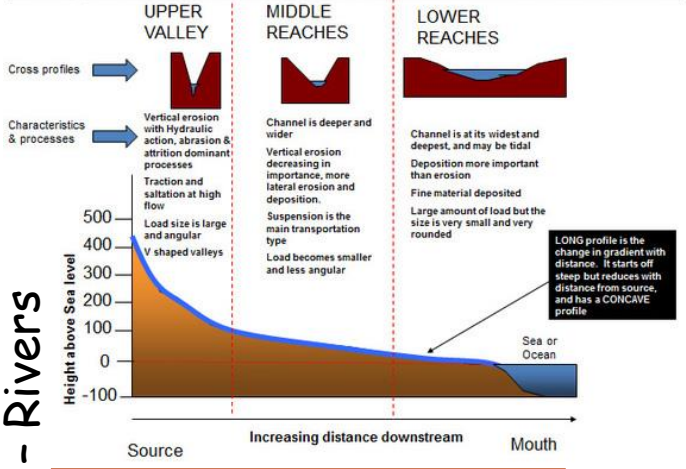


Long and cross profiles on a TYPICAL river



| Types of Transportation | |
|--|---|
| A natural process by which eroded material is carried/transported. | |
| Solution | Minerals dissolve in water and are carried along. |
| Suspension | Sediment is carried along in the flow of the water. |
| Saltation | Pebbles that bounce along the sea/river bed. |
| Traction | Boulders that roll along a river/sea bed by the force of the flowing water. |

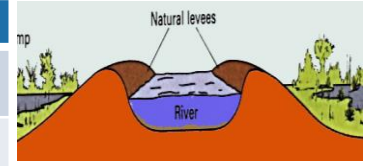
| Types of Erosion | |
|---|--|
| The break down and transport of rocks - smooth, round and sorted. | |
| Attrition | Rocks that bash together to become smooth/smaller. |
| Solution | A chemical reaction that dissolves rocks. |
| Abrasion | Rocks hurled at the base of a cliff to break pieces apart. |
| Hydraulic Action | Water enters cracks in the cliff, air compresses, causing the crack to expand. |

Water Cycle Key Terms

| | |
|-----------------------|---|
| Precipitation | Moisture falling from clouds as rain, snow or hail. |
| Interception | Vegetation prevent water reaching the ground. |
| Surface Runoff | Water flowing over surface of the land into rivers |
| Infiltration | Water absorbed into the soil from the ground. |
| Transpiration | Water lost through leaves of plants. |

Formation of a Waterfall

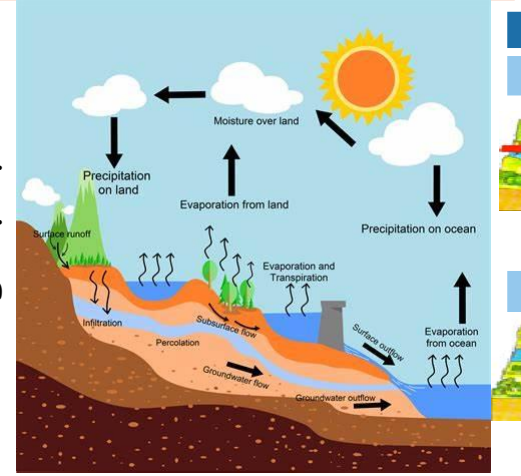
- 1) River flows over alternative types of rocks.
- 2) River erodes soft rock faster creating a step.
- 3) Further hydraulic action and abrasion form a plunge pool beneath.
- 4) Hard rock above is undercut leaving cap rock which collapses providing more material for erosion.
- 5) Waterfall retreats leaving steep sided gorge.



Formation of Floodplains and levees

When a river floods, fine silt/alluvium is deposited on the valley floor. Closer to the river's banks, the heavier materials build up to form natural levees.

- ✓ Nutrient rich soil makes it ideal for farming.
- ✓ Flat land for building houses.



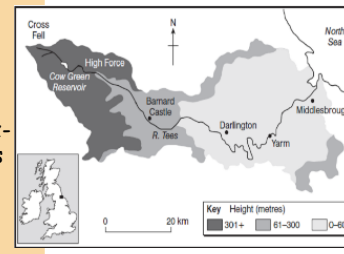
Formation of Ox-bow Lakes

| | |
|--|--|
| Step 1 | Step 2 |
| Erosion of outer bank forms river cliff. Deposition inner bank forms slip off slope. | Further hydraulic action and abrasion of outer banks, neck gets smaller. |
| Step 3 | Step 4 |
| Erosion breaks through neck, so river takes the fastest route, redirecting flow | Evaporation and deposition cuts off main channel leaving an oxbow lake. |

Case Study: The River Tees

Location and Background
 Located in the North of England and flows 137km from the Pennines to the North Sea at Red Car.

Geomorphic Processes
Upper - Features include V-Shaped valley, rapids and waterfalls. High Force waterfall drops 21m and is made from harder Whinstone and softer limestone rocks. Gradually a gorge has been formed.
Middle - Features include meanders and ox-bow lakes. The meander near Yarm encloses the town.
Lower - Greater lateral erosion creates features such as floodplains & levees. Mudflats at the river's estuary.



Management
 - Towns such as Yarm and Middleborough are economically and socially important due to houses and jobs that are located there.
 - Dams and reservoirs in the upper course, controls river's flow during high & low rainfall.
 - Better flood warning systems, more flood zoning and river dredging reduces flooding.

Causes of Flooding:

Physical: Heavy rain, Storms, Steep slopes, impermeable bed rock
Human: urbanisation, Deforestation, Land use

Hydrographs and River Discharge

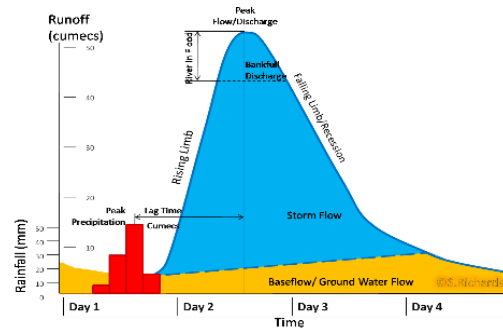
River discharge is the volume of water that flows in a river. Hydrographs show discharge at a certain point in a river changes over time in relation to rainfall

1. **Peak discharge** is the discharge in a period of time.

2. **Lag time** is the delay between peak rainfall and peak discharge.

3. **Rising limb** is the increase in river discharge.

4. **Falling limb** is the decrease in river discharge to normal level.



Boscastle Flood 2004

On 16 August 2004, a devastating flood swept through the small Cornish village of Boscastle.

Very heavy rain fell in storms close to the village, causing two rivers to burst their banks. About two billion litres of water then rushed down the valley straight into Boscastle.



Impacts

There was a huge financial cost to the floods. This included:

- the rescue operation - involving helicopters, lifeboats, and the fire service.
- the loss of 50 cars
- damage to homes, businesses and land
- a loss of tourism, a major source of income for the area

The flooding also had several other key impacts on Boscastle and its inhabitants. These included:

- environmental damage to local wildlife habitats
- coastal pollution caused as debris and fuel from cars flowed out to sea.
- long-term disruption to the village, as a major rebuild project had to be carried out.
- long-term stress and anxiety to people traumatised by the incident.

MANAGING FLOODING – HARD ENGINEERING

- **Dams**
Although very expensive, dams can significantly reduce the risk of flooding downstream
- **Levees**
These are man-made embankments constructed along the edge of the river. They increase the capacity of the channel to prevent the overflow of water.
- **Flood Defence Barriers**
Similar to levees, only constructed from man-made materials flood defence barriers increase the channel size of a river which prevents the overflow of water.

MANAGING FLOODING – SOFT ENGINEERING

- **Afforestation**
Planting more trees reduces run-off and increases interception.
- **Flood Plain Zoning**
Floodplain zoning policies influence how land on, or close to, floodplains are used.
- **River restoration** involves removing any hard-engineering strategies and restoring the river to its original course. This can involve making the river less straight which can slow the flow of the river.

TASK:

1. Sketch a cross section of the upper course of the river. Label the bed, channel and banks. Annotate which erosional and transportation processes would be occurring.
2. Explain how an ox bow lake is formed.
3. Explain the formation of a waterfall and gorge.
4. In your opinion are hard engineering or soft engineering strategies more effective? Why?

Questions from previous exams

1. Describe how the cross profile of the river valley changes downstream. (2 marks)
2. State one reason why the size of sediment carried by the river decreases downstream. (1 mark)
3. Explain how river meanders may change over time. (4 marks)
4. Explain the formation of river levees (4 marks)
5. 'The causes of river flooding are usually the result of human factors'. Do you agree with this statement? Explain your answer. (6 marks)
6. Evaluate the flood management strategies implemented in an area you have studied. (6 marks)