Geography A Level

Bridging Work

Welcome to A Level Geography! You can expect an engaging and varied two years of teaching in this course, with three fieldtrips and a range of relevant and interesting topics to learn. All of the topics learnt have applications to the real world and are dynamic (they are always changing), with the opportunity to really focus in on topics of your interest in the second year of the course.

Before you start, complete the bridging work to start to apply your skills and knowledge to the course- the bridging work is aimed at the year 12 content (tested in the AS exam) and will give you a boost in understanding the first half terms worth of content.

If you need any help or guidance, get in touch with the course teachers:

Miss Moses Leanne.moses@kingsburyhigh.org.uk & Mrs Barclay lisa.barclay@kingsburyhigh.org.uk

If you are on twitter, follow these geography accounts to keep up to date:

- OCR Geog @OCR_Geography
- National Geographic @Natgeo
- UN @UN

If you are interested in reading on key geography topics we will address in the course:

- Factfulness by Hans Rosling
- The Almighty Dollar by Dharshini David
- Prisoners of Geography by Tim Marshall
- 27 stories of AIDS in Africa by Stephanie Nolen

Task 1:

Print the specification for your folder (AS specification only) downloadable at the OCR website.

Task 2:

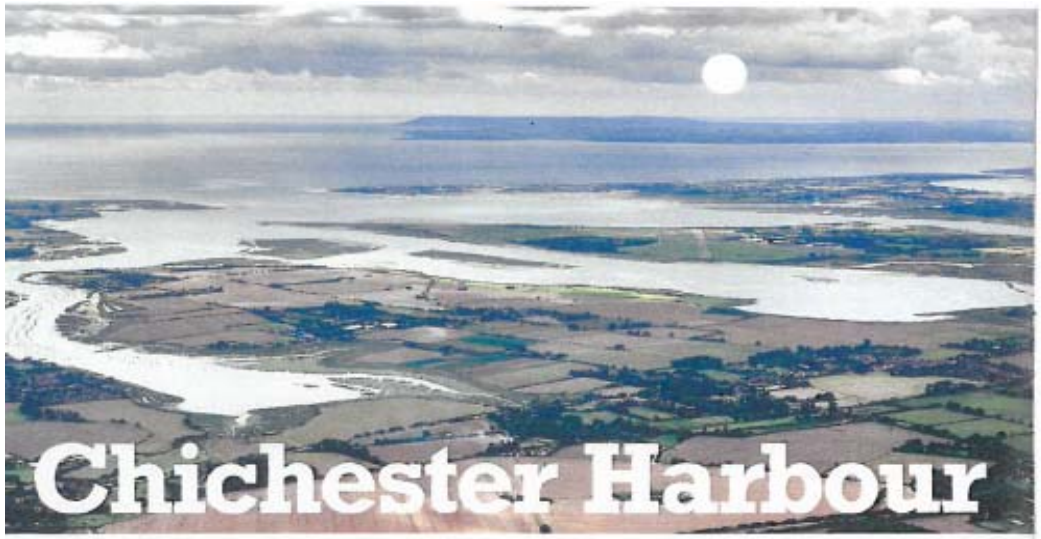
Make a set of illustrated flashcards to show how the following landforms are formed:

- Headlands and bays
- Cliffs
- Shore platforms
- Geos
- Blow holes
- Caves, arches, stacks and stumps
- Beaches
- Spits
- On shore bars
- Tombolos
- Salt marshes

Task 3:

Read the attached article and answer the following 6 questions

1. How did the natural harbour of Chichester form?
2. Describe and explain all the inputs of sediment into the coastal system.
3. Describe and explain the processes that have an impact on the harbour.
4. Describe and explain the stores and outputs from the coastal system.
5. Examine how East Head spit has changed over time.
6. Evaluate the threats to the saltmarsh and mudflats.



Chichester Harbour

Case study of a coastal system

Coastal landscapes operate as systems. This article uses Chichester Harbour as a case study of a dynamic coastal system and shows how understanding the functioning of the system is vital to successful management of the harbour. This is a useful case study for coastal environments options

Jane Dove

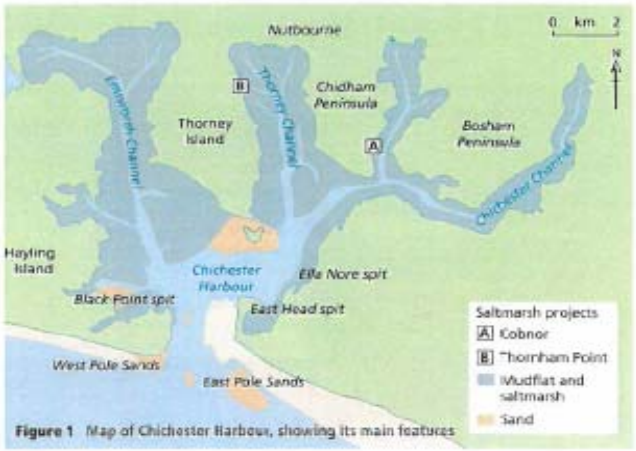
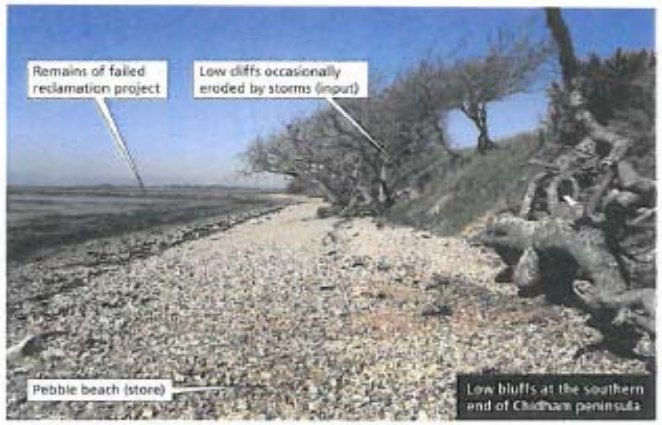


Figure 1 Map of Chichester Harbour, showing its main features

Chichester Harbour is an area of outstanding natural beauty (AONE) and a Site of Special Scientific Interest (SSSI). It consists of 31 km^2 of mudflats and saltmarsh, sandbanks, spits and deep water channels (Figure 1). This natural harbour formed when part of an ancient river system was inundated by the post-glacial rise in sea level. During the Pleistocene, sea levels were around 120 m lower than today and tributaries of an ancient Solent River cut into the coastal plain. At the end of the Pleistocene (11,700 BP), sea level rose, flooding the river valleys, and effectively creating a **ria** coastline. By the Bronze Age (4200–2650 BP), the coastline was only 1 or 2 m lower than it is today and spits began to form at the harbour entrance, while mudflats and saltmarsh became established in the basin.

The harbour as a system

The harbour, which is largely enclosed, can be viewed as a system, the main components of which are shown in Table 1.



Inputs

Energy inputs include winds, waves, tides and sunlight. The coast here is protected from prevailing southwesterly winds and waves by the Isle of Wight, but is exposed to southerly gales, especially in winter, and these can create high waves. However, the narrow harbour entrance prevents sea waves penetrating too far into the basin, creating a low-energy environment. Local waves, created by wind blowing across the water surface inside the harbour, also have limited power because of the restricted **fetch**. Tidal currents, however, are an important energy input.

Sediment and nutrient inputs are derived from several sources. Waves and currents erode material from the floor of the Solent, which is carried into the harbour by the incoming flood tide. Sediment is also eroded from the edges of the harbour and estuary floor. Overall yields are low, despite the fact that the rocks (Eocene, Pliocene and Pleistocene sands, clays and gravels) are relatively easy to erode, because local waves have limited energy. Coastal bluffs are also low in height (5 metres max) which limits the amount of sediment available for wave erosion. In addition, 90% of the harbour is protected by structures such as sea walls, rock armour, earth embankments and gabions, all of which reduce erosion.

Other, smaller, sediment inputs include sand and gravels transported westwards by **longshore currents**, although, as discussed below, coastal defences also limit this source of supply. Beach recharge derived from material dredged from the harbour entrance to improve navigation may be regarded as an input. Streams flowing into the harbour contribute little sediment input from upstream because they are small and sourced from chalk springs which yield little bed or suspended load. Because of this low sediment input the harbour has experienced little silting up over time. Its shape, apart from that caused by human interference, has remained largely unchanged since at least the sixteenth century.

Nutrient inputs, brought in by the sea and rivers, contribute to the high productivity of the saltmarsh ecosystem. Any excess fertiliser (i.e. not taken up by crops) also drains into the harbour, contributing to eutrophication. Sea-grass, saltmarsh and sand-dune plants are important system components and inputs. Their roots help to trap mineral sediment and when they die they contribute dissolved and particulate organic matter.

Processes

Processes including marine and aeolian erosion, transportation and deposition all shape the landforms in the harbour. An interesting feature of the Solent tides is that the outgoing (ebb) tide is faster, but of a shorter duration, than the incoming (flood) tide. At the harbour entrance, for example, the maximum speed of an ebb (spring) tide is 3.3 m s^{-1}, and its duration is 5.7 h, whereas the speed of the flood tide is 1.4 m s^{-1} and it lasts for 7.1 h.

Such differences have important consequences for the distribution of sediment in the harbour. The lower speed and longer duration of the flood tide ensures a net input of clay, silt and fine sand into the harbour, while coarser sand and gravel rarely enter because of the weakness of the flood tide (unless a spring flood tide coincides with stormy conditions). Sand and gravel which do enter the basin are quickly returned seawards by the strong

Table 1 Chichester Harbour as a system

Inputs	Processes	Outputs	Stores
Waves	Erosion	Silt and clay	Saltmarsh
Tides	Transport	Sand	Mudflats
Currents	Deposition	Organic matter	Sand banks
Sunshine	Sedimentation	Tides	Sand and gravel beaches
Offshore sediment	Weathering	Dredged sediment	Spit (aeolian sand and shingle)
Fluvial sediment	Mass movement		
Basin edge and estuary sediment			
Beach recharge			
Sea-grass and saltmarsh plants			

Glossary

Accretion Growth in height of the land owing to accumulation of sediment.

Coastal squeeze Loss of intertidal habitat which occurs when the high water mark is fixed by a defence such as a sea wall and the low water mark migrates landwards in response to sea-level rise.

Fetch The distance of open sea over which the wind blows to generate waves. It is a factor in the height and energy of waves.

Isostatic sea-level change When the level of the land moves relative to the sea, for example as a result of uplift when glaciers melt and their weight is removed.

Longshore current A current, created by wave approach, that runs parallel to the shore.

Ria A coastal inlet created by the submergence of a former river valley.

Tidal prism The volume of water in the estuary between mean high and mean low tide.

ebb current. These differences in the strength and duration of the tides help to explain why fine-grained sediments are dominant inside the basin, while coarser sands and gravels occur near the harbour entrance.

Outputs

The ebb tide removes seawards some silt and clay and almost all the sand and gravel which occasionally enters the system. The sand and gravels are then deposited to form the Pole Sands, offshore sand banks. About 3–4 km² of saltmarsh have been reclaimed for agriculture, much in the last 200 years. This could also be regarded as an output, or loss, because it means the area of mudflat and saltmarsh has been reduced. Other outputs include sediments lost as the result of channel dredging and marina construction.

Stores

The major stores include material held in:

- mudflats and saltmarsh, e.g. Nuthourne marsh
- gravel and sand beaches on west-facing shores of Thorney and Bosham peninsulas, created by the erosion of coastal bluffs and the estuary floor
- inter-tidal sand banks deposited by the ebb tide, e.g. the Pole Sands just outside the harbour entrance
- spits of shingle and aeolian sand, e.g. East Head, Black Point and Ella Nore

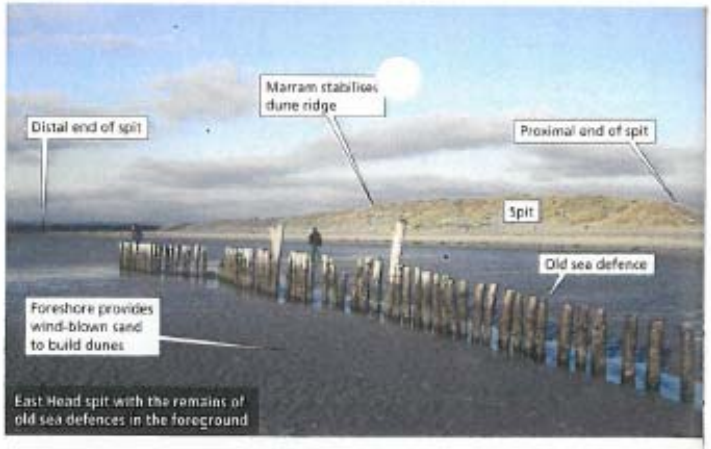
Natural events and human activities operating over a range of time scales can alter these stores and affect the system as a whole:

- Dredging improves navigation by making the channels deeper, but it also increases the speed of tidal flows and the circulation of sediment within the harbour.
- Sea walls may prevent flooding, but they also limit cliff erosion and restrict the release of sediment into the system which might otherwise have been re-deposited and helped protect the harbour.

A closer examination of East Head spit and the saltmarshes in the harbour further demonstrates such feedbacks.

East Head spit

The eastern entrance to Chichester Harbour is flanked by East Head — a shingle spit topped with sand dunes (Figure 2). The spit is about 1 km in length. Its southern end, known as 'the hinge', is only 25 m wide, and it broadens out to the north to about 400 m. To the west, between the spit and the main entrance channel, is The Winner, an area of sand and gravel. Behind the spit is saltmarsh and mudflats.



East Head spit with the remains of old sea defences in the foreground

Historical maps show that before 1870 the spit grew westwards, supplied by shingle and sand eroded from cliffs and beaches near Selsey and carried west by longshore currents. The drift is westwards here (contrary to much of the south coast). This is because the Isle of Wight acts as a breakwater, causing prevailing southwesterly waves to refract and diffract to a more southerly and southeasterly approach.

After 1870 the spit began to rotate clockwise (see Figure 3), largely because sea defences built between Selsey and West Wittering deprived it of longshore-drift sediment. Occasional storms may also have contributed to the shift in spit orientation. Rotation and retreat have resulted in:

- The creation of The Winner. This feature plays an important role in dissipating wave energy, and supplies wind-blown sand for dune formation, both of which help to protect the spit. There is evidence that since 1926 its surface has been lowered by erosion, which in turn threatens the existence of the spit.
- The harbour entrance becoming wider. Although this has reduced the speed of tidal currents and, in turn, the circulation of sediments within the basin, it has also exposed some coastal fringes in the harbour to more wave erosion.

The narrow neck and hinge of the spit remain vulnerable to breaching. In 1963, for example, a combination of high tides and a winter storm surge caused a breach in the neck. Human trampling of the sand-dune ridges may have reduced their effectiveness in preventing a breach.

The National Trust, which owns East Head, has used rock gabions to protect the neck. It has also put up brushwood fences orientated at an angle to the prevailing wind and planted small shrubs to intercept sand blown from the The Winner and stabilise the dunes (see Figure 2). This has proved highly effective, so much so that the northern end of the spit is now larger than at any time in its recent history.

Further breaches have occurred in the neck and hinge, and coastal protection is ongoing. This is expensive, which raises the question of whether natural processes should be allowed to take their course. Without protection the spit could break up into a mass of shoals which would pose a danger to shipping. At the same time the release of sediment could contribute to the formation of new spits and areas of mudflat elsewhere in the harbour.

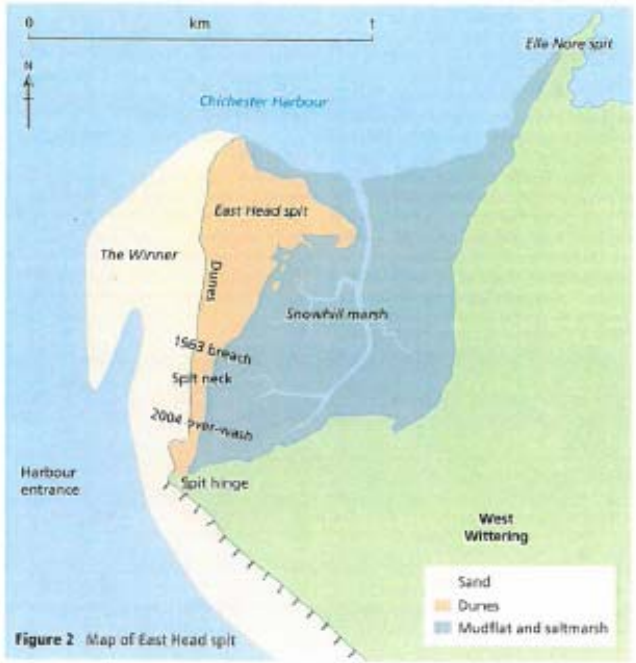


Figure 2 Map of East Head spit

Saltmarsh and mudflats

Saltmarsh and mudflat are present near the heads of the estuaries and behind spits such as East Head, where the water is shallow and tidal currents weak. Each flood tide brings in sediment, although some is then lost in the ebb tide. Deposition occurs at high water and at the 'young flood stand' — this is a pause in the incoming tide of 2 hours before it resumes again to high tide — a characteristic of the Solent tides. Vertical accretion of the mudflat eventually leads to its surface becoming exposed for long enough for vegetation to become established and, in time, a plant succession develops and it becomes saltmarsh.

Historical maps, aerial photographs and remote-sensing data show that the area occupied by the marsh and

Figure 3 Former positions of East Head spit

Further reading

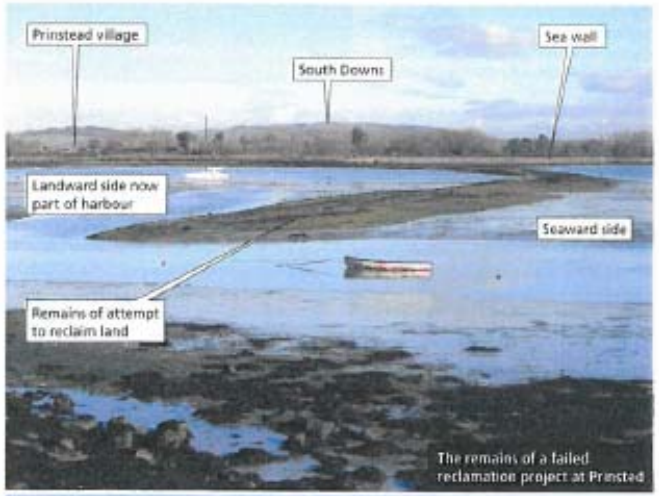
Chichester Harbour Conservancy website: www.conservancy.co.uk

The following reports provide more technical detail on the harbour:

ABP Research (2001) 'Geomorphological Analysis of East Head and Chichester Harbour': www.tinyurl.com/o2rckqe

Bray, M. (2010) 'Chichester Harbour and East Head Spit Field Guide': www.tinyurl.com/q8dbdll

May, V. J. (1980) 'East Head': www.tinyurl.com/njmvluv



The remains of a failed reclamation project at Prinstead

Saltmarsh experiencing coastal squeeze in front of sea wall

mudflat has shifted over time. In late medieval times (1300–1400), a period of increased storminess resulted in a loss of saltmarsh on Thorney Island. In the last two centuries saltmarsh has been reclaimed for agriculture as at East Hayling, Nutbourne, and on Thorney Island, which became a peninsula in 1870. Some reclamation attempts have failed, as at Prinsted, where the remains of a flood barrier can be seen at low tide. These natural and human-induced changes can affect the system as a whole, as the two following examples illustrate.

Spartina dieback

Cord-grass (*Spartina anglica*), an important saltmarsh coloniser, is on the decline in Chichester Harbour (Figure 4). Reasons for the decline are uncertain. *Spartina* plays a vital role because its roots trap and stabilise mud, while its foliage dissipates wave energy, encouraging sedimentation and saltmarsh colonisation. Without it, the marsh is becoming eroded and fragmented. Erosion releases sediment into the estuary which is deposited as new mudflat, or carried seawards on the ebb tide. A reduction in saltmarsh area increases the **tidal prism** — the volume of water in the estuary between mean high and mean low tide. This in turn increases fetch and local wave power, leading to more erosion and a greater release of sediment. In other words, this is a positive feedback.

Sea-level rise

It is predicted that Chichester Harbour will experience a 4 mm y^{-1} rise in sea level up to 2025 and then an 8.5 mm y^{-1} increase to 2055, due to global warming. At the same time, the Solent is responding to **isostatic** readjustment causing a fall in land levels of 0.5 mm y^{-1}.

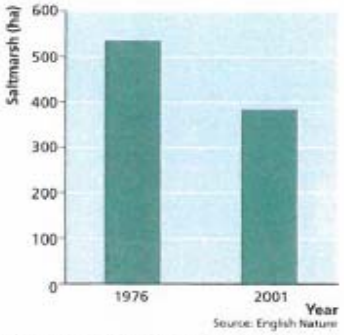
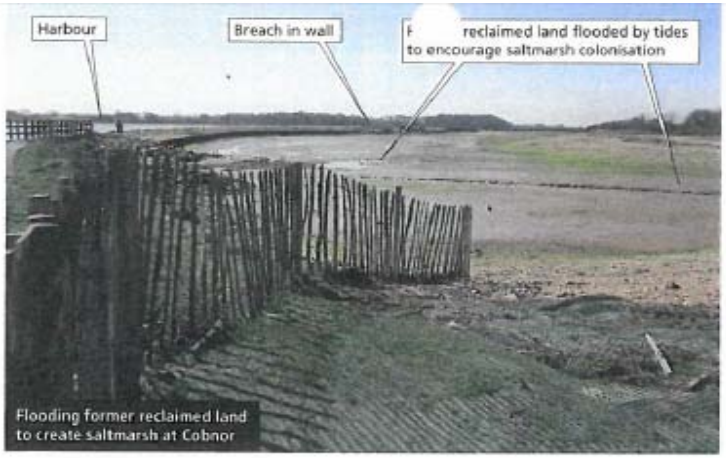


Figure 4 Loss of saltmarsh area (ha), 1976–2001



A rise in sea level may affect the coastal system in a number of ways. **Coastal squeeze** will occur where the saltmarsh is prevented from migrating landwards by sea walls. Loss of saltmarsh will increase the tidal prism and lead to more erosion and a greater release of sediment. To prevent coastal squeeze, sea-walls have been dismantled to flood former reclaimed land and encourage saltmarsh colonisation at Thornham Point (1996) and Cobnor (2006). Unprotected low bluffs around the harbour may experience more erosion, releasing sediment which may contribute to the formation of new mudflats and saltmarsh elsewhere. Meanwhile, low-lying areas will experience more frequent flooding which may, in time, create new mudflat.

Conclusions

Understanding the dynamics of coastal systems is vital for their successful management. Saltmarsh regeneration, for example at Prinsted and Cobnor, will only succeed if sediment inputs, outputs and transfers within the harbour are fully appreciated — but at the same time it is important to realise that these processes are difficult to quantify. Similarly, justifying the cost of protecting East Head spit requires an understanding of how its loss would affect other parts of the coastal system.

Coastal systems are dynamic, and left alone the harbour would in time adjust to the various forces acting upon it and find a new equilibrium. A different harbour configuration, however, could have less appeal for boat owners because sandbanks are a navigation hazard for recreational and commercial craft. At present 10,000 craft use the harbour and there are some 5,500 moorings. Conservationists would also lament the loss of this internationally-renowned coastal wetland, which is a significant feeding ground for winter migrants such as Brent geese and godwit. Effective management of this coastal system is, therefore, of great importance.

Questions for discussion

1 Justify the continued protection of East Head spit.

2 All the saltmarsh may disappear by 2100. What impacts will this have on the coastal system as a whole?

Dr Jane Dove is a retired teacher and lecturer with research interests in coastal management.

Key points

- Chichester Harbour can be viewed as a system, with inputs, processes, outputs and stores.
- Natural events and human activities affect the system as a whole.
- East Head spit is an example of a feature that has changed owing to natural and human influences.
- The harbour's saltmarsh and mudflats are threatened by human impacts and sea-level rise.
- Understanding the system as a whole is essential for successful management.
- The costs and impacts of management must be balanced against the importance of preserving the harbour's functionality and ecosystems.

Task 4:

Compile the factfile about your local area (e.g.: Kingsbury, Wembley, Edgware) as a place, with as many facts as possible in each box.

You can start with the local council's website (e.g.: Brent, Harrow, Barnet) and looking for census information or secondary sources online, you can also go for a walk in the main street in your area to collect information about what is there (look up at main buildings and see if there is a year that they were built on the wall).

Physical Geography (altitude, slope steepness, geology)	**Built Environment** (age and style of buildings, density of housing, services)
Demography (number of inhabitants, age and gender)	**Socio-economic** (employment, income, family status and economy)
Cultural (religion, local traditions, ethnicity)	**Political** (local, regional and national government)

Task 5:

Make a key word glossary with the geographical definitions of the following words:

- Adaptation
- Causality
- Feedback
- Gentrification
- Globalisation
- Inequality
- Interdependence
- Mitigation
- Rebranding
- Resilience
- Primary sector employment
- Quaternary sector employment
- Secondary sector employment
- Sustainability
- Tertiary sector employment