

1.1 Brief description of each case study

In the following each case study is characterised in terms of the responsible authority, a brief description and the most outstanding aspects. The cases are listed in accordance with table 2.

European countries

AUSTRIA

Alterbachsystem, Salzburg

Responsible:	City council of Salzburg, Municipal Hydraulic Engineering Department
Description:	Soil-bioengineering measures have been implemented at the Alterbachsystem. Habitat quality was improved tremendously, being for instance displayed by 9 different species of fish to compared one species before the project was implemented.
Outstanding:	Early European project with soil-bioengineering measures with a broad monitoring program

Wienfluss, Vienna

Responsible:	MA 45, Vienna Municipal Hydraulic Engineering Department
Description:	About 15 years ago due to flood requirements and a new ecological focus in water management the rehabilitation of the Wienfluss was started with preliminary hydrologic and hydraulic studies, a 1:1 test model and laboratory tests. Major objectives are the relocation of the stream into its original bed including the ecological enhancement of the site and flood protection for the City of Vienna.
Outstanding:	Interesting approach including a soil-bioengineering testing reach, broad monitoring program

BELGIUM

Woluwe, Brussels

Responsible:	Brussels Institute for Managing the Environment (BIME)
Description:	In the early 1980s it was decided to daylighten the Woluwe River, which at that time had completely disappeared under a four-lane city road and was diverted into a side pipe of the main mixed sewer. A narrow stripe between the road and housing had remained green secured from development for potential road extension. The opportunity to use this stripe to reconstruct a narrow river channel for a part of the river was used after the Brussels Central Region program "The Blue Network" was set up. The project has to conciliate a number of restrictions such as limited water discharge, disruptions from existing ponds,

necessity to drive an ancient mill – all together making the rehabilitation project a representative urban compromise.

Outstanding: Extremely restricted urban situation, original river course covered by main city road

CZECH REPUBLIC

Náhon (Mill Race), Chrudim

Responsible: Chrudim city council, board of green spaces

Description: An ancient millrace running through today's town centre of Chrudim after long period of deterioration was identified as the first and so far only (MZP CR 2003) example of urban river rehabilitation in the Czech Republic. The old masonry channel was replaced by a quasi-natural river course, modelled on the basis of international geomorphologic knowledge about rivers of comparable size in comparable climatic and geologic/topographic conditions. Other techniques are applied in other, differently constrained sections of the rehabilitation reach.

Outstanding: Rehabilitation of an artificial water body in a diversely restricting urban situation utilising individual techniques and geomorphologic modelling

FRANCE

La Chaudanne, Grézieu-la-Varenne (Rhône region)

Responsible: SAGYRC (Syndicat d'Aménagement et de Gestion de l'Yzeron – Cooperation board for the Management of the Yzeron river basin)
SIAHVY (Syndicat Intercommunal d'Assainissement de la Haute Vallée de l'Yzeron – Inter-municipal partnership of convenience for waste water purification in the upper Yzeron river valley)

Description: The problem of mixed sewer overflows in the municipality of Grézieu-la-Varenne into the river La Chaudanne (tributary of the Yzeron river) was solved by a partnership of convenience for inter-municipal basin management. The surface and waste water systems were separated, and stormwater retaining, treatment and infiltration structures installed. The SAGYRC presents an interesting organisation form for planning and implementing effective management and rehabilitation of water courses. The very young scheme (2003) already has proved its functionality in terms of reducing sewer overflow, though little can be stated about the definite ecologic effects.

Outstanding: A project addressing issues of water treatment and storage, sewer overflow etc, an example of French approach to inter-municipal cooperation for basin management (planning and implementing the management of water courses)

La Saône, Lyon

- Responsible: Conseil général du Rhône (section CATER 69 - Rhône Insertion Environnement) – Regional Council of the Rhône region (Environment management section)
- Description: The course of the Saône river in Lyon presents an extreme combination of confining factors: impounded navigation way, quarry stone covered steep river banks and a parallel highway degrade the water course in both ecological and visual means and restrict the options for rehabilitation. A new technique developed at the Lyon University was tested, adopted and applied to cover the loose boulders allowing for the development of a site appropriate floristic and faunistic biodiversity of the riverbank and attempting to enrich the structural conditions in a short part of the denaturalised impounded river section.
- Outstanding: Rehabilitation techniques in extremely inflexible settings

GERMANY

Elbe Harbour Facilities, Hamburg

- Responsible: City board for Environment and Health, Hamburg
- Description: In the course of the reuse of a waste harbour facility as new neighbourhood park, parts of the harbour basin became filled. The head of the former shipping dock has been turned into a sloping, green riparian zone. The success of this measure was put into question when residents started a public “Bathing in the dock” campaign that is conflicting with the original goal of recreating a nature-like habitat.
- Outstanding: Interesting measures for ecological enhancement at heavily degraded urban harbours

Emscher, Deinhauser Bach, Castrop-Rauxel

- Responsible: Emschergenossenschaft, City of Castrop-Rauxel
- Description: The collapse of coal mining industry brought new opportunities for rehabilitation of the Emscher and its tributaries. One of them is the Deininghauser Bach. Within the entire Emscher basin major efforts are undertaken to re-establish a more natural flow regime. It is being assisted through stormwater infiltration measures.
- Outstanding: Comprehensive approach of rehabilitating a whole urban river basin according to WFD

Isar, Munich

- Responsible: Department for water management, Munich, City Council

Description:	The city of Munich has initiated an elaborate rehabilitation effort along the city's main River Isar. The goal is to meet new flood protection requirements, to enhance ecological quality and water quality to improve recreational values of the river and river corridor. The objective of the project was to restore what the river used to be: a wild river, shaping its own natural bed.
Outstanding:	Comprehensive and effective approach of rehabilitation covering ecologic and social, as well as security aspects, reference and testing section

Kaitzbach, Dresden

- Responsible: Technical University of Dresden
- Description: This 19th century mill creek became severely degraded by carrying run-off from urban and industrial development. A section of the stream was rehabilitated in a demonstration project of soil-bioengineering practices, carried out by Dresden University of Technology students.
- Outstanding: Diverse social appraisal tools have been applied during a research project, several small projects resulted, one of them a student one

Leine, Hannover

- Responsible: Hannover city council
- Description: In the scope of the EXPO 2000 in Hanover a rehabilitation project of the Leine river valley (especially in the flood plain) was implemented. High water dykes were opened to allow the flooding of the valley, parts of the flood plain were lowered to increase the frequency and duration of flooding, and quarry stone stabilised river banks along the insides of bends were removed (despite the "federal water way" status of the Leine river).
- Outstanding: Process restoration in the floodway incl. riparian forests; combined approach – ecological enhancement in the flood plain, improved flood management and public accessibility

Pegnitz, Nuremberg

- Responsible: Wasserwirtschaftsamt Nürnberg
- Description: A more dynamic course of the Pegnitz should foster ecologic functions of the urban riverscape as well as its recreational uses. Therefore citizens and historical maps were consulted to restore the first section of 14 kilometres of the river's flood plain and ensure access towards, along, and across the stream. Measures included a completely new river cross-section, restoration of four sinuosities and islands, and a playground designed as temporary detention basin.
- Outstanding: Comprehensive urban river rehabilitation effort with wide citizen involvement

Wandse, Wandsbek

- Responsible: City of Wandsbek
- Description: "Trout 2010" was started to create more natural habitats at small brooks and rivers. The urban brook Wandse is a pilot project for enhancement through restoration of gravel and boulder areas with pools and riffles. The public was invited to

participate in this process. Brook sponsorships were established.

Outstanding: Low budget project, implemented with help of many brook sponsorships

ITALY

Fosso della Bella Monaca Ditch, Rome

Responsible: City of Rome, Waterdesign Rome

Description: The Borough of Tor Bellamonaca was subject to the EU urban regeneration programme **Urban**, which is directed to the realisation of urban design projects, social projects etc. The programme also contained the rehabilitation of the “Bella Monaca Ditch”. Goals of the project were to maintain a constant water flow, treatment of solid waste, consolidation and enhancement of morphology and vegetation of the riverbed, giving back of adjacent area to the citizens and foster activate participation and educational projects.

Outstanding: The first project in the Roman metropolitan area that dares to tackle the problems of re-naturalisation and the rehabilitation of a former ditch

Torrente Mugnone, Florence

Responsible: City of Florence, Servizio Geologico

Description: Water quality of Mugnone Brook was ameliorated by burying a public wastewater inlet under the bank and by obtaining a natural pre-treatment. Further modifications of the riverbanks with willow piles and of the bed (e.g., boulder riprap, groins) led to an improved oxygen level. New turbulences helped wildlife species to resettle in the once artificial stream. Citizens' acceptance of the water body was increased.

Outstanding: The first project in Italy, enhancing an urban stream in 1990

NETHERLANDS

Rhine, Arnhem

Responsible: Rijkswaterstaat, Dir. Oost-Nederland

Description: Main objective of the 'Teruglegging van de Bakenhofs dijk' (Relocation of the Bakenhof dike) project was to mitigate the bottleneck situation of the Lower Rhine's tributary IJssel in Arnhem. That was reached by a dike realignment of over 1.500 m, using the vacant area of a former brick work factory. The works of Rijkswaterstaat, Dir. Oost-Nederland, included improvement of habitat connections, restoration of an old IJssel bend, and a new secondary channel. The implementation period was from April 2000 to June 2003.

Outstanding: First project of the "Rhine-Meuse-Program – more room for the river"

UNITED KINGDOM

Skerne River, Darlington

- Responsible: River Restoration Centre (RRC, Silsoe), Environment Agency Northeast, York
- Description: An over 2 km long degraded stretch of the Skerne river at its entrance into Darlington was selected as a demonstration site for a European Life project. Spatial restrictions from parallel pipelines, power lines, housing and extensive historic spoil tipping had to be considered when implementing this rehabilitation. Thus in different stretches are different techniques applied. The surrounding landscape was extensively reshaped, material reused, the site accessibility improved and features of safety and experience introduced.
- Outstanding: Large project, innovative soft revettement techniques applied, good combination of ecological, landscape and participation aspects, good data availability.

Quaggy River, Chinbrook Meadows (LB Lewisham), London

- Responsible: Environment Agency South London (Reading and Farnborough)
Borough Council of Lewisham
- Description: The purpose was to improve flood protection onsite and downstream. A concrete channel dividing an urban park was reshaped following historic information "restoring" meanders, riffles, pools, flood plain and allowing for a natural development of the river course. Additionally the adjacent park area was landscaped to raise the public amenity value.
- Outstanding: Consequent rehabilitation of a heavily modified water course in an urban park area

SWITZERLAND

Albisrieder Dorfbach, Brook Concept Zurich, Zurich

- Responsible: ERZ Entsorgung & Recycling Zurich
- Description: During the 1980's, requirements for wastewater management and municipal cost controls, resulted in the "Brook Concept Plan" for Zurich. Since then about 14.5 km of underground brooks and springs that were previously connected with the sanitary sewerage system were placed on the surface, hence saving treatment costs and enhancing neighbourhoods.
- Outstanding: Citywide effort with community involvement to daylight city creeks

North America

CANADA

Don, Toronto

- Responsible: Task Force To Bring Back the Don
- Description: Since the mid 90ties the city has seen many efforts to restore the heavily modified Don. The main actor was and is the "Task Force to Bring Back the Don", an independently working group of representatives from the city, diverse interest groups and citizens. The strategy for regeneration includes big scale projects and supporting small-scale project under community involvement.
- Chester Springs Marsh – Chester Springs Marsh is part of the ongoing effort to "Bring Back the Don" by restoring some of the natural habitat that once flourished in this degraded area of the valley. This restoration project was developed to demonstrate the benefits, of a wetland.
- Outstanding: Rehabilitating of an entire urban river basin imitated by citizens, comprehensive monitoring program during rehabilitations efforts

Mud Creek, Toronto

- Responsible: Envision the Hough Group, City of Toronto
- Description: A covered tributary of the Don River, the Mud Creek, that functions as a storm sewer has been day-lighted and turned into a series of extended detention ponds. Now the site cleanses run-off pollution and functions as a nature education site at the newly restored Don Valley Brickworks.
- Outstanding: Rehabilitation of a heavily degraded brook in combination with nature and cultural education

U.S.A

Anacostia, Kingman Lake, Washington D.C.

- Responsible: District of Columbia Office of Planning
- Description: Kingman Lake Area Program – The morphology of the tidal river system has been dramatically altered through seawall construction, mainstream navigational dredging and associated filling. Efforts were undertaken to manage the sediment inputs generated by upstream erosion and to restore riverine fringe wetlands.
- Outstanding: One of the projects of District of Columbia's planning to improve water quality and habitat condition within the metropolitan area

White Clay Creek, Wilmington, Delaware

Responsible:	Water Resource Agency for New Castle County
Description:	The White Clay Creek watershed is one of the a few relatively intact, unspoiled river systems in the highly developed corridor between Philadelphia and Newark, Delaware. Mill Creek restoration occurred on the site of a golf course involving the "bio-restoration" of 1000 linear feet of degraded stream, including stream meanders, pools and riffles, riparian vegetation and non-tidal wetland habitat. Pre- and post restoration assessments of macro invertebrates and fish populations were conducted showing an increase in species abundance and diversity. A reduction of fine sediments blanketing the streambed was found.
Outstanding:	The White Clay Creek Valley is the only "Wild and Scenic River" designation in an urban area in the US.

1.2 Comparison of general characteristics

The selected rehabilitation schemes are all dedicated to water courses – that means linear, flowing natural or artificial more or less degraded urban surface water bodies. The spectrum of rehabilitation objectives, urban settings and pressures, size of water courses and amount of the projects in terms of costs are wide. To know about this differences is a fundamental knowledge to interpret the detailed comparison for the topics of this study.

Objectives of rehabilitation

In total 22 of 23 case studies where implemented considering the aim of rehabilitating an urban water course, which means to partially return to a functional and/or structural former or pre-degradation condition referring the ecologic state (**Error! Reference source not found.**). Only 17 schemes, however, named *ecologic improvement* as one of the main objectives (not reflected by the figure). Usually several issues of main emphasis where named per case study.

The total prevalence of ecologic issues (96 %) can easily be explained by the criteria set for the choice of the cases - of which 'ecologic improvement' is one of. Looking at other issues of interest unveils that in urban areas especially *amenity and recreation* (43 %) and *urban upgrading* in general (43 %) play a predominant role, followed by *flood defence* (39 %). Almost as important seem to be *public involvement* (35 %) and *visual enhancement* (26 %).