AS Geography 1.2 Fluvial Environments *Student Notes*

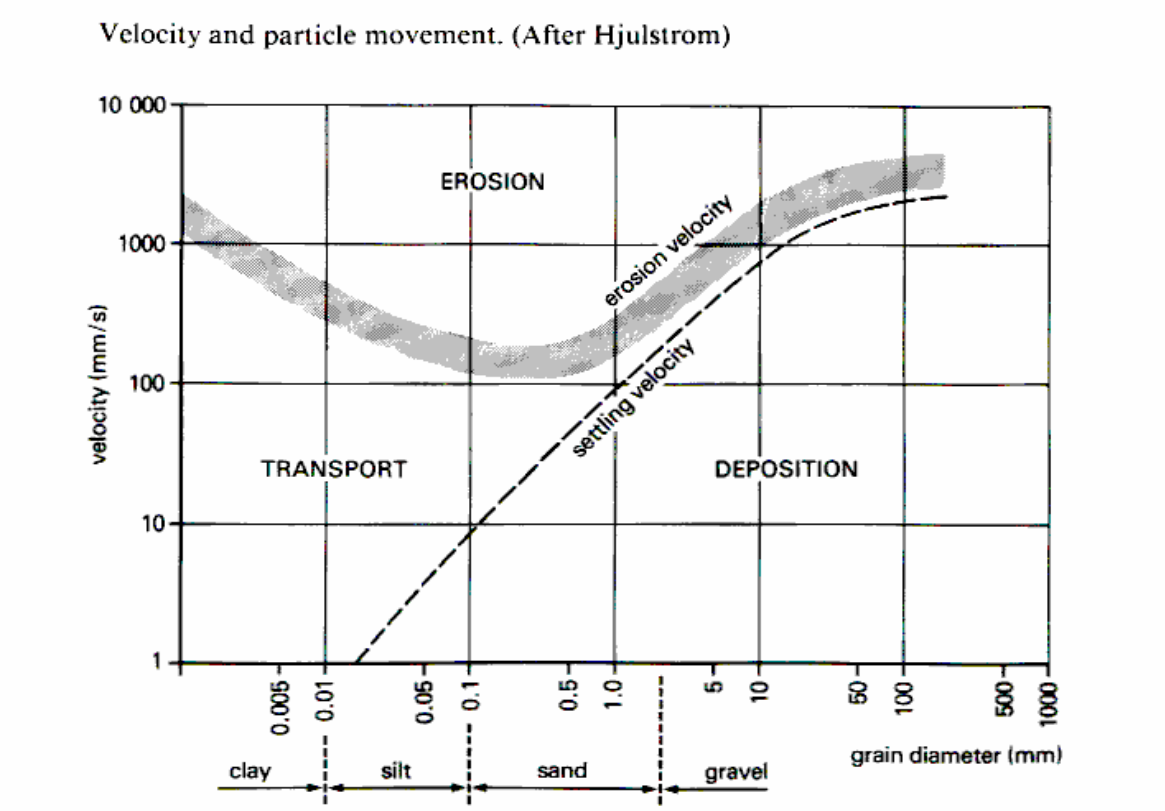
The relationship between river velocity and processes (Hjulstrőm curve).

Under normal conditions of flow, the total energy of a river is small compared with flood conditions. As discharge rises, the velocity increases. The higher velocity makes the river competent to carry larger particles.

Competence is measured by the largest transported particle that can be transported at a particular stream velocity.
Capacity is measured by the total volume of load that can be carried in the channel at specific location at a specific time.

Can you think of circumstances in which the competence could be low, but the capacity high?

The relationship between particle size, stream velocity and erosion, transport and deposition is shown in the **Hjulstrőm curve.**



For an example, consider a particle of 0.2mm diameter. If the velocity of the flow rises to 300mm/s it will be eroded from the river's bed or banks. However if the velocity falls, the particle will not be deposited until the velocity is as low as 10mm/s. This is because the transportation of the particle requires less energy than erosion. To erode, there needs to be more energy to overcome the frictional and cohesive forces between the particles. Once the particle is being transported, these forces are reduced and the particle has momentum.

The graph shows that erosion operates more effectively at higher velocities and the velocity also determines the size of the particles that can be transported as the rivers load. Should there be a fall in velocity, the larger particles will be deposited first. Fine clay particles are only deposited after some time in almost stationary water.

Notice that smaller particles of less than 0.1mm in diameter require disproportionately larger amounts of energy to raise them from the channel bed. They offer less resistance to water flow than the larger particles as they lie on the channel bed and are held to each other by greater cohesive forces. Consequently, they need a more energetic stream (greater velocity) to *lift* them from the bed.

You need to be able to explain the variations in fall velocity line (settling velocity) and the erosion velocity band. The erosional velocity is shown as a band as there will be variations in particle shape, rock type, density and angularity; all of which will cause variations in the velocity required to erode different particles with the same diameter.

Note that, with increasing distance from the river's source, you would expect to find, although there are often exceptions:

Increase in:	Decrease in:
Velocity	Channel roughness
Discharge	Friction
Cross-sectional area	Turbulence
Efficiency (hydraulic radius)	Competence (maximum load size)
Capacity (amount of load)	Gradient

The need for, and methods of, managing river processes.

You need to investigate one river management scheme. You need to be able to describe and explain the management of processes (not flooding or water supply)

A Summary of the Cole Project near Swindon in Wiltshire

- Supported by LIFE (a EU Scheme providing grants for schemes of environmental benefit.
- A combined project of the Environment Agency, English Nature, National Trust and Countryside Commission.
- The aim of the scheme is to increase the level of interaction between the stream and its flood plain and to sustain a landscape rich in riverine and wetland wildlife. The scheme was undertaken in conjunction with local land managers.

Stretch 1: The riverbed was to be raised to make it an important landscape feature. This involves building artificial gravel riffles and some small weirs.
Stretch 2: A new meander course was to be cut and the stream re-routed to fit in with a mill channel. Part of the old course was to be retained as backwaters, providing shelter for fish, birds and insects during periods of high discharge. A water meadow was to be created in a neighbouring field.
Stretch 3: Natural flood meadows to be restored as a more natural flood control measure.
Stretch 4: An old millstream to be raised and restored to allow the mill to be used. The mill stream was also to be used as a lake with wet pasture and reed beds to help cleanse the stream which has become polluted with silt, treated sewage and fertiliser.

A Summary of the Skerne Project in Darlington, Yorkshire

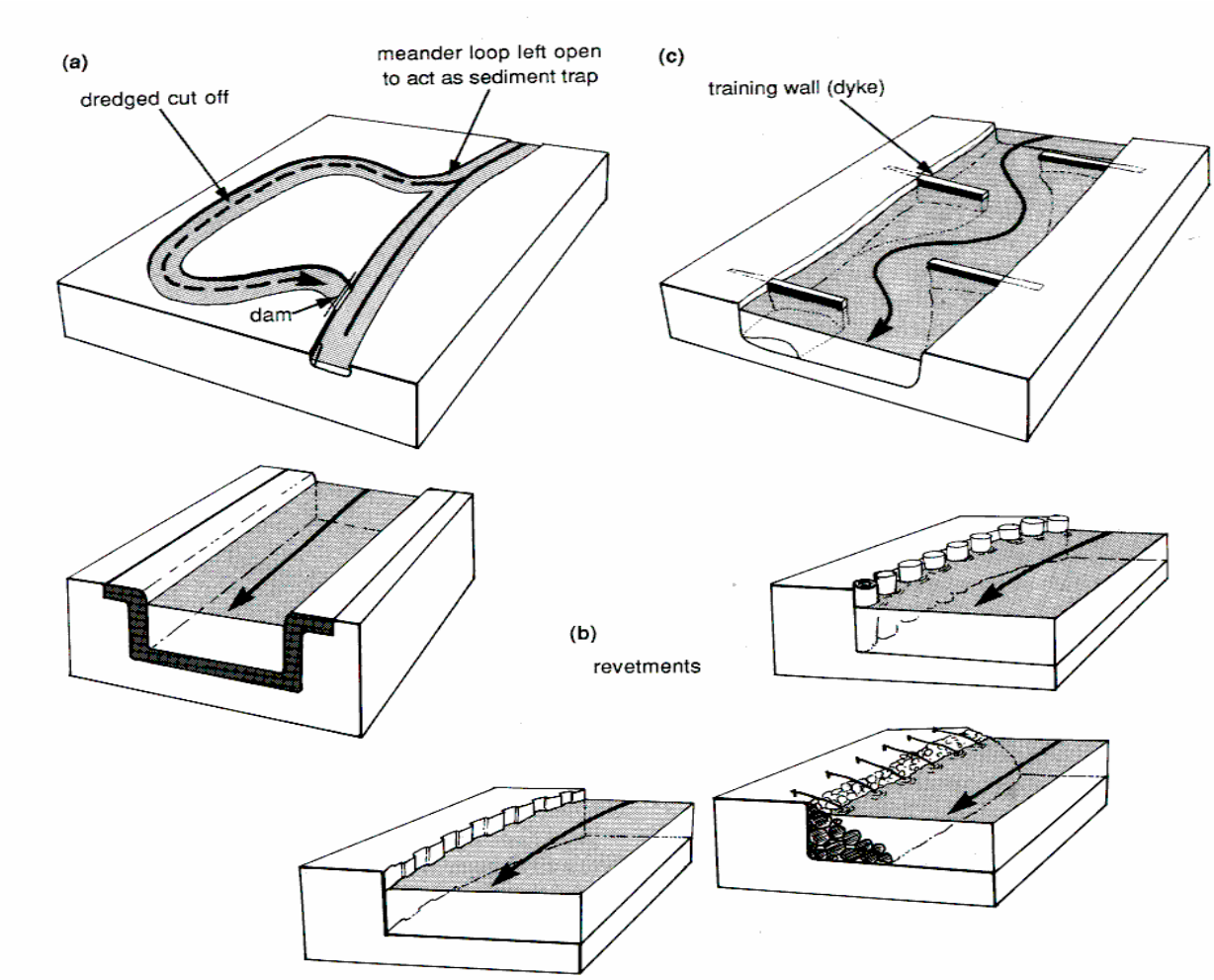
The Problems:

- The river had a high sediment load, especially silt.
- It was slow moving
- The bank was overgrown with weeds
- Water quality was poor due to sewage and industrial discharge
- The flood plain is heavily urbanised with housing, roads, railways and industries.

The Project. The aim was to improve the quality of the river without reducing its function for flood defence. This was to be done by:

- Creating new meanders in the river
- Replacing vertical banks with sloping banks
- The planting and growth of wetland plants on the inside of meander belts.
- Strengthening banks by planting trees. And reeds.
- Creating new wetland ecosystems
- Improving water quality from the sewage works
- Improving access with new footbridges
- Planting native plant species to attract a richer, more diverse insect population.

A range of more traditional channel management techniques used on the Mississippi:



a) **Cut-offs**. These are dredged new channels designed to shorten meanders to improve navigation.
b) **Revetments**. Brick, concrete, wooden pile, sheet steel, rock or wire mesh structures designed to reduce bank erosion and to prevent meander development and thus to protect homes and farmland from erosion.
c) **Wing Dykes and training walls**. These built out from the bank towards the centre of the channel in order to direct the fastest river current or thalweg away from the bank. This decreases bank erosion and increases the river's velocity in the centre so that it erodes a deeper, navigable channel, which is self-dredging. Wing dykes may increase he risk of flooding on the Mississippi
d) **Dredging** (no diagram). This is the regular removal of accumulated sediments from the riverbed. Some may be dumped on the river's bank to raise levees. This can result in severe reduction in water quality and increased sedimentation downstream.