Case Study Location Description: Yorkshire: Flamborough Head, UK
Point of Spec refers to: 2.b Coastal landforms are inter-related and together make up characteristic landscapes.

Geology:
- North York Moors are nearby and 400m above sea level made of **sedimentary rocks**. (This area is on the south of the Tees-Exe line)
- Chalk headland with **superficial deposit** left by glaciers.
- **Differing rock resistance** is important for landscape, headland/bay sequence.
- Shale and clay = **0.8m/year eroded**
- Sandstone & limestone erodes at **0.1m/year**

Energy:
- Waves from North and Northeast
- **Fetch** over 1500km (wind from Arctic)
- Saltburn.= north facing & gets highest inputs of wave energy
- 2010/11 wave height exceeded 4m even in summer
- Significant **longshore drift** from north to south along coastline.
- Headlands interrupt longshore drift and **bays accumulate** sand and shingle

Sediment Sources:
- Sub-cell 1d of major cell 1 which extends from St Abbs in Southern Scotland to Flamborough.
- **Source of sediment:** nearshore (brought onshore from sea level rise), river Esk (enters North Sea at Whitby) limited source due to up stream weirs and reinforced banks.
- Recent increase in beach sediment by 9245m^3 between 2008-11
- Winter storm systems increase erosion at the back of the bay particularly 2010-11.

Inter-relationship of landforms within the characteristic landscape system

- Reoccurring themes of geology changes means there is a consistent discordant planform and series of bays and headlands.
- Geology also contributes to geos and blowholes
- Geology contributes to gradient of cliffs
- Geology of beds or strata of sediment cause the landforms to erode at different rates and thus form similar landforms repeatedly. Joints and bedding planes (the part between each layer) are exploited by erosion (moving force) and weathering (in-situ).
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Landforms:

Cliffs:
- Sedimentary rock
- Horizontally bedded
- Vertical cliff face
- Cliffs overlain by weaker glacial till (superficial rock)
- Flamborough = chalk, tightly bonded particles
- 20-30m high cliff, mass movement 40° angle
- Robin Hoods bay to Saltburn, cliffs = higher but varied geology.
- Steeper = harder rock sandstone/limestone
- Gentler = weaker rock clay/shale

Shore platforms:
- High energy waves = erosion = cliff retreat leaving rocky shore platforms e.g. Robin Hood's Bay, shale, 1-15° 500m wide.
- Could have been formed in the last 6000 years with stable sea level.
- OR could be relict features from interglacial periods when sea level = same as now.

Headlands and bays:
- Variation in rock type.
- Discordant – bays and headlands
- Robin Hood's bay = shales (weak) and sandstones (headlands)
- Filey Bay = weak Kimmeridge Clay and limestone and chalk headlands.
- Chalk hard/Clay weak

Landforms on headlands:
- Wave energy focused on resistant headlands in N.Sea
- Joints & faults eroded -stump
- Selwicks Bay = crack
- Green Stacks Pinnacle = stack
- 50 geos NE or NNE facing (dominant wave direction)
- Selwick's Bay = lot of blowholes = complex inlet.
- Chalk and Clay collapses into underlying sea caves.
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Beaches:
- Few well-developed beaches
- Sheltered lower-energy Scarborough and Filey Bay = best beaches
- Deposition from river sediment = low
- Sand and shingle build up
- High energy waves remove sediment = no build up
- Longshore drift but surprisingly no drift-aligned features /spits. Probs because high tidal range of 4m and no estuarine envi. To provide sediment sink.

Landscape system changes over time *(split into seconds v millennia)*:
- Glacial till deposited in cliffs in Devensian glacial period (long term)
- 2008-2011 net increase in beach sediment by 9245m^3 at Salturn (short term)
- Winter storm systems increase erosion at the back of the beach (seasonal impact)
- Shore platforms = possibly 6000 years old.
- Pre-glacier time the cliffs were half the height. After glaciers retreated deposits of boulder clay were left, now it is being eroded by the N. Sea to reveal original features.