HR Wallingford
Working with water

HRPP 323

Challenges in meeting the WFD and achieving sustainable flood risk management in urban rivers

Valerie Bain, Roger Bettess, Matthew Hardwick,
Steve Vernon

Reproduced from a paper published in:
Proceedings of the 41st Defra Flood and Coastal Management Conference
4 to 6 July 2006
University of York, UK

CHALLENGES IN MEETING THE WFD AND ACHIEVING SUSTAINABLE FLOOD RISK MANAGEMENT IN URBAN RIVERS

Valerie Bain[1], Roger Bettess[1], Matthew Hardwick[2], Steve Vernon[2]

[1] *HR Wallingford Ltd*
[2] *Royal Haskoning*

Key Words: WFD, river rehabilitation

Abstract

The improvement of urban rivers to reach good ecological status or good ecological potential represents a significant component of the work to meet the Water Framework Directive (WFD), given that the ecology of urban rivers is frequently highly degraded and that many of the rivers in the UK flow through urban centres. Likewise, the degradation of urban rivers has an impact on the hydrology and sediment regime of the catchment which can result in channels with low conveyance for flood flows.

The URBEM European research project that was completed in October 2005, has provided extensive information on urban river rehabilitation schemes throughout Europe and North America. This paper draws on the lessons learnt from these international experiences of urban river rehabilitation, including information on the effectiveness of rehabilitation schemes in improving the ecological status of a river and on the timescales required for such improvement.

Having explored the wide range of international examples, the paper then discusses in more detail the use of best practice geomorphological techniques in river rehabilitation for the Rothes Catchment case study in Scotland. Techniques such as Fluvial Audits and Conservation Baseline Assessments complement a multi-disciplinary approach to meeting the WFD and achieving sustainable flood risk management.

In addition to the scientific aspects of rehabilitation, consideration will be given to the legislative framework for urban river rehabilitation schemes and will emphasise the importance of assigning organisational powers, time and budget to this task. The range of issues discussed in this paper highlight the growing challenges in implementing the WFD as the time to meet the requirements ticks by.

INTRODUCTION

A major challenge of our time with regard to river management is the achievement of the objectives of the Water Framework Directive (WFD; EC, 2000) and there are specific challenges that are essential to address *now* in order for the UK to meet the WFD requirements. The WFD utopia of integrated catchment management is a commendable target to aim for but there may not be sufficient time to implement improvement of entire catchments before WFD deadlines are reached. In an urban context, the practical difficulties of rehabilitating all rivers within towns and cities are significant as water quality issues, spatial restriction, infrastructure requirements and conflicting uses of the land all create pressures and impacts on river ecology and river management. Since rehabilitation at a catchment or city scale is not achievable within the WFD timeframe, rehabilitation schemes are likely to be limited to site and reach scale. Schemes implemented at a small scale may not result in a significant improvement of the ecological status. In addition to the technical and practical difficulties, there is currently a lack of legislation to give any authority the legal power to implement works for ecological purpose. If there is any hope of achieving the WFD and securing the availability of clean, environmentally rich watercourses for future generations, we must act *now* in order to resolve the issues discussed in this paper.

Overcoming the challenges to achieve the WFD is no small task, particularly since there are potential conflicts between management strategies that are most beneficial to ecology and those that are best for conveyance of flood flows. Flood risk management in urban areas is particularly important as the density of development and numbers of people are greater than in sparsely populated areas and therefore the consequences of flooding can be great. The objectives of managing flood risk and ensuring our rivers have a good ecology have generally not been complementary in the past. With the advent of the WFD, it is now paramount to ensure that sustainable flood risk management is practised. Moreover, with the increase in the number and size of urban areas in the UK between the 1991 and 2001 censuses (Office for National Statistics, 2005), the challenge of balancing WFD objectives and flood risk management becomes greater as the potential ecological impacts and potential flood consequences increase.

In this context of managing the flood risk as well as the ecological status of rivers, it is recognised that a number of rivers in urban areas will require rehabilitation to achieve good ecological status or potential. It is vital that river management and rehabilitation is carried out on the basis of sound science and with a clear management structure for roles and responsibilities in order to ensure that projects are successful at achieving objectives.

International experiences of urban river rehabilitation

The URBEM Project

Urban River Basin Enhancement Methods (URBEM) is an EC FP5 Project that ran from 2002 to 2005. The overall aim of the project was to provide new tools, techniques and procedures to enhance watercourses located in urban areas. A multi-disciplinary team of thirteen organisations from six European countries worked on the project. One element of the research carried out for the project was a study on the current state of urban river rehabilitation (Schanze *et. al.,* 2003). This was achieved by collecting and analysing information on selected schemes to provide an understanding of the state of the art in urban river rehabilitation and of good planning practices. The findings from this research are significant for river managers and technical specialists who design and plan river rehabilitation schemes as the results demonstrate those approaches and techniques that have been successful and those that have not. The lessons learnt from these experiences of urban river rehabilitation inform the management and implementation of river rehabilitation now and in the future, and are all the more important as the requirement for improvement measures increases with the growth of urban areas, the increasing pressures on flood risk management and as the deadline for meeting the WFD becomes closer.

Case Studies

A total of twenty-three case studies were investigated in detail; nineteen of which were in Europe and four were in North America. These case studies were selected on the basis of those that would represent a range of geographical regions, river type, rehabilitation approach and that would convey most information on best practice approaches. The case studies were investigated by use of a standard enquiry approach involving an extensive questionnaire, telephone interviews and interviews carried out in person. The outcome of the research gives an insight to a wide range of issues associated with river rehabilitation; we focus here on the implications on ecological status and that were drawn from the case studies.

River rehabilitation measures must be implemented as appropriate for the physical, hydromorphological and ecological context of the river. The case studies therefore included a wide range of river types from a range of different ecoregions within Europe and North America. The case study rivers included rivers in the UK, France, Germany, the Netherlands, Austria, Belgium, the Czech Republic, Italy, Switzerland, Canada and the US. The case studies were all located in urban areas and included London, Lyon, Dresden, Munich and Rome, among others. Most of the rivers were small (less than 25m in width) but a few were larger (up to 300m wide). The types of schemes carried out included daylighting of culverted streams, rehabilitation of natural morphology, soil bio-engineering and catchment drainage intervention. The case studies were generally implemented with multiple objectives, the most common across all examples being the improvement of the ecology (22 of the 23 case studies stated this as a goal). Nine of the case studies were implemented with the improvement of flood management as an objective. The three most common constraints that influenced the case study rivers were channelisation (16 rivers), spatial constraints (11) and statutory constraints (10).

Rehabilitation approaches

The case studies exemplify a wide range of rehabilitation techniques that were used to improve the rivers. In general, the rehabilitation projects were carried out on short reaches of river, with only four of the examples being of schemes carried out over a river length greater than 3 km. This has implications for the success of the schemes, which will be discussed in the sections below. The costs of the schemes also varied from €5000 to €27 million. The majority (52%) of the schemes cost between €100,000 and €2 million. The relationship between the cost of the project and the length of river rehabilitated is illustrated in Figure 1.

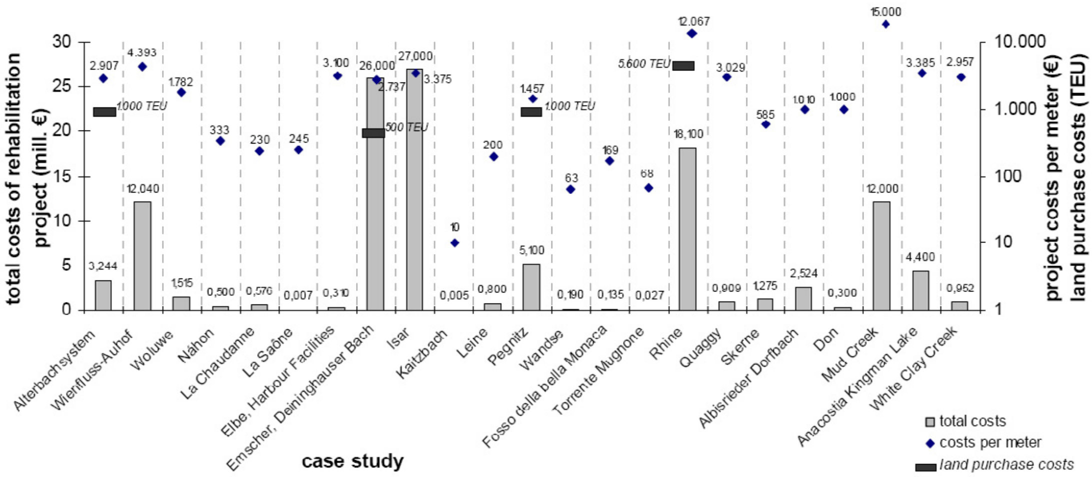

Figure 1 Total costs of rehabilitation projects and cost per metre *(from Schanze et. al., 2003)*

The rehabilitation measures targeted the improvement of:

- hydrology and hydrodynamics;
- stream morphology and connectivity;
- water quality;
- stream biodiversity;
- flood management.

The case studies implemented different ranges of techniques as appropriate to the specific objectives of their rehabilitation project and to the types of problems and characteristics of their river environment. The range of techniques used included commonly implemented designs as well as innovative approaches. The URBEM outputs contain detailed information on techniques used in the case studies (Schanze *et. al.,* 2003, Faber, 2005, Tourbier & Westmacott, 2005).

Timescale for implementation

The case study research highlighted some interesting information on the timescales for conceiving, planning and implementing a river rehabilitation project. The average time lapse between the conception of the initial rehabilitation idea and the completion of the rehabilitation was between six and eight years; ranging from a few months (La Saône) up to about two decades or more (Isar, Emscher).

The funding of the case study projects took an average of 1.7 years to put in place; the shortest time being a few months and the longest being 5 years. The planning process took an average of 2.6 years, varying from a few months up to 9 years. Implementation took an average of 2.9 years, varying from a few weeks (La Saône) up to 15 years (Mud Creek). The timescale for implementation was inevitably linked to the spatial scale of the project.

Table 1 shows these timescales in the context of the WFD timetable for implementation. Given that there now remain just nine years until the deadline for achieving good ecological status or potential is reached, the case studies research would suggest that the average timescale of six to eight years for previous projects will fall within this timeframe. This does not, however, take into account the duration for ecological recovery after the project and there may be some time lapse between completion of rehabilitation and seeing the ecological benefits. With this knowledge of the timescales for improving the ecological status of rivers, it is of great importance that action is taken *now* to plan and start implementing rehabilitation schemes. The time remaining for meeting the WFD is not likely to be sufficient for the implementation of catchment or city scale projects as experience on Mud Creek and the Isar demonstrate that larger scale projects can take over 10 years to complete.

Table 1 WFD timetable for implementation compared with average timescales of rehabilitation from case studies experiences

Year	WFD Milestones	Case Studies timescales
2000	WFD adopted	
2006	Start public consultation	Start planning (working on RBMPs and programmes of measures) and public consultation. (Average time for planning is 3 years).
2009	Finalise river basin management plan (RBMP) including programme of measures	Finalise plans.
2009 - 2012		Funding takes an average of 2 years to get in place. Minimise the time lapse between completion of plans and start of implementation in order to maximise the time for ecological recovery after implementation.
2012	Start implementation of programme of measures	Start implementation (average time to completion is 3 years)
2015	Meet environmental objectives	Implementation complete but ecological recovery in early phases and therefore may not have met environmental objectives

Impact on Ecological status

Assessing the impact of the schemes for each case study was a challenge since few post-project appraisals had been carried out and, in the past, guidance on the use of indicators and evaluation methods has been lacking. The URBEM research used the WFD ecological status classifications to measure the impact of schemes on ecology as it provides a common scheme of measurement so that case studies can be compared. The process by which the correspondents to the case study inquiry assessed the ecological impact of their projects was to translate their national classification schemes to WFD status categories themselves as guidance that has recently become available through the WFD Common Implementation Strategy (CIS) working group was not available then. This was the best available basis upon which a comparison could be made but is associated with some uncertainty since there was no intercalibration of this assessment process between sites.

The results of this assessment showed that in most case studies, biological conditions improved by between 1 and 3 status classes, the average improvement being 1.5 classes for macrophyte and phytobenthos conditions, 1.4 classes for benthic invertebrate fauna and 1.7 classes for fish fauna (see Figure 2). It is encouraging that the rehabilitation efforts have resulted in a measurable increase in ecological status, however for rivers that are currently classified as having bad ecological status, past experience has shown that it is difficult to improve this to good status. Before rehabilitation, the majority of case studies were recorded as having bad or poor biological status. After the implementation of the rehabilitation projects, the majority of case studies were classified as having moderate biological status (across the board for macrophytes and phytobenthos, benthic invertebrates and fish).

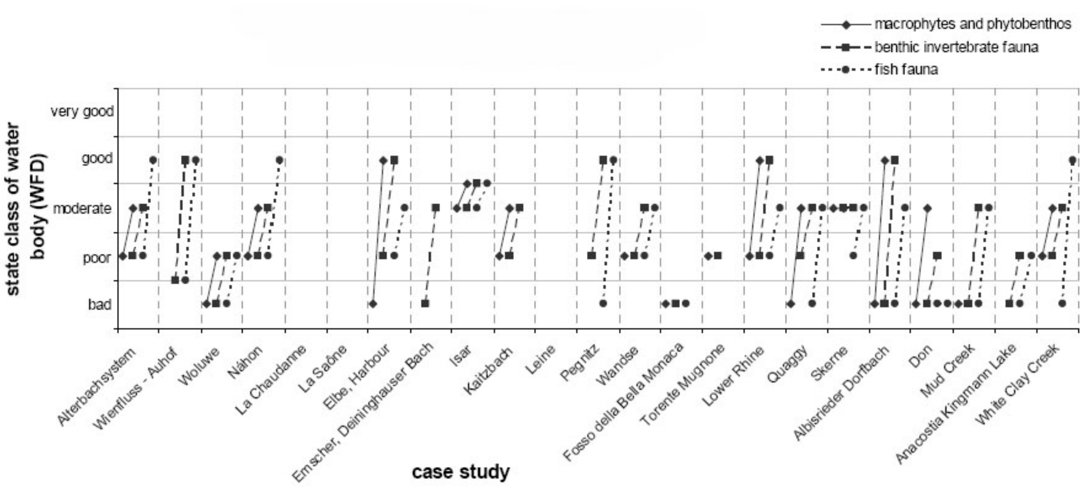

Figure 2 Biological conditions of case study rivers before and after rehabilitation *(from Schanze et. al., 2003)*

The impact of schemes on the hydromorphological and physico-chemical conditions was also assessed as these aspects contribute to the habitat quality of the river. Figure 3 shows that the average impact on the hydrological regime was an improvement of 1.4 classes, 2 classes for river continuity and 2 classes for morphological conditions. This shows a slightly greater improvement than the biological classification, showing that an increase in habitat quality may not be matched directly by the same amount of improvement in biological status.

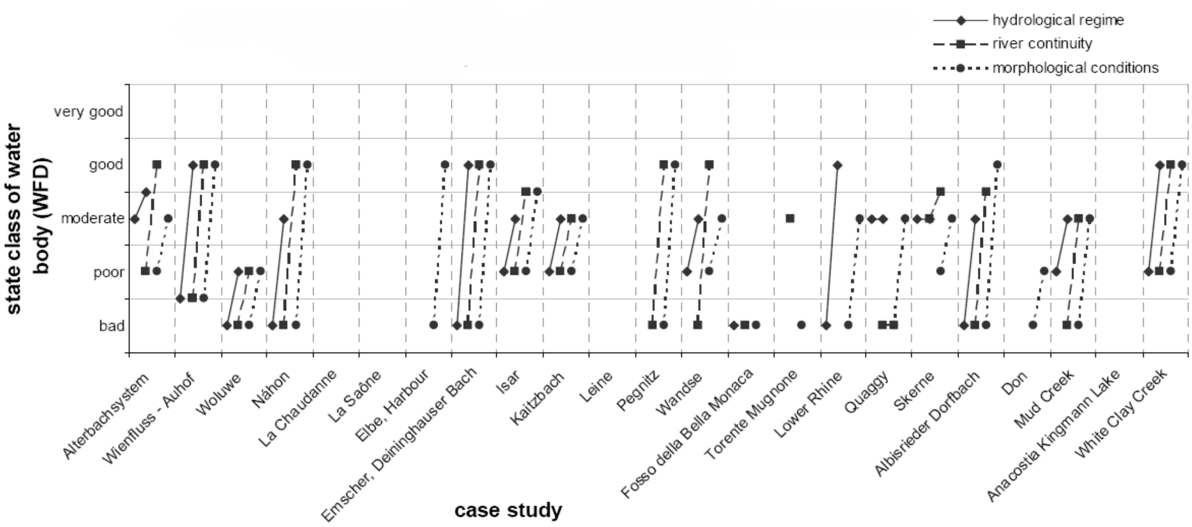

Figure 3 Hydromorphological conditions of case study rivers before and after rehabilitation *(from Schanze et. al., 2003)*

As described above, the majority of schemes were carried out at a site or reach scale with rehabilitated lengths of less than 3 km. This may be one of the reasons why the projects were not more successful at achieving good ecological status. Geomorphological and hydrological processes happen at a catchment scale and therefore the problems experienced upstream in the river corridor or elsewhere in the catchment will have an influence on the flow and sediment dynamics within the rehabilitated reach which must be taken into account when designing the rehabilitation scheme. Even if reach-based schemes are designed to sustain these influences or are designed with planned maintenance, the flow and sediment problems elsewhere in the catchment will influence the connectivity of the ecosystem and will reduce the mobility and, therefore, the diversity and abundance, of species. Likewise, carrying out fish stocking, vegetation planting or water quality improvements to just one reach will not overcome the problems of the catchment.

This information on the difficulties that past rehabilitation schemes have had in improving the ecological status of rivers highlights the fact its not always possible to predict the ecological impact of a proposed scheme and is therefore not straight-forward to determine which rehabilitation approach is most suitable for achieving environmental objectives.

Example of using geomorphic techniques to achieve WFD and sustainable flood management objectives

In future, to implement the WFD, studies will have to take account of the river sediment transfer system and the effect of sediment dynamics on in-channel habitats. The WFD requirement for watercourses to achieve good ecological status or potential, means it is essential that management activities take due consideration of the relationship between flood defence infrastructure, morphology and habitats. Disruption of sediment dynamics in the fluvial system impacts sustainable flood risk management through:

- Morphological instability
- Promotion of erosion and deposition
- Delivering potentially polluted sediments to rural floodplains and urban areas
- Damaging valuable aquatic, riparian and floodplain habitats

The following sections provide examples of methods and techniques that capitalise on the best science and understanding of morphological processes to achieve WFD objectives and to support sustainable flood management.

Rothes Flood Alleviation Scheme, Morayshire, Scotland

The town of Rothes in Morayshire is located at the foot of a steep sided valley and has experienced at least 6 flood events in the past 50 years. The most recent severe flooding, in November 2002, inundated 155 residential properties, resulting in damage estimated at £2 million, affected production at three of the town’s five distilleries, blocked roads and caused the collapse of a major road bridge. The town is at risk from flooding from four burns (streams) and the River Spey which is the seventh largest River in the UK. Both the river and the burns are nationally and internationally important in terms of their environmental value. The river has been designated as a Site of Special Scientific Interest (SSSI) and a Special Area of Conservation (SAC) for its internationally important populations of Atlantic Salmon, Sea Lamprey, Otter and Freshwater Pearl Mussel. The burns are also productive for juvenile salmon and trout, and the downstream sections are designated as SACs.

There are few flood defences protecting the town. Most of the burns either have no flood defences or are protected by garden walls, properties or informal earth banks, many of which are in a poor condition. There is a history of boulders, cobbles and gravel blocking existing structures causing the burns to overtop their banks. These localised sediment sinks have also resulted in reaches immediately downstream being starved of sediment causing bed degradation and severe bank erosion. The adopted strategy for protecting the town from flooding comprises a three pronged approach consisting of channel rehabilitation, construction of formal flood defences and long term management to secure the performance of the scheme.

The Water Environment and Water Services (Scotland) Act 2003 places a duty on local Authorities and others, to promote sustainable flood management and incorporate the WFD into Scottish Law. The adopted strategy for Rothes flood alleviation scheme must therefore be sustainable and and use innovative approaches to meeting the objectives of the WFD.

Fluvial Audit & Conservation Baseline Assessment

A Fluvial Audit was employed for initial examination of the four burns flowing through Rothes in accordance with the relevant Environment Agency guidance (Environment Agency, 1998) using standard geomorphological reconnaissance techniques (Thorne, 1998).

This qualitative approach provides an overview of the geomorphology of the stream on a reach-by-reach basis. It supports a qualitative understanding of the sediment budget of each reach by observing and documenting sediment transport processes, the impact of past flood events and effects of past catchment development or river management practices (Environment Agency, 1998; Guidebook of Applied Fluvial Geomorphology, Defra 2003). Historical evidence from a variety of sources (including flood defence records, maintenance operations and historical maps) was used to compile a time chart of changes and identify Potential Destabilising Phenomena (PDP) responsible for instability in the past that could trigger problems in the future. Stream reconnaissance was then performed to characterise the current geomorphology of the channel and classify reaches as sediment sources, transfer links, exchange zones or sinks.

The Conservation Baseline Assessment was based on a system of classifying river channel susceptibility to disturbance (Environment Agency, 1998). This assessment allowed a rapid walkover of the burns in question, utilising a reconnaissance evaluation to help score the environmental condition of the stream in comparison with an ideal ‘natural’ channel. The very nature of the urban development within the town means that very few reaches are likely to comply with this ideal natural unaltered state. Table 2 summarises the resulting six-fold classification ranging from almost natural channels which are highly susceptible to disturbance and culverted reaches which have a low susceptibility to disturbance.

Table 2 Summary of Environment Agency (1998) method for classifying river channel susceptibility to disturbance

Susceptibility to Disturbance	Score	Description
High	8 – 10	Conforms most closely to natural, unaltered state and will often exhibit signs of free meandering and posses well-developed bedforms (point bars and pool-riffle sequences) and abundant bank side vegetation
Moderate	5 – 7	Shows signs of previous alteration but still retains many natural features, or may be recovering towards conditions indicative of higher category.
Low	2 – 4	Substantially modified by previous engineering works and likely to possess an artificial cross-section (e.g. trapezoidal) and will probably be deficient in bedforms and bankside vegetation.
Channelised	1	Awarded to reaches whose bed and banks have hard protection (e.g. concrete walls or sheet piling).
Culverted	0	Totally enclosed by hard protection.
Navigable	-	Classified separately due to their high degree of flow regulation and bank protection, and their probable strategic need for maintenance dredging.

Sediment transport modelling

The Fluvial Audit highlighted that the three burns flowing through Rothes display active morphological adjustments at many locations, which potentially could be a key risk to the design and implementation of flood defence scheme. In light of these observations, and to assist the design team and catchment planners, it was decided to obtain further quantification of sediment dynamics using a 1-D, hydrodynamic flow model with a sediment transport module.

To provide some quantification of sediment dynamics within the burns the iSIS one-dimensional hydrodynamic model was used to simulate peak water levels, sediment transport and bed level adjustments (Halcrow and HR Wallingford, 1997). Initial set-up run and model scenarios were run to verify the findings from the Fluvial Audit and also assess possible solutions for re-connecting reaches and enhancing sediment conveyance within the fluvial system.

Results

Figure 4 shows the patterns of erosion and deposition experienced in the Burn of Rothes during a 1 in 5 year return period as well as for other events i.e. 1 in 50, 1 in 100 and 1 in 200 year events.

The main findings during this stage of the project were that:

- The modelling was successful in reproducing the erosion and deposition trends observed during the qualitative Fluvial Audit in both the Burn of Rothes and Back Burn;
- Sedimentation seems to occur in areas in or around in-channel structures, especially the A941 Road Bridge on the Burn of Rothes and underneath Station Street Bridge on the Back Burn;
- Areas of erosion are located in hydraulically steep areas and areas downstream of extensive sedimentation zones, which can be linked to the starvation of sediment as the sediment transport continuity is disrupted;
- Areas of deposition occur immediately downstream of an area where the bed or hydraulic gradient flattens locally.

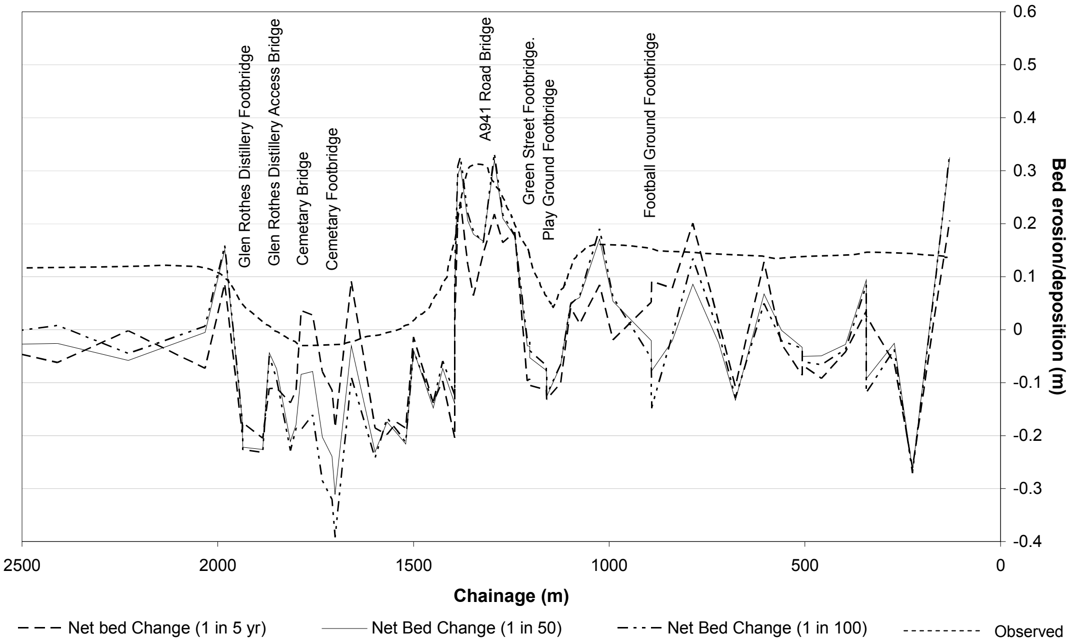

Figure 4 Burn of Rothes Sediment Transport model net bed level change

Overall the ISIS sediment module, together with geomorphic reconnaissance, as tools for appraising and developing options for reducing flooding in the town of Rothes, have been proven to be beneficial and valuable in investigating the sediment dynamics within the Rothes burns.

Furthermore, as required under the WFD, through the development of these new approaches, valuable sources of information for the project team have enabled the development of a sustainable scheme which seeks to improve WFD ecological status by accounting for the movement of sediment as well as water through the fluvial system. The understanding of sediment dynamics, and in particular the impact of flood management on the morphological functioning of the river, has assisted in assessing in-channel hydromorphology and habitats within an urban environment.

Legal context for WFD schemes

Within England and Wales, DEFRA (The Department of Environment, Food and Rural Affairs) is the responsible ministry and the Environment Agency is the implementing agency for the Water Framework Directive. The Environment Agency has a range of statutory powers to carry out flood defence works in connection with main rivers. In the past much of the in-channel environmental enhancement work that the Environment Agency has promoted has been carried out in association with the construction of flood defence schemes and under the Water Resources Act 1991 and the Land Drainage Act 1991, the Environment Agency has powers to carry out such flood defence works. To achieve the objectives of the WFD, however, it seems likely that schemes will be required to improve the ecological status of a water body but which will not lead to an improvement in flood risk. In this case it is not clear if the Environment Agency has the powers to carry out such works. The Environment Agency does have incidental general powers (Howarth, 2002). For ‘relevant purposes’ the Environment Agency may ‘do anything which, in its opinion, is calculated to facilitate, or is conducive or incidental to, the carrying out of its functions’. In relation to this, the Environment Agency may carry out such engineering works or building works as it considers appropriate. It is not clear whether these powers could be used to promote schemes aimed solely at improvements to ecological status. While it is to be expected that many schemes aimed at improving the ecological status of rivers will be welcomed, it is conceivable that some proposed schemes will attract objections. In this case it is not clear whether the Environment Agency would have the powers to implement such schemes. Thus it seems that to be confident of achieving the WFD objectives in the required timescale the powers of the Environment Agency in this area may need to be clarified as soon as possible.

Conclusions

The European Water Framework Directive (WFD) requires all surface water bodies to achieve good ecological status by 2015, or good ecological potential, if defined as a heavily modified water body. Urban rivers commonly experience a range of pressures on their environmental and ecological quality, by the nature of the intense land use in the urban area surrounding them. The EC FP5 URBEM research project has demonstrated that past experience of urban river rehabilitation in Europe and North America indicates that urban river rehabilitation faces a number of practical and technical challenges. Those challenges that are most significant for meeting the WFD are that, firstly, the timescales of implementation of projects are generally between 6 and 8 years, with ecological recovery after this. This shows that action must be taken *now* to initiate river improvement schemes in order to have any chance of meeting the WFD objectives in time for the EC deadline. Secondly, the river rehabilitation schemes in the past have generally only improved ecological status by an average of two classes or less. This means that rehabilitation schemes must be incredibly well planned and designed in order to achieve the necessary ecological improvement to attain the good status or good potential.

The experience of using geomorphic techniques on the Rothes flood alleviation scheme demonstrates how an understanding of geomorphological processes is essential to river improvements that meet the requirements of sustainable flood management at the same time as fostering the hydrogeomorphological conditions that contribute to the achievement of good ecological status.

Finally, this paper has highlighted the need to grant legal powers to the Environment Agency or other relevant authority to enable them to carry out schemes solely for ecological benefit. Without this legal and organisational framework in place, it will not be possible to achieve the objectives of the WFD.

Acknowledgements

The authors would like to acknowledge the work of Jochen Schanze and Alfred Olfert of the Leibniz Institute of Ecological and Regional Development, Dresden (IOER) and Joachim Tourbier, Ines Gersdorf and Thomas Schwager of Dresden University of Technology (TUD) on rehabilitation case studies. In addition, the wider group of URBEM partners and organisations and stakeholders that supplied information for the case studies research have made a valuable contribution and we would like to thank them for their involvement. The authors would also like to thank Prof. Colin Thorne, University of Nottingham for his assistance with the geomorphological reconnaissance and his review and comments relating to the sediment modelling application.

References

Environment Agency (1998) *Geomorphological Approaches to River Management*, Project Record W5A/i661/1, prepared by Thorne, CR, Downs, PW, Newson, MD, Clarke, MJ, and Sear, DA, Environment Agency, Bristol, 197p.

European Commission (2000) *Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy.* EC, Brussels.

Faber, R. (2005) *New Techniques for urban river rehabilitation. Specifications for new materials and techniques. Improve Instream morphology. Soil Bioengineering.* BOKU, Vienna.

Halcrow and Hr Wallingford (1997) *iSIS* users manual, Halcrow Group Ltd., Burderop Park, Swindon, UK.

Howarth W (2002), Flood defence law, Shaw and Sons

Office for National Statistics (2005) Urban Areas. Referenced from http://www.statistics.gov.uk/cci/nugget.asp?id=1307. Accessed April 2006, published December 2005.

Schanze, J., Olfert, A., Tourbier, J., Gersdorf, I., Schwager, T. (2003) *Existing Urban River Rehabilitation Schemes.* IOER / TUD, Dresden.

Sear D.A., Newson M.D., and Thorne C.R. (2003) Guidebook of Applied Fluvial Geomorphology. Defra, Environment Agency Swindon.

Thorne C.R. (1998) Stream Reconnaissance Guidebook: Geomorphological Investigation and Analysis of River Channels, J Wiley and Sons, Chichester, UK.

Tourbier, J. & Westmacott, R. (2005) *Manual of Urban River Rehabilitation Techniques.* TUD, Dresden.

Fluid thinking...smart solutions

HR Wallingford provides world-leading analysis, advice and support in engineering and environmental hydraulics, and in the management of water and the water environment. Created as the Hydraulics Research Station of the UK Government in 1947, the Company became a private entity in 1982, and has since operated as a independent, non profit distributing firm committed to building knowledge and solving problems, expertly and appropriately.

Today, HR Wallingford has a 50 year track record of achievement in applied research and consultancy, and a unique mix of know-how, assets and facilities, including state of the art physical modelling laboratories, a full range of computational modelling tools, and above all, expert staff with world-renowned skills and experience.

The Company has a pedigree of excellence and a tradition of innovation, which it sustains by re-investing profits from operations into programmes of strategic research and development designed to keep it – and its clients and partners – at the leading edge.

Headquartered in the UK, HR Wallingford reaches clients and partners globally through a network of offices, agents and alliances around the world.

HR Wallingford
Working with water

HR Wallingford Ltd
Howbery Park
Wallingford
Oxfordshire OX10 8BA
UK

tel +44 (0)1491 835381
fax +44 (0)1491 832233
email info@hrwallingford.co.uk

www.hrwallingford.co.uk