

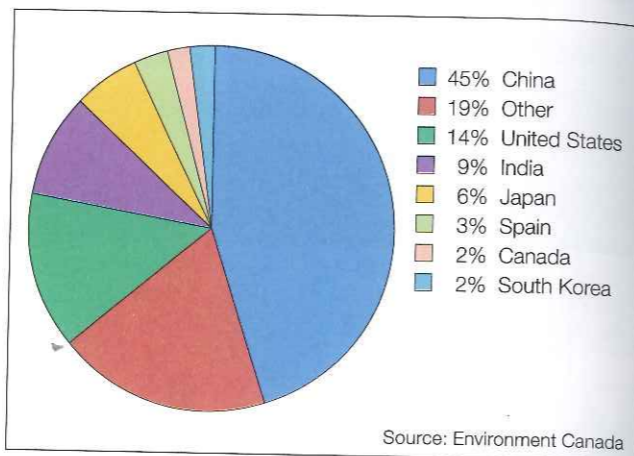
5.6 Dams change landscapes

Of the world's 228 largest rivers, approximately 60% have been changed by the construction of dams, weirs and canals along their journey from source to mouth. In Australia, after 150 years of dam building some people wonder if the problems arising from dams outweigh the benefits. At present there is a debate over the construction of a dam on the Mary River in south-east Queensland after the river experienced flooding in 2010, 2011 and 2013. The traditional Gubbi Gubbi people object to the construction of a dam as the river touches spiritual places, birth places and sacred pools.

Damming the world

A dam retains water, while floodgates, levees and dykes are used to manage or prevent water flowing onto the land. The ideal location for building a dam is the narrow part of a deep river valley where the valley sides act as natural walls. Behind the dam wall a reservoir of water collects, frequently enjoyed for recreational activities, such as fishing. Dams are used to irrigate farms in the Murray–Darling Basin, provide water to urban settlements in London and supply electricity for Chinese industries. Additionally, dams reduce the impacts of floods downstream.

The construction around the world of 48 000 dams, over 15 m high, has displaced natural landscapes, such as forests, as well as agricultural lands



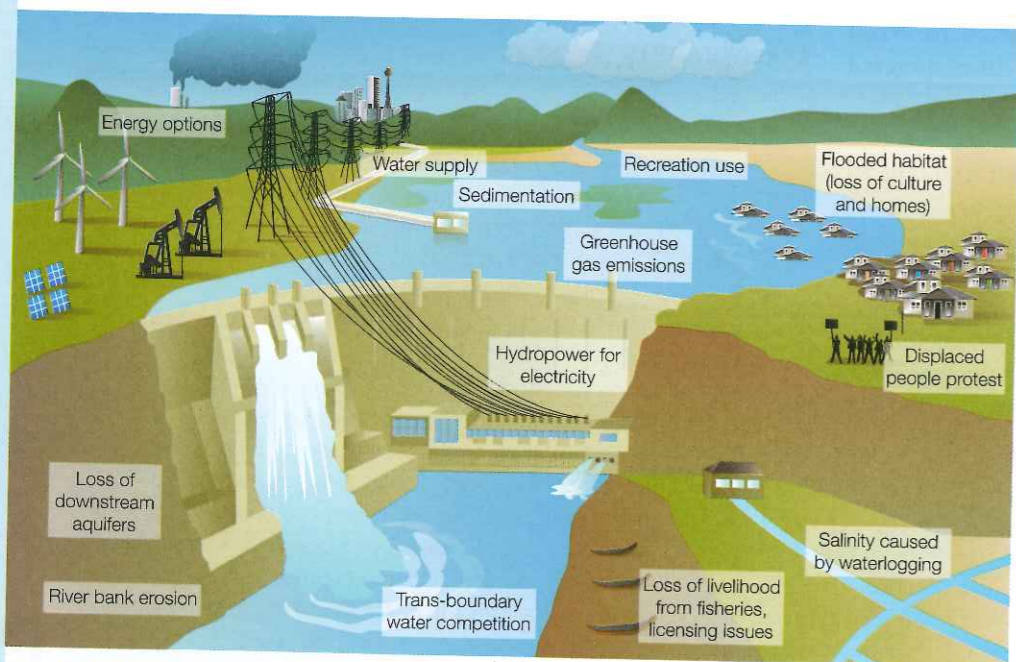
5.6.2 Global distribution of large dams

and settlements. Dams have caused the degradation of wetland and riverine ecosystems, and their reservoirs have changed biodiversity, because water temperature is colder behind the dam wall where the water is deeper. Fish such as salmon are unable to migrate upstream to breed, although in many cases fish ladders have been built to assist their migration.

A dam collapse from an earthquake or faulty construction increases the chance of floods downstream. Dam failures are rare, but in 1975 the collapse of Banqiao and Shimantan dams in China killed 171 000 people and displaced the 11 million who had lost their homes.

Belo Monte Dam, Brazil

The Belo Monte Dam in Brazil is under construction on the Xingu River, a tributary of the Amazon River. When built it will be the third-largest hydroelectric dam in the world, flooding 1300 km² of rainforest and displacing 12 000 indigenous people. Indigenous people consider the construction of the dam environmentally destructive, leading to loss of vegetation and changes in water supply and fish migration routes.



5.6.1 Dams cause changes to people and landscapes

Geoinfo

- Approximately 40–80 million people have been displaced from their homes as a result of dam construction.
- Australia's largest artificial lake by volume is Lake Argyle, Western Australia, completed in 1971.

Three Gorges Dam, China

In 1954, the Yangtze River in Central China flooded, killing 33 169 people and forcing 18 884 000 people to relocate. The Three Gorges Dam built on the river reduces floods downstream, provides electricity, and increases shipping capacity by constructing locks and lifts.

However, the future of the dam is uncertain as it sits on a seismic fault and 80% of the land around the river experiences high rates of soil erosion. As a result, around 35 million tonnes of sediment is deposited into the Yangtze River annually, which means sediment builds up behind the dam instead of

5.6.3 Three Gorges Dam changes landforms

Changes in Yangtze River upstream of dam and towards the source

- Large storage of water created behind the dam
- Gradient and speed of river reduced
- Build-up of sediment behind the dam could cause water to overflow or break the dam over time—needs constant dredging

Changes in Yangtze River downstream of dam and towards the mouth

- Discharge of water downstream reduced and more regular
- Less alluvium in the river downstream to provide fertile soil for agriculture

Advantages of Three Gorges Dam

- Improved navigation and trade as far as Chongqing, one of the fastest-growing cities in the world
- Flooding reduced
- Water stored behind dam used for drinking and irrigation
- Produces renewable energy

Disadvantages of Three Gorges Dam

- Increased traffic and pollution placing stress on freshwater species (e.g. freshwater dolphin, sturgeon and alligator)
- Dam is vulnerable to earthquakes
- 1.3 million people relocated when reservoir was flooded

5.6.4 The Three Gorges Dam

flowing downstream. The Yangtze carries the fifth-largest sediment discharge of any river in the world.

The Yangtze River basin is home to 361 fish species and accounts for 27% of endangered freshwater fish species in China. The Three Gorges Dam is adversely affecting freshwater fish, especially the extinct Chinese River Dolphin.

Geoactivities 5.6

Knowledge and understanding

- 1 What is a dam?
- 2 How does a dam differ from a dyke?
- 3 List the advantages of dams.
- 4 Explain how dams cause landscape degradation.

Inquiry and skills

- 5 Refer to 5.6.1.
 - a What is the ideal location for a dam?
 - b List the multiple uses of dams.
 - c Explain how dams impact positively and negatively on people.
- 6 Refer to 5.6.2 and name the three countries where most large dams are constructed.
- 7 Refer to 5.6.3.
 - a Where is the Three Gorges Dam located?
 - b How has the dam changed the river upstream and downstream?
 - c Explain anticipated future problems of the dam.
 - d Determine whether the dam is an engineering miracle or an environmental disaster. Explain your answer.
- 8 Refer to the text and research Belo Monte Dam.
 - a Where is the Belo Monte Dam to be constructed?
 - b List the advantages and disadvantages of the dam to Brazil.
- 9 Investigate the proposal for the construction of a dam on the Mary River or a dam in another country. List the different views of people on its construction (e.g. indigenous communities, people who lost properties during a flood, conservationists, town planners and displaced settlements). Present the different perspectives as a table and summarise conclusions.
- 10 In groups, research a dam in Australia. When was it built? Why was it built? How did it change the landscape? Evaluate your sources and present the information as a PowerPoint or short essay.
- 11 Climate change could cause a decline in water for drinking, industry and agriculture. As a result, dam construction could become a popular solution. What would be the implications? Suggest alternatives.
- 12 Research a significant dam failure and the impact on people and the environment. Present your findings as a TV news item.



5.7 Humans construct canals

Humans have changed landscapes by constructing features to reduce the impact of sea level rises (e.g. sea walls and dykes), decrease floods (e.g. dams and levees) and improve transport (e.g. canals). From one perspective, these human-built structures are aesthetically unattractive and cause landscape degradation, and from another perspective they are marvels of human engineering that have improved people's lives.

Rivers have been changed by dredging and damming their journey from their source in mountains to their mouth at oceans. Some meandering rivers have been straightened, resulting in degradation of **wetlands** and **riparian** vegetation.

5.7.1 Straightening rivers

Advantages

- Rivers are more suitable for navigation by larger vessels
- Larger and deeper river channels reduces floods
- Reduces natural erosion

Disadvantages

- Loss of wetlands causes a decline in habitat for wildlife and the loss of an important filter for fresh water
- Straightening causes the rivers to flow more rapidly, which can increase soil erosion and flooding downstream from the channelised area
- Causes decline in river fish populations

Canals

Canals are human-made channels for water that serve a variety of functions:

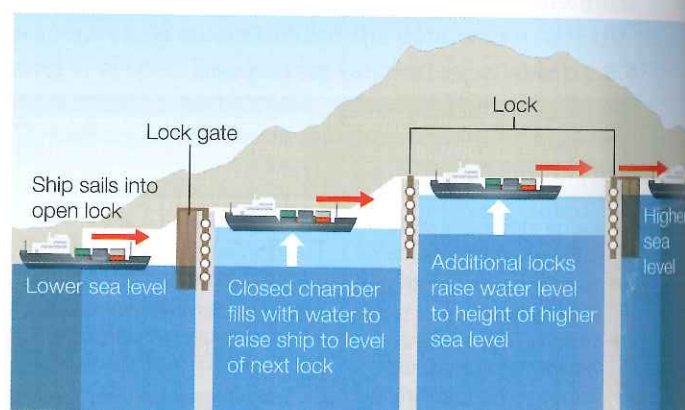
- connecting lakes (Erie Canal, USA), rivers (Lenin Volga–Don Shipping Canal, Russia) and oceans (Suez Canal in Egypt and Panama Canal)
- connecting city networks e.g. the canals in Venice.

Amsterdam has been called the 'Venice of the North' with over 100 km of canals and 1500 bridges. Bangkok is referred to as the 'Venice of the South', with canals, or klongs, transporting people and products. Today many canals in Bangkok have been drained or filled and replaced by roads.

The Suez Canal connects the Mediterranean Sea and the Red Sea, and all seaborne trade between Asia and Europe passes through the canal. Marine species located in the Mediterranean Sea are threatened by the movement of 300 species from the Red Sea. In Central America, the Panama Canal connects the



5.7.2 A canal in Amsterdam

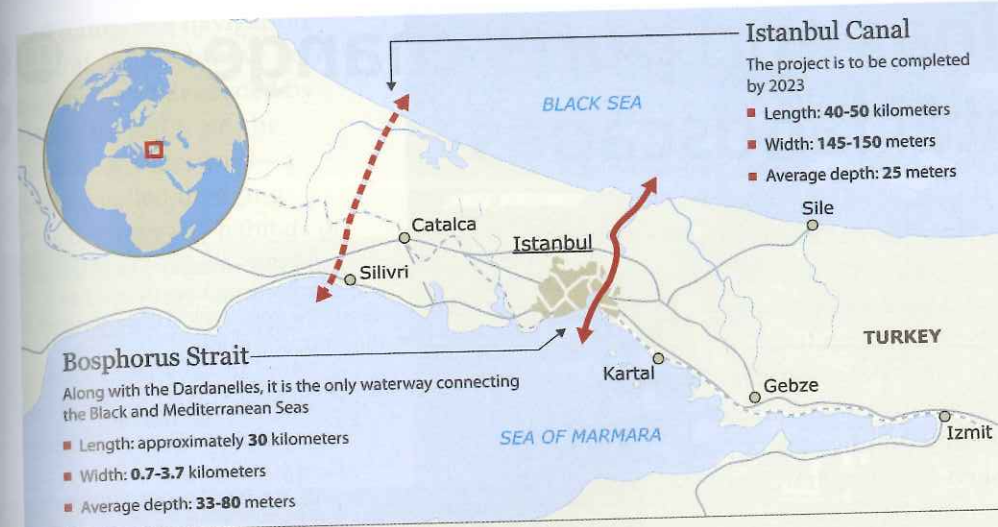


5.7.3 Operation of the Panama Canal. Ships move via locks, which increase or decrease their water level to raise or lower the ships

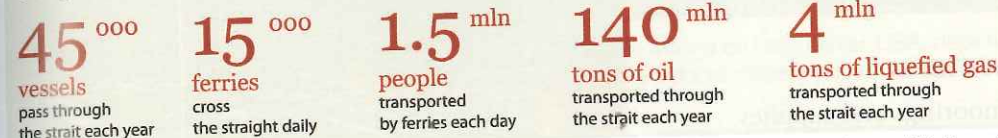
Pacific and Atlantic oceans, enabling faster transport of goods and people. At present there is a proposal for the construction of Canal Istanbul in Turkey to link the Black Sea with the Sea of Marmara by 2023. However, Greenpeace Turkey warns that the canal will change the native habitat, excavations will cause erosion, and agriculture and water resources will be negatively affected.

Restoring rivers

The global trend to straighten rivers has recently changed its course. For example, in Europe some constructed canals have been restored to the natural meandering courses of the original rivers. In the USA a 'no wetlands loss policy' is popular, which means



Congestion in the Bosphorus Strait



canals constructed in one place are to be offset by creating a new wetland in another place.

From wetland to sewage dump

Gowanus in Brooklyn, New York, was originally a tidal inlet with mangroves teeming with fish and wildlife. During the mid 1850s, the Gowanus Creek was deepened into a canal and marshlands eradicated. It soon became the hub for Brooklyn's commercial

shipping activities, and factories, tanneries, coal stores and gas refineries sprang up along its banks. These industries polluted the water and obstructed the growth of aquatic plants. Today, rising gas bubbles emerge from sewage sludge and a horrendous stench pervades the air. A proposed clean-up plan for the Gowanus Canal aims to prevent raw sewage overflow and remove contaminated sediments, such as lead, mercury and copper.

Geoactivities 5.7

Knowledge and understanding

- List the features constructed by humans that change the flow of rivers and ocean currents.
- Name two different types of human-made canals.
- What is meant by a 'no wetlands loss policy'?
- Give an example of a landscape restored to its natural state.
- Describe the changes to Gowanus Creek in New York and its impacts on the landscape.

Inquiry and skills

- Refer to 5.7.1. Explain your perspective on whether rivers should be straightened.
- Refer to 5.7.2.
 - Discuss why Amsterdam is called the 'Venice of the North'.
 - Design a day excursion travelling on the canals of Amsterdam or Bangkok. Identify the different landscapes you would pass. Present as a Prezi.
- Refer to 5.7.3.
 - Where is the Panama Canal located?
 - How does the canal work?
 - What are the advantages of the canal?
 - Investigate plans for future expansion of the canal.
- Refer to 5.7.4.
 - Describe the location of the Istanbul Canal project.
 - Explain why it will be important for the flow of people and goods.
 - Discuss how the canal could degrade landscapes.
- Using ICT, research the Suez Canal. Explain the reasons for the construction of the canal and its impacts on the global movement of people and goods.
- Where is the St Lawrence Seaway located? What are the advantages of the canals for North Americans?
- Plan a holiday on a barge in the UK or Europe. In your response include a map showing the canals. Present your information as an eco-tourist pamphlet.

5.7.4 Istanbul Canal project

i Geoinfo

- More than 200 million tonnes of cargo move through the Great Lakes Seaway System annually.
- The Grand Canal of China is the longest canal in the world.



5.8 Marinas and ports change coastal landscapes



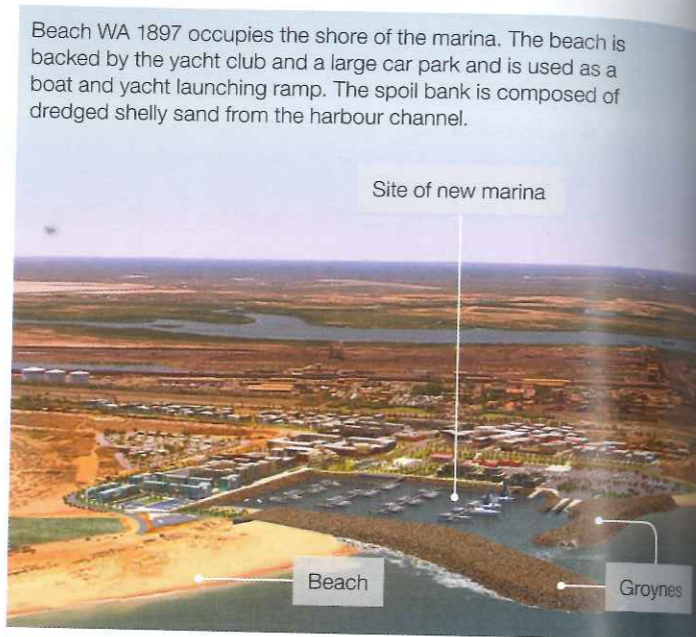
The construction of port facilities modifies coastal and **estuarine** habitats by physically altering the shoreline. Frequently, wetlands and seagrass beds are destroyed, which reduces aquatic habitats. Construction of marinas has similar environmental impacts to ports, although generally smaller due to their smaller size. The increasing number of marinas and associated structures, such as jetties and boat ramps, along the Australian coast has altered shorelines and habitats, and degraded natural landscapes.

Marinas and breakwaters

A marina is a dock with moorings and supplies for yachts and small boats. They are located beside oceans, rivers and lakes, such as Salt Lake, USA. San Francisco Bay is a mecca for sailors as it contains 40 marinas and over 11 000 slipways. In Greece there are 20 marinas under construction and 50 in operation, such as at Piraeus—the starting point for boat trips to the Aegean islands for millions of tourists every year.

Australia's coastline stretches approximately 60 000 km. Two-thirds of the population live in towns and cities located near the coast. Marinas have been constructed to accommodate affluent lifestyles, such as in the Docklands in Melbourne, Darling Harbour in Sydney, the Gold Coast, Hamilton Island, and Hillarys Boat Harbour, north of Perth.

At present the Western Australian Government aims to build a multi-million dollar marina and port facility in Port Hedland. The Spoilbank Marina Precinct is part of the Pilbara Cities initiative, which aims to revitalise Port Hedland into a city of 50 000 people. However, dredging during construction will cause loss of species in the intertidal zone associated with mangroves, salt marshes and cyanobacterial mats. These mats are rich in organic matter and phosphorous, and reduce erosion by binding and stabilising land. The Spoilbank Marina project has strategies in place to reduce loss of biodiversity, trap nutrients, maintain water quality, protect against storm surges and erosion, and promote the recreational value of fishing.



5.8.1 The planned Spoilbank Marina, Port Hedland, WA

Landscape degradation

Excessive boating activity in river mouths and estuaries leads to erosion of riverbanks and destroys the vegetation that is important for the preservation of biodiversity. Boats and marinas cause water pollution from oil spills and sewage disposal. Additionally, they require wharves, navigational markers, dry-docks, slipways, fuel storage, pump-out facilities and parking access.

Before a marina is constructed, an environmental statement of its effects is prepared. Questions to be answered include:

- Is a breakwater or channel diversion required?
- Can clearing of natural riparian vegetation be avoided?
- Will wetlands or seagrass be affected?
- Is bank erosion likely?
- Will nearby aquaculture and fishing grounds be affected?
- Will there be significant visual impact?
- Is the proposal likely to affect the significance of Indigenous or non-Indigenous heritage items found on the sites?

To improve navigation, natural channels have been widened and deepened by removing soil from the bottom of waterways—a process called dredging. This destroys the habitats of benthic, or bottom-dwelling, organisms that live in the sediment. To reduce the impact of waves, such as tsunamis or storm surges after cyclones, stone breakwaters are constructed around ports and marinas. This interferes with natural erosion and seagrass species and their habitats.



5.8.3 Photo of Gainsville Marina on Lake Lanier, USA, depicting the facilities a marina requires. A–G and 1–10 are docks offering various facilities



5.8.2 Images of Mantoloking, New Jersey, before and after Hurricane Sandy in 2012

Geoactivities 5.8

Knowledge and understanding

- 1 What is a marina?
- 2 How does a marina differ from a port?
- 3 Describe how marinas can cause landscape degradation.
- 4 Why are cyanobacterial mats and riparian vegetation important?

Inquiry and skills

- 5 Refer to 5.8.1.
 - a What is a spoilbank?
 - b What is the aim of developing the Spoilbank Marina?
 - c How will the construction of the Spoilbank Marina impact on the environment?
 - d How will the project reduce landscape degradation?
- 6 Refer to 5.8.2.
 - a What were the impacts of Hurricane Sandy on New York marinas?

- b Explain how the hurricane degraded the landscape.
- c Describe what could occur in marinas with rising sea levels and increasing intensity of storms.
- 7 Refer to 5.8.3.
 - a What facilities does a marina require?
 - b Explain how the natural environment surrounding a marina changes over time.
- 8 Plan a class debate on the following statement: *Marinas are the environmentally destructive playgrounds of the rich.* Evaluate your sources and summarise conclusions.
- 9 Organise a sailing trip around the world staying at marinas. Plot your course on a world map. Include latitude and longitude of each place and the anticipated weather you would experience by including three climate graphs.

