

PAPER 1

PLATE TECTONICS

Hazard - A perceived natural event that has the potential to threaten both life and property.

Disaster - The realisation of a hazard, when it causes a significant impact on a vulnerable population. The Centre for Research on the Epidemiology of Disasters (CRED) states that a hazard becomes a disaster when 10 or more people are killed, and/or 100 or more people are affected.

Resilience - The ability of a community to resist, absorb and recover from the impacts of a hazard.

Vulnerability - The weakness of people in a situation where they are exposed to risk.

Andesite It is richer in silica and more viscous than the basalt from which it is derived. Andesitic magma typically produces explosive volcanic eruptions, such as those of Andean volcanoes and at Montserrat. Typically found at destructive plate margins. (Andesite is named after the Andes mountain chain).

Ash falls Volcanic explosions can throw large amounts of ash into the atmosphere that then descends to the earth and is transported by the wind.

Asthenosphere Layer of the Earth immediately below the lithosphere; this layer is hotter and weaker than the lithosphere above and is capable of plastic flow when stress is applied.

Basalt A fine grained volcanic rock formed by the partial melting of the mantle, typically at divergent (constructive) plate margins.

Benioff Zone An inclined zone of earthquake foci in the upper part of a subducting oceanic plate at a convergent (destructive) plate margin.

Continental Crust A collective term for the crust that forms the continents; it has an average thickness of 35 km but can be up to 70 km under mountain ranges. Typically the composition is granitic with a density of 2.7 meaning that it is too buoyant to be subducted at convergent (destructive) plate margins.

Continental Drift Theory proposed by Alfred Wegener in 1915 to support the notion that the continents had changed position through geological time. Wegener was unable to propose a mechanism to explain how drift occurred and the idea was ignored for almost half a century.

Convection Currents Heat generated by the breakdown of radioactive minerals in the mantle is redistributed by currents that rise at the mid ocean ridges and descend at the

ocean trenches. Convection currents were long thought to be responsible for driving plate motion but this is still the subject of intense debate (see slab pull).

Conservative Margin A plate margin where two plates slide past each other along a transform fault. The margin is characterised by shallow focus earthquakes but no volcanic activity. The San Andreas Fault Zone that separates the North American Plate from the Pacific Plate is an example; both plates are moving in a north easterly direction but the Pacific Plate is moving faster than the North American Plate.

Convergent (Destructive) Oceanic-Oceanic Margin A plate margin where two oceanic plates collide and one is subducted to produce a volcanic island arc-oceanic trench system. The margin is characterised by andesitic volcanism and shallow, intermediate and deep focus earthquakes. An example is the Caribbean Islands (Montserrat) where the South American Plate is subducted westwards down the Puerto Rico Trench.

Convergent (Destructive) Oceanic – Continental Margin A plate margin where an oceanic plate is subducted beneath a continental plate to produce an ocean-trench-mountain belt system. An example is where the Nazca Plate is subducted eastwards below the South American Plate along the Peru-Chile Trench. The Andes fold mountain chain is formed to the east of the trench.

Convergent (Destructive) Continental-Continental Margin A plate margin where an ocean closes and two continental plates collide. An example is The Himalayas, formed by the collision of India with South East Asia.

Divergent (Constructive) Margin A plate margin where two oceanic plates are moving away from each other. Divergent margins are responsible for the formation of ocean basins (e.g. Mid Atlantic Ridge), which start out as rift valleys e.g. the African Rift.

Focus (earthquake) The point of fracture of rocks at depth within the Earth, giving rise to earthquakes.

Folding The process where rocks are deformed by compressional forces, often leading to the formation of fold mountains. The rocks show plastic deformation and flow to form anticlines and synclines. Associated with convergent (destructive) plate margins.

Frequency This is how often a hazard event occurs.

Gas eruptions - Magma contains dissolved gases, which provide the driving force that causes most volcanic eruptions. As magma rises towards the surface and pressure decreases, gases are released from the liquid portion of the magma (melt) and continue to travel upward and are eventually released into the atmosphere.

Granite A coarse grained igneous rock comprising the minerals quartz, feldspar, and mica. It corresponds to the average composition of the continental crust. It is formed at convergent (destructive) plate margins, typically in fold mountain (orogenic) belts.

Ground displacement - this is not hazardous in itself but when it impacts upon roads, buildings, bridges and other structures it most certainly is. Displacement can also lead to the bursting of gas pipes and electricity lines leading to fires as a secondary impact.

Hazard profiles are a common way of comparing different hazards, and look at the magnitude, speed of onset, duration, aerial extent, spatial predictability and frequency.

Hess Harry Hess proposed the idea of Sea Floor Spreading, following echo sounding work to reveal the topography of the ocean basins.

Hot Spot An area of abnormally intense active volcanism thought to be underlain by a mantle plume. Many hot spots, for example Hawaii are located in the middle of a lithospheric plate whilst others such as Iceland are located on divergent (constructive) plate margins.

Intra-plate earthquakes: These occur in the middle or interior of tectonic plates and are much rarer than boundary earthquakes.

Jökulhlaup (glacial outburst) - this is when a large section of a glacier breaks free from a glacier due to the heat from a volcano. This may turn into a mudflow if it is in contact with ash. (Secondary hazard)

Lahars (mudflows) - when ash mixes with water a muddy liquid with the consistency of wet cement. This can damage property and lead to drowning. (Secondary hazard)

Landslides - mass movements of rock and debris can be triggered by earthquakes.

Lithosphere The outer cool, rigid and brittle layer of the Earth. It comprises the crust (oceanic or continental) and part of the upper mantle.

Liquefaction - this is when the shaking of silts, sands and gravel causes them to lose their load-bearing capacity. As a result, buildings and other structures may sink into the ground.

Magnitude measures the size of a tectonic event

Magnetic stripes Linear magnetic stripes, resembling a bar code, run parallel to mid ocean ridges. The stripes reflect repeated magnetic reversal of the Earth's magnetic field. The magnetic anomalies are also symmetrical either side of the mid ocean ridges. The discovery of magnetic anomalies was crucial evidence for sea floor spreading.

Mantle The zone lying between the Earth's crust and core. It includes the lower part of the lithosphere and all of the asthenosphere.

Mantle Plume Hot buoyant rock rising through the mantle from the core-mantle boundary. Thought by some geologists to rise beneath hot spots causing doming up of the crust. Cylindrical in shape, seem to be fixed in position and have a radius of around 150 km.

Mid Ocean Ridge The junction between two oceanic plates along a divergent (constructive) plate margin. eg the Mid Atlantic Ridge.

Mohorovičić discontinuity (Moho) The boundary between the crust and the mantle.

Mountain Building The process by which fold mountain belts are formed. These occur at convergent (destructive) plate margins.

Oceanic Crust The crust that forms the ocean basins. The average thickness is 7 km and it is formed at mid-ocean ridges and subducted at ocean trenches. The oldest oceanic crust is less than 200 million years old.

Ocean Trench An elongate depression of the ocean floor which runs parallel to a volcanic island arc or mountain belt. Oceanic trenches are the deepest part of the oceans and can be up to 11 km. They are locations where oceanic lithosphere is being subducted back into the asthenosphere. An example is the Peru-Chile Trench which runs parallel to the west coast of South America.

Pangea The name given by Wegener to the supercontinent that he proposed to explain his theory. It was a single land mass comprising most of the world's land areas joined as a single unit.

Palaeomagnetism The study of the fossil magnetism locked in rocks which record the inclination and direction of the Earth's magnetic field at the time of their formation. Such data is used to determine the past arrangement of the continents over time and support the theories of continental drift and sea-floor spreading.

Polarity The Earth's magnetic field is known to reverse periodically. When it reverses, what was the north magnetic pole becomes the south magnetic pole, and vice versa. A polarity reversal gives rise to a distinctive magnetic pattern in ocean floor basalts.

Pyroclastic flows Pyroclastic flows contain a high-density mix of hot lava blocks, pumice, ash and volcanic gas. They move at very high speeds (typically greater than 80km/hour) down volcanic slopes, typically following valleys. The extreme temperatures of rocks and gas inside pyroclastic flows, generally between 200°C and 700°C, can ignite fires and melt snow and ice.

Rhyolite A fine grained igneous rock with the same mineral composition as granite. It is commonly associated with volcanoes at convergent (destructive) oceanic-continental plate margins. It is rich in silica, viscous, felsic and is characterised by infrequent but violent eruptions.

Rift Valley A central block downthrown between two normal faults that face one another. Continental rift valleys represent areas where continents are being stretched (extended), as in the case of the East African Rift Valley. They may eventually extend to the point where new ocean-floor is created, as in the Red Sea. Slowly spreading mid-ocean ridges, such as the Mid-Atlantic Ridge, may also have rift valleys running down their centres, but fast spreading ridges such as the East Pacific Rise, do not.

Sea Floor Spreading The process by which oceans are formed at divergent (constructive) plate margins. New oceanic crust is formed as two oceanic plates move apart. (Radiometric dating and fossil evidence shows that the sea floor becomes progressively older in both directions away from mid ocean ridges. First proposed by Harry Hess following echo sounding work to reveal the topography of the ocean basins.)

Slab Pull As oceanic lithosphere cools, it becomes denser and thicker. At a convergent plate boundary the oceanic lithosphere sinks beneath the adjacent plate forming an ocean trench and subduction zone. As a result of its own weight, the descending plate is pulled by gravity through the mantle asthenosphere, which is hotter and less rigid. This force is known as slab pull. It is believed to be the major force driving plate motions.

Subduction Zone A zone where oceanic lithosphere is recycled back into the mantle. At the surface the subduction zone generally coincides with the bottom of oceanic trenches. At depth, the subduction zone is marked by earthquakes, some of which are deeper than 400 km.

Tectonic Plate A segment of the lithosphere which has earthquake activity along its margins and in certain situations, eg when associated with subduction zones. Tectonic plates can consist of just oceanic areas (Nazca Plate) or a combination of oceanic and continental areas (Eurasian Plate).

Tsunamis - these are ocean waves with extremely long wavelengths, generated by a sudden displacement of water in the ocean.

Tuzo Wilson John Tuzo Wilson was a Canadian geologist who synthesised all the plate tectonic components into a logical cycle. The Wilson Cycle starts with rifting followed by sea floor spreading, then subduction and continental collision and accounts for the formation and break up of supercontinents. He was also the first to recognise the significance of hot spots and transform faults.

Wegener Alfred Wegener (1880 - 1930) was a German meteorologist, polar researcher and geophysicist, who proposed the theory of Continental Drift in 1912.

COASTS

A

Abrasion - rocks carried along by the sea wear down the cliff face.

Advance the line - New defences are built further out in the sea in an attempt to reduce the stress on current defences and possibly extend the coastline slightly.

Anticline - 'A' shaped, convex up.

Arches - When caves, which have developed on either side of a headland, join together they form a natural arch.

Attrition - The process whereby rock particles wear down through collisions with other rock particles. This often occurs when pebbles are thrown against cliffs, boulders or other pebbles, causing them to shatter and break.

B

Beach - A gently sloping deposit of sand, pebbles or mud, deposited along the coast.

Backshore - Above high tide level, only affected by waves during high tide or storm surges.

Backwash - Water moves up a beach as a wave breaks. This is called the swash. The return movement of the water, back down the beach, is called the backwash.

Bar - A bar is very similar to a spit. It is a ridge of sand or shingle which forms across the mouth of a river, the entrance to a bay or harbour. It is usually parallel to the coast.

Berm - Small sand ridges which develop around the spring tides resulting in deposition at the top of the 'swash'.

Bayhead beach - Bay head beaches develop at the head, or innermost part, of a bay. In this area wave action is usually not very strong and deposition occurs. The beach will not extend to the headlands since erosion from waves increases strongly towards the headlands and deeper water.

Barrier beach - a sand ridge that rises slightly above the surface of the sea and runs roughly parallel to the shore, from which it is separated by a lagoon.

Bedding plane - Where rock strata are separated.

Beach nourishment - describes a process by which sediment, usually sand, lost through longshore drift or erosion is replaced from other sources.

Bay - A wide indentation into the land by the sea, protected on each side by a headland. The water in a bay is usually relatively shallow; the wave action less strong than at the headlands.

Blow hole - A blow hole is formed when a joint between a sea cave and the land surface above the cave becomes enlarged and air can pass through it. As water flows into the cave, air is

expelled through the pipe like joint, sometimes producing an impressive blast of air or spray which appears to emanate from the ground.

C

Coastal Management - It is a general term that refers to any activity taking place in the coastal zone, which has a specific purpose.

Coastline - The margin of the land. Where the margin consists of cliffs, it is known as the Cliff line

Constructive - When waves break at a rate of ten or less per minute each wave is able to run up the beach and drain back again before the next wave arrives. The swash is more powerful than the backwash so deposition can occur.

Concordant - occurs where beds, or layers, of differing rock types are folded into ridges that run parallel to the coast

Corrosion - Acids contained in sea water will dissolve some types of rock such as chalk or limestone.

Corrasion - This is a form of wave erosion. Pebbles, boulders and rocks are thrown against the cliff face by breaking waves. This causes undercutting of the cliff and leads to the breakup of both the cliff and the objects being thrown against it. (This is sometimes also called abrasion)

Cusps - It is a general term that refers to any activity taking place in the coastal zone, which has a specific purpose.

Cave - A weakness, such as a joint, is enlarged by wave action, finally creating a cylindrical tunnel which follows the line of weakness. Caves developing back to back may give rise to arches and stacks.

Carbonation - Occurs on rocks containing calcium carbonate, such as limestone and chalk. Rainwater and dissolved carbon dioxide mix to form a weak carbonic acid. Calcium carbonate in the rocks reacts with the acidic water and dissolves leaving behind calcium bicarbonate. This compound is soluble and is easily washed away by running water.

Cuspate foreland - are geographical features found on coastlines and lakeshores that are created primarily by longshore drift.

Cliff - A steep, and usually high, rock face found at the edge of the land where it meets the sea. Cliffs can be formed from most rocks, height generally increasing with hardness of rock.

D

Discordant - occurs where bands of different rock type run perpendicular to the coast.

Destructive wave - When waves break at a rate of more than ten per minute each wave is able to run up the beach but unable to drain back again before the next wave arrives. Thus the backwash of the previous wave interferes with the swash, reducing it's efficiency. Such waves remove material from a beach and are destructive.

Dune - are a natural coastal feature on moderately exposed and exposed coasts. Dunes are formed by the sand, which blows inland from the beach and is deposited in the area behind the coastline.

Deformation - the action or process of deforming or distorting.

E

Emergent Coast - Coastal areas which have become raised above current sea level. The cause is believed to be isostatic adjustment.

Erosion - is the wearing away of rock (e.g. hydraulic action, abrasion/corrasion, corrosion, attrition)

Eustatic - is when the sea level changes due to an alteration in the volume of water in the oceans or, alternatively, a change in the shape of an ocean basin and hence a change in the amount of water the sea can hold. Eustatic change is always a global effect.

Estuary - The mouth of a river where freshwater and seawater mix, and tides have an effect. Estuaries are often to be found on submerged coastlines, where a river valley has been flooded by the sea. See ria.

F

Fall - is the rapid, free-fall of rock from a steep cliff face. Rock fragments fall from the face of the cliff because of the action of gravity.

Flow - occurs on steep slopes over 10°. It's a rapid sudden movement which occurs after periods of heavy rain.

Fetch - area of ocean or lake surface over which the wind blows in an essentially constant direction, thus generating waves.

Foreshore - Where wave processes occur during high tide and low tide

Fissures - a long, narrow opening or line of breakage made by cracking or splitting, especially in rock or earth.

Faults - is a fracture in rock where there has been movement and displacement.

Flocculation - form or cause to form into small clumps or masses.

Freeze thaw - is when water seeps into a crack in a rock, as the temperature drops below freezing, the water freezes and expands causing the crack to enlarge.

Folding - When planer surfaces are bent.

G

Groyne - a rigid structure built along an ocean shore (in coastal engineering) that interrupts water flow and limits the movement of sediment.

H

Horizontal dip - steep vertical cliff profile, strata runs horizontally.

Halophyte - a plant that grows in waters of high salinity.

Halosere - a succession in a saline environment. An example of a halosere is a salt marsh.

Hydraulic action - When a wave breaks against a cliff it causes air, trapped within cracks, to suddenly become compressed. As the water retreats the air is allowed to expand, often explosively. Repeated expansion and contraction of the cracks leads to the breakup of the surrounding rock.

Holistic management approach - refers to taking care of coasts as a whole.

Hold the line - Where existing coastal defences are maintained but no new defences are set up.

Headland - Areas of harder rocks tend to resist the erosive powers of the sea. The resulting area of land, jutting out into the sea, is a headland. Bays are to be found between headlands.

I

Igneous - (of rock) having solidified from lava or magma.

Isostatic - is the result of an increase or decrease in the height of the land.

L

Lithology - the study of the general physical characteristics of rocks.

Longshore drift - When waves break on to a beach at an angle, material is pushed up the beach at an angle by the swash, but pulled back down the beach by the backwash at ninety degrees to the coast. In consequence, material is slowly moved along the coast, in the direction of the waves.

Lagoon - When a spit extends across the mouth of a river, to the extent that it causes the river to become diverted along the coast, an area of water is created separated from the sea by a narrow strip of land. This is a lagoon.

Load - Solid matter carried by water, including material in solution, material suspended in the water, and larger material moved along the water / ground interface.

Longitudinal coast - These occur when valleys parallel to the coast become flooded by the sea. As the land becomes submerged, the ridges of land between the valleys become chains of islands parallel to the new coast. The area of water between the island chains are sometimes referred to as sounds.

Littoral zone - Wider coastal zone including adjacent land areas and shallow parts of the sea offshore.

Landward dip - generally steep cliff profile, strata runs at an angle.

Littoral cells - is a coastal compartment that contains a complete cycle of sedimentation including sources, transport paths, and sinks.

M

Mass movement - Mass movement is the movement of material downslope under the influence of gravity.

Microtidal - Tidal range 0-2m

Mesotidal - tidal range 2-4m

Macrotidal - tidal range 4m and above

Marsh - A marsh is a type of wetland, an area of land where water covers ground for long periods of time.

Managed realignment - It is the deliberate process of altering flood defences to allow flooding of a presently defended area.

Metamorphic - rock made due to heat and compression, typically quite strong

Mud Flats - Gently sloping coasts where fine sediments can settle, perhaps together with river sediments, can allow the build up of mud as a sheet known as a mudflat. Plants able to withstand salt water will often colonise the area. In tropical areas this may lead to the formation of mangrove swamps.

N

Nearshore - shallow water area close to land, often where intense human activity takes place

No active intervention - The easy option, deal with the effects of flooding and erosion as they come or just ignore them. This is generally what happens in areas where there's no people, and so nothing of "value" (to the government) to protect.

O

Oxidation - rocks combine chemically with oxygen.

Offshore - Area furthest away from the coast where deeper waters are found.

P

Permeability - the ability to allow liquids or gas to pass through material.

Psammosere - Succession initiated on sand.

Pore water pressure - refers to the pressure of groundwater held within a soil or rock, in gaps between particles (pores).

Plant roots - The roots of plants and trees penetrate into the soil in search of nutrients and water. As the roots penetrate the soil, they go through cracks or joints in the rocks and as they grow they progressively crack the rock apart, contributing to biological weathering.

Pioneer species - is a species that is first to establish itself in an area where nothing is growing-or in an area that has been devastated by fire,flood, plowing etc.

R

Ria - When a non-glaciated river valley fills with sea water. As the area becomes flooded the coast becomes indented and higher parts of the surrounding land may become islands. Plymouth Sound and Southampton Water are examples of rias in the United Kingdom.

Rotational slumping - The layer collapses down the front of the cliff face in a rotational manner. This can be called 'failing' or 'slumping'. Rotational slumping typically occurs where permeable (absorbs water) rock in a cliff face is upon impermeable (doesn't absorb water) rock. Sand/gravel is often the permeable rock and clay is impermeable.

Rip Rap - are just rocks and stones that have been put against the base of a cliff. They're similar to gabions in their purpose but they aren't bound together in a mesh.

Revetments - Concrete (or in some cases wooden) structures that are built along the base of a cliff. They're slanted and act as a barrier against waves not too dissimilar to a sea wall. The revetments absorb the energy of the waves, preventing the cliffs from being eroded.

S

Secondary coast - Dominated by marine erosion.

Submergent coast - Coastal areas which have become lowered below current sea level. The cause is almost always a rise in sea level in consequence of ice melting since the last ice age.

Seaward dip high angle - cliff profile slopes at a low angle and only one rock layer faces the sea.

Seaward dip low angle - Layers of rock are overhanging and susceptible to falling.

Strata - different layers of rock.

Sedimentary rock - fine sand or silt which has not been properly compressed together.

Succession - a group of strata representing a single chronological sequence.

Surface runoff - is the flow of water that occurs when excess stormwater, meltwater, or other sources flows over the Earth's surface. This might occur because soil is saturated to full capacity, because rain arrives more quickly than soil can absorb it, or because impervious areas send their runoff to surrounding soil that cannot absorb all of it.

Sand dune - a dune is a hill of loose sand built by aeolian processes or the flow of water.

Stack - When a natural arch collapses, the remaining upright sections form stacks, isolated rocks sticking up out of the sea.

Spit - Longshore Drift transports material along the coast. When the mouth of a river, or an indented area, is encountered material starts to be deposited. The deposition begins where the coast changes direction and extends down coast in the direction of longshore drift. The result is a narrow ridge of material (sand or pebbles) attached to the mainland at one end and terminating in the sea. The spit may extend sufficiently to form a lagoon.

Sub-aerial processes - are land-based processes which alter the shape of the coastline. These are a combination of weathering and mass movement.

Salt crystalization - This is when salt crystals are deposited in cracks and over time the salt accumulates and applies pressure to the crack (similar to freeze-thaw weathering).

Subsidence - sinking of the ground because of underground material movement.

Storm surge - is a coastal flood with rising water commonly associated with low pressure weather systems (storms).

Syncline - 'U' shaped, concave up.

Sea wall - Giant walls that span entire coastlines and attempt to reduce erosion and prevent flooding in the process.

Swash - The movement of water in a breaking wave as it moves up the beach.

T

Tombolo - A bar linking an island to the mainland.

Tides - The daily movements of the sea as it covers and exposes the coastline due to lunar activity.

U

Unconsolidated material - Loosely arranged or unstratified sediment whose particles are not cemented together.

W

Wave refraction - Friction with the sea bed as waves approach the shore causes the wave front to become distorted or refracted as velocity is reduced.

Wave cut notch - As cliffs become eroded down to beach level they appear to migrate inland. The remains of the former cliffs form a flat rock platform. This is known as a wave cut platform.

Wave cut platform - The remains of a former cliff that form a flat rock platform

X

Xerophyte - a plant which needs very little water.

CARBON CYCLE AND ENERGY SECURITY

Adaptation strategies - strategies designed to prepare for and reduce the impact of events (e.g. Climate Change)

Afforestation - the re-planting of trees when deforestation has occurred.

Albedo - the amount of heat that is reflected by the Earth.

Arctic amplification - the phenomenon where the Arctic region is warming twice as fast as the global average.

Bio-geochemical carbon cycle - the continuous transfer of carbon from one store to another, through the processes of photosynthesis, respiration, decomposition and combustion.

Biological carbon pump - where phytoplankton in the oceans sequester carbon dioxide through the process of photosynthesis - pumping it out of the atmosphere into the ocean store.

Biological decomposers - organisms such as insects, worms and bacteria which feed on dead plants, animals and waste.

Biologically derived carbon - carbon which is stored in shale, coal and other sedimentary rocks.

Carbon Capture and Storage (CCS) - the technological 'capturing' of carbon emitted from power stations (it is often stored underground, under a layer of impermeable rock).

Carbon fixation - turns gaseous carbon (CO₂) into living organic compounds that grow (e.g. trees).

Carbon fluxes - the movement or transfer of carbon, in different compounds, between stores in the atmosphere, biosphere, hydrosphere and lithosphere.

Carbon pathway - the steps involved in moving carbon to a store where it is fixed.

Carbon sequestration - the removal and storage of carbon from the atmosphere, usually in oceans, forests and soils through photosynthesis.

Energy mix - the range of energy sources used by a country or region, from non-renewable ones such as fossil fuels to renewables such as wind energy.

Energy pathway - the route by which an energy type is transferred from the production area to the consumption area, such as a pipeline or shipping route.

Energy security - situation where there is a secure and affordable supply of energy to meet the needs of consumers. (Often countries that are self-sufficient in energy resources will be more energy secure than a country that relies on imports.)

Energy demand - This is the need or desire for energy resources. Sources of demand include: Electricity (the biggest user of energy resources), residential, industry, transport (the biggest user of oil).

Energy poverty - This is the lack of access to energy either due to a lack of availability or due to people being unable to afford the energy that is available.

Fuel - Fuel is any material that is burned or altered in order to obtain energy

Fossil fuels - Those formed over geological time from the fossilised remains of land based vegetation (coal), aquatic vegetation (natural gas) or fish (oil). They can be used (or combusted) only once and are therefore finite (non-renewable).

Greenhouse gases - gases that trap outgoing long-wave radiation (including CO₂, CH₄, Nitrous oxides and halocarbons)

Non-renewable energy resources - Resources that are finite (will run out) and have been formed over millions of years, e.g. coal.

Mitigation - ways in which people can reduce human impacts on climate by reducing emissions and creating or enhancing stores of greenhouse gases

Outgassing - the release of a gas that was dissolved or stored due to changes in heat or pressure; for example carbon is released by metamorphic activity at plate boundaries or hotspots.

Phytoplankton - minute plants found in a place of oceans which fix large amounts of carbon through photosynthesis and form the base of aquatic food webs. (E.g. Cyanobacteria).

Primary energy - the main original sources of energy before conversion in alternative forms e.g. coal and oil.

Recyclable energy resources - Energy resources that may be partly used again once they have undergone a human process of restoration. Examples include biomass and nuclear.

Renewable energy resources - Energy resources capable of natural regeneration on a human timescale, e.g. solar power.

Secondary energy - convenient and more usable energy source such as electricity that has been created from a primary energy source.

Sequestration - processes by which carbon is removed from the atmosphere and stored for a long period of time for example by plants and soil in nature or through Carbon capture and storage.

Tipping point - the point at which even a small change significant enough to cause larger more significant changes which then cannot be prevented or reversed.

WATER SECURITY

Antecedent moisture - water from one storm that has not drained away before more rain arrives.

Aquaculture - the breeding and harvesting of aquatic animals and plants.

Aquifer - an underground reservoir most commonly formed in rocks such as chalk and limestone.

Base flow - known as ground-water flow - slow moving water that seeps into a river channel through rocks

Blue water store - Is the visible part of the water system, namely water running on the surface and supplying rivers or travelling underground, recharging aquifers.

Channel flow - the volume of water flowing within a river channel (also called discharge)

Channel storage - water held in rivers and streams

Complex river regimes - where larger rivers cross several different relief and climatic zones, and therefore experience the effects of different seasonal climatic events. Human factors can also contribute to the complexity, such as damming rivers for energy or irrigation.

Closed system - a sequence of linked processes with a transfer of energy but not matter between the parts of a system (the inputs and outputs happen within the system). An example is the global hydrological cycle.

Convective precipitation - occurs when intense insolation (solar radiation) reaches the ground and lower atmosphere and causes convection in humid air. As the warm moist air rises, it cools and water vapour condensed into clouds, forming precipitation - often in the form of thunderstorms.

Desalination plant - the process of converting salt water to freshwater suitable for human consumption and industrial purposes.

Discharge - The rate of water flow in a river, measured in cubic metres per second (cumecs)

Drainage basin - area of land drained by a river and its tributaries and separated from neighbouring drainage basins by a ridge of Highland called a watershed or divide

Drainage density - the total length of all the streams and rivers in a drainage basin divided by the total area of the drainage basin.

Drought - the definitions vary internationally. According to the UN drought is an extended period of deficient rainfall relative to the statistical average for region measured over a very long period of time.

Economic water scarcity - occurs when water resources available but there is insufficient human, institutional and financial capital to access the water in order to meet the demand. Occurs when

development of blue water flow sources is limited to human and financial capacities. E.g. 1 billion people live in such areas globally and use less than 25% of river resources available.

ENSO cycle - A naturally occurring phenomenon that involves the movement of a mass of very warm water in the equatorial Pacific due to changes on the surface trade winds, atmospheric circulation and ocean currents. There are two phases known as El Niño (warm water to the east) and La Niña (warm water to the extreme west).

Eutrophication - Pollution of ecosystems with excessive nitrate and phosphate from human activity (agricultural). This stimulates the growth of aquatic plant life (algae) usually resulting in the depletion of dissolved oxygen.

Evapotranspiration - the total amount of moisture transferred from the Earth to the atmosphere by evaporation and transpiration.

Fossil water - water that has been contained and undisturbed for an extremely long period of time, usually as groundwater in an aquifer. There is little to no significant recharge, perhaps due to a change in climate due to tectonic movement such as in the Sahara, therefore it is a non-renewable resource.

Frontal precipitation - occurs frequently in mid-latitudes when a warm tropical air mass meets cooler polar air mass. The warmer and less dense air rises over the colder air, which causes the warm air to cool leading to condensation of water vapour, clouds of different types and precipitation.

Global hydrological cycle - the continuous transfer of water between land, atmosphere and oceans and seas on a planetary scale within a closed system, driven by solar radiation.

Groundwater flow - water moving sideways through a permeable or porous rock under the influence of gravity.

Green water flow - Interception and transpiration of water by vegetation or its evaporation from variety of surfaces.

Hard engineering - the use of man-made, artificial structures to manage flooding or water supply.

Helsinki Rules - A 1966 international legal agreement on the fair uses of international waterways, such as river between 2 countries.

Hydrological drought - occurs when there is insufficient soil moisture to meet the needs of vegetation at particular time

Hydropolitics - Political negotiations centred on conflicts over the shared use of water sources, especially rivers that form an international border.

Infiltration - the movement of water vertically downwards through the spaces in the soil

Interception - the process by which raindrops are prevented from falling directly onto the ground by the leaves, branches and twigs of vegetation.

Meteorological drought - occurs when long-term precipitation trend is below the long-term average

Monsoon - a seasonal change in the direction of prevailing winds of a region causing wet and dry seasons in many subtropical areas

Open system - a sequence of linked processes with inputs and outputs, including transfers of energy and matter to and from other systems, for example a drainage basin.

Percolation - water moving vertically downwards through and into a permeable or porous rock

Physical water scarcity - occurs when there is physical lack of available freshwater resources to meet demand due to over abstraction by agriculture, industry and domestic purposes. Occurs when more than 75% of country's river flows are being used. E.g. ¼ world's population lives in areas like these.

Salt water encroachment - the movement of salt water into freshwater aquifers due to sea level rise, storm surges and or human obstruction of groundwater which lowers the water table

Saturated overland flow - occurs when water accumulates in the soil until the water table reaches the surface forcing further rainwater to run off the surface. May also occur when the amount of precipitation exceeds the infiltration capacity of the soil

Smart irrigation - water conservation scheme to provide crops with the sub optimal watersupply causing mild stress during the crop growth stages when the plants less sensitive to moisture deficiency, and therefore there is no significant reduction in yield.

Storm hydrograph - shows change into rivers discharge at a given point on the river over a short period of time (usually before, during or after a storm).

Thermohaline circulation slow, large-scale seawater movement between all of the oceans, caused by differences in temperature and density

Transboundary water where river, lake, or aquifer across this one or more major political border

Transfer - Movement of resources. particularly water/energy, from a source region to a region of consumption. Resources move along pathways.

Transpiration the biological process by which water is drawn upwards from the soil by plants and evaporated through the pores called stomata in the leaves

Water budget the annual balance between the inputs and outputs at a place

Water conservation - Involves reducing the amount of water used (demand) rather than trying to increase water supplies. Water is finite and supply.

Water Stress - Annual supply of water per person falls below 1,700m³.

Water Scarcity - Annual supply of water per person falls below 1,000m³.

Water security - Extent to which a community, region or country can secure sufficient, reliable water supplies.

Water Poverty Index - Uses 5 parameters: *resources* (quantity of surface and groundwater per person and its quality), *access* (time/distance involved in obtaining sufficient safe water), *capacity* (how well community manages water), *use* (how economically water is used in home and by agriculture/industry) and *environment* (ecologically sustainable).

OTHER GENERAL

Sustainability	Development that meets environmental, economic and social needs of today's population without compromising the ability of future generations to meet their own needs.
Technological fix	Is an innovation that can be used to solve a problem facing humans.
Attitudinal fix	It involves changes in peoples perception and personal actions about a problem.

PLAYERS

Player	Individual, group or organisation with a stake in an issue.
IGOs (UN, World Bank, IMF)	Invest money for economic and social projects to promote trade and increase living standards
TNCs	Offer employment, investment (but often exploit and cause profit leakage)
Governments	Take decisions, regulate and provide investment
NGOs	Do charity work and provide assistance or raise awareness
Individuals	Consumers...
Scientists and engineers	Help research problems (e.g environmental issues), design and build structures (e.g. hard engineering projects)