River restoration in urban areas

This factsheet provides a short introduction to issues facing rivers flowing through urban areas and how to restore them, under the following headings:

1. **Rivers in urban settings**
2. **Particular issues in urban rivers**
3. **Ways to restore urban rivers**
4. **Benefits of urban river restoration**
5. **Further information**

1. Rivers in urban settings

The term 'urban rivers' can make one think that these rivers have always flowed through towns and cities or that they were built to flow through urban centres for transport. But long before human settlement, these **rivers would have been more dynamic and flowed more naturally across the landscape** without the limitations of concrete banks and culverts.

Humans have settled **next to and altered rivers since medieval times** to use the resource as potable water, to power mills, for transportation and waste disposal (Figure 1). In urban areas, rivers continued to be **channelised to accommodate for development and flood prevention**. As human conurbations have expanded, rivers at their centres have come under more pressure and lost the ability to function naturally.

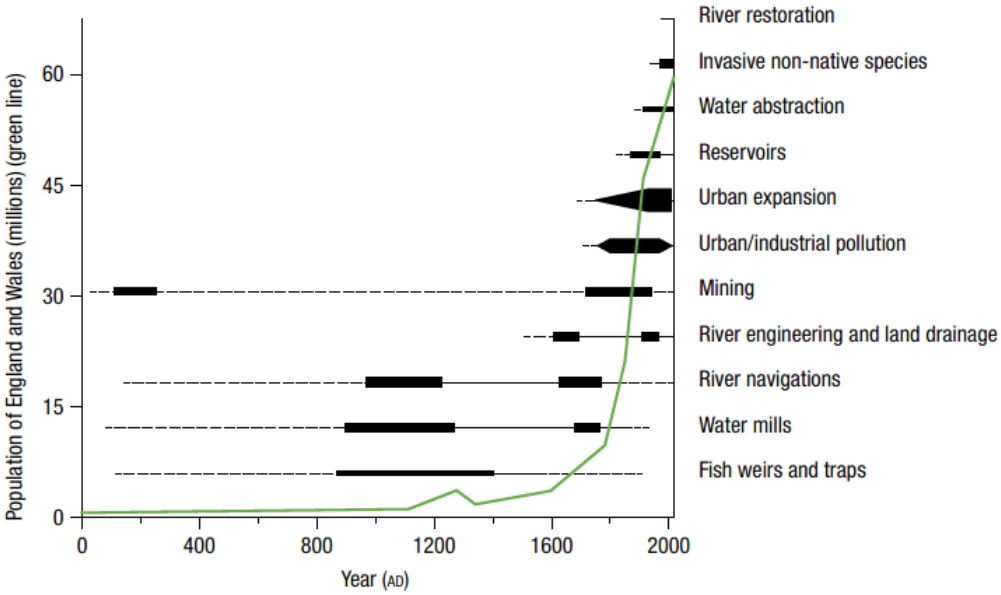

Figure 1 A graph to show the timespan and extent of the main impacts on rivers over the last 2000 years. Image from River Restoration and Biodiversity publication.

2. Particular issues in urban rivers

Impacts on rivers in urban areas are varied and plenty. Once the issues have been identified you can begin to **plan a river restoration project to alleviate some of these impacts**. The following section lists issues to look out for in urban rivers.

Channelisation, artificial banks/bed and dredging

Physical structure of the river is altered, natural movement of its course is prevented, floodplain connection lost and natural habitat is removed meaning aquatic life cannot be supported.

Figure 2 Reach of the channelised River Brent in London (Image from RRC).

Water quality degradation

Impervious urban surfaces increase run-off directly entering a river, which can contain contaminants from roads degrading the water quality. Sewer and industry discharges plus misconnected domestic plumbing systems regularly degrade water quality further.

Removal of riparian vegetation

A lack of bankside trees increase river temperature (reduced shading) and in some cases reduces bank stability, habitat variety and in-stream woody debris (which is good habitat and a nutrient source).

Low-flows and increased flood frequency

Over-abstraction and increased surface run-off in urban areas reduces low flows within a river but increases the flood frequency and response time when there is heavy rainfall.

Invasive species

Cities are hubs in global transportation networks so urban rivers are particularly vulnerable to invasive non-native species introductions. Many damage the natural environment and outcompete native species.

The cumulative impact of these issues make **urban rivers less resilient to the predicted effects of climate change,** making river management difficult.

Figure 3 Bank protection enhancement on the River Ravensbourne with holes for nesting birds. Image from RRC.

3. Ways to restore urban rivers

The management of urban rivers, which previously involved diverting them through drains, has been changing in recent decades with focus shifting towards **working with natural processes**. Attitudes have changed from using hard-engineering techniques to prevent movement to softer approaches and reconnecting rivers to their floodplains.

In urban areas, the **potential for river restoration is limited** by constraints such as the need for flood protection. Restoration therefore has to be innovative and unique to specific conditions with the aim of mimicking natural processes as much as possible without increasing flood-risk. Below are some examples of in-channel and larger-scale urban river restoration techniques.

In-channel enhancements

Large-scale restoration is often impossible in restrained urban rivers so in-channel enhancements can be a good way to **introduce some habitat complexity to improve biodiversity** and make a river more aesthetically pleasing (Figure 3). Table 1.1 highlights some in-stream techniques with links to examples.










Driver	Technique	Example
Create **sinuosity** to increase habitat complexity and improve biodiversity	Narrowing the channel (e.g berms or two-stage channel)	River Somer, Somerset (3.10) River Valency, Cornwall (5.10) River Medina, Isle of Wight
	Introduce/rework gravels	River Darent, Kent (5.8) River Chess, Buckinghamshire (3.9)
	Addition of woody material	River Avon, Wiltshire (5.6) River Bure, Norfolk (5.7)
Improving longitudinal **connectivity** for fauna	Weir removal/lowering	River Monnow, Monmouthshire/ Hereforshire (12.3) River Calder, East Lancashire (12.4) Babingley River, Norfolk (12.1)
	Fish pass creation	Inchewan Burn, Scotland (5.9) Lodge Burn, Northern Ireland (12.2)
Improving **aesthetics** where possible	Riparian planting or enhancing bank protection	Most of the above + Figure 3

Table 1.1 In-channel urban river enhancement techniques and their drivers. Examples are hyperlinked and number in brackets indicates their chapter location in the Manual of Techniques.

Larger-scale river restoration

If there is space to undertake larger scale restoration such as **floodplain reconnection or re-meandering** in urban areas, it is usually within public areas such as parks. Improving the **aesthetics** of a river is important to consider in urban river restoration projects as it raises awareness of local waterways and **promotes communities involvement and engagement** in the natural environment. Table 1.2 details urban restoration techniques outside of the main channel.

Driver	Technique	Example
Floodplain reconnection to provide flood storage, fish refuge, habitat diversity and	Artificial protection removal/ replacement	Yardley Brook, SE Birmingham (3.7) Braid Burn, Edinburgh (1.10) River Thames, Oxfordshire (4.7) Burn of Mosset, Scotland (6.4)
	Re-meandering	River Marden, Wiltshire (1.5) River Alt, Merseyside (3.4) Braid Burn, Edinburgh (1.10) Sugar Brook, Manchester (11.1)
	Wetland creation	River Thames, Oxfordshire (7.2)
Improving **water quality**	Improving surface water outfalls	River Skerne, County Durham (9.1)
	Sustainable Drainage Systems	See next page + River Wandle SuDs case study
Improve **aesthetics** to engage local communities and create a sense of ownership over the river	Daylighting	River Ravensbourne, Bromley (1.6)
	Accessibility	River Skerne, County Durham (8.3) River Marden, Wiltshire (8.5) River Cole, Oxon/Wilts border (8.2)

Table 1.2 Larger-scaled urban river restoration techniques and their drivers. Examples are hyperlinked and number in brackets indicates their chapter location in the Manual of Techniques.

*This factsheet is one in a series of guidance factsheets produced by the River Restoration Centre and funded by the Esmée Fairbairn Foundation. Find out more **here** and view more factsheets **here**.*

Sustainable Drainage Systems

Water quality is a key component of urban river restoration as it is usually degraded due to the high density of people living in close proximity and the subsequent waste water production and runoff. The physical aspects of a river can be partially restored, but **without improved water quality fauna and flora may still not be able to survive** - and the return of this life tends to be a key driver to the success and continued support for river restoration projects.

Sustainable Drainage Systems or SuDS can be used as an **alternative to traditional drainage systems** to combat flooding and pollution whilst promoting biodiversity and amenity value. Emulating the **natural hydrological cycle** in urban areas through slowing, storing and filtering rainwater and waste water (Figure 4), can reduce flooding and erosion rates and improve water quality.

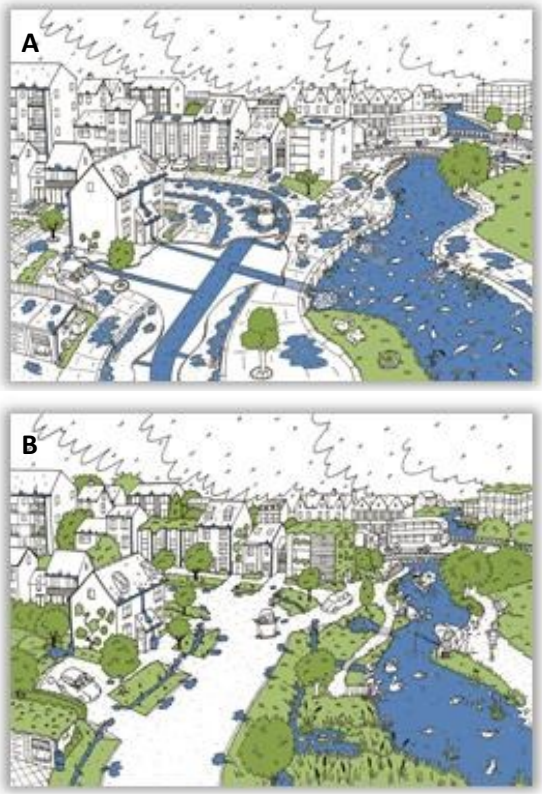

Figure 4 Diagrams showing urban areas pre-(A) and post-(B) SuDS installation. Images from Thames21.

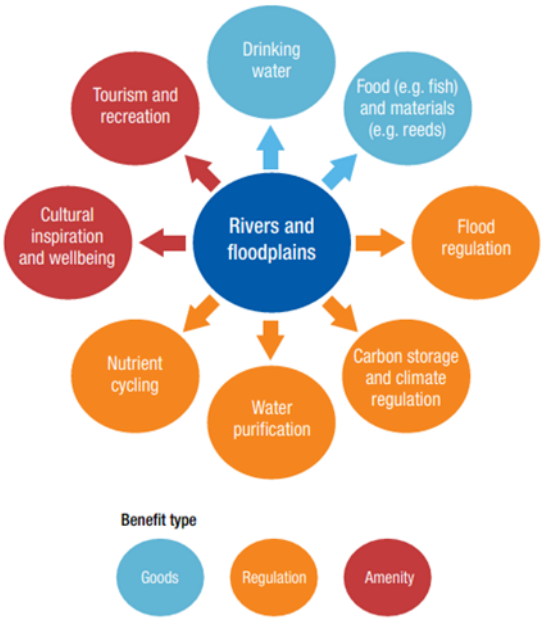

Figure 5 Benefits of naturally functioning rivers and floodplains. Image from River Restoration and Biodiversity publication.

4. Benefits of urban river restoration

River restoration, or any environmental improvement project, can have **multiple environmental, social and economic benefits** (Figure 5). In urban settings, although environmental benefits or flood risk may still be the main driver of restoration, social benefits can be just as important and are key in evaluating urban river restoration success.

Some benefits specific to urban river restoration are:

⇒ **Raising awareness of natural spaces** in urban areas encouraging people to engage with nature, improving physical and mental well-being

⇒ **Community building** - restoration projects, especially those within parks, can be maintained by volunteers creating a sense of pride and ownership for the community

⇒ Improving **access and safe use** of river environments for recreation and socio-economic activities.

⇒ Improving **urban area resilience** to the effects of climate change by improved water management.

5. Further information

You can find many more examples of urban river restoration projects and techniques using the RRC Manual of Techniques and by searching for keywords on the RiverWiki. The European Centre of River Restoration has a comprehensive webpage on urban river restoration best practise with further case study information and specific technique descriptions. The Catchment-Based Approach Urban Working Group also has information on urban river restoration. Find case studies, guidance, videos and photos of SuDS at susdrain.