RIVER RESTORATION CENTRE (RRC)
11th ANNUAL NETWORK CONFERENCE

River Restoration: From Policy to Practice

Wednesday 14th April to Thursday 15th April 2010

(Optional site visit on Friday 16th April to Birkby Nab Flood Storage Reservoir and Galphay Mill, River Laver)

University of York,
York
England

For more information about the RRC or to contact us please
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…….

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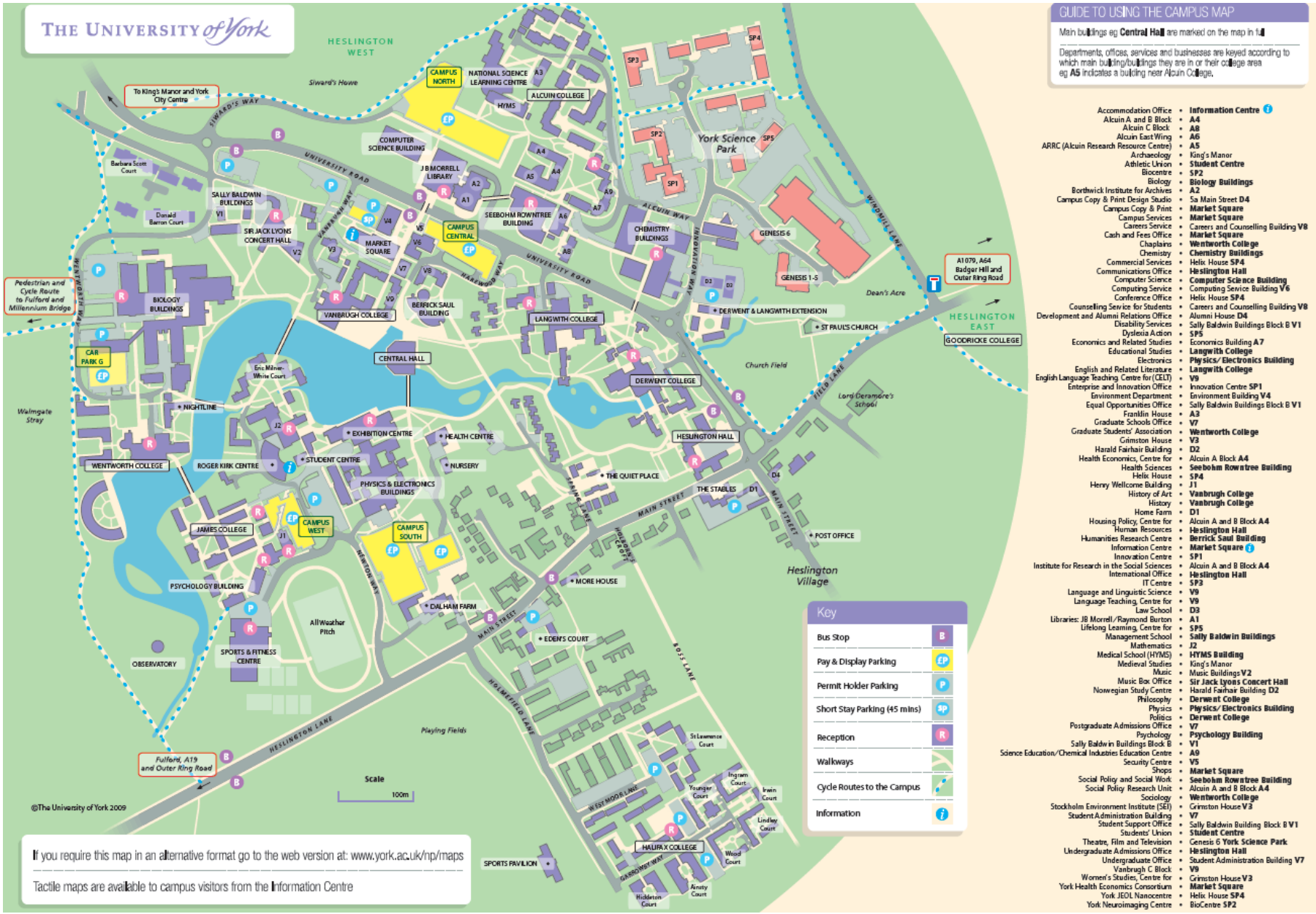
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Fulford, A19 and Outer Ring Road
Walmgate Stray
Scale
100m
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Departments, offices, services and businesses are keyed according to which main building/buildings they are in or their college area eg A5 indicates a building near Alcuin College.
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Cycle Routes to the Campus
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Alcuin C Block • A8
Alcuin East Wing • A6
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Archaeology • King's Manor
Athletic Union • Student Centre
Biocentre • SP2
Biology • Biology Buildings
Borthwick Institute for Archives • A2
Campus Copy & Print Design Studio • 5a Main Street D4
Campus Copy & Print • Market Square
Campus Services • Market Square
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Commercial Services • Helix House SP4
Communications Office • Heslington Hall
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Computing Service • Computing Service Building V6
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Dyslexia Action • SP5
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Educational Studies • Langwith College
Electronics • Physics/Electronics Building
English and Related Literature • Langwith College
English Language Teaching Centre for (CELT) • V9
Enterprise and Innovation Office • Innovation Centre SP1
Environment Department • Environment Building V4
Equal Opportunities Office • Sally Baldwin Buildings Block B V1
Franklin House • A3
Graduate Schools Office • V7
Graduate Students' Association • Wentworth College
Grimston House • V3
Harald Fairhair Building • D2
Health Economics, Centre for • Alcuin A Block A4
Health Sciences • Seebohm Rowntree Building
Helix House • SP4
Henry Wellcome Building • J1
History of Art • Vanbrugh College
History • Vanbrugh College
Home Farm • D1
Housing Policy, Centre for • Alcuin A and B Block A4
Human Resources • Heslington Hall
Humanities Research Centre • Berrick Saul Building
Information Centre • Market Square
Innovation Centre • SP1
Institute for Research in the Social Sciences • Alcuin A and B Block A4
International Office • Heslington Hall
IT Centre • SP3
Language and Linguistic Science • V9
Language Teaching, Centre for • V9
Law School • D3
Libraries: JB Morrell/Raymond Burton • A1
Lifelong Learning, Centre for • SP5
Management School • Sally Baldwin Buildings
Mathematics • J2
Medical School (HYMS) • HYMS Building
Medieval Studies • King's Manor
Music • Music Buildings V2
Music Box Office • Sir Jack Lyons Concert Hall
Norwegian Study Centre • Harald Fairhair Building D2
Philosophy • Derwent College
Physics • Physics/Electronics Building
Politics • Derwent College
Postgraduate Admissions Office • V7
Psychology • Psychology Building
Sally Baldwin Buildings Block B • V1
Science Education/Chemical Industries Education Centre • A9
Security Centre • V5
Shops • Market Square
Social Policy and Social Work • Seebohm Rowntree Building
Social Policy Research Unit • Alcuin A and B Block A4
Sociology • Wentworth College
Stockholm Environment Institute (SEI) • Grimston House V3
Student Administration Building • V7
Student Support Office • Sally Baldwin Building Block B V1
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Theatre, Film and Television • Genesis 6 York Science Park
Undergraduate Admissions Office • Heslington Hall
Undergraduate Office • Student Administration Building V7
Vanbrugh C Block • V9
Women's Studies, Centre for • Grimston House V3
York Health Economics Consortium • Market Square
York JEOL Nanocentre • Helix House SP4
York Neuroimaging Centre • BioCentre SP2

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PROGRAMME

The River Restoration Centre 11th Annual Network Conference 2010 University of York.

Day 1: Wednesday 14th April 2010

9.00 – 10.20	REGISTRATION & REFRESHMENTS (**Vanbrugh Foyer)**	

Main Auditorium (Large Lecture Theatre LN028, Langwith College)

CHAIR Karen Fisher (*KR Fisher Consultancy Ltd*)

10.30	**Announcements:** Martin Janes (*River Restoration Centre*)	5 mins
10.35	**Introduction:** Karen Fisher (*River Restoration Centre Chair*)	15 mins
10.50	**Keynote Speaker:** Hans Ole Hansen (*Danish Forestry and Nature Agency*). The Houting Project – The largest nature restoration in Denmark.	25 mins
11.15	**Discussion**	10 mins

Main Auditorium (Large Lecture Theatre LN028, Langwith College)

Session 1 Planning restoration for the WFD era

CHAIR Jonty Gibson (*Environment Agency)*

11.25	James King et al. (*Republic of Ireland Central Fisheries Board).* Planning restoration for the WFD: addressing hydromorphology and biodiversity issues in arterially-drained Irish catchments.	15 mins
11.40	Roy Richardson (*SEPA*). Delivering River Restoration in Scotland.	15 mins
11.55	**Discussion**	10 mins
12.05	Duncan Huggett et al. (*Environment Agency*). Working with Natural Processes: New Paradigm or Old Hat?	15 mins
12.20	George Heritage, Neil Entwistle. (*JBA Consulting, University of Salford*). Managing reactive rivers. Lessons from upland channels in the UK.	15 mins
12.35	**Discussion**	10 mins
12.45	**Poster Introductions**	10 mins
12.55	LUNCH **(Vanbrugh Dining Room – collection at Servery nearby)**	60 mins

Session 2 commences at 14:05 (parallel sessions)

Please allow sufficient time to get to your chosen session

Allowances are made in the schedule to move between rooms, times listed are session start times.

Session 2	**A – Your river, your views!**	**B – Making space for water**	
	Main Auditorium (Large Lecture Theatre LN028, Langwith College)	**Second Auditorium (Lecture Theatre V045, Vanbrugh College)**	
CHAIR	**Fiona Bowles *(Wessex Water)***	**Geraldene Wharton (*Queen Mary, University of London*)**	
14.05	Eva Stuetzenberger (*Natural England*). Evaluation of the Living River Project.	Robin Field (*Revital-ISE Project*). Wet meadow restoration on the Rivers Nene and Ise, Northamptonshire.	15 mins
14.20	Ulrika Aberg et al. (*University of Leeds*). Public perceptions 10 years on: assessment of the social benefits of the River Skerne rehabilitation project.	Paul Winfield et al. (*Royal Haskoning*). Creating Wet Floodplain Forest: a sustainable flood management solution.	15 mins
14.35	Emma Westling et al. (*Catchment Science Centre, University of Sheffield*). River restoration schemes: are outcomes desirable for local residents?	Duncan Huggett et al. (*Environment Agency*). Working with natural processes – the role of flood storage areas.	15 mins
14.50	**Discussion**	**Discussion**	15 mins
Session 3 15.05	**POSTER SESSION (Vanbrugh JCR)** & TEA/COFFEE **(Vanbrugh Snack Bar and Registration Foyer)**		40 mins

Please refer to page 11 for list of posters

Session 4 commences at 15:55

Please allow sufficient time to get to your chosen session

Allowances are made in the schedule to move between rooms, times listed are session start times.

Session 4	**A – River restoration: policy to practice** **Main Auditorium (Large Lecture Theatre LN028, Langwith College)**	**B – Multi-functional river restoration schemes** **Second Auditorium (Lecture Theatre V045, Vanbrugh College)**	
CHAIR	**Archie Ruggles-Brise *(Association of Rivers Trusts)***	**Sue Tapsell *(Flood Hazard Research Centre)***	
15.55	Rosie Blackmore, Deborah Dunsford (*Environment Agency*). The WFD: Flood & Coastal Risk Management contribution to the First River Basin Planning Cycle.	Richard Peddie (*Environment Agency*). Ravensbourne River Corridor Improvement Plan.	15 mins
16.10	Lucy Bolton, Jonty Gibson (*Environment Agency*). Restoration and the EA: Policy to Practice.	Mark Job (*Arup*). Designing for integrated social and ecological benefits in river restoration.	15 mins
16.25	Matt Jones (*Staffordshire Wildlife Trust*). Farming Floodplains for the Future: Promoting New Approaches to Flood Risk Management.	Rob Mungovan (*South Cambridgeshire District Council*). River Cam Habitat and Access Enhancement Project.	15 mins
16.40	**Discussion**	**Discussion**	10 mins
16.50	BREAK **(Water will be made available)**		15 mins

Session 5 — Sediment and rivers

Main Auditorium (Large Lecture Theatre LN028, Langwith College)

CHAIR — **Shaun Leonard (*Wild Trout Trust*)**

17.05	Jo Shanahan et al. (*Atkins*) Sediment Matters for Successful River Restoration.	15 mins
17.20	Simon Hirst, A Pierre (*North Yorkshire Moors National Park Authority, Environment Agency*). River Restoration Work for Freshwater Pearl Mussels and Atlantic Salmon on the River Esk, North Yorkshire.	15 mins
17:35	Nick Streeton et al. (*JBA Consulting*). Wider global perspectives - rehabilitation of incised valley floors.	15 mins
17.50	**Discussion**	10 mins
18.00	**Open Discussion**	20 mins
18.20	**End of Day 1**	

19.45 **CONFERENCE DINNER at Vanbrugh Dining Room**
To be Served at 20.00

Vanbrugh Bar (extension until 01.00)

PROGRAMME

The River Restoration Centre 11th Annual Network Conference 2010
University of York

Day 2: Thursday 15th April 2010

8.30 – 8.50	DAY DELEGATE REGISTRATION (**Vanbrugh Foyer)**		
Session 6			
9.00	**Announcements**		10 mins
	A - Urban river corridors	**B – Strategic restoration**	
	Main Auditorium (Large Lecture Theatre LN028, Langwith College)	**Second Auditorium (Lecture Theatre V045, Vanbrugh College)**	
CHAIR	**Rob Oates (*Thames River Restoration Trust)***	**Hans Ole Hansen (*Danish Forestry and Nature Agency*)**	
9.10	Tom Wild et al. (*Catchment Science Centre, University of Sheffield*). Can collaborative visualisation help deliver more sustainable urban river corridors?	Katherine Causer et al. (*Environment Agency*). Mersey Life – Integrating River Restoration into Regional and Local Planning.	15 mins
9.25	Geraldene Wharton et al. (*Queen Mary, University of London).* Restoring Mayes Brook and Mayesbrook Park, East London: an interdisciplinary pre-project appraisal.	Fiona Bowles et al. (*Wessex Water*). The trials and tribulations of strategic restoration planning on the River Avon SAC.	15 mins
9.40	Lucy Shuker (*Queen Mary, University of London*). Using the Urban River Survey (URS) to appraise potential sites and restoration options for heavily modified rivers and streams.	David Brown et al. (*Environment Agency*). Evaluating the Benefits of River Restoration: A Cumbrian Perspective.	15 mins
9.55	**Discussion**	**Discussion**	15 mins
10.10	TEA & COFFEE (**available in Langwith JCR upper & lower**)		30 mins
(10:20)	**Site Visit** (Meet in Vanbrugh turning bay) - Tang Hall Beck (page 52)		(2.20hrs)
10.45	(Or) **Workshops,** please refer to page 51 **(all in Langwith college)**		1hr 55 mins
12.40	LUNCH (**Vanbrugh Dining Room**)		1hr 10 m

Session 7 commences at 14:00 (parallel sessions)

Please allow sufficient time to get to your chosen session

Day 2 Continued - PARALLEL SESSION PROGRAMME

Session 7	A – Designing form and function **Main Auditorium (Large Lecture Theatre LN028, Langwith College)**	B – Assessing restoration potential **Second Auditorium (Lecture Theatre V045, Vanbrugh College)**	C – In-channel barriers: can we get over them? **Third Auditorium (Langwith college, room LN036)**	
CHAIR	**Jenny Mant (*River Restoration Centre*)**	**Martin Janes (*River Restoration Centre*)**	**Andy Pepper (*ATPEC River Engineering Consultancy*)**	
14:00	Antonia Scarr (*Environment Agency*). Estuary edges: Ecological design guidance.	Sally-Beth Kelday et al. (*Jacobs*). Linking Environmental Impact Assessment, Hydromorphology and the WFD: The Potential for River Restoration.	Ed Shaw et al. (*Catchment Science Centre, University of Sheffield*). Where weirs were: A look at the benefits of weir removal.	15 mins
14.15	George Heritage et al. (*JBA Consulting*). Value of large woody debris in erosion mitigation and morphological enhancement: a case study of River Churnet, Staffordshire.	Judy England et al. (*Environment Agency*). Application of new biotic index (PSI) to assess the effectiveness of river restoration schemes on in-stream biota.	Gert Akkerman et al. (*Royal Haskoning).* River restoration in combination with controlled removal of fixed weirs: A case study in the Netherlands: Gammelkerbeck.	15 mins
14.30	Claire Thirlwall (*Thirwall Associates*). A river runs through it - the importance of landscape context in river restoration.	Samantha Hughes et al. (*Centre for the Research and Technology of Agro-Environment and Biological Sciences, Tras-os-Montes e Alto Douro University, Portugal*). An integrated approach for restoring Mediterranean river systems: habitat quality, biological indicators and appropriate restoration techniques.	Jonah Tosney et al. (*Durham University*). Reintroducing spate flows to impounded rivers – measuring the ecological impacts of short-duration reservoir releases.	15 mins
14.45	**Discussion**	**Discussion**	**Discussion**	20 mins
15.05	INTERVAL **(Return feedback forms)**			15 mins

Allowances are made in the schedule to move between rooms, times listed are session start times.

Session 8 Monitoring for management; what it tells us

Main Auditorium (Large Lecture Theatre LN028, Langwith College)

CHAIR **Peter Worrall (*Penny Anderson Associates Ltd)***

15.20	Helen Dangerfield, Joanna Eyquem (*Royal Haskoning*). Quantitative monitoring of river restoration: review of techniques for future application.	15 mins
15.35	Jenny Mant (*River Restoration Centre).* Lessons from the Shopham Loop monitoring programme.	15 mins
15.50	Jenny Wheeldon (*Natural England/Environment Agency).* The physical restoration of SSSI rivers in England.	15 mins
16.05	**Discussion and closing remarks**	25 mins
	********* End of Conference ********	
16.30	TEA & COFFEE (**Langwith Snack Bar**)	30 mins

SITE VISIT INTRODUCTIONS
(John Shillcock, *Yorkshire Dales River Trust*)

17.00	**Main Auditorium (Large Lecture Theatre LN028, Langwith College)** Birkby Nab Flood Storage Reservoir (page 65) Galphay Mill, River Laver (page 66) Only applicable to delegates staying for site visits on the third day	30 mins
17.30	**End of Day 2 and evening arrangements**	

Allowances are made in the schedule to move between rooms, times listed are session start times. Delegates staying for the site visit have the evening free to explore York.

Posters

Hong Kyu Ahn and Hyoseop Woo (Korea Institute of Construction Technology)
River Restoration by Small Dam Removal - Removals 2 Small Dams in Korea

Lucy Bolton and Rosie Blackmore (Environment Agency)
WFD Mitigation Measures Manual for flood risk management and land drainage sector

Ian Dennis et al. (Royal Haskoning et al.)
Re-wilding the River Adur: Floodplain restoration in a rural river catchment

Lesley Dunne and Emma Smith (Halcrow)
Ponesk Burn Diversion – Design challenges associated with the diversion of a large-scale bedrock river channel.

Benjamin R. Gillespie and David C. Bradley (APEM Ltd)
The role of walkover assessments in river rehabilitation

George Heritage et al. (JBA Consulting et al.)
Managing with the river: a Case Study from the River Wharfe, UK

Du Han Lee and Samhee Lee (Korea Institute of Construction Technology)
Flow characteristics of dikes in compound channel

Mikko Saikku (University of Helsinki)
The Fall and Rise of a Small Urban Stream? Environmental History of the Mätäpuro Brook, Helsinki, Finland

Miloslav Šindlar (Holding group SINDLAR EU)
Examples of river restoration projects completed in the Czech Republic and experience with operation of these projects

Alasdair Maxwell (Environment Agency)
How to obtain suitable gravels for riffle creation on Chalk Rivers

Kevin Nash (Environment Agency) - no abstract in delegate pack
The Torrs Hydropower and Fish Pass Partnership

Alfonso Fernández Salor (Projar)
Slope river restoration. Case Study Jucar River in Riola, Valencia, Spain

Geoff Waite et al. (Weetwood Services Ltd)
River and Pond restoration in the Thames catchment: Small scale changes making big differences

Martin Wilkes et al. (University of Birmingham)
Ecosystem development in a flood relief channel

THE HOUTING PROJECT – THE LARGEST NATURE RESTORATION IN DENMARK

***Hans Ole Hansen**; Danish Forest and Nature Agency, Regional Office Wadden Sea*
Skovridervej 3, DK-6510 Gram, Denmark.

Background

In Denmark more than 350 species of plants and animals have disappeared over the last 150 years.

The fish called the houting now definitely belongs amongst the rare species. It only lives in the Danish sector of the Wadden Sea area, having disappeared from Germany and the Netherlands.

To save this fish species from complete extinction the Danish Forest and Nature Agency has initiated the Houting Project.

Taken as a whole, the entire population of houting in Denmark – and thereby in the world! - has been estimated to about 7000 spawners. Therefore, the houting has been designated as a special priority species in the EU Habitat Directive – as a consequence we have an imperative duty to protect the species and improve its survival.

Previous restocking attempts in Denmark have not been successful as they were not followed up by habitat restoration.

Today we know that a total restoration of the habitat is necessary for the houting to survive and once again become common. The project amongst other measures therefore includes removal of obstacles, creating new spawning grounds and nursery areas.

The houting has a natural leading part in the Houting-project… But many other animal and plant species will gain from the project as the houting's habitats and survival are ensured – species as e.g. salmon, lampreys and otter.

The Project

The EU-LIFE fund financially supports the Houting-project with 8 million € of a total budget of 13.4 million €.

At the end of 2010 the Houting-project will have restored four Danish rivers. The project will have:

- Removed 13 obstacles
- Given access to additional 130 km new river habitats
- Eliminated mortality of drifting fry past fish farms
- Created new spawning grounds
- Restored approx. 30 km river
- Created 500 ha new nursery areas

PLANNING RESTORATION FOR THE WATER FRAMEWORK DIRECTIVE: ADDRESSING HYDROMORPHOLOGY AND BIODIVERSITY ISSUES IN ARTERIALLY-DRAINED IRISH CATCHMENTS

James J. King, Martin F. O'Grady, Karen Delanty *and* ***Denise Delaney****; Central Fisheries Board, Swords Business Campus, Swords, County Dublin, Republic of Ireland.*

Richard Dooley *and* ***Nathy Gilligan****; Office of Public Works, Headford, County Galway, Republic of Ireland.*

A large number of Ireland's major fisheries channels were arterially drained subsequent to World War II and continue to be subject to channel maintenance. The river corridor is entrenched in the landscape with little lateral floodplain connectivity. The longitudinal and cross-sectional forms tend to reduce or eliminate natural flow patterns such as that of riffle-glide-pool. In addition, flow-regulation structures such as drop-weirs further alter the flow regime and impact on longitudinal connectivity. The Environmental River Enhancement Programme (EREP) is an ambitious 5-year programme of works designed to address issues raised by Water Framework Directive through a series of capital works and enhanced maintenance strategies. The programme focuses on salmonid channels and aims to deliver 'improvement' to 100 km of channel annually. Monitoring of pre-and post- works situations enables assessment of works on biodiversity and hydromorphology.

DELIVERING RIVER RESTORATION IN SCOTLAND

***Roy Richardson**; Scottish Environment Protection Agency (SEPA) Borders Office, Burnbrae, Mossilee Road, Galashiels, TD1 1NF, Scotland.*

River Basin Management Plans will be finalised in December 2009. In Scotland, they set very ambitious targets over the next 18 years for the restoration of rivers, lochs and coastal areas. This presentation will outline the scale of the task required, current gaps in delivery mechanisms and tools, and work underway to close these gaps and ensure we can deliver restoration objectives. Specifically, the presentation will cover the development of a restoration framework for Scotland, which includes; partnership projects through SEPA's restoration fund, work to restore rivers as part of diffuse pollution priority catchments, the development of new regulatory powers for restoration, and links being made to other planning processes such as flood risk management, fisheries management and rural development.

WORKING WITH NATURAL PROCESSES: NEW PARADIGM OR OLD HAT?

***Duncan Hugget**; Environment Agency, Anglian Regional Office, Kingfisher House, Goldhay Way, Orton Goldhay, Peterborough, Cambridgeshire, PE2 5ZR, England.*

***Wendy Brooks**; Environment Agency – Head Office, Anglian Regional Office, Kingfisher House, Goldhay Way, Orton Goldhay, Peterborough, Cambridgeshire, PE2 5ZR, England.*

In flood and coastal risk management, there is great interest in the concept of working with natural processes, almost as if it were something novel and new. However, *Making Space for Water* stated that success would be measured on the ground with more flood and coastal erosion solutions working with natural processes. Sir Michael Pitt in his review of the 2007 floods recognised that some forms of working with natural processes – such as flood plain storage – has been common for decades. However, whilst the aspiration was clear, achieving it was not as effective as people hoped.

So working with natural processes is nothing new, but neither is it old hat. Whilst it is widely acknowledged that a framework exists which allows working with natural processes to be considered (e.g. catchment flood management plans and shoreline management plans), the desired outcome is still not being achieved. There are some key reasons for this. First, there is no clear shared understanding of what we mean by 'working with natural processes'. Second, the benefits of working with natural processes – especially at a catchment scale – are obscure. Third, the legal framework has to date failed to provide the basis for working with natural processes. And forth, the policy framework which should encourage working with natural processes is weak.

However, flood and coastal risk management which works with natural processes has new political impetus. The forthcoming Floods and Water Management Act legitimises the approach, making it a valid response to flood risk. New project appraisal guidance stresses the importance of considering such techniques along side more traditional approaches. New and ongoing research and pilot projects continue to explore how working more with natural processes can help achieve flood and coastal risk management benefits. Whilst it is too early to say what the outcome of all this will be, the desire to work more with natural processes in order to achieve more sustainable and resilient management responses is clear.

MANAGING REACTIVE RIVERS - LESSONS FROM UPLAND CHANNELS IN THE UK

***George L. Heritage**; JBA Consulting, the Brew House, Wilderspool Park, Greenall's Avenue, Warrington, WA4 6 HL, England.*

***Neil S. Entwistle**; University of Salford, School of Environment and Life Sciences, Peel Building, Manchester, M5 4WT, England.*

Britain's upland rivers are characterised by moderately steep single thread wandering cannels that exhibit frequent gravel transport and slowly shifting channel pattern. Efforts to engineer these channel systems has resulted in rapid and often negative channel response with erosion and deposition common in both rural and urban areas. The failure to recognise the dynamic nature of these channels and to consider the character and impact of sediment transport are the primary causes of these problems. Sediment accumulation through engineered sections is perceived to be problematic due to the loss of flow capacity and efforts have been made to control this though sediment trapping. Favoured approaches to sediment management have been sediment trapping or direct dredging of deposited sediments, despite the fact that such approaches fundamentally upset the sediment regime, working against rivers natural processes of erosion and deposition. The preponderance of sediment related stability issues both within engineering schemes and up and down stream attest to this. It is argued that sustainability can only be approached when efforts are concentrated on balancing sediment budgets rather than disrupting them. A protocol is presented that places sediment transport/management studies at the forefront during the design stages of river engineering and enhancement works offering a range of assessment methods often readily available to the hydraulic engineer. The potential benefits of adopting such a protocol in terms of sustained stability and economics are discussed.

EVALUATION OF THE LIVING RIVER PROJECT

***Eva Stuetzenberger**; Natural England, Salisbury International Arts Festival Office, 87 Crane Street, Salisbury, Wiltshire, SP1 2PU, England.*

The Living River project is a £1 million project that aims to increase awareness and appreciation of the River Avon and its tributaries with a focus on how the special wildlife of the river has developed alongside the history of the area.

Working with local communities from the river's headwaters in the Wiltshire Downs to the sea at Christchurch, the project involves people who live and work in the River Avon catchment in the conservation of its natural heritage. The four year project (2006-2010) is supported by the Heritage Lottery Fund.

Living River Project Goals & Objectives
The overall goal of the Living River project is:
A healthy River Avon system that is valued by everyone living and working in the catchment.

Project Target Groups
The project targets a range of audiences - Land Mangers, River users, Influencers and the General Public.

Evaluation Strategy
The Living River Project developed an extensive monitoring and evaluation strategy to assess both the project's impact and whether it has achieved its desired outcomes within the various target groups.

The strategy uses a monitoring framework that is able to allow an assessment of the success of the Living River project. Results will inform project end reports and draw learnings for future projects.

Indicators of success (project key messages)
The indicators or key messages of the project against which the success of the project will be evaluated are based on the key messages of the project

- It's chalky - And full of life
- It's wet - And comes out of your taps every time you turn them on
- Go see!- And discover for yourself

We will be presenting and analysing this approach and our preliminary results at the conference.

PUBLIC PERCEPTIONS 10 YEARS ON: ASSESSMENT OF THE SOCIAL BENEFITS OF THE RIVER SKERNE REHABILITATION PROJECT

***Ulrika Åberg**; University of Leeds, School of Geography, Woodhouse Lane, Leeds, LS2 9JT, England.*

***Liz Chalk;** Environment Agency, North East Region, Dales Area Office, Coverdale House, Amy Johnson Way, Clifton Moor, York, Yorkshire, YO30 4UZ, England.*

***Deirdre Murphy**; Environment Agency, North East Region, Northumbria Area Office, Tyneside House, Skinnerburn Road, Newcastle Business Park, Newcastle upon Tyne, NE4 7AR, England.*

***Sue Tapsell**; Flood Hazard Research Centre, Middlesex University, Trent Park Campus, Bramley Road, London, N14 4YZ, England.*

This paper will compare the results from three public perception surveys of local residents carried out at the River Skerne rehabilitation site, Darlington, NE England. The three surveys carried out in 1995, 1997 and 2007 will be used to discuss the long-term social benefits of the Skerne river rehabilitation project.

The River Skerne was one of three rivers included in a joint initiative between the UK (the River Restoration Centre) and Denmark to demonstrate best practice in urban and rural river rehabilitation. The 2 km long reach rehabilitated on the River Skerne flows through an urban area on the outskirts of Darlington. Before the river rehabilitation project was initiated a substantial monitoring scheme included sampling for water quality, geomorphology, invertebrates and fish, hydraulic modelling, landscape assessment, river corridor survey, and a survey of public perception. The aim of the perception survey was to assess public appreciation of the objectives and effects of river rehabilitation. A detailed questionnaire survey (interviews) was undertaken prior to the construction phase of the rehabilitation project, and a post-project questionnaire survey (interviews) was carried out about one year after the completion of the main rehabilitation (Tunstall et al., 1999). In 2007 a new questionnaire survey (postage) was carried out in the same residential area around the rehabilitation site on the River Skerne, following a similar structure as the previous pre- and post-project surveys. The aim of the survey was to look at long-term social benefits and perceptions of the rehabilitation project.

In urban river rehabilitation the potential for ecological restoration is often fairly limited compared with the possibilities for amenity and aesthetic enhancement. The local community at the River Skerne rehabilitation site have shown a continued appreciation of the river and landscape enhancements carried out, but also an appreciation of the wildlife that planted trees and bank vegetation now support. On a spatial scale the social benefits could be argued to have been limited mostly to residents living in the direct vicinity. However, the project has led to an increased interest for nature conservation which in the long-term could lead to an increased public pressure for further nature and river rehabilitation.

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RIVER RESTORATION SCHEMES - ARE OUTCOMES DESIRABLE FOR LOCAL RESIDENTS?

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Over recent decades, river management has shifted from a hard engineering approach, focused on objectives such as flood control, towards softer engineering techniques which incorporate environmental objectives alongside anthropocentric demands (McDonald et al., 2004). This re-focusing on environmental objectives has benefited the biophysical river system itself, but by aspiring to a more natural water environment such management has also been claimed to deliver value for local residents and visitors to rivers (House and Sangster, 1991). However, there is currently no clear consensus that a more natural landscape is more appreciated by the public (Junker et al., 2008). Indeed, what is valued from an environmental perspective may have little to do with people's preferences regarding a desirable river environment (Green and Tunstall, 1992). However, to date little consideration has been given to determining whether social gains result from water management decisions and actions, including river restoration which is the focus of this paper (Hooper, 2003). This is primarily due to the lack of consistent post-project appraisals of restoration schemes (Bernhardt et al., 2005; Skinner and Bruce-Burgess 2005), especially for social impacts resulting from environmental change. As a consequence, opportunities to understand the relationships between environmental improvement and social impacts, and to use this understanding to inform the design and implementation of future restoration schemes, have been neglected.
In this paper we explore whether the outcomes of a typical river restoration scheme in the north of England were seen as desirable and were appreciated by local residents. Semi-structured interviews with 32 people from 20 households were conducted to explore how local residents perceived and valued their river. Interviews were conducted with residents living near to both restored and non-restored river reaches. Photographs of the river were used in the interviews to distinguish between the restored and non-restored reaches, and acted as aids to explore people's attitudes and preferences regarding the restoration scheme. This paper reports and discusses the outcomes of these interviews.

In general, the outcomes of the restoration scheme were highly valued by the majority of the interviewees, and the restored reach was preferred in comparison to the non-restored reach. Local residents living near to the restored reach valued more highly and used more often their river compared to residents living near to the non-restored reach who generally held more negative feelings towards their river. Whether the outcomes of a restoration scheme have a positive impact on local residents may be influenced by the level of awareness of the scheme and its purpose among the residents. Residents interviewed for this paper that were aware of the restoration scheme and visited the river on a regular basis were more likely to appreciate the outcomes of the restoration than residents who were unaware of the scheme or its purpose. In addition, characteristics not directly related to the restoration itself, such as litter, public access and the condition of the surrounding environment, strongly influenced people's perception and appreciation of the river. This suggest that to plan future restoration schemes that deliver benefits both for the environment and for members of the public, the scope of the scheme must go beyond just the river channel itself and consider wider elements of the riverine landscape.

WET MEADOW RESTORATION PROJECT ON THE RIVERS NENE AND ISE, NORTHAMPTONSHIRE

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Project objectives:
Recreate riverside meadows along the Rivers Nene & Ise to:
reduce run off into the river from arable fields
increase the amount of species rich grassland in Northamptonshire
recreate the mixture of arable and pasture land which was characteristic of the area
help alleviate flood risk from new developments

Abstract
Northamptonshire is part of the Milton Keynes South Midlands Growth Area and is therefore allocated large numbers of new houses. The major towns of Northampton, Wellingborough, Kettering, Corby, Daventry and Towester have been allocated the majority of these with Growth Area Funds (2004-8) and Housing Growth Funds (HGF) (2008-11) available to help with major infrastructure. A small part of those funds have been allocated to Green Infrastructure improvements. The River Nene Regional Park administered that money from 2004 to 2008 and funded a range of projects such as the Tree Top Way at Salcey Forest.

Now the Revital-ISE Project, part funded by the Environment Agency, is involved with several of the larger Urban Extension Projects (Kettering, Wellingborough and Desborough/Rothwell) to influence the planning process, create and restore habitats, work with the local communities, and improve access. Liaison between the developers and the Revital-ISE Project has taken place as large scale river restoration is required to accommodate the greater water run off from the new urban extensions. Much of this will be helped by creation or recreation of wetland features along the rivers. Species rich meadows and pastures (13.5 ha) have already been recreated using Natural England's Higher Level Scheme on the River Nene above Northampton, with others planned around Kettering, Great Doddington, Grendon and Oundle, This grassland has been or will be recreated using a native seed mixture suitable for the soil type and area. The process is expensive and time consuming and must include long term management of the sites which this project is seeking to provide.

The project is run as a partnership which includes the Local Authorities, Natural England, Environment Agency, the Wildlife Trust, local land owners such as Wicksteed Park, local estates such as the Boughton Estate, Northamptonshire County Council's Pocket Parks, developers and community groups.

Various new projects are planned to re-instate old meanders along the River Ise at Kettering, while one scheme at Desborough is in the process of being completed. This will send the river back down its old course, while creating a backwater in the current river bed. Two residents groups have been either established or re-established to help clean up the river corridor and manage local pocket parks or create new ones. Funding is sought from various sources including, landfill tax, aggregates levy, agri-environment schemes, developers contribution and HGF.

CREATING WET FLOODPLAIN FOREST – A SUSTAINABLE FLOOD MANAGEMENT SOLUTION

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The Government's Flood and Coastal Erosion Risk Management Strategy 'Making Space for Water', promotes a whole catchment approach to flood alleviation, drawing on opportunities provided by rural land use and land management practices. Native wet woodland habitat provides a sustainable flood management approach for reducing overland flows and enhancing flood storage. Once trees have become established this can also help to offset climate change.

This paper will illustrate the reasons why, the benefits of and the methods used to create a wet floodplain woodland and anabranched channel system on the Burn of Mosset. This approach was integrated as part of a scheme to reduce flood risk in the town of Forres, Moray, Scotland. The main aim of the 'Burn Management Works' in this flood storage scheme has been to create an extensive natural sediment accretion zone with a large capacity to store sands and gravels and retain large woody debris that will require minimal ongoing management and little or no maintenance. This thereby reduces the risk of sediment blockage of the dam control structure or damage from large woody debris, whilst meeting the objectives of the Water Framework Directive and enhancing the ecological status of the watercourse.

The breaching of existing man made embankments has enabled the natural channel to be reconnected to its floodplain, creating wet woodlands and, permanent and seasonal wetland areas. The scheme will also restore the river to a more natural, meandering state, which had historically been modified due to straightening and dredging of the channel. The development of an anabranched reach is a form of 'prompted recovery' through which the watercourse is being encouraged to restore itself through onset of back and side channels. The planting of native, local provenance tree species that are suited to this wetland environment are also a key factor in this restored system.

The creation of this wet floodplain woodland is consistent with a range of environmental and habitat targets for the region and has enabled the implementation of a flood management scheme which meets Water Framework Directive objectives and reduces future capital and maintenance works, working with and not against natural processes.

WORKING WITH NATURAL PROCESSES – THE ROLE OF FLOOD STORAGE AREAS

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The Pitt Report was published in June 2008. It recommended that Defra, the Environment Agency and Natural England should work with partners to establish a programme through Catchment Flood Management Plans and Shoreline Management Plans to achieve greater working with natural processes. Part of the evidence in support of this was the suggestion that nature reserves could act as flood storage areas without adverse consequences. However, experience suggests that as catchment land use and climate changes, the once symbiotic relationship between biodiversity and flood risk management may be lost (eg Ouse Washes). Elsewhere, existing flood storage areas struggle to develop high value biodiversity (eg Beckingham Marshes). The question of washland management and biodiversity has often focussed on how to extend damp soil conditions beyond flood events. However, between year variation maybe as important – if not more so. Many habitats and species may be able to tolerate a degree of flooding in a year, but only if it occurs no more than once every 10 years. Before embarking on greater use of flood storage areas for flood risk management and biodiversity benefits, we need to better understand the operational requirements of flood storage areas to deliver desired standards of protection and how these might dictate the biodiversity values that could be achieved.

RIVER RESTORATION BY SMALL DAM REMOVAL - REMOVALS 2 SMALL DAMS IN KOREA -

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About 18,000 small dams (weirs) are located across the streams in Korea and about 50~150 small dams are abandoned annually. This study is to develop the technology for restoring the stream eco-corridors by removing the small dams whose functions have been lost, and improve the water quality deteriorated by the small dams. We removed two small dams, Gokreung2 small dam was 76m in length and 1.5m in height and Gotan small dam was 190m in length and 2.8m in height, for demonstration purposes. We analyzed physical impacts, such as the change in the river bed (changes in grain size distribution, bed elevation, and cross section), chemical impacts, such as the changes in water quality, and biological impacts, such as the changes in the ecological habitats of fish, large benthic invertebrates and vegetation in the upper and lower reaches of the small dams.
In the results, Gokreung2 small dam in the Gokreung stream whose riverbed was made up with sand, swamps in the upper and lower reaches of the small dam quickly changed to rapids after the removal of the small dam, whereas swamps in the Gotan small dam in the Hantan River whose riverbed consists of gravel is very slowly changing to rapids.
Results of a short period monitoring and analyses of monitored data show some positive effects on stream corridor restoration.

Key Words: eco corridor, habitat change, river restoration

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WFD MITIGATION MEASURES MANUAL FOR FLOOD RISK MANAGEMENT AND LAND DRAINAGE SECTOR

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Over the last 20 years, considerable progress has been made in mitigating the impacts of flood risk management activities on water bodies. The Water Framework Directive (WFD), the Floods Directive and Flood Management Plans has resulted in a host of new demands upon practitioners within both the FCRM and land drainage communities. One of the most significant is identifying mitigation measures to achieve good and maximum ecological potential for artificial and heavily modified water bodies.

Whilst there is a broad range of existing guidance on good engineering design and the application of mitigation measures, the array of guidance can create problems when trying to ascertain the most appropriate mitigation for new or historic modification, and it is often difficult to ensure that the selected mitigation has sound scientific grounding.

The WFD Mitigations Manual for Flood Risk Management and Land Drainage Sector has been developed, jointly funded by the Environment Agency, SNIFFER and the Scottish Government, following a review of a scientific evidence base, as a single source of advice for a wide ranging of practitioners and river and coastal managers. It intelligently signposts users to the best available design guidance for different types of engineering activity and will be updated in future, as more knowledge becomes available. It provides guidance on the practicable use of measures and their ecological benefits as well as cross-referencing to more detailed technical design guidance.

RE-WILDING THE RIVER ADUR: FLOODPLAIN RESTORATION IN A RURAL RIVER CATCHMENT

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The River Adur Floodplain Restoration Project was established in 2004 by the Environment Agency, Natural England, Sussex Wildlife Trust and the Knepp Castle Estate. The project forms part of the wider Knepp Wildland Project which aims to return the Knepp Castle Estate to the state it was in prior to the introduction of intensive agriculture. The main aim of the River Adur Floodplain Restoration Project is to enhance the channel and floodplain habitat diversity by physical manipulation of channel planform, bed levels and flow patterns with a particular emphasis on reconnecting the floodplain to the river channel. Once implemented, this project will contribute towards the implementation of the Water Framework Directive, the Environment Agency's "Creating a Better Place" strategy, and Biodiversity Action Plan habitat creation targets.

This poster presents the results of the detailed design stage of the project, which built upon existing outline designs produced by the River Restoration Centre in 2004 and 2006. The site offers some unique opportunities, providing scope for 're-wilding' by creating a new river and floodplain landscape complete with a new meandering river channel, debris dams, ponds, and a range of new wetland habitats.

However, the restoration of the river and its floodplain is not entirely without constraints. Consideration of flood risk to low-lying properties, several in-channel structures, bridges, and archaeological remains was required to produce a design that could deliver considerable geomorphological and ecological benefits without impacting upon the existing constraints.

The end results of this stage of the project are a coherent set of designs for a new 2.5 km-long channel that is closely connected to its floodplain. These designs will be used to guide construction during 2010.

PONESK BURN DIVERSION – DESIGN CHALLENGES ASSOCIATED WITH THE DIVERSION OF A LARGE-SCALE BEDROCK RIVER CHANNEL

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The Ponesk Burn is a tributary of the River Ayr, an important salmonid river in South West Scotland. The lower reaches of the Ponesk Burn were diverted 25 years ago to facilitate coal extraction from an adjacent surface mine site. Hard engineering features created by this previous diversion continue to have an adverse effect on the geomorphology and ecology of the reach, especially to fish, which are currently prevented from reaching the upstream spawning grounds. Scottish Coal Company Ltd now wish to re-divert and restore a 1.4km stretch of the Ponesk Burn with the aim of significantly improving the hydromorphology, riparian habitat, and spawning and nursery potential of the river channel, whilst enabling continued extraction of coal from the existing surface mine complex.

This project requires the creation of a 30m deep river valley, carved almost entirely through rock, within complex ground conditions and close to deep mine workings. Innovative design is required to harmonise the complex interaction between the current and historical mining operations and hydraulic, hydrological, geotechnical, geomorphological, hydrogeological, environmental and ecological issues. Key design considerations include the creation of appropriate hydraulic and morphological conditions for a sustainable watercourse, integrating the diversion channel with the surrounding topography, managing sediment transport issues, and ensuring no detrimental flood impact on local communities.

Baseline surveys were undertaken to determine ecological, geomorphological and hydrological conditions of the catchment, and to determine the interaction between them. The natural upstream reach of the Ponesk Burn comprises a sinuous channel with plane bed-riffle morphology with sediment input from river banks and bed as well as from geotechnical failures of the steep valley sides.

Carving a new river valley through bedrock poses a number of design challenges including the planform and morphology of the channel that should be created as part of the restoration. Although a meandering planform with pool -riffle morphology was considered desirable from a fisheries perspective, this was not considered appropriate or sustainable in a bedrock setting. Following agreement from key stakeholders, the design focussed on step-pool and chute-pool morphology. There is very little guidance on the design of bedrock channels, compared to that available for alluvial channels, but by using a combination of hydraulic geometry and geomorphological principles, a conceptual channel design was created.

A phased design and construction programme has been adopted which allows the concept design to be developed following bulk rock excavations in the river valley and detailed ground investigation. As bedrock morphology is a function of the rock structure itself, this staged approach will enable varying morphological features to be created at appropriate locations allowing the channel to work in harmony with natural rock features.

It is anticipated that, in time, post-construction monitoring will help inform the wider engineering community, leading to continued improvements in river restoration.

THE ROLE OF WALKOVER ASSESSMENTS IN RIVER REHABILITATION

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Walkover surveys are often undertaken to provide information on the physical character of rivers to inform appropriate river rehabilitation. Fluvial audit provides a standardised survey method for obtaining geomorphological information at the reach scale and is often used to prioritise river reaches and to guide rehabilitation practices on rivers designated as Special Areas of Conservation (SAC) and Sites of Special Scientific Interest (SSSI). However, a recent study suggested that the fluvial audit methodology could be made more ecologically relevant by incorporating standardised ecological habitat classifications (Bradley *et al*. 2009).

This poster outlines several alternative walkover survey methodologies that have built on existing standardised protocols and have been successfully applied to different river rehabilitation projects in the UK with specific aims. Three case studies are used to demonstrate the range of walkover survey techniques that have been developed recently: A walkover survey aimed specifically at identifying sources and pathways of sediment input into the River Lud and Waithe Beck, Lincolnshire; a geomorphological walkover on the River Mease SAC; and a species-specific walkover survey on the River Wensum SAC aimed specifically at informing the restoration of spawning habitats for Barbel *Barbus barbus*.

These case studies demonstrate the range of methodologies that have been developed within the standardised walkover survey framework which have been used to optimise the information provided to inform appropriate river rehabilitation on specific schemes with the focus on achieving ecological outcomes.

MANAGING WITH THE RIVER: A CASE STUDY FROM THE RIVER WHARFE, UK

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The River Wharfe, like many other upland gravel-bed rivers in the UK, actively transports considerable quantities of bedload during floods. The transport process is intermittent with considerable volumes of gravel being stored within the channel between high flow events. In several places these accumulations have formed large mid-channel bars generating channel instability in the form of severe local lateral erosion of the river banks. This channel widening is creating conditions of shallower flow promoting further deposition. In many cases the loci of deposition are predictable from a review of flow energy variation along the river, however, newer deposits are also developing in an upstream direction in response to hydraulic changes induced by these large scale deposits. Alterations to the catchment and changes to the river flow regime presently promote the development of these instability zones and earlier quick fix solutions to the bank erosion problem through activities such as gravel trapping and piecemeal bank revetment have failed. In many cases these actions are exacerbating the sediment management problem causing additional erosion and deposition at new locations along the river.

An assessment of the dynamic geomorphology of the upper Wharfe has succeeded in generating a model of geomorphic functioning for the river, revealing a complex interaction between upstream sediment delivery, local morphology, anthropogenic alterations to flood hydraulics (through flood defence construction) and flow regime alteration. This model has allowed the National Trust to develop a long term targeted management strategy designed to work with the active nature of the channel at depositional sites and instigate long term sediment delivery controls. At depositional sites flood bank realignment is occurring in order to preserve wider flood risk levels, provide increased floodplain space to accommodate channel migration, increase connectivity with the floodplain helping to restore channel hydraulics and create functional floodplain habitat. Gully and hillside tree planting is also being carried out in the catchment with the aim of slowly reducing sediment inputs allowing the river to respond over time to a staged change.

FLOW CHARACTERISTICS OF DIKES IN A COMPOUND CHANNEL

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Dikes are generally constructed to concentrate flow in a specified region for the navigation channel or bank protection. The reduced flow area by dikes construction results in an increase in flow velocity thus increasing the sediment transport capability. However, in the dikes installed region, the sediment deposition is activated thus special aquatic habitats are created. This feature makes dikes important river restoration techniques recently.

Flow structure of dikes shows very complicated characteristics and it is a three dimensional flow. Dominant factors of dikes are reported as angle and spacing, and the effect of these factors are well analyzed by the various experimental researches. However, these researches were focused on a simple section. In compound channel, flow structure of dikes might be more complicated and different behaviour.

In this research, flow characteristics of dikes in a compound channel are studied from 3-D numerical model. In a compound channel flow characteristics of dikes shows much different structure from a simple section. Especially location and shape of separation zone in a compound channel are much different. In the downstream of the dike, another low velocity zone is developed along the bank line.

Comparative analysis of a simple channel and a compound channel would suggest the different effect of dikes with channel types.

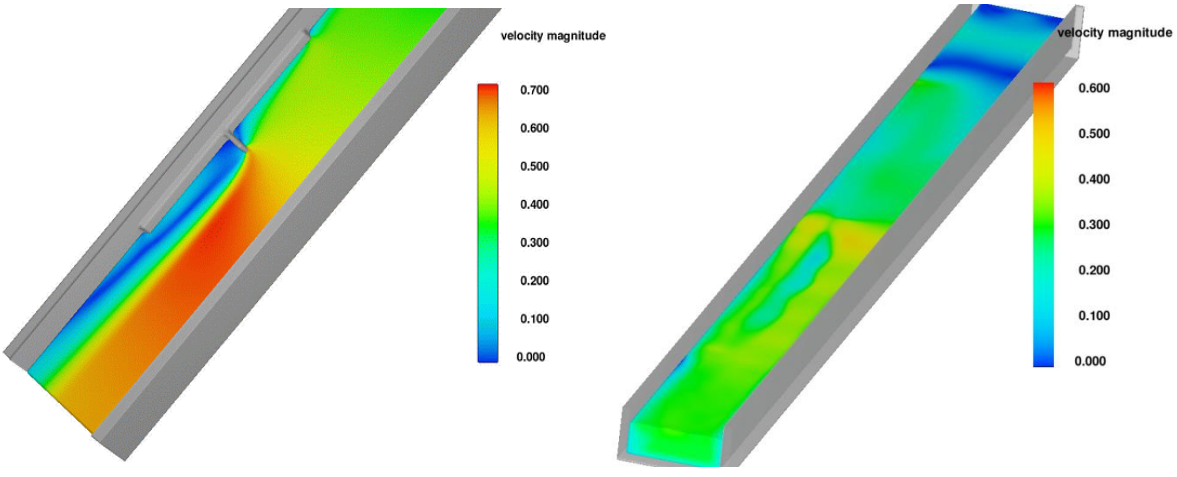

Figure 1. Numerical simulation of a single dike in the simple section and compound section

THE FALL AND RISE OF A SMALL URBAN STREAM?

ENVIRONMENTAL HISTORY OF THE MÄTÄPURO BROOK, HELSINKI, FINLAND

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The Finnish capital, Helsinki (in Swedish, Helsingfors), provides an excellent setting for the study of urban environmental history, as the most significant human-induced changes in the city have taken place only during the last two centuries. Founded in 1550 at the mouth of the Vantaa River, Helsinki remained a minor town until the annexation of Finland by the Russian Empire in the early nineteenth century. Anxious to sever the close cultural ties between Stockholm and the Finnish provincial capital Turku (Åbo), the Czar in 1812 made Helsinki the official capital of the Grand Duchy of Finland. Fuelled by profound changes in the Finnish society and economy, Helsinki soon experienced an unprecedented urban and industrial growth in the Finnish context: between 1860 and 1940 the city's population doubled every twenty years. By the year 2000, the greater metropolitan area included some 1.2 million inhabitants, or, well over twenty percent of the entire population of Finland.

The rapid urbanization of Helsinki inevitably resulted in enormous changes in the city's natural environment. Among the natural systems most affected by urban and suburban development were the city's numerous small streams. This poster examines the changes in one of these streams, the Mätäpuro Brook, in the western part of the city. The Mätäpuro is the second largest stream in Helsinki with a drainage area of 11.2 km^2 (4.6 sq. miles) and length of 6.9 km (4.3 miles). Land use changes in the stream basin from the mid-18th century are reconstructed by an examination of maps and other archival sources.

Despite continuous urban development within the Mätäpuro's catchment area and persistent runoff, erosion, and littering problems, the water quality in the stream has improved during the last two decades. Since 2000, environmental NGOs have carried out restoration work on the Mätäpuro. Due to these efforts—and much to the surprise of urban dwellers and city planners—the endangered anadromous brown trout (*Salmo trutta)* again reproduces naturally in the stream. The ecological and recreational value of the "reborn" Mätäpuro was officially acknowledged in 2006 by its inclusion into the ambitious Helsinki Small Streams Program.

EXAMPLES OF RIVER RESTORATION PROJECTS COMPLETED IN THE CZECH REPUBLIC AND EXPERIENCE WITH OPERATION OF THESE PROJECTS

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Restoration of artificially modified streams and floodplains in the Czech Republic has an increasing tendency (one of the reasons is that it is possible to fund these projects from the European Union grants). The author of this abstract and the team of his colleagues and other cooperating experts have taken an active part in preparation and realization of restoration projects since the 1990s. The result of their activities is a wide range of realized projects that include restoration of streams in the landscape, river restoration in the urban areas or a combination of flood control and stream and floodplain restoration measures.
The elaboration of all the realized restoration projects was based on a methodology that was developed by the holding group SINDLAR EU s.r.o. The principal of this new methodology is a basic assessment of the types of dynamism of the channel morphological processes and of their potential. The characteristic and dynamically changing morphology of a stream evolves according to the type of dynamism. The geomorphological type of stream channel is the result of the ongoing channel morphological processes in definite conditions. This methodology determines the types of channel morphological processes.
This typology of fluvial processes and geomorphological types of stream channels is the result of a long time research that combines the theoretical knowledge of the issue and the practical experience gained during the preparation of construction designs, restoration of streams and floodplains and the assessment of the result (the restored fluvial ecosystems).

Examples of completed river restoration projects:
Dry polder "Žichlínek": The construction of this polder was completed in 2006. It is situated on the river "Moravská Sázava" and on the creek "Lukovský potok", approx. 10 km southeast from the city "Lanškroun". The project involved restoration of the whole flooding area. The natural potential of this locality (this type of valley) is a meandering stream. However, the streams in the valley had been artificially straightened and deepened, the floodplain had been turned into an arable land and the natural biotopes had been destroyed. That is why the works comprised restoration of the original and natural state of the floodplain and natural morphology of water bodies, especially streams and their development stages. Parts of the main stream "Moravská Sázava" and it's tributary "Lukovský potok" were restored (stretches of the length of 2,8 km and 1,2 km). The resulting nature-like meandering streams with pools have the area of 15,6 ha and the nature-like flood control measures occupy the total area of approx. 170 ha. Restoration of the river "Kněhyně": The project is situated in the Flysch Carpathians and it involved the restoration of the ecological state of a braided river. The former accelerated deep erosion was stopped and a stretch of 0,3 km was restored, including the floodplain. The geomorphological type of a braided river was rehabilitated and new nature-like biotopes created. The construction was completed in 2004. Restoration of the former mill canal on the river "Chrudimka" in the city of Chrudim: It is an example of river restoration in the urban areas. Former modifications of a stretch of 0,2 km totally suppressed the natural morphology of the channel and the biotope structure. The restoration works, that were completed in 2003, consisted in the creation of a nature-like channel and a floodplain. The surrounding areas were turned into a park and are now suitable also for active relaxation, thematic education etc.

HOW TO OBTAIN SUITABLE GRAVELS FOR RIFFLE CREATION ON CHALK RIVERS

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The EA's Water Level Management Plan in Wessex Area Blandford has been piloting 2 River Restoration schemes, on the Rivers Wylye and Frome. Both schemes involved gravel riffle creation in reaches devoid of these salmonid spawning habitats. The option available to both is as usual to bring the required size and quantity of gravel to site from gravel extraction or waste transfer sites but this project wanted to explore novel alternatives. These novel approaches aimed at sourcing gravels of the right type and size for improving salmonid spawning habitat currently missing on the target reach on both rivers.

The targeted reach on the Frome has suffered from historic dredging, the material of which had been left on the banks creating a berm. The berm material consisted of high gravel concentrations (the original riffle features) sands, silts and possible clays. The approach here was to extract the gravel from the berm, clean if necessary and return back to the river creating at least one large riffle and a number of in channel gravel features. The banks of the reach would then be reprofiled incorporating the resulting spoil into a new lower berm set back away from the river. The berm edge back to the river would also be reprofiled giving a range of low pools and shelves and higher sections which would give a range a new habitats in all expected water levels throughout the year.

Photos and video are available of all during and post works.

The scheme on the Wylye was again to address historic dredgings. In this case there was no berm containing the original gravels. Instead here the riparian owner was Wiltshire Wildlife Trust who agreed as a partner of the project and as part of a larger habitat enhancement scheme to allow gravels to be extracted from the adjacent pasture. A large 'lake' was excavated exposing a natural gravel seem in the field. This was piled up and sent through industrial sized gravel cleaner which separated out small, medium and large sized gravel from the soils and clay. The gravel materials were then introduced to the river Wyle creating 4 large riffles and a number of smaller in channel gravel features. The spoil material along with material form the reprofiled banks were placed in the 'lake' which upon completion of the project is now just a wide shallow scrape in the field.

Both schemes extracted more gravel than expected and roughly 3-400 tonnes at each. We are currently working out the costs of each approach and how these compare to the traditional method of obtaining gravels. These figures will be available by end of November.

SLOPE RIVER RESTORATION. CASE STUDIE JUCAR RIVER IN RIOLA, VALENCIA (SPAIN)

***Alfonso Fernández Salor**; Projar, Environment Restoration Department,46930, S.A. Valencia, Spain.*

Jucar river in eastern Spain, flows in a southerly and then easterly direction for 309 miles through Cuenca, Albacete, and Valencia provinces and into the Mediterranean sea in Valencias´s Gulf. On the lower course, the Jucar´s waters irrigate a large plain section of La Ribera, from *Riola* to the lagoon of *La Albufera*, mostly under orange groves and rice fields, the river has had a great tendency to flood. The river restoration aim in degraded areas must be the environmental recovery to natural conditions, trying to integrate the human actions with a minor impact. A flexible revetment volumetric mat is provided within the water's edge zone at the toe of the bank to the crowning slope point utilising coir rolls with drive stakes on the water´s edge and an hydro-blanket® treatment spread on the slope surface. Due to important erosion event on the river slope and a critical loose of soil adjoining an orange grove, we must act and prevent future erosion events.

The river Jucar has been managed for the purposes of flood defence, with hard actuation as gabions retaining wall or rock layer, this technique demonstrates a high effectiveness on flood defence, but a very difficult natural restoration. The system used permits the effectiveness of flood defence on these particular hydraulic conditions and a complete revetment of the actuation area.

There were three different systems to revet and defend the slope.

- Reinforced Volumetric Mat ***TRINTER-R***
- Coir Rolls ***PRO-ROLL*** planted with *Tipha Latifolia, Iris pseudacorus, Cladium mariscus*
- hydro-blanket® ***ECOFLEX***

RIVER AND POND RESTORATION IN THE THAMES CATCHMENT: SMALL SCALE CHANGES MAKING BIG DIFFERENCES

Geoff Waite, Jenny Hand *and* ***Emily Farquharson-Smith****; Weetwood Services Ltd, No 2 Smithy Farm, Chapel Lane, Bruera, Chester, CH3 6EW, England.*

River and pond restoration projects of any scale make large differences to the ecological potential of water bodies in the UK. In the dense built up areas of the south of England, it is important to utilise the open areas of watercourse that are available. Two projects that Weetwood have undertaken that highlight this rationale are the London Wildlife Trust's Yeading Brook restoration project, and Riverbank Flats pond restoration project, Staines. Both projects emphasise how small scale changes can create large benefits for local communities in terms of both ecological and aesthetic improvements.

The London Wildlife Trust's Yeading Brook restoration project was established with funding from the Heritage Lottery Fund in 2005. Yeading Brook was struggling to support a sustainable aquatic environment largely because unmanaged dense scrub along the bank led to loss of light, and flood alleviation projects resulted in low flow velocities and loss of riverine habitat. Four sites in the Yeading Valley were highlighted for the works; Ickenham Marsh, Gutteridge Wood, Ten Acre Wood and Meadows, and Yeading Brook Meadows, all in the London Borough of Hillingdon. A strategic vision was established identifying possible works to enhance and restore Yeading Brook that would benefit the different types of wildlife in and around the sites and also improve public access. The major proposals included scrub and tree management along banks, installation of deflectors to create pools and riffles, and bank re-profiling to encourage the development of marginal habitats including providing habitats for water voles.

In contrast, Riverbank Flats pond restoration project is at a much smaller scale focusing on a single pond that is connected to the River Thames by a short link channel. The residents of the flats funded the scheme in 2009 with the aim to provide a more useable and ecologically friendly environment. The pond and link channel were severely silted and choked with reeds and self-set willows, water from the Thames was unable to reach the pond and a large amount of garden rubbish was disfiguring the pond. Works on site have included selected tree removal to increase light penetration, dredging of silt from the link channel and pond to ensure connectivity and seed sowing around waterside margins.

The restoration work at both sites have now been completed, therefore the ecological benefits that were first visualised at the design stage by Weetwood are now seen first hand in the natural environment. The Yeading Brook restoration work was completed in 2005 and has had significant time to establish resulting in an enhanced and well managed environment. In contrast, Riverbank Flats pond was completed in February 2010 and therefore is only in the initial stages of developing a lasting ecological feature. Continued maintenance of these two schemes will ensure that they continue to provide a haven for wildlife in the surrounding area.

ECOSYSTEM DEVELOPMENT IN A FLOOD RELIEF CHANNEL

Martin Wilkes, Sada Al-Janabi, Jessica Elam, Rebecca Ratcliffe, Alex Bence, Nicola Nineham *and* ***Edward Hopes****; School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, Birmingham, B15 2TT, England.*

In November 2009 flood alleviation works were completed at Campden BRI, Chipping Campden, Gloucestershire. The works involved the excavation of a 385m length of new stream channel to convey 100 year plus climate change flood flows (15 m^3 s^{-1}). The second order rural stream arises from a groundwater spring near Hidcote Boyce 3 km to the north-east of the study site and is a tributary of the River Cam in the wider River Stour catchment. The new channel represents a rare opportunity for long-term monitoring of channel evolution and ecosystem development. We therefore initiated a project to provide baseline data on the condition of the new channel and establish site infrastructure for future monitoring. The primary objective of the poster is to present data on the geomorphological, topographical, physico-chemical and biological characteristics of the new channel. Some initial observations on early channel development are also outlined.

The new channel was found to be varied in terms of morphology, with a range of physical habitats present. Early observations suggest that the stream has already begun to adjust through deposition of silt and gravel in wider sections. Erosional features were also present after the first winter season had passed: riprap had been displaced on the outside of a meander bend; and some bank erosion had occurred where the new channel meets the existing stream. Water quality was generally found to be good and this was reflected in a favourable macroinvertebrate Average Score Per Taxon (ASPT), although phosphate concentrations were relatively high. The paucity of macroinvertebrate taxa found within the new reach is expected to improve with time, particularly throughout the coming spring and summer seasons. In addition to data collection we established fixed cross-section markers and a stage board along with a crest gauge to monitor high stage at regular intervals. It is hoped that this project will provide the framework for future investigations into the development of the ecosystem, including those concerned with macroinvertebrate colonisation and vegetation communities.

THE WATER FRAMEWORK DIRECTIVE – FLOOD AND COASTAL RISK MANAGEMENT CONTRIBUTION TO THE FIRST RIVER BASIN PLANNING CYCLE

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The First Cycle of River Basin Planning has led the Environment Agency to identify how it can achieve improved status for waterbodies through its own Flood and Coastal Risk Management activities. Around 400 measures have been identified already for delivery through flood risk capital schemes. Tools and processes are being designed to deliver mitigation measures to achieve GEP in heavily modified waterbodies, through asset management and operational activities.
In addition, a large scale trial is being designed to test the ecological effectiveness of four mitigation measures and their compatibility with flood risk management: the 'use' of the waterbody. These results will help us to target better for the second cycle of river basin planning from 2015 onwards.

RESTORATION AND THE ENVIRONMENT AGENCY: POLICY TO PRACTICE

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***Jonty Gibson**; Environment Agency, North East Regional Office, Rivers House, 21 Park Square South, Leeds, Yorkshire, LS1 2QG, England.*

The Environment Agency has responsibility to protect or improve the hydromorphological condition of water-bodies to WFD objectives. Inadequate legal powers and duties, and a lack of scientific understanding of the impacts of hydromorphological activities on these objectives make fulfilment of these responsibilities difficult. These gaps are currently being addressed by ensuring policy is developed in consultation with Defra and WAG, specifically in relation to: 1. preventing deterioration of waterbody status or potential, and
2. improving ecological conditions to achieve WFD objectives

Preventing Deterioration – developing Policy

The EA is seeking to influence policy development in several areas:

1. Influence the role of WPZs in delivering environmental improvements by, for instance, allowing the use of WPZs for the purpose of protecting hydromorphological conditions to provide greater control of damaging activities on land and in water.
2. We are calling for an extension of Works Notices powers to restore hydromorphological conditions in cases where recent damage has occurred.
3. Flood Defence Consenting: we are pursuing amendment of land drainage legislation to prevent, limit or mitigate damage to hydromorphological conditions.
4. We are calling for an equivalent level of duty to the WFD to be placed on all drainage authorities with respect to their operational, regulatory and Flood Risk Management Activities.

Delivering WFD Targets by Improving Conditions – developing Policy

We deliver many improvements on an opportunistic basis through voluntary means but EA has no free-standing powers to improve morphology for WFD. This limits our ability to deliver strategically-planned improvements targeted for WFD, and we are working to develop both policy and understanding to improve our impacts on outcomes.

1. Clarification is being sought on our ability to act in cases where, for example, no responsible party can be found or where the past damaging activities were legally compliant at the time.
2. EA are calling for works notices to be used to restore water quality if the river bed or banks are damaged.
3. EA are calling for a permissive power to undertake morphological improvements in cases where historic damage has occurred where no responsible party can be found where the polluter-pays principle cannot apply, to be viewed and used as a power of last resort

The next stage: Implementation, project appraisal and removing uncertainty

Our next key task is to prioritise and implement all the RBMP measures at a catchment RBD scale. Project appraisal and reducing uncertainty using trials will be important tasks for us over the 1st round. Our understanding of how measures will directly impact ecological outcomes and WFD status is limited. We are developing trials using catchment scale pilots of both planned and historic mitigation measures to investigate the impact of measures on biological quality elements.

FARMING FLOODPLAINS FOR THE FUTURE: PROMOTING NEW APPROACHES TO FLOOD RISK MANAGEMENT

***Matt Jones**; Staffordshire Wildlife Trust, The Wolseley Centre, Wolseley Bridge, Stafford, ST17 0WT, England.*

Farming Floodplains for the Future is an important national pilot project with the key aim of developing an understanding of how the farmed landscape can be viably managed in ways that reduce flood risk downstream, while also enhancing the natural environment. A partnership project hosted by Staffordshire Wildlife Trust, it has been funded by Defra through its Flood and Coastal Erosion Risk Management Innovation Fund. Focussing on the practicalities of implementing solutions on the ground, it is intended to inform future policy direction.

Analysis of flood models for the Rivers Sow and Penk in west Staffordshire (that form the core of the project area) highlighted the need to take a catchment-wide approach. The key to success appeared to be the cumulative slowing and storing of water in the headwaters and tributaries, as new attenuation opportunities are limited in downstream functional floodplains.

The project has completed works on 8 sites. These demonstrate opportunities ranging from the re-connection of floodplains and diversion of watercourses, to the alteration of existing ponds and construction of debris dams and other water control structures - all show the role that multi-functional wetlands might play in the reduction of flood risk.

The initial 3 years of the project comes to an end in March 2010. The paper will outline the approach that the project has taken, describe some of the case studies delivered, report on the overall results (including monitoring results to date), and discuss the key outputs and recommendations arising from the project.

RAVENSBOURNE RIVER CORRIDOR IMPROVEMENT PLAN

***Richard Peddie**; Environment Agency, Thames Region, South East Area Office, Swift House, Frimley Business Park, Frimley, Camberley, Surrey, GU16 5SQ, England.*

The River Ravensbourne is recognised as one of the most 'engineered' rivers in metropolitan London. Development has historically tended to turn its back on the river, seeing it more as an inconvenience rather than a benefit. This has resulted in the river being frequently constrained within concrete channels, or piped underground in culverts. These constraints have a strong impact upon; our ability to further reduce flood risk and mitigate the potential impacts of climate change; the wildlife the river can support; as well as our ability to use and enjoy the river.

The London Borough of Lewisham and the Environment Agency are currently working together to produce a 'river corridor improvement plan'. It assesses the current constraints to the corridor of the River Ravensbourne and identifies how regeneration and local initiatives could be used to help enhance its quality for all.

Lewisham is currently undergoing a period of major transformation. With this comes great opportunities to enhance the environment, community facilities and urban design standards in new developments. The plan interprets existing policies and action plans in a practical and meaningful way, to demonstrate how future riverside development can locally meet their objectives. It will be used as evidence to help inform the production of local policy within the London Borough of Lewisham 'Local Development Framework', as well as aiding our discussions with those proposing riverside development.

The study area follows the river between Catford in the south and the River Thames at Deptford in the north, which corresponds with the Thames Gateway within the London Borough of Lewisham. The plan is currently being finalised, but when published, it will set out our vision for the River Ravensbourne. We have identified four key objectives that together will meet this vision:
A river corridor with a unique image and identity
A river corridor that reduces and manages flood risk, as well as the impacts of climate change
A river corridor for wildlife as well as for people
A well integrated, convenient, safe and secure river corridor

Within the plan we have discussed the issues and opportunities for each of these objectives and identified local key principles to be considered in the planning and design process by those proposing riverside development. The plan also identifies all the key riverside sites where either redevelopment is expected, or other opportunity sites (such as parks and public open space). For each of these sites we have produced a two page case study, including a site plan, that identifies the key opportunities for enhancement of the river. These provide practical suggestions of how redevelopment might be provided in a manner that meets the relevant planning policies. When those proposing development at these sites come to us, we will use the case studies to support our discussions on meeting the relevant policies.

The draft case study drawings were recently used to support a successful bid for almost £2m funding to invest in Ladywell Fields and along the Waterlink Way. The project will transform the central and southern parts of Ladywell Fields including enhancements to the river.

DESIGNING FOR INTEGRATED SOCIAL AND ECOLOGICAL BENEFITS IN RIVER RESTORATION

***Mark Job**; Ove Arup & Partners Ltd, 13 Fitzroy Street, London, W1P 6BQ, England.*

The ecological value of river restoration has long been acknowledged, and the drive towards naturalising river systems is now firmly on the agenda of key statutory authorities with an interest in our waterways. However, the business case for river restoration is often a stumbling block, with most opportunities existing only in conjunction with a package of essential flood risk management works. Such schemes are often characterised by limited funding for environmental enhancement and highly constrained sites. It is therefore crucial that money spent on river restoration maximises the delivery not only of ecological improvements but also tangible social benefits.

Arup has been working closely with the Environment Agency over the last five years to deliver a programme of multi-functional river restoration schemes across the country. Our integrated teams work to deliver schemes with the most value to the local area through integrating advice from all disciplines. Identifying appropriate habitat creation opportunities crucial, but can also be aligned with potential community benefits. One opportunity in highly visible and accessible locations is to form human scale wetland nodes with open water bodies and meandering streams rich in wildlife and public interest, whereas focused habitat creation can be provided in less accessible areas. The key is in finding a balance between the two, and so generate opportunities for the public to interface with the local ecology. It is at this interface that the key social benefits begin to be realised. Promoting access to water and nature has well documented benefits for health and well being, as well as educational. For children, there can be clear links to subjects such as biology and geography.

Another key opportunity associated with river restoration and floodplain habitat creation is designing landscapes for natural play. Providing shallow banks to small streams and ponds allows children to play safely in the water, while small copses of wet woodland managed to retain an open character also become focuses for play. This is aligned with current policy and guidance adopted by many local authorities and promoted by Play England, and can attract additional funding. One example is a large river restoration project we are currently designing in East London (Beam Parklands), where the local authority is seeking to contribute funding for natural play in response to local community interest. We helped to demonstrate these local ambitions through an interactive set of public participation events at which children were invited to model and draw how they would like to improve their park.

We are working towards delivering this scheme in 2010/11, with the design based on all of these key principles. A typical detail here is the restoration of a small stream running through the open space. The stream begins at the northern end of the site as a culvert, essentially run-off from a large urban area, and flows through the park with a shallow long profile, leading to poor water quality in the stream. We are working with the bed levels to create shallow ponded stretches characterised by a narrow low flow channel passing through an extensive wet reedbed, creating extensive areas of habitat, targeting species such as water vole and reed bunting, while also improving downstream water quality. Faster flowing stretches downstream would have steeper gradients and contribute to a habitat mosaic across the site while also becoming a focus for natural play in an open and accessible part of the site.

River restoration is a crucial part of modern sustainable design, but opportunities are often missed because of funding constraints. Considering methods of integrating social, ecological and economic benefits at the outset maximises the potential value for money in river restoration, while also maximising the funding potential from interested parties. Our country's watercourses deserve to be the focus for this sustainable and exemplary approach.

RIVER CAM HABITAT AND ACCESS ENHANCEMENT PROJECT

***Rob Mungovan**; South Cambridgeshire District Council, South Cambridgeshire Hall, Cambourne Business Park, Cambridge, Cambridgeshire, CB3 6EA, England.*

Trumpington Meadows is located on the outskirts of Cambridge where 1200 new homes are to be built. To serve the new community a 60 hectare Riverside Community Park is to be established adjacent to the River Cam. Enhancements have been delivered to the river prior to the set-up of the Park.

The River Cam is a County Wildlife Site. Whilst increased access to the countryside is generally welcomed, concern was expressed at the risk of increased disturbance to a presently remote reach of river. This issue was debated at the planning application stage. It became clear that the environmental capacity of the river needed increasing to counteract the potential disturbance posed by increased access. However, Planning Officers did not consider the issue to be one that should oblige the developer to deliver specific river enhancements (given that many resources were being put into establishing the Community Riverside Park). A point of agreement was achieved on the case for enhancement and South Cambridgeshire District Council took the lead to deliver enhancements with funding secured primarily from the Department of Communities and Local Government / Cambridgeshire Horizons *Housing Growth Fund* (plus others including the developer).

A main objective of the project was to deliver safe access to the river. This was achieved by placing approximately 1000T of gravel to raise the riverbed and to form shoals. The bank was re-graded in the locality of the shoals. It is now possible to gain safe access to the water's edge in eight locations totalling approximately 200m.

A dilapidated ditch system of 730m runs parallel to the river. Water levels in the ditch will be raised so that the ditch acts as a "wet fence" to control the movement of people. This should restrict access to a natural riffle used by spawning fish, a kingfisher bank and an artificial otter holt.

The gravel placement should also provide new fish spawning areas and increase the invertebrate biomass. Large woody debris has been incorporated into revetments and two flow deflectors to further diversify in-channel habitats. Five large root balls have been secured to the bed to provide shelter "reefs". Backwater habitats have also been created to add further visual interest to the site and to provide refuge for fish in flood periods.

The bank re-grading has also removed levees in places to allow water to spill out onto a wet meadow at lower flood levels thus delivering some local flood storage benefits and biodiversity gain for wetland birds. Hydraulic modelling has been used to demonstrate that the maximum flood levels and extents for higher return periods are not affected.

It is hoped that the project will act as a showcase for river restoration techniques for the local area and therefore as a catalyst for similar projects.

Key words:
Riverside Community Park, access, planning application, environmental capacity, shoals, re-grade, wet fence, large woody debris, levees, hydraulic modelling

SEDIMENT MATTERS FOR SUCCESSFUL RIVER RESTORATION

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Sediment is an important part of a healthy river system and is an essential component of many aquatic ecosystems. However, significant problems can arise when the amount of fine grained sediment in a river channel is too high and is out of step with the river's natural processes. Impacts can relate to a wide variety of concerns that include habitats, flood risk, water quality and amenity. Our changing climate also means that these impacts could increase in the future.

Importantly, the EU Water Framework Directive requires sediment pressures to be identified and any risks managed in order for watercourses to meet good ecological status. However, sediment problems are not simple and every catchment is unique. An understanding of sediment dynamics and sediment impacts is therefore a key element of successful river restoration with a catchment-wide, multi-benefit perspective.

Given the range of potential impacts there is a need for a tool that can be used by a wide range of non-specialist users to help understand catchment sediment issues. In view of this, the Sediment Matters handbook is currently being developed by Atkins Ltd for the Environment Agency. A draft of the handbook has been produced and it is currently being piloted across 10 UK catchments. It is due for publication in 2010. The handbook provides a cross-sectoral, user-friendly and practical tool for understanding sediment matters in UK catchments. The approach that has been developed to enable users to:

- Understand catchment sediment dynamics
- Identify sediment-related problems
- Devise sediment monitoring programmes and collect evidence of sediment-related problems
- Focus management and restoration for multiple benefits

The handbook can help users to identify the need for sediment-related river restoration to address issues ranging from rehabilitation of salmon habitats to mitigation measures for flood risk management. In addition, it enables users to develop an ongoing understanding of sediment issues and management successes in their catchments via monitoring.

RIVER RESTORATION WORK FOR RESHWATER PEARL MUSSELS (*Margaritifera margaritifera*) AND ATLANTIC SALMON (*Salmo salar)* ON THE RIVER ESK, N YORKSHIRE

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The River Esk is the only river in Yorkshire with Freshwater Pearl Mussels (*Margaritifera margaritifera*), and only a very small number of mussels are left (<1000). The vast majority are old (60+ years of age), and there has been no evidence of successful recruitment in the river for 40 years. The pearl mussel will become extinct in the River Esk in the next 25 years unless action is taken to halt its decline.

The quality of rivers and their catchments are under threat from land-use pressure. A key issue is land use change, including the resulting changes in sediment supply, which is one of the most significant threats to global biodiversity. Currently the river habitat is in unfavourable condition due to fine sediment. This sediment reduces the permeability of the gravels, reducing the supply of oxygen to salmonid eggs and to juvenile freshwater pearl mussels. Under the Water Framework Directive (WFD) the main River Esk is currently classified as having moderate ecological quality, most of the tributaries at the top of the catchment have poor ecological quality.

River restoration work will focus on implementing a series of practical river restoration techniques to improve the riparian habitat for the Freshwater Pearl Mussel, Atlantic Salmon, Sea Trout and a whole host of other species dependant upon the river.

In line with the WFD Programme of Measures, the project is improving land management through:

- Creation of buffer strips
- Improvements to cattle crossing points
- Provision of drinking troughs for livestock and use of innovative techniques such as sheep frame pumps, pasture pumps and solar powered water pumps, to obtain drinking water for livestock

We are providing habitat enhancements through:

- Installing riverbank fences to allow “assisted natural recovery” of the river
- Managing bankside vegetation including coppicing and pollarding of trees, removal of trees that are causing bank erosion, tree planting and non-native plant species control

In order to raise awareness of the project and to promote best practice in river restoration work a demonstration farm was set up to showcase a number of the river restoration techniques. A number of training events have been run for local farmers, land managers, wildlife groups and angling groups to promote good land management.

This is a partnership project between the Environment Agency and the North York Moors National Park Authority. The National Park Authority is lead partner and is implementing the WFD Programme of Measures with the support of the Environment Agency. Funding has been obtained from the Environment Agency, North York Moors National Park Authority, the Heritage Lottery Fund and Yorventure.

WIDER GLOBAL PERSPECTIVES – REHABILITATION OF INCISED VALLEY FLOORS

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The dramatic alteration in character of many streams in south-eastern Australia since European settlement has been widely documented. Originally the morphology of many of these streams consisted of densely vegetated intact valley floors with no definable channel. Widespread clearing of native vegetation and increased grazing pressure by exotic herbivores instigated increases in surface runoff and soil erosion in many catchments. As a result, many valley floors in south-eastern Australia contain incised gullies with floodplains covered by eroded colluviums and there is reduced stream-floodplain connectivity. In an attempt to stabilise and aggrade incised valley floors, control the transport of sediments and improve stream-floodplain connectivity, a restoration technique called Natural Sequence Farming (NSF) is now being implemented along streams in south-eastern Australia. NSF is a holistic management technique which makes use of a combination of structural measures such as porous weirs, contour banks and channels to divert water onto floodplains, and non-structure measures such as reducing the use of fertilisers, herbicides, minimising cultivation and ploughing activities in areas adjacent to the incised stream, and implementing alternative grazing management strategies and revegetation programs. The thirteen kilometre long ephemeral Spring Creek in central western New South Wales is one example of a drainage line which has undergone significant morphological changes, and is now heavily incised along much of its reach. As a result of continued erosion in the catchment, sediments are readily transported along Spring Creek during streamflow events. NSF was implemented along Spring Creek in 2006, consisting of 13 porous weirs, the exclusion of grazing and revegetation of floodplain areas adjacent to the stream. This study investigated the impacts of NSF on the morphology and functionality of Spring Creek and the surrounding floodplain areas over a three year period, as part of an on-going monitoring program. Baseline morphologic and landscape functionality measurements were collected in April 2006 prior to installation of the porous weirs; these measurements were repeated again in February 2009. In addition, this study included the collection and analysis of streambed sediments along the entire reach of the stream for electrical conductivity, pH and particle size distribution. This data was collected in order to investigate sediment properties and longitudinal patterns of sediment transport along Spring Creek. The results suggest that porous weirs are trapping significant quantities of sediments, including silts and clays; rates of sediment aggradation upstream of weirs are ten times higher than occur elsewhere along Spring Creek. However, based on current aggradation rates, it is estimated that deeply incised sections of the stream which are located upstream of these structures still require over 200 years to infill to the levels of their former floodplains. Results also indicate that ecological functionality is improving in areas of Spring Creek fenced off as part of NSF. The analysis of streambed sediments suggests that much of Spring Creek is longitudinally connected, with sediments eroded in the upper catchment being deposited on an intact valley floor in the lower reaches of the middle catchment. This intact valley floor is acting as a sediment buffer, protecting intact wetland habitats in lower catchment from infilling by coarse sediments. In conclusion, the results obtained in the current short-term study should be viewed with cautious optimism, as they suggest that NSF is achieving a range of desired results such as (i) altering the morphology of the incised Spring Creek, (ii) trapping fine sediments, and (iii) improving ecological functionality within fenced off areas.

CAN COLLABORATIVE VISUALISATION HELP DELIVER MORE SUSTAINABLE URBAN RIVER CORRIDORS?

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We report on work to explore scenarios for river restoration in a dense urban setting, undertaken through the URSULA[1] research project in collaboration with the Sheffield Waterways Strategy Group (SWSG). Convened by the local strategic partnership Sheffield First, SWSG has the aim of promoting more sustainable forms of regeneration along the city's urban river corridors. In this respect it is an important and interesting group, since it brings together spatial planners with those responsible for river basin management planning, as well as other interests including biodiversity, community cohesion and economic growth.
During the last year, URSULA researchers held a series of participative workshops with SWSG to consider current flood defence and public realm enhancement proposals, located at the Wicker-Riverside area of central Sheffield. The work with this group has included generating and discussing new river restoration ideas at this key city centre location, involving deculverting, weir modification and habitat enhancement.

One of the most fascinating and exciting aspects of our research has been the development and use of interactive, 3-D visualisations of urban river corridors, built using computer-gaming technology. This research represents a major innovation in its own right. However, perhaps as important is to consider how such techniques can be employed strategically, in the setting of a collaborative planning process, alongside other tools such as GIS and models of flood-risk. These findings offer insights into how practitioners of urban river restoration might adopt such partnership approaches, using an iterative process of envisioning, developing and testing urban designs. We contend that with careful planning, an open mind and sufficient resources, these techniques may help deliver more sustainable approaches to regeneration.

The talk will present new findings highlighting some of the challenges and opportunities presented when attempting to develop new responses to old problems using the 'engage-deliberate-decide' approach to planning. We show how this iterative process – one of sharing perspectives, sketching out ideas, considering impacts and refining responses in the light of people's varying aspirations - is a far cry from the usual practice of decide-announce-defend.

[1] URSULA is a major (£2.5m) interdisciplinary project on urban river corridors and sustainable living agendas, funded by EPSRC and undertaken by a consortium including many partners such as the Environment Agency and Sheffield City Council.

RESTORING MAYES BROOK AND MAYESBROOK PARK, EAST LONDON: AN INTERDISCIPLINARY PRE-PROJECT APPRAISAL

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Mayes Brook, a tributary of the River Roding, is an urban stream in East London, extensively channelized and identified as *at risk* of point source pollution and *probably at risk* of diffuse source pollution. Significantly, it has *not* been classified as a Heavily Modified Water Body under the European Union Water Framework Directive and thus needs to achieve good ecological and chemical status. In this context, the Environment Agency (EA) and Barking and Dagenham Council have identified an opportunity to restore a 1.6 km channelized reach in Mayesbrook Park, as part of a wider park regeneration scheme. Ecological surveys (diatoms, macrophytes, invertebrates and fish) have been undertaken by the EA, and Jacobs, commissioned by the EA, have completed a geomorphological and landscape assessment. To complement this, and provide an interdisciplinary pre-project appraisal, the EA and RRC funded researchers at QMUL to conduct a park user survey and an assessment of the water and sediment quality (nutrients, heavy metals, hydrocarbons, total and faecal coliforms) of Mayes Brook in 2009. This paper focuses on the results of the QMUL study and examines the implications of the findings for the restoration of Mayesbrook Park and Mayes Brook.

The importance of the Mayesbrook restoration scheme in the context of appraisal of restoration projects will also be discussed. The rare opportunity to conduct several baseline surveys has provided an interdisciplinary pre-project appraisal that will be used in at least three main ways. First, to inform the development of detailed restoration options for the river and floodplain within the park. Secondly, to provide valuable baseline data against which the completed scheme can be evaluated. Specifically, the aim is to be able to study the link between changes in geomorphology and habitat composition (including water and sediment quality), and ecological response, following restoration. And thirdly, the database will provide an ongoing source of information to guide adaptive management at the site.

USING THE URBAN RIVER SURVEY (URS) TO APPRAISE POTENTIAL SITES AND RESTORATION OPTIONS FOR HEAVILY MODIFIED RIVERS AND STREAMS.

***Lucy Shuker**; Department of Geography; Queen Mary, University of London, London, E1 4NS, England.*

Rivers and streams draining urban catchments are typically heavily modified due to engineering works associated with local industrial uses or flood defence which have adapted the channel to provide vital environmental goods and services to society. To redress this legacy, current environmental policy drivers at European and regional levels (including EU Habitats Directive, WFD, RBMPs and LRAP) are setting targets for the ecological improvement of urban watercourses in relation to BAP species and their habitats and improvements in ecological potential which together will provide increased resilience to adapt to future environmental change resulting either from human or natural causes.

In the context of modern governance, effecting these ecological improvements will require integrated goals, the alliance of partnerships and stakeholders, and a shared vision of ecological and social restoration that pivots around the river and its floodplain. For urban planners and river managers, successful stewardship of rehabilitated urban rivers works best with the involvement and active participation of local residents and stakeholders thus delivering a range of social, ecosystem-service and amenity benefits. To deliver this vision, integrated decision making tools are needed in order to target limited resources at the most cost effective solutions for social and environmental gain.

This presentation considers how such integrated restoration projects can improve both ecosystem services and ecological potential in urban river reaches and the extent to which the Urban River Survey (a modification of the River Habitat Survey for urban rivers) can offer an effective decision making tool for the selection and subsequent monitoring of suitable restoration sites.

Drawing upon examples of pre- and post-restoration sites located on urban tributaries in the Thames catchment, this presentation will:

- describe how the URS can be used to provide a rapid assessment of habitat condition of urban river reaches or ‘stretches’ of a specific engineering type.
- discus the ways in which the URS can be used to support the planning stages of urban river restoration projects
- examine the wider role of URS in the monitoring of pre- and post-restoration sites on urban rivers in a longer term management context.

MERSEY LIFE – INTEGRATING RIVER RESTORATION INTO REGIONAL AND LOCAL PLANNING.

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***Peter Worrall** and **Gene Hammond**; Penny Anderson Associates Ltd, Park Lea, 60 Park Road, Buxton, Derbyshire, SK17 6SN, England.*

***Martin James**; Environment Agency, North West Region, Central Area Office, Lutra House, Dodd Way, Walton Summit, Bamber Bridge, Preston, Lancashire, PR5 8BX, England.*

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Described as 'the river that changed the world' [2] the Mersey has been at the heart of the evolving cultural landscape of the north-west, from the Pennine fringes to the Irish Sea coast. An axis of manufacturing and trade during the Industrial Revolution the River Mersey continued to be at the heart of the economic growth of the region into the 20th Century. However, this came at a great cost to the river in terms of pollution, leaving the system as the most polluted and degraded in Europe. However, the past 25 years has seen a turn round in water quality, with the river now supporting salmon in some limited reaches. Despite the success of dealing with water quality the river and its corridor still have a legacy of poor and fragmented habitats, extensive flood defences and an adjacent population of 5 million who largely turn their backs on the river.

To address this, The Mersey Life Project was developed. This Project is seeking to realise the socio-economic and ecological potential of the river and its main tributaries by making it a great place for people and wildlife. Similar aspirations have been developed for other rivers, such as The London Rivers Action Plan, but what sets Mersey Life apart is the integration of a catchment wide complex of schemes to bring people and wildlife back to the river, in a regional and local green infrastructure planning framework. River restoration in the UK has largely beena piecemeal affair with relatively small scale projects capitalising on opportunities thrown up by the development process; for example on the back of flood risk management programmes, or as part of limited local authority and community scheme. With Mersey Life, a Portfolio of projects has been created which together or as individual schemes contribute to the visions and strategies enshrined in green infrastructure planning across the whole of the north-west. This strategic approach adds weight to projects and proposals for habitat restoration and amenity access improvements, making them more attractive to local authorities and other potential commercial funders.

The Portfolio of projects for Mersey Life contains over 160 schemes which, for example, involve the restoration of 400 hectares of flood plain, 35 km of river channel and 870 hectares of riverine woodland management. Integrated with this are 100 schemes to enhance access and recreation including improved fishing access to 60km of river and schemes to introduce art and address safety issues along urban reaches of the river. Many of these projects cross local authority boundaries but are unified by the role they play in contributing to green infrastructure planning. The Portfolio approach also assists in developing collaborative processes and partnerships between key agencies and interest groups.

In essence this presentation uses the Mersey Life Project as demonstration of how river restoration for both people and wildlife is best facilitated through being part of strategic green space planning.

[2] Mersey - the river that changed the world – 2007. Published by Bluecoat Press ISBN 1 872568 55 5

THE TRIALS AND TRIBULATIONS OF STRATEGIC RESTORATION PLANNING ON THE RIVER AVON SAC

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The River Avon which arises on the Wiltshire chalk and flows through Hampshire to Christchurch, is designated as a SAC for it's chalk stream habitat and below Salisbury, lies within the Avon Valley SPA, home to wintering Gadwall and Bewick swans. The Ramsar and SSSI interests include nesting birds and the fish communities as well as the associated wetland habitats. Both river and floodplain have a long history of modification from Roman times to the recent years, resulting in an over widened and over deepened channel, impounded and managed by many structures through its length. As a managed mixed and game fishery, opportunistic river restoration has been carried out by riparian occupiers since 1990s and in the last 3 years, the STREAM project has restored 6 demonstration stretches with LIFE funding.

In order to plan catchment scale restoration work from 2009, particularly by the Environment Agency (EA), and to direct future financial support a strategy or framework for restoration was needed. In August 2008, a project was let through the Wessex Chalk Stream Project (WCSP) to develop a strategic framework. The WCSP provides advice for riparian management on the River Avon is a partnership between the EA, Natural England and Wessex Water, Wiltshire Wildlife Trust and the Wiltshire Fisheries Association. These organisations formed a steering group with Hampshire Wildlife Trust. The project was let to Halcrow and GEODATA using a specification developed by Natural England for the pilot strategies. The Avon strategy will be completed in November 2009.

This paper reviews the successes and frustrations of developing a strategic framework as an aid to implementing river restoration in order to achieve favourable condition. Particular reference is made to:

- The development of a shared vision for the river
- Identifying the interested parties for the consultation phase and timing of consultation
- Communicating the objective of this project (as distinct from the ongoing projects on water quality, abstraction, water level management and the EA Catchment flood management strategy for the Avon and the first River Basin Management Plan phase).
- Obtaining land owner buy in for future implementation
- Meeting the needs of all of the SAC designation features and those of the SPA

The programme and funding are discussed and recommendations given for future restoration strategies.

EVALUATING THE BENEFITS OF RIVER RESTORATION: A CUMBRIAN PERSPECTIVE

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***Maggie Robinson**; Natural England, Juniper House, Murley Moss, Oxenholme Road, Kendal, LA9 7RL, England.*

***Suzie Maas**; Jacobs, Fairbairn House, Ashton Lane, Sale, Manchester, England, M33 6WP, England.*

Defra has a Public Service Agreement (PSA) target (3) to restore 95% of SSSIs by area in England & Wales into 'favourable/unfavourable recovering' condition by 2010. Physical modification is a contributory reason for which 18 river SSSIs in England are assessed as being in Unfavourable Condition and therefore, requiring a river restoration strategy. This work within the Eden, Derwent and Kent catchments is aiding the achievement of this target for 2010 and beyond. It is also helping to fulfil WFD objectives as Natura Protected Areas comprise some of the highest priority sites in the current river basin characterisation programme.

This project is a partnership between the Environment Agency and Natural England and has involved a geomorphological and ecological survey of over 400 km of rivers within the three Cumbrian catchments. The consultants, Jacobs, are undertaking the study.

The majority of these reaches are classified as failing due to physical modification. However, all are SSSIs and have SAC status, despite being classified as unfavourable due to physical modification. The question then remains as to the scale of the problem and the potential for river restoration. Land use and the topical issues of food production and the rural economy remain challenging constraints to address.

This paper will present the joint geomorphological and ecological appraisal undertaken to identify the scope of the problem. This project has set itself the challenging target of defining the ecological/geomorphological links explicitly rather than making assumptions about ecological value based on geomorphological characteristics. Catchment restoration visions and plans for physical restoration measures to attain favourable condition within each reach (as required by Natural England guidance), will then be discussed for each of the three rivers. Responsibilities and potential delivery mechanisms for restoration will also be considered and an evaluation of this strategic approach to future river restoration presented.

RIVER RESTORATION CONFERENCE WORKSHOPS

1: FORECASTER and River Rehabilitation
Langwith college (Room LN002)

Ian Cowx *(University of Hull)*
Martin Janes *(River Restoration Centre)*
Tom Buijse *(Deltares)*
Natalie Angelopoulos *(University of Hull)*

The framework of the FORECASTER *(Facilitating the application of Output from REsearch and CAse STudies on Ecological Reponses to hydro-morphological degradation)* project will be introduced, in particular the web-based support tool, for illustrating rehabilitation measures used in project partner countries in Europe. The project aims to link science with practical implementation of robust, cost-efficient rehabilitation strategies. The session aims to debate key criteria used for selecting the most appropriate measure(s) for bringing rivers to good ecological status and the importance of these when developing a decision support tool for managers. An interactive discussion will discuss how to ensure the project meets the aspirations of end-users and stakeholders.

2: Hyporheic Zone and River Restoration
Langwith college (Room LN047)

David Lerner *(Catchment Science Centre, University of Sheffield)*
Stefan Krause *(University of Keele)*
Geraldene Wharton *(Queen Mary, University of London)*
James Holloway *(River Restoration Centre)*

River restoration may affect the hyporheic zone and alter the exchange between surface water and groundwater. The workshop will aim to draw together potential users of the recently published Hyporheic handbook with the author and researchers to promote the transfer and development of knowledge and best practice. Some of the key discussion topics are as follows:
* How are these changes controlled by morphology and geology?
* Are the changes beneficial or damaging for water quality and ecology?
* How might these changes have an impact on river restoration aspirations?

3: Appraisal Guidelines for River Restoration
Langwith college (Room LN036)

Jenny Mant *(River Restoration Centre)*
Judy England *(Environment Agency)*
Di Hammond *(River Restoration Centre)*

With any river restoration work there is a need to measure the success or failure of the scheme. Practical River Appraisal Guidance for Monitoring Options (PRAGMO) is aimed at assisting practitioners in setting suitable monitoring protocols. The assessment may be quantitative, or it may be qualitative. By using this knowledge in future projects, uncertainty as to what are the best methods to use is reduced and the risk of failure of the scheme is reduced. The monitoring assessment should answer the question ‘was the project successful’ i.e. ‘did it achieve its objectives?’ Hence SMART objectives need to have been set in the first instance. The interactive workshop will actively engage participants in understanding the set out protocol.

RIVER RESTORATION CONFERENCE SITE VISIT
THURSDAY 15TH APRIL 2010 DAY TWO

TANG HALL BECK

Tang Hall Beck is an example of a rural beck flowing into an urban area that retains many rural features in some section, but has been badly degraded in other sections. It has to fulfil the roles of land drainage, public amenity and green urban space but also poses a flood threat, is subject to low flows and is subject to fly tipping. Some sections have been culverted and there has been pressure to culvert other sections, largely to prevent fly tipping.
The EA's biodiversity team aim is to retain the rural characteristics and the floodplain and to restore the degraded sections where possible.

Tang Hall Beck just before it meets the River Foss

Tang Hall beck in flood

Heworth Holm in flood conditions

Heworth Holm in the upper reaches of Tang hall beck is a site of six acres of wet grassland alongside the Tang Hall Beck, and a small wood on higher ground. It is a remnant of old countryside in the town, protected from development by its regular winter flooding.

ESTUARY EDGES: ECOLOGICAL DESIGN GUIDANCE

***Antonia Scarr**; Environment Agency, Thames Region, South East Area Office, Swift House, Frimley Business Park, Frimley, Camberley, Surrey, GU16 5SQ, England.*

Well-planned developments next to our estuaries can create better places to live and work. When reconstructing or refurbishing the banks of an estuary this guidance helps engineers, architects and ecologists to include features that support wildlife, improve public access, and educate people about the importance of protecting the environment.

Replacing grey sheet piling with lush colourful plants and swards of reed stems rustling in the wind add significantly to the waterside experience. The natural habitats of our estuaries are often missing, especially in urban areas. For example, in the Thames Estuary only around 2% of the tidal banks are now natural in profile. The absence of the soft edges, where wildlife is most abundant, impacts on the ecological recovery of our estuaries and aquatic ecosystems.

Improving lengths of estuary habitat can restore nursery areas for commercially sought fish, such as Sea Bass. It can also benefit recreationally important fish such as Dace and Roach. By seeking refuge in the margins during the flooding tide, juvenile freshwater and marine fish are safer from predators and can feed on the aquatic insects that are abundant in the plants and mudflats.

Government guidance on biodiversity now requires developers to protect and enhance biodiversity in their schemes, particularly priority habitats such as mudflats and saltmarsh. Through delivery of legislation such as the Water Framework Directive industry needs guidance on how to develop without degrading the aquatic environment.

The guidance looks at design considerations, different engineering methods and highlights the need for monitoring and aftercare. It explains methods where, plants are essential for the long-term integrity of the water's edge with very little 'hard engineering' needed to how to create habitat on hard engineered walls.

The guidance was developed by the Environment Agency through a project co-ordinated and steered by the Thames Estuary Partnership. Importantly there were a number of different organisations involved in developing the guidance.

VALUE OF LARGE WOODY DEBRIS IN EROSION MITIGATION AND MORPHOLOGICAL ENHANCEMENT: A CASE STUDY OF RIVER CHURNET, STAFFORDSHIRE

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***Neil. S. Entwistle** and **Rhys Kibble**; University of Salford, School of Environment and Life Sciences, Peel Building, Manchester, M5 4WT, England.*

***Julie Wozniczka**; Independent consultant.*

Large woody debris was an integral component of UK gravel bed rivers prior to large scale engineering works involving desnagging and general conveyance improvement. Large woody debris dams develop through natural processes involving bank erosion, tree fall and debris trapping and have been demonstrated to enhance geomorphological and ecological diversity. Over the last decade various attempts have been made to reintroduce large woody debris into rivers. This paper reviews the effectiveness of engineering works on the River Churnet, where woody debris has been reintroduced to the river system in order to provide bank protection through flow deflection and encourage sedimentation through velocity reduction. Erosion at the site is prevented though installation of a primary large woody debris deflector at the upstream entrance to the bend and secondary flow retard structures along the outer bank. Scheme design was informed by an assessment of the local dynamic geomorphology which predicted reduced flows around the outer bank following the development of an inner bank chute channel across a wooded floodplain area. The large woody debris structures were tested only one week after installation following a bankfull event. The river reacted to this flow in the way predicted by the study and other bank erosion was negligible. Post event assessment of local habitat character revealed a considerably enhanced geomorphological diversity improving the environmental, ecological and aesthetic value of the reach. It is clear by undertaking an assessment of the dynamic geomorphology that large woody debris design was optimised to work with river process to achieve the designed environmental and engineering outcomes.

A RIVER RUNS THROUGH IT – THE IMPORTANCE OF LANDSCAPE CONTEXT IN RIVER RESTORATION.

***Claire Thirlwall**; Thirlwall Associates, 57 Church Street, DIDCOT, OX11 8DG, England.*

As river restoration professionals we are used to considering many factors when planning a project. One aspect that can sometimes be overlooked is the landscape context of the river. The landscape context can include the social, cultural, historical and even the emotional importance of the setting.

Our perceptions of the landscape change with our experiences. We often have strong memories and feelings about places we visited as children only to find the same places seem quite different when we visit as adults. Rivers are at the heart of our culture, from films to books to historic events.

When working in an unfamiliar landscape we may personally perceive it as of low value or judge it solely in relation to our specialism. It may not be classed as nationally or even regionally important by the local planning authority and there may be no significant wildlife designations. However, to those who live and work in that landscape there may be other factors that are just as important and it is our responsibility to understand these perceptions as fully as possible.

The importance of these issues has been recognised by the creation of the European Landscape Convention (ELC). Created by the Council of Europe, the Convention promotes landscape protection, management and planning, and European co-operation on landscape issues.

The Convention applies to all landscapes, towns and villages, as well as open countryside; the coast and inland areas; and ordinary or even degraded landscapes, as well as those that are afforded protection. The European Landscape Convention (ELC) is the first international convention to focus specifically on landscape. Signed by the UK Government in February 2006, the ELC became binding from March 2007.

The ELC defines landscape as:
"An area, as perceived by people, whose character is the result of the action and interaction of natural and/or human factors." (Council of Europe 2000)

This paper makes use of thought provoking images and cultural references to

- Explain why assessing the perception of the landscape is so important
- How public perception of a landscape relates to river restoration projects and
- Techniques for recording and acting on these perceptions.

LINKING ENVIRONMENTAL IMPACT ASSESSMENT, HYDROMORPHOLOGY AND THE WATER FRAMEWORK DIRECTIVE: THE POTENTIAL FOR RIVER RESTORATION.

Sally-Beth Kelday *and* ***Andrew Brookes****; Jacobs, School Green, Shinfield, Reading, RG2 9HL, England.*

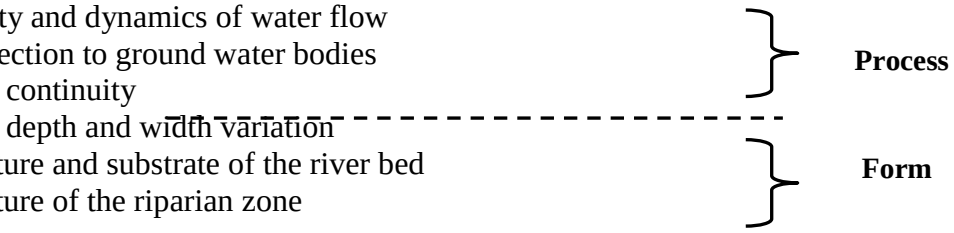
Duncan Wishart*; Jacobs, 1 City Walk, Leeds, LS11 9DX, England.*

Introduction

The aim of this paper is to consider how the hydromorphological elements of the Water Framework Directive (WFD) can practically be addressed in UK Environmental Impact Assessment (EIA). A proposed working methodology for compliance with the WFD (in line with the EU Common Implementation Strategy) in EIA is put forward. This paper outlines some examples of where this method has been used on rivers at project level and what river restoration techniques/ mitigation measures have been proposed as a result.

Linking EIA to Hydromorphology

The proposed assessment methodology is based on the sensitivity of the receiving watercourses and a classification of the magnitude of impact as a result of a planned development. It draws on existing methods such as those used for defining the geomorphological conservation status of a channel described in the DEFRA Guidebook for Applied Fluvial Geomorphology. The significance of impacts, both negative and positive, can then be assessed and appropriate mitigation and enhancement determined. The key hydromorphological parameters considered under the Water Framework Directive are separated into fluvial processes and forms and this underlies the basis of the assessment:



Mitigation and Enhancement

Input to the design of projects to minimise impacts in the first instance is key but there are often opportunities for river restoration as mitigation for geomorphological, ecological or landscape impacts. This includes opportunities to implement measures that are identified in the River Basin Management Plans.

Project Examples

This methodology has been use on several projects including: a road widening scheme in England were the creation of a backwater channel and improved floodplain connectivity are now part of the design; flood defence works in England where a discrete river restoration scheme is proposed as mitigation; a new bypass route in Scotland that is subject to CAR and where environmentally sensitive designs have been incorporated with particular focus on sediment movement due to site sensitivities; a road scheme in Ireland where sympathetic stream realignment will lead to an improvement in the quality of the watercourse compared to the baseline condition. Specific case studies will be used to demonstrate this approach.

APPLICATION OF NEW BIOTIC INDEX (PSI) TO ASSESS THE EFFECTIVENESS OF RIVER RESTORATION SCHEMES ON IN-STREAM BIOTA

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***Chris Extence** and **Richard Chadd**; Environment Agency, Anglian Region, Northern Area, Steppingstone Walk, Winfrey Avenue, Spalding, Lincolnshire, PE11 1DA, England.*

A change in substrate composition of a channel is one of the key features associated with a river restoration scheme. There are few established methods of assessing the ecological response to this physical change. The development of a new silt-sensitive invertebrate metric (PSI- Proportion of Silt-intolerant-Invertebrates), which acts as a proxy to describe temporal and spatial siltation impacts, may assist in this assessment.

The PSI score is derived from assigning individual species and families of British benthic macroinvertebrates to one of five silt- tolerance groups and assigning each taxa a score based on their abundance. The metric is then calculated using the following below.

$$PSI\ (\Psi) = \frac{\varepsilon \text{ Sediment Scores for Tolerance Groups A \& B}}{\varepsilon \text{ Sediment Scores for all Tolerance Groups A, B, C \& D}} \times 100$$

PSI scores will range from 0 (entirely silted river bed) to 100 (entirely silt-free river bed). PSI scores may be standardised by utilising the predictive programme RIVPACS (Wright *et. al.* 1984) which models the unstressed invertebrate community expected at a site from that site's physical and chemical characteristics. The sampled communities PSI index can then be compared to that expected, by deriving observed over expected Environmental Quality Indices (EQI's). PSI, EQI's provide a simple way of assessing site condition (the lower the ratio, the greater the sedimentation stress) and enable direct spatial comparisons.

Application of the PSI to data collected during the assessment of two river restoration schemes within Hertfordshire suggests that the metric will be useful in assessing the response of in-stream biota to the physical changes. These examples are presented in more detail.

Reference:

Wright J.F., Moss D., Armitage P.D. & Furse M.T. (1984) A preliminary classification of running water sites in Great Britain based on macro-invertebrate species and prediction of community type using environmental data. *Freshwater Biology* **14**, 221-256.

AN INTEGRATED APPROACH FOR RESTORING MEDITERRANEAN RIVER SYSTEMS: HABITAT QUALITY, BIOLOGICAL INDICATORS AND APPROPRIATE RESTORATION TECHNIQUES.

Samantha Jane Hughes, ***Rui V. Cortes*** *and* ***Simone G. Verandas****; Centre for the Research and Technology of Agro-Environment and Biological Sciences, Trás-os-Montes e Alto Douro University, 5000-911 Vila Real, Portugal.*

Maria Rosário Fernandes, ***Isabel Boavida***, ***José Maria Santos*** *and* ***Maria Teresa Ferreira****; Forest Research Centre, Superior Agronomy Institute, Technical University of Lisbon, Lisbon, Portugal*

The Odelouca River, an intermittent Mediterranean system situated in the Algarve region of Portugal has valuable stands of riparian vegetation. Compulsory implementation of compensatory restoration measures along selected reaches has been implemented following construction of a dam to meet increasing water supply in the region. Mediterranean rivers are characterized by a strong annual cycle of flood and drought that varies in intensity according to rainfall levels. This regime is an extremely strong environmental filter, shaping biological community traits and constituting a potential source of environmental covariance concerning biotic reactions to anthropogenic pressures. Primary environmental and anthropogenic "pressures" were assessed using data collected from 30 sites in the field using River Habitat Survey and desk top analysis of GIS data. Extensive collections or observation of groups of key biological elements (benthic macroinvertebrates, fish, birds and macrophytes) were also made at each site, together with physicochemical data. The KT Method was used to produce a map of "River Corridor Conservation Status". Reaches defined using geographic and hydrogeomorphological variables were assessed according to anthropogenic pressures: concordance of biological and habitat quality variables from the sample sites gave promising results. Typologically appropriate ecological monitoring of the effect of 'pressures' based on appropriate indicators (relative abundance and selected metrics) from the four biological communities was assessed. Principal components analysis of non redundant variables revealed scale-dependent longitudinal differences in valley form separating narrower upstream sites and tributaries with good quality habitats from more open degraded sites downstream. Large scale pressures described changes in land use related to agriculture with associated physical bankside and channel impacts. Redundancy analysis (RDA) forward selection indicated that environmental variables were selected more frequently than pressure variables for all groups. Very high collinearity occurred with altitude and pH both within and between groups, demonstrating essentially longitudinal structural and functional distribution patterns. Redundancy was lower between selected pressure variables, but single or no pressure variables retained for some groups indicated poor association with the identified pressures: RDA results clearly showed that larger, mobile organisms (birds and fish) provided a reliable link between organism group, environmental factors and physical disturbance of the channel, bankside and wider river corridor. Benthic macroinvertebrate and macrophyte structural data revealed distribution patterns in relation to water velocity, a key parameter for developing appropriate compensation measures. Based on fish habitat preference data, five scenarios for river restoration have been developed, with a view to improving endemic fish habitats and riparian habitat restoration.

WHERE WEIRS WERE: A LOOK AT THE BENEFITS OF WEIR REMOVAL

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Eckart Lange*; University of Sheffield, Department of Landscape, Crookesmoor Building, Conduit Road, Sheffield, S10 1FL, England.*

Weir removal is commonly advocated as a river restoration measure. It is also a proposed draft River Basin Management Plan (dRBMP) action for achieving the Water Framework Directive (WFD) objective of reaching Good Ecological Status for river ecosystems. The assumption that weir removal will result in an improvement in river ecological quality and be of net benefit to stakeholders often appears to be unquestioned.

We review how impoundment by weirs and weir removals affect river ecology, and the provision of ecosystem services, using the Don Catchment, South Yorkshire, as a case study. It is found that the benefits of weir removal are not clear cut. Removal increases the provision of some ecosystem services at the expense of others. The same applies to measures of ecological health. However there is a lot of uncertainty as the impacts of weirs on some ecosystem processes aren't clearly understood. Also it is noted that impacts of removal are highly dependent on a weir's biotic, physical, economic and social context. Therefore the costs and benefits of weir removal must be considered on an individual weir basis, while maintaining a strategic overview that accounts for the effect of multiple weirs on catchment wide processes, such as fish migration. Further it is concluded that by focusing on weir removal to achieve Good Ecological Quality, the WFD may underemphasise some ecosystem services provided by rivers. The removal of weirs is a trade-off situation, not necessarily improving the provision of all ecosystem services, natural processes or fish populations. It is clear further research is required before we can be confident in impact assessments of weir impoundment and removal.

RIVER RESTORATION IN COMBINATION WITH CONTROLLED REMOVAL OF FIXED WEIRS
A CASE STUDY IN THE NETHERLANDS: GAMMELKERBEEK

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A. Toine. F. M. Tünnissen*; Netherlands Land Development Agency DLG, the Netherlands.*

The Netherlands Land Development Agency (DLG) and the eastern Waterboard (Regge & Dinkel) initiated restoration of small rivers in the Netherlands as a response to the European Water Framework Directive.

Restoration of one of the steep rivers in the eastern part of the Netherlands, the Gammelkerbeek, was considered a major pilot for restoration of comparable rivers in future. Royal Haskoning carried out this pilot study and came up with innovative solutions for sufficiently controlling the river in a morphological way after removal of a large number of fixed weirs, whilst optimally providing natural conditions for nature restoration.

Typically, the Water Framework Directive urges the rivers to become more natural again and as a consequence fixed weirs have to be removed, the rivers re-meandered, ecological connection zones restored and vegetation zones introduced. An impression of the targeted changes is shown in the figures below.

present situation

future situation

The basic concept is to remove the weirs and to raise the river bed level considerably, whilst maintaining flood levels below their present maximum. However, when the weirs would be removed without countermeasures, the river would experience strong vertical degradation in the upstream. This would lead the opposite of the desired increase of water tables in the cathment and, hence, cannot be considered acceptable.
The solution was found in introducing maximum small scale meandering (denoted micromeandering) in combination with applying morphological ‘controllers’ that fix the bed at certain intervals and introduce sufficient energy losses in the river at the same time as to compensate for the removal of the weirs. After extensive elaboration, the most natural concept for these controllers was arrived at: small dams consisting of low spur dikes with a vertical slot in the middle. These controllers have been designed such that they are excellent fish pass weirs as well. The paper will especially zoom in on the detailed design of these controllers.

REINTRODUCING SPATE FLOWS TO IMPOUNDED RIVERS – MEASURING THE ECOLOGICAL IMPACTS OF SHORT-DURATION RESERVOIR RELEASES

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The majority of UK rivers are impounded, often by large reservoirs. These impoundments remove natural variations in flow patterns, preventing or diminishing the floods and droughts which are important for ecosystem maintenance. This paper examines the possibilities for re-introducing spate flows to impounded Yorkshire rivers, and examines the impacts of short-term reservoir releases and trial spate flows upon the downstream biota in two upland millstone-grit catchments. The study used PIT technology to track the responses of 300+ brown trout as well as monitoring quantitative and qualitative changes to macro-invertebrate populations. A suite of physio-chemical measurements were taken during the reservoir releases to monitor changes in water quality, sediment content etc. Flow changes were modelled across high-resolution maps of the river bed to investigate explanations for any ecological responses. The study found no negative impacts of the reservoir releases and suggests that it would be possible to re-introduce regular seasonal spate flows in these catchments, and that they may have beneficial effects to downstream fish and invertebrate populations.

QUANTITATIVE MONITORING OF RIVER RESTORATION: REVIEW OF TECHNIQUES FOR FUTURE APPLICATION

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***Joanna Eyquem**; Royal Haskoning, previously Burns House Harlands Road, Haywards Heath, RH16 1PG, England. Now resides in Canada.*

Demonstrating Strategic Restoration and Management (STREAM) was a £1 million, four-year conservation project centred on the River Avon and the Avon Valley in Wiltshire and Hampshire, The River Avon and its main tributaries are designated as a Special Area of Conservation (SAC), and the Avon Valley is designated as a Special Protection Area (SPA) for birds. Under the STREAM project, completed in September 2009, river restoration schemes were implemented at six locations within the River Avon catchment on the Rivers Avon, Wylye, Nadder and Dockens Water.

One of the key objectives of the STREAM project was to monitor the physical changes occurring as a result of the restoration scheme and compare the findings with biological conditions pre and post scheme to begin to identify possible linkages between morphology and ecology. A monitoring protocol was established to record physical and biological conditions pre- and post-restoration including qualitative monitoring for all sites with additional quantitative monitoring at two sites - Upper Woodford and Seven Hatches. Quantitative monitoring at Seven Hatches has been continued under the Environment Agency's "Managing Hydromorphological Pressures in Rivers" project to appraise the effectiveness of river restoration.

This paper will present key findings from quantitative monitoring to date to inform future monitoring of other river restoration schemes. Findings to be presented include:

- Conclusions drawn from the quantitative monitoring undertaken regarding the success of river restoration techniques at Seven Hatches.
- Practical lessons learnt to inform future quantitative monitoring of river restoration effectiveness.
- Discussion of the limitations and constraints associated with quantitative monitoring.
- Suggestion of where, when and how quantitative monitoring can be best used to evaluate the success of river restoration.
- Discussion of how qualitative monitoring techniques can be used to complement quantitative monitoring.

MONITORING RIVER RESTORATION PROJECTS: LESSONS FROM THE SHOPHAM LOOP PROJECT, WEST SUSSEX

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Karen Fisher*; KR Fisher Consultancy Ltd, 4 Stokes Croft, Haddenham, HP17 8DU, England.*

Charlie Smith*; Environment Agency, Southern Regional Office, Guildbourne House, Chatsworth Road, Worthing, Sussex, BN11 1LD, England.*

It is generally agreed that there is a need to monitor river restoration projects, both for the detection of changes which may require management intervention, and to appraise the success or failure of the techniques used, such that lessons learnt can feed forward to future applications. However, a combination of limited funding and the fact that schemes are often opportunistic and involve many different parties has meant that effective and appropriately designed monitoring is not the norm. Monitoring of the Shopham Loop project (reprofiling and reconnection of a historically bypassed and subsequently silted-up meander in West Sussex) was designed to be an integrated and holistic assessment, sensitive to changes in geomorphology; hydrology and hydraulics; the ecology within the channel; and ecology of the surrounding landscape. Among the aims were to shed light on on the drivers of these changes, and on best practice for the design of future monitoring programmes. The following datasets were compiled:

	Before	As built	2005	2006	2007	2008	2009
Topographic survey [1 2]	+	+	+	+			+
Fixed-point photography [3]			+++	+++	+++	+	
15-minutely water levels [3]			+	+	+	+	+
Invertebrate kick samples [3]	+		+	+	+		+
Electro-fishing [3]			+	+	+		+
Macrophyte survey [3]			+	+	+		+

[1] Halcrow Geomatics [2]Southampton University [3]Environment Agency

Much of these data have now been analysed, and they show the evolution of more complex cross-sections and physical habitat; increased floodplain inundation; increased invertebrate biomass; and changes in fish and invertebrate community structure. However, data collection problems have limited the assessment of the project's success. Furthermore, a lack of explicit links to the original objectives, which themselves were not defined in a measurable, quantitative way, has been a significant obstacle to this assessment. Despite this, many a lesson has been learnt from this project which should be beneficial for future appraisal exercises. These include issues related to small problems of inconsistency between years in data collection methods, particularly in terms of methodological details (e.g. location and timing of sampling). This can result in cumulative impacts that disproportionately affect the analytical power of the data. Consequently, the value of planning a detailed and robust monitoring scheme, well in advance of works, becomes clear. It is suggested that responsibility for the management of this be assigned to a single person.

Given the importance of setting specific, measurable objectives, and yet the difficulty of predicting the course a restoration project will take, on top of often tight financial constraints, the RRC are currently working on distilling the technical aspects of lessons learnt from this project, a review of research and first-hand experience, into pragmatic guidelines to aid objective setting and monitoring design – the PRAGMO project.

THE PHYSICAL RESTORATION OF SSSI RIVERS IN ENGLAND

***Jenny Wheeldon**; Natural England, Prince Maurice Court, Hambleton Avenue, Devizes, Wiltshire, SN10 2RT, England.*

Jenny is also speaking on behalf of the Environment Agency

In 2005, English Nature (the predecessor body to Natural England) embarked on a process of developing strategic physical restoration plans for English rivers designated as Sites of Special Scientific Interest (SSSIs), working in close collaboration with the Environment Agency. This work formed part of a range of initiatives and activities aimed at achieving the Favourable condition of the SSSI series as a whole.

The process of developing these plans was described in a poster presented at the 2006 River Restoration Conference in Edinburgh. This talk provides an updated look at the work that has been undertaken since that time, including: learning from the lessons of early pilot studies; gaining acceptance of the problem and building trust in the solution; and an overview of progress in rolling out the planning process and implementation of restoration on to SSSI rivers most in need of physical restoration measures.

This story reflects the considerable difficulties involved in making the transition from small-scale, piecemeal restoration schemes to large-scale restoration working as closely as possible with geomorphological processes. Potential institutional, socio-economic and technical barriers to progress remain at national and local scales; however the recent appointment of a joint Natural England/Environment Agency officer has helped the initiative gain momentum.

Twenty one whole river restoration plans are under currently under development, and substantial funds have been allocated by the Environment Agency for SSSI river restoration between 2010 and 2014. Restoration of upland rivers presents particular challenges, particularly as agri-environment schemes cannot currently accommodate mobile river systems.

The roll out of restoration planning on SSSI rivers will greatly increase confidence in a large-scale, strategic approach to river restoration, and feed into decision-making about restoration of the wider river network under the EC Water Framework Directive.

For more information please view the poster “Making progress with the physical restoration of SSSI rivers” or contact Jenny Wheeldon.

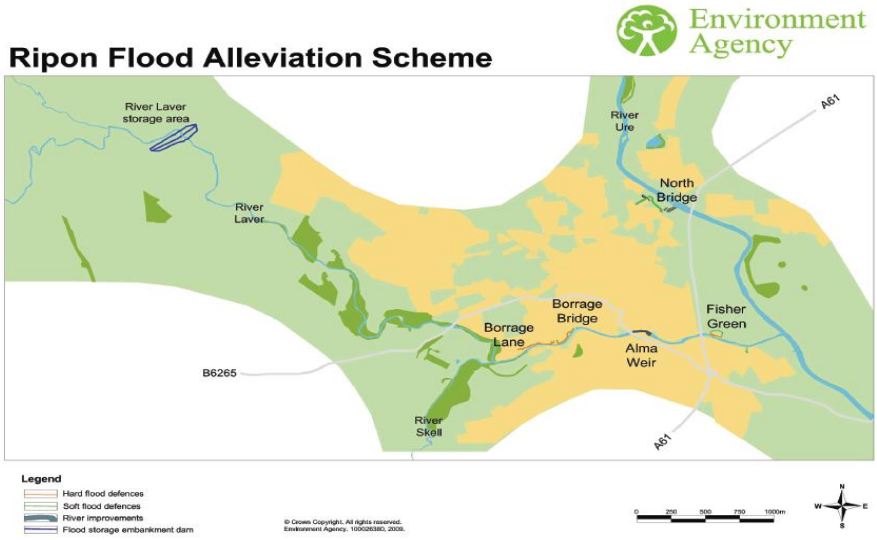
RIVER RESTORATION CONFERENCE SITE VISIT – SITE A
FRIDAY 16TH APRIL 2010 DAY THREE

BIRKBY NAB FLOOD STORAGE RESERVOIR

Ripon has a long history of flooding because it is located at the confluence of the Rivers Laver, Skell and Ure. The Environment Agency is carrying out a £14.4m defence scheme for the city, which has been badly hit by flooding in the past - most recently in 2005 and 2007. The scheme includes a flood storage reservoir which is being built at Birkby Nab Dam on the River Laver. Works within the town will include;

- Building flood defences at Borrage Lane specific to each property
- Walls and embankment will be built along the River Skell at Fishers Green
- Roads will be raised and an embankment built at North Bridge
- Alma weir will be replaced with a new gauging station.

The Birkby Nab dam is a very significant part of the scheme and will reduce water levels in the town during a flood by between 0.3-0.6 metres depending upon the location in Ripon. This means that the flood alleviation works within town can be much lower than they would need to be without the dam.
The Birkby Nab dam and the alleviation works within the town will significantly reduce the flood risk for 548 homes and 96 commercial properties.



The earth dam for the new reservoir at Birkby Nab on the River Laver will be about 400 metres long, up to 90 metres wide and nine metres high. When full, the reservoir will hold around a million cubic metres of water, which is enough to fill 400 Olympic-sized swimming pools.

Artists' impression of the completed dam

GALPHAY MILL, RIVER LAVER

The Galphay Mill site is on the River Laver just upstream from Birkby Nab. The site was modelled as part of the DEFRA project - Restoring Floodplain Woodland for Flood Alleviation. It followed on from the existing Ripon Multi Objective Project (MOP). The Restoring Floodplain Woodland for Flood Alleviation Project set out to appraise the impact of planting floodplain woodland on flood flows and flood risk at Ripon and assess the influence of woodland design and management factors on flood flows and the effect on flood depth, storage, velocity and timing.

Modelling results showed there was a benefit in planting woodland. The site the land owner was interested in the modelling results but remained concerned about the effect of woodland planting on local views. A way of mitigating these possible impacts was identified by restricting planting to the lower lying wettest parts and avoiding areas of raised ground. While this limited the area of planting to around 6 ha it would comprise the best ground for flood mitigation and thus was still worth pursuing.

The landowner's main concern, however, was the loss in capital value of the planted land. This was despite the fact the summer floods of July 2007 had led to the River Laver changing course at Galphay Mill exploiting relic side channels necessitating major restoration work. The landowner felt that he would still be better off restoring the land to wet grassland and applying for HLS grant than converting to floodplain woodland. A grassland cover would preserve the capital value of the land and the option of switching back to cereal cropping at a later date. He did not completely rule out woodland planting but wanted compensation for any loss in value and acknowledgement for any flood mitigation provided to downstream beneficiaries. The funding offered for woodland planting would barely cover his costs but more importantly, the farm woodland payments would cease after 15 years.

Soil erosion caused by July 2007 flooding


Galphay Mill site in February 2010 area of soil erosion is now grassed over with a grass buffer strip running parallel to the river

DATES FOR YOUR DIARIES:

RRC Training Course
Understanding River Restoration

Please contact the Centre with a statement of interest.

Dates and location TBC

Please contact Ian Brown at the Centre for more information

River Restoration Centre
Annual Networking Conference
2011

University of Nottingham

Provisional Dates:

Tuesday 12th April to
Friday 15th April 2011.

Call for abstracts will be sent out in July

We would appreciate it if you would spend 5 minutes filling in this form so that we can take suggestions/comments into account when organising next year's event.

<table>
<tr><td>1. What did you expect to learn or gain from the Conference?</td><td rowspan="2">6. How did you travel to the conference?
❑ Car
❑ Train
❑ Bus / Coach
❑ Plane
❑ Other ……</td></tr>
<tr><td rowspan="2">2. Have your expectations of the Conference been fulfilled?

If not was it useful anyway?

Would you recommend to a colleague?
Yes/No</td></tr>
<tr><td>7. This year there were workshops to encourage debate on specific topics.
Next year would you prefer:
❑ Workshops
❑ More papers
❑ No preference</td></tr>
<tr><td>3. Are there any themes or topics that you would like to see presented next year when we return to Nottingham?

By yourself

By others</td><td>8. Were the discussion sessions long enough, and frequent enough?

9. Would you be interested in:

A) Details for next year's conference? Yes/No

B) Presenting a paper at next year's conference? Yes/No</td></tr>
<tr><td>4. How did you hear about the Conference?

❑ RR News (RRC newsletter)
❑ Flier sent to me by email/post mailshot
❑ Info passed on by my colleagues
❑ Other
(please state)……</td><td>10. Any additional comments or suggestions</td></tr>
<tr><td>5. Were the venue, facilities and location suitable?

If not, please comment.

How did the service compare to others?</td><td>If you would like to discuss comments further please provide your name and organisation:

Name……

Organisation……</td></tr>
</table>