Pond Conservation
For Life in Fresh Waters

Small-scale solutions for big water problems

Contents

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1. Key messages

- Small waterbodies are relatively cheap and easy to create
- Creating small waterbodies offers a solution to important water management issues such as flooding and pollution control
- Small waterbodies provide practical small-scale solutions at a local scale that build together to provide networks that give national benefits
- Clean ponds benefit wildlife- protecting ponds is an excellent way to conserve aquatic biodiversity
- Pond Conservation recommends that small waterbodies are added to the Defra Water Strategy to encourage and stimulate the planning and adoption of a national strategy for small-scale water management initiatives.

Pond Conservation is the UK's leading centre for information and practical advice on the conservation of ponds. We believe that effective conservation requires a sound scientific basis and underpin all our activities with an extensive programme of applied research.

2. Water management issues

Water resources have never been more under stress. Human demands for water are still increasing annually[1]. There are major concerns about how we maintain the quality of drinking water. There is evidence that aquatic biodiversity is suffering: with the most pollution-sensitive species continuing to decline. Despite major financial investment, river water quality has not increased over the last 10 years – and some of our best watercourses have declined in quality. Climate change, bringing with it extremes of flood and drought, has added to these stresses - and has brought home to many people the need for rapid solutions to our problems of water management.

3. Solutions

This paper discusses how small waterbodies can provide sustainable solutions for some of the key issues of water management.

Specifically, it shows how a policy focus on small waterbodies has the potential to benefit:

- Flood amelioration
- Diffuse pollution mitigation
- Urban water management
- Agricultural water supply
- Protection of aquatic biodiversity, including climate change proofing
- Public and individual engagement with water issues

In all of these areas, the key benefit of small waterbodies is that, because they are easy and cheap to create, small waterbodies provide a practical small-scale solution that works at a local scale, but also builds together as a network to give major benefits.

Creating small waterbodies offers a solution to many of these water management problems – particularly in rural environments.

3.1 Flood amelioration

Washland and large-scale wetland creation is currently in vogue as a rural solution to flooding - but there are limits to where they can be put, and they often need major engineering works to implement. Washlands also suffer as a “downstream” solution that attacks the problem too late. So although these schemes store water, they do little to hold water back at source, recharge aquifers or reduce the volumes generated before they become a problem. Strategic networks of smaller waters do all these things. At the Allerton Research Centre’s Loddington farm (Fig 1), small ponds intercept *all* the flow from a 25 ha field drainage network, with *no outflow*. This is no fluke: modelling and experimental studies by hydrologists at Newcastle University show that large reductions can be made in water loss from strategically placed small

[1]Environment Agency (2007). *Water for people and the environment*. Bristol, Environment Agency.
National Audit Office (2007). *Ofwat – meeting the demand for water*. London: The Stationery Office

basins[2]. For example, by installing 10,000 m^3 of storage per km^2, roughly equivalent to ten medium-sized ponds, it is possible to capture *all* of a typical heavy rainfall event from that 1 km^2.

The systems at Loddington, and in the Newcastle models, effectively mimic what can be seen in natural systems. In Europe's largest lowland forest (Fig 2), wooded headwater valleys do not flow – they are a series of terraced temporary ponds.

Fig 1 Inflow, but no outflow*. At the Allerton Research Centre's Leicestershire farm a series of small pools – ranging in size from only 3 m^2 - intercept the entire flow from a 25 ha clay catchment field drainage system. All the water is intercepted by these ponds and there is no outflow, even in winter storms.*

Fig 2 Natural systems show us the answer: *it's easy to assume that "flow" is the normal condition for streams. But in the most natural European woodlands, like these in Białowieza, Poland, the top kilometre of a stream does not flow - it is a series of terraced seasonal pools which hold back winter water in the catchment.*

3.2 Diffuse pollution mitigation

Diffuse agricultural pollution degrades a very large proportion of UK freshwaters for biodiversity, and will make it difficult for us to achieve many important WFD targets. It also presents considerable difficulties for maintaining the supply of potable water for human consumption. On-going diffuse pollution also means that *less* water is available for supply.

A plethora of approaches have been proposed for tackling diffuse pollution, from nutrient taxes to catchment afforestation, or simply taking land out of agriculture. Sometimes proposed approaches conflict, and there has been little effective integration - for example, conservation tillage reduces soil loss and water loss - both apparently beneficial - but water running off conservation tilled land has the same nutrient *concentration* as always. Where catchments are dominated by farmed land this gives little benefit for water quality – just less water. Small pools are amongst the techniques

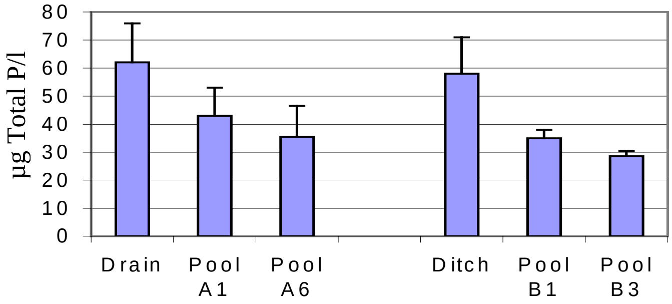

Fig 3 Small waterbodies working to reduce pollution. *The bars show how the Loddington pools progressively reduced total phosphorus concentrations in the water by up to half.*

[2]Quinn PF, Hewett JM, Jonzyk J and Glenis V (2007). *The PROACTIVE approach to Farm Integrated Runoff Management (FIRM) plans. Flood storage on Farms*. Newcastle University.

best proven for their ability to remove diffuse pollutants (including sediment, phosphorus and nitrogen) from surface waters. At Loddington, for example, small treatment ponds reduced P concentrations by 50% in-pond (Fig 3). At the same time these ponds also supported aquatic ecosystems of High to Very High ecological quality, improving down the sequence - one of the few demonstrations, anywhere, of a proven biodiversity improvement resulting from a diffuse pollution control measure[3].

At a larger scale, catchment models suggest that small waterbodies could remove 50% of P and 20% of N, *without any other measure added*[4].

3.2 Urban water management

Modern urban landscapes already provide clear evidence of the value and practicability of using small water bodies in water management. Over the last 10 years, ponds – both temporary and permanent – have become an integral part of SUDS (Sustainable Urban Drainage Systems), which are now very widely implemented in conventional urban water management. Pools taking road run-off now line our motorways and dual-carriageways, and they form an essential part of the SUDS treatment train in many new urban developments, where small waterbodies store and treat pollutants (Fig 4) and reduce peak runoff: typically in the region of 50%[5].

Given, that small waterbodies are now so widely and effectively used for water management in urban situations, there seems no reason why their multiple-benefits should not be transferred to agricultural landscapes.

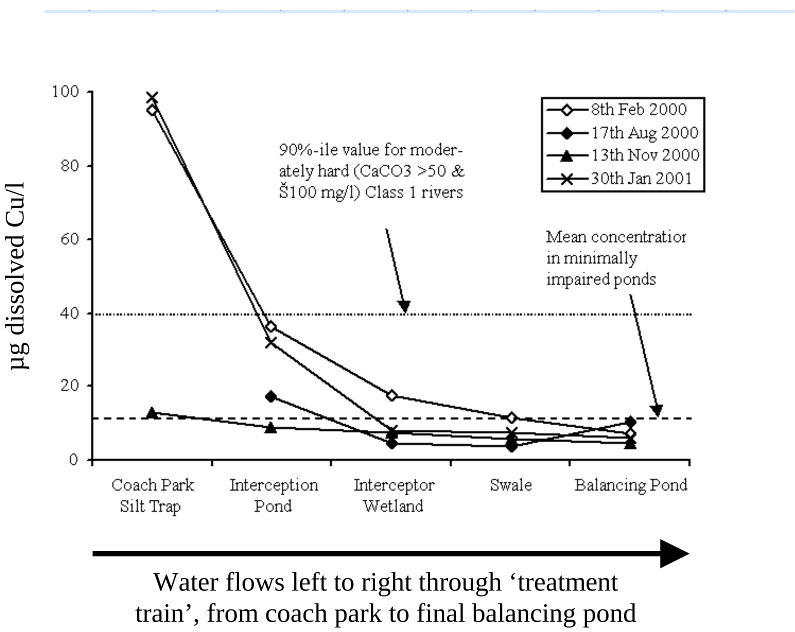

***Fig 4 Urban treatment systems can reduce some toxic pollutants to background levels.** Effect of SUDS treatment system on dissolved copper concentration in the Hopwood Park Motorway Services Area.*

The figure shows how copper concentrations in the outfall of the final treatment train balancing pond in the treatment system are below those of Class 1 rivers and High Ecological Quality, 'minimally impaired', ponds.

[3]Williams P and Biggs J (2007). *SOWAP project: Aquatic Studies*. Oxford: Pond Conservation.

[4]Hawkins J and Schofield D (2003). *Scoping the potential for farm ponds to provide environmental benefits*. North Wyke: IGER.

[5]Jeffries. (2004). *SUDS in Scotland – The Monitoring Programme*. SNIFFER Final Report SR (02)51 and Environment Agency R&D Technical report P2-258. Edinburgh: SNIFFER.

3.4 Agricultural water supply

In many parts of Britain, irrigated agriculture (particularly potatoes and vegetables which use about 80% irrigation water) and turf grass leisure activities will increasingly be stressed by shortages of water.

The total volume of irrigation water used in England is about 130,000 Ml/per annum and is growing at about 2%-3% per annum. This is a relatively small proportion of total abstraction but is concentrated in some of the most water stressed parts of the country, exacerbating problems of supply and environmental impact. The availability of additional winter water storage is likely to be essential in both sectors. Use of ponds to capture winter runoff in artificially lined pools, and re-cycle it for summer irrigation is already undertaken on some farms.

Used more widely the technique has the potential to become an effective part of the water management solution. As an aside, and *theoretically*, to supply the *entire* current usage for irrigation water would require 13,000 ponds of 1 ha area and 1 m mean depth. This is approximately the same as the total number of 1 ha water bodies that currently exists: doubling the number of such water bodies agrees almost exactly with targets that have been proposed in the Wetland Vision for England[6].

3.5 Protection of aquatic biodiversity, including climate change proofing

Recent research shows the importance of small waterbodies, especially ponds, for biodiversity. Ponds occupy the smallest area of land, in agricultural landscapes, but these waterbodies make the greatest contribution to regional aquatic biodiversity, compared to rivers, streams, lakes and ditches (Fig 5).

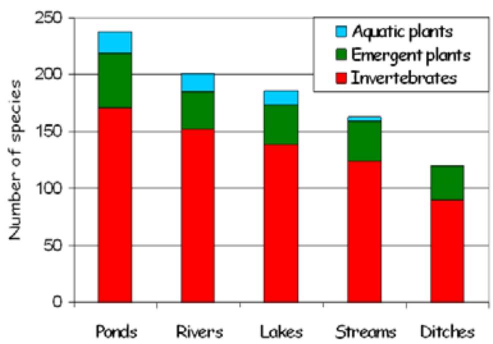

Fig 5 Ponds are biodiversity hotspots. *In the first study of catchment scale patterns of aquatic biodiversity in typical English farming landscapes, we showed that ponds make the largest contribution to regional aquatic biodiversity compared to other aquatic habitats. The ponds in the region were not exceptional, and this result has since been replicated elsewhere in England and in continental Europe.*

Sources: Williams, P., Whitfield, M., Biggs, J., Bray, S., Fox, G., Nicolet, P., Sear, D., 2004. Comparative biodiversity of rivers, streams, ditches and ponds in an agricultural landscape in Southern England. *Biological Conservation*. 115, 329-341. Biggs, J., Williams, P., Whitfield, M., Nicolet, P., Brown, C. Hollis, J., Arnold, D., Pepper, T. (2007). The freshwater biota of British agricultural landscapes. Agriculture Ecosystems and Environment. *Agriculture Ecosystems & Environment* 122: 137-148

Critically from the perspective of climate change proofing, new small waterbodies with clean, unpolluted catchments can easily be created: and as recently noted by the RSPB[7], making ponds is one of the things we can have a high degree of confidence will be good for aquatic biodiversity in the face of climate change. The reason is because it is simple to make new, unpolluted, ponds which can provide islands of clean water in otherwise intensively managed landscapes where

[6] Hume C (2008) (ed.). *Wetland Vision Technical Document: Overview and reporting of project philosophy and technical approach*. Sandy: RSPB.

[7] RSPB (2007). *Climate change. Wildlife and adaptation*. Sandy: RSPB.

near pristine water quality is likely to remain scarce. It is very much harder to make clean unpolluted rivers, lakes or streams.
The exceptional importance of ponds for aquatic nature conservation has recently been emphasised by the recognition of ponds of high ecological quality as Priority Habitats in the UK BAP. As part of the new Pond Habitat Action Plan, high quality pond creation will be targeted over the next 20 years, and is also enshrined in the Wetland Vision for England.

3.6 Public and individual engagement with water issues

Ponds are, of course, “the local waterbody”: in the garden, in the village, next to the path where you walk the dog, on the farm, even in the town, a place to fish or simply to recharge your batteries. They are the ideal place to bring together messages about water management, and again, because they are small and easy to create - a place to encourage individual action.

4. A way forward

Creating small waterbodies is a simple, easily achievable way of providing *win-win* benefits for the water environment.

The short-hand concept of what we need is “*a pond in every field*”. Just as we currently have a grass strip along every ditch and stream.

In practice these waterbodies need to be strategically placed to intercept and clean drainage water, but this isn’t rocket science - just a matter of instating pools at the end of drains, and mimicking nature by creating on-stream ponds at the top of drainage catchments (Fig 2).

There are simple changes to drainage systems at the field scale that can help this process: changing the mole drainage system to a herringbone pattern, can direct water from entire fields, or series of fields, into a small pond sequence (e.g. 3-4 pools linked by seasonal swales). These take all the flow: stripping-out the nutrients, ameliorating the winter floods, and feeding groundwater for slow release when it is needed later in the year (Fig 3).

These new small waterbodies need not be intrusive – they can often be built into pre-existing grass buffer strips on field edges next to ditches and streams – with little land-take implications for individual farmers. In pastoral landscapes small waterbodies can be shallow grassy bowls, which dry in summer, and still provide pasture. Small waterbodies can be easily, quickly and very cheaply created using standard ditch management equipment. Some periodic dredging will be necessary to remove accumulated sediments from the waterbodies, but this can be incorporated into the normal ditch-dredging regime, with the silts spread on the land adding to fertility.

5. Implications for water management policy

There is a widely recognised need for more joined-up thinking in water management. With a growing consensus that water policies, urban development and agri-environment schemes need to be focussed so that they function together to minimise flood risk, reduce diffuse pollution, and increase water storage.

There are many well-recognised techniques that can be used to help this water management. In the rural environment, practices such as conservation tillage, creation of floodplain washlands, grass buffer strips and riparian woodland are practical solutions which can be implemented at field and valley scale – either singly, or in concert as part of Integrated Catchment Management.

All these known techniques have their place – but also their limitations: so that even if all are fully implemented and optimised, they will not solve our water quality problems. Buffer strips will still be under-cut by field drains - pushing huge volumes of polluted runoff down the catchment. In lower reaches, flood storage basins cannot address the major problems of nutrient pollution.

Widespread creation of small waterbodies is a key extra tool in the armoury of water management methods. It is particularly valuable because it works sustainably to treat problems at source, and acts to ameliorate both run-off quality and quantity. It provides a controllable means of reducing flood peaks, storing runoff for irrigation purposes, and increasing infiltration to recharge aquifers. More fundamentally, it slows water down at source, simulating the natural storage in catchments that intensive land management inevitably removes.

The main problem is that widespread small waterbodies creation is still a new idea and there is limited appreciation of its wider potential. Added to this, the successful results of working examples, such as the Allerton Project's Buffer Strip Pools, have only recently become available – so there has been little chance for widespread adoption of this technique.

6. What's needed now?

Given the considerable potential of small waterbodies as an easy, cheap and truly multi-functional water management tool, there is now an urgent need for wider assessment and application of this technique.

We suggest that the Defra Water Strategy provides a good opportunity for policy to encourage and stimulate the planning and adoption of a national strategy for small-scale water management initiatives.

The development of such a strategy would provide an excellent test-ground for the truly multi-functional, climate-proofed, integrated catchment management thinking which will be needed in the future: it has the particular advantage that partnerships involve a uniquely wide range of those involved in environmental management, literally from the individual members of the public to Brussels bureaucrats interested in water management, but with few vested interests to complicate the process.

Following on from this, a series of other initiatives would help to rapidly promote and sustain small waterbodies creation as a water management tool.

6.1 Collation of knowledge and ideas through workshops / seminars
Many scientists and practitioners working on small waters do not yet recognise that they have common and complementary interests because of conceptual chimneys. Others, brought up in the disciplines of traditional large-scale water management, are not aware of the potential for the application of small-scale, practical, solutions. To rapidly progress small waterbodies knowledge and development there will be synergistic benefits from bringing these disparate groups together. For example, it will be particularly fruitful to apply the considerable knowledge of urban SUDS to rural schemes.

6.2 Technical Review
(a) Local scale benefits: A review of existing data related to small waterbodies from various disciplines (hydrology, morphology, nutrient cycling, biodiversity, modelling, agronomy, and economics) would be beneficial. Particularly since it would be possible to include new data that is beginning to become available from continental Europe.

(b) Wider benefits: Although the *local* benefits of small waterbodies creation have begun to be proven, the wider benefits to catchment water management are not (this, incidentally, is true of almost all mitigation techniques – a fact noted in the recent Blueprint submission on the Defra Water Strategy). There is a need for both hydrological modelling and economic analysis to fully cost the benefits of widespread use of small waterbodies in agricultural landscapes. Such analyses also have the potential to identify how and where small waterbodies could be used strategically to give greatest gain.

6.3 Regional trials
Regional trials are already justifiable to provide wider ground-truthed evidence of the practicability and efficacy of small waterbodies creation. It would be particularly beneficial if such trials are built into existing assessment areas for Catchment Sensitive Farming, so that the results can be assessed in a wider context.

6.4 Rapid knowledge transfer
Where the review results and trial results indicate significant benefit from widespread creation of small waterbodies, there needs to be rapid spread of knowledge to stake-holders and integration within policy frameworks.