FLOODING AND RIVER BASIN MANAGEMENT: THE RIVER TEES

by Ann Bowen

THIS UNIT looks at how the River Tees (Figure 1) has been managed to provide a water supply and to reduce the effects of flooding.

Rivers are managed for four main reasons:

- to prevent or reduce flooding
- to provide a water supply
- to improve water quality and the environment
- to increase the river use for leisure and recreation.

A river floods when the channel can no longer hold all of the water and the water spills out onto the surrounding land. Floods are a natural event and rivers have created flood plains to cope with the water when the river floods. The problem is that people use flood plains; there are towns and cities, roads and railways, industry and farmland on flood plains. When the river floods people may be killed, properties flooded, transport disrupted and jobs and income lost. The financial costs and the disruption caused make people keen to try to stop or reduce the effect of floods.

The demand for water increases as populations grow. More water is needed for use in the home, for industry and for agriculture. Many rivers are managed to ensure that there is a good, clean water supply. Today rivers are also managed in ways that preserve the water quality and the environment. This is called **sustainable development.**

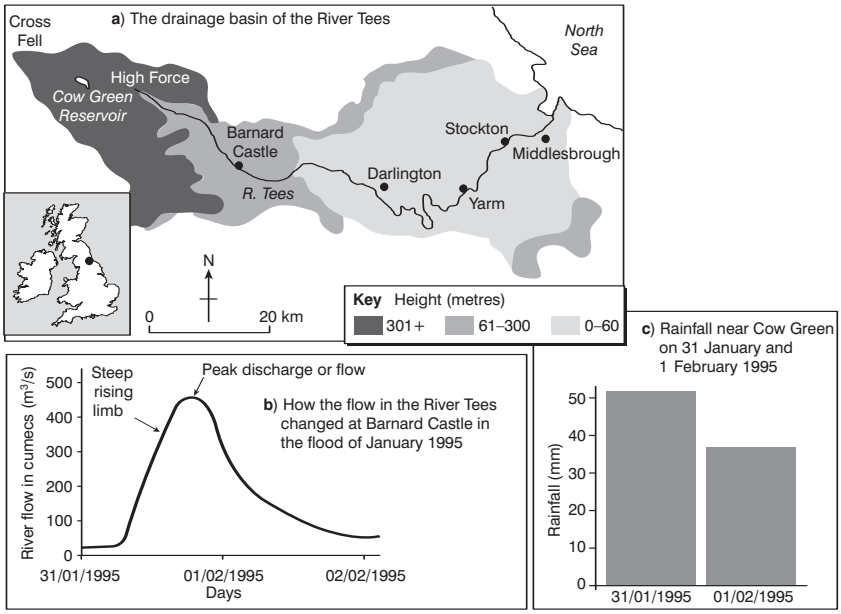

Figure 1: **The drainage basin of the River Tees and the flood event of 1995**

Figure 2: **Aerial view of Yarm**

Why does the River Tees need to be managed?

A flashy river

The River Tees rises on the slopes of Cross Fell at a height of 893 metres. The area receives over 2,000 millimetres of rain each year. The rainfall reaches the river quickly because the slopes are steep and very little water can infiltrate due to the impermeable rocks and saturated peat. After heavy rainfall or when the snow melts in the spring the river level can rise quickly and the water also flows downstream quickly. This can cause the 'Tees roll' or 'Tees wave', when the river level may rise as much as a metre in 15 minutes. There is a long history of flooding along the River Tees, especially in its lower course. Figure 2 shows the town of Yarm.

A densely populated area

In the lower course of the river there are towns such as Yarm, Stockton and Middlesbrough. The area is densely populated and there are also large industrial areas such as the ICI chemical works. Flood damage can run into hundreds of thousands of pounds. There is also a huge demand for water for use in homes, industry and agriculture. The long history of heavy industry in the region had caused water pollution and the loss of salmon and trout in the river.

Managing the River Tees

In the upper Tees basin

There are nine reservoirs in the River Tees drainage basin (Figure 3). The largest is Cow Green Reservoir, completed in 1971, which can hold 41 million cubic metres of water. The reservoirs store water which can then be released in times of low flow to cope with the increasing water needs of homes, industry and agriculture further downstream. The reservoirs are also used to store large quantities of water at times of heavy rainfall or snowmelt to reduce the peak flow and so help to prevent flooding.

Reservoir	Year of completion	Capacity (million m^3)	Catchment area (km^2)
Hurworth Burn	1871	0.7	13.9
Lockwood	1877	0.5	–
Hury	1894	3.9	43.1
Blackton	1896	2.1	43.1
Crookfoot	1903	1.1	5.4
Grassholme	1915	6.1	78.7
Selset	1960	15.3	78.7
Balderhead	1965	19.7	43.1
Cow Green	1971	40.9	58.9

Figure 3: **Reservoirs in the Tees valley**

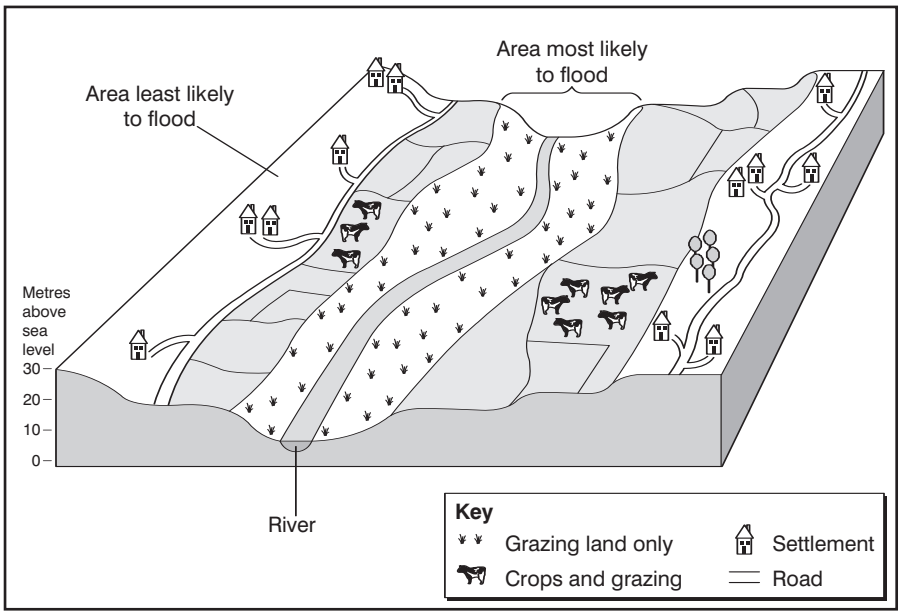

Figure 4: **Flood plain zoning**

In recent years new developments of housing or industry have been discouraged in low-lying areas to reduce the likelihood of flooding of properties and to allow the flood plain to act naturally if a flood occurs.

In the lower Tees basin

The land here may suffer flooding from the river but also from storms and high tides in the North Sea. Some strategies aim to prevent flooding while others aim to reduce the impact of a flood should it occur. These include:

- improved flood warning systems
- new developments being refused planning permission in low-lying areas
- monitoring of river and sea defences
- building of the Tees barrage to reduce the risk of flooding by the river and the sea
- dredging the river bed to increase the channel size and improve navigation
- new sewerage works and strict laws on dumping and industrial discharges to improve water quality.

From 1810 the river was straightened by cutting through meanders. The first of these was the Mandale loop which shortened the river by 4 km. The flood water is therefore able to flow more quickly out to sea.

The introduction of flood plain zoning (Figure 4) allows the river to flood naturally and reduces the need for flood defences, which are expensive and do not always last very long. The Tees

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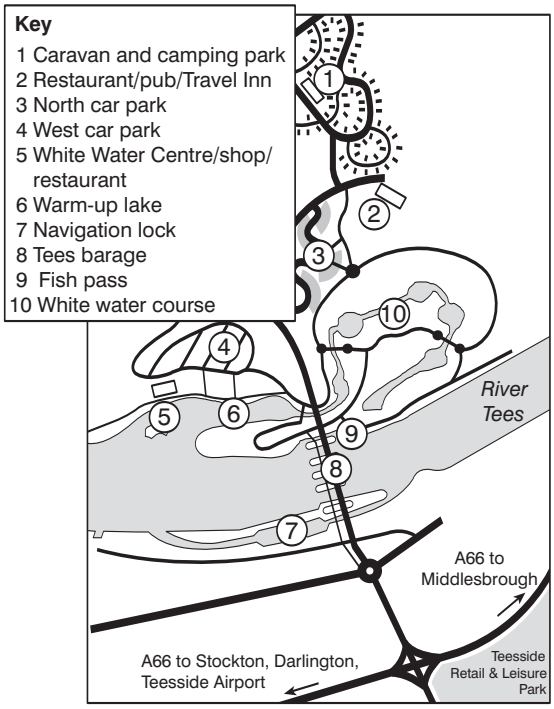

Figure 5: **The Tees barrage**

barrage (Figure 5) has been designed to preserve the environment, for example by not damaging the unique ecosystem in the estuary and including salmon leaps so that the fish can migrate upstream for breeding. Seal Sands at the mouth of the estuary is a world-famous site for seals and migratory birds. Recent river management schemes have made sure that the area is not damaged.

The Yarm flood defence system

Yarm is a market town on the River Tees with a long history of serious flooding. The earliest recorded flood was in 1575. The town has suffered a lot of damage due to flooding over the years. A new defence scheme has been built to cope with an extreme flood, one that may only happen every 100 years, and to improve the riverside environment. The scheme was only finalised after extensive consultation with many local people and environmental groups. The defences have cost £2.1 million. The town is built around a large meander on the River Tees (see Figure 2). Parts of the river have been reinforced with concrete walls covered with stone. The walls have flood gates in them to allow access by people and vehicles. A new landscaped earth embankment has been built to protect Yarm school. Gabions (rocks in wire cages) have also been put in place to reduce erosion along embankments. Pipes have been laid to redirect the flow of a tributary, the Skyterring Beck. To improve the environment, street lighting, flower beds, street furniture and fishing platforms have been developed.

The Tees barrage

The barrage was officially opened in 1995 by HRH The Duke of Edinburgh. The barrage (Figure 5) stops the tidal flows upstream and has opened up 25 km of clean navigable waterway for leisure. It has led to the regeneration of derelict land along the riverside and attracted new jobs and businesses to Teesside.

The barrage cost £54 million and links the north and south banks of the Tees at Stockton. It includes a lock that allows boats to pass through as well as a fish pass, a road bridge and Britain's finest white-water course. Salmon have now returned to the River Tees. The barrage is 70 metres wide and 32 metres long. Between the barrage supports are four gates, each weighing 50 tonnes and measuring 13.5 metres long and 8 metres high. These regulate the flow of river water and also act as a barrier to prevent tidal flooding moving upstream. Around the barrage are car parks, a camping and caravan site, restaurants, shops and woodland planting of 100,000 trees and shrubs.

Conclusion

The River Tees has seen a range of management strategies, from hard engineering such as the reservoirs and the Tees barrage, to softer management strategies including tree planting and flood plain zoning. Some of the strategies aim to stop floods happening while others aim to reduce the effects of floods when they occur. The reservoirs also ensure there is a large water supply for the people who live and work in the Tees valley. In recent years new developments have improved the water quality and the environment and encouraged more recreational use of the Tees valley.

Glossary

Dredging – deepening the river channel by removing sand and silt.
Ecosystem – the combination of plants and animals in an environment with certain soils and climate.
Estuary – the drowned river mouth in a lowland area.
Flood – when river water leaves its channel.
Flood plain – the flat area of land on either side of a river in its lower course.
Flood plain zoning – restricting the use of land close to a river to reduce the impact of a flood, for example grazing land nearest the river and settlement further away.
Gabions – rocks set in wire cages to reduce erosion.
Impermeable – does not allow water to pass through.
Infiltration – the rate at which water may pass through soil or rocks.
Meander – a bend in the river.
Peak flow – the maximum flow of a river during a rainstorm.
Reservoir – an artificial lake built to store water.
River basin – the area of land drained by a river.
Runoff – the amount of water that reaches a river.
Sustainable development – new developments that do not destroy the environment but may improve it.

Activities

1 Give four reasons why rivers may be managed.

2 (a) Look at Figure 6. Add these labels in the correct places on the map to show why the River Tees floods:

- Rainfall over 2,000 mm
- Steep slopes
- Heavily built-up and populated flood plain
- Impermeable rocks
- Threat of flooding from the sea

(b) Why is the River Tees called a 'flashy' river?

3 (a) Using the information in Figure 7, draw a graph to show rainfall and runoff for the River Tees.
(b) What is *runoff*?
(c) In which season is runoff the greatest?
(d) Describe the link between rainfall and runoff.
(e) Suggest why the gap between rainfall and runoff changes during the year.

4 Study Figure 3.
(a) Complete a graph to show the capacity of the reservoirs and the year in which they were built.
(b) What has happened to the size of the reservoirs over time?

(c) True of false? Which of the following statements may explain the change that has occurred?
(i) A larger water supply was needed as the towns and industries grew on Teesside.
(ii) The amount of rainfall increased.
(iii) New technology allowed larger reservoirs to be built.
(iv) There was more demand for flood protection.
(v) People wanted more reservoirs for fishing and yachting.

5 Choose *one* of the following:

- the Lower Tees
- the Yarm flood defence scheme
- the Tees barrage.

Produce a flyer informing the local residents about the scheme. You should include the following:

- Title
- Reasons for / aims of the scheme
- What the scheme involves
- Some photos/diagrams of the scheme – search the internet.

6 **Discussion**

In small groups, discuss the different strategies of river basin management used along the River Tees. Each group might like to consider just one of these schemes:

- reservoirs
- embankments with gabions
- the Tees barrage
- meander cut-offs
- flood plain zoning
- flood warning systems
- dredging.

In your groups consider the following questions:
(a) Is the technique an example of hard or soft engineering?
(b) What are the advantages of the strategy?
(c) What are the disadvantages of the strategy?
(d) If further management was needed in the Tees valley, would it be a good strategy for the future?
(e) Overall, how many marks out of 10 would you give it?
Record your thoughts on a piece of A3 paper and contribute your ideas to a class discussion.

	J	F	M	A	M	J	J	A	S	O	N	D
Rainfall (mm)	181	120	143	92	92	88	94	116	129	146	167	184
Runoff (mm)	151	108	129	89	64	55	58	68	73	97	119	151

Figure 7: **Average rainfall and runoff for the River Tees**

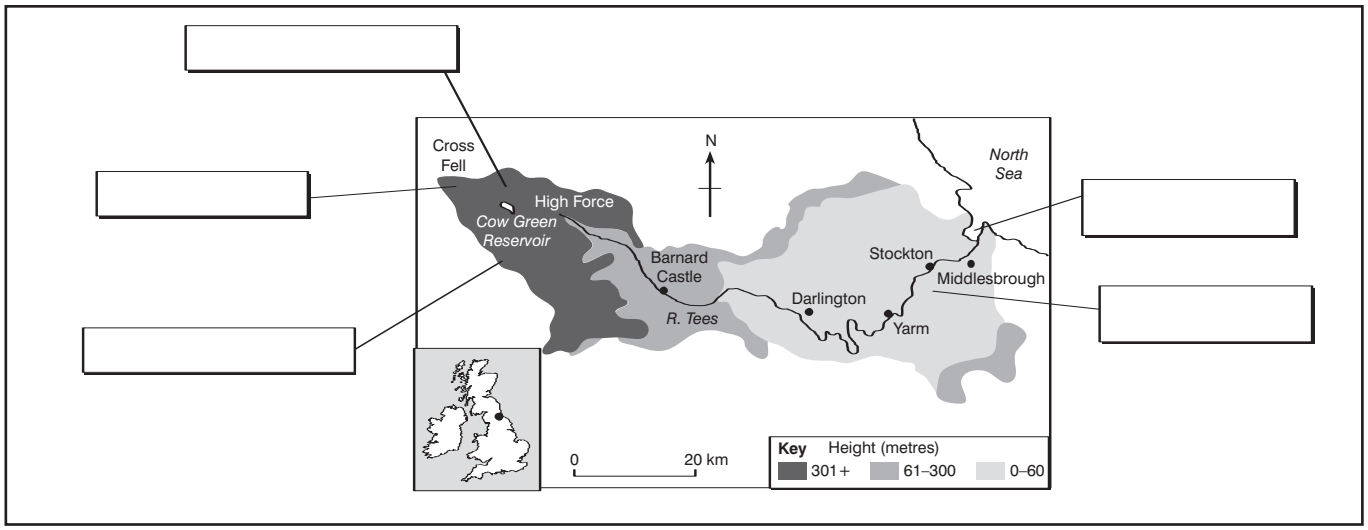

Figure 6: **The drainage basin of the River Tees**

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