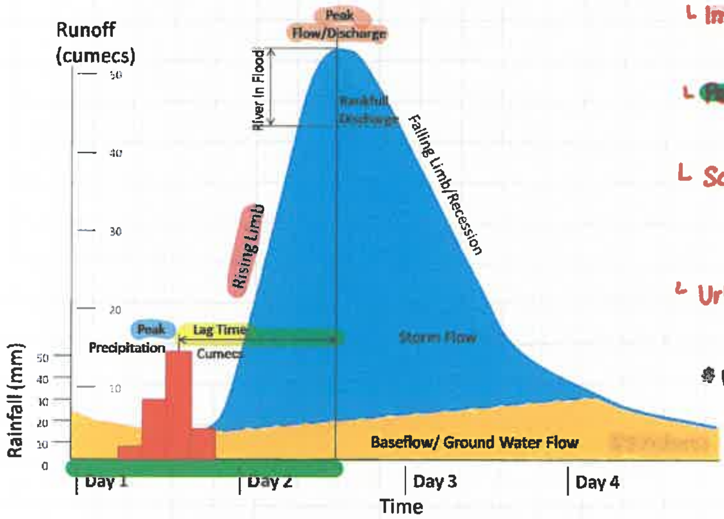
Solution: Chemical load carried dissolved in water
Traction: Heaviest material dragged or rolled along river bed
Flotation: Leaves or twigs carried on the river surface

Features of deposition include deltas, leeves, oxbow lakes and floodplains.

2. Flooding & flood mitigation

Hydrograph characteristics (lag time, peak discharge, base flow) and natural influences on hydrographs, including geology and seasonality.

Rising limb: Indicates the amount of discharge
Peak flow/Discharge: Highest discharge
Lag time: Time interval between peak rainfall & peak discharge
Response time: Time between first rain falling & first change in discharge
Peak rainfall: Highest rainfall



Factors affecting variations in hydrographs:

Permeable and impermeable rock:

- Impermeable rock -> less infiltration/more surface run-off
  - ↳ Reducing response & lag time
- Permeable surfaces -> more infiltration/less surface run-off
  - ↳ increase lag time
- Saturated soil -> Limited infiltration => more surface run-off
  - ↳ reduce response & lag time, increase peak discharge
- Urbanisation -> Deforestation -> increase impermeable surfaces

* However: large # of buildings increase interception & lag time

REVIEW:

How urbanization, deforestation and channel modifications affect flood risk within a drainage basin, including it's distribution, frequency and magnitude.

Human causes:

Deforestation:
↳ reduces strength of the hills
↳ reduces interception & transpiration
↳ Soil => more saturated
=> increasing surface run-off & stress on slopes
↳ makes landslides more likely

Urbanisation:
↳ increases amount of impermeable surfaces

No Building regulations:
↳ Houses weak & vulnerable
↳ Few drainage systems:
=> increasing saturation of soil & likelihood of floods

Building on marginal land:
↳ Caused by urban migration

Physical causes:

Channel modifications:

Steep drainage basins & valley sides:
↳ Rainfall reaches streams & rivers very quickly causing flash floods

Mudslides:
↳ secondary hazard of floodwater
↳ Floodwater saturates ground
=> increasing stress on the slopes

Impermeable rock:
↳ increases risk of flooding
-> because less precipitation can infiltrate

Flood migitation, including several measures (dams, afforestation, channel modification and levee strengthening) and planning (personal insurance and flood preperation, and flood warning technology)

Soft engineering:

Reforestation

Advantages: Natural; increases interception, transpiration & root uptake
Disadvantages: Only scalable to a certain degree, trees lose leaves in autumn

Flood proofing:

Advantages: Cheap, may be done individually
Disadvantages: Only protects against weak floods

Hard engineering:

Channel enlargement (widening / deepening):

Advantages: increases bank full discharge and velocity
Disadvantages: Expensive, may not be possible everywhere

Dams:

Advantages: Storage of water
Disadvantages: Expensive, several non-beneficial side effects

Channelization:

Advantages: Reduces friction, increases velocity & decreases bank erosion
Disadvantages: Expensive and bad for ecosystem => Flood may occur downstream

REVIEW:

3. Water scarcity & water quality:

Environmental consequences of agriculture activities on water equality, to include pollution (eutrophication) & irrigation (salinization)

Eutrophication:

- Artifically added nitrates and phosphates causes excessive growth of algae in wetlands & lakes
- It originates from agro-chemical runoff (fertilizers) and domestic sewage
- They reduce oxygen content and sunlight and harm other species

Salinization:

- Unsustainable water extraction causes an increase in the salt content of the water, with harmful effects on wildlife

Study case: Colorado:

- Passes through 7 states in South West USA
- 1.5 km wide, 2,334 km long
- 25 mill. people rely on river
- Has 15 dams

Advantages:

Flood control-

- River exceeding it's bankful capacity is less common
- Controlled flooding taking place regularly

Agriculture:

- 80% of water => used for farming purpose

Recreation:

- White-water rafting: commonly practised upstream

Disadvantages:

Salinisation:

- Widespread irrigation from river can cause a high salt-content in the soils around it

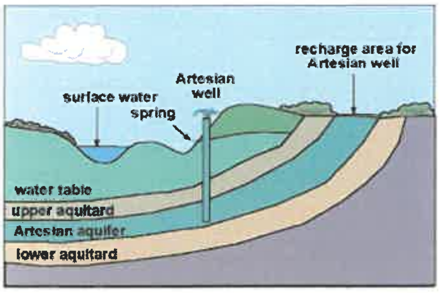
Waterloss & waste:

- Through the outputs in the hydrological cycle

Groundwater overdraft:

- Occurs when water use exceeds the amount of recharge into the rivers basin

Growing human pressures on lakes and aquifers, including economic growth and population migration



CROSS SECTION OF EARTH SHOWING PARTS OF AN AQUIFER

- Artesian basin example: Great Artesian basin in Australia

Phreatic zone: The area of ground that is permanently saturated

Aeration zone: The area of land that is only partially saturated or unsaturated

Water table: Boundary between saturated & unsaturated ground

Aquifer: Rock that can hold water (porous)

Aquitard: layer of rock that limits the movement of groundwater => non-porous & low hydraulic conductivity

Aquiclude: Rock that won't hold water or allow movement (impermeable)

Natural recharge:

- precipitation
- infiltration
- Groundwater flow

Artifial recharge:

- Leakage from irrigation channels, reservoirs or pumps
- If too much water is extracted, the pressure reduces and less water will rise naturally

Groundwater abstraction:

- e.g. wells, springs, pumping, piping

Environmental impacts:

- Lack of water for the ecosystem
- Natural flow of water may change, affecting the ecosystem

IDBM

4. Water management futures:

Introduction:

Location: Florida, USA

Length: 216km

IDBM is requested because:

1970 => river was changed (straightening, channelisation, dam...etc.)

↳ to prevent flooding

↳ If River is restored biodiversity returns/restores

Definition of IDBM:

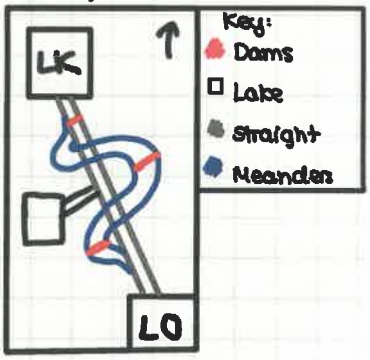
↳ Incorporate stakeholders

↳ conversation

↳ economic

↳ environmental factors

Box form:



1 Body paragraph:

Dam removal

└ why got the dam removed => why reeinstated

Benefits:	Problems:
└ Increase water flow	└ Loss of control. / Possible flooding (economic)
└ Increase channel width	└ noise pollution, Deconstruction of dams (temporary)

Explain factors (in depth):

Evidence !!

└ numerical values

└ allows silt & sediment -> more vegetation

└ Biodiversity

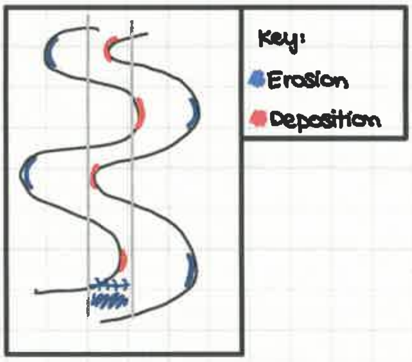
2 Body paragraph:

Channelisation & River straightening

Why got the river straightened => why reverse it

└ Through channelisation the river is straight, velocity increases

=> Bugs can't survive, also no deposition



Benefits:	Problems:
└ Biodiversity returns:	└ very expensive (300$ mill.)
- Giant water Bug	└ not all stakeholder could be happy
- Water Scorpion	- economic losses
- Grass shrimp	- agriculture
	- lack of flood control meanders -> floods easily

Evidence:

└ Because of changes in river, this biodiversity returns again = good thing

└ system, wetland, Biodiversity, vegetation restored

3 Body paragraph: (could be put under channelisation)

Back filling

└ restoring wetlands => water quality

Benefits:	Problems:
└ Biodiversity	└ Time consuming
└ Backfilling takes time but could go faster with pumping => many logistics though	└ Wait for refill
	└ Wait for wet saison