KS3 Geography Knowledge – The Challenge of Natural Hazards (Part 1)

A natural hazard is natural process that poses a threat to people and property. A natural hazard only occurs when it impacts on people. If it poses no threat to humans it is called a natural event.

- **Atmospheric or meteorological hazard – hazard that occurs in the atmosphere (e.g. hurricane, thunder and lightening, tornado, drought)**
- **Tectonic hazard – a hazard that occurs due to the movement of tectonic plates (e.g. volcanoes and earthquakes)**

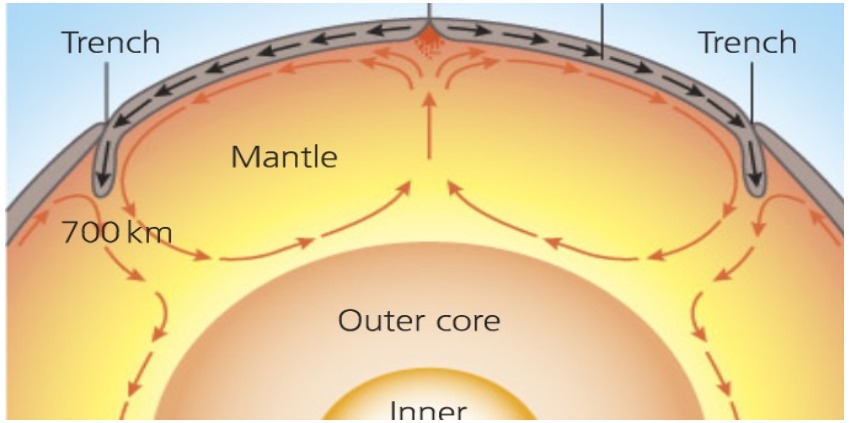
FACTORS AFFECTING HAZARD RISK

- **Poverty**: In LICs hazard risk is typically higher as the buildings and infrastructure are less able to withstand hazards, and they are often less prepared.
- **Urbanisation:** Can lead to a large nearby population resulting in increased risk (over 50% of the world's population live in cities). In an urban area the population density is higher, so more people will be affected.
- **Climate change:** increased atmospheric energy means there is a higher risk of extreme weather events such as longer and more severe droughts.

Crust	Outer layer of the earth (solid, thin layer)
Mantle	Layer beneath the crust (semi-liquid, thick)
Outer Core	Layer beneath the mantle (liquid iron)
Inner Core	Very centre layer (solid iron)
Tectonic Plates	The crust is split into several pieces (like a cracked egg shell). These pieces of rock are called tectonic plates. They float on the mantle.
Oceanic Crust	Curst found under the oceans (thin, young, more dense)
Continental Crust	Crust found under land (thick, old, less dense)
Continental Drift	Theory that said the earth's continents are very slowly moving and that once all the continents were joined together to form a super-continent called Pangea.

CONVECTION CURRENTS

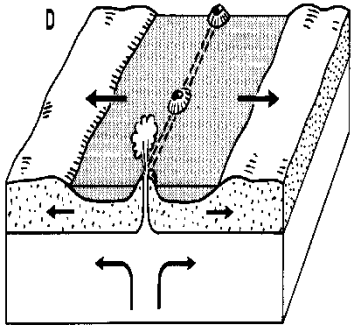
- The mantle is made up of semi molten rock. Mantle rock is heated by the core. The warm material rises to earth's surface. As it rises, the material starts to cool and sink. This motion of rising and sinking rock forms **convection currents** in the mantle. The semi molten rock flows in a circular motion.
- Convection currents cause the overlying tectonic plates to move.



CONSTRUCTIVE PLATE MARGIN

2 plates move away from each other due to convection currents/slab pull, leaving a gap between the two plates. Magma rises up from the mantle to fill the gap, constructing NEW CRUST (new land). This usually happens under the oceans. The new creation of land is called SEA-FLOOR SPREADING.

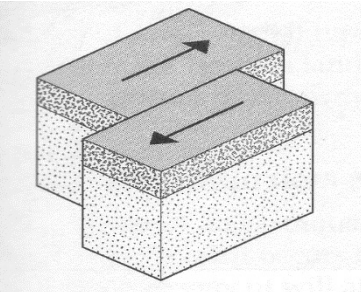
- ***Volcanoes** – there is no build-up of pressure = gentle eruptions*
- ***Earthquakes** – there is no build-up of pressure = gentle earthquakes*



CONSERVATIVE PLATE MARGIN

Two plates slide past each other due to convection currents/slab pull. They can be moving in opposite directions or moving in the same direction but at different speeds. The line between the two plates is called the FAULT LINE.

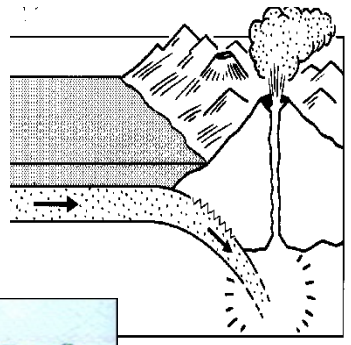
- ***No volcanoes** (no subduction and so no melting)*
- ***Earthquakes** – as the two plates slide past each other, pressure builds up. This is suddenly released, it causes VIOLENT EARTHQUAKES.*



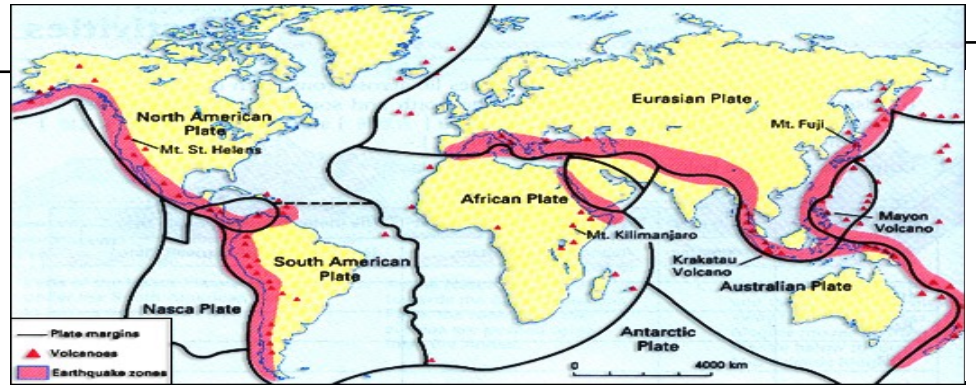
DESTRUCTIVE PLATE MARGIN

2 different types of plate move towards each other due to convection currents. The denser oceanic plate sinks beneath the lighter continental plate. This process is called SUBDUCTION and occurs at a subduction zone.

- ***Volcanoes** – as the oceanic plate sinks into the mantle, it melts = magma. This rises up through the continental crust until it reaches the surface.*
- ***Earthquakes** – as the oceanic plate sinks beneath the continental plate, it causes friction and pressure to build up. This pressure is suddenly released = earthquakes.*

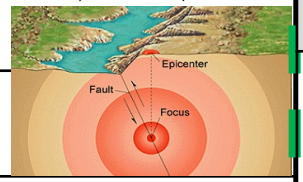


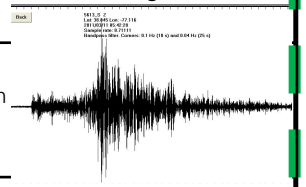
The continental plate is forced upwards creating volcanoes and mountain ranges, leaving trenches in the rift



Distribution = the spread of something. **Earthquakes** and **volcanoes** are distributed around the world on or near to the edge of plates, (plate boundaries/margins). This is because movement here creates either rubbing (conservative), gaps (constructive) or collisions at destructive plate boundaries.

An earthquake is….	A sudden or violent movement within the earth's crust. It is caused by a build up and sudden release of pressure/tension.
Shockwaves	As the tectonic plates suddenly move, they send out SHOCK WAVES (vibrations) from the point of movement in the earth's crust.
Focus	The point of movement in the earth's crust.
Epicentre	The point directly above the focus is called the EPICENTRE. The closer you are to the focus and epicentre, the stronger the earthquake will be.
Magnitude	The amount of energy released during an earthquake.
Seismometer	The instrument that measures the strength /magnitude of an earthquake.
Richter Scale	The scale on which earthquake magnitude is measured. The higher the magnitude on the Richter Scale, the more powerful the earthquake.
LICs are worse affected by earthquakes because…	The quality of infrastructure (buildings, roads, ports) is worse in LICs. As a result they more easily fall down and trap people. Many HICs have earthquake proof buildings. LICs are poorer than HICs. As a result they are unable to meet the costs of immediately responding to earthquakes (search and rescue, clear rubble, build temporary structures) or reconstruct cities. They rely on financial aid from other countries or organisations = less in control. HICs are able to meet many of the costs and immediately respond to the earthquake = less loss of life. LICs do not have as many planning and prediction strategies so are unable to predict when the earthquake will occur or prepare people for when it does occur.





L'AQUILA EARTHQUAKE (HIC)

Where: L'Aquila, Italy (Abruzzo region)
Plate Margin: Destructive plate margin(African and Eurasian plates)
When:3.32am 6th April 2009 **Magnitude**: 6.3 on the Richter Scale.

PRIMARY EFFECTS	SECONDARY EFFECTS
• 308 dead • 1500 injured • 10-15,000 buildings destroyed including the San Salvatore Hospital • A bridge in Fossa collapsed	• 67,500 people were made homeless • Fires in collapsed buildings • A burst pipeline near the town of Paganio caused a landslide • Cost: $11,434 million
IMMEDIATE RESPONSE	**LONG TERM RESPONSE**
• Camps were set up for homeless people providing food and medical care. 40,000 tents were distributed. • British red cross raised £171,000 • Ambulances, fire engines and the army were sent to rescue survivors. 36 ambulances and dog units attended. • Italian post office provided free mobile phones and SIM cards for people who had lost their homes • The government suspended mortgage, gas and electric payments.	• New settlements built for 20,000 residents • City centre has been rebuilt • Residents did not have to pay taxes in 2010 • Students did not have to pay university fees for 3 years.

HAITI EARTHQUAKE (LIC)

Where: Haiti, Caribbean Islands.
Plate Margin: conservative plate margin (Caribbean and North American plates)
When: 12th January, 2010 **Magnitude**: 7.0 on the Richter Scale.

PRIMARY EFFECTS	SECONDARY EFFECTS
• 220,000 dead • 300,000 injured • 300,000 homes damaged or destroyed. • 8 hospitals destroyed in Port-au-Prince • 5000 schools destroyed or damaged • Transportation routes (roads, rail, ports, airports) destroyed by fallen buildings • Service lines (water, gas, electricity) destroyed	• Trauma and diseases from dead bodies. • 1.3 million Haitians in temporary camps • Unemployment • High crime rates • Aid supplies could not reach victims. • 2 million Haitians with no food, electricity, water • Cost: $11.5 billion
IMMEDIATE RESPONSE	**LONG TERM RESPONSE**
• People were evacuated • USA sent ships, helicopters and the army to search and rescue for victims and clear rubble at the port so that companies could start to export goods again. • UN sent police to distribute aid & keep order. • The Red Cross set up temporary hospitals • The UK raised £100 million for emergency aid. • USA gave $100 million for emergency aid.	• Relocation – 1000s left Port-au-Prince permanently • Cash for work programs set up to clear rubble to give locals jobs in the long term. • World Bank gave $100 million to support long term reconstruction in Haiti. • ¾ of the buildings were repaired.

Why do people live in areas of risk?

- Friends and family
- Employment
- Confident the government will protect them (planning & prediction e.g. by monitoring volcanic gases)
- The land is very fertile near volcanoes (good for farming).
- They do not know it is unsafe – lack of education.

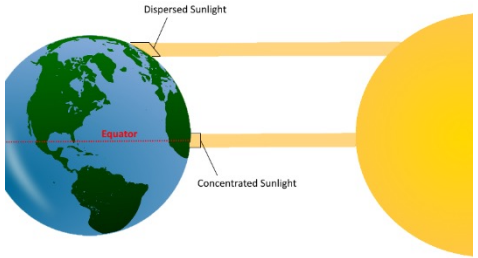
Monitor earthquake prone areas to PREDICT when it will occur.

Previous Earthquake Data	Historical records can be used to show patterns and trends. These can then be used to predict future earthquakes.
Measure for Small Tremors	Before a larger earthquake often there is an increase in the number of small tremors. Scientists use seismometers to record any ground movement.
Unusual Animal Behaviour	Animals often act strangely before an earthquake. In China, the city of Haicheng was evacuated following strange animal behaviour. Days later a 7.3 magnitude earthquake struck. It is estimated it saved 150,000 lives.

PLAN to prepare for when an earthquake occurs.

Earthquake Proof Buildings	Buildings are designed to withstand the earthquakes ➢ *Using flexible steel frames which sway as the ground moves.* ➢ *Rubber foundations that absorb the shockwaves/shaking.* ➢ *Building with a larger base than top will be less likely to topple over.*
Practice Drills	Educate people about to do should an earthquake occur. ➢ *On 1st September everyone in Japan practices what to do in an earthquake. It is called Disaster Prevention Day.*
Emergency Kit	Residents are encouraged to have an emergency kit ready, including *a torch, canned food, batteries, radio, medical kit, dust mask, water…etc.*
Hazard Mapping	Prevent building on loose/weak ground & reduce the height of buildings in high risk areas. This means that in high-risk areas, stronger and lower buildings can be used.

KS3 Geography Knowledge – The Challenge of Natural Hazards (Part 3)



Global atmospheric circulation is the system that redistributes heat around the earth. The temperature depends on latitude (how far north or south you are from the Equator):

At the Equator, temperatures are high because the sun's rays are concentrated on a small surface area.

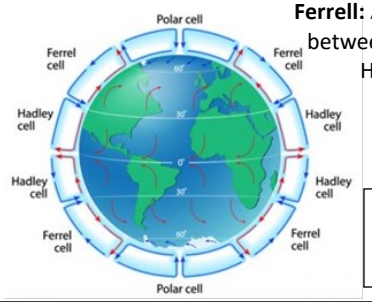
At the poles, temperatures are low because the sun's rays are dispersed across a large surface area.

In both the Northern and Southern Hemisphere there are 3 air circulation cells:

Polar cell: Coldest air

Ferrell: Air that circulates between the Polar and Hadley cells

Hadley cell: Warmest air

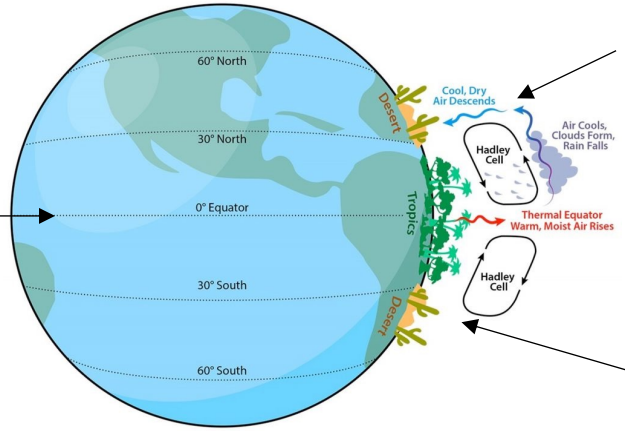


Where air is rising (at the equator, 60° North and South of the Equator):
This creates *low pressure* (as the air is not 'pushing down on us'). Water vapor rises into the atmosphere and condenses, causing rain.

Where air is sinking (30° North and South and 90° North and South):
This creates *high pressure* (as the air is 'pushing down on us). This creates clear skies and dry conditions.

Global atmospheric circulation links to the location of global biomes:

At the Equator, there is a low-pressure belt created by warm rising air (Hadley cells). This leads to the formation of tropical rainforests which are located 0-20° north and south of the Equator and receive 2000mm of rain annually.



At 30° North and South of the Equator, there are high pressure belts where air being circulated by the Hadley Cells cools and sinks. This leads to low rainfall and the formation of **hot deserts**, which are usually located 15-30° North and South of the Equator and receive less than 250mm of rain per year.

At the poles, cool dry air also sinks, creating high pressure. Polar such as Antarctica are therefore fairly dry, but the temperatures are low due to the dispersed sunlight.

Global atmospheric circulation links to the formation of tropical storms:

- The low pressure created by the Hadley Cells, where warm, moist air rises at the Equator helps to explain why tropical storms only form between 5 and 15° North and South of the Equator.

A tropical storm is a storm that is formed over warm water, near the tropics. It has wind speeds of over 74mph and torrential rain.
Hurricanes (USA and Caribbean), **Typhoons** (Japan and the Philippines) **Cyclones** (SE Asia and Australia).

Tropical storms conditions:
- **Warm water (>27°C)**. As a result they are often found in tropical areas and occur in the summer/autumn when seas are at their hottest.
- **Latitudes between 5 -20°** north and south of the equator. A tropical storm is a spinning mass of clouds. The earth's spin between 5-20 is enough to spin the clouds = tropical storm.

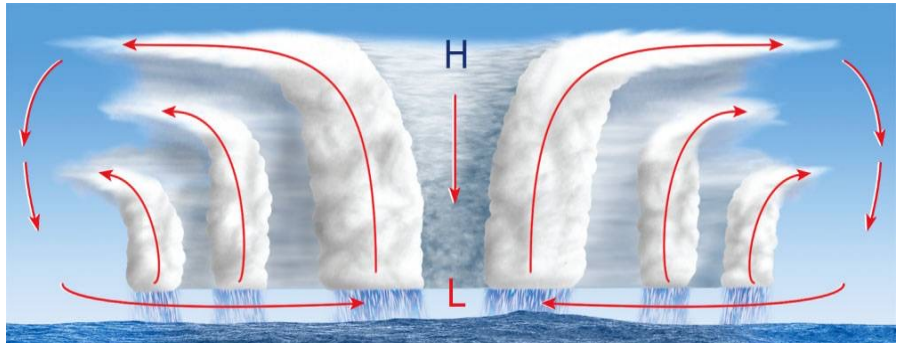
Tropical storms are measured using the **Saffir-Simpson scale**. There are 5 categories.

TROPICAL STORM FORMATION:

HEAVY	HEAT	The sun HEATS the sea/ocean.
ELEPHANTS	EVAPORATE	Warm, moist air EVAPORATES and rises.
REALLY	REPLACE/ REPEAT	More air rushes in to REPLACE the air that has just evaporated. It is also evaporated.
CAN	CONDENSATION/ CLOUDS	As the air rises it CONDENSES to form thick CLOUDS.
SQUASH	SPIN/SPIRAL	The clouds SPIN because of the rotation of the earth forming a SPIRAL.
SUMOS	SINKING AIR = EYE	Cold air SINKS in the centre of the storm forming the EYE of the storm.
MASSAGING	MOVE	It MOVES in the prevailing wind direction.
LIONS	LAND/LOSE ENERGY	It reaches LAND and LOSES energy as no warm water is being evaporated.

Up to 300miles across.

Heavy rain & possible thunderstorms on the edges of the storm



On either side of the eye is the eye wall – a tall bank of cloud. Here are very strong winds, heavy rain, thunder and lightening.

The eye – in the centre of the tropical storm cold air sinks. There are no clouds or wind. It is very calm.

Climate Change and tropical storms:
Intensity: With sea surface temperatures rising, larger bodies of water are warming and remaining warm. This fuels the tropical storm for longer increasing its intensity.
Frequency: Data does not show a change in frequency.
Distribution: As sea surface temperatures rise by 0.25C-0.5C over the last decade or so, the areas where tropical storms can form is becoming larger.

KS3 Geography Knowledge – The Challenge of Natural Hazards (Part 4)

CASE STUDY - TYPHOON HAIYAN

Where: Philippines, Asia
When: November, 2013
Saffir-Simpson Scale: category 5 with wind speeds of 170mph and waves 15m high

PRIMARY EFFECTS	SECONDARY EFFECTS
• 6,300 dead • 27,000 injured • 1.1 million homes damaged • 30,000 fishing boats destroyed • Schools, hospitals and shops destroyed. • 400m of rain flooded agricultural land. • Transportation routes (roads, rail, ports, airports) blocked by trees and debris Specifically the Tacloban airport was damaged • Service lines (water, gas, electricity) destroyed	• Trauma and diseases from dead bodies. • 1.1million people in temporary camps • Increase in unemployment – ¾ farmers and fishermen lost their jobs • Crops destroyed = loss of $53million to rice crop not being exported • Surface and groundwater was contaminated by floodwater • Looting and violence in Tacloban • Aid supplies could not reach victims. • Some areas had no power for 1 month • Shortages of water, food and shelter led to disease.

IMMEDIATE RESPONSE	LONG TERM RESPONSE
• People were evacuated to 1200 evacuation centres that were created • USA sent aircraft/helicopters to search and rescue • People cleared rubble • Emergency food from Philippine Red Cross • Emergency hospitals from France, Belgium and Israel • Emergency shelter from UK	• Reconstruction and relocation – 1000s of new homes built in flood safe areas • Reconstruction of roads, bridges & airports • NGOs (e.g. Oxfam) replaced fishing boats. Fishing industries were re-established. • UN, UK, Australia, Japan and USA provided long-term medical supplies and financial aid • US, Australia and EU provided financial support for people to start new lives • Cash for work programmes were created to help people earn money in the long term

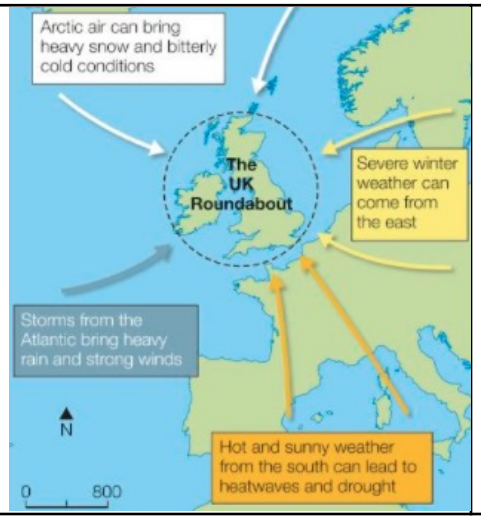
How can we reduce the risk posed by tropical storms?

MONITOR	PREDICT	PLAN	PROTECT
PREVIOUS TROPICAL STORM DATA We can use previous data and computer models to predict the course of a tropical storm. We can then instruct people living in hurricane prone areas how to protect themselves.	**TRACK TROPICAL STORMS USING SATELLITE IMAGERY** We can watch the hurricane progress using satellites and use this to get a better idea of where it will go next.	PLANNED EVACUATION ROUTES Educate people where they need to go should a tropical storm occur. Use signs to clearly show where people should go and meet	COASTAL DEFENCES: To reduce flooding caused by storm surges. STORM DRAINS: Take away excess flood water. CYCLONE SHELTERS: Provide shelter to reduce risk of drowning. 

Extreme weather is a weather event that is significantly different from the normal.

The UK experiences varied weather and occasional extreme weather events as the UK is located at the meeting point of a number of air masses, which bring different weather from different directions.

Hazards include:
- ❑ Droughts
- ❑ Thunderstorms
- ❑ Intense rainfall
- ❑ Snow
- ❑ Extreme cold
- ❑ Strong winds



Evidence that weather is becoming more extreme:
- ➢ **International Disaster Database** – records show the number of **floods have increased since 1960s**. Climate models show an **increase in the frequency and length** of extreme events.
- ➢ **2003 Heatwave** affected the whole of Europe. It lasted from June till August. Tourism increased in parts of the UK due to hot weather, however 2045 people died in the UK due to heat.
- ➢ **2014 Somerset Floods** (wettest January on record)
- ➢ **2018 Beast From the East;** temperatures in some areas dipped to -11°C, the lowest since 1986.

SOMERSET FLOODS (December 2013-February 2014)

Where: Somerset Levels, South West England.
Physical landscape: Low lying farmland drained by several rivers including the River Tone and the River Parrett which flow into the Severn Estuary. Flooding has occurred her for centuries.
Why: 350mmm of rainfall fell in Jan and Feb (100mm more than normal precipitation), High tides and bad weather = storm surges forced water onto land and into the river channels. Several rivers converge here and had not been dredged for 20 years (silt hadn't been removed from the river bed, so the channel couldn't hold as much discharge).

SOCIAL EFFECTS	ECONOMIC EFFECTS	ENVIRONMENTAL EFFECTS
• 600 houses flooded. • Powerlines flooded, so no power. • Transport routes flooded. • Villages such as Muchelney cut off.	• 16 farms evacuated, Over 1000 livestock evacuated. • 14,000 hectares of agricultural land was under water for weeks. • Somerset County Council estimated cost at £10 million • Local roads and railway lines were flooded	• Habitats were underwater, as a result, animals were displaced • Floodwater contained sewage and chemicals, contaminating farmland.

To prevent this from happening again, a £20 million flood management scheme and a £100 million pledge in total was offered by the government over a period of 20 years:
- ❑ In March 2014, 8km of the **River Tone and the River Parratt were dredged**. As a result, the river channels can now hold more water during periods of high rainfall.
- ❑ **Roads have been elevated in places**. As a result settlements are more likely to remain accessible during floods.
- ❑ **Settlements in areas of flood risk have flood defences.** As a result reducing the likelihood of property damage.
- ❑ **River banks have been raised.** These are called embankments, as a result reducing the likelihood of the channel overflowing it's banks during high discharge.
- ❑ In the future, a possible tidal barrage on the River Parrott is planned at Bridgewater to protect from tidal surges.