NAME:

GCSE Geography Revision Pack: Key Themes Paper

River and coasts

River and coasts - need to know

- Processes within a river basin
- River flooding and management
- **River landforms**
- **Coastal landforms**
- **Coastal management**

General erosional processes

These processes erode material at the coast and in a river.

Hydraulic action

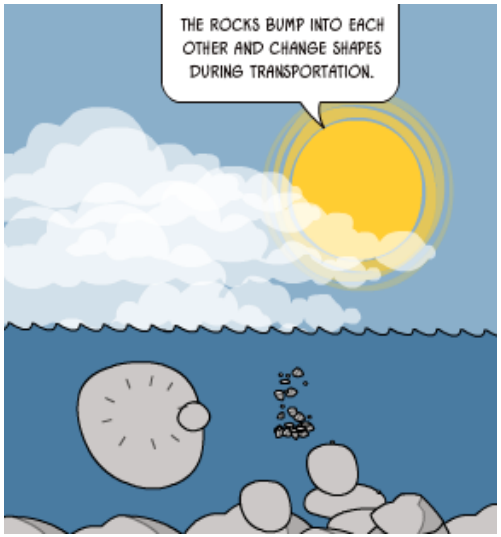
The force of the water breaks rock particles away from the river channel/cliff.

Corrasion/Abrasion

Eroded rocks rub against the channel/thrown against the cliff wearing it away.

Corrosion/Solution

River/sea dissolves some types of rock such as chalk and limestone.



Attrition

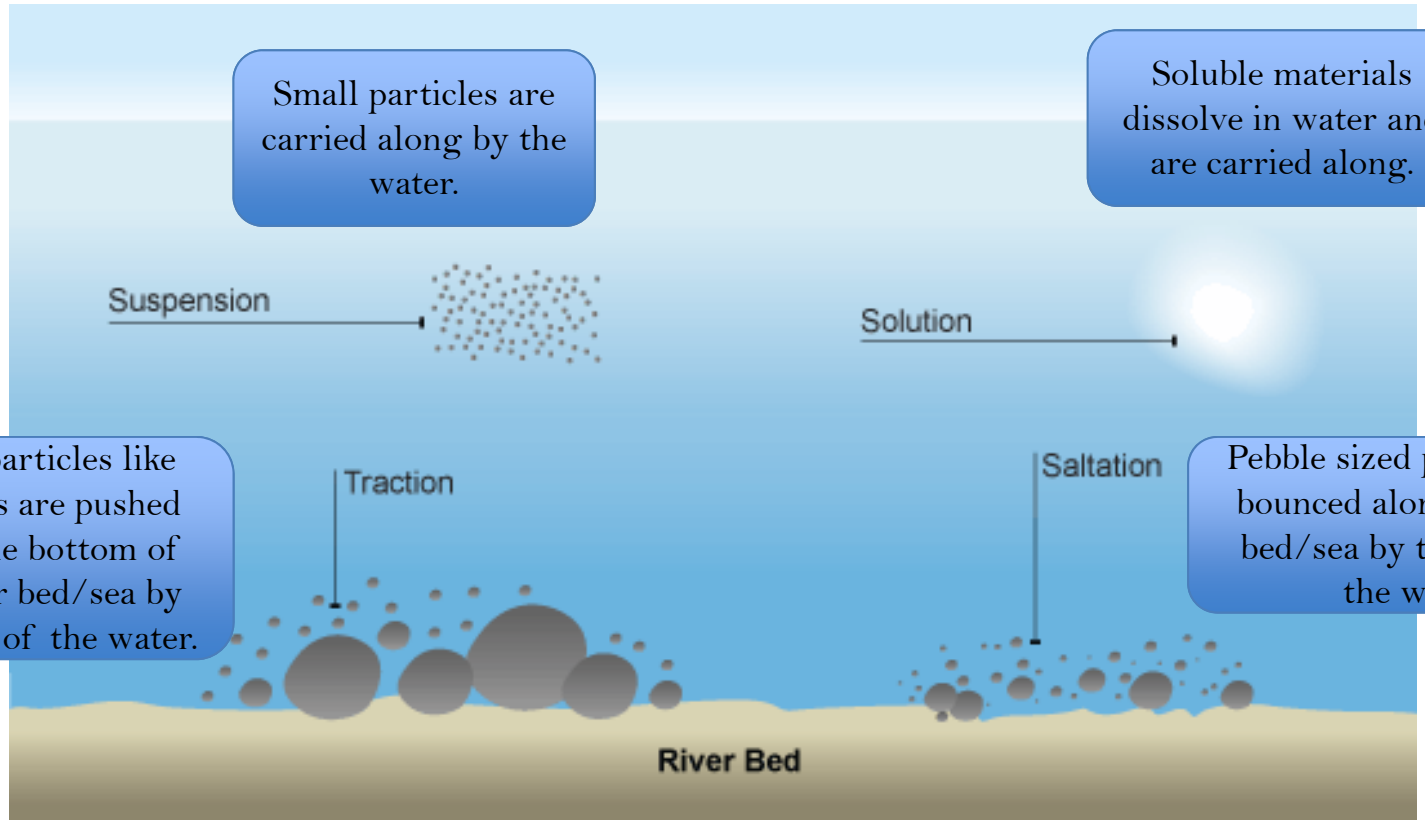
Eroded rocks picked up by the river/waves smash into each other.

Coastal erosion is affected by:

- ✓ The point at which the wave breaks
- ✓ Steepness of the wave.
- ✓ Rock type and structure - (hard rock such as granite is far more resistant to erosion than soft rocks, such as clay).

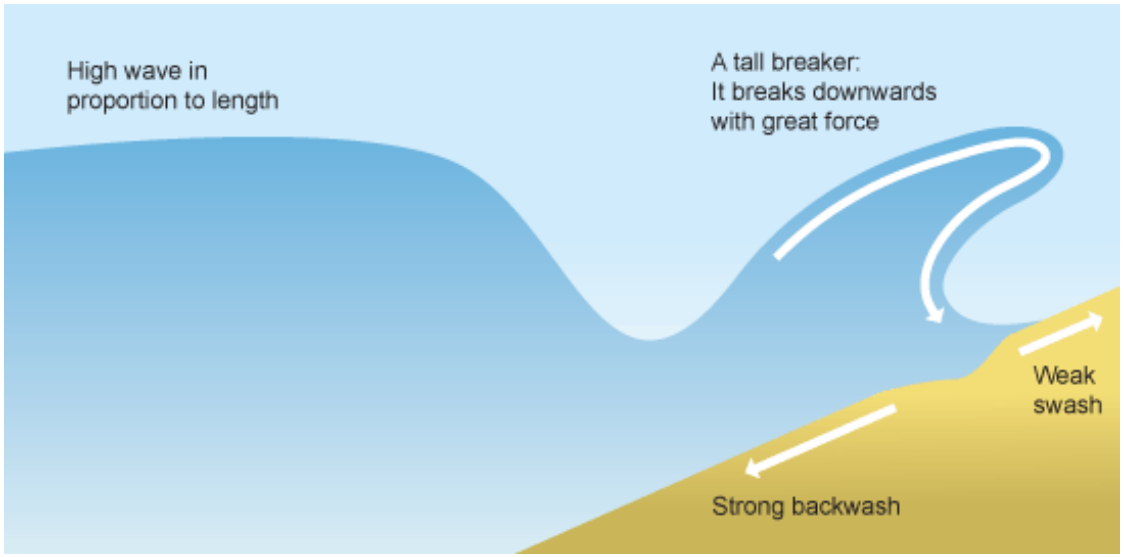
General transportation processes

These processes move material at the coast and in a river.



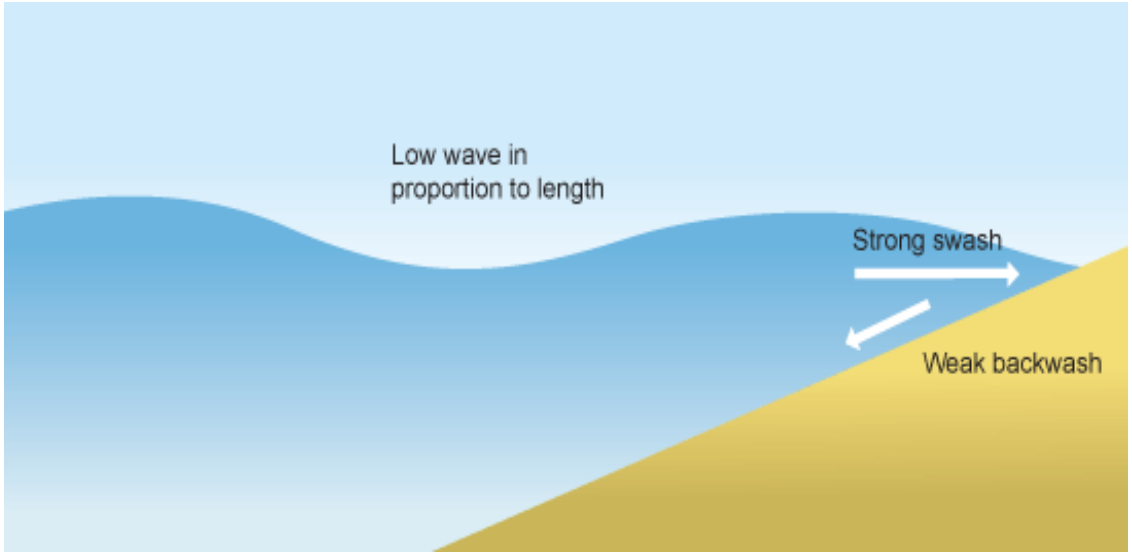
Types of waves

The size and energy of a wave is influenced by:
- ✓ how long the wind has been blowing
- ✓ the strength of the wind
- ✓ how far the wave has travelled (the **fetch**)



Destructive

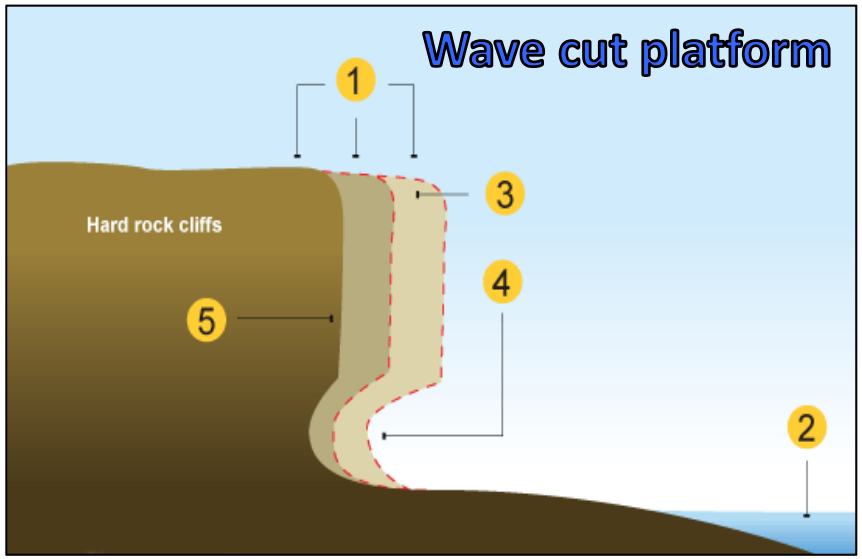
- ✓ Destroys (takes beach away)
- ✓ Strong backwash
- ✓ Weak swash



Constructive

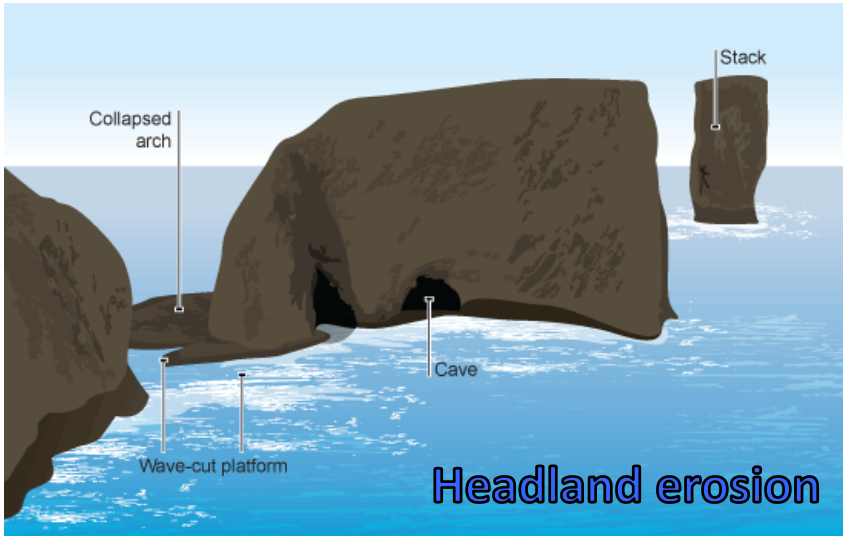
- ✓ Creates (put sand on the beach)
- ✓ Strong swash
- ✓ Weak backwash

Coastal erosional landforms



1. Weather weakens the top of the cliff.
2. The sea attacks the base of the cliff forming a wave cut notch.
3. The notch increases in size causing the cliff to collapse.
4. The backwash carries the rubble back to the sea forming a wave cut platform.
5. The process repeats itself and the cliff continues to retreat.

Coastal erosional landforms



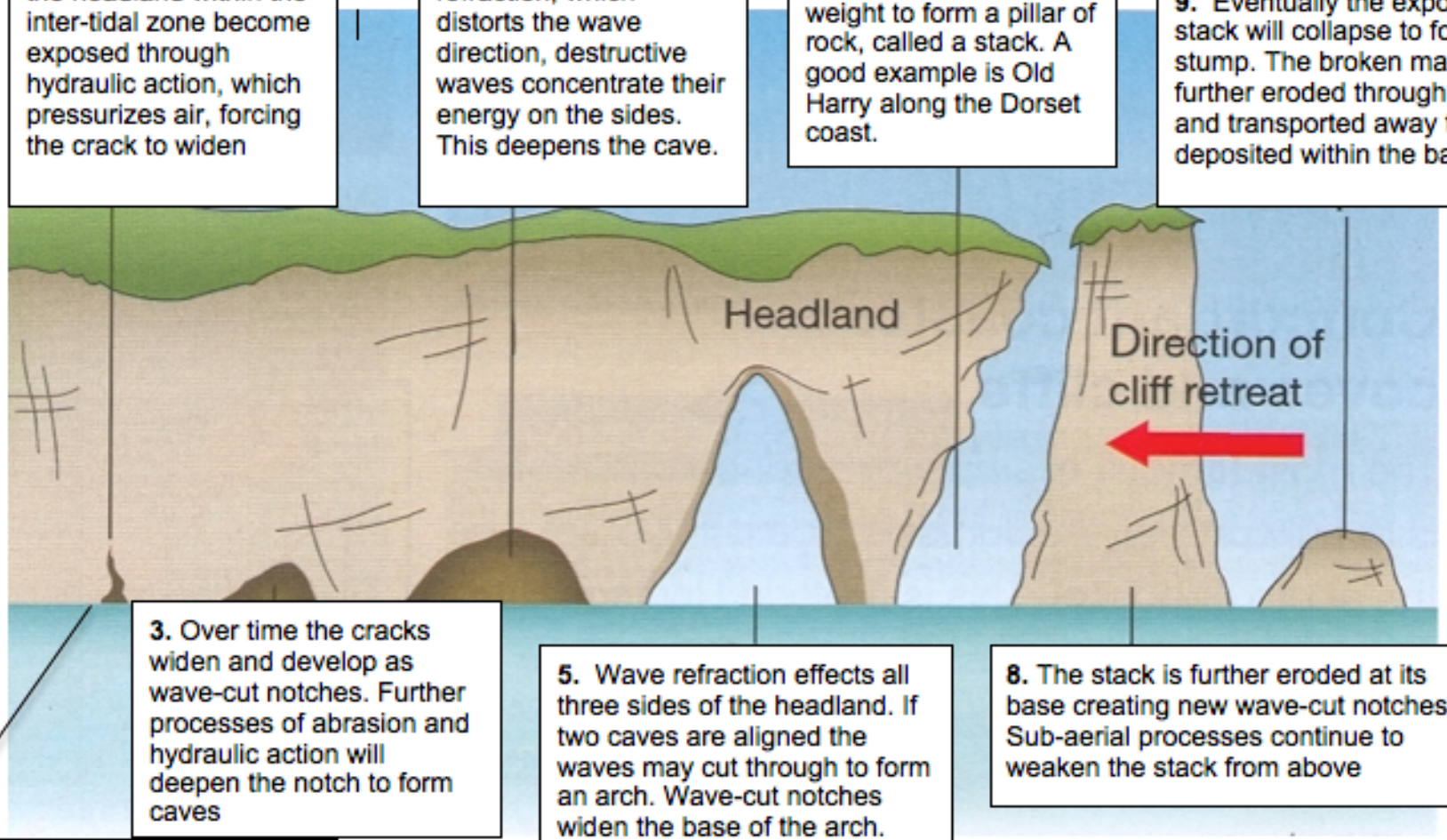
Hydraulic action creates cracks in the headland. 1

Overtime the hydraulic action causes the crack to become deeper. 2

This creates a cave. This may eventually break through. 3

This creates an arch. The arch will eventually become bigger and collapse. 4

This leaves a stack. Forces of erosion turn the stack into a stump. 5



1. Cracks at the base of the headland within the inter-tidal zone become exposed through hydraulic action, which pressurizes air, forcing the crack to widen

2. Cracks are further widened by weathering processes such as salt crystallization and wet and dry weathering that affects chalk.

3. Over time the cracks widen and develop as wave-cut notches. Further processes of abrasion and hydraulic action will deepen the notch to form caves

4. As a result of wave refraction, which distorts the wave direction, destructive waves concentrate their energy on the sides. This deepens the cave.

5. Wave refraction effects all three sides of the headland. If two caves are aligned the waves may cut through to form an arch. Wave-cut notches widen the base of the arch.

6. Vertical joints are exposed by tall breakers associated with destructive waves. Joints can also be weathered from above such as through carbonation in limestone. Here blowholes may form.

7. Over time the arch becomes unstable and collapses under its own weight to form a pillar of rock, called a stack. A good example is Old Harry along the Dorset coast.

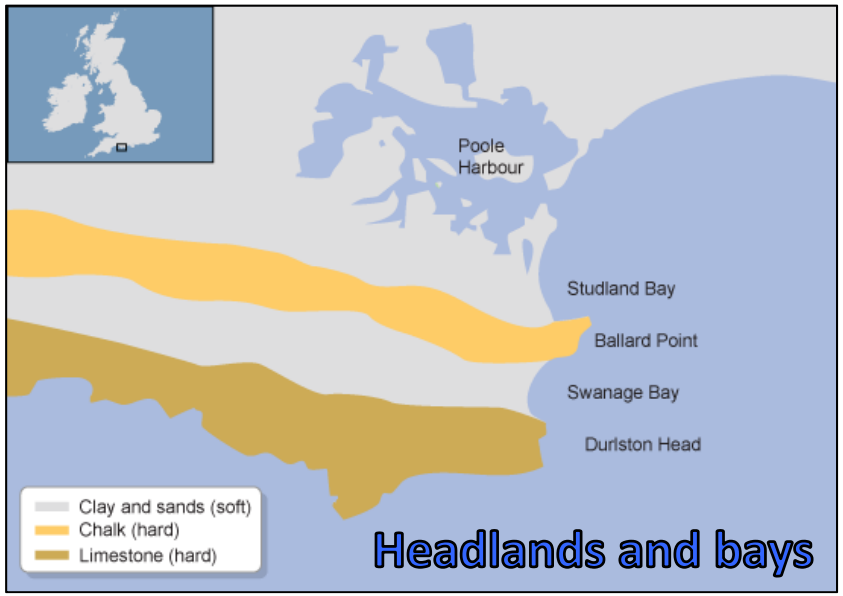
8. The stack is further eroded at its base creating new wave-cut notches. Sub-aerial processes continue to weaken the stack from above

9. Eventually the exposed stack will collapse to form a stump. The broken material is further eroded through attrition and transported away to be deposited within the bay

Coastal erosional landforms

Case study: Swanage, Old Harry Rocks

Coastal erosional landforms



The sea attacks an area of coast with alternating bands of hard and soft rock. 1

↓

The soft rock (sand or clay) are eroding more quickly. 2

↓

This creates a bay. 3

↓

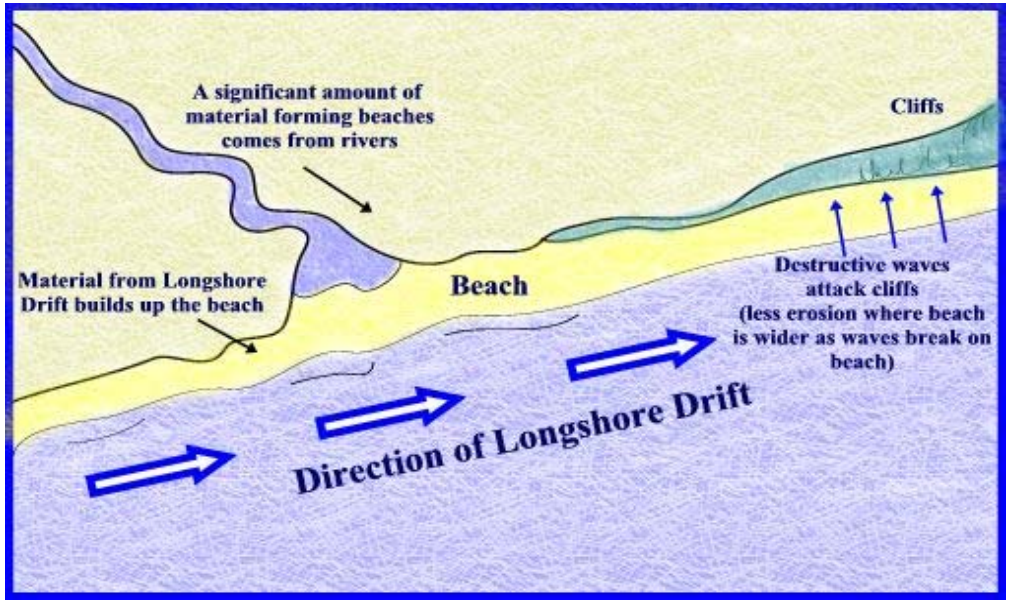
The hard rock is more resistant and takes longer to erode. 4

↓

This leaves a headland jutting out to sea. 5

Coastal depositional landforms

Beaches



Constructive waves help to build up beaches. 1

↓

The soft rock (sand or clay) are eroding more quickly. 2

↓

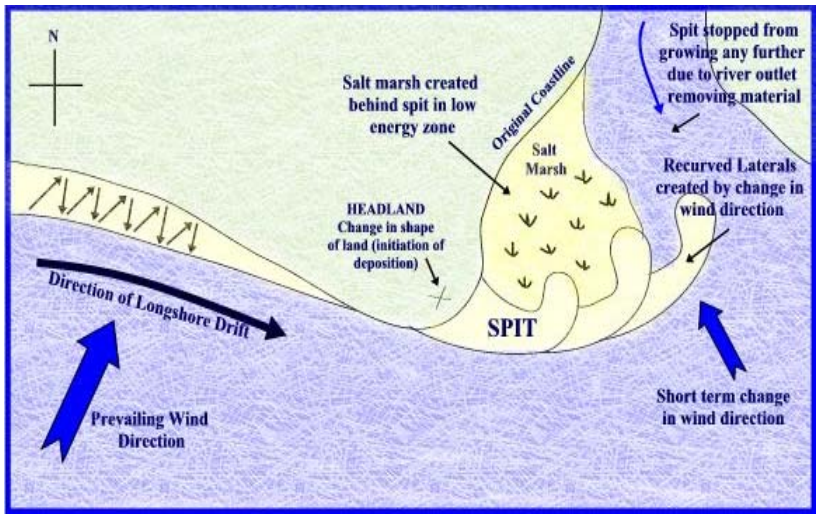
This creates a bay. 3

↓

The hard rock is more resistant and takes longer to erode. 4

Coastal depositional landforms

Spits



Longshore drift moves material along the coastline. 1

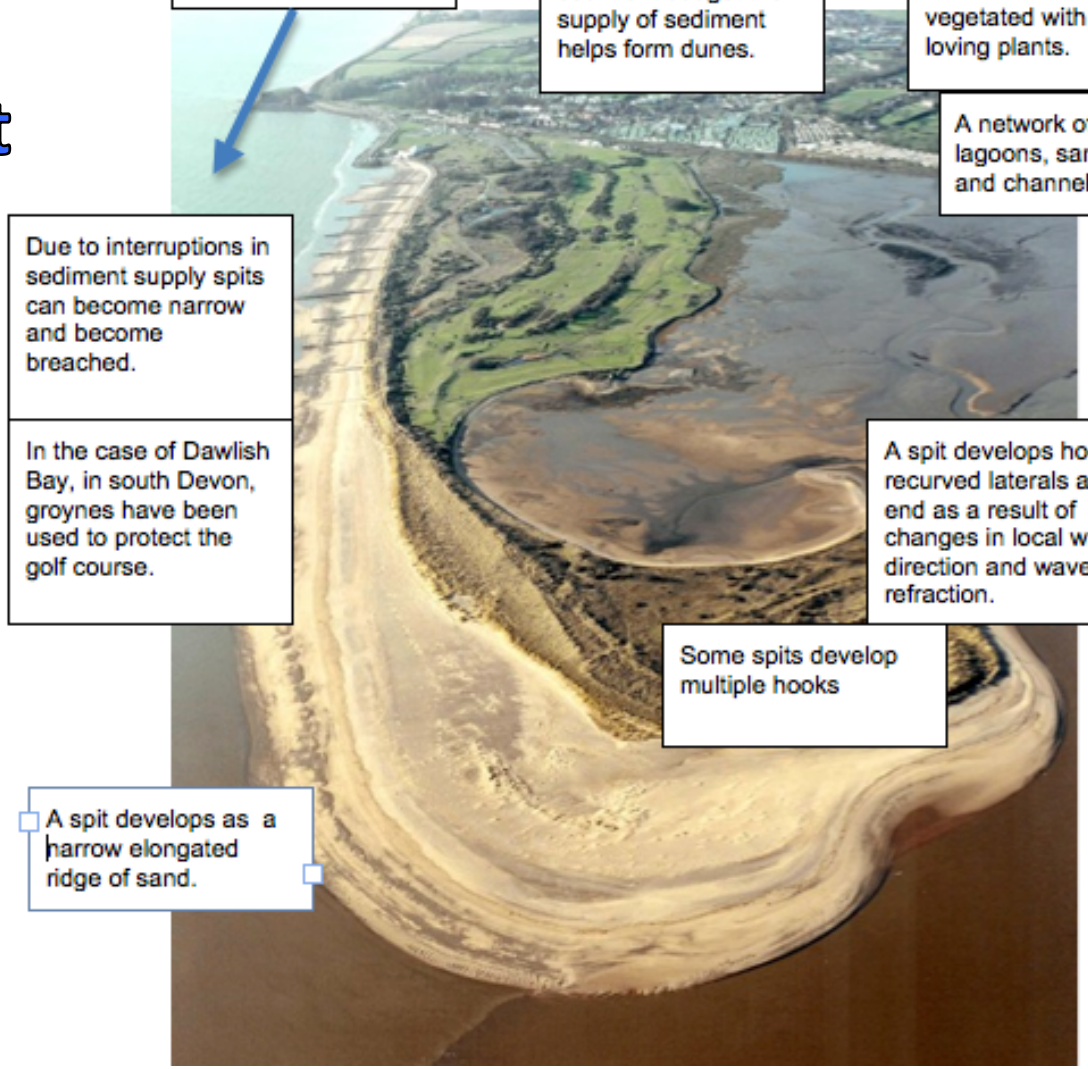
A **spit** forms when the material is deposited. 2

Over time, the spit grows and develops **a hook** if wind direction changes further out. 3

Waves cannot get past a spit, which creates a sheltered area where silt is deposited and mud flats or **salt marshes** form. 4

A bar forms when a spit joins to two headlands. 5

Coastal depositional landforms Case study: Hurst Castle spit



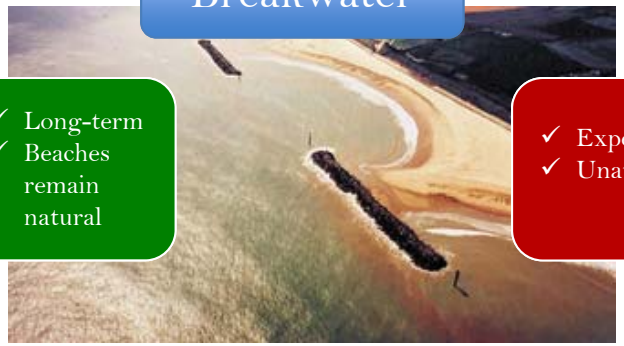
Coastal management

Hard engineering

Groynes

- ✓ Build up the beach
- ✓ Cheap
- ✓ Easily destroyed
- ✓ South beaches a deprived of sediment

Breakwater

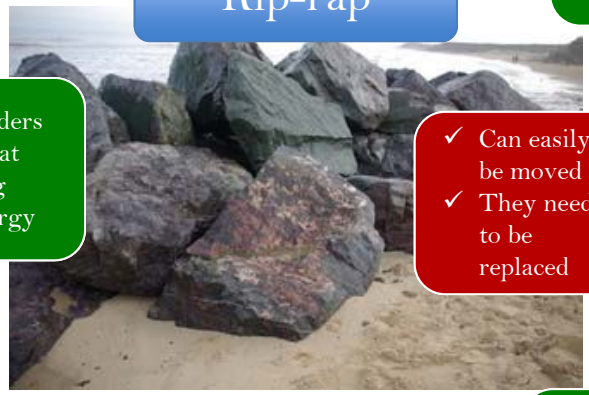


- ✓ Long-term
- ✓ Beaches remain natural
- ✓ Expensive
- ✓ Unattractive

Gabions

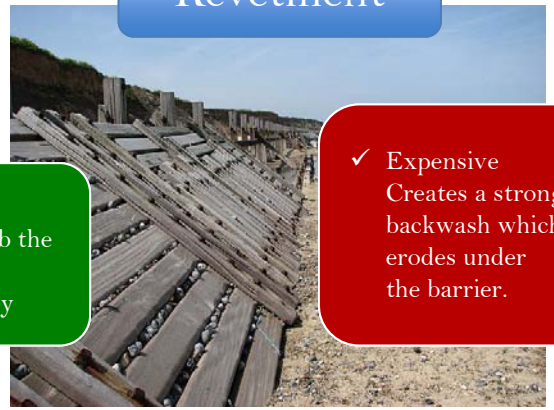
- ✓ Cheap
- ✓ Efficient
- ✓ Cages rust
- ✓ Short lifespan

Rip-rap



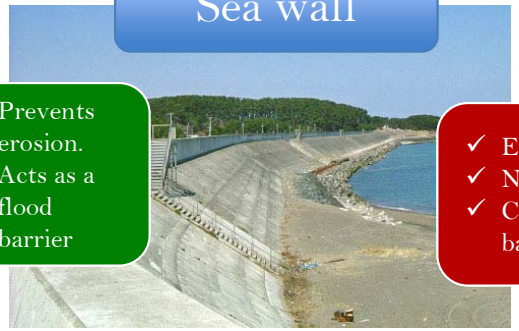
- ✓ The boulders are good at absorbing wave energy
- ✓ Can easily be moved
- ✓ They need to be replaced

Revetment



- ✓ They absorb the wave energy
- ✓ Expensive Creates a strong backwash which erodes under the barrier.

Sea wall



- ✓ Prevents erosion.
- ✓ Acts as a flood barrier
- ✓ Expensive
- ✓ Need maintaining
- ✓ Creates a strong backwash

Coastal management

The purpose of soft engineering is to work with the **natural processes** of the coast.

Soft engineering

Beach replenishment

- ✓ Creates wider beaches.
- ✓ Protects from erosion and flooding
- ✓ Looks natural

- ✓ Taking material can kill organisms
- ✓ It is very expensive
- ✓ It has to be repeated
- ✓ Could affect tourism

Beach replenishment

Adding sand and sediment to the beach from the sea floor.

Managed retreat

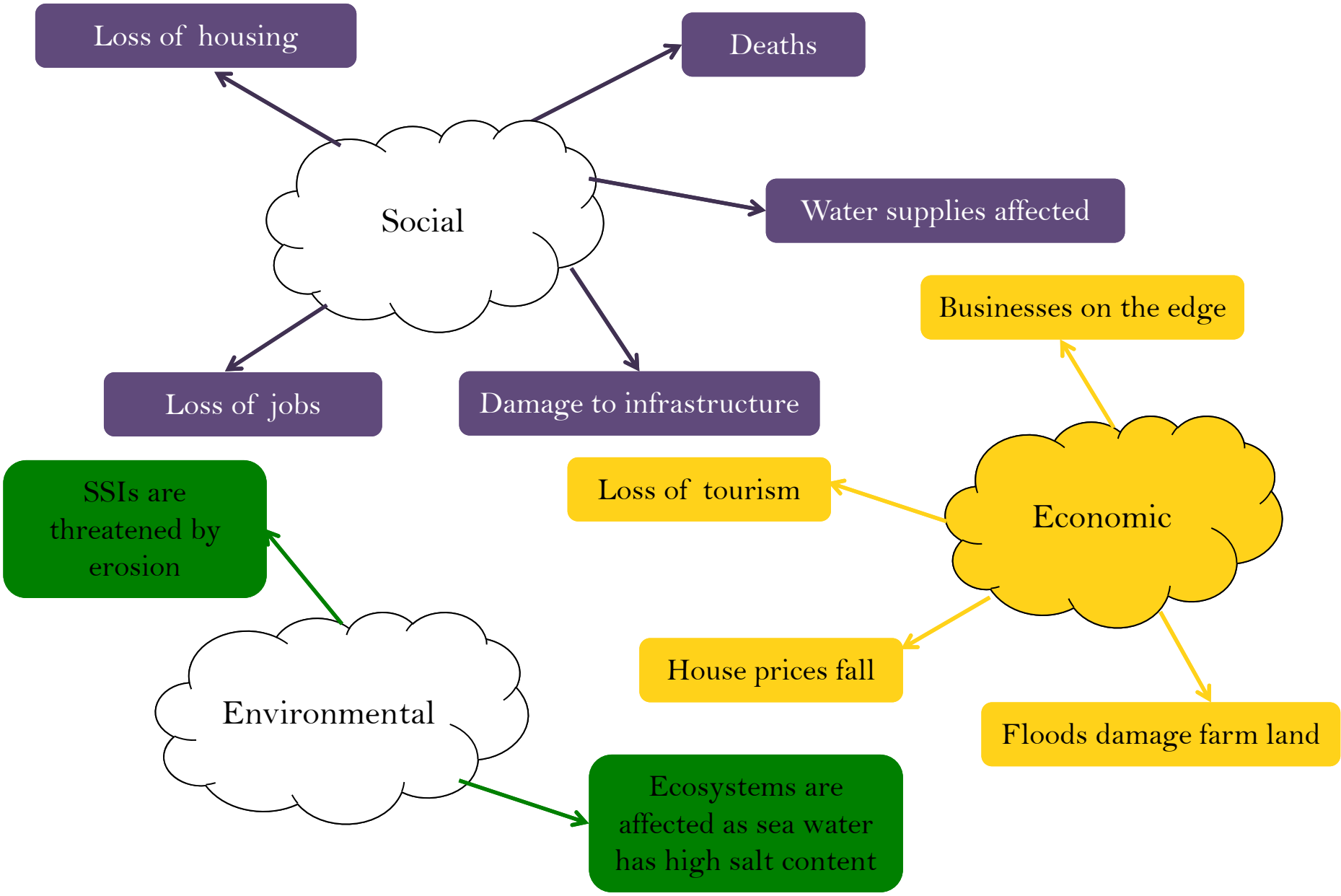
- ✓ Creates new marshland habitats
- ✓ Fairly cheap
- ✓ Flooding is reduced

- ✓ May cause conflict due to lost land.
- ✓ Could affect peoples lives.

Managed retreat

Allowing a section of land to flood in order for plants to grow and therefore become a natural wave and flood barrier.

Why protect the coast?



Managed Retreat & conflict

Happisburgh, Norfolk

Eroding 12metres each year

By 2055, loss of 20 more properties
Loss of caravan park and farmland

-A small village with a pub , tea shop, lighthouse, church and homes
-850 population
-Mainly farmland
-No main roads

-Historic records indicate that over **250 m of land were lost between 1600 and 1850.**
-The cliffs are soft clay, so erode very quickly. Weathering increases the erosion rate. The location of Happisburgh causes increasing problems with powerful waves from the North sea, which creates landslides from eroding the base of the cliff.

Management case study

Old Management (all 40 years old)

-Revetments – now damaged (from a storm) and not effective
-Groynes were placed to stop the rate of erosion, however they are not helping enough.
-Rock Armour – now little effectiveness

Increasing climate change and sea level rise are impacting and increasing erosion

Conflict from managed retreat

-To repair revetment cost £5 million, not cost effective
-Farmers lose land and livelihood
-Insurance companies won't pay out
-Increasing protest from locals to central government but g'ment has said no.
-Defences would cost more than the land and homes are worth.
-Locals want compensation for the lack of management and for their homes collapsing into the sea.

-The historical lighthouse has had to be moved further back from the edge of the cliff.
-local campaign 'buy a rock for Happisburgh' to raise money for private defences.

Managed Retreat- monitor but no management

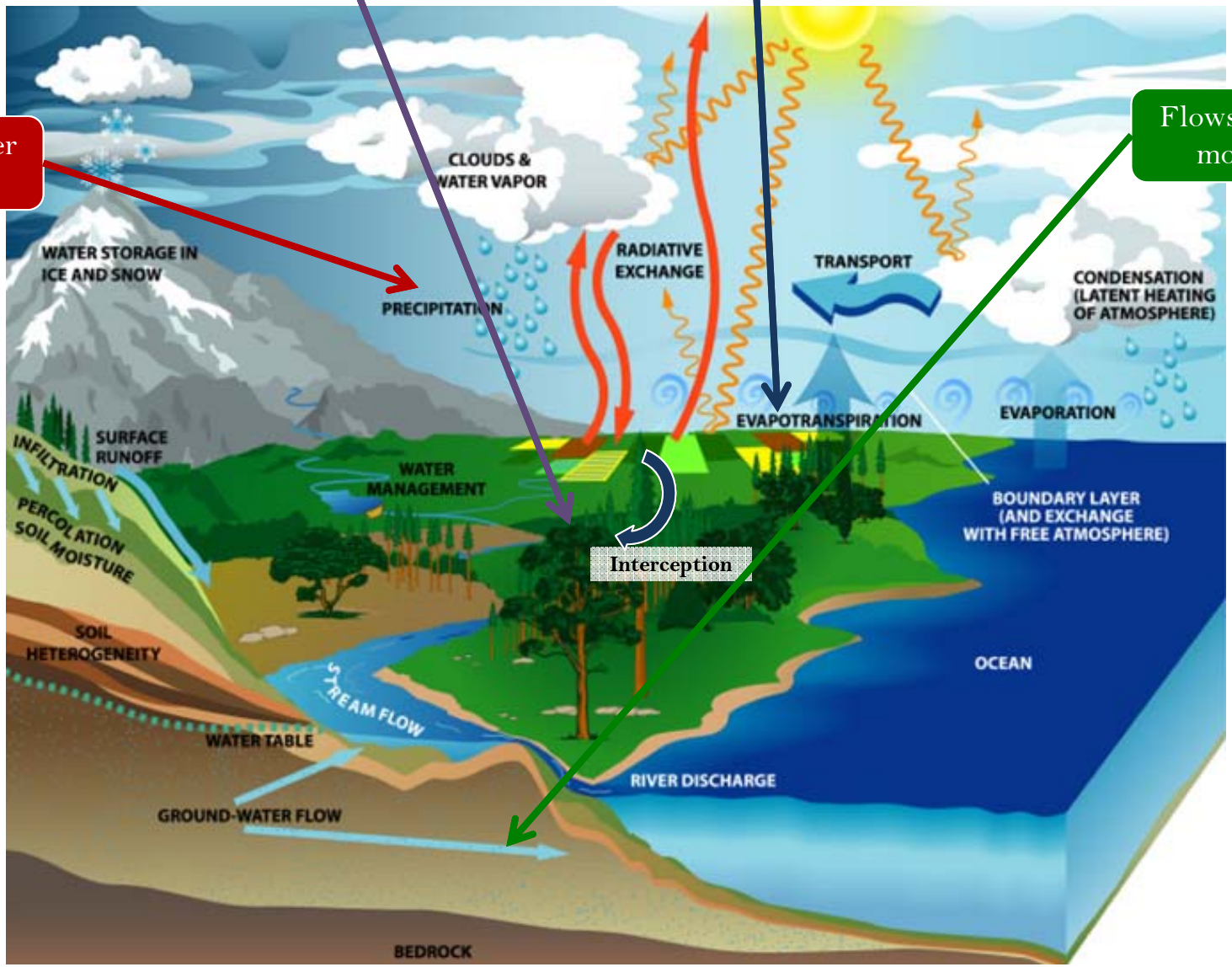
Hydrological cycle

Stores- Water stored.

Outputs- Water leaving.

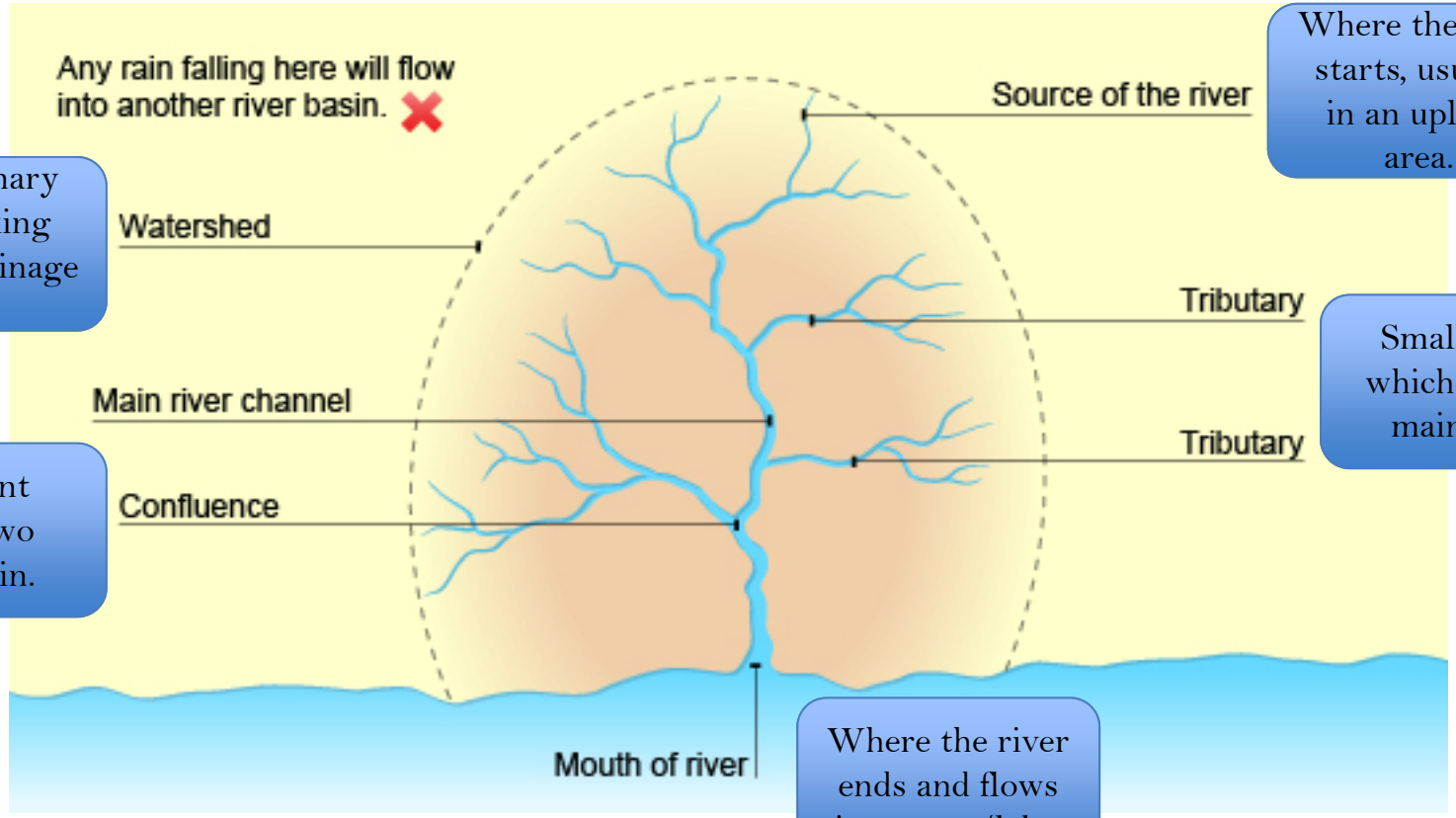
Inputs- Water coming in.

Flows- Water moving.



Drainage basin

The area of land a river gets its water from. It is defined by the watershed.



Where the river starts, usually in an upland area.

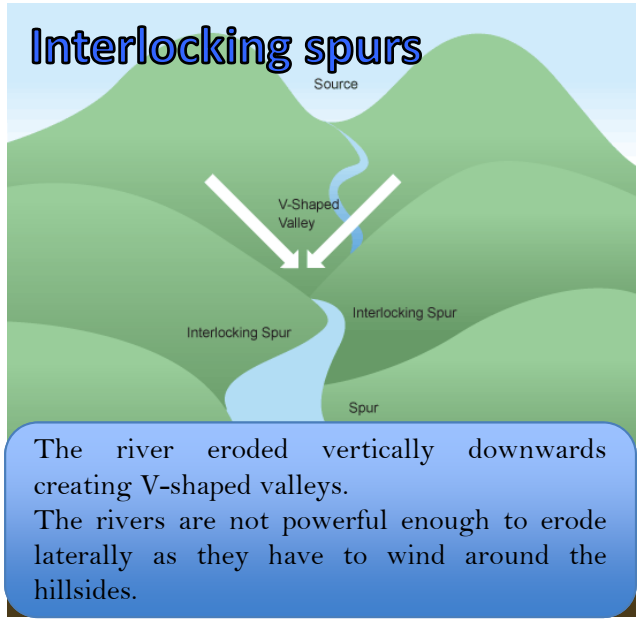
An imaginary line marking out the drainage basin.

Small rivers which join the main river.

The point where two rivers join.

Where the river ends and flows into a sea/lake.

Upper course



The river eroded vertically downwards creating V-shaped valleys.
The rivers are not powerful enough to erode laterally as they have to wind around the hillsides.

Created when the river flows over an area of hard rock followed by soft rock. 1

The soft rock is eroded more quickly creating a step. 2

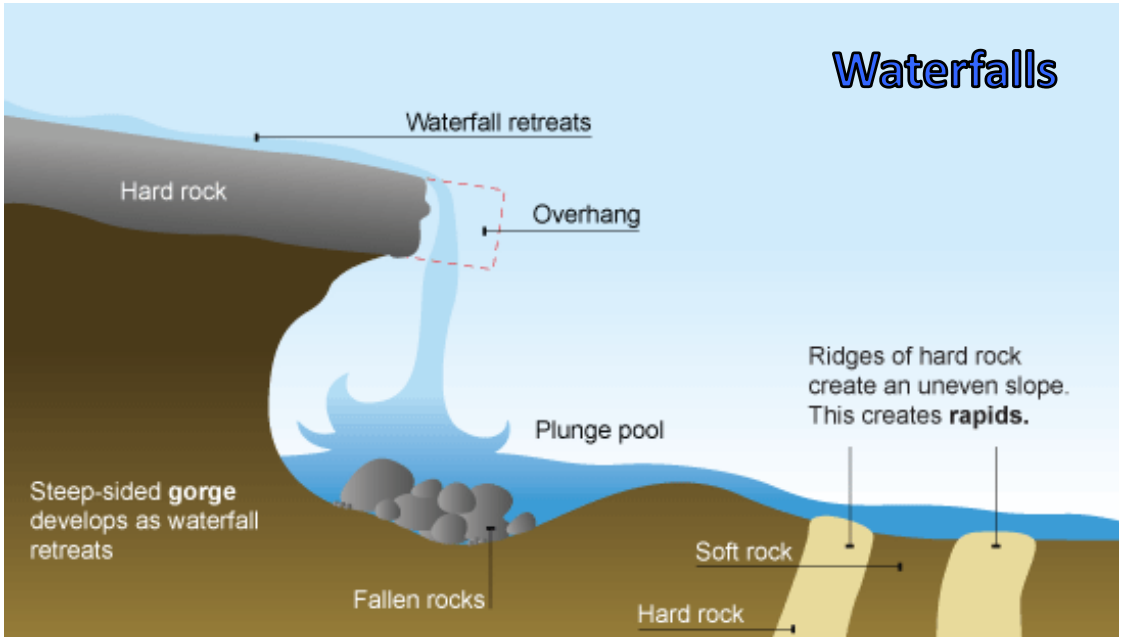
As the water goes over the step it eroded more and more of the softer rock. 3

A steep drop is created which is called a waterfall. 4

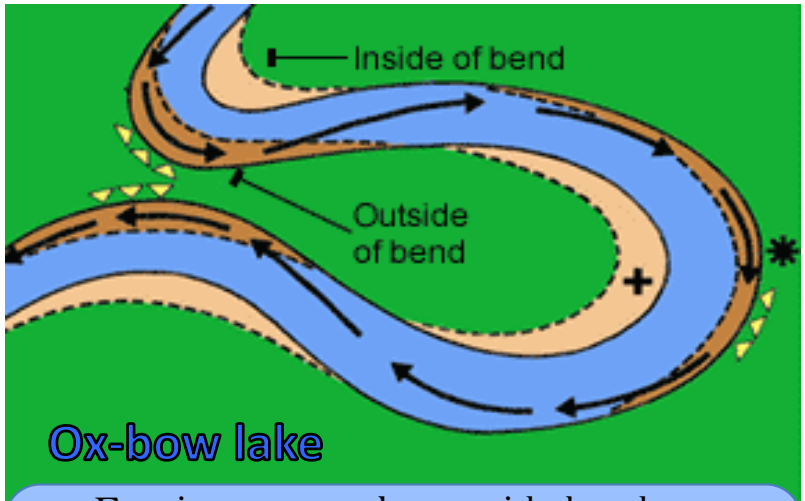
The hard rock is undercut by the erosion and collapses. 5

The collapsed rock is swilled around and helps to erode the softer rock in the plunge pool. 6

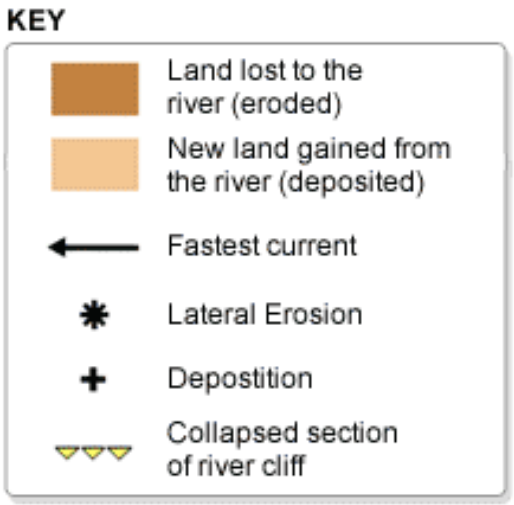
Overtime more collapses occur and the waterfall retreats creating a gorge. 7

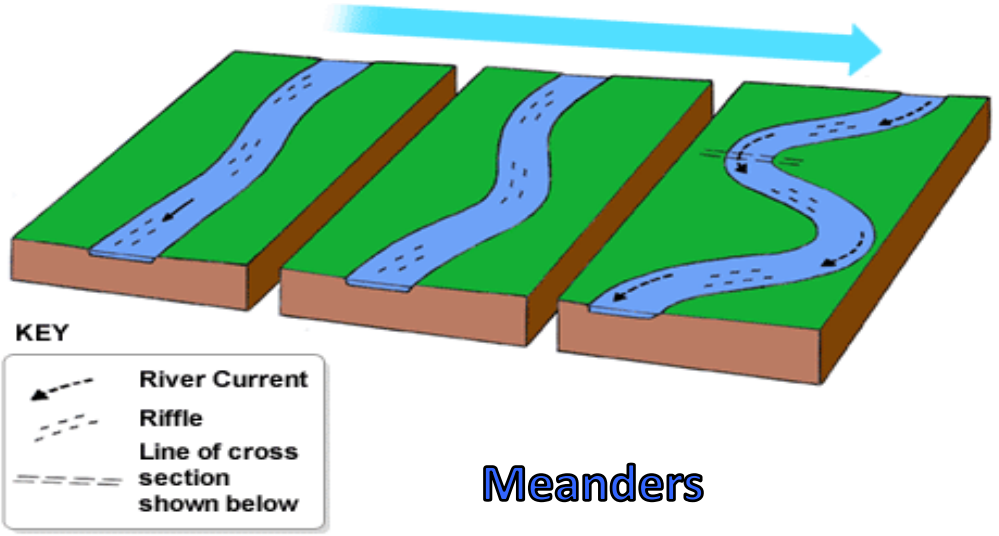


Middle course



Erosion causes the outside bends to become closer and the river breaks through. Deposition cuts off the meander forming an ox-bow lake.





Meanders

The current if faster on the outside of the bend because the channel is deeper. 1

↓

Therefore more erosion takes place on the river bend forming a river cliff. 2

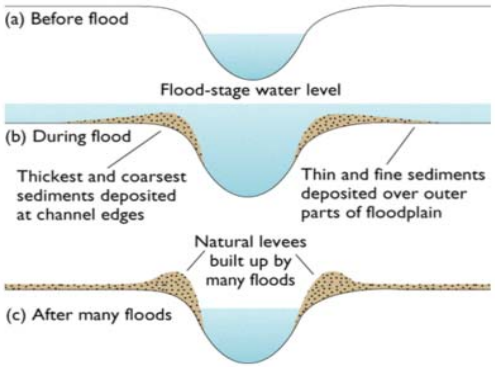
↓

The current is slower on the inside of the bend because the channel is shallower. 3

↓

So eroded material is deposited on the inside forming a slip-off slope. 4

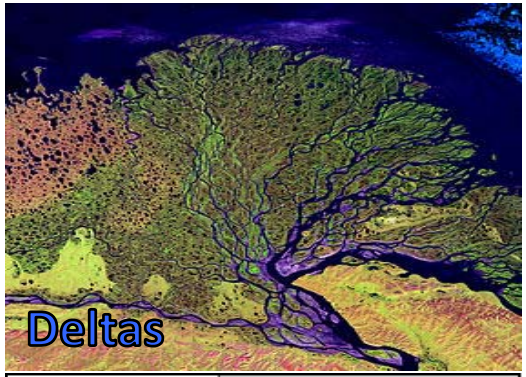
Lower course

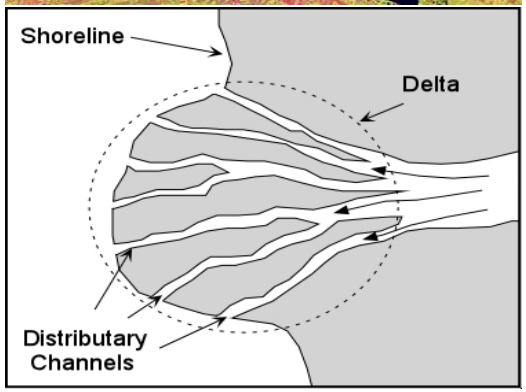


Levees are natural embankments. During a flood eroded material is deposited over the flood plain.

The heaviest material is deposited nearest the river channel.

Overtime the deposited material builds up creating levees along the channel edge.

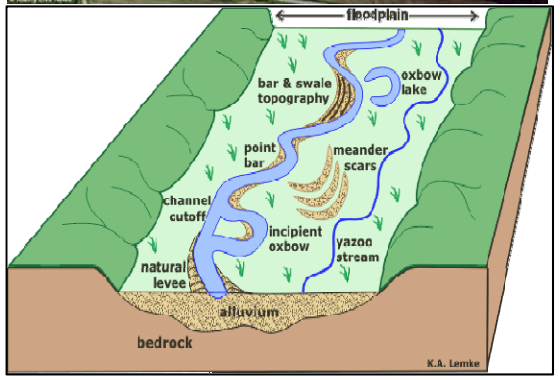




River are forced to slow down when they meet the sea or a lake.

If the sea does not wash away the material it builds up and the channel gets blocked and is forced to split up.

Eventually the material builds up so much that low lying areas called deltas are formed. There are three types.

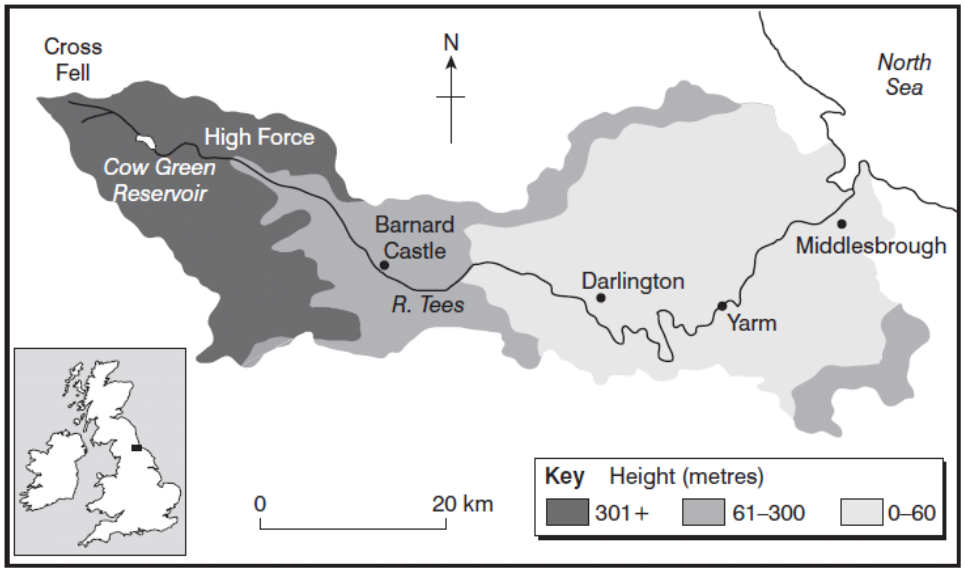


When a river floods onto the flood plain the water slows down and deposits the eroded material. This builds it up.

Meanders migrate across the flood plain making it wider.

The deposition that happens on the slip off slopes of meanders also helps to build up the flood plain.

Long Profile of a river
River Tees - North East England



85 miles in length

It drains an area of 710 square miles

River Management

-Long history of flash flooding
-Cow green reservoir, controls water supply for industries along the river
-Straighten the river for easier navigation during the industrial revolution
Flood protection schemes in Yarn

Industry located in the Lower course so need for management

Upper Course

-Source high in the Pennines (893m above sea level)
-High run off as steep V shaped valleys of impermeable rock
-High rainfall – good water supply
-Many tributaries
-Famous high fall waterfall – tallest in England 21 metres high
-Gorges, rapids and potholes at Low force

River flows east ward

Middle Course

-Clear widening and meandering
-Meanders cut off in the 19th century
-Sides become less steep
-Lateral erosion

Lower Course

-Very urbanised and large populations. Eg Yarn
-Important wildlife seals & migratory birds also SSSI
-Ox bow lakes
-Large oil, gas and petrochemical industries (as flat land)
-Natural Levees formed due to silt build up
-Mouth is in the North sea
-Wide Mudflat estuary (tidal)
-Huge water sports complex Tees Barrage

Causes of flooding

Physical

Snow melt

When a lot of snow or ice melts it means a lot of water goes into the river in a short space of time.

Geology

If the rock is impermeable water cannot infiltrate and goes to the river.

Relief

If the valley is steep the rain just not have a chance to infiltrate and it runs off quickly.

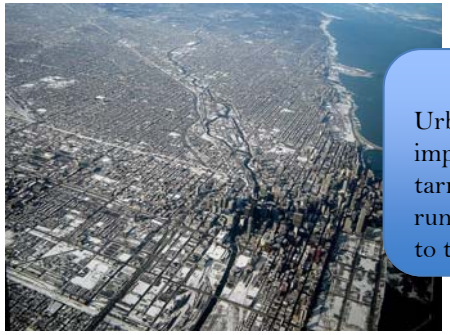
Heavy rainfall

Heavy rainfall means that there is a lot of runoff This increases the volume of water in the river.

Prolonged rainfall

After a period of long rainfall the soil becomes saturated, it can't allow any more infiltration.

Human



Urbanisation

Urban areas have lots of impermeable surfaces such as tarmac. This means the water runs off the surface quickly and to the river.

Deforestation

Trees intercept the rainwater. They also take up water. Cutting down the trees increases surface-runoff and therefore the volume of water in the river.

A flood hydrograph

A flood hydrograph shows whether a river has flooded. The lag time shows how quickly the water reached the river.

The time it takes for the water to reach the river.

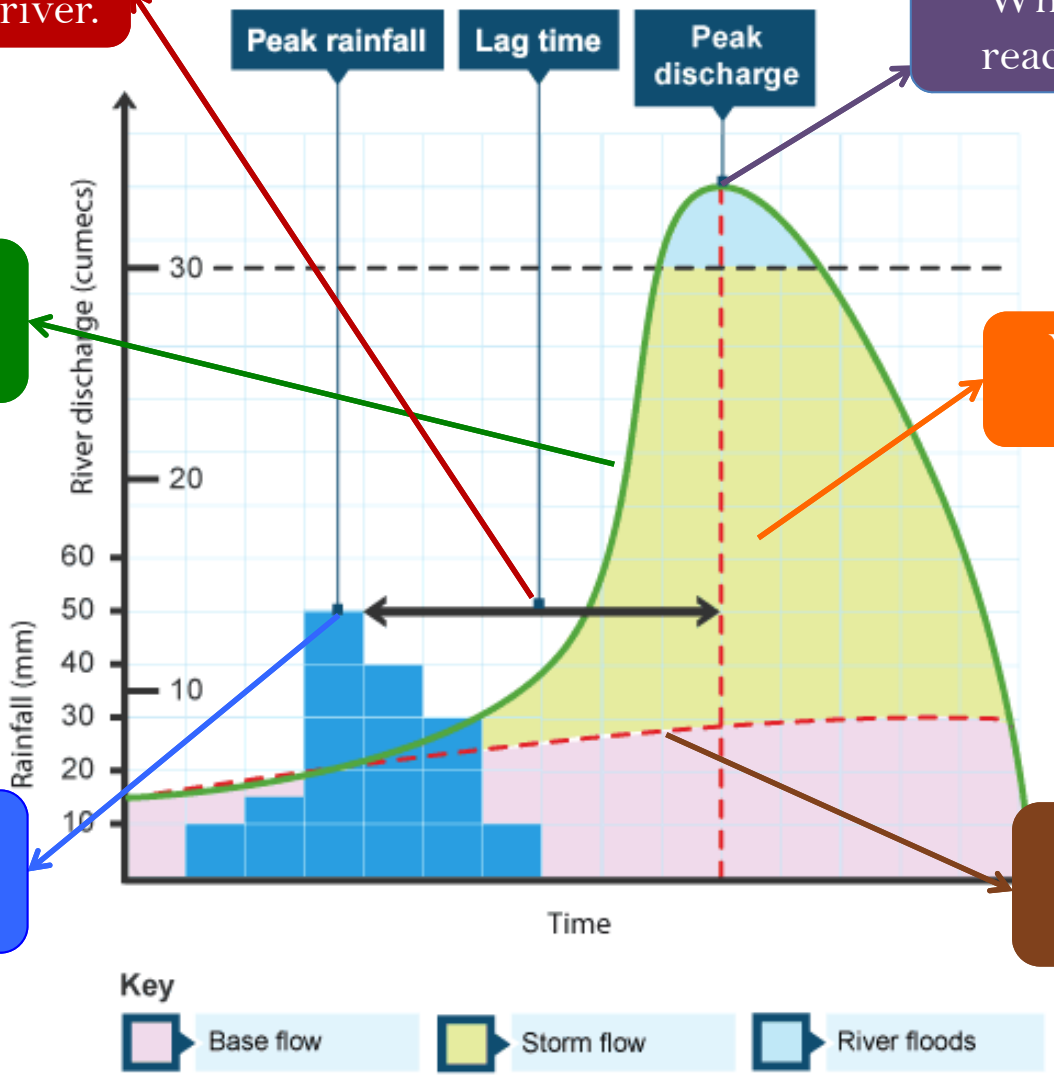
When the river has reached its capacity.

When the river flow increases.

When the river flow decreases.

When the rainfall is at its highest.

The normal flow of the river.



Flood management

Hard engineering

Dams and reservoirs

- ✓ Store water
- ✓ Hydroelectric power
- ✓ Flow control

- ✓ Very expensive
- ✓ Flooding downstream

Channel straightening

- ✓ Water moves more quickly

- ✓ Flooding may happen downstream as water gets there faster

Man-made levees

- ✓ River can hold more water

- ✓ Catastrophic flooding if levees break

Soft engineering

Flood warnings

- ✓ Impact of flooding reduced
- ✓ Evacuation

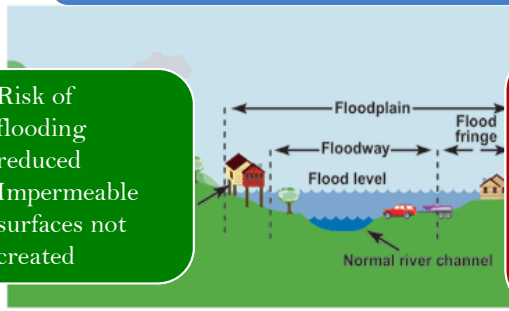
- ✓ Don't stop the flood
- ✓ LEDC lack of access to radio etc

Preparation

- ✓ Impact of flood reduced
- ✓ People know what to do

- ✓ Does not mean safety
- ✓ Expensive to modify buildings

Flood plain zoning



- ✓ Risk of flooding reduced
- ✓ Impermeable surfaces not created

- ✓ Urban expansion is limited
- ✓ No help in places already built on

6cm (2ins) of rain fell in two hours

MEDC Flood

Boscastle 2004

Very Short Lag Time

Largely economical impacts

Clear rescue and relief

Reasons for the flooding

PHYSICAL

-A very wet August (2 times average rain) SO the ground was already saturated

-Impermeable rocks & thin soils

-Steep slopes – rapid runoff

-Confluence of Rivers Valency & Jordan is just above the village

-A very high tide – made it difficult for water to flow out to sea

HUMAN

-Bridges were low so acted a a dam - debris such as tree trunks caught on them water piled up until it burst through in a great wave

-Many buildings & roads were positioned close to the river so more property damage

Primary Impacts

-50+ cars, and caravans were swept out to sea

-a wall of water swept through the village destroying everything in its path

-6 buildings were swept away

-Many other houses, shops etc were flooded, with mud + sewage as well as water; possessions also ruined

-Roads under 2.75m of water

-No deaths, few serious injuries

New Management & defence

-£4.6m scheme includes: raise car park to safer level; move & raise bridge; widen & lower the river bed to increase the amount of water it can hold

-Removing of dead vegetation to stop blocking of the river

- 'At risk' properties – encouraged to use more flood resistant material, raise height of electrical wiring etc

-Environment Agency – flood warning system + information

-Council runs special advice days, encouraging people to have an emergency evacuation

pack & to take out insurance. Council has an emergency action plan.

Since 2004 – flooding again, still damage but not as damaging as this event

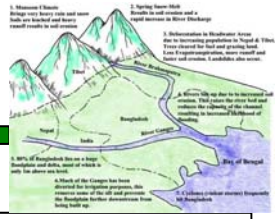
Secondary Impacts

-90% of economy dependent on tourism > lost money >20 accommodation providers & tourist attractions/shops forced to shut

-Insurance companies pay out £20 million

LEDC Flood Bangladesh 2004

60% of Dhaka flooded



Characteristics of Bangladesh

-Lays mainly on floodplains, so flat land
Most of the land lies 6metres below sea
-3 main rivers- The Ganges, Brahmaputra and Meghna.
-Monsoon season evey year – high concentrated rainfall in a few months (June to September).
-1,800mm and 2,600mm rain a year.
-Poverty is a huge issue in Bangladesh-low literacy rate
-Flooding occurs naturally in Bangladesh
-Snow from the Himalayas melts each year and increase river discharge
-Sediment blocks up the river and causes flooding
-Deforestation in the forest increases run off and reduces lag time
-Cyclones occur in the Bay of Benegal and causes coastal flooding
-Densely populated areas meaning increase in deaths

Social impacts

-36 million people were made homeless
-People died as a result of disease because they had no access to clean water.
-Impacted on rural farmers and urban slum dwellers the most.
-Over 800 died with many more from disease

Environmental impacts

During July and August approximately 38% of the total land area was flooded including 800,000 ha of agricultural land and Dhaka
Floods caused river bank erosion especially on embankment areas close to the main channels, soil erosion, water-logging, water contamination

Economic impacts

-serious damage to infrastructure – roads, bridges, embankments, railway lines, irrigation systems
-All domestic and internal flights had to be suspended during July
-Value of damage was assessed as being in region of $2.2 billion of 4% of total GDP for 2004

Response and management

-Reliance on Ngo support – financial and emergency supplies –UN disaster management support
-Self help schemes promoted
-local community early warning system implemented, plus shelters
-Increasing use of levees to protect field and villages
-Increasing monitoring to reduce the impact as happens every year.
-encourage farmers to build homes on stilts.

The 2004 floods lasted from July to September and covered 50% of the country at their peak.