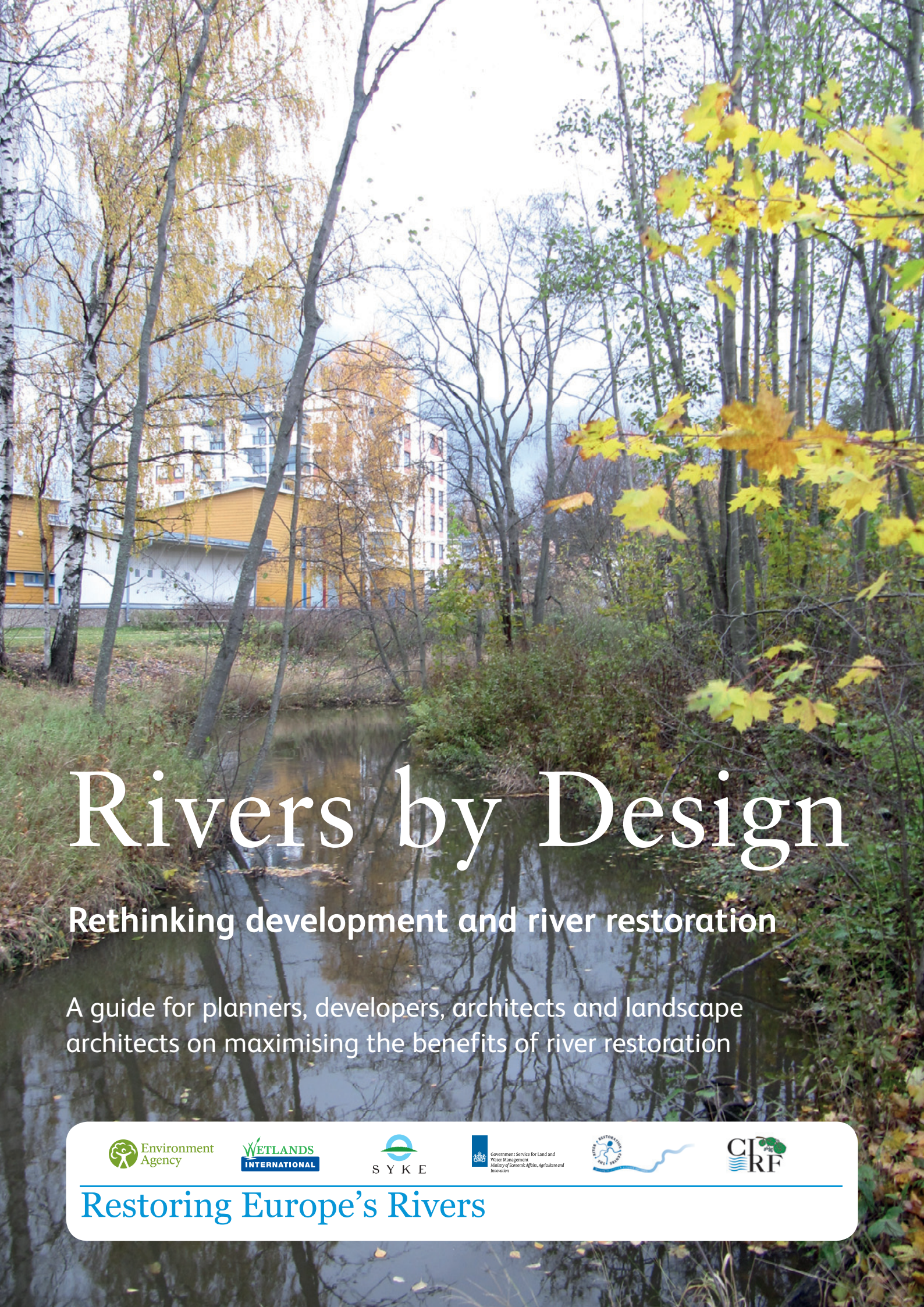


Rivers by Design

Rethinking development and river restoration

A guide for planners, developers, architects and landscape architects on maximising the benefits of river restoration

Environment Agency

WETLANDS INTERNATIONAL

SYKE

Government Service for Land and Water Management
Ministry of Economic Affairs, Agriculture and Innovation

CIRF

Restoring Europe's Rivers

This guide has been written and prepared by **RESTORE**. Case study material has been supplied by RESTORE partners. All pictures have been supplied by **RESTORE** and the **River Restoration Centre** unless otherwise specified.

RESTORE is a **partnership** for sharing knowledge and promoting best practice on river restoration in Europe. It is supported by LIFE+ funding from the European Commission and works closely together with the **European Centre for River Restoration** (**ECRR**).

RESTORE encourages the restoration of European rivers towards a more natural state. This delivers increased ecological quality, flood risk reduction, and social and economic benefits.

This guide has been written with the contribution of the **LIFE+ financial instrument** of the European Community working in partnership with ECRR.

Published by:

Environment Agency, Horizon House, Deanery Road, Bristol BS1 5AH
Email: enquiries@environment-agency.gov.uk
www.environment-agency.gov.uk

Further copies of this guide are available from: http://www.restorerivers.eu
Email:restore@environment-agency.gov.uk.

Restoring Europe's Rivers

Front cover photo by ©SYKE/RESTORE, Rekolanoja Brook, Vantaa, Helsinki Metropolitan Area.

Contents

Foreword by Bart Fokkens

'River restoration' describes a wide range of activities aimed at restoring the natural state and functioning of rivers and the water environment.

Restoring a river's natural conditions brings considerable benefits for people and the environment, from improving wellbeing by creating attractive landscapes to ensuring a healthy, thriving ecosystem. Restoration has become increasingly popular worldwide and, as the case studies in this document demonstrate, there has been a substantial improvement in river restoration techniques over the last few decades.

The most widespread pressures on rivers in the past have been caused by inappropriate development in floodplains, dam construction for hydropower, improvements for navigation, land drainage, flood protection and over abstraction of water. Integrating effective spatial planning within future development, therefore, has a key role to play in securing the restoration and enhancement of Europe's rivers.

Recent European Environment Agency reports for the EU Water Framework Directive show that currently only 43 % of European rivers are at 'good ecological status'. The river basin management plans for these rivers show that by 2015 at least 53 % should achieve this standard. This means substantial improvements to our rivers are planned for the next two years.

> *"Integrating effective spatial planning within future development has a key role to play in securing the restoration and enhancement of Europe's rivers."*
>
> Bart Fokkens

These improvements will often be in highly urbanised and industrialised or intensively used agricultural areas. This will be a great challenge to developers, architects and planners and will require innovative planning approaches, creative design concepts and effective project delivery. Engaging with local communities can be highly conductive to making these improvements happen.

This river restoration publication is a useful guide for planners, designers and developers, providing practical advice and information on restoring and protecting rivers and sharing best practice case study examples of projects that have been successfully implemented across Europe.

Bart Fokkens is the Chairman of the European Centre for River Restoration, a pan European network of national river restoration centres and other members bound by a common mission to promote and enhance river restoration throughout Europe.

1 Introduction

As our towns and cities have grown and the way in which we use the land has changed, we have spent enormous amounts of money, time and effort altering our rivers.

Rivers have been straightened and culverted to provide flood protection and to make maximum use of land for housing, industry and agricultural use. As a result of this activity the European Environment Agency said in 2012 that "there are many national examples illustrating that a large proportion of waters have been significantly modified. For example, only 21 % of German rivers are still in their natural state or are only slightly to moderately altered."

These changes have often led to rivers losing their economic value and created problems of flood management, drainage, waste management and a lack of quality open space.

To halt the damage being done to the water environment and bring our rivers back to life it is vital that future development is well located, planned and designed.

"Between 1998 and 2009, floods in Europe caused 1126 deaths, displaced half a million people and cost €52 billion."

http://ec.europa.eu/environment/water/flood_risk/index.htm

2 Who this guide is for and how it works

This guide is designed to show planners, architects and developers the crucial role that they can play in river restoration.

It provides practical advice and information aimed at maximising the ecological, social and economic benefits of development by integrating water management into the planning and design of development at all scales.

The document explains the context and need for river restoration and provides guidance on planning projects to make sure sustainable development is achieved.

A series of case studies, provided by **RESTORE** demonstrate successful examples of how well located, planned and designed development can increase ecological quality, reduce flood risk and create social and economic benefits such as improved recreational facilities and public spaces.

3 What is river restoration and why do we need it?

River restoration aims to improve the quality and function of rivers and to restore them to support healthy and thriving ecosystems.

There are different degrees of restoration. On a larger scale, a restoration project might include the entire floodplain, removing past structures and restoring more natural processes and channel forms to the watercourse. On a smaller scale, restoration might be simply removing the hard banks and replacing these with more natural features. Even using systems such as green roofs can contribute to restoration by enhancing sustainable drainage and biodiversity.

It is important to think about river restoration *wherever* development is taking place and at *whatever* scale.

What has happened to our rivers?

The changes to our rivers to meet the demands of development over many years have taken their toll on the natural environment. Typical problems include:

1. **Poor drainage:** rain now falls onto hard surfaces such as roofs, paving and roads and drains quickly into the river system increasing storm flows and runoff increasing the potential for flooding. This can also quickly enter sewerage systems risking overload and flooding.
2. **Development within the floodplain:** housing, industry, infrastructure and agriculture can lead to greater flood risk, loss of habitats and biodiversity.
3. **River profile:** raising river banks, culverting and straightening were used to try and reduce flooding and drain land. They might have solved a local problem but they often put pressure on the watercourse and downstream land.
4. **Water supplies:** abstracting water from rivers, canals, reservoirs, lakes or underground aquifers to provide public water supply for agriculture and industry. Over abstraction can lead to problems such as drying-out of watercourses and wetlands and sinking water tables.
5. **Pollution:** waste dumping, chemicals from industry, sediment, pesticides and fertilisers from agriculture and drainage from roads containing oil are all contributors to river pollution, leading to loss of water quality and biodiversity.

4 The benefits of improving our rivers

Healthy rivers are good for people and for the environment. Restoring our rivers can improve water quality, tackle flooding and pollution and secure water supplies, as well as enhancing the natural environment for plants and animals.

In this section we outline some of the general benefits of naturally functioning rivers and focus specifically on the ways planners and developers can contribute to, and benefit from, river restoration.

A better quality of life

By providing new green spaces, people can reconnect with nature and enjoy recreation opportunities, which benefits their health and improves their sense of wellbeing.

Reducing polluting run-off into rivers means better quality water, improving health and cutting the costs of purifying water.

> *"Diffuse pollution from agriculture remains a major cause of the poor water quality currently observed in parts of Europe. Agriculture contributes 50-80 % of the total nitrogen load observed in Europe's freshwater, with point discharges, including from wastewater treatment plants, providing much of the remainder"*
>
> European Environment Agency, 2010

Makes economic sense

With less risk of flooding, the costs of maintaining flood protection schemes are reduced, while better water quality means lower treatment costs for drinking water.

Nurtures new habitats

Re-establishing natural river channels and creating wetlands improves biodiversity.

Better flood protection

Restoring floodplains increases flood storage capacity and reduces volume and speed of water. This improves the likelihood that urban settlements will be able to better mitigate flood risk.

Tackles climate change

Climate change is leading to more flood prone areas and more droughts that threaten homes, businesses and ecosystems. Restoring rivers creates new floodplains for increased water storage, green networks and increasing biodiversity and more natural spaces to provide refuge for people and wildlife from higher summer temperatures.

The benefits of river restoration to land use professionals

The table below shows the range of benefits river restoration can bring for those involved in the planning and development process.

We have separated the benefits between planning and development, as the main focus for planners will be to meet government targets, while developers aim to maximise their investment and profits.

Benefits	Planning	Development
1. Improved open spaces	Opportunities for river restoration in parks and open spaces	High quality design – improved sales and reputation
	More communal space, increased access and recreational facilities	Support from planning authorities
	Opportunities for education	
2. Sustaining habitats and species and contributing to biodiversity	Integral part of successful eco-strategies: adaptable, resilient environment	
	Conserves local variation and existing habitats	
3. Partnership working	Involving local people and businesses in decisions about their environment and homes through consultation	
	Opportunities to promote jobs and training in construction for local people	
		Reduces local opposition
		Opportunities for match funding
4. Improved drainage techniques	Natural drainage techniques in line with national planning policy	
	Improved water quality	
	Drainage incorporated into landscape (also improves landscape resiliency)	
	Reduced risk of flooding by using sustainable drainage systems	Long-term costs of drainage maintenance reduced
5. Improved water and soil quality	Decrease in pollution	
	Decrease in taxes spent on water purification and soil decontamination	
6. Economic benefits	Encourages regeneration and business growth	
	Increased land and property values	
7. Government, regional and local policy	Achieves aims of national and local planning policy (water quality, restoration of habitats)	
	Helps determine outcome of planning applications (planning permission granted or refused based on quality of environment and restoration achieved)	
	Contributes to wider aims of good spatial planning	

5 Policy and legislation

Europe's rivers and other waterbodies are protected through a framework of European and national policy and legislation.

Below are the key European river restoration policies and supporting legislation that inform the development of spatial plans.

Water Framework Directive

The Water Framework Directive, adopted in 2000, is the key piece of European legislation supporting river restoration. It introduced an integrated approach to water management through the development of river basin management plans and aims to restore Europe's rivers, lakes, small waterbodies and wetlands to good ecological status.

River basin management plans (RBMPs) are aimed at protecting and improving the water environment. These plans contain the main issues for the water environment and the actions needed to tackle them.

Further information can be found on the **European Commission's website**

Floods Directive

This requires member states to assess the risk of flooding from all watercourses and coastlines. The extent of flooding together with the risk to people and assets are being mapped. Flood risk management plans focusing on prevention, protection and preparedness are being drawn up in accordance with these maps.

EU Floods Directive

Habitats Directive

The EU Habitats Directive supports river restoration across Europe. It aims to protect the wild plants, animals and habitats that make up our diverse natural environment.

The directive created a network of protected areas around the European Union of national and international importance known as Natura 2000 sites.

Habitats Directive

6 Economic value and funding river restoration projects

An attractive water environment is a valuable asset. It makes economic and environmental sense to design and construct developments working with the natural environment.

Lack of funding is often cited as a key reason for failing to consider the restoration of watercourses and rivers, but there are many potential sources of funds including the EU LIFE programme, environmental organisations and government bodies.

Many funding streams support integrated initiatives that look at both social and environmental concerns. River restoration schemes are well placed to exploit these funds because of their ability to provide a wide range of social, economic and environmental benefits.

Natural space can increase property values and reduce healthcare costs. Views and access to waterways can increase the value of property as well as helping to sustain values over and the long-term and improving the image of regeneration sites. This can be seen, for instance, in the **Mayesbrook Park** restoration project which is highlighted in the case studies in this guide. A calculation made by the Environment Agency estimates that Mayesbrook Park will bring up to seven times the €4.6million cost of the project over the next 40 years. Most of the benefits will be in health, recreation and tourism (Environment Agency, UK 2011)

"Improved landscapes and views of waterways can increase property values by between 6-8%."

Source: Does Money Grow on Trees, CABE Space, 2005 and Biodiversity by Design, TCPA

Planning how the water space will be used at the start of the process will help with costs. If changes are necessary late on in the project, designs will become more restricted and potentially costly. For example, fitting hard flood defences retrospectively is more costly than designing land levels within the landscaping to protect the development.

While developing an area, improvements to the water environment can be secured from the landowners' increase in land value and as part of development agreements. The resourcing of ongoing management also needs to be considered from the outset. Revenue funding can be secured in a number of different ways relating to specific river space or as part of community-wide green spaces. A trust could be formed, the residents could pay service charges, or partnerships could be established with the knowledge and skills to manage the river and any green space.

7 How to get started

The following sections provide a step-by-step guide on how to get started in incorporating river restoration in your development project. The approach you take will vary depending on the scope of the project.

There are five steps you need to consider:

1 **What do you want to achieve?**

2 **A community approach to planning**

3 **Designing sustainable schemes**

4 **Effective project delivery**

5 **Sharing best practice**

The following sections look at each of these areas, providing useful and practical advice and guidance to help your development successfully and sustainably meets the needs of local people and the local environment.

8 What do you want to achieve?

Considering what opportunities may be feasible at an early stage of your project and incorporating them into your design will increase the likelihood of public support, and may help to increase the potential value of the site.

Policies are now emerging across Europe to make sure goods and services that the environment provides us, like clean air and good quality water, are valued alongside goods such as food. Many governments have committed to what is known as an 'ecosystem services approach'. Ecosystem services are the benefits provided by the natural world such as clean water, air and soil. It can also refer to intangible benefits these services offer such as well-being and happiness. Guidance on this issue is **now widely available**. The **Mayesbrook Park restoration project** is a good example of this approach in practice where the value and benefits of the scheme were assessed.

Typical benefits of river restoration

Improved quality of housing and landscape
Improved sustainable transport - footpaths and cycleways, jogging
Opportunities for education and informal learning about the environment
Having a positive impact on people's health and well-being
Climate change adaptation and reduction in flood risk
Improving the river corridor and green space networks
Increasing access to nature and recreation
Improving biodiversity
Addressing water quality and land drainage

What are your aims?

It can be a challenge incorporating different aims within your project, but implementing a scheme that has a wide range of benefits for people and the environment is likely to mean greater public support. This table briefly describes the different areas you can focus on. We have provided a case study to illustrate each point.

Access and recreation	Restoration schemes present opportunities to incorporate areas for walkers, cyclists, families and other groups. **Involving all groups using the area will be a great help.** The 'Urban River Concept' on the **Isar River** in Munich provides a river for people and wildlife.
Green space	Local neighbourhoods benefit from attractive, accessible and safe environments where people can get closer to nature. **Restoration can help create quality natural environments.** A riverside access and flood protection project on the **River Marden** in Calne town centre has proven popular, serving as a focal point for local events.
Biodiversity	**Encourage natural colonisation and utilise existing habitats wherever possible.** Wetland areas for example can store and filter water, capture carbon, provide food and fuel, and support a wealth of uniquely adapted wildlife. The **Ciobarciu Wetland Project** led to a significant improvement in the ecological value of grassland, which had been disconnected from the river.
Heritage and cultural environment	**Accentuate features of archaeological or heritage importance.** Evidence of the historic river channel by using old maps can help guide restoration work. A case study on the **River Vidå** illustrates the need for careful planning when considering fish passage and heritage.
Education	**A restored environment can provide valuable opportunities for learning.** Signage should be eye-catching, artistic and straightforward. Launch events are a good way to communicate the project to the public. The **Cheonggyecheon stream project** in Seoul is hailed as a world leading urban greening project, which has had a profound impact in educating a population of more than 25 million people about the importance of green and blue corridors.
Natural flood risk management	Natural flood risk management can offer more than traditional hard engineered approaches. **Carrying out a feasibility survey** to identify any site-specific hazards is important in helping you decide which approach to take. Re-connecting a river with its floodplain has improved the coverage of floodplain forest on the **River Great Ouse**, habitat that has been in decline across Europe.
Maintenance costs	Restoration of the **Ritobäcken Brook** in Finland was a good example of a low cost, sustainable approach to drainage. If viable, **discharge rainwater** through ditches and swales linking into the river **to create a variety of habitats**. Bad drainage design, such as poorly designed outfalls may lead to localised erosion, an increase in flood risk or habitat degradation.

Be creative and consider all possibilities when thinking what your project could achieve.

9 A community approach to planning

Understanding the needs of local people and involving them from the outset in the planning and design of your project is vital to its success.

It is important to deliver projects that benefit people and wildlife - multi-faceted schemes ensure better value for money

Effective local planning

To help you gather the detailed information and local knowledge you need about the proposed area for your site, including current pressures, risks to watercourses and opportunities to improve the local environment, it is important to liaise with local experts.

Try and incorporate your project within existing planning strategies and neighbourhood plans. Speak to your local authority and/or environmental body to find out about plans already in place in the area you're interested in.

Involving and consulting with the public

Local people are a very important and often undervalued resource in helping design, implement and maintain the site. Consultations should focus on what local people and businesses want, and their impressions and understanding of what can be achieved. Involving and consulting with them brings a number of benefits:

- **Encourages local interest** – communities are well informed about policies affecting them in their area. This is an important factor in creating a sense of ownership of the finished project.
- **Fosters partnership working** – local groups know the area best.
- Can offer a **fresh insight into how to approach problems**.

Recreation is an important part of local community life.

Public event on flood risk, England

Local people are a very important and often undervalued resource in helping design, implement and maintain the site.

Involving interested groups

Seeking the views and priorities of all groups and organisations that have a vested interest in the location will ensure that you consider everyone's needs and priorities. While a private organisation funding a project may wish to demonstrate corporate environmental responsibility, the priority for local people and the local municipal authority will be in providing services that benefit local communities. Below is a list of some other organisations that may wish to be involved.

Organisation	Involvement
Rivers trust, wildlife trust, voluntary organisations	River conservation and education and facilitate volunteers and resources
Local authority/ council/ municipality	Project management or steer, local partnership broker
Environmental body	Project management or steer, statutory consultee
Academic institution	Project monitoring
Non-departmental public body	Statutory consultee and project advisor
Design organisation	Project design and planning
Private	Environmental corporate responsibility support funding
Local community liaison	Represent local community aspirations
Landowners, local people and businesses	Long-term support for the project and knowledge of the local area

Try and incorporate your project within existing planning strategies and neighbourhood plans.

10 Designing sustainable schemes

Successfully creating a project that will be sustainable in the long term depends on combining the advice and support of a specialist team, working together with natural river processes and in partnership with local authorities and groups.

Creating a specialist team

Depending on the scope and nature of your project, you will need to bring together the skills, advice and support of a number of specialists. It is important to work with these experts at the start of a project so that its full possibilities can be achieved.

Archaeologist/ heritage professional

Shares knowledge of local heritage and culture to help guide project planning and restoration.

Biologist/ecologist

Checks that project approach and restoration techniques benefit habitats and species found at the site and within the catchment. They also help shape the design.

Community contact

A trusted locally based contact between the project team and the public, and decision-making.

Construction contractor

Makes sure the project is completed on time and budget.

Design engineer

Inputs into designs and is available to answer any questions on-site to steer works.

Geomorphologist

Provides advice on river channel and floodplain regarding morphology, sediment and natural river processes. Also advises on project design.

Hydrologist

Expert knowledge about river flow, floods, drought and groundwater systems and how these interrelate.

Landscape architect

Gives direction on project design, landscape and planting.

Project manager

Has overall responsibility for the project, day-to-day management, controlling budgets and communicating with specialists and the public.

Site supervisor

Makes sure everyone meets their health and safety responsibilities on- and off-site.

Making the benefits last – the importance of maintenance

Maintenance may be necessary to make sure the project continues to provide sustainable benefits. You must make sure you:

- Liaise with landowners, local people, the local authority and statutory organisations to maintain the restored site.
- Develop links with local people who may be able to act as stewards on your behalf.
- Suggest building in repeat site visits after the project is completed and include this within the project budget so unforeseen problems can be identified and dealt with. Clients may appreciate this level of support.

Working with natural processes

Working with natural processes means '*taking action to manage the risk of flooding and coastal erosion by protecting, restoring and emulating the natural regulating function of catchments, rivers, floodplains and coasts*' (Environment Agency, 2010).

It is widely accepted that flood risk cannot be managed by simply building bigger and taller hard flood defences. Sustainable 'soft engineering' approaches must be considered. More space can be made for water through, for example, widening river corridors.

Sourcing materials locally and implementing measures to mimic natural processes to provide more sustainable environments.

Natural flood alleviation scheme, River Skerne restoration project, UK

11 Effective project delivery

This section offers useful advice and tips to make sure your works stay on track. It is also important that you recognise that local projects can also have an impact across the whole catchment.

Top tips to a successful project

- Identify key masterplan aims and look at site specific options. Consider existing and future use of site.
- Involve experienced contractors and consultants from an early stage to steer the design of an appropriate scheme.
- Confirm funding delivery mechanism at the start to ensure effective delivery of project.
- Manage the expectations of different audiences, including the project team and the public.
- Work with appropriate organisations to produce technical specifications for river restoration designs, products and materials.
- Use locally sourced sustainable materials if feasible and appropriate.
- Plant only where necessary. Natural recolonisation will normally establish a more sustainable landscape.
- Where possible use softer solutions. Look to the surrounding area to guide your design.

There are many different elements to a successful project. Most importantly look at the following:

Masterplanning

- Key masterplan aims
- Identify key problems and issues by talking to local authorities and landowners and those with expertise
- Look at options for site, considering existing and future users
- Discuss options with users and partners

Construction

Follow a construction code during development to minimise adverse effects on wildlife and the environment. Be aware of animal breeding seasons and spawning areas and plan works accordingly. Minimise disturbance to plant life by erecting temporary barriers.

Utilising drainage ditches

Drainage ditches, or small streams and ponds, allow developers the opportunity to achieve significant improvements at low cost and with low effort. Benefits include:

- Reduction in flood risk by opening up (daylighting) a channel that may have been constrained in a culvert.
- Aesthetic improvements to the local area and improvements to the landscape.

Make sure you:
- Obtain local service maps (for example gas, electricity and sewer pipes) for your site.
- Identify misconnections from sewage and waste water pipes at an early stage and design a suitable and sustainable solution.

Recognising that local works have a catchment-scale impact

Whilst from different countries, the two examples below emphasise the need to carry out works at a local scale, and incorporate these within wider catchment-scale planning.

- **Community led restoration schemes**

  In southern Finland, many small-scale brook restoration projects are carried out by local volunteers and fisheries groups, who are keen to restore habitat for brown trout. Local municipalities (councils) and non-governmental organisations (NGO) provide technical support and guidance.

  The benefits include:
  - Encourages greater local stewardship of rivers.
  - Strengthens local community togetherness.
  - Increases local volunteering opportunities.

- **Catchment scale planning in practice**

  Le SAGE – Implementation in the Sèvre Nantaise basin, Loire Valley, France

  'Le SAGE' refers to the programme of activities carried out in France in relation to the river basin management planning cycle. Work was carried out in three stages:

  1. Hydraulic and other technical criteria were used to assess structures in order to select appropriate sites where restoration could take place.

  2. Liaison with groups representing the local area. This included statutory agencies, water company representatives and importantly local interest and recreational groups.

  3. Social, economic and environmental criteria were used to prioritise sites where projects were feasible. The 10 year process has improved relations between the environmental bodies and local groups. Restoration work has been carried out at a majority of the prioritised sites across the basin.

Local interest in the works.

12 Sharing best practice

Learning from others and sharing lessons and experience from your own work improves best practice and may influence funding for similar schemes in the future.

Support and guidance

The ***RESTORE RiverWiki*** is a tool for sharing best practice and lessons learned. It showcases river restoration examples from across Europe in a Wikipedia website that anyone can freely add to and edit. It provides project data (including objectives, techniques and outcomes) as well as information on ecosystem benefits, stakeholder participation and costs.

Learning lessons from other's schemes and documenting your own for all to see

Users are encouraged to:

- Search for suitable examples to help plan your project.
- Submit your own project to celebrate your success.
- Discuss the benefits of using certain techniques and approaches.

You can draw upon evidence and information such as **green infrastructure** guidance and strategies available at European, national and regional scales in order to develop your approach. **http://ec.europa.eu/environment/nature/ecosystems/index_en.htm**

Evaluation should be included in the costs of a project to avoid it being overlooked.

Gathering evidence of success

Under the Water Framework Directive, statutory agencies are responsible for routinely monitoring watercourses, and it may be possible to use their data to evaluate the outcome of your project. In many EU countries, technical universities and academic institutions may also be able to support project appraisal. You may wish to monitor public perception or the cost-effectiveness of the scheme.

Benefits:

- Justifies the project spend.
- Effective way to demonstrate the benefits to clients, politicians and the general public.
- Outputs feed into future work and any modification to the project.

How to share good practice

- Share project benefits with the public.
- Demonstrate the project work you have carried out to the public and interested stakeholders with site tours, seminars and exhibitions.
- Share information through industry accredited events and meetings.
- Add project to the **RESTORE RiverWiki**

Realising the vision – site visits bring projects to life

Celebrating your successes

Benefits of communicating your project

- Increase in project exposure (awareness raising).
- Positive knock-on impact on available funding for similar schemes.
- Increased awareness of benefits of river restoration.
- May be used as an exemplar project or case study by other prospective developers.
- Continues to build the pool of available best practice for all to use.

13 Case studies

The following case studies draw on lessons from six different countries and could potentially be applied in a variety of river settings. The projects are grouped according to size, and illustrate how river restoration can be carried out at all scales, from the smallest site to the catchment scale.

For further information about the project and case studies visit the **RESTORE Riverwiki**.

Small scale – site specific projects

Restoring a natural river channel

Ritobäcken Brook, Finland P24

River access in a local urban setting

River Marden, UK P26

Climate adaption and social benefits

Mayes Brook, UK P28

Medium scale - river continuity and connectivity with floodplains

Balancing fish passage and heritage

River Vida, Denmark P30

Natural flood risk management

River Great Ouse, UK P32

Large scale – river corridor and landscape planning

'Blue and green' river corridors

Cheonggyecheon Stream, South Korea P34

Creating wetland and habitat

Ciobarciu Wetland, Romania P36

Recreation, access and flood defence

River Isar, Germany P38

CASE STUDY

Restoration of Ritobäcken Brook

The restoration of Ritobäcken Brook was carried out to address flooding and to reduce the need to maintain the river channel. This was achieved by cutting a new channel, which allowed the river channel to carry more water. The risk of flooding has been reduced and there have been improvements in wildlife and water quality.

Project summary

Location: Municipality of Sipoo, Southern Finland

Length: 800m

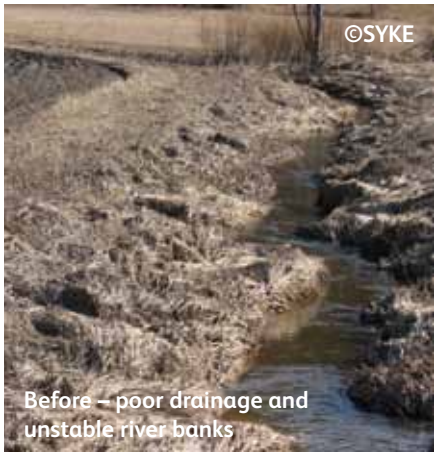
Cost: €15,000, planning €2,500

Dates: 2010

Delivery

Delivered through: Regional environmental authority, Uusimaa ELY-centre.

Partners: Aalto University School of Engineering, Jami Aho Ltd.



Before – poor drainage and unstable river banks

A flood terrace was built on the left hand river bank. The right hand river bank was left untouched. Soil dug for the flood terrace was used on nearby fields.

After – low flow water in the river all year round

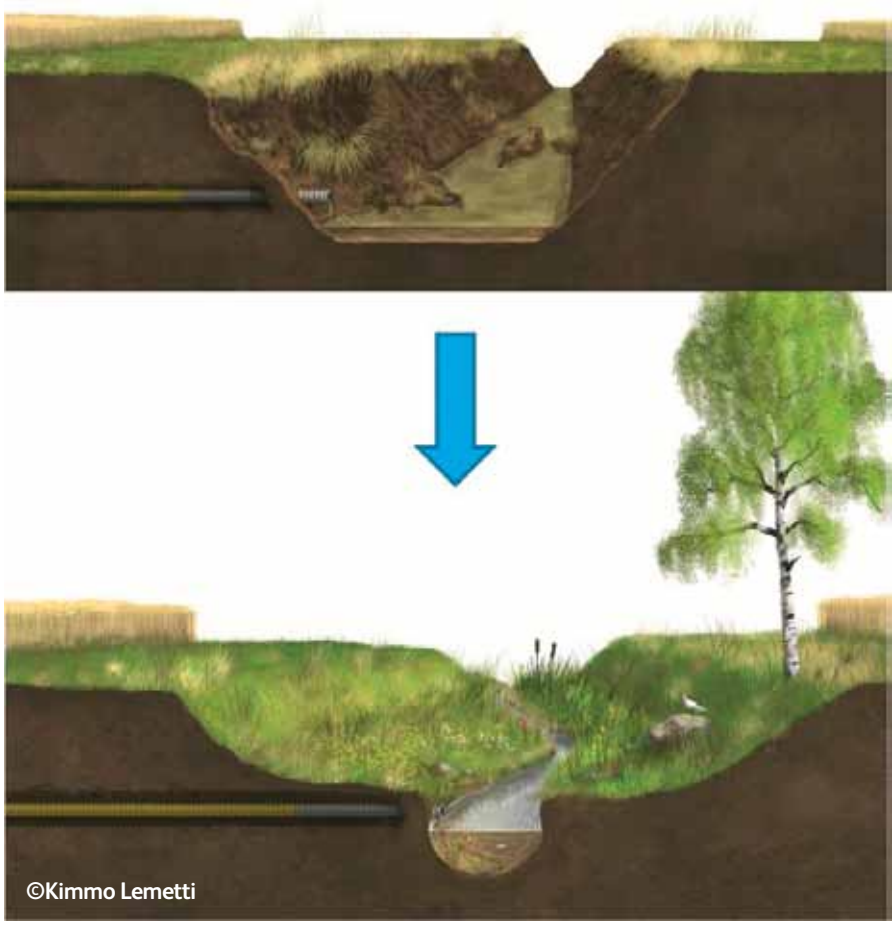
Background and issues

- Poor drainage
- Regular maintenance (such as dredging) necessary
- Unstable banks causing erosion and sediment build up in the river channel
- Agricultural areas frequently flooded.
- Artificial channel due to dredging and straightening in the past.
- Poor habitat for fish caused by river banks being eroded.

CASE STUDY

Step-by-step

1. A digger was used to excavate the flood terrace above the existing river channel, to allow it to carry more water.
2. The excavated soil (2,500 m³) was transported to nearby arable land to fill in the lowest areas.



Benefits

- Reduced risk of flooding to nearby arable land.
- Less maintenance required
- Cost of maintenance is lower as dredging and managing vegetation is no longer needed.
- 2 stage channel with flood terrace improves plant and wildlife in agricultural areas.
- Quality of water has improved.
- Vegetation has stabilised the bank, reducing erosion
- Wet channel year round better for aquatic life

Lessons learned

- Low cost project delivered a sustainable approach to drainage.
- Excellent demonstration of a successful local project involving a number of partners.
- Interested groups were willing to test new ideas, which was extremely helpful for the project.

Project Contact: Finnish Environment Institute (SYKE)

CASE STUDY

River Marden, Calne

As part of a larger town centre regeneration project, the River Marden, which had previously been straightened, was re-meandered and stone, gravel and planting were used to create a more natural river channel. The project has reduced the risk of flooding in the town and increased public access to the river.

Project summary

Location: Town centre at Calne, Wiltshire, UK

Length: 100m

Cost: Unknown

Dates: 1999

Delivery

Delivered through: Part of €5.1M town centre rejuvenation project, led by district council.

Partners: RRC, Nicholas Pearson Associates, Calne Town Centre (local authority).

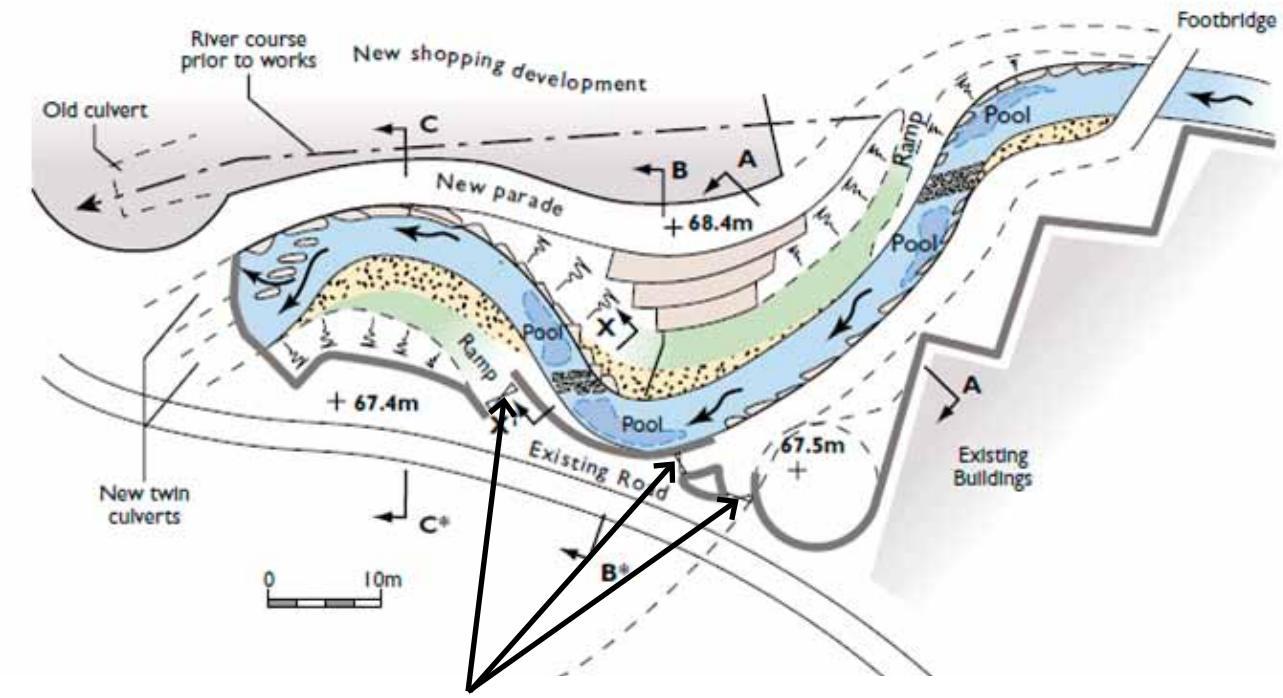
Background and issues

- Artificial concrete channel - canalised and culverted.
- Restricted access for the public.
- Lack of local amenities and 'sense of identity'.

Visually pleasing culverts to fit in with character of the town

Public access points created on inside of meanders

Straightened channel re-meandered



Flood gates that can be closed off to prevent the town from flooding during high water and prevents public access during these events

CASE STUDY

Step-by-step

1. Redevelopment of Calne town centre designed to give access to the riverside.
2. Works: removing artificial channel and weirs and improving flood defence standards, re-meandering river to more natural form, using natural stone to stabilise river and bankside planting.
3. Local Castlefields Canal and River Park Association (CARP) set up to develop and improve the environment, and provide public amenities for recreation and leisure.

After – inner bend of each meander configured to allow the public close access to the river ©NPA

©RRC

Before – straightened river channel

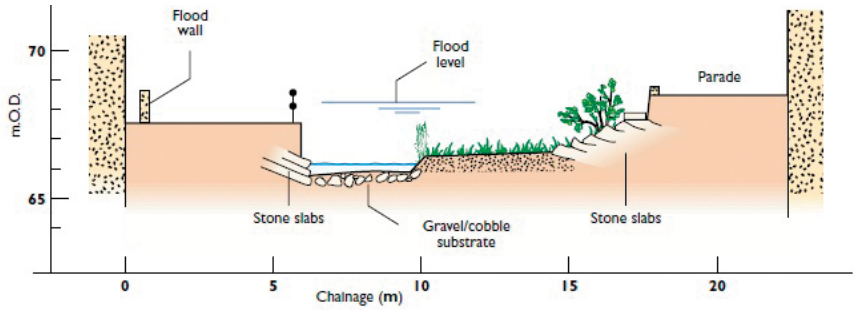
©RRC

After – river diverted and meandering channel created

Benefits

- Improvement in public access and amenity value.
- Developed a focal point for local people.
- Reduced the risk of flooding.
- River channel no longer constrained in a culvert – more naturalised form and processes.

Local stone slabs used to create 'as natural' river bed



©NPA

Improvements withstood the floods of 2012

©NPA

Calne annual charity duck race, 2007

Lessons learned

- Carried out as part of a town development project that has had numerous social, environmental and economic benefits.
- Riverside access design has proven popular, serving as a focal point for local events.

Project Contact: River Restoration Centre

CASE STUDY

Mayes Brook restoration project

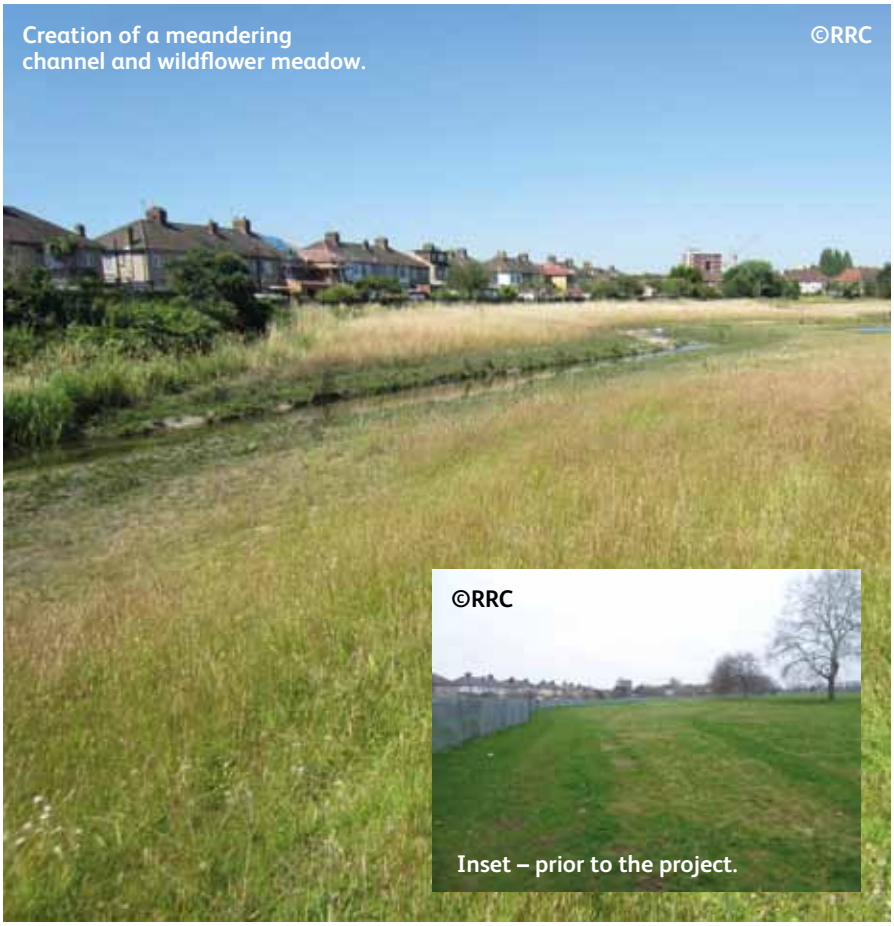
Mayesbrook Park is the UK's first climate change adaption park. Reconnecting the river with its floodplain has increased flood storage by one hectare. Restoration has improved access, recreation and plant and wildlife for the local community. An ecosystem services study estimated the project would produce a wide range of benefits.

Project summary

Location: Mayesbrook, East London, England
Length: 1600m
Cost: €3,800,000
Dates: 2008 (planning) - 2012, Phase 2 of the park restoration scheme (lake restoration) due to start in 2014

Delivery

Delivered through: Multi-partnership funding, including the London Organising Committee of the Olympic Games and a private insurance firm.
Partners: Thames Rivers Trust, London Borough of Barking and Dagenham, Environment Agency, Natural England, Greater London Authority, London Wildlife Trust and Design for London, Royal Society of Arts, SITA Trust, LOCOG.



Creation of a meandering channel and wildflower meadow.

Inset – prior to the project.

Background and issues

- Concern over risk of flooding in a densely populated part of East London.
- River hidden behind a metal fence – many locals did not realise it was there.
- Crime and antisocial behaviour a major problem.
- Degraded park – poor and few public facilities.

Public consultation event at the park, 2009

Step-by-step

1. Improvement to water quality by identifying misconnected domestic water pipes (Thames Water), which had led to pollution flowing into the brook.
2. River construction works to increase flood storage by 1ha; and increase in park habitats and wildlife.
3. Improvement in landscape, social and aesthetic value. New recreation facilities (outdoor gym and sports facilities) and better access for park users.

Volunteer clear up event to help keep park tidy, 2012

Benefits

- Assessed over 40 years, the lifetime benefits of restoration were estimated at €31.2 million - a benefit-to-cost ratio of 7:1.
- Vast improvement in plant and wildlife in the park.
- Successfully involved the public.
- Identifying misconnected waste water pipes should improve the quality of water over time.

Lessons learned

- Creation of a river corridor and a wider 'green network', such as paths, parks and gardens, to create a dramatically improved natural infrastructure. UK's first 'climate change adaption park'.
- Social benefits significant such as increased numbers of visitors and greater feeling of safety – demonstrated by formal monitoring. The role of the on-site ranger as a friendly face for local people, and event organisation has been a great success.
- An integrated monitoring strategy to coordinate all evaluation activities related to water, land, social and climate change issues.

Project Contact: River Restoration Centre

CASE STUDY

Historic Mill restoration, River Vidå,Tønder

Reducing the risk of flooding, tackling subsidence and improving access for fish was dealt with by removing sluice gates and installing a weir allowing fish to swim over more easily. Retaining the historic mill and mill pond were central to the scheme. Economic, social and environmental benefits have been reported in a project that dealt sensitively with the cultural heritage at the site.

Project summary

Location: Bachmanns Water Mill, River Vidå, Tønder, Denmark

Length: 1000m

Cost: €1,370,000

Dates: 2009-2010

Delivery

Delivered through: EU LIFE+ funded project to restore habitat and passage for houting.

Partners: Danish Nature Agency, Municipality of Tønder local authority.

Background and issues

- Risk of flooding in the urban centre of Tønder.
- 2m high weir preventing fish from migrating, an endangered EU designated species, houting.
- Subsidence issues around the millpond.

Lateral sheet piling used to create the weir

Sheet piling faced with concrete

The structure once vegetated

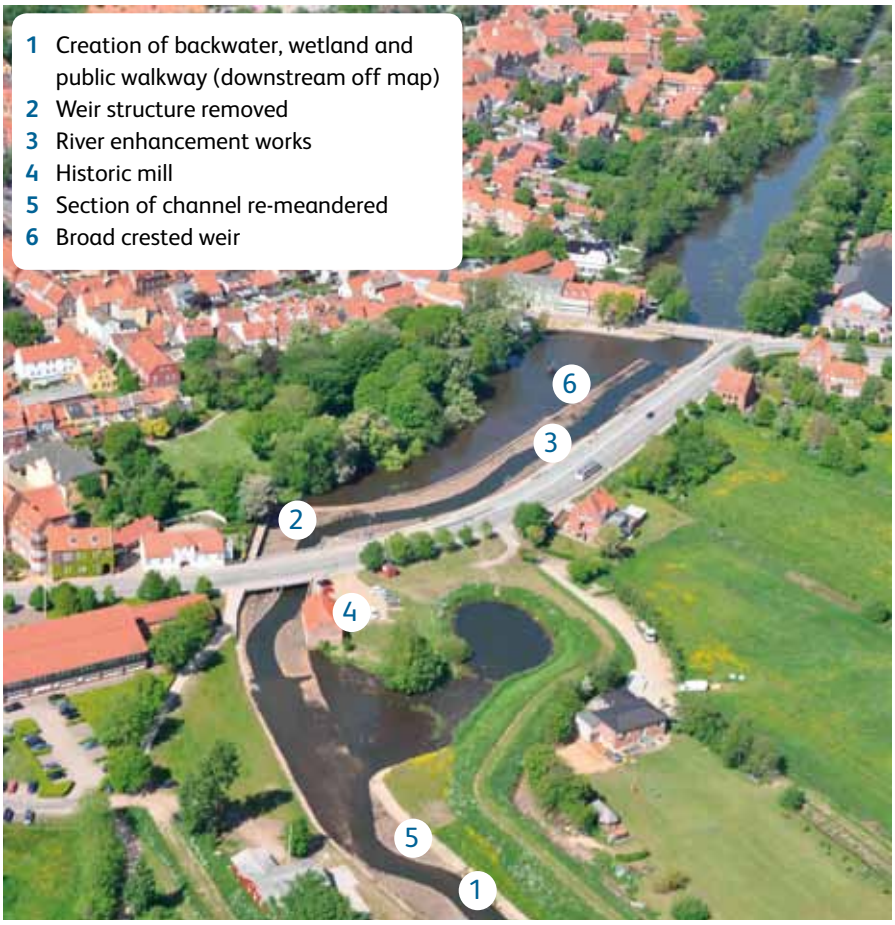
Cultural legacy: Historic mill retained

Step-by-step

1. The mill pond and river were separated with a sheet-piled, concrete-faced weir. Flood banks were set back to increase capacity for flood waters.
2. Sluice gates and the fish ladder upstream of the mill bridge were removed. The millpond was retained as a functioning nursery area for fish.
3. Downstream of the mill, spawning grounds were formed by creating areas of shallower water using gravel (riffles). Resting areas (backwaters) were created and an otter pass was built under the bridge.
4. A new access point downstream of the mill was made for the Tønder Rowing Club to minimise disturbance to nature.
5. 700m of wetlands was created downstream of Tønder to create a wider nature corridor. This has been very popular with walkers and local people.

Benefits

- Historic mill retained.
- Aesthetic improvements have led to an increase in local house prices.
- Public access to nature improved - wetland walk.
- Balanced project aims with recreational needs.
- Improved river habitat.
- Fish pass more freely past the mill.
- Passage for houting has been restored.



Lessons learned

- Taking into account the historic context of the site, the project was delivered sensitively.
- The legacy of the project will benefit wildlife and people in a number of ways (access to nature, recreation).

Project Contact: Danish Forest and Nature Agency

CASE STUDY

Milton Keynes floodplain forest, River Great Ouse

Privately funded through gravel extraction, this project has successfully tackled the risk of flooding, improved the quality of the landscape, and plant and wildlife, and created educational opportunities.

Project summary

Location: Milton Keynes, England

Length: 50ha, approx. 2000m

Cost: €1,120,000

Dates: Works began May 2007, Completion due by 2014/15

Delivery

Delivered through: Private funding from Hanson Aggregates Ltd through commercial gravel extraction.

Partners: The Parks Trust, Hanson Quarry Products, Scott Wilson, Milton Keynes Council.

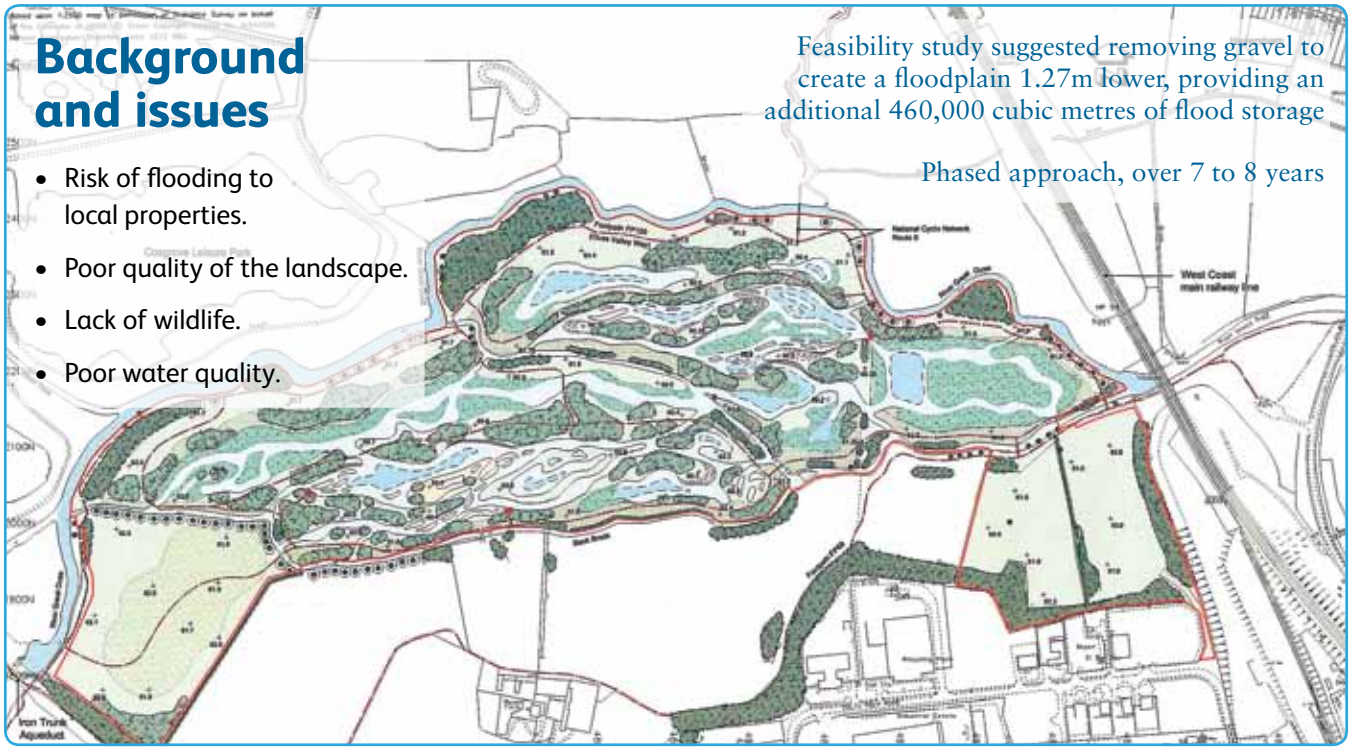
Risk of flooding to local properties ©RRC

Background and issues

- Risk of flooding to local properties.
- Poor quality of the landscape.
- Lack of wildlife.
- Poor water quality.

Feasibility study suggested removing gravel to create a floodplain 1.27m lower, providing an additional 460,000 cubic metres of flood storage

Phased approach, over 7 to 8 years



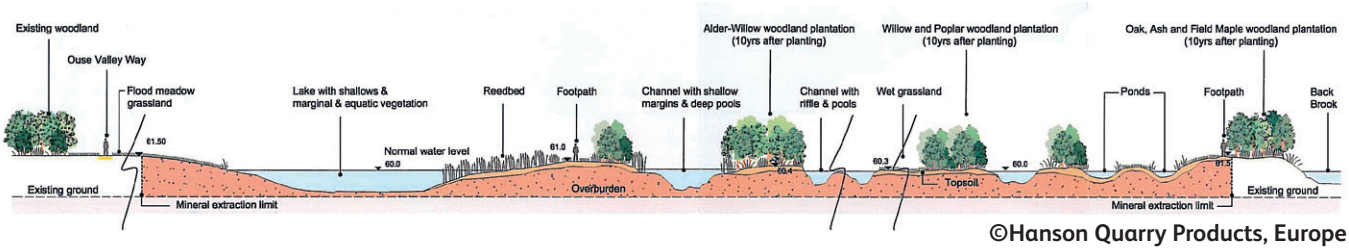
(©Hanson Quarry Products, Europe)

CASE STUDY

Step-by-step

1. 1992 – The Parks Trust charity established to manage 1,800ha parkland in Milton Keynes.
2. 1994 – Proposal to create floodplain forest developed and feasibility study carried out.
3. 2000 – Contractor (Hanson Gravel Aggregates) awarded contract to remove gravel, restore and enhance site.
4. 2004 – Consultation (some opposition from councillors, planning officers and public), planning permission was granted.
5. 2007 – Project began to remove soil, extract gravel and create river habitat. A residents' liaison committee was set up and events, letters and open days organised to ensure ongoing community involvement.

Cross section of floodplain forest



©Hanson Quarry Products, Europe

Benefits

- Public access to the area.
- Created an educational park for Milton Keynes.
- Reduced risk of downstream flooding.
- Increased flood water storage capacity.
- Created habitat.

4.1km of paths, boardwalks and bridges provide full public access, some of which will be underwater during flood.

The park being used as an educational resource

Lessons learned

- Introduced measures to sustainably manage the risk of flooding.
- Unique partnership project led by a charity with funding from a private gravel extraction company to improve the environment for wildlife and people.

Project Contact: The Parks Trust

CASE STUDY

Cheonggyecheon Restoration Project

Large-scale urban regeneration achieved by removing a two-tier overpass and landscaping the river channel it exposed. Seoul Metropolitan Government successfully addressed a range of economic, social, cultural and environmental problems through a scheme that has provided a template for planning across South Korea and further.

Project summary

Location: Cheonggyecheon stream, Seoul, South Korea
Length: 5.8 km
Cost: US $280million
Dates: 2000-2005

Delivery

Delivered through: Government funded, multi-partner project to deliver large-scale urban regeneration.
Partners: Cheonggyecheon Restoration Centre, Seoul Development Institute, Cheonggyecheon Restoration Citizens Committee, Seoul Metropolitan Government.

Background and issues

- The river was culverted and buried underneath a 12 lane highway.
- Severe degradation of surrounding area.
- Poor water quality.
- Poor quality of the natural environment and lack of plant and wildlife.

Zone 1: History

Underground waterways redirected to create a new stream bed with landscaped banks; former bridges used as decorative elements; seating to encourage the public to use the space.

Zone 2: Urban and Culture

Created a park in the centre of the city with recreation areas, waterfront decks and stepping stones; designed using environmentally friendly materials, with artwork and maps on walls along the river corridor.

Zone 3: Nature in the middle of the city

Designed to look natural and overgrown; sections of the pier and overpass left as industrial mementoes; wetland designated as an ecological conservation area.

Step-by-step

1. The Seoul Metropolitan Government established the Cheonggyecheon Restoration Centre to act as a focus for research, development and planning.
2. The Cheonggyecheon Restoration Citizens' Committee helped to gauge public opinion, communicating the projects goals through information sessions and conveying concerns.
3. The highway was de-commissioned.
4. The new river channel was excavated.
5. Works were undertaken to the river corridor.

Benefits

- Urban renewal and revitalisation.
- Economic growth and tourist attraction.
- Public access to the river – fishing and bathing.
- Educational resource.
- Historical and cultural values reflected in design.
- Significant ecological improvement.
- Air and water quality improved.
- Reduction in air temperature (cooling effect) in surrounding area by an average of 3.6˚c demonstrated by thermal imagery.

All photos ©Nepal Asatthawasi, with thanks to Design Council

Lessons learned

- Hailed as a global best practice example of successful urban greening in a densely populated city.
- Provided a template for planning across South Korea and wider afield.
- Example of a metropolis scale, multi-partner project benefitting a population of 25 million people.

Project Contact: CABE/Design Council

CASE STUDY

Ciobarciu Wetland Project

Issues such as the loss of wetlands essential for bird and plants and the loss of floodplain resulting from agricultural and irrigation practices were addressed by removing embankments and restoring flow to an old river course. The project has had numerous social benefits as well as improving the ecology of the area.

Project summary

Location: Near the village of Costuleni, Iasi. Prut Barlad River Basin, Romania
Length: 5,500m
Area: 250ha
Cost: €388,000
Dates: 2003 - 2006

Delivery

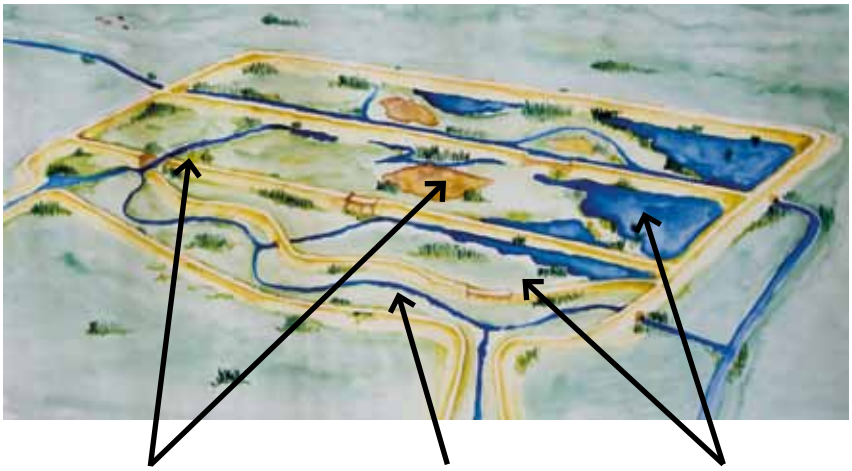
Delivered through: Dutch governmental fund to protect and rehabilitate areas for nature in Eastern European countries.
Partners: Prut–Barlad River Basin Authority, RIZA, Hunze & Aa's and Het Drentsche Landschap (NGO).

Participatory approach to designing the scheme

Landowner agreements

Background and issues

- Historic diversion of Jijia river dramatically changed the area.
- Loss of floodplains.
- Most of area is grassland with limited ecological value.
- Poor quality of the soil.
- Lack of habitat and suitable breeding areas for birds.



Channels created through embankments and some embankments removed entirely.

Flow restored to Old Jijia River.

Wetland areas creating good habitat and breeding areas for birds on the migration route to the Danube delta.

Step-by-step

- October 2003 - Land evaluation.
- 2005-2006 - Land purchase of 224ha grassland from approximately 400 landowners.
- Community participated in scheme design.
- Channels created between embankments to improve connectivity, inner embankments removed completely.
- Restoration of old meanders.
- Restored flow on the Old Jijia River.

Benefits

- Local people consulted and involved in decision making - led to support for changes
- Increased public access.
- Improved recreational opportunities.
- Educational and scientific opportunities.
- Water available for livestock and irrigation.
- Reeds for traditional manufacturing.
- Reconnected the floodplain.
- Improved the overall look of the area.
- Improved water quality.
- Re-created important habitats.

Restoring flow on the Old Jijia river (from left; before, during and after work)
All images ©Prut-Barlad River Basin Authority (ABAPB)

Lessons Learnt

- Good example of project developed by involving the local community.
- Good example of land purchase for ecological restoration.

Project Contact: ABAPB (Prut-Barlad River Basin Authority, Romania)

CASE STUDY

Isar River, Munich

The 'Isar Plan' was developed to improve flood control, to improve plant, fish and animal habitats, and to increase opportunities for recreation. These issues were addressed by regrading river banks, setting back flood defences and creating public beaches. The results have been dramatic, particularly considering its urban location: the risk of flooding has been reduced, the local ecology enhanced and public access to the area improved.

Project summary

Location: Munich, Germany
Length: 8km
Cost: €35,000,000
Dates: 2000-2011

Delivery

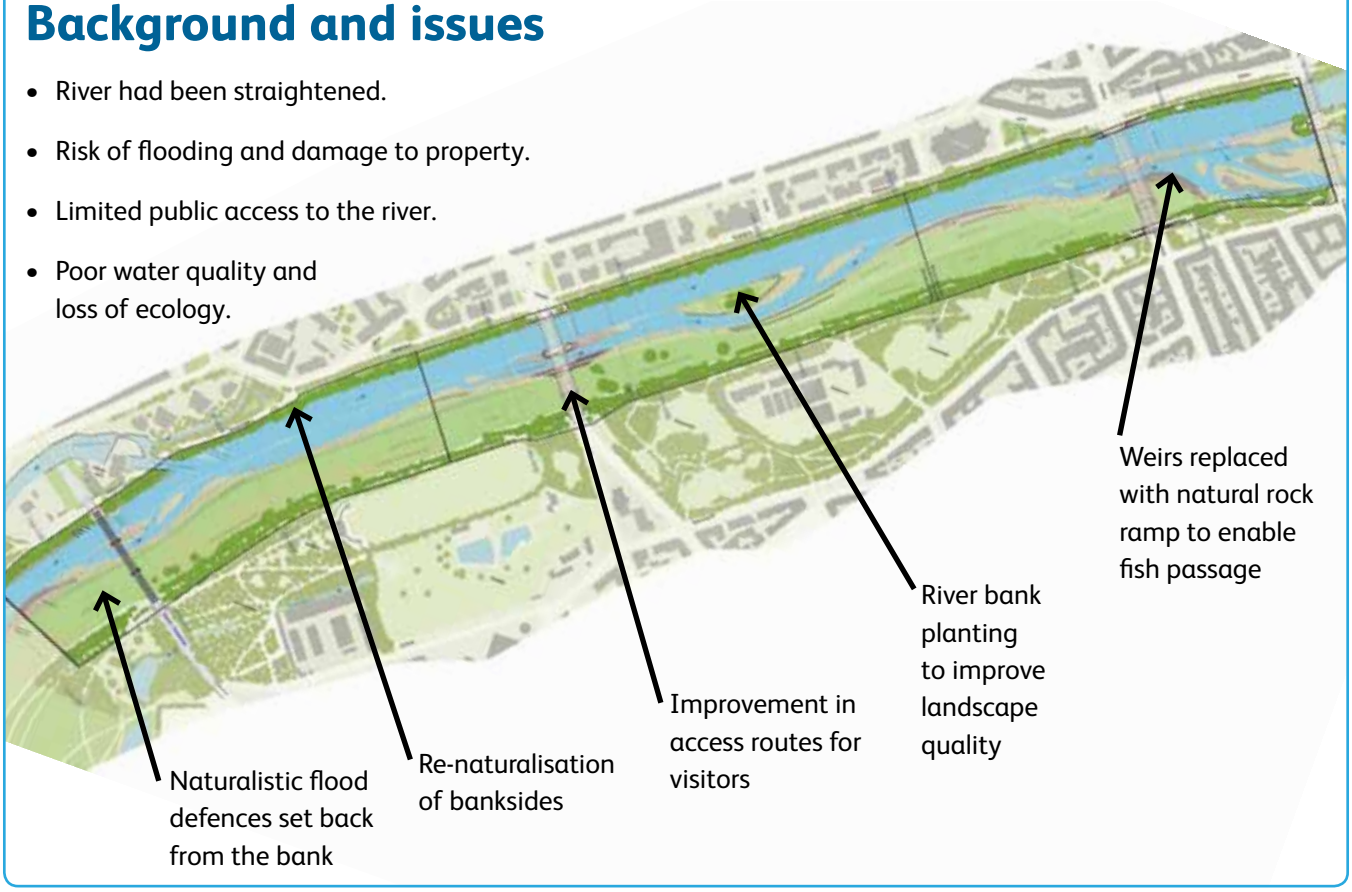
Delivered through: State funding, with high public consultation.
Partners: State of Bavaria, City of Munich, Regional Office for Water Management, Isar-Alliance.

"The **urban river concept** combines the nature oriented design of an urban river with an urban lifestyle, it goes beyond simple cost benefit analysis and is of immeasurable value to the population"
(Urban river restoration in Munich, Arzet and Joven)

Increased access for local people following restoration

Background and issues

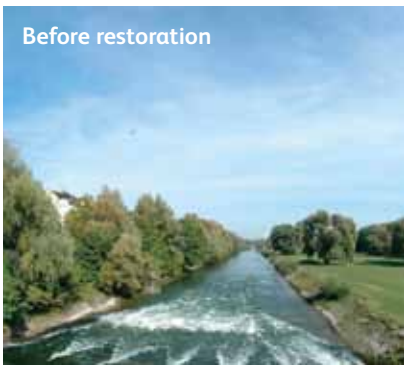
- River had been straightened.
- Risk of flooding and damage to property.
- Limited public access to the river.
- Poor water quality and loss of ecology.

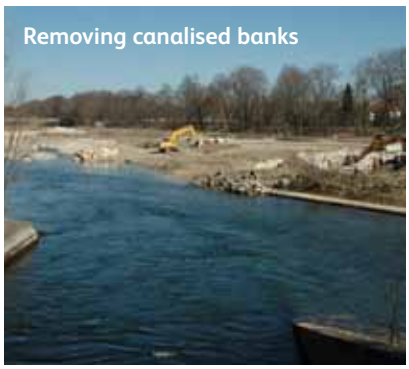


Step-by-step

The scheme was delivered in two phases:

1. 1995-2000- Working group 'Isar-Alliance' set up. Public input into the design of the project through consultation period.
2. 2000-2011- Remediation works carried out in seven sections, approximately one completed every 12 months, including:
   - €7M remediation of contaminated sites and removal of debris from World War II.
   - €28M of works, including increasing flood protection, creating a public beach, bank re-grading, weir removal, river bank planting and installing water disinfection systems to improve quality.


Before restoration

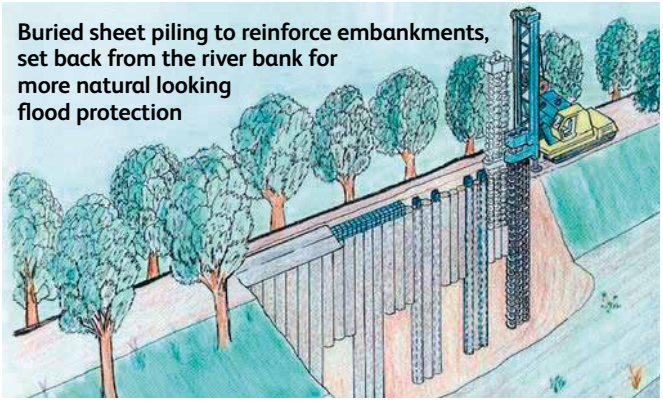

Removing canalised banks


The restored multi-purpose Isar River

All images © State Office for Water Management, Munich

Benefits

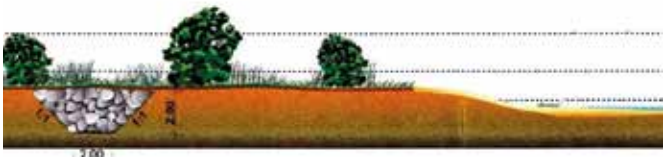
- Reduced risk of flooding.
- Community involvement in design meant design and changes were more readily accepted by the public.
- Increased public access.
- Aesthetic improvement.
- Improved water quality.
- Fish can pass more freely.


Buried sheet piling to reinforce embankments, set back from the river bank for more natural looking flood protection

Two flood protection approaches were used to restore the alpine character of the river.

1. Sheet piling was used to reinforce embankments at both edges of the floodplain.
2. Stone was buried in trenches set back up to 25m to as a precaution in case the river moved more than expected.

Hidden stone barrier to limit migration of the river bed and further protect the embankments



Lessons Learnt

- Natural and attractive design that creates an appealing green space for people in the centre of Munich, without compromising the level of flood protection.
- The Isar-Alliance provided a platform for public consultation.

Project Contact: State Office for Water Management, Munich

Further information on planning projects

Further information and advice on planning river restoration projects and river management can be found on RESTORE's website.

RESTORE: encourages the restoration of European rivers towards a more natural state for increased ecological quality, flood risk reduction, and social and economic benefits.
http://www.restorerivers.eu

The River Restoration Centre: technical advice and information on all aspects of river management. Advisers have a wealth of practical experience in river engineering, hydrology, geomorphology, ecology and river management.
www.therrc.co.uk

River restoration should be considered on any part of the river including its estuary. Detailed design guidance here: **http://www.environment-agency.gov.uk/cy/busnes/sectorau/100745.aspx**

Glossary

Biodiversity
A term to describe the diversity of living species including animals, plants and their habitats.

Buffer zone
A strip of land adjacent to a watercourse that is protected, often with fencing, from impacts such as paving, livestock, grazing. In urban settings a buffer zone might be the setting back of a building and allowing natural vegetation to grow. See riparian.

Catchment
The land (and its area), which drains (normally naturally) to a given point on a river, drainage system or other body of water.

Culvert
A closed conduit carrying a watercourse beneath an obstruction such as a road, railway or canal.

Ecosystem services
'Services' such as climate, water, air, food, soil, woodlands or nutrient recycling, which benefit humans. Ecosystem services are interdependent, therefore if one part is damaged it can have an impact on the larger system.

Embankment
A bank of earth or stone that prevents the land behind from flooding.

Flood risk management
Understanding the probability and consequences of flooding, and seeking to manage flood risk to people, property and the environment.

Floodplain
Area of land bordering a river that is prone to flooding.

Hydromorphology
Hydromorphology describes the characteristics of a water body. Hydrology refers to the flow and quantity of water. Geomorphology refers to the physical elements and processes of waterbodies such as lakes, rivers and coasts.

Land drainage
The movement of water to a point in a river.

Maintenance
Work that sustains the desired condition and intended performance of an asset.

Modified water bodies
Water bodies that have been physically altered to fulfil important 'uses' such as flood and coastal risk management or navigation.

Riparian
Along the banks of a watercourse. Riparian zones support riparian vegetation and are of environmental importance, providing diverse habitats and supporting a range of ecological communities.

River basin
A river basin is the area of land from which all surface run-off and spring water flows through a sequence of streams, lakes and rivers into the sea at a single river mouth, estuary or delta. It comprises one or more individual catchments.

River basin district
A river basin or several river basins, together with associated coastal waters.

Sustainability
The concept of development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Water body
Under the Water Framework Directive this is a manageable unit of surface water, being the whole (or part) of a stream, river or canal, lake or reservoir, transitional water (estuary) or stretch of coastal water.

Water quality
The physical, chemical and biological characteristics of water.

Bibliography and further reading

Klaus Arzet and Stefan Joven, The Isar Experience, Urban River Restoration in Munich
www.wwa-m.bayern.de/fluesse_seen/massnahmen/isarplan/doc/the_isar_experience.pdf

CABE Space (2005), Does Money Grow on Trees?
www.cabe.org.uk/files/does-money-grow-on-trees.pdf

Environment Agency (2011), Evidence, The Mayes Brook restoration in Mayesbrook Park
www.theriverstrust.org/projects/water/Mayes%20brook%20restoration.pdf

Environment Agency (2010), Working with Natural Processes
cdn.environment-agency.gov.uk/geho0310bsfi-e-e.pdf

TCPA (2004), Biodiversity by Design, A guide for sustainable communities
www.tcpa.org.uk/data/files/bd_biodiversity.pdf

An Introductory Guide to Valuing Ecosystem Services, Defra, 2007
www.defra.gov.uk/publications/2011/03/28/pb12852-ecosystem-services/

Natural England, Green Infrastructure Guidance, 2011
http://publications.naturalengland.org.uk/publication/35033?category=49002

River Restoration: A stepping stone to urban regeneration, Environment Agency, 2001
http://therrc.co.uk/pdf/References/southriver_combined_2up.pdf

Estuary Edges, Environment Agency, and Bringing rivers back to life, (Environment Agency)
http://www.environment-agency.gov.uk/cy/busnes/sectorau/100745.aspx

Useful websites

European Centre for River Restoration
http://www.ecrr.org/

European Commission (Water Framework Directive and other water related issues)
http://ec.europa.eu/environment/water/water-framework/index_en.html

European Environment Agency
http://www.eea.europa.eu/

Green infrastructure
www.greeninfrastructurenw.co.uk

RESTORE
www.restorerivers.eu

Sustainable drainage systems
www.susdrain.org

RESTORE is a partnership of seven organisations from five European countries. We are developing an information-sharing network for policy makers, river basin planners, practitioners, enthusiasts and experts across Europe to communicate the importance of river restoration and understand the barriers to achieving it. We promote best practice through events, seminars and our website.

Project partners

RESTORE is organised into four regions across Europe:

Project Manager
Environment Agency (England) – Toni Scarr
Email: restore@environment-agency.gov.uk
www.restorerivers.eu
Telephone: +44 207 863 8714

Western Region
River Restoration Centre (UK) – Martin Janes
Email: rrc@cranfield.ac.uk
www.therrc.co.uk
Telephone: +441234 752 979

Northern Region
Finnish Environment Institute (SYKE) – Jukka Jormola
Email: jukka.jormola@ymparisto.fi
www.environment.fi
Telephone: +358 405 125 736

Southern Region
Italian Centre for River Restoration (CIRF) – Andrea Goltara
Email: a.goltara@cirf.org
www.cirf.org
Telephone: +39 389 1104025

Eastern Region
Government Service for Land and Water Management (Netherlands) – Rogier Vogelij
Email: r.j.vogelij@dlg.nl
www.dienstlandelijkgebied.nl
Telephone: +316 319 66318

In association with (as subcontractor): National Institute of Hydrology and Water Management (Romania) – Elisabeta Cserwid
Email: elisabeta.cserwid@hidro.ro
www.inhga.ro
Telephone: +4021 318 11 15/109

Communication Manager
Wetlands International (international) – Chris Baker
Email: ChrisBaker@wetlands.org
www.wetlands.org
Telephone: +313 186 60917

Environment Agency · Wetlands International · SYKE · Government Service for Land and Water Management, Ministry of Economic Affairs, Agriculture and Innovation · River Restoration Centre · CIRF

Restoring Europe's Rivers

LIT 8146