Rock is broken down by Mechanical and Chemical Weathering

Mechanical weathering is the breakdown of rock without changing its chemical composition.
Freeze-thaw weathering:

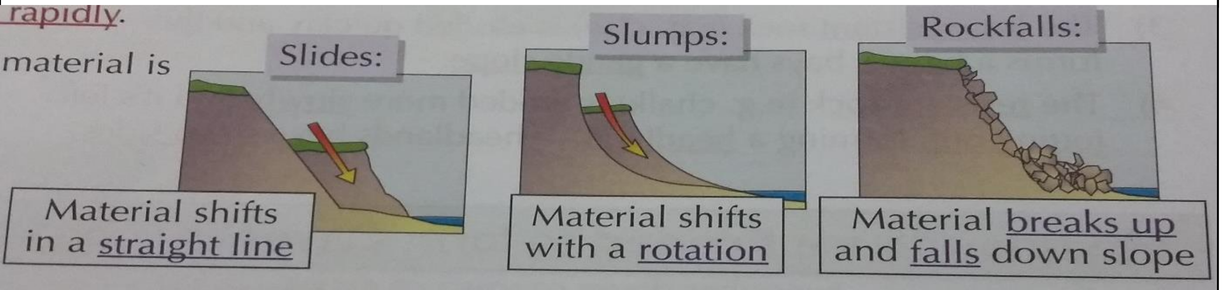
1. It happens when the temperature alternates above and below 0 degrees
2. Water gets into cracks
3. When the water freezes it expands, which puts pressure on the rock
4. When the water thaws it contracts, which releases the pressure on the rock
5. Repeated freezing and thawing widens the cracks and causes the rock to break up

Chemical weathering is the breakdown of rock by changing its chemical composition.
Carbonation weathering is a type of chemical weathering that happens in warm and wet condition:

1. Rainwater has carbon dioxide dissolved in it, which makes weak carbonic acid
2. Carbonic acid reacts with rock that contains calcium carbonate so the rocks are dissolved by the rainwater

Mass movement is when material falls down a slope

Mass movement is the shifting of rocks and loose material down a slope. It happens when the force of gravity acting on a slope is greater than the force supporting it.
Mass movement cause coasts to retreat rapidly
They're more likely to happen when the material is full of water – it acts like a lubricant, and makes the material heavier



Waves wear away the coast using three processes of erosion

Processes of erosion

- Hydraulic power – waves crash against rock and compress the air in the cracks. This puts pressure on the rock. Repeated compression widens the cracks and makes bits of rock break off
- Abrasion – eroded particles in the water scrape and rub against rock, removing small pieces
- Attrition – eroded particles in the water smash into each other and break into smaller fragments. Their edges also get round off as they rub together

Types of waves

Wave characteristics – there are two types of waves:
Destructive

- High frequency – 10-14 waves per minute
- Weak swash (push up the beach), strong backwash (pull down the beach)
- Material is removed from the coast

Constructive

- Low frequency – 6-10 waves per minute
- Low and long
- Strong swash (push up the beach), weak backwash (pull down the beach)
- Material is deposited (left behind) on the coast

Deposition – the dropping of material

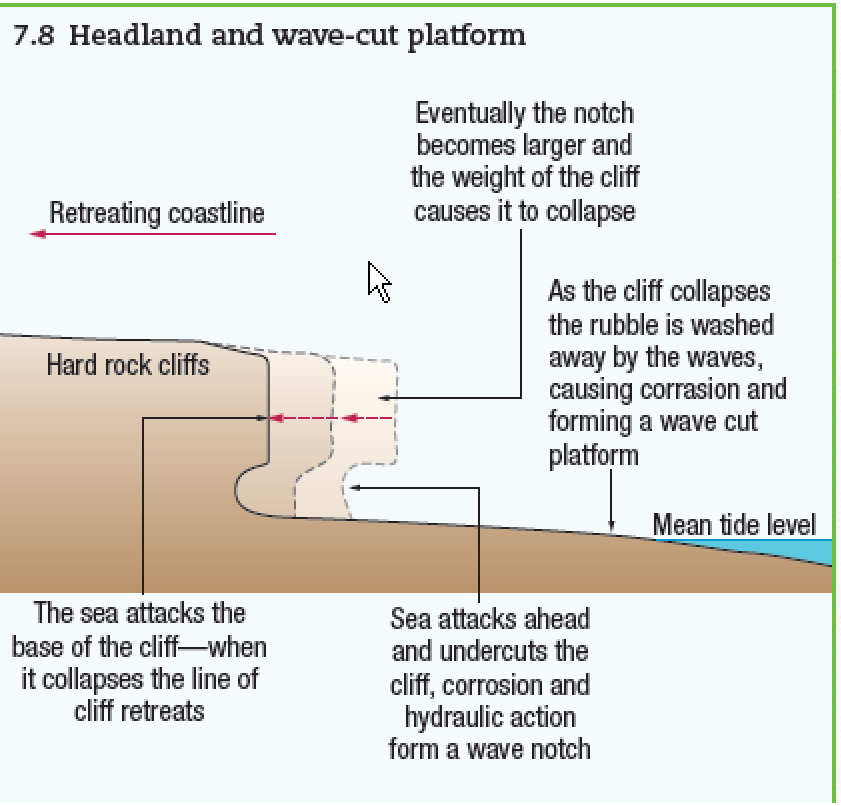
Deposition is when material carried by the sea water is dropped on the coast. It occurs when water carrying sediment slows down so that it isn't moving fast enough to carry so much sediment
Coasts are built up when the amount of deposition is greater than the amount of erosion.
The amount of material deposited on an area of coast is increased when:

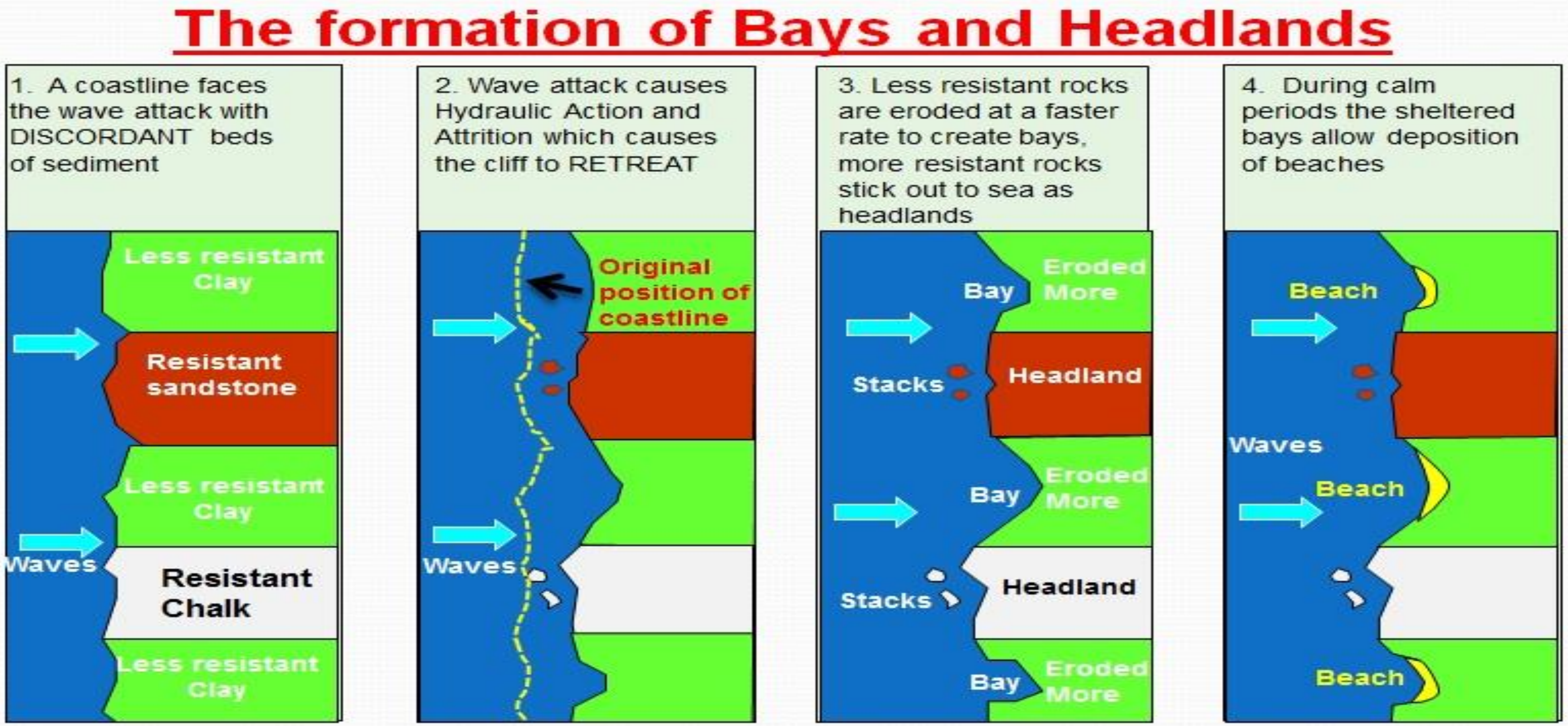
- There's lots of erosion elsewhere on the coast, so there's lots of material available
- There's lots transportation of material into the area

Low energy waves carry material to the coast but they are not strong enough to take a lot of material away – more deposition and little erosion

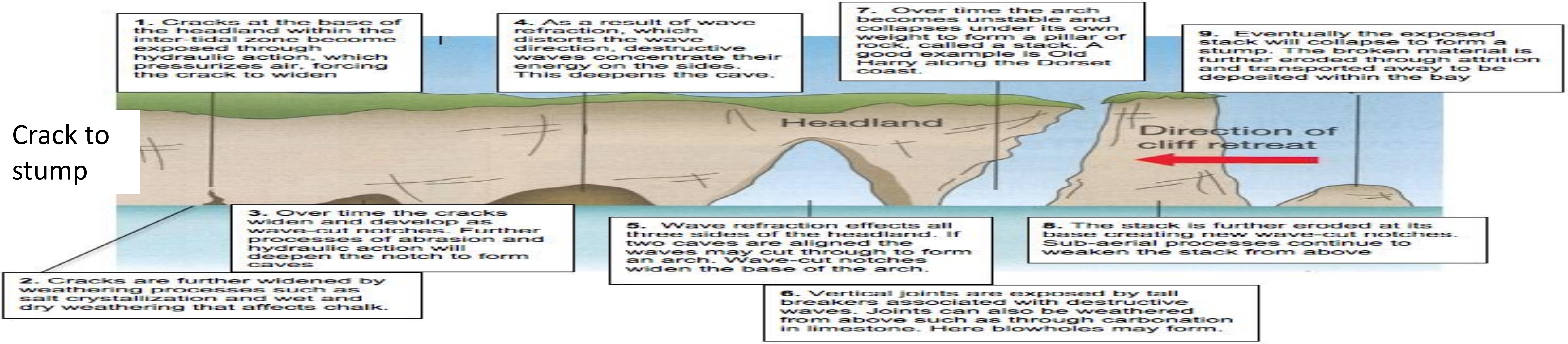
Wave-cut notches and platforms

Coasts – landforms of erosion



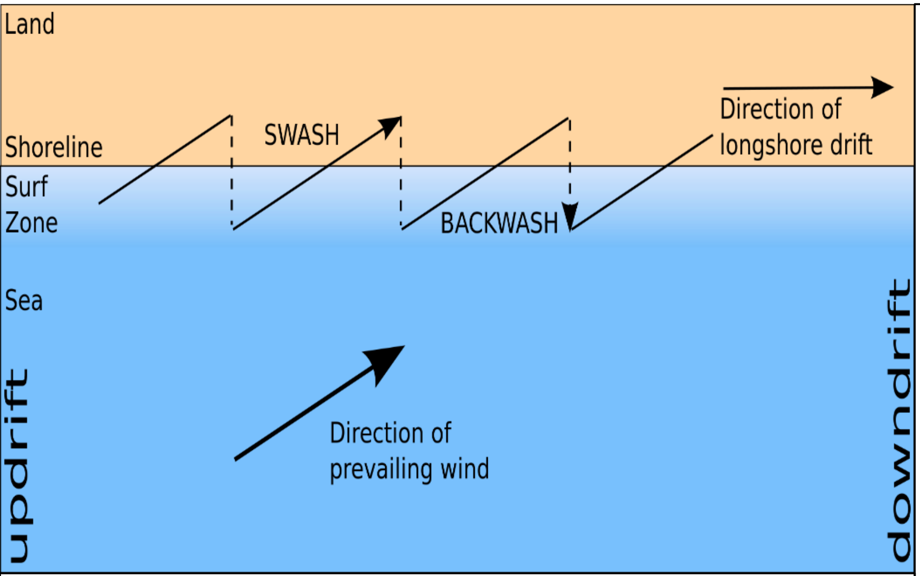


Crack to stump



Coasts – transportation & landforms of deposition

Longshore drift

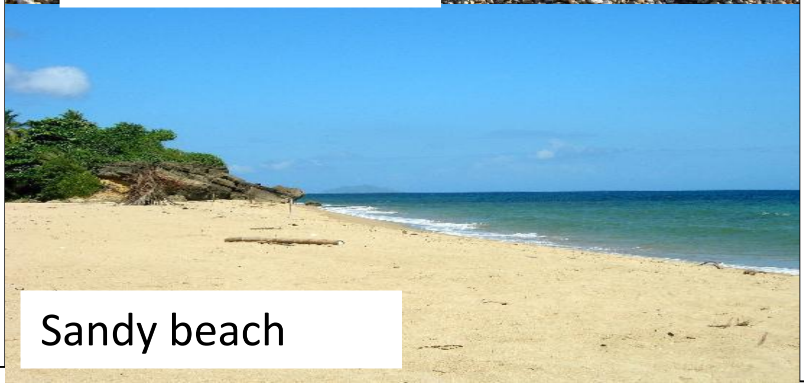


Material is transported along coasts by a process called longshore drift.

1. Waves follow the direction of the prevailing (most common) wind
2. They usually hit the coast at an angle (not right angle)
3. The swash carries material up the beach in the same direction as the waves
4. The backwash then carries material down the beach at right angles, back towards the sea
5. Over time, material zig-zags along the coast

Processes of transportation:
Traction: large particles like boulders are pushed along the sea bed by the force of the water
Saltation: pebble-sized particles are bounced along the sea-bed by the force of the water
Suspension: small particles like silt and clay are carried along in the water
Solution: soluble materials dissolve in the water and are carried along


Shingle beach


Sandy beach

Beaches are formed by deposition

Beaches are found on coasts between the high water mark (the highest point on the land the sea-level gets to) and the low-water mark (the lowest point on the land the sea-level gets to.
They're formed by constructive waves depositing material like sand and shingle where there is more deposition than erosion.
Sand and shingle beaches have different characteristics:
Sand beaches

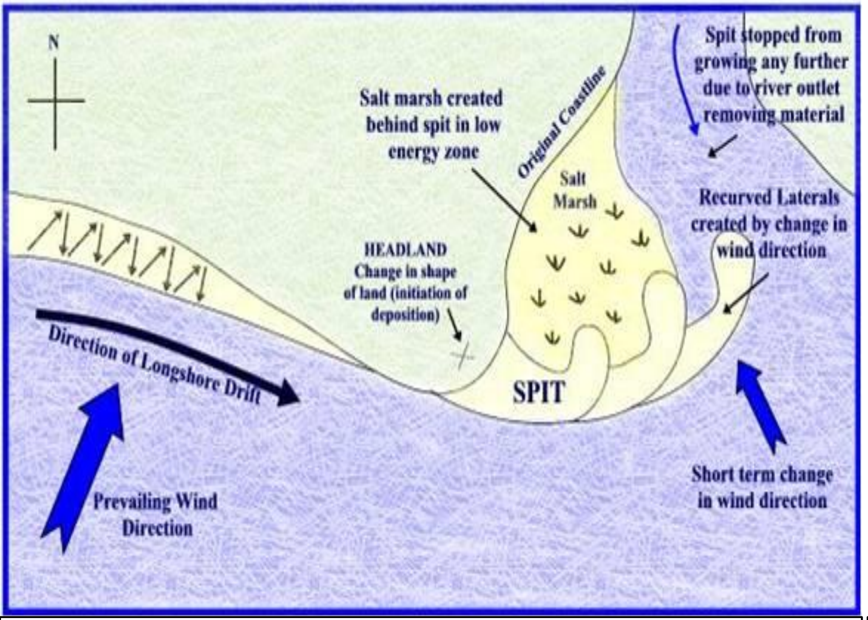
- Flat and wide
- Sand particles are small
- Weak backwash can move them down the beach creating a long, gentle slope

Shingle beaches:

- Step and narrow
- Shingle particles are large
- Weak backwash can't move the material back down the beach, creating a steep slop

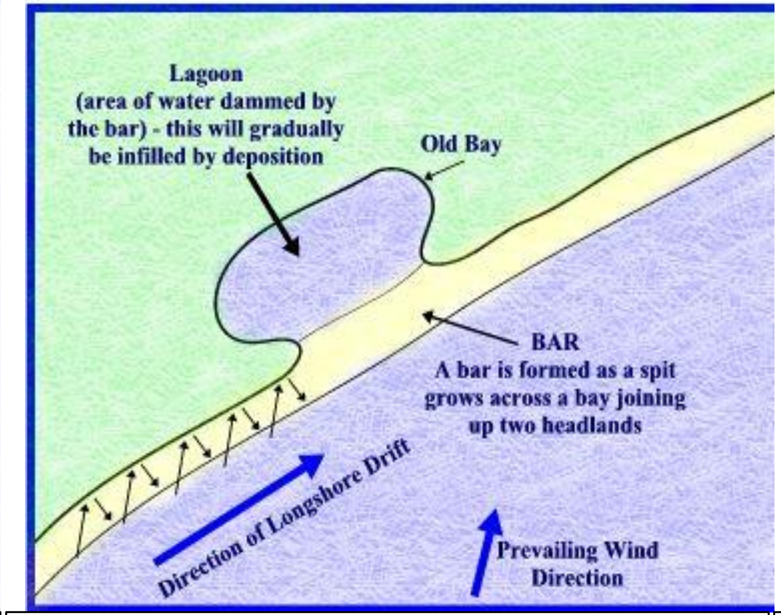
Coasts – landforms of deposition

The Formation of a Spit



1. Spits form at sharp bends in the coastline, e.g. at a river mouth
2. Longshore drift transports sand and shingle past the bend and deposits it in the sea due to a loss of energy
3. Strong winds and waves can curve the end of the spit (forming a recurved end)
4. The sheltered area behind the spit is protected from waves – lots of material accumulates in this area, which means plants can grow there
5. Over time, the sheltered area can become a mud flat or a salt marsh

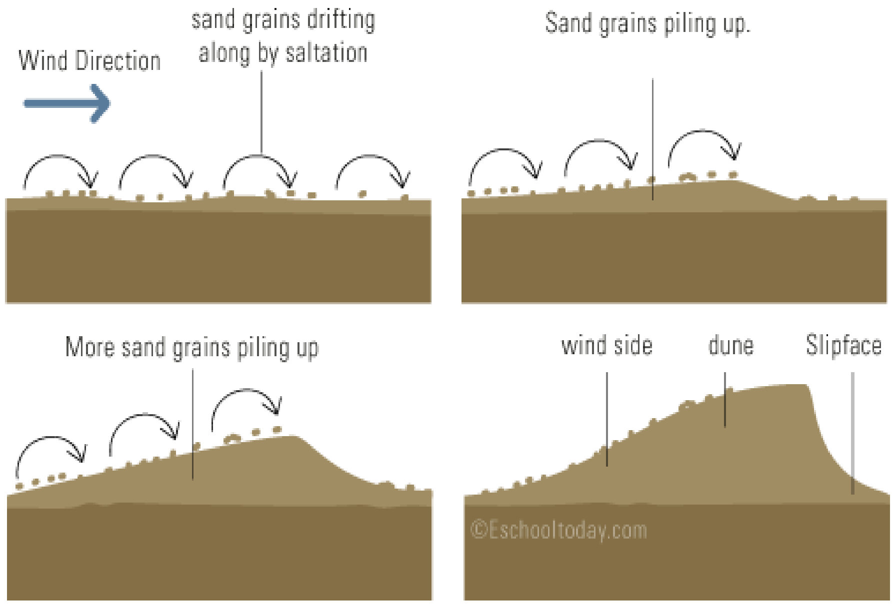
Formation of a Bar



1. A bar is formed when a spit joins two headlands together (explain how a spit is formed in any exam answer – see left)
2. The bar cuts off the bay between the headlands from the sea
3. The means a lagoon can for behind the bar


Marram grass

Formation of a sand dune



1. Sand dunes are formed when sand deposited by longshore drift is moved up the beach by the wind
2. Obstacles (e.g. driftwood) cause wind speed to decrease so sand is deposited. This sand is colonised by plants and grasses. The vegetation stabilises then sand and then encourages more sand to accumulate there, forming small dunes called embryo dunes
3. Over time the oldest dunes migrate inland as new embryo dunes are formed. These mature dunes can reach height of up to 10m

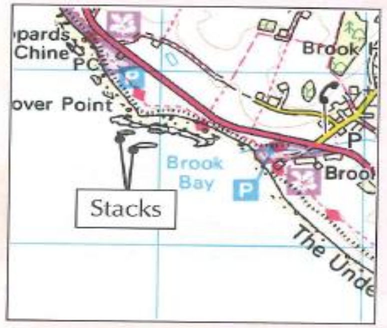
Coastal landforms on a map

Identifying Landforms Caused by Erosion

You might be asked to identify coastal landforms on a map in the exam. The simplest thing they could ask is whether the map is showing erosional or depositional landforms, so here's how to identify a few erosional landforms to get you started:

Have a lo
pages 17(
for mor
reading

Caves, Arches and Stacks



1) Caves and arches can't be seen on a map because of the rock above them.
2) Stacks look like little blobs in the sea.

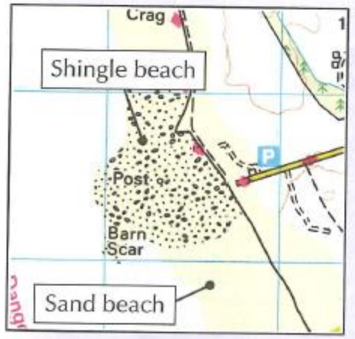
Cliffs and Wave-cut Platforms

1) Cliffs (and other steep slopes) are shown on maps as little black lines.
2) Wave-cut platforms are shown as bumpy edges along the coast.

Identifying Landforms Caused by Deposition

Identifying depositional landforms is easy once you know that beaches are shown in yellow on maps. Here's how to identify a couple of depositional landforms:

Beaches



1) Sand beaches are shown on maps as pale yellow.
2) Shingle beaches are shown as white or yellow with speckles.

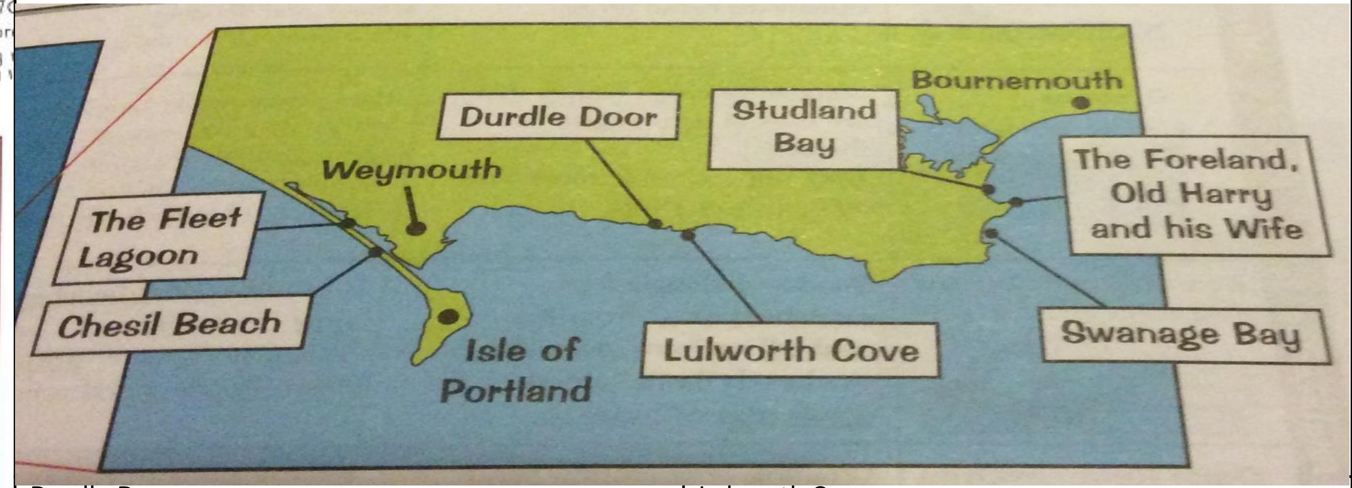
Spits

1) Spits are shown by a beach that carries on out to sea, but is still attached to the land at one end.
2) There might also be a sharp bend in the coast that caused it to form (see p.58).

Topic: Coastal landscapes

Context: The major landforms of a UK coastline

Location and map:



Durdle Door:
Durdle Door is a great example of an arch – erosion by waves opened up a crack in the limestone headland, which become a cave and then developed into an arch.

Lulworth Cove:
Lulworth Cove is a small bay formed after a gap was eroded in a band of limestone. Behind the limestone is a band of clay which has been eroded away to form the bay. The same is not starting to happen at Stair Hole further west along the coast.

Chesil Beach:
Chesil Beach is a tombolo (a type of bar) formed by longshore drift. It joins the Isle of Portland to the mainland. Behind Chesil Beach is a shallow lagoon called the fleet lagoon

Swanage Bay, The Foreland and Studland Bay:
There are two bays with beaches called Swanage Bay and Studland Bay. They're areas of softer rock (sandstone and clay). In between them is a headland called the Foreland made from a band of harder rock (chalk).The end of the headland has been eroded to become a stack called Old Harry and a stump (a collapsed stack) called Old Harry's Wife.

Example questions:
Using an example describe the features of a UK coastline – 6 marks

Hard engineering: man-made structures built to control the flow of the sea and reduce flooding and erosion

	Defence	What it is	Benefits	Costs
Hard Engineering	Sea Wall	A wall made out of a hard material like concrete that reflects waves back to sea.	It prevents erosion of the coast. It also acts as a barrier to prevent flooding.	It creates a strong backwash, which erodes under the wall. Sea walls are very expensive to build and to maintain.
Hard Engineering	Gabions	A wall of wire cages filled with rocks usually built at the foot of cliffs.	The gabions absorb wave energy and so reduce erosion. They're cheap and easy to build.	They're ugly to look at and the wire cages can corrode over time.
Hard Engineering	Rock Armour	Boulders that are piled up along the coast. (It's also sometimes called rip-rap.)	The boulders absorb wave energy and so reduce erosion and flooding. It's a fairly cheap defence.	Boulders can be moved around by strong waves, so they need to be replaced.
Hard Engineering	Groynes (← longshore drift)	Wooden or stone fences that are built at right angles to the coast. They trap material transported by longshore drift.	They create wider beaches which slow the waves. This gives greater protection from flooding and erosion. They're a fairly cheap defence.	They starve beaches further down the coast of sand, making them narrower. Narrower beaches don't protect the coast as well, leading to greater erosion and floods.
Soft Engineering	Beach Nourishment and Reprofiling	Sand and shingle from elsewhere (e.g. from the seabed) or from lower down the beach that's added to the upper part of beaches.	It creates wider beaches which slow the waves. This gives greater protection from flooding and erosion.	Taking material from the seabed can kill organisms like sponges and corals. It's a very expensive defence. It has to be repeated.
Soft Engineering	Dune Regeneration	Creating or restoring sand dunes by either nourishment, or by planting vegetation to stabilise the sand.	Sand dunes provide a barrier between the land and the sea. Wave energy is absorbed which prevents flooding and erosion. Stabilisation is cheap.	The protection is limited to a small area. Nourishment is very expensive.

Soft engineering: schemes set up using knowledge of the sea and its processes to reduce the effects of flooding and erosion

Managed retreat

1. This (also called coastal realignment) involves removing current defences and allowing the sea to flood the land behind
2. Over time the land will become marshland, which then protect the land behind from flooding and erosion
3. It is a cheap and easy strategy, and it doesn't need maintaining. The marshland can also create new habitats for plants and animals
4. Because the land is lost to the sea, choosing areas to flood can causes conflicts, e.g. flooding farmland would affect the livelihood of farmers. The saltwater can also have a negative effect on existing ecosystems


Marshland

Coasts – Management scheme in the UK

Topic: Coastal landscape	Context: A coastal management scheme in the UK

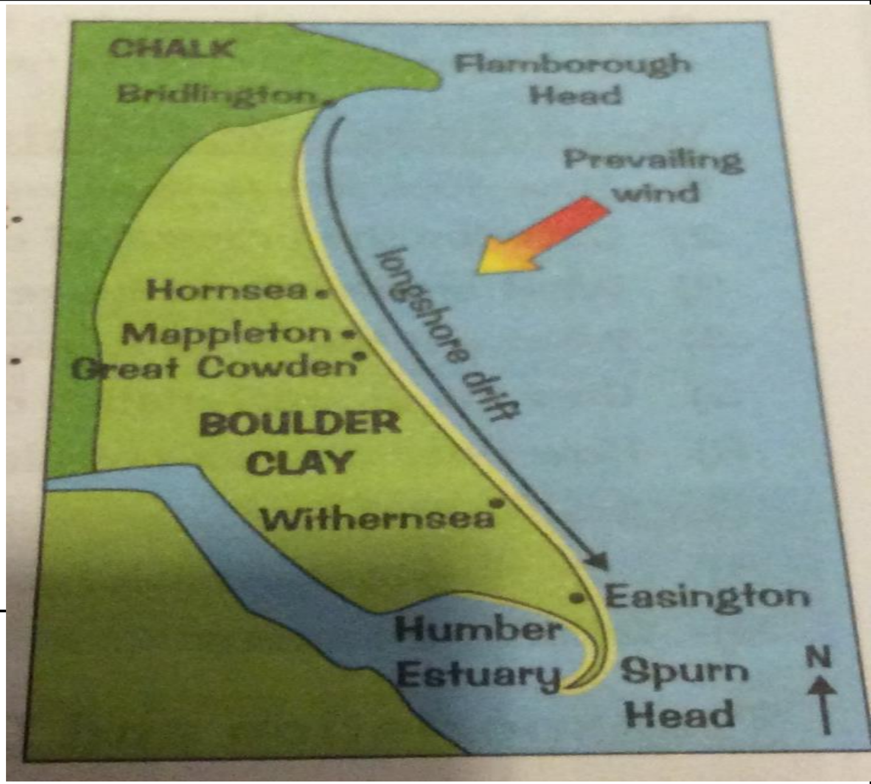
Background information:

- Erosion is causing the cliffs to collapse along the Holderness coastline. The cliffs are made from soft, easily eroded boulder clay.
- The prevailing winds mean that the eroded material is moved south along the coast by longshore drift instead of staying in the place it came from, exposing a new area of cliff to erosion and causing the coastline to retreat
- About 1.8m of land is lost to the sea every year – in some places e.g. Great Cowden the rate of erosion has been over 10m per year in recent years. Farms, businesses and homes are threatened by the erosion.

Over 11km of the Holderness coastline is managed using hard engineering strategies:

- There are towns and villages like Hornsea (pop 8000), Withernsea (pop 6000) and Mappleton where people live
- There is important infrastructure like the B1242 road which links many of the towns and businesses along the coast
- The gas terminal at Easington supplies 25% of the UK's gas and is right on the edge of the cliff.

Map of the Holderness Coastline:



Management strategy:

In 1991, 450m of coastline around Mappleton had to be protected at a cost of £2 million using over 61,000 tonnes of rock

Coastal management at Mappleton involved two types of hard engineering:

- Placing rock armour (granite boulders) along the base of the cliff to absorb the power of the waves.
- Building two rock groynes to trap sand and create a beach to absorb the power of the waves

There are also defences at Hornsea (where there is a sea wall and some groynes), and at Withernsea (where there is a sea wall, groynes and rock armour).

Conflicts caused:

The scheme was successful – the village of Mappleton and the B1242 road are no longer at risk from erosion.

However the management strategy have caused conflicts. The rock groynes prevented sediment moving south along the coast by longshore drift. This has caused increased erosion south of Mappleton and led to:

- Loss of land to the south of Mappleton – especially around Great Cowden's farms and caravan park
- The operation of coastguard and lifeboat services from Spurn Head are under threat from erosion
- A loss of habitat for wildlife on Spurn Head – lesson material is coming down the coast to collect at Spurn Head, so it is at risk of being washed away
- In 1999, a 1km stretch of coast near the gas terminal as Easington have to be protected by rock armour – at a cost of £6.6 million
- Bays forming between the protected areas and the protected areas becoming headlands
- Maintaining the defences in the protected areas is becoming more expensive and may cause conflict
- The conflicts focus on the loss of jobs and homes in the non-protected areas. The people living on the protected areas are happy as their jobs and home are protected

Rivers – River valley & processes

The river's long profile and cross profile vary over its course

Long profile: shows you how the gradient (steepness) changes over the different courses

Cross profile: shows you what a cross-section of the river looks like

1. The path of a river as it flows downhill is called its course
2. Rivers have an upper (closest to the source of the river), a middle course and lowest course (closest to the mouth of the river)
3. Rivers form channels and valleys as they flow downhill
4. They erode the landscape – wear it down, then transport the material to somewhere else where it is deposited
5. The shape of the valley and channel changes along the river depending on whether erosion or deposition is having the most impact

Course	Gradient	Valley and channel shape
Upper	Steep	V-shaped valley, steep sides Narrow, shallow channel
Middle	Medium	Gently sloping valley sides Wider, deeper channel
Lower	Gentle	Very wide, almost flat valley Very wide, deep channel

Vertical erosion: this deepens the river valley (and channel), making it V-shaped. It's dominant in the upper course of the river. High turbulence causes the rough, angular particles to be scraped along the river bed, causing intense downwards erosion.

Lateral erosion: This widens the river valley (and channel)during the formation of meanders. It's dominant in the middle and lower courses.

Processes of erosion:

Hydraulic action: the force of the water breaks rock particles away from the river channel

Abrasion: eroded rocks picked up by the river scrape and rub against the channel, wearing it away. Most erosion happens by abrasion.

Attrition: eroded rocks picked up by the river smash into each other and break into smaller fragments. Their edges also get rounded off as they rub together. The further material travels, the more eroded it gets – attrition causes particle size to decrease a river's source and its mouth

Solution: river water dissolves some types of rock, e.g. chalk and limestone

Processes of transportation:

Traction: large particles like boulders are pushed along the river bed by the force of the water

Saltation: Pebble-sized particles are bounced along the river bed by the force of the water

Suspension: Small particles like silt and clay are carried along by the water

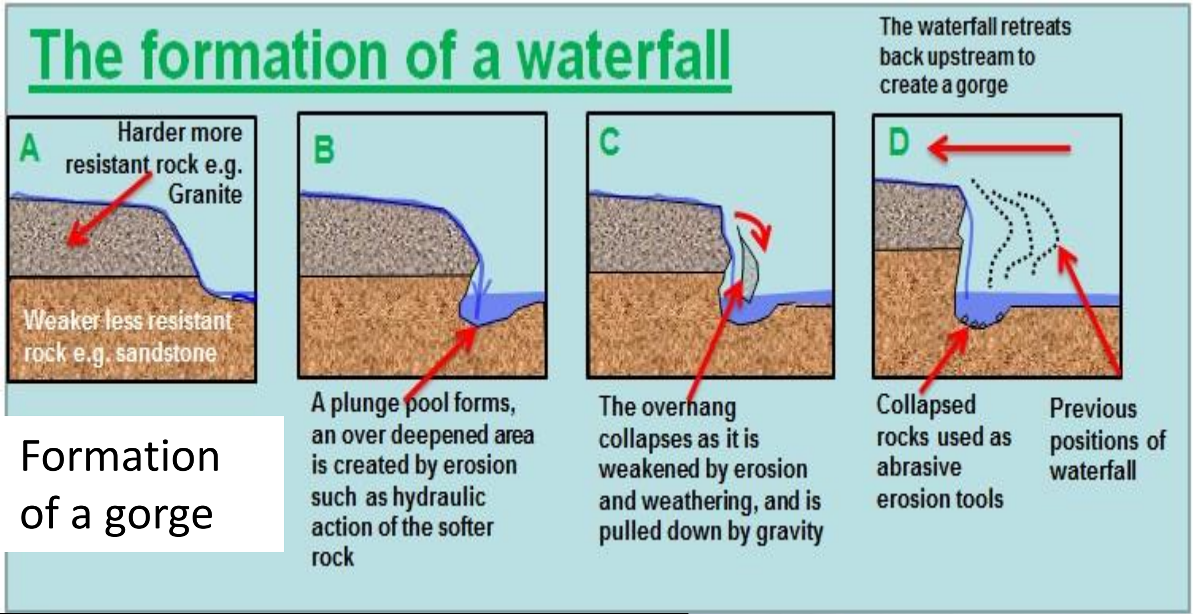
Solution: soluble materials are dissolved in the water and are carried along

Deposition:

This is when a river drops eroded material (load). It happens when a river slows down (loses velocity). This happens because:

1. The volume of water in the river falls
2. The amount of erode material in the water increases
3. The water is shallower, e.g. on the inside of a bend
4. The river reaches its mouth

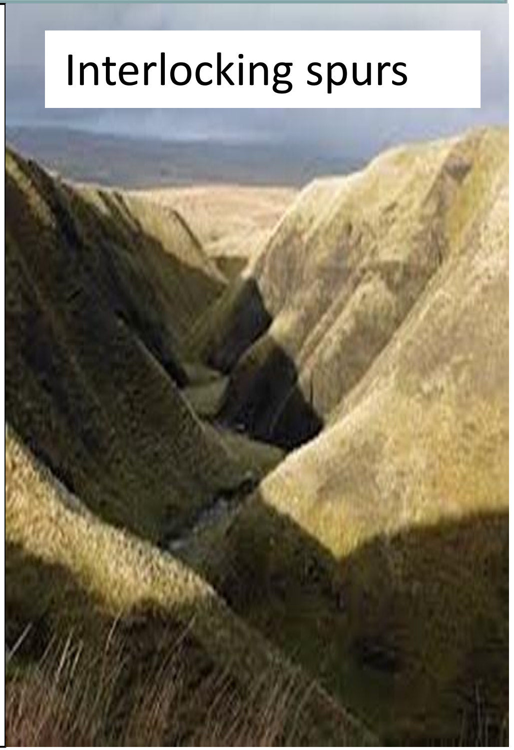
Rivers - Landforms of erosion



Formation of a gorge

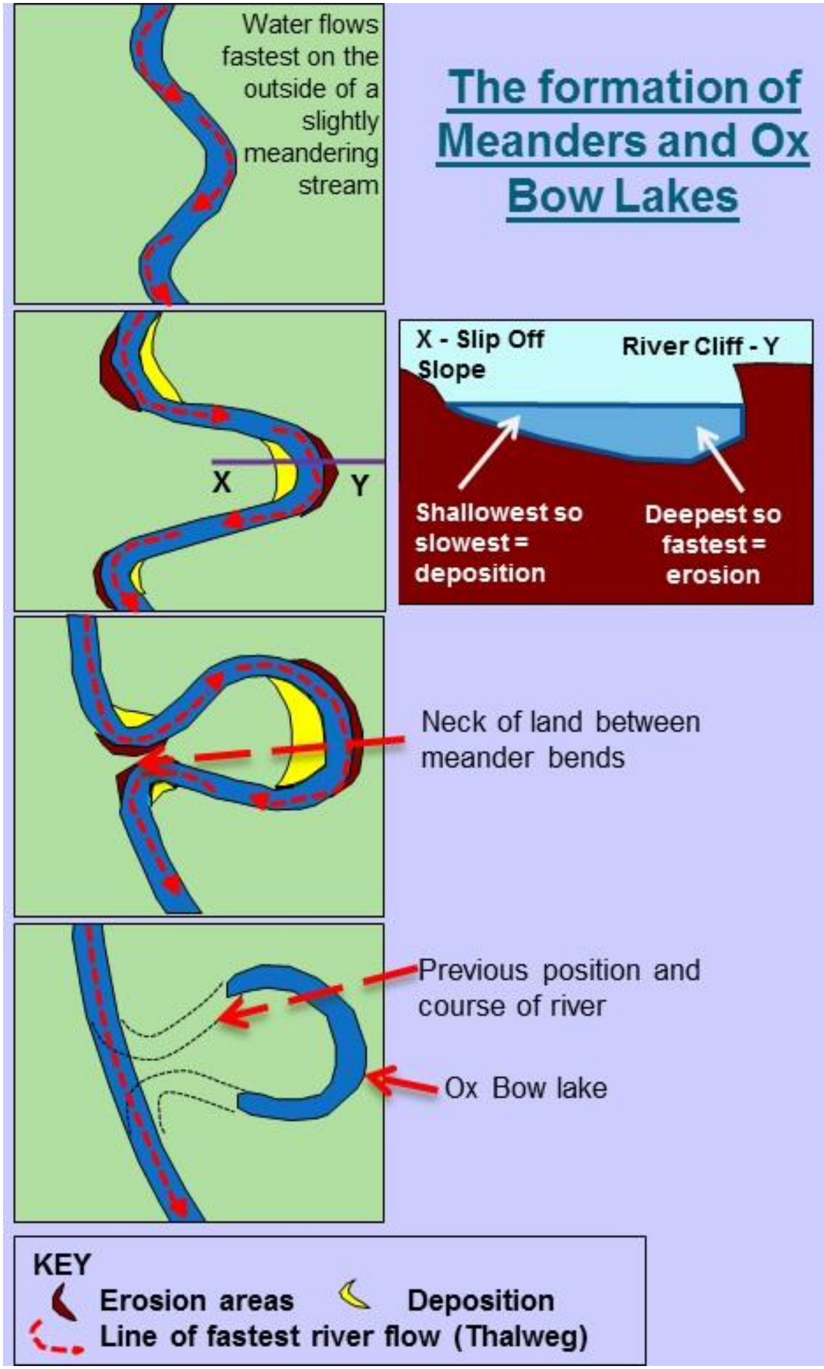
Interlocking spurs

1. In the upper course or a river most of the erosion is vertically downwards. This creates steep-sided, V-shaped valleys
2. The rivers aren't powerful enough to erode laterally (sideways) – they have to wind around the high hillsides that stick out into their paths on either side
3. The hillsides that interlock with each other (like a zip if you were looking from above) as the river winds around them are called interlocking spurs



Interlocking spurs

Rivers - Landforms of erosion & deposition



Meanders:

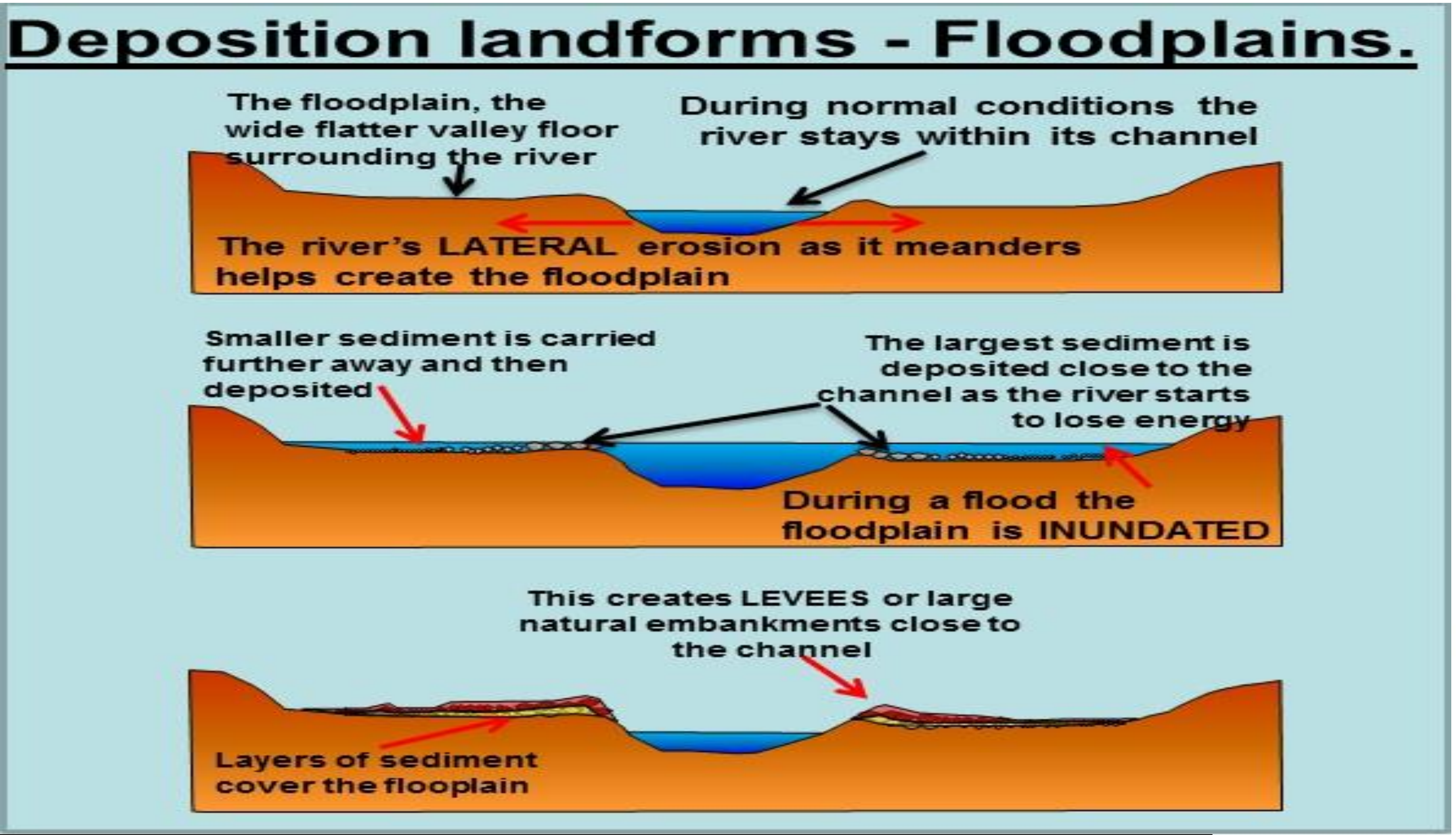
Rivers develop large bends in their middle and lower courses

1. The river flows but the bed is uneven which causes the water to become turbulent
2. This forces the current to spin and form the thalweg (fast flowing current of water in a helicoidal motion – corkscrew)
3. The current (the flow of the water) becomes faster on the outside of the bend because the river channel is deeper (there's less friction to slow the water down)
4. So more erosion takes place on the outside of the bend, forming river cliffs
5. The current is slower on the inside of the bend because the river channel is shallower (there's more friction to slow the water down)
6. So eroded material is deposited on the inside of the bend, forming slip-off slopes

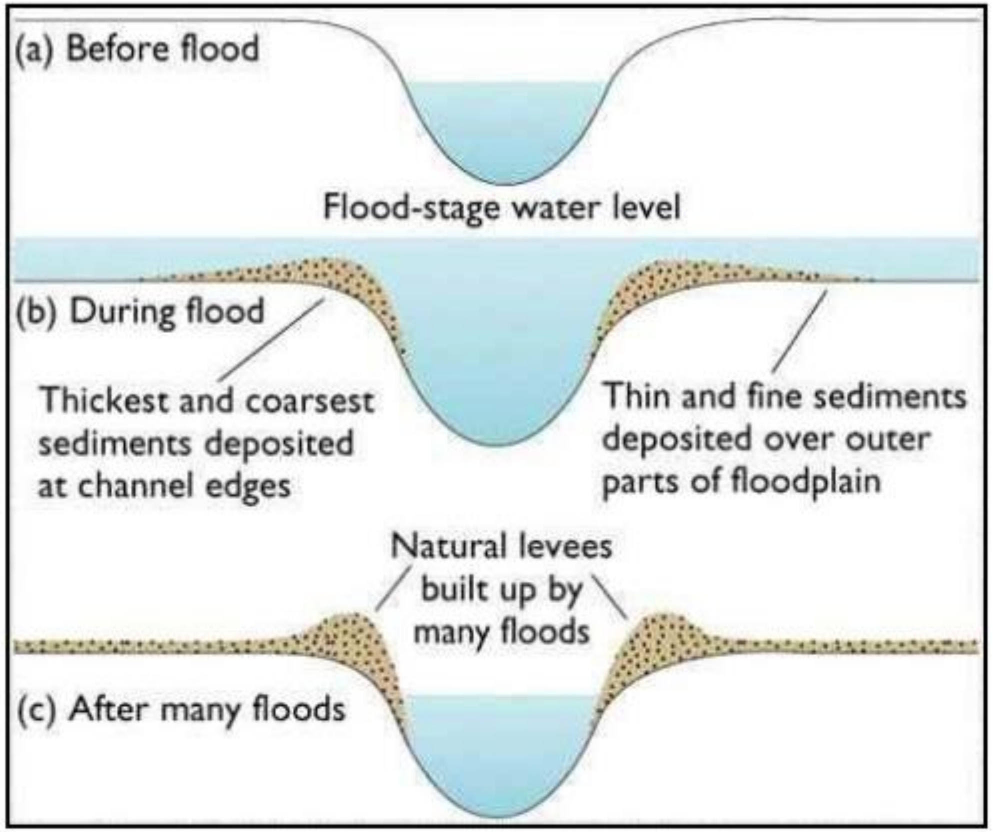
Ox-bow lakes:

1. Erosion (hydraulic action, abrasion) causes the outside of the bends to get closer
2. Until there's only a small but of land left between the bends (called the neck)
3. The river breaks through this land, usually during a flood
4. The flows along the shortest course
5. Deposition eventually cuts off the meander
6. This forms an ox-bow lake

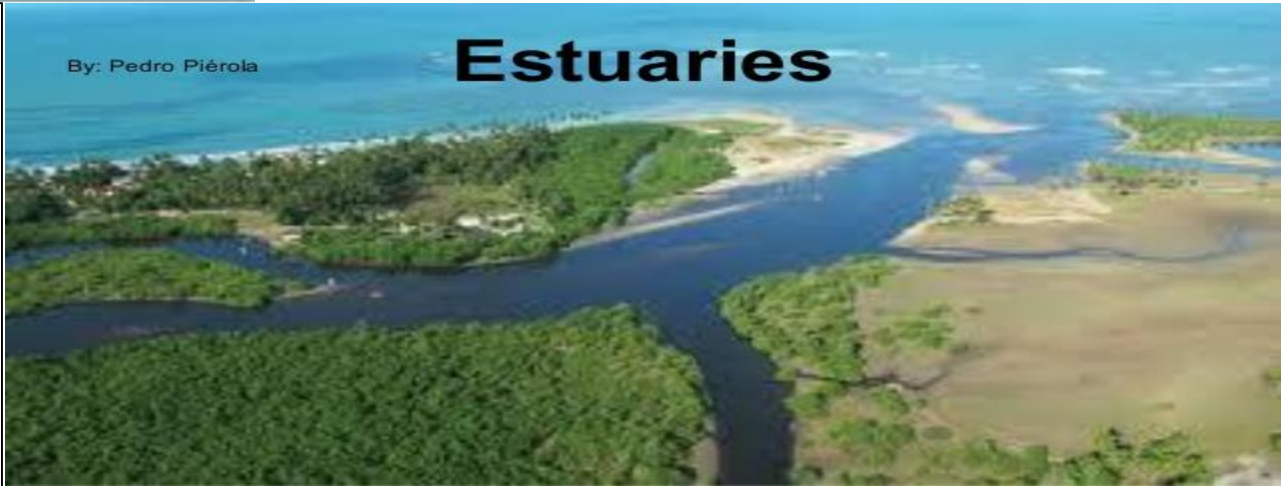
Rivers - Landforms of deposition



Levee formation



1. Estuaries are found at the mouth of a river, where it meets the sea
2. The water here is tidal – the river level rises and falls each day
3. The water floods over the banks of the river carrying the silt and sand onto the valley floor
4. As the tide reaches its highest point, the water is moving very slowly so the sediment is deposited
5. Over time, more and more mud builds up, creating large areas of mudflats
6. At low tide, the wide, muddy banks are exposed



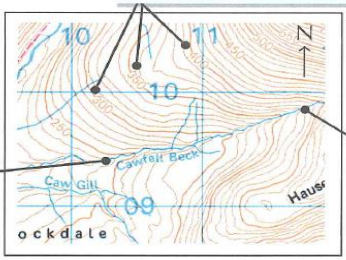
Rivers - Landforms on a map

Contour Lines Tell you the Direction a River Flows

Contour lines are the orange lines drawn all over maps. They tell you about the height of the land (in metres) by the numbers marked on them, and the steepness of the land by how close together they are (the closer they are, the steeper the slope).

It sounds obvious, but rivers can't flow uphill. Unless gravity's gone screwy, a river flows from higher contour lines to lower ones. Have a look at this map of Cawfell Beck:

Take a peek at pages 170–171 for more on reading maps.

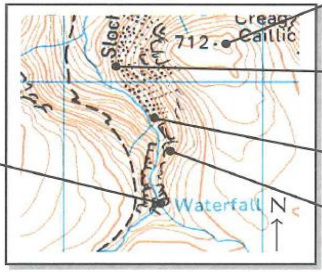


1. The height values get smaller towards the west (left), so west is downhill.
2. Cawfell Beck is flowing from east to west (right to left).
3. A V-shape is formed where the contour lines cross the river. The V-shape is pointing uphill to where the river came from.

Maps contain Evidence for River Landforms

Exam questions might ask you to look at a map and give the evidence for a landform. Remember, different landforms are found in the upper and lower course — you can use this evidence to help you identify them.

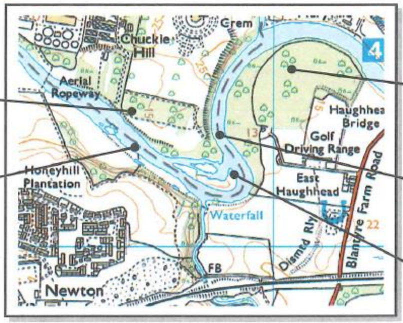
Evidence for the Upper Course



- The nearby land is high (712 m).
- The river crosses lots of contour lines in a short distance, which means it's steep.
- The river's narrow (a thin blue line).
- The contour lines are very close together and the valley floor is narrow. This means the river is in a steep-sided V-shaped valley.
- Waterfalls are marked on maps, but the symbol for a cliff (black, blocky lines) and the close contour lines are evidence for an upper-course waterfall.

Evidence for the Lower Course
in a steep-sided V-shaped valley.

Evidence for the Lower Course

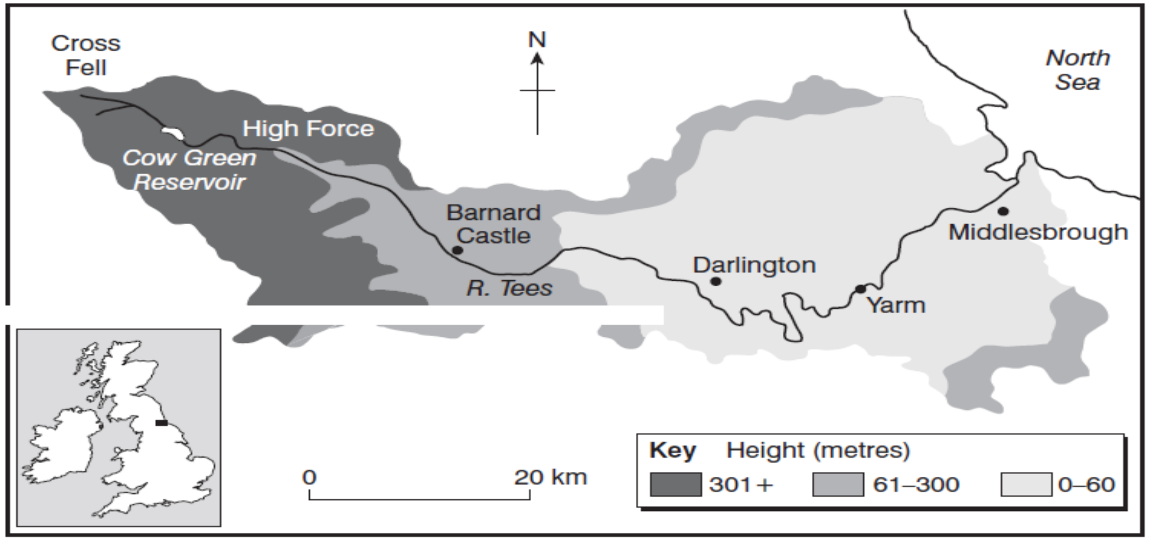


- The nearby land is low (less than 15 m).
- The river doesn't cross any contour lines so it's very gently sloping.
- The river meanders across a large flat area (no contours), which is the flood plain.
- The river's wide (a thick blue line).
- The river has large meanders and an ox-bow lake may be formed here.

Topic: River landscapes | Context: Landforms in a UK river valley

Location and map:

The River Tees, north-east England



Upper course:

Source: this is found to the west of the mouth. It starts at Cross Fell – it is 893 metres above sea level. The river flows east to its mouth

The valley is v-shaped and the river is turbulent and clear

Water fall at High Force with a gorge and rapids. The gorge is formed from the waterfall retreating and the water fall is 21 metres high.

Middle course:

The gradient is less steep here and the river begins to erode sideways rather than downwards. The river gets wider and river valley gets wider and meanders begin to form.

Meanders:

This is a bend in the river. As the bends get bigger their erode across the flood plain and make a large U-shaped valley

Lower course:

Very large meanders at Yarm – this has led to the formation of ox-bow lakes

Flooding has caused Levees to form

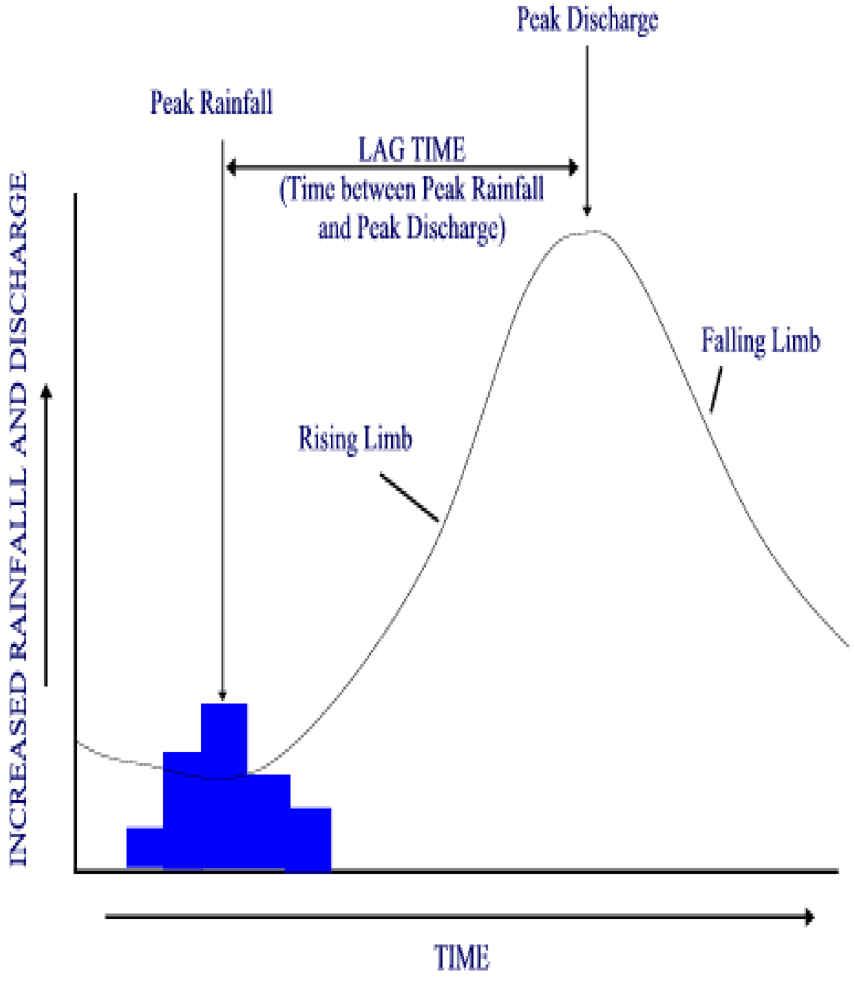
The lateral erosion (sideways) by the meanders and the occasional floods build up a wide, flat flood plain on either side of the River. Here the valley is a broad U-shape with quite gentle sides

The mouth the River Tees is an estuary – this is a river valley in a lowland area that has been flooded. It is very wide and has mudflats and sandbank. It is an important wildlife area and some areas are Special Sites of Scientific Interest (SSSI's)

River discharge is the volume of water flowing in a river:

Discharge is measured in cumecs.

Hydrographs show how the discharge at a certain point in a river changes over time in relation to rainfall



Rivers – River discharge and flooding

Peak discharge: the biggest discharge in the period of time you're looking at
Lag time: the delay between peak rainfall and peak discharge
Rising limb: the increase in river discharge as rainwater flows into the river
Falling limb: the decrease in river discharge as the river returns to its normal flow

Lag time happens because most rainwater doesn't land directly in the river channel – there's a delay as rainwater gets to the channel. It gets there by flowing quickly overland (called surface runoff, or just runoff), or by soaking into the ground (called infiltration) and flowing, slowly underground

Rivers flood due to physical and human factors

Flooding happens when the level of a river gets so high that it spills over its banks. The river level increases when the discharge increase because a high discharge means there's more water in the channel. This means the factors that increase discharge can cause flooding.

Factor	Why it causes flooding
Prolonged rainfall (physical)	After a long period of rain, the soil becomes saturated. Any further rainfall can't infiltrate, which increases runoff into rivers. This increases discharge quickly, so flooding is more likely.
Heavy rainfall (physical)	Heavy rainfall means the water arrives too rapidly for infiltration so there's a lot of rainfall. This increases discharge quickly, increasing the risk of a flood.
Geology (rock type) (physical)	Clay soils and some rocks, e.g. granite and shale are impermeable (i.e. they don't allow infiltration) so runoff is increased. When it rains, discharge increases quickly, which can cause a flood.
Relief (change in the height of the land) (physical)	If a river is in a steep-sided valley, water will reach the river channel much faster because water flows more quickly on stepper slopes. Discharge increases rapidly, increasing, the flood risk.
Land use (human)	1. Buildings are often made from impermeable materials, e.g. concrete, and they're surrounded by roads made from tarmac (also impermeable). Impermeable surfaces increase runoff and drains quickly take runoff to rivers – discharge increases quickly, so there's a greater risk of flooding. 2. 2. Tree intercept rainwater on their leaves, which then evaporates. Trees also take up water from the ground and store it. This means cutting more trees increases the volume of water that reaches the river channel, which increases discharge and make flooding more likely.

Hard engineering:
Man-made structures built to control the flow of rivers and reduce flooding

River management

Soft engineering:
Schemes set up using knowledge of a river and its processes to reduce the effects of flooding

Method	What it is	Benefits	Disadvantages
Dams and reservoirs	Dams (huge walls) are built across the rivers, usually in the upper course. A reservoir (artificial lake) is formed behind the dam.	Reservoirs store water, especially during periods of prolonged or heavy rain, reducing the risk of flooding. The water in the reservoir can be used as drinking water and to generate hydroelectric power (HEP).	Dams are very expensive to build. Creating a reservoir can flood existing settlements. Eroded material is deposited in the reservoir and not along the river's natural course so farmland downstream can become less fertile.
Channel straightening	The river's course is straightened — meanders are cut out by building artificial straight channels.	Water moves out of the area more quickly because it doesn't travel as far — reducing the risk of flooding.	Flooding may happen downstream instead, as water is carried there faster. There's more erosion downstream because the water's flowing faster.
Embankments	Raised walls are built along the river banks.	The river can hold more water so it will flood less frequently, protecting buildings on the flood plain.	They're quite expensive and there's a risk of severe flooding if the water rises above the level of the embankments or if they break.
Flood relief channels	Channels are built that divert the water around important areas or take it elsewhere if the water level in the river gets too high.	Flooding is prevented because river discharge is reduced. Gates on the flood relief channels mean that the release of water can be controlled.	There will be increased discharge where the relief channel rejoins the river (or joins another river) which could cause flooding in that area. If the water level gets too high for the relief channels they could also flood.

Method	What it is	Benefits	Disadvantages
Flood warnings	The Environment Agency warns people about possible flooding through TV, radio, newspapers and the internet.	The impact of flooding is reduced — warnings give people time to move possessions upstairs, put sandbags in position and to evacuate.	Warnings don't stop a flood from happening. People may not hear or have access to the warnings.
Preparation	Buildings are modified to reduce the amount of damage a flood could cause. People make plans for what to do in a flood — they keep items like torches and blankets in a handy place.	The impact of flooding is reduced — buildings are less damaged and people know what to do when a flood happens. People are also less likely to worry about the threat of floods.	Preparation doesn't guarantee safety from a flood and it could give people a false sense of security. It's expensive to modify homes and businesses.
Flood plain zoning	Restrictions prevent building on parts of a flood plain that are likely to be affected by a flood.	The risk of flooding is reduced — impermeable surfaces aren't created, e.g. buildings and roads. The impact of flooding is also reduced — there aren't any buildings to damage.	The expansion of an urban area is limited if there aren't any other suitable building sites. It's no help in areas that have already been built on.
Planting trees	Planting trees in the river valley increases interception of rainwater and also increases the lag time.	Discharge and flood risk are reduced. Vegetation reduces soil erosion in the valley and provides habitats for wildlife.	Less land is available for farming.
River restoration	River restoration involves making the river more natural, e.g. by removing man made levees, so that the flood plain can flood naturally.	There is less risk of flooding downstream because discharge is reduced. Little maintenance is needed as the river is left in its natural state and there are better habitats for wildlife.	Local flood risk can increase, especially if nothing's done to prevent major flooding.

Rivers - flood management

Topic: River landscapes	Context: Flood management on a UK river
Location: The River Tees, north-east England	
Why is the scheme needed? • To reduce flooding – lots of serious flooding at Yarm • To improve water supply • To improve water quality • To improve navigation • To provide more opportunities for recreation	
Management strategies • Cow Green Reservoir – this was built in the upper course to store water for the growing areas of population. The reservoir holds a lot of water and slows down the amount of water entering the river reducing its discharge and making flooding less likely • At Yarm – discouraging building on the floodplain, improve flood warning systems with the Met Office, the police and other emergency services. They built reinforced concrete walls with metal flood gates for access by people and vehicles, Earth embankments, Gabions to protect wall and embankment from erosion. • The Tees Barrage – (a man-made barrier across a river) – the aim of the Tees Barrage was to improve the water quality and recreational value of 22km of the lower Tees. It reduces the risking of flooding at high tides or during a storm surge.	

The effects		
Social impacts/effects	Economic impacts/effects	Environmental impacts/effects
The flood defences at Yarm means people do not fear flooding anymore. People can leave their house and it will be in the same condition as they left it.	The defences cost £56.1 million. This is far too much. The money should be used for schools, hospitals and to fix potholes in the roads.	The dredging of the river removes the bed which is so important for a range of insects and fish. The insects live here and are food for the fish. The fish in turn lay their eggs on the bed. Removing the bed ill see a reduction in fish numbers which is bad for otters and fishermen.
The area around the barrage has been regenerated. There are new cafes and kayaking course which provides jobs and another source of income for local people. There are new footpaths which are wheelchair accessible so everyone can enjoy the river.	The cost is justified when it stops houses and businesses kept getting flooded. With global warming it is predicted that there will be more floods in the future. The cost of repairing the houses will go up so the flood defence scheme will stop this.	The dredging of the river removes the bed which is so important for a range of insects and fish. The insects live here and are food for the fish. The fish in turn lay their eggs on the bed. Removing the bed ill see a reduction in fish numbers which is bad for otters and fishermen.

Conflicts:

There are numerous conflicts. The main ones are between the environmentalists and the flood management engineers. Dredging of the river destroys habitats for endangered species. Fishermen and the Environment Agency are in conflict as the dredging removes habitat for salmon which the fishermen like to catch.