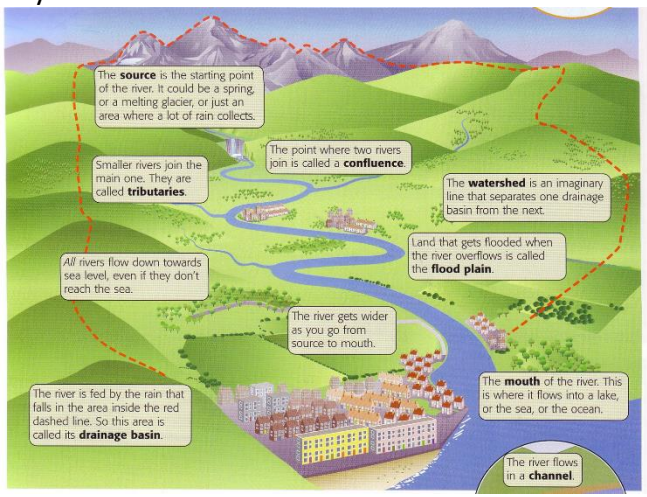
Subject	Geography	Year Group	10	Sequence No.	3	Topic	Rivers

Retrieval	Core Knowledge	Student Thinking
What do teachers need retrieve from students before they start teaching new content?	What specific ambitious knowledge do teachers need teach students in this sequence of learning?	What real life examples can be applied to this sequence of learning to development of our students thinking, encouraging them to see the inequalities around them and 'do something about them!'
Recap from the rivers year 7 topic.	Key words:  <u>Long profile of a river:</u> 1. A Long profile shows the gradient of the river from its source to mouth. 2. The steepest gradient in the long profile of a river is found in the upper course near to the source. 3. The gradient of the long profile becomes more concave as vertical erosion reduces. 4. It becomes narrow and steep sided in the upper course due to vertical erosion. 5. The river channel becomes deeper due to the increase in discharge and wider due to lateral erosion. 6. The increase in lateral erosion. 7. Discharge increases downstream because of additional water from tributaries. Velocity increases due to the additional water from tributaries and less water is in contact with the bed and banks so there is less friction.	Using the knowledge gained in this topic students will take part in fieldwork to assess whether what happens in theory in a river is replicated in real life. Understand how a river forms and how it changes downstream. Studying the long profile of a river is useful because the students can see how the UK landscapes can vary and identify these when they are exploring the UK themselves. What causes a river to flood – this provides students with an understanding of how their actions can lead to a flood. It also helps them to identify where flood risk areas are so that they can protect themselves in the future.

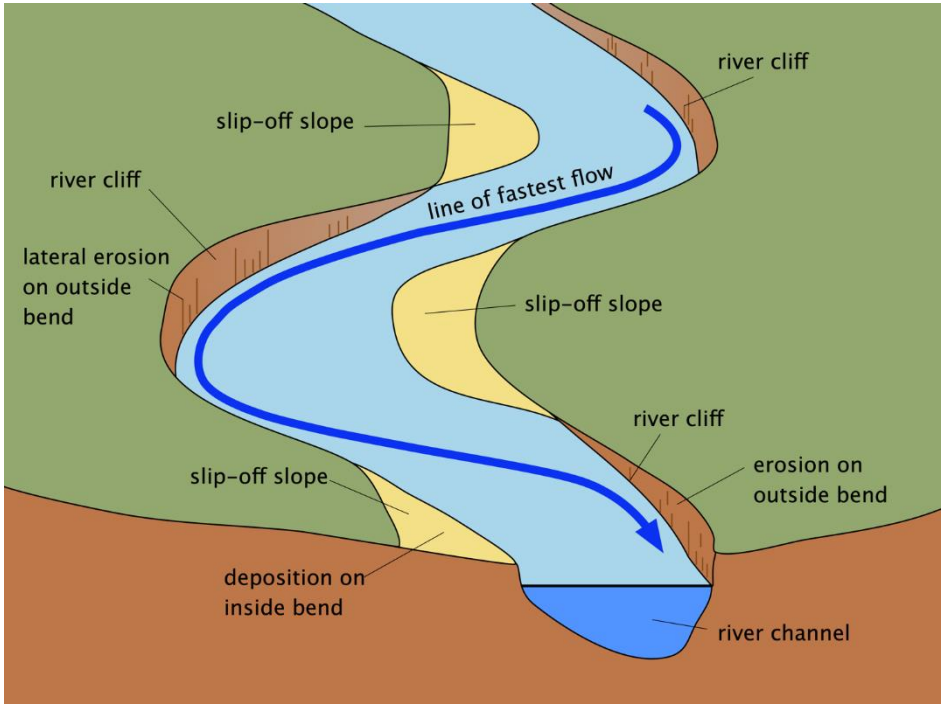
Cross profile – remember types of erosion for understanding how rivers are eroded laterally.	<u>Processes in a river:</u> ETD – Erosion, Transportation and Deposition – EROSION 1. Vertical erosion involves the deepening of the river bed. This is mostly by hydraulic action. It is most common in the upper course of the river. 2. Lateral erosion erodes the banks of the river. This is more common in the middle and lower courses of a river. 3. 4 types of erosion - Abrasion (corrasion), attrition, hydraulic action and solution or (corrosion). 4. Hydraulic action is when the force of fast-flowing water hits the bed and banks and forces water and air into cracks in the bedrock. The repeated changes in air pressure cause the river bed to weaken. 5. Abrasion, also known as corrasion, is when boulders and stones wear away the river banks and bed. Angular rocks that have entered the channel (usually in the upper course) recently are useful tools of abrasion because they are more angular (sharpe). Abrasion is responsible for both lateral and vertical erosion of the river channel 6. Attrition is when sediment particles knock against the bed or each other and break, becoming more rounded and smaller as you move down the river. 7. Solution (or corrosion) is when acidic water dissolves rocks such as chalk or limestone. TRANSPORTATION 1. 4 types - Solution, suspension, saltation and traction. 2. Large boulders and rocks are rolled along the river bed – traction. 3. Small pebbles and stones are bounced along the river bed - saltation. 4. Fine, light material is carried along in the water – suspension. 5. Minerals are dissolved in the water and carried along in solution - solution. DEPOSITION 1. Deposition is the processes by which a river drops its load. 2. Deposition occurs whenever a river loses energy and velocity falls. 3. Deposition occurs: • a river enters a shallow area (this could be when it floods and comes into contact with the flood plain)	Helps students to understand why the river systems in the UK look the way they do. Linking the knowledge they gain from the topic, to a real-life example of places along the River Tees. This helps the students to better understand areas in the UK, in order to broaden their knowledge of areas outside of Mansfield. DME – allowing the students to gain experience in deciding the best solution for managing flood risk in an area. This is useful for their future career development.

Must know what the upper course is to understand its features. Must understand the processes of erosion to	• at the base of a waterfall • on the inside bend of a meander • towards its mouth where it meets another body of water. <u>THE CROSS PROFILES OF A RIVER</u> 1. River cross profiles show you a cross-section, taken sideways, of a river's channel and/or valley at certain points in the river's course. 2. A channel cross-profile is a cross section of only the river channel. 3. A valley cross-profile includes the channel, the valley floor and the sides of the valley. 4. In the upper course the channel is very narrow and very shallow. By the middle course the channel becomes wider and deeper usually over 1 m. By the lower course the channel becomes wider still and the channel is much deeper. 5. In the upper course, the river erodes its bed by hydraulic action and abrasion. As the river flows downstream it is joined by tributaries, increasing the volume of water, velocity and therefore its erosive power. This enables it to cut a deeper channel as it flows downstream. 6. Downstream, the channel becomes wider as the gradient becomes more gentle leading to less vertical erosion. By the middle course of the river lateral erosion becomes the dominant type of erosion. The channel becomes wide because of lateral erosion. 6. In the upper course, the valley cross-profile is narrow and steep-sided. The river takes up most of the valley floor. In the middle course, the valley becomes wider due to lateral erosion. By the lower course, the valley is almost flat, consisting of a wide flood plain. 7. A steep, V-shaped cross-profile is typical in the upper course. This is because of vertical erosion by the river combined with weathering and mass movement of the valley slopes. 8. In the middle course, the river is flowing through lower lying land. The gradient is gentler, so the river begins to meander (bend). As it does this the dominant type of erosion becomes lateral, eroding the valley sides. The makes the valley broader. Also, the rate of weathering increases on the softer rocks of the valley sides.	

understand how upper course features are created. Must know the processes of erosion and deposition to know how oxbow lakes are formed.	9. In the lower course, the river is passing through the low-lying country. Flooding results in deposition building up the flood plain and this, along with migrating meanders builds up and widens the valley further. <u>Upper course features (landforms):</u> 1. Interlocking spurs are fingers of land that jut out into the river valley that streams and rivers are forced to flow around in the upper course. 2. Steep gradient, convex slopes, separated by a narrow valley floor which is mainly taken up by the river channel, sometimes covered in Woodland and may have scree slopes. WATERFALLS AND GORGES 1. Waterfalls and gorges are typically found in the upper course of the river. 2. A waterfall is a step in the long profile of the valley. It is where water falls down the vertical drop in the channel usually from a considerable height. Formation of a waterfall: 1. Waterfalls often occur when a layer of hard, resistant rock lies over a layer of softer rock 2. The river's bedload swirls around at the foot of the waterfall, gradually eroding the riverbed to form a plunge pool – through hydraulic action, abrasion and attrition 3. The less resistant rock is eroded more quickly, undercutting the harder rock to form an overhang. This overhang eventually collapses under its own weight 4. Over many years this process is repeated many times and the waterfall retreats upstream leaving behind a steep-sided valley called a gorge. Formation of a gorge: 1. As a waterfall it leaves behind the steep sided valley which is called a gorge. Every time the overhanging rock breaks off the gorge retreats and grows longer. A gorge is a narrow, steep sided valley, with bare, rocky walls Characteristics of gorge include: 1. very narrow valley 2. very steep, high valley sides is 3. located immediately downstream of a waterfall 4. river channel takes up most, if not all, of the valley floor 5. boulders litter the riverbed 6. turbulent, fast flowing whitewater	

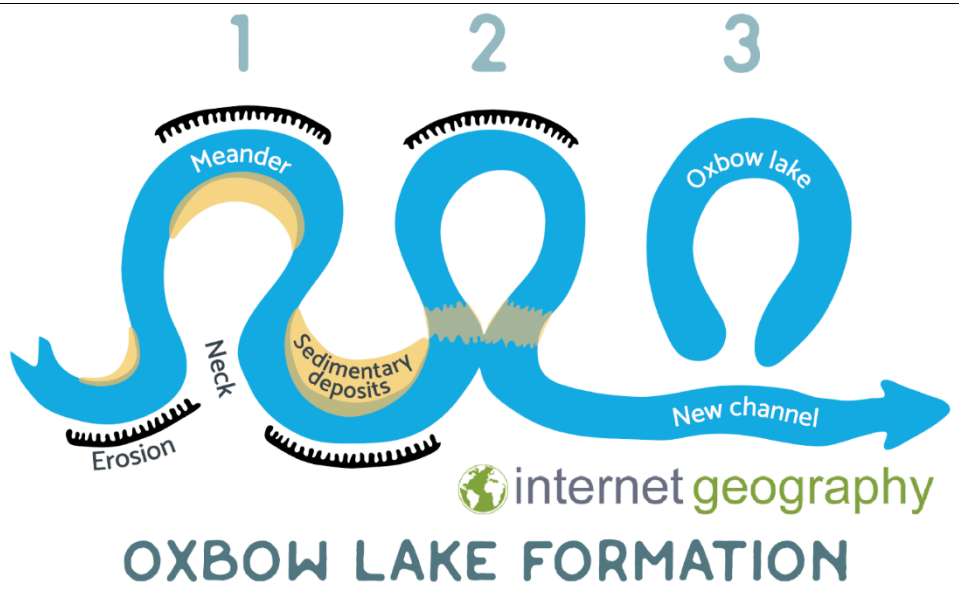
Middle course landforms.

Formation of meanders and oxbow lakes:

1. 

2. Water flows slowly over shallow areas (riffles) in the riverbed and faster through pools, deeper sections of the river. This leads to helicoidal flow that cork screws from one bank to another. Fast flowing water on the outside bank or bend causes lateral erosion through hydraulic action and abrasion. This erosion will under cuts the bank outside bends of the banks, creating a river cliff. Eroded material is then deposited on the inside of the next meander where friction slows the flow, creating a slip-off slope. The reason for this deposition is due to the water being shallower on the inside bend which means the water loses energy so material can no longer be carried by the discharge of the river.

oxbow lake is a small, horseshoe shaped lake that is located several meters from a straight etch of river.

Must understand the process of deposition to know how levees are formed.	 3. Due to erosion on the outside of a bend and deposition on the inside, the shape of a meander will change over a period of time. Erosion narrows the neck of the land within the meander and as the process continues, the meanders move closer together. When there is a very high discharge (usually during a flood), the river cuts across the neck, taking a new, straighter and shorter route. Deposition will occur to cut off the original meander, leaving a horseshoe-shaped oxbow lake. LEVEES AND FLOODPLAINS: Levees are naturally raised riverbanks found along the sides of the river channel that has experienced flooding. The main characteristics of levees are: 1. Raised river banks 2. Consist of gravel, stones and small sediment 3. Steep on the channel side, gentle sloping on the land side 4. Relatively flat top covered in grass	

Must understand the process of erosion and deposition to know how a floodplain is formed. Must understand the processes of ETD, formation of upper, middle and lower course landforms, to apply this	Formation of levees: When a river floods, friction with the floodplain leads to a rapid decrease in the velocity of the river and therefore its capacity to transport material. Larger material is deposited closest to the riverbank, because the energy of the river slows and cannot hold on to the larger material, so they are deposited first. This often leads to large, raised mounds being formed. Smaller material is deposited further away and leads to the formation of gently sloping sides of the levees. Floodplains: A flood plain is a large area of flat land either side of the river that experiences or has experienced flooding. Characteristics of a flood plain include: 1. A large area of flat land either side of a river 2. Layers of alluvium cover the flood plain 3. A river bluff along the edge of a flood plain 4. Meander scars 5. Levees 6. Rich, fertile soil 7. Reeds and marsh plants Formation of floodplains: Floodplains form due to erosion and deposition. Erosion removes any interlocking spurs, creating a wide, flat area on either side of the river. During a flood, material being carried by the river is deposited (as the river loses its speed and energy to transport material). Over time, the height of the floodplain increases as material is deposited on either side of the river. The floodplain is often a wide, flat area caused by meanders shifting along the valley. It's made up of alluvium (deposited silt from a river flood). Estuary formation:	

to the case study of the River Tees	An estuary is the tidal part of a river – where the channel widens as it reaches the sea. Characteristics: Is the point where freshwater (river) meets with salt water (sea). Can be very wide May have a tidal bore – this is where huge waves funnel up the river as the tide comes in. Will have mudflats – visible at low tide (some mudflats may have salt marshes on). Estuary formation & development: 1. As sea-levels rise (e.g. After ice age), low lying valley sides either side of rivers were flooded creating estuaries (e.g. The Severn Estuary). 2. Where fresh and salt water meet and during a rising tide the river's velocity falls and sediment is deposited. This forms extensive mudflats in sheltered areas (exposed at low tide) 3. Over time these may develop into saltmarshes. <u>EXAMPLE OF A RIVER VALEY IN THE UK</u> The River Tees Landforms of erosion will be identified and include waterfalls, interlocking spurs, gorges and meanders. Landforms of deposition will be identified and include meanders, levees and floodplains. Upper course: The source of the River Tees is high up in the Pennines (893m ASL) close to Cross Fell at Tees Head. High Force Waterfall – located in the upper course of the River Tees close to Forest-in-Teesdale. Has a 20m drop into a turbulent plunge pool. An impressive gorge runs approx 700m. Consists of resistant whinstone (dolerite) rock overlying weaker carboniferous limestone. Middle course:	

	The River Tees becomes less steep as it enters its middle course and meanders develop with increased lateral erosion. The River Tees meanders it way through a lower gradient past Barnard Castle. Lower course: There is a sweeping meander at Sockburn (near Darlington) – may eventually develop into an ox-bow lake as the neck of the meander becomes narrower. Flooding has caused the development of raised banks (levees) along the lower course – for example near Neasham. The River Tees flows roughly east from its source for around 128km to reach the North Sea at Middlesbrough at its mouth. The Tees Estuary is wide with mudflats and sandbanks, formed by sea-level rise at the end of the last ice-age. There are parts of the estuary important for wildlife and have become SSSI's (Sites of Special Scientific Interest. Iron and Steel and engineering / chemical works have developed along the estuary. PHYSICAL CASUSES OF FLOODING 1. The drainage basin hydrological cycle shows how precipitation, falling on catchment areas, reaches a river. It also shows how water leaves the catchment area. 2. Precipitation is any form of moisture reaching the ground. 3. Interception is when precipitation is prevented from reaching the ground. This could be by vegetation or buildings. 4. Surface run-off is when water flows over the surface of the ground. 5. Evaporation is when water is lost from the ground as it turns from liquid to vapor due to an increase in temperature or pressure. 6. Transpiration is the loss of water from vegetation through pores. 7. Natural ways flood risk can be increased include: - heavy rainfall caused by depressions causing heavy, continuous rain which saturates the soil. The land can no longer absorb water as it is saturated increasing surface run-off, higher river discharge and flooding.	

Hydrological cycle links to the key words - runoff and infiltration when understanding flood risk.	-sudden downpours occurring following a very dry period can lead to flooding because the surface is baked hard. Surface run-off occurs as water cannot infiltrate leading to higher river discharge and flooding. -sudden snow melt releases stored water that flows over the land as surface run-off -the loss of vegetation cover through drought or disease can lead to flooding as less interception occurs so more precipitation reaches the surface leading to increased surface run-off. 8. Geology can increase the risk of flooding when: -The upland bedrock is impermeable, such as slate, which means there is more surface run-off -Soil in low lying areas is made up of clay. Because it is so compact it is difficult for infiltration to occur. -Areas of permeable rock, such as limestone, become inundated with water leading to increased surface run-off -Relief can increase flood risk because: -Steep sided slopes mean that it is hard for infiltration to occur which leads to greater surface run-off -Low lying flood plains are at risk of flooding because they do not have enough gradient to move the water on quick enough. This risk increases when the soils have a high clay content. -Upland areas are more likely to experience rain due to relief rainfall. This increases the likelihood of high levels of precipitation and therefore surface run-off. HUMAN CAUSES OF FLOODING Three ways humans can increase the risk of flooding in urban areas are: -Building new infrastructure -Building new houses -Disappearing gardens Three ways humans can increase the risk of flooding in rural areas are: -Deforestation -Intensive farming, leaving fields bare in the winter -Over grazing	

Understand the keys word precipitation for hydrographs. Must know what the word discahrge is for hydrographs. Must understand how different types of land use can influence a hydrographs – such as the urbanisation, causing more surface runoff leading to a shorter lag time.	Building a new housing estate on the floodplain increases the risk of flooding because the surface becomes impermeable due to the construction of houses, tarmac roads and concrete pavements. Surface run-off increases leading to a rapid increase in a river's discharge. HYDROGRAPHS 1. A hydrograph is a way of showing how a river's discharge changes in response to a precipitation event. 2. Precipitation and discharge 3. Time 4. The highest amount of rainfall per time units (the highest bar). 5. The highest discharge following a rainfall event. 6. The time between the peak rainfall and the peak discharge. 7. How quickly the discharge increases after a storm event. 8. Shows the reduce in discharge over time after the peak. 9. The normal discharge of a river when its level is being sustained by groundwater flow. 10. The maximum discharge level before flooding will occur. 11. A flashy or storm hydrograph will have a steep rising limb and a short lag time. RIVER MANAGEMENT: HARD ENGINEERING Hard engineering involves the use of heavy machinery to build artificial structures which work against nature to reduce a flood risk. Examples of hard engineering include: Dams and reservoirs Channel straightening Embankments Flood-relief channels A social cost of constructing dams and reservoirs is the displacement of people due to flooding.	

	One economic benefit of constructing dams and reservoirs is that it boosts tourism. For example, the local economy of Kielder has been boosted by £6 million thanks to the construction of Kielder Dam. Benefits of embankments: Social: Safer from flooding due to the increased carrying capacity of the river so the risk of flooding to nearby settlements is reduced. Embankments are often used for walking routes which makes the embankment a more attractive walkway for local people. Economic: Cheap compared to other methods of hard engineering Environmental: Habitats are provided for riverbank animals such as otters, voles and kingfishers RIVER MANAGEMENT: SOFT ENGINEERING Soft engineering involves working with nature and adapting to a river and learning to live with it. Flood warnings, flood plain zoning, planting trees and river restoration. Low cost solution, reduces additional impermeable surface coverage of the floodplain, protects and conserves water meadows for wildlife and recreation and reduces insurance costs when property has been flooded Restricts economic development as certain land uses are prohibited, if land cannot be used for building the current housing shortage will continue, through building elsewhere habitats may be lost, and it is very difficult to implement retrospectively where urban development has already taken place on the floodplain. Benefits wildlife by creating habitats, natural method of intercepting precipitation and slowing water transfer in a river basin, absorbs and stores carbon reduce the amount of carbon dioxide in the atmosphere and it is relatively inexpensive.	

Recap – understanding why there is a need to manage an area from flooding.	Can reduce habitat diversity when hillsides are covered in trees, can lead to acidity in soil and the loss of farm land. EXAMPLE OF A FLOOD MANAGEMENT SCHEME IN THE UK Banbury UK Banbury is a historic market town on the River Cherwell in Oxfordshire, England. Banbury is located in the north of Oxfordshire. In the Cotswold Hills about 50km north of Oxford. Population about 45,000. Why is there a problem? Banbury is located on the floodplain of the River Cherwell – this is a tributary of the River Thames. The geography & geology of the valley that the River Cherwell runs through makes Banbury particularly susceptible to flooding. There has been a history of devastating floods in Banbury. 1998 and 2007 both experienced devastating floods. 1998 Flood effects: closure of town's railway station £12.5 million damage 150 homes and businesses affected. Flood management scheme: The Environment Agency are responsible for managing flood risk. The construction of a new defence scheme started in 2011 and was completed in 2012, with five major strategies to try and reduce the chances of flooding in the future. Strategy 1- Road Raising 860 metres of the A361 was raised in the flood storage area and culverts (small tunnels) to improve drainage beneath road to reduce flooding. Strategy 2. Pumping Station built Pumping station built at Moorfield Brook to transfer excess rainwater into the river downstream of the town.	

	Strategy 3 – Earth Embankments and Floodwalls New 2m high, 400m long earth embankment to protect the industrial estate from flooding and specifically, a flood wall built around the site of prodrive (a motorsport business). Strategy 4 – A Biodiversity Action Plan (BAP) New habitats, including ponds, trees and hedgerows provide greater interception and areas to absorb and store excess water to reduce flood risk. Strategy 5 – Flood Storage Area A new flood storage area has been created by building a 2.9km earth embankment parallel to the M40 – it can hold 3 million cubic metres of water, 1200 Olympic size swimming pools. On the natural floodplain, collecting rainwater that otherwise would have caused the river to swell and flood. Within the flood embankment there is a control structure with an opening which controls the rate of flow. Excess water builds up behind, filling the reservoir and protecting Banbury beyond. Positives and negatives of the scheme: • The raised A361 into Banbury will remain open in flood, reducing disruption for people. • Cost of scheme – about £18.5 million • Quality of life improved for people with new green areas / footpaths. • Around 100,000 tonnes of earth needed for embankment – created a small reservoir • New Biodiversity Action Plan created new habitats • By protecting 441 houses / 73 businesses the benefits are estimated to be over £100 million • Part of the floodplain will be allowed to deliberately flood if river levels are high • Reduced levels of anxiety / depression as reduced flood risk.	