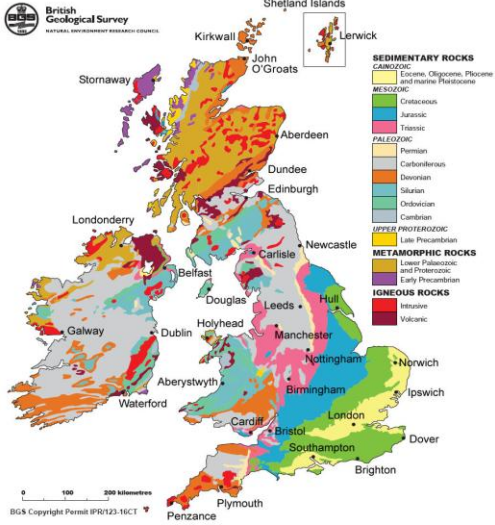




UNIT 1: CHANGING LANDSCAPE OF THE UK



THE UK'S GEOLOGY

The UK's **geology** is varied, with different rock types found in a range of locations across the country. All three distinct rock types – sedimentary, metamorphic and igneous – can all be found in the UK, and each presents distinct characteristics due to their unique formation.

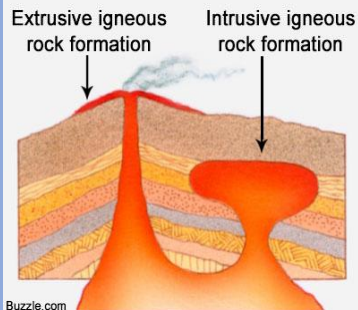
ROCK TYPE	CHARACTERISTICS	EXAMPLES	DISTRIBUTION
Sedimentary	Formed in layers, often contain fossils.	Chalk, sandstone	South East
Metamorphic	Formed by heat/pressure, crystals arranged in layers.	Marble, slate	Scotland, especially Hebrides
Igneous	Formed from magma, random crystal, very resistant to erosion.	Basalt, granite	Northern Ireland, Cornwall, Northern Scotland

FORMATION OF DIFFERENT ROCK TYPES

Sedimentary: Formed when weathered or eroded rocks and dead sea creatures are transported and deposited in layers. The weight of the sediment above causes layers at the bottom to compact and over millions of years, rocks are formed.

Metamorphic: Formed when sedimentary or igneous rocks are changed by extreme pressure or heat. These cause the rocks to change chemically.

Igneous: Formed when molten rock (magma) cools. There are two different types of igneous rock that can form through this process: intrusive and extrusive rocks.



IGNEOUS ROCK FORMATIONS

Intrusive igneous rocks are formed by magma that cools slowly underground. They are characterised by large crystals. An example is granite.

Extrusive igneous rocks are formed by magma that cools quickly above ground. These are characterised by small crystals. An example is basalt.

HUMAN ACTIVITY IN UK LANDSCAPES



Settlement building: Mass deforestation took place to make room for settlements. New build housing may not be reflective of local character in material and design, losing distinctiveness.



Agriculture: Decline in chalk grasslands due to the use of chemicals in farming. Agriculture clears the natural surface of vegetation and replaces it with monoculture and/or an artificial landscape.



Forestry: Planting coniferous trees has led to reduction of biodiversity in tree species, as deciduous are native. Cutting down large areas of forest has further worsened this issue.

UPLAND AND LOWLAND LANDSCAPES



UPLAND LANDSCAPES

Location of upland landscapes

Scotland: Cairngorm Mountains, Grampian Mountains e.g. Ben Nevis, the UK's highest peak.

Wales: Snowdonia e.g. Snowdon, Brecon Beacons.

England: The Pennines, Lake District e.g. Scafell Pike, Dartmoor and Exmoor.

Formation of upland landscapes

Geology: Made of more resistant rock types e.g. igneous or metamorphic rocks, which erode at a far slower rate.

Tectonic processes: Millions of years ago, the UK was closer to plate boundaries than today. Tectonic activity led to the formation of the geology and landscapes of today, for example, the igneous and metamorphic rock roots were formed through volcanic activity.

Glaciation: Glacial erosion during the last ice age led to rocks above the granite being eroded and the intrusive rock left exposed. It has also created U shaped valleys, hilltops and ridges found in our landscapes.

River processes: Mass movement, particularly rock fall during glacial and interglacial periods, cause broken off rocks to move downslope.

Weathering: Mechanical, biological and chemical weathering have been influenced by changes in the climate. For instance, glacial periods led to more mechanical (freeze-thaw) weathering, whilst the hot and humid climate of the South West accelerates weathering too.



LOWLAND LANDSCAPES

Location of lowland landscapes

Lowland landscapes are predominantly found in southern and eastern parts of England.

England: The Wash (East Anglia), Lincolnshire, London Basin, Vale of York.

The Fens (East Anglia) are the lowest part of the UK.

Formation of lowland landscapes

Geology: Sedimentary rocks. Lowland landscapes are not always flat, and can contain rolling hills, but they tend to be lower than uplands as the rock type is less resistant to physical processes.

Tectonic processes: 250-350 million years ago, the UK was surrounded by warm, tropical seas rich in plant and animal life. Dead plant and sea creatures were deposited on the sea bed in layers, forming sedimentary rocks.

Glaciation: The lowland areas of the UK were shaped by glacial erosion to a greater extent than upland landscapes. These formed distinctive lowland landscapes continually shaped by river processes today.



UNIT 1A: COASTAL LANDSCAPES AND PROCESSES

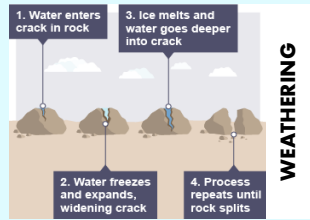
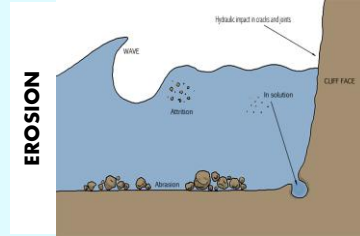
PHYSICAL PROCESSES

Hydraulic action: Water crashing into joints and faults causes pressure to increase, breaking the rock apart.

Abrasion: Rocks carried in waves grind away at the cliff face.

Attrition: Rocks being carried by waves hit into each other, causing them to become smaller, smoother, and rounder.

Solution: Rock minerals dissolve in the water.



WEATHERING

Biological: Plant roots get into cracks in the rock. As plant grows, rock is forced apart. Burrowing animals may cause rock to weaken.

Chemical: Slightly acidic rainwater reacts with minerals in rock, causing it to dissolve.

Mechanical: One example of this is freeze-thaw, where the repeated freezing and thawing of water causes a crack to widen over time and the rock forced apart.

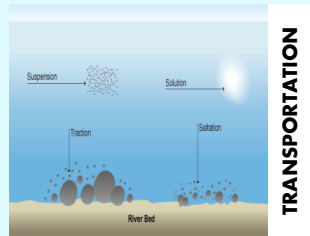
Coastal cliffs become less steep over time as material is moved by:

Sliding: Where weathered/eroded rock or earth material moves down a slope. Gravity pulls the weakened material downwards quickly.

Slumping: When saturated (filled with water) soil slumps down a curved surface. Common after heavy rainfall or storm surges in winter.



MASS MOVEMENT



TRANSPORTATION

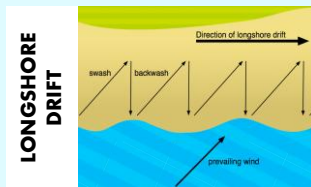
Solution: Minerals in rocks like chalk and limestone are dissolved in water and carried in solution – the load is not visible.

Suspension: Small particles are suspended in flow of water.

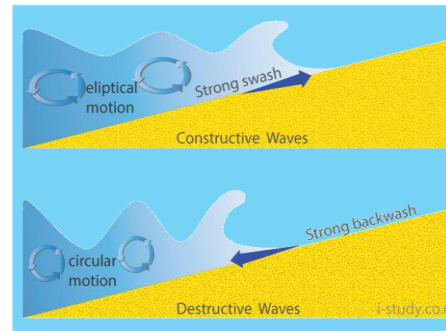
Saltation: Where small pieces of shingle bounce along the sea bed.

Traction: Larger material are rolled along the sea bed e.g. boulders.

Due to the direction of the prevailing wind (strongest wind), waves approach coast at an angle. The swash carries material towards the beach, and the backwash carries material back down the slope of the beach and back out to sea at a right angle due to gravity. Over time, this process repeats and material moves along the beach in a zig-zag formation.



LONGSHORE DRIFT



WAVE TYPES

Constructive waves have a strong swash (wave moving towards the coast) and a weak backwash (wave moving away from the coast). This means that they bring material to the beach and contribute to the creation of depositional landforms such as beaches and spits.

Destructive waves have a weak swash and a strong backwash. These are responsible for erosion, forming arches, bays and wave-cut platforms.

COASTAL LANDFORMS

Longshore drift moves material along the coastline, its direction dictated by the prevailing wind. As the coastline changes direction, material is deposited offshore due to a loss of energy in the water. Over time, there is a build up of material off the coast, forming a spit. Gradually, the spit can become hooked or recurved, its shape influenced by both the river and coast. Behind the spit, mudflats or a saltmarsh can form, creating a habitat for seabirds and marine life.

Bars are formed in a similar way to spits. They occur where there is a gap in the coast with water in it. This might be a bay or a natural hollow along the coast. The process of longshore drift occurs and carries material across the front of the bay. The deposited material eventually joins up with the other side of the bay and a strip known as a sand bar blocks off the water in the bay. The area behind this newly formed bar is known as a lagoon.

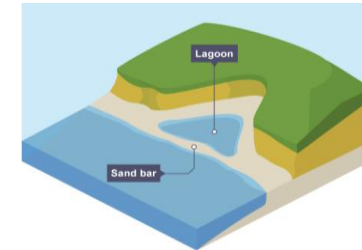
Wave refraction causes waves to attack the side of the headland. This causes faults in the rock to be exploited through processes of erosion (hydraulic action and abrasion), which widen over time to create caves. Over time, erosion cuts through to the other side of the headland and an arch is formed. Consequently, due to a lack of support, the arch collapses under the force of gravity and a stack is left behind in the water, separated off from the mainland.

The sea attacks the base of the cliff between the high and low water mark. A wave-cut notch is formed by erosional processes such as abrasion and hydraulic action. This causes the notch to increase in size, and the top of the cliff is weathered, causing it to weaken further. Over time, the instability of the cliff will result in eventual collapse, resulting in mass movement as a large quantity of material falls onto the beach or in the water. The backwash transports this material away, revealing a wave-cut platform. This process will repeat, causing the cliff to retreat further back over time.

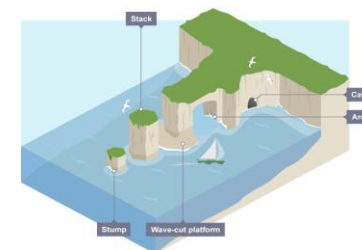
LONGSHORE DRIFT & SPIT FORMATION



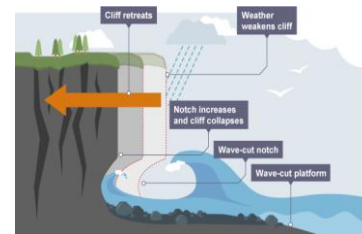
BAR FORMATION



CAVES, ARCHES, STACK & STUMPS



WAVE-CUT PLATFORMS





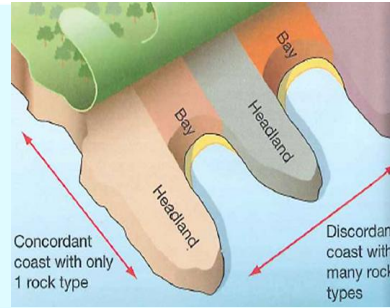
UNIT 1A: COASTAL LANDSCAPES AND PROCESSES

GEOLOGY OF THE COASTLINE

Concordant coastlines are found where there is only one rock type present. **Discordant** coastlines, by comparison, are made up of alternating rock types and will therefore experience differential erosion.

Hard rocks are more resistant e.g. igneous which will be less affected by weathering and erosion. These will form headlands.

Soft rock are less resistant rocks e.g. sedimentary which will be more vulnerable to physical processes.



LOCATED EXAMPLE: HOLDERNESS COASTLINE

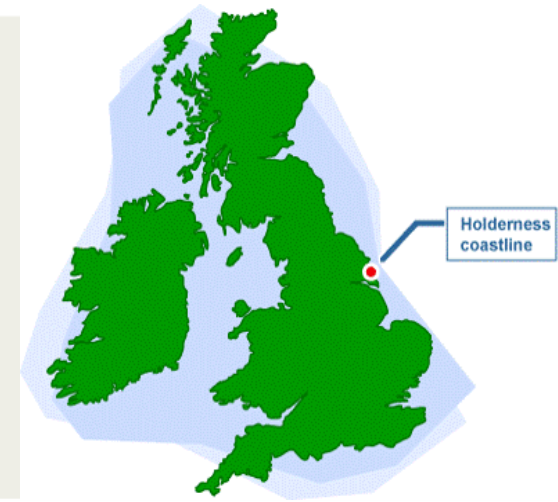
The Holderness Coastline is the fastest eroding coastline in Europe, eroding at an average rate of 2 metres per year, rising to 7-10 metres in particularly stormy years. The area is mostly rural and sparsely populated, with the most dominant land use being for agriculture.

Geology: Discordant coastline composed of soft boulder clay that is easily eroded and more susceptible to slumping after heavy rain.

Fetch: Large fetch over the North Sea, resulting in destructive waves and strong winds hitting the Holderness coast.

Physical processes: Rapid erosion due to geology and fetch. Clay slumps after rainfall (mass movement), and strong waves contribute to transportation of material that is then deposited further south e.g. the spit at Spurn Point.

Human intervention: Rock groynes at Mableton trap sediment, depriving beaches further south of material.



IMPACTS OF COASTAL EROSION



These may vary by coastline, its geology and any existing sea defences, but may include:

Social: Disruption to electricity supplies, damage to transport and communication networks, loss of people's homes.

Economic: Decreasing value of property, difficulty obtaining home insurance, loss of business from disappearing cliffs, loss of agricultural land, reduction in tourism.

Environmental: Wildlife habitats destroyed for plants and animals, particularly nesting seabirds.

COASTAL DEFENCES



SEA WALL



ROCK ARMOUR/RIP RAP



GROYNES



BEACH NOURISHMENT

	HOW IT WORKS	ADVANTAGES/DISADVANTAGES
SEA WALL	A curved concrete wall that deflects waves back out to sea to reduce erosion.	Most effective solution that lasts a long time, promenade for tourists to enjoy. Expensive (£6k a metre), visually displeasing and can make beach less accessible
ROCK ARMOUR	Large boulders at the base of a cliff that absorb wave energy. The gaps between the rocks allow the water through, dissipating the energy.	Effective protection for many years, acts as a barrier in front of the cliff. Expensive to transport boulders, beach inaccessible, different to local geology.
GROYNES	Wooden/rock structures built at right angles that trap sediment being transported through longshore drift. Built up beach can absorb energy.	Quick to construct, widens the beach to attract more tourists. Stops longshore drift which leads to more erosion further along coast, wooden groynes can rot.
BEACH NOURISHMENT	When sand/shingle is added to the beach to make it wider. The beach can absorb more wave energy and protect the coastline.	Provides beach for tourists, looks natural, cheaper than hard engineering strategy. Requires constant maintenance as material is washed away, so can become costly

HOW DOES THE UK'S WEATHER AND CLIMATE AFFECT THE COAST?

Prevailing wind: The UK's prevailing winds come from the south-west. This brings warm, moist air from the Atlantic and frequent rainfall, which contributes to weathering and mass movement on the coast.

Seasonality: In the winter, cold temperatures lead to freeze-thaw weathering in cliffs. This is also the season in which storms are most frequent.

Storm frequency: Frequent storms can damage delicate coastal landforms like spits. Beach sediment may be removed from sections of the coastline, which may lead to increased rates of erosion in these places.

Climate change: A warmer climate causes thermal expansion and glacier melt, contributing to rising sea levels. This will result in greater rates of erosion and coastal retreat increasing in places.



If an engineering strategy cannot be justified then **managed retreat** is implemented, which is the controlled flooding of low-lying coastal areas to reduce the volume of water available to flood other built-up areas of land containing buildings and houses. This is a low-cost strategy and it can create a salt marsh which can encourage wildlife, however landowners have to be compensated for lost land.



UNIT 1B: RIVER LANDSCAPES AND PROCESSES

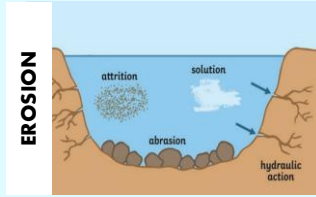
PHYSICAL PROCESSES

Hydraulic action: Water crashing into river bed causes air to become trapped in cracks, breaking the rock apart.

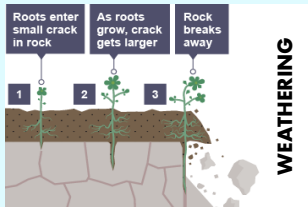
Abrasion: Pebbles grind against river bed, creating a sand-paper like effect.

Attrition: Rocks being carried by the river hit into each other, causing them to become smaller, smoother and rounder.

Solution: Rocks are dissolved e.g. limestone and carried by the water.



EROSION



WEATHERING

Biological: Plant roots get into cracks in the rock. As plant grows, rock is forced apart. Burrowing animals may cause rock to weaken.

Chemical: Slightly acidic rainwater reacts with minerals in rock, causing it to dissolve.

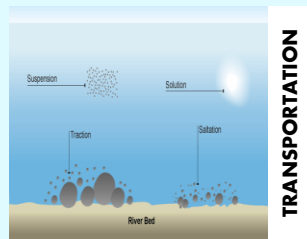
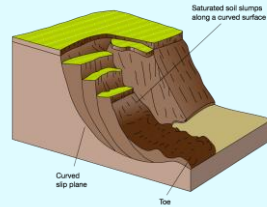
Mechanical: One example of this is freeze-thaw, where the repeated freezing and thawing of water causes a crack to widen over time and the rock forced apart.

River valleys become less steep over time as material is moved by:

Sliding: Where weathered/eroded rock or earth material moves down a slope. Gravity pulls the weakened material downwards quickly.

Slumping: When saturated (filled with water) soil slumps down a curved surface. Common after heavy rainfall caused by winter storms.

MASS MOVEMENT



TRANSPORTATION

Solution: Minerals in rocks like chalk and limestone are dissolved in water and carried in solution – the load is not visible.

Suspension: Small particles and silts are suspended in flow of water.

Salutation: Where large pebbles are bounced along the river bed.

Traction: Larger material is rolled along the river bed e.g. boulders.

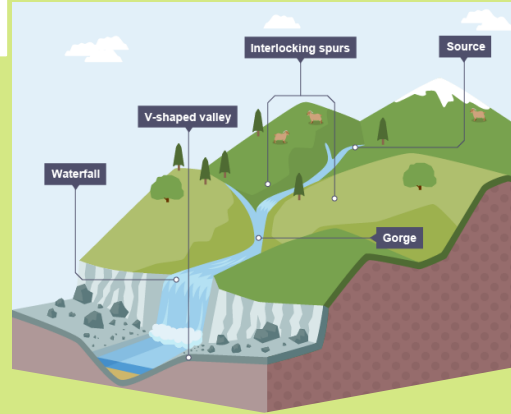
The rate at which these physical processes occur will vary at different points along a river's course:

Upper: Vertical erosion is the main process, often through hydraulic action and abrasion.

Middle: Tributaries increase the volume of water, leading to more energy for lateral erosion and transportation.

Lower: The energy of the river decreases, leading to greater rates of deposition.

RIVER LANDFORMS FROM SOURCE TO MOUTH



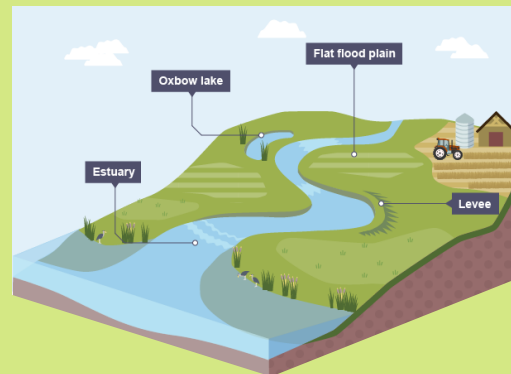
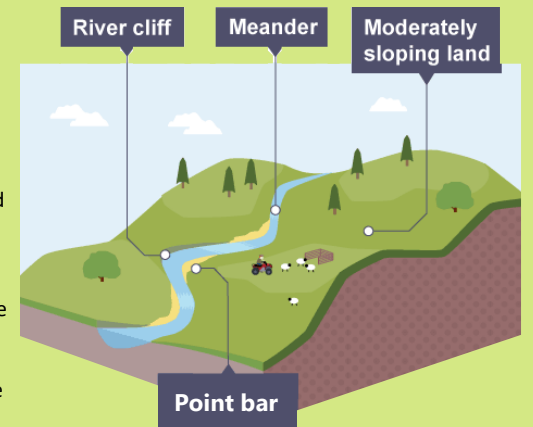
In the **upper course**, rivers are shallow (low discharge) and have less energy (slower velocity) due to friction with the riverbed. The surrounding land is made up of varying rock types, some of which are more resistant to erosion. The river will wind around these areas, cutting down into weaker rock which creates **interlocking spurs**. As the main form of erosion in the upper course is vertical, V-shaped valleys will also feature in upper course landscapes.

Waterfalls are formed in areas where hard rock overlies softer rock. The soft rock is less resistant and erodes faster, creating a **step**, with a **plunge pool** at the bottom. As the river flows over the step, hydraulic action and abrasion deepen and widen the plunge pool and the soft rock erodes further. When the overhang becomes top heavy and unstable it breaks off, collapsing into the plunge pool beneath. Over time, this process will repeat, leading to waterfall recession and a **gorge** being created.

Moving into the **middle course**, the river deepens and widens due to vertical and lateral erosion. This causes the velocity (speed) and the discharge (volume of water) to increase, resulting in the formation of distinctive landforms.

Meanders are formed through erosional and depositional processes. The forces of the fast-flowing water erode the outside bend of the river, undercutting the bank and forming a steep **river cliff**. On the inside bend, the river is shallower and moves slower. Less energy results in deposition and the formation of a point bar. Continued erosion will widen the meanders over time.

Where land is flatter in the middle/lower course, **ox-bow lakes** feature. These are formed when continued erosion of the outside bend of a river cause the neck of the meander to narrow. In a flood, the water breaks through the neck and takes the straighter, faster route. This causes material (alluvium) to be deposited in the old bend, cutting it off and creating an ox-bow lake.



The relief of the land is flattest in the **lower course** of the river. Gravity has less of an influence, resulting in a slower velocity and more deposition occurring.

Floodplains are wide, flat areas either side of a river which are covered in water in event of a flood. When this occurs, the water loses speed and energy once it leaves the river channel, causing deposition to occur. The largest/heaviest material is deposited on the banks since it requires the most energy to be transported. Over time, further flooding will raise the height of the floodplain and cover it in a material called **alluvium**, which makes the land very fertile and good for agriculture. The steeper riverbanks are known as **levees**, and these decrease future flood risk as the river channel can hold a greater volume of water.

Estuaries are found where a river meets the sea. The river here is tidal and when the sea retreats, the volume of water in the estuary reduces. This will result in deposition and the formation of mudflats, an important wildlife habitat.



UNIT 1B: RIVER LANDSCAPES AND PROCESSES

HOW DOES THE UK'S WEATHER AND CLIMATE AFFECT RIVERS?

Droughts: Decreased erosion, weathering and transportation due to a loss of energy resulting from lower discharge (volume of water). Baked soil becomes impermeable which increases surface-run off and flood risk.

Seasonality: More freeze-thaw weathering in the winter when temperatures are colder.

Storms: Heavy rainfall from storms leads to greater discharge and therefore more erosion and transportation.

Climate change: Increased frequency of storms will lead to more erosion and transportation, whilst rising temperatures will lead to more evaporation and less erosion due to the decrease in water.

HOW DOES HUMAN ACTIVITY AFFECT RIVER LANDSCAPES?

Urbanisation: More impermeable surfaces e.g. concrete lead to more surface run-off. Homes built on floodplains to meet housing demands. Channelisation of rivers for urban development disrupts physical processes e.g. erosion and deposition, and can increase flood risk elsewhere.

Agriculture: Ploughing fields can increase sediment in rivers and increase deposition. Field drains may cause surface run-off into rivers. Abstracting water for irrigation reduces discharge of river, causing more deposition.

Industry: May lead to over abstraction (more water taken from river than can be replenished). Industrial processes may pollute rivers with chemicals, harming plants, animals and damaging the natural landscape.

CAUSES AND EFFECTS OF FLOODING

Urbanisation: More impermeable surfaces e.g. concrete and drainage systems lead to more surface run-off.

Deforestation: Less interception so rain reaches ground faster. Ground becomes saturated, more run-off.

Agriculture: Irrigation creates channels allowing water to reach rivers faster.

Climate change: More frequent storms will increase discharge.

Relief: Steep slopes increase surface run-off and allow less time for water to be absorbed by the soil.

Geology: Impermeable rocks reduce infiltration. Water unable to percolate from thin soil above.

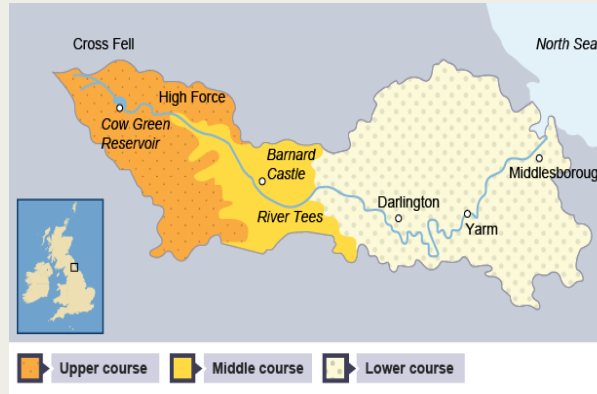
High rainfall intensity: Soil becomes saturated and infiltration reduced.

Weather conditions: Hot, dry soils can make the soil impermeable leading to an increase in surface run-off.

The **effects** of flooding will depend on the intensity of the flood event, the area affected and the river defences that are in place. However, they are likely to include: landslides, soil erosion, loss of natural habitats, contamination of water supplies, death, diseases, damage to property, loss of crops/farm animals and disruption to transport.

LOCATED EXAMPLE: RIVER TEES

Located in the north of England, the source of the River Tees is located in the Pennines and flows east to its mouth where the river joins the North Sea.



Upper course: Made up of hard, impermeable rocks with vertical erosion creating a V-shaped valley. High Force, the largest waterfall in the UK at 21m high, is located in the upper course, made up of hard rock (Whinstone) above a layer of softer rock (sandstone/shale).

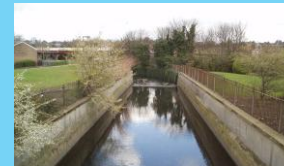
Middle course: Lateral erosion creates meanders, which can begin to be identified in the middle course near Barnard Castle.

Lower course: The meanders in the lower course are much larger and ox-bow lakes have formed. In this area, there are also levees which have formed when the river has flooded. The River Tees has a very large estuary with mudflats and sandbanks which support wildlife in the area. Sites such as Seal Sands are protected areas.

RIVER DEFENCES



DAMS



CHANNELISATION



WASHLANDS



FLOOD PLAIN ZONING

	HOW IT WORKS	ADVANTAGES/DISADVANTAGES
DAMS AND RESERVOIRS	Control the level of water in the river.	Can provide a water supply and produce hydroelectric power (HEP). Creates a large area of water that can be used for recreational activities. Expensive to build and control the flow of the water. Construction often involves flooding habitats or large areas of land. Reduces flow downstream which may create conflict e.g., Ataturk Dam has led to tension between Turkey and Iraq.
CHANNELISATION	Straightening channels and making them wider and deeper, increasing channel capacity.	Allows more water to flow through the channel, decreasing flood risk. Can also be used to divert water from at risk areas e.g., city centres. Water is taken downstream which may increase flood risk elsewhere. Do not look natural so will not fit into the landscape. Very costly to build.
WASHLANDS	Allows either side of the river (floodplains) to be deliberately flooded.	Can store a large volume of water and help to protect the areas against significant flooding. Controlled flooding means there is less disruption to people's lives. Preserves parklands within urban areas. Land cannot be used during flooding, which may create economic costs for agricultural industry.
FLOODPLAIN ZONING	Identifying areas at risk of flooding and managing the land use of the area.	More expensive buildings and land use are moved to safer areas. Less damage leads to lower insurance claims. Restricts future land use and development. Cannot move existing property, so particularly ineffective in historical areas.