Geo Factsheet

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River restoration – Case Studies

Introduction

Very few rivers have not been affected by human activity. All large rivers have been modified to some extent and it is only remote, isolated streams that may have survived any impact from human activity. Rivers have been straightened, deepened, diverted, dammed, altered by steel and concrete, and adapted to benefit people and reduce the risk of flooding. However, many of these changes have had negative impacts and unforeseen consequences. For example, dams have reduced flooding, improved navigation and allowed year round farming to occur. However, they have also triggered earthquakes, increased rates of evaporation and increased rates of river erosion below the dam. The straightening of the meanders on the Mississippi 'worked' only for a short time. The river began to meander again after being straightened and abandoned the new channels that engineers had created. Thus human activity on rivers has often been far from effective.

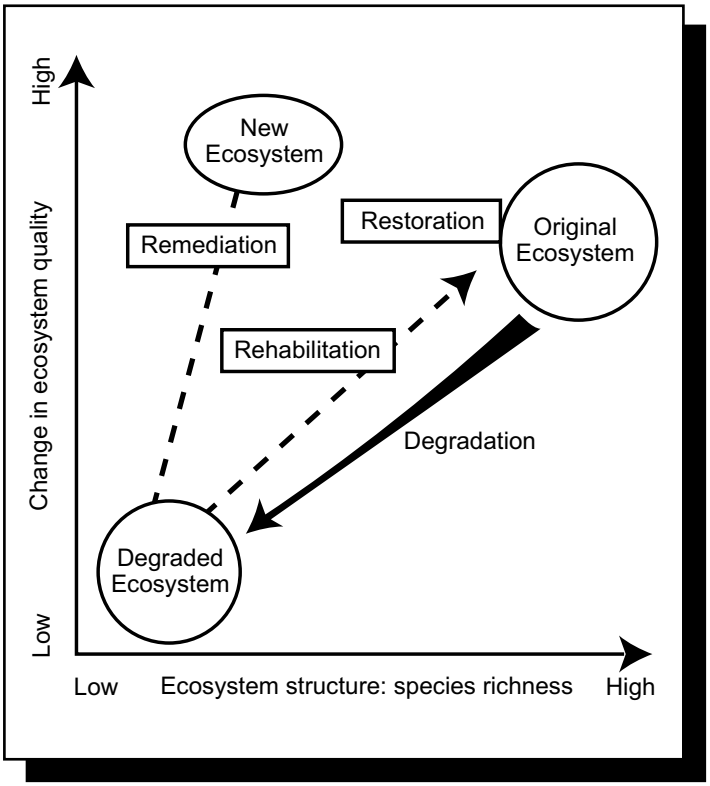
Increasingly it is realised that there are many benefits of allowing rivers to behave as naturally as possible. For examples, rivers meander and they flood each year. Whilst it might not be possible to allow all parts of a floodplain to be covered in water (due to housing, industry and infrastructure) there may be selected parts that can be flooded (parks, allotments) or sections of the river upstream where the land is largely used for farming and so can form **washlands**.

The return of a river to its natural state is known as **river restoration**. It is far more cost effective to keep streams and rivers clean than allowing them to deteriorate and then have to undergo expensive rehabilitation and restoration. It is also difficult and a very slow process restoring rivers, whereas it is relatively cheap, easy and quick to keep them healthy. However, rivers still require management to keep them healthy, and to prevent them from deteriorating.

The term restoration implies that the river is returned to its original quality *(Fig. 1)*. Defining river quality is not easy for it includes a wide range of factors such as water chemistry, sediment and flow regime, plants and animals present, and the health of neighbouring riparian (adjacent) areas. Restoration may not be possible in many cases (since rivers had a pristine quality before human activities affected them) so it may only be possible to rehabilitate rivers instead.

Exam Hint: *Find a river near where you live that has been 'restored'. Visit www.therrc.co.uk for details on projects around the UK. You are more likely to remember local details.*

Fig. 1 A model of restoration, rehabilitation and remediation.



Rehabilitation refers to an improvement in the river quality, although it may not reach the same quality as the original river. It is effectively a pragmatic approach to improving river standards, i.e. there is recognition that it is impossible to reach the original standard but it is possible to improve on the current condition of the river. This may mean fixing (improving) only certain aspects of the stream. In contrast, remediation recognises that the river has changed so much that the original condition is no longer relevant and a new condition is designed.

Remediation aims to improve the ecology of the stream, but the end result may not necessarily resemble the original stream. In practice most restoration schemes will only partially restore or rehabilitate the river due to the large number of human-related uses in the floodplains, e.g. buildings, industry, gas and electricity infrastructure, farmland and transport.

River restoration

There is a need to restore rivers because many have been seriously affected by urban and agricultural flood defences, land drainage and floodplain urbanisation. The result has been:

- extensive straightening and deepening of river channels, which has damaged wildlife habitats, reduced the value of fisheries and reduced much of the natural appeal of river landscapes.
- major loss of floodplains and wetlands to intensive agriculture and urbanisation, which has destroyed floodplain habitats and reduced the ability of floodplains to provide economically valuable functions, such as water and sediment storage.
- rivers are used intensively as transport routes, carriers of waste disposal, for industrial purposes, water abstraction, recreation etc.

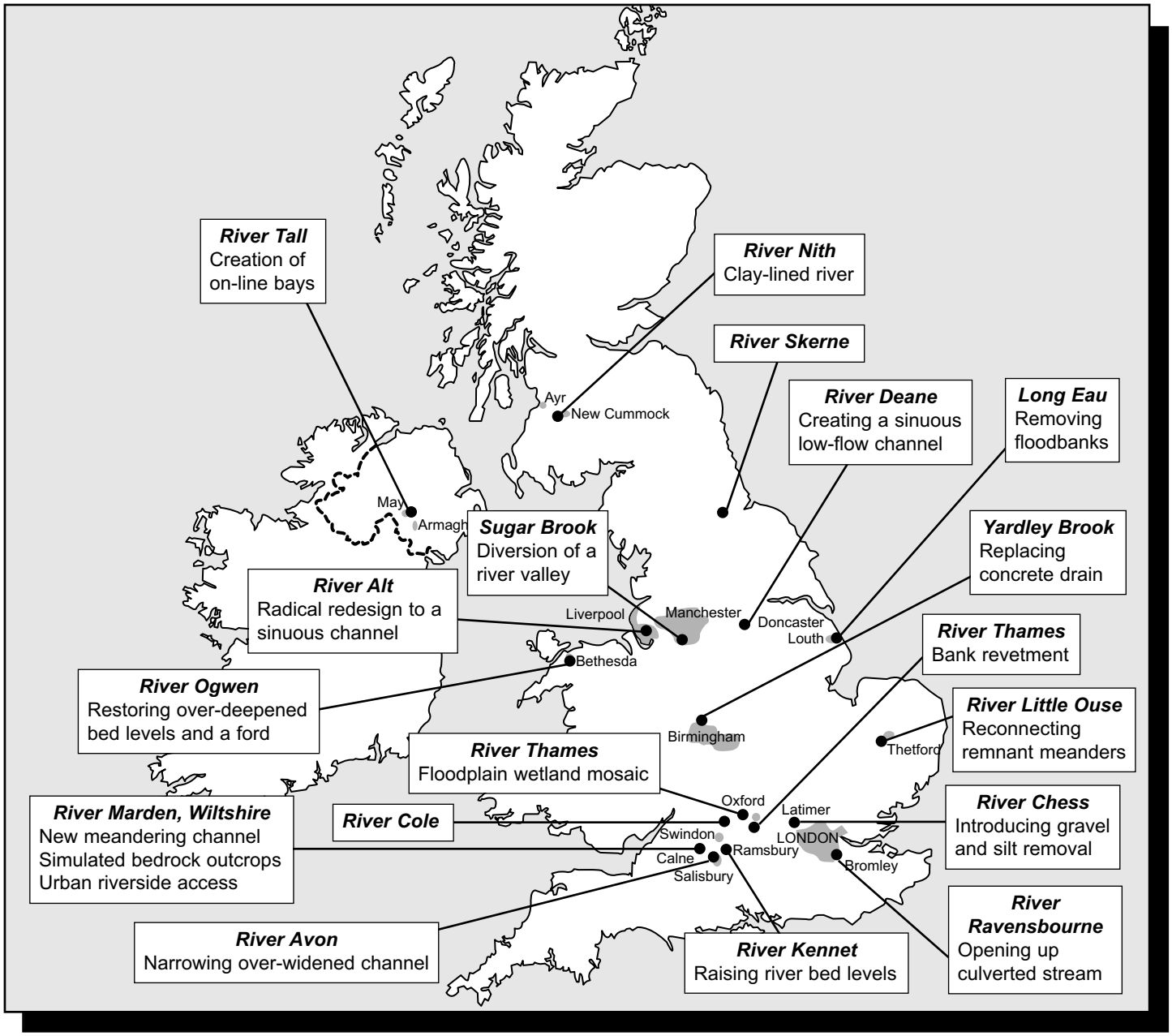
There are two main ways in restoring rivers, natural and artificial. The first can take hundreds of years, consequently **artificial** restoration needs to take place. The benefits are greatest when natural channel forms, flows, sediment loads and floodplains are reinstated. However, structures which only copy natural features, such as a weir, give fewer benefits than the natural features.

River restoration schemes are becoming increasingly common as the benefits of natural rivers and their floodplains are realised. The aims of the River Restoration Project (RRP) are to:

- establish international demonstration projects which show how the state-of-the-art restoration techniques can be used to recreate natural ecosystems in damaged river corridors.
- improve understanding of the effects of restoration work on nature conservation, water quality, visual amenity recreation and public perception.
- encourage others to restore streams and rivers.

The River Restoration Project is an independent organisation backed by scientific and technical advisers drawn mainly from organisations connected with rivers and river environments. Its aims are to restore and enhance damaged rivers for conservation, recreation and economic us, returning them as closely as possible to their natural condition. While there are many examples of river restoration in the UK *(Fig. 2),* three rivers in particular – two in the UK and one in Denmark – are considered to be showcase examples of restoration. These are the rivers Cole and Skerne in the UK, and the Brede in Denmark. One other example considered here is the Kissimmee in Florida, for here the scale and cost of restoration is immense.

Fig. 2 Restoration projects in the UK.



Case studies of restoration

Case Study 1: The River Cole

The River Cole is one of three river restoration sites financially supported by LIFE, an EU fund which provides grant aid for schemes of environmental benefit (Fig. 3). The aim of the RRP for the River Cole near Swindon was:

- *to change the water course,*
- *improve water quality and*
- *manage the bankside vegetation.*

The project is being run by the RRP, the Environment Agency, English Nature, the National Trust, the Countryside Commission and the EU.

The River Restoration Project was set up in 1994 with the main aim of establishing demonstration projects which showed how state of the art restoration techniques could be used to re-create natural ecosystems in damaged river corridors. Three demonstration projects were set up, funded by European Union LIFE money. The rural River Cole has been restored over a 2km reach, and was completed in 1996.

Improving the River Cole

- ***Stretch 1*** *The river bed below Coleshill Bridge was raised to bring it back in line with its floodplain and to make it an important feature in the local landscape. This involved the introduction of more gravel riffles (fast flowing midstream ridges) and some small weirs.*

- ***Stretch 2*** *The new river bed runs at the higher level at this length to fit in with the mill channel just upstream of the bridge. Rather than filling in part of the straightened river, a new meandering course was cut. Parts of the old course have been retained as backwaters to provide shelter for fish, birds and insects during high flows. This also means that neighbouring fields floods more frequently and help to recreate a water meadow.*

- ***Stretch 3*** *The restoration of the ancient course of the Cole appears to be possible at this site. Floodwaters have restored the flood meadows along the western side of the mill.*

- ***Stretch 4*** *The RRP hopes to restore the Cole Mill for occasional operation. The water levels in the Mill stream need to be raised for this to happen. The feeder stream (known locally as the Leat) is to be developed as a long lake with wet pasture and reed beds along its side.*

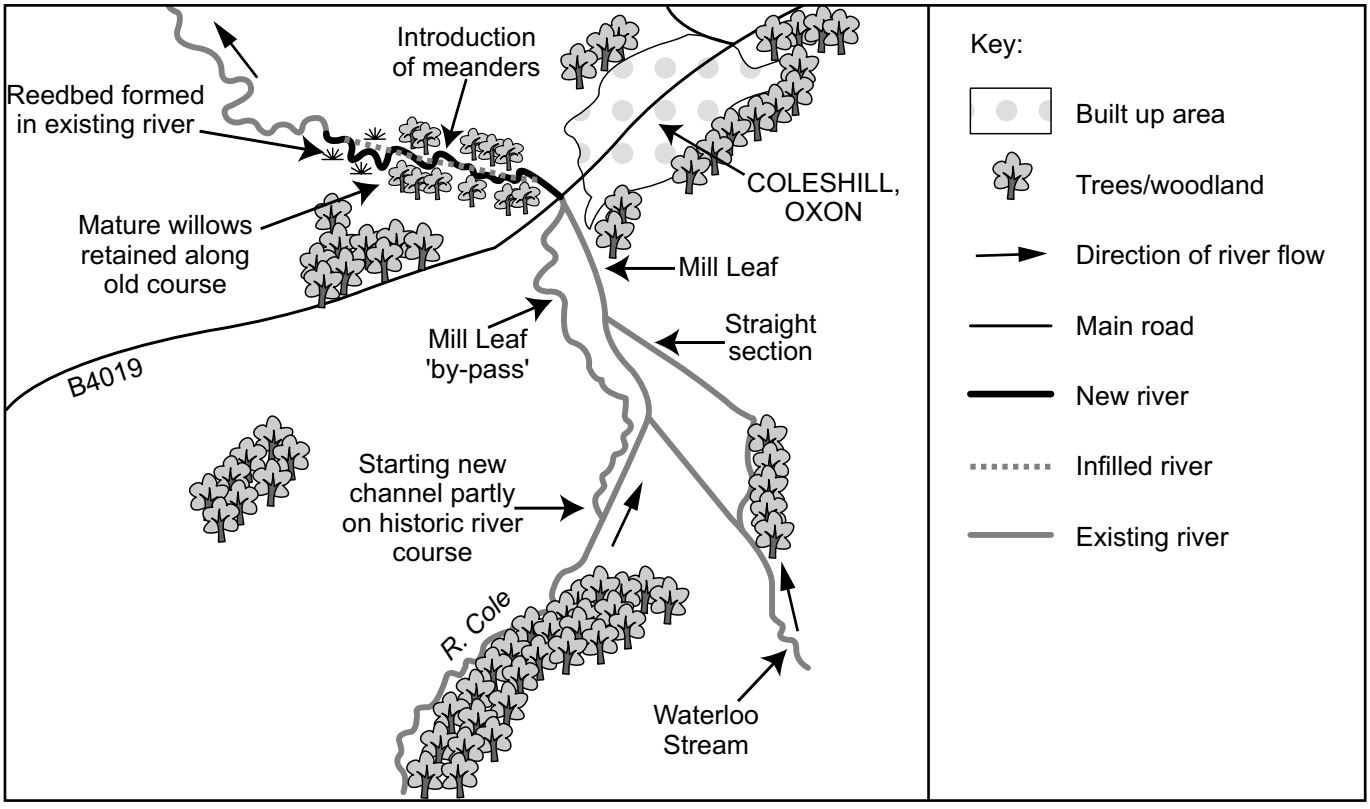
Reed, willow and alder tree beds are very useful in cleansing streams which have been polluted by silt, fertiliser and treated sewage. A few carefully located beds of these plants are very effective at removing unwanted debris and pollutants.

The overall aim of the proposals is to increase the extent to which the river and its floodplain interact, to sustain a landscape that is rich in riverine and wetland wildlife. The key to success is the management of the floodplain, worked out in conjunction with local land managers. The main road at Coleshill Bridge and nearby buildings and sports fields have been protected from the increased risk of erosion and flooding.

There are many benefits of restoration. These include:

- ***nature conservation:*** *wetland wildlife in the river and on the floodplain*
- ***fisheries:*** *improved species diversity and numbers*
- ***water quality:*** *increased interception of pollutants by vegetation and natural settling of sediments on flood plain and river bed*
- ***flood defence:*** *additional flood storage is offered by the enlarged floodplain*
- ***recreation:*** *there is a strong public perception in favour of natural landscapes*

Fig*. 3 River Cole restoration site.*



Case Study 2: The River Skerne, Darlington

The River Skerne shares many characteristics with other urban streams:

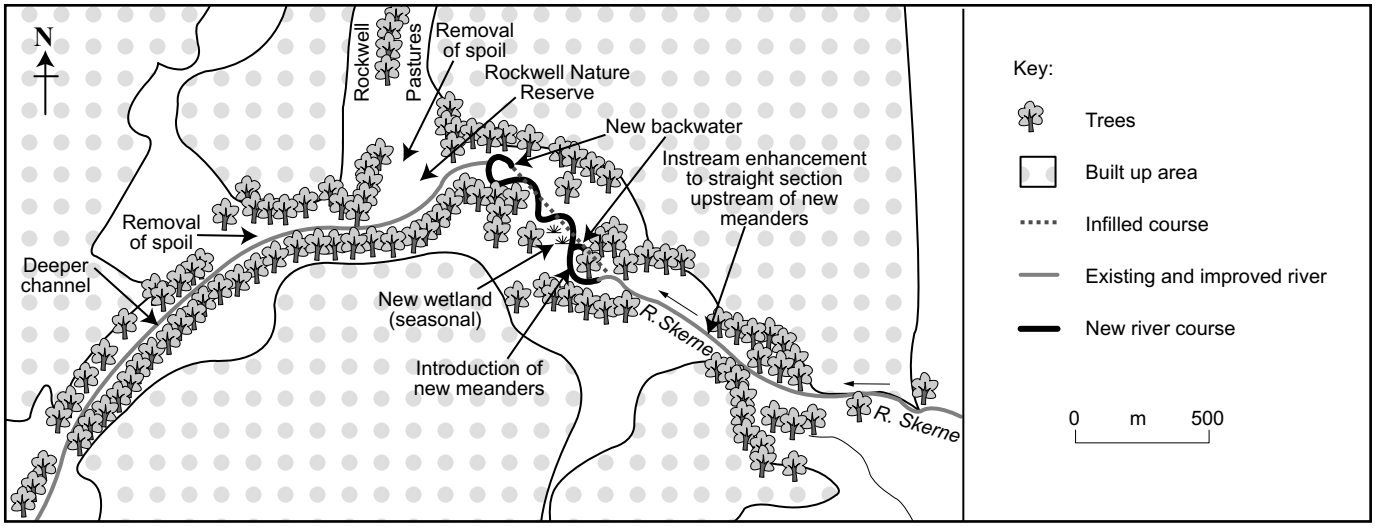
- *It has a high sediment load, especially of silt.*
- *It is slow moving.*
- *Banks are overgrown with weeds.*
- *Many polluting developments such as factories and sewage works discharge into the river.*
- *The floodplain contains a large amount of housing, roads, railways, factories and other industries (Fig. 4).*

The aim of the Skerne restoration project is to improve the quality of the river without reducing its function for flood defence (Fig. 4). In particular, the Skerne has been improved by:

- *the creation of new meanders in the river.*
- *the introduction of sloping banks rather than vertical banks.*
- *the growth of wetland plant species on the inside of meander belts.*
- *strengthening the banks by planting trees and reeds.*
- *creation of new wetland ecosystems.*
- *improving the water quality from the sewage works.*
- *creating a new footbridge so that access to the site is improved.*
- *planting native species of plants to attract a richer, more diverse insect population.*

The result has been an improved landscape and a more natural river. However, only 2 km of the Skerne has been restored and it is likely that such a small amount of river restored is not having a major impact on the quality of the river overall. On the other hand, the restored river is in an urban location, with a high density of residential and industrial land use. Improving this stretch of river may produce benefits which outweigh the restoration of any other 2km stretch of the river.

Fig. 4 The River Skerne restoration scheme.

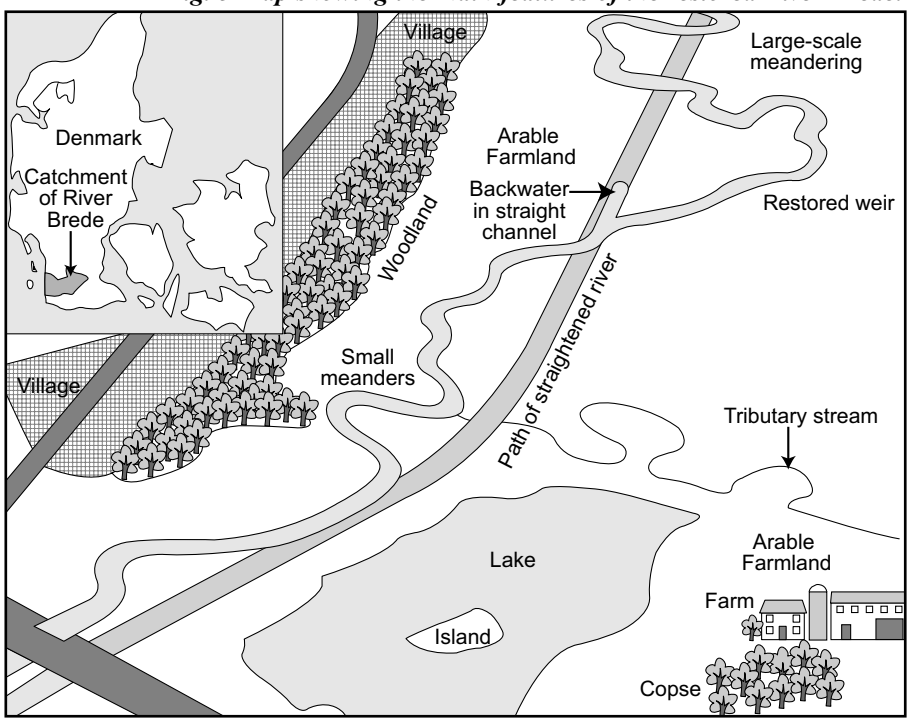


Case Study 3: River Brede

The River Brede flows through farmland in the low-lying county of South Jutland (Fig. 5). It differs from the Cole in that the floodplain soils are much lighter sands and peats. Meanders had been removed from the river to create a straight course to enable intensive grassland farming. Weirs in the river, as well as the straightening, virtually eliminated a once valuable sea trout fishery.

A 5km reach was re-meandered under the EU-LIFE project, but over 20km of the Brede has now been restored as part of a nation-wide strategy to improve the environmental management of river valleys. The scale of re-meandering is much greater than in the UK; the Brede once again meanders along the 500m long floodplain and seasonal flooding has been restored to the valley. The natural regeneration of the meandering river has been rapid and the sea trout are taking full advantage. As with the two UK sites the progress of natural recolonisation is being closely monitored.

Fig. 5 Map showing the main features of the restored River Brede.



Case Study 4: Changing river management - the Kissimee River

The world's largest wetland restoration project will spend US$700 million over two decades to revive the Florida Everglades It will include a series of six artificial wetlands known as 'storm water treatment areas', which will receive and clean up excess nutrients that enter the wetland from neighbouring farming districts.

The Kissimee (Fig. 6) is a river in Florida that was adversely affected by hard engineering. To counter this, the river has been partially restored to some of its natural state. Between 1962 and 1971 the 165 km meandering Kissimmee River and flanking floodplain were channelized and thereby transformed into a 90 km, 10 m deep drainage canal. The river was channelized to provide an outlet canal for draining floodwaters from the developing upper Kissimmee lakes basin, and to provide flood protection for land adjacent to the river.

Fig. 6 The Kissimmee Restoration Scheme.

The channelization of the Kissimee River had several unintended impacts:

- *the loss of 30 000-35 000 acres of wetlands.*
- *a reduction in wading bird and waterfowl usage.*
- *a continuing long-term decline in game fish populations.*

Concerns about the sustainability of existing ecosystems led to a state- and federally-supported restoration study. The result was a massive restoration project, on a scale unmatched elsewhere.

The aim of the Kissimee River Restoration Project is to restore over 100km² of river and associated floodplain wetlands. The project will benefit over 320 fish and wildlife species, including the endangered bald eagle, wood stork and snail kite. It will create over 11,000 ha of wetlands.

Restoration of the river and its associated natural resources requires dechannelization. This entails backfilling approximately half of the flood control channel and reestablishing the flow of water through the natural river channel. In residential areas the flood control channel will remain in place.

It is estimated the project will cost $414 million (initial channelization cost $20 million) a bill being shared by the state of Florida and the federal government. However, restoration, which began in 1999, will not be completed until 2010. Restoration of the river's floodplain could result in higher losses of water due to increased evapotranspiration losses during wet periods. Navigation may be impeded in some sections of the restored river in extremely dry spells. It is, however, expected that navigable depths will be maintained at least 90% of the time.

Overall, there are many benefits of restoration. These include:

- *higher water levels capable of supporting a natural river ecosystem again;*
- *reestablishment of floodplain wetlands and the associated nutrient filtration function should result in decreased nutrient loads to Lake Okeechobee;*
- *restoration of the Kissimmee River floodplain could benefit populations of key avian (bird) species, such as wading birds and waterfowl, by providing increased feeding and breeding habitats;*
- *potential revenue associated with increased recreational usage (such as hunting and fishing) and ecotourism on the restored river* could significantly enhance local and regional economies.

Conclusion

Rivers and their floodplains are complex physical systems. However, they also have economic, social and political consequences. Balancing the physical demands of rivers with the economic and political demands that are based on the human use of the floodplain is difficult. The impact of human activity on natural systems is often very negative and it is impossible to imagine rivers and floodplains without wide-scale human activity. We are witnessing, perhaps, the beginning of a new era in river management, one in which human activity is trying to restore rivers to their natural state rather than continually try to use and abuse them.

Further reading

Managing River Environments. Wharton, G. Cambridge University Press
River Restoration, Manual of techniques. 1999 and 2002, the River Restoration Centre

Useful websites

- River Restoration Centre - *www.therrc.co.uk/demonstration_projects.php*
- *www.therrc.co.uk/projects/brede_brochure.pdf* - details about the Brede
- *www.sfwmd.gov/org/erd/krr/* - for the Kissimmee home page

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