Urban Catchment Forestry:

The strategic use of urban trees and woodlands to reduce flooding, improve water quality, and bring wider benefits

“Urban Watershed Forestry has developed in the United States over the last 10-15 years in response to the need to improve water quality and manage flooding. It is now embedded in how we manage our urban watersheds, with engagement from a range of professionals, including engineers, planners, developers, and foresters.

In developing the concept, we have held many similar discussions to those now taking place in Europe; concerning the relationship between grey and green infrastructure solutions, metrics to quantify the impacts of the urban forest on water quality and quantity, and knowledge exchange between different professions.

We can share our knowledge and experience to help accelerate progress towards what you now hope to achieve in Europe, identifying funding opportunities and together seeking out ways to ensure that urban forests in both the United States and Europe continue to be seen as key assets for our towns and cities.

It was great to be involved in the formal launch of this concept in Europe, and I look forward to our future collaborations.”

Bryan Seipp, Watershed Manager, Center for Watershed Protection, United States

Why Urban Catchment Forestry?

Surface water flooding from overwhelmed drains is an increasing challenge in urban areas across Europe, having significant economic costs for businesses, landowners and individuals, as well as impacts for health and wellbeing. Poor water quality is also a challenge, with the EU Water Framework Directive objective for all water bodies to reach 'good ecological and chemical status'. Urban diffuse pollution contributes to poor water quality, impacting on the ecological status of rivers and making them unattractive and unsustainable, with associated treatment costs for water companies and public bodies. Such challenges will be further exacerbated by increasing levels of urbanisation and a changing climate, with projections of changing rainfall patterns, including more intense rainfall events.

The increasing challenge of urban surface water flooding. Image: Anthony Beyga

Trees and woodlands within urban areas can help reduce flooding and improve water quality, by intercepting rain, allowing infiltration into the ground, reducing the volume and speed of runoff to drains and watercourses, drawing water up from the ground for transpiration, removing pollutants and decreasing sedimentation. Their water management role can be further enhanced by planting trees as part of biofiltration systems and in engineered tree pits, which can include structural cells, soils and reservoirs designed to filter and store water. The use of trees and woodlands for urban water management can help to reduce the pressure on and complement more traditional engineered approaches. And unlike the more engineered approaches, trees and woodlands also bring a wide range of economic, social and environmental benefits, making urban areas much more attractive and healthy places to live, work, visit and invest in.

However, urban trees and woodlands in Europe tend to not be strategically used for their water management benefits. The Urban Catchment Forestry programme seeks to address this. Urban Catchment Forestry is a concept that has emerged and is applied in the United States, where it is known as Urban Watershed Forestry. It seeks to integrate urban forestry and urban water management; managing urban water through safeguarding, enhancing and planting urban trees and woodlands.

Urban Catchment Forestry, or the use of trees and woodlands for water management within urban areas, complements other natural approaches to managing water. This includes natural solutions in the wider water catchment, such as targeted tree and woodland planting to improve water quality, and to hold back water and reduce flooding in downstream urban areas. It also includes Sustainable Drainage Systems (SuDS) or Best Management Practices (BMPs) within urban areas, which use soft engineering approaches to manage water, but generally have included trees as landscaping elements rather than soft engineering solutions in their own right.

This document is a prospectus for an Urban Catchment Forestry programme, which will seek to make a convincing business case to enable the strategic use of urban trees and woodlands to reduce flooding, improve water quality, and bring wider benefits; building upon experiences in the United States. The prospectus has been developed by The Mersey Forest, a community forest in the north west of England, and will be used to develop partnerships, the programme and funding bids to take this agenda forward.

Some statistics on how trees and woodlands help manage water

- Conifer stands intercept 25-45% of annual rainfall, whilst broadleaves intercept 10-25%[1]
- Considering interception and transpiration, and assuming an annual rainfall of 1000mm, conifer stands use 550-800mm of water compared to 400-640mm for broadleaves[1]
- Daily losses are highly variable depending on the amount of rainfall; light showers can be completely intercepted, while losses as a proportion of rainfall decline with increasing rainfall intensity, reaching a maximum of 6-7mm per day[1]
- Isolated single trees (e.g. as in urban street tree planting) have a much higher water use on account of their larger canopy and greater exposure; maximum transpiration rates range from 500-2000 litres per day for individual trees of varying species, compared to 18 litres per day for a tree in a stand of Sitka spruce[1]
- Individual tree canopies can intercept as much as 79% of a 20mm, 24-hour rainfall event under optimum, full leaf conditions[2]
- A single young tree planted in a small pit over an impermeable asphalt surface can reduce runoff by around 60%, even during the winter when it is not in leaf[3]
- Tree roots can increase infiltration rates in compacted soils by 63%, and in severely compacted soils by 153%[4]
- Structural soils could further improve the infiltration properties of tree pits[4]
- Increasing tree cover by 10% in built-up town centres can reduce runoff from an 18mm rainfall event by 8%[5]
- Urban runoff is a source of urban diffuse pollution, containing pollutants such as metals and chemicals from road transport, faecal matter from animal fouling, and sediment[6]
- Trees in biofiltration systems resulted in significant reductions of soluble nitrogen and phosphorus in stormwater, compared to unplanted controls; reducing nitrate plus nitrite (NOx) by 2-78% and filterable reactive phosphorus by 70-96%, depending on the soil profile[7]
- Woodland stream buffers of <40m and >40m width remove 55% and 89% of subsurface nitrate, respectively; whereas 65% and 85% of sediment is trapped by 10m and 30m buffers[8]
- The annual stormwater benefit of an urban tree is $34 (equivalent to €26)[9]

[1] Nisbet (2005). Water use by trees. Forestry Commission Information Note 65.
[2] Xiao and McPherson (2003). Rainfall interception by Santa Monica's municipal urban forest. Urban Ecosystems, 6: 291–302.
[3] Armson et al (2013). The effect of street trees and amenity grass on urban surface water runoff in Manchester, UK. Urban Forestry Urban Greening, 12: 282–286.
[4] Bartens et al (2008). Can urban tree roots improve infiltration through compacted subsoils for stormwater management? Journal of Environmental Quality, 37 (6): 2048-2057.
[5] Gill (2006). Climate change and urban greenspace. PhD thesis, University of Manchester.
[6] Defra (2012). Tackling water pollution from the urban environment: Consultation on a strategy to address diffuse water pollution from the built environment.
[7] Denman et al (2012). The use of trees in urban stormwater management. Trees, people and the built environment. Proceedings of the Urban Trees Research Conference. 104-112.
[8] Sweeney and Newbold (2014). Streamside forest buffer width needed to protect stream water quality, habitat, and organisms: a literature review. Journal of the American water Resources Association, 50 (3): 560-584.
[9] Averaging data from 17 US cities presented on p11 of: US EPA (2013). Stormwater to Street Trees – Engineering urban forests for stormwater management.

Developing partnerships

The Mersey Forest covers 1,370 km^2 in Merseyside and North Cheshire, in the north west of England, and is home to 1.7 million people. It is a partnership of seven local authorities, Natural England, Forestry Commission, and the Environment Agency, along with landowners, businesses and local communities, and is coordinated by a dedicated team. The work of the team and partners is guided by the long-term and strategic Mersey Forest Plan, which sets out a vision to get "more from trees" (www.merseyforest.org.uk/plan). It includes a policy on flood alleviation and water management as well as one on tree planting. The team coordinates tree and woodland planting across rural and urban areas, with urban planting in a range of locations, including street tree planting as part of the Green Streets programme.

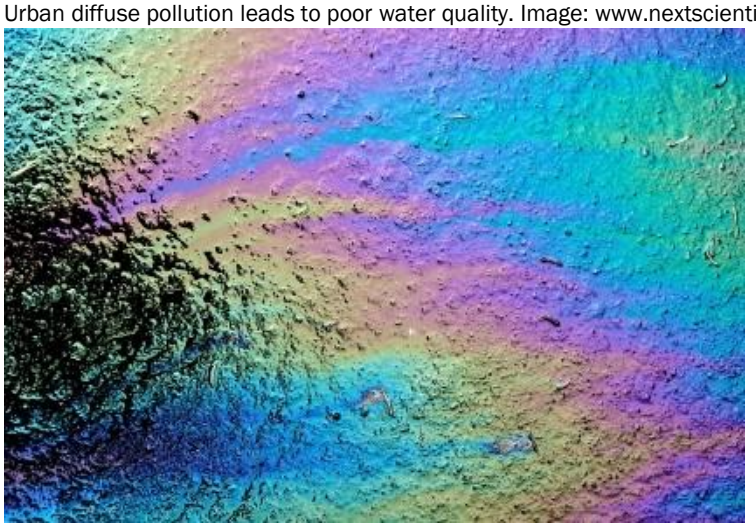
The Mersey Forest team has developed strong partnerships across Europe through the Interreg IVB ForeStClim project and is keen to develop these further in order to take the Urban Catchment Forestry agenda forward, involving different sectors and professions. This needs to include urban foresters and water managers, engineers, planners, developers, landscape architects, regulating bodies, academics, local and national government, landowners, and others. We would like to have a strong focus on our own area, of Merseyside and North Cheshire, but also with partners from further afield who are interested in developing this agenda.

In July 2014 we held a seminar in the north west of England, which brought together 50 stakeholders, potential funders, researchers and policy makers, to raise awareness of the topic and the emerging Urban Catchment Forestry programme. One of the speakers at the seminar was from the Center for Watershed Protection in the United States, which has been developing, applying and communicating the approach over a number of years. The seminar garnered significant interest and enthusiasm, with a number of organisations wanting to become partners or interested in the outcomes of the programme.

We are now keen to build upon this enthusiasm and develop a partnership for the Urban Catchment Forestry programme across Europe. We will work with organisations that have already expressed an interest, and maintain links with the Center for Watershed Protection, as well as seek new partners. We would also like to firm up a commitment as to what each organisation would like to do as part of the programme, funds that they can offer, or that they can bid towards.

Please get in touch with us if you are interested in becoming a partner or the outcomes of this programme.

Urban diffuse pollution leads to poor water quality. Image: www.nextscientist.com/science-blog-scientists-oil-water



Developing the programme

The Urban Catchment Forestry programme is ambitious and long-term, seeking to make a convincing business case to enable the strategic use of urban trees and woodlands to reduce flooding, improve water quality, and bring wider benefits. We envisage that due to its ambitious nature and the wide range of potential partners, it will be composed of a number of different projects.

We are keen to work with partners to develop the programme and specific projects. We think that it will encompass the following elements:

- Reviewing the scientific, policy and practice contexts
- Characterising the urban forest
- Characterising urban water catchments
- Tree planting interventions within selected urban catchments and experimental plots
- Long-term monitoring of urban water catchments and experimental plots
- Developing and refining runoff and water quality models to incorporate urban trees
- Making the economic case for investment in urban trees and woodlands
- Identifying opportunities for ongoing implementation
- Influencing policy and engaging different sectors.

Please get in touch with us if you are interested in developing and working on any of these elements, or think that there is anything else that the programme should include.

Integrating trees into urban water management practices in the United States. Image: Center for Watershed Protection

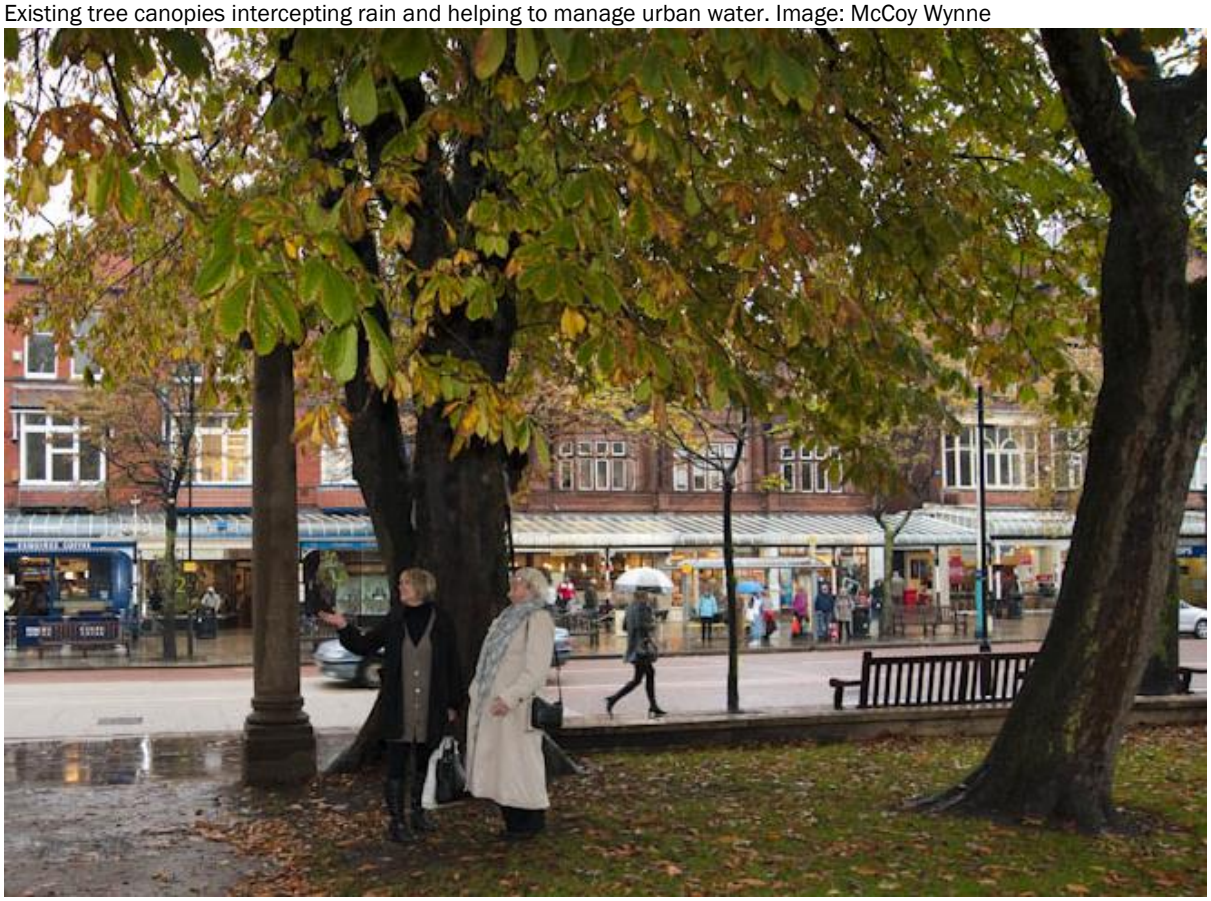
Developing funding bids

We will be exploring a number of options for funding the Urban Catchment Forestry programme. It is likely that funding will come from a range of sources, depending on the specific project. We will also be exploring opportunities for match funding. Potential funding opportunities we will explore include:

- EU Interreg transnational cooperation programmes for North West Europe and the Atlantic Area, which include priorities on combined climate change mitigation and adaptation solutions, catchment approaches to adaptation and the biodiversity, and enhancement of ecosystem services.
- Horizon 2020 which provides funding for research and innovation. An overall priority is 'Climate Action, Environment, Resource Efficiency and Raw Materials', including research associated with water innovation.
- LIFE 2014-2020 has an emphasis on replicability/transferability and long term sustainability of project results. The priority of most relevance in the new programme is climate change adaptation within the climate action.
- Government departments such as the UK Departments for Environment, Farming and Rural Affairs, and for Energy and Climate Change.
- Charitable trusts, sponsorships, catchment partnerships, etc.

Please get in touch with us if you are interested in developing any funding bids, know of any additional suitable funds, or have any match funds available.

Existing tree canopies intercepting rain and helping to manage urban water. Image: McCoy Wynne



The Mersey Forest, 2014

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