**Summary**

**Option A: Freshwater – issues and conflicts**

**Definitions:**

Drainage basin: The area drained by a river and its tributaries.

Drainage divide: Also known as a watershed, it is the line defining the boundary of a river or stream drainage basin separating it from adjacent basin(s).

Maximum sustainable yield: The maximum level of extraction of water that can be maintained indefinitely for a given area.

Wetlands: Areas that are regularly saturated by surface water or groundwater, including freshwater marshes, swamps and bogs.

**The Water System**

**The hydrological cycle:**



* Causes and consequences of the change in balance between water stored in oceans and ice.

|  |  |
| --- | --- |
| Causes: | Consequences: |
| -Ice melting-Increase in precipitation-Increase in temperature (increase in evaporation) | -Floods-Droughts (when the opposite happens)-Increase in sea level |

**Drainage basins and flooding**

**Drainage Basins:**

Memphis, Tennessee

A drainage basin is an example of an **open system** because it is open to inputs from outside, such as precipitation, and is responsible for outputs out of the system, such as output of water into the sea and evaporation of water into the atmosphere.

* **Inputs:** precipitation
* **Outputs:** where the system loses water. By either:
	+ The river carrying the water out to sea
	+ Through evapo-transpiration
* Within the system, some water:
	+ Is stored in lakes and/or the soil
	+ Passes through a series of transfers or flows, e.g. infiltration, percolation, throughflow.

**Discharge:**

Stream discharge:

A measurement of how much water flows through a stream in one second

• The greater the flow, the greater the stream discharge.

• The greater the stream discharge, the wider the channel.

**Hydrographs:**



* **Hydrograph** - a graph showing changes in river discharge over time in response to a rainfall event.
* **Lag time**- the time taken between peak rainfall and peak discharge
* **Rising Limb**- shows the increase in discharge on a hydrograph
* **Falling Limb** - shows the return of discharge to normal / base flow on a hydrograph
* **Peak Rainfall** - maximum rainfall (mm)
* **Peak Discharge**- maximum discharge (cumecs)

**Hydrographs and river discharge**

Hydrographs are graphs which show **river discharge** over a given period of time and show the response of a drainage basin and its river to a period of rainfall.

Analysis of hydrographs can help hydrologists to predict the likelihood of flooding in a drainage basin. The response of a river to a rainfall event can be measured in terms of the lag time - the time between peak rainfall and peak discharge. Rivers with a short lag time respond rapidly to rainfall events and are therefore more prone to flooding than rivers with a longer lag time

**Variations in the shape of a Hydrograph:**

The shape of a hydrograph is determined by the speed in which flood waters are able to reach the river. The nature of the drainage basin therefore has a great influence on the way a river responds to a river as it will determine the types and speeds of the flow of water to the river.



The fastest route to the river is via **overland flow**. If most of the water in a drainage basin travels in this way, a river will respond quickly to heavy rainfall and the hydrograph shape will be 'peaky' (graph A) with steep rising and recessional limbs. The lag time will be short and there will be a greater risk of flooding. Where more water is able to pass into the soil and travel to the river via **through flow / groundwater flow**, there will be a slower rise in discharge and the river will respond slower (graph B). The lag time will be longer and the risk of flooding will be much lower.

**Floods:**

Mississippi:

Human causes

- People build levees that channel the river in order to build houses and farms near the river, making it narrower making the water rise faster. This means that floods occur faster and that more damage is done.

- Global temperatures being pushed upwards would cause more rain which drains into the Mississippi river much more quickly.

Natural causes

* Hurricanes
* Increase in precipitation
* Storms

**Management issues and strategies**

**Dams and reservoirs:**

Costs:

- Hydrological changes

-Water levels in rivers changes

-Water availability

- Floods upstream

- Lack of water downstream

- Change in river flow hence a change in the sediments

- Problems with the transportation

- Excess of deposition

- Fauna affected: e.g. Salmon

Benefits:

• Cheaper price for electricity/ industries are settle near

• Good for irrigation

• Control of water levels

• Production of green energy

• Tourism

• Transportation

• Urbanization

**Floodplain management:**

Floodplain is a flat or nearly flat land adjacent to a stream or river that stretches from the banks of its channel to the base of the enclosing valley walls and experiences flooding during periods of high discharge.

Why people use floodplains: access to fresh water; the fertility of floodplain land for farming; cheap transportation, via rivers and railroads, which often followed rivers; ease of development of flat land.

EROSION

Corrosion - this is the wearing away of the river channel by water + load (load = material carried in the river e.g. boulders, pebbles, sand etc.)

Attrition - as the load is carried by the river, bits collide and these are further broken up.

Solution - this is where certain rocks (e.g. limestone) are dissolved by the river.

Saltation: when loose material is removed from a bed and carried by the fluid, before being transported back to the surface.

River erosion: gradual removal of rock material from the river banks and bed.

 4 types:

1. Corrosion (abrasion): The river uses its load to grind against the bed and sides, this action would dislodge the materials and carry them away.
2. Attrition: The loosened materials that are being carried away collide against the river side’s and bed and against one another.
3. Solution: The solvent action of water dissolves soluble materials and carries them away in solution.
4. Hydraulic action: River erosion is the gradual removal of rock material from the river banks and bed.

A river transport its load (mud, sand, silt, boulders, dissolved materials) in the following ways:

• Suspension: movement of fine eroded materials (silt and clay) floating in water.

• Traction: movement of large rocks such as boulders by being rolled along the river bed.

• Solution: movement of minerals dissolved in water.

• Saltation: process by which rock fragments like gravel and pebbles are lifted briefly and then dropped on the river bed. They are thus transported in a series of hops and jumps along the river bed.

RIVER DEPOSITION

A river deposits its load of eroded materials when it is unable to transport it. This occurs when:

1. There is not enough water to transport the load during a day season

2. River flows across a desert where there is a high rate of evaporation.

3. River flows across permeable rocks which allow water to infiltrate into the underlying rocks.

4. River carries a larger load than it can transport.

5. There is a sudden change in gradient (e.g. river leaves the mountain and flows onto a plain)

6. River flows into a lake or sea.

7. One side of the river is shallower than the other (e.g. the convex bank of a meander)

8. There are aquatic plants or rocks obstructing the flow.

**Freshwater wetland management:**

The main functions of wetlands are as water purification systems, flood control, shoreline stability, and as reservoirs of biodiversity.

The function of natural wetlands can be classified by their ecosystem benefits. Wetlands are of biosphere significance and societal importance in the following areas:

* Flood control
* Groundwater replenishment
* Shoreline stabilisation and storm protection
* Water purification
* Reservoirs of biodiversity
* Wetland products
* Cultural values
* Recreation and tourism
* Climate change mitigation and adaptation

‘’The economic worth of the ecosystem services provided to society by intact, naturally functioning wetlands is frequently much greater than the perceived benefits of converting them to ‘more valuable’ intensive land use – particularly as the profits from unsustainable use often go to relatively few individuals or corporations, rather than being shared by society as a whole‘’.-Ramsar convention

The Caño Negro Wildlife Refuge was the first designated Ramsar Site (together with Palo Verde) in Costa Rica, on December 27, 1991. This mixed reserve comprises permanent and intermittent lakes, forested wetlands and flooded areas. The Ramsar Site area of 9,969 ha is only a fraction of a larger wetland system with similar characteristics.

**Irrigation and agriculture:**

Examine the environmental impact of agriculture and irrigation on water quality.

Salinization: process by which water-soluble salts accumulate in the soil. Excess salts hinder the growth of crops by limiting their ability to take up water. It may occur naturally or as a result of management practices.

Agrochemical run-off: chemicals in agriculture and irrigation affect water sources such as rivers and lakes. These end up affecting not only the water but also the plants and roots which absorb it.

Pollution of groundwater: substances and chemicals which contaminates water when it reaches the water source.

Eutrophication: The nitrates and phosphates used in fertilizers increase the plant biomass in the rivers or lakes, these plants take out most of the oxygen from the water causing the fishes and other organism to die due to hypoxia (lack of oxygen).

**Competing demands for water**

**Conflicts at the local or national scale:**

Israel has obtained up to 80% of the water from the mountain aquifer in the West Bank and has prevented the Palestinians from obtaining more access to the water. This aquifer provides one third of its water consumption, 4% of its drinking answer and 50% of its agricultural water.

Israel’s 5 and a half million people consume 3 or 4 more times as much water per head as the 2 million Palestinians. Palestinians where kept short for their crops since they were forbidden to dig wells or deepen old ones. The Gazan’s and West Bankers get a little bit of domestic water from Israel meaning that they have to pump more water from their wells than the wells can support making some sea water come in, affecting their health.

The problem of water supply is widespread throughout the Middle East region, with Jordan Israel and Palestine suffering the most acute shortages. As part of the Israeli-Jordanian peace process in 1995, Israel agreed to provide Jordan with 150 million m3 of water per annum. This will be supplied by:

• Diverting water

• Building new dams

• Desalinization

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**Conflicts at the international scale:**

The Nile River is subject to political interactions since the Nile River has been a main source of water for many countries; Egypt uses the Nile River to irrigate all of its crops. There is a sudden need for more water in the African countries and all have started to compete for the water in the Nile River.

Ethiopia wants to build a dam in order for obtaining hydroelectric energy but this might disrupt Egypt’s economy since it would decrease the amount of water used for irrigation of the crops. Sudan also hay hydraulic potential and has created 4 dams in the last century, making Sudan the most extensive user of the Nile. Ethiopia's tributaries supply about 86 percent of the waters of the Nile and Egypt has historically threatened war on Ethiopia and Tanzania over the Nile River.

Kenya is calling for the treaty to be revised, Tanzania is building a pipeline to extract drinking water from the Nile, and Ethiopia is planning to use the water for irrigation. Egypt has reportedly said that any effort to alter the terms of the colonial treaty would be regarded as an act of war.