GUIDE TO THE RESTORATION, CREATION AND MANAGEMENT OF PONDS

Bringing ponds to life

UCL

Freshwater Habitats Trust

About the guide

Carl Sayer (University College London)
Jeremy Biggs (Freshwater Habitats Trust)
Helen Greaves (University College London)
Penny Williams (Freshwater Habitats Trust)

September 2023

Citation: Sayer, C.D., Biggs, J.,Greaves, H.M., & Williams, P. (2023) Guide to the restoration, creation and management of ponds. University College London, London, UK

Acknowledgements

The authors would like to thank Ruth Hall (Natural England) for the idea of creating this booklet, and for guiding and supporting all stages of its production. Our thanks also to Juliet Hawkins for commenting on an earlier version and for much good advice. Many thanks to Miles Irving (Department of Geography, University College London) for laying out and designing this guide. We are enormously grateful for the knowledge and expertise provided by many Freshwater Habitats Trust staff, including former members: David Walker and the late Mericia Whitfield for their work on aquatic invertebrates which underlies many of our insights into pond ecology. We thank members of the Norfolk Ponds Project and UCL Pond Restoration Research Group for considerable underpinning redearch and the late, great Richard Waddingham for passing on much knowledge and experience regarding farmland pond management. We owe a further debt to many farmers and landowners across the country who have allowed us to undertake pond conservation, creation and restoration on their land. Finally, many thanks to the University College London Office of the Vice Provost for Research fund for supporting the production of this guide.

Contents

Restoring, creating and managing ponds for wildlife

Key Messages

- Having a variety of pond types in the landscape, including unshaded, shaded, permanent, seasonal, deep, shallow, large, small, grazed or ungrazed ponds, is best for wildlife.
- Pond restoration, resurrection, creation and management are needed to create a better balance of pond types in the landscape.
- Two thirds of the ponds in England and Wales have been lost, so lots of new ponds need to be created and old, deliberately infilled ponds, resurrected to replace these losses.
- In many farmland landscapes shaded, tree-covered ponds overwhelmingly dominate and so restoration and management is needed to increase numbers of open, less shaded ponds.
- Ponds need to be surrounded by the largest area of natural vegetation possible which helps protect them from pollution as well as providing important habitat for wildlife.
- Clean water is essential for wildlife; create, restore, resurrect and manage ponds where water is unpolluted.
- Ensure new ponds are not fed by streams, ditches or drains.
- The ponds that are best to restore and resurrect are those that are not fed by stream, ditch or pipe inflows that drain arable or urban land.
- Do not create and restore ponds for wildlife and use them for other activities such as angling, duck shooting, natural flood management or pollution interception as this reduces their ability to support wildlife.
- Maintain (or reintroduce) grazing around traditionally grazed ponds, since these are often of high biodiversity value.

1. Introduction

Figure 1. This temporary pool in an Oxfordshire green lane has unpolluted water and supports the endangered Tassel Stonewort

The value of ponds

Ponds pack a huge punch for wildlife considering the small area that they occupy. When unpolluted, ponds can act as biodiversity hotspots that are critically important for aquatic invertebrates (like dragonflies), wetland plants, amphibians and fishes. Many freshwater species are now rare or threatened, and ponds provide an important refuge for them. Additionally, recent evidence shows that good ponds are also vital habitats for declining terrestrial species, providing sources of food and important nesting sites for farmland birds, flowering plant oases for pollinators, and drinking water for mammals.

Whilst ponds were once a widespread natural habitat in the English landscape many have been lost through drainage and especially agricultural land reclamation. Many man-made ponds have also been created, and these are often indistinguishable in their importance for wildlife from those created by natural processes. They were made, often many centuries ago, for all sorts of reasons, such as digging for marl and other clays, or for livestock watering. They can be of great historical significance in the landscape and are often a distinctive feature either within their immediate setting (e.g. designed historic parklands) or the wider farmed landscape context. Hence the guidance given here can be applied to enhance pond wildlife in any setting, to ponds created for any reason, and to natural ponds too.

Unfortunately, both natural and man-made ponds have declined: two thirds of the ponds that were present in England and Wales in the late 19th century have been lost through drainage and infilling. However, the infilled traces of some of these ponds still exist. These ponds have been called “ghost ponds”. Traditional land and pond management practices that kept ponds open have also declined in recent decades leading to a much greater proportion of ponds being encroached by scrub and trees. Many ponds are also badly affected by nutrients (elevated concentrations of nitrogen and phosphorus) and other pollutants, derived from drains, ditches and spray-drift.

Figure 2. A treefall pool in Hothfield Forest, Kent. Treefall pools can sometimes support endangered species, especially in high quality landscapes: Pond Mud Snail and the rare Fen Diving Beetle have been found in such situations

What do we need for pond wildlife to thrive?

More high quality ponds are needed in the landscape, with fewer ponds subject to pollution, dominated by scrub or lacking sufficient adjacent terrestrial habitat. The aim is that, at a landscape scale, many ponds are pollution-free and that a variety of types of ponds are present, including ponds of many shapes, sizes and depths and which vary in terms of permanence and shading.

Figures 1-10 give an idea of the wonderful range of ponds found in different habitats.

Figure 3. A natural pool in Wybunbury Moss, a wetland in Cheshire. When wetlands are not drained and undulations in topography are present, wildife-rich pools such as this are a natural feature.

Figure 4. A farmland pond set in the middle of an arable field. This pond was subject to major scrub and sediment removal a few years before this photograph was taken. It is open to the south, has a good sized buffer and supports a species-rich wetland plant community.

Figure 5. A temporary pond set in farmland. This pond is dry by late summer and is extremely rich in wetland plants and invertebrates.

Figure 6. Landham Pond, Surrey, home to Frogbit and Greater Water-parsnip. This pond is a former channel of the River Thames.

Figure 7. This pond in the New Forest could justify the title of Britain's most remarkable wildlife pond with an unrivalled mixture of uncommon and endangered plants and animals. It is about 0.2 ha in area and 50% open and warm and 50% shaded.

Figure 8. Densely vegetated pond on Stensall Common, Yorkshire, rich in uncommon water beetles and supporting the declining Slender Pond Snail.

Figure 9. Dune slack pond - a wonderful and very rich pool at Lindisfarne, Northumberland, that dries out every year.

Figure 10. High quality pond in Northamptonshire set in old grassland that is gently grazed by cattle at a low stocking density.

Different pond types

Pond management is often aimed at changing the extent to which ponds are shaded by trees or removing sediment, thus increasing water volume. However, as pond variety is critical for wildlife, it is important to have ponds with different amonts of shading and to maintain ponds that dry out each year as well as those which retain water all year round. The following pond types give some idea of the variation you may see and will help you understand their value for wildlife.

Figure 11. An open pond in an arable field kept open by periodic scrub management.

Figure 12. An open pond in grassland near Whitcurch, Cheshire.

Figure 13. An open pond in the New Forest that contains water in summer and winter despite its shallowness. This area is grazed by ponies which help to keep it open.

Open ponds dominated by plants

Ponds that are open and a little shaded can be the very richest of wildlife habitats (Fig. 11-13). If they are not polluted, they usually have abundant vegetation including aquatic plants growing under and above the water. In shallow areas tall reed, bulrush and sedges (emergent plants) can form substantial beds. Low scrub and bramble can be valuable around the pond edges. The depth and profile of the pond, the presence of grazing animals, and whether it is permanent or seasonal will in part dictate if it becomes dominated by emergent plants or also retains a mix of submerged and/or floating-leaved plants.

Nevertheless, all of these situations are of high value for wildlife. In lowland England today, open, sunny ponds tend to be declining in the landscape as many ponds have become heavily shaded by trees due to scrub encroachment over recent decades.

Figure 14. Heavily shaded farmland pond dominated by dead wood and leaf litter from the outside (a) and inside (b).

Woodland ponds

A variety of open and shaded ponds should ideally be present in woodlands (Fig. 15 & 16). These ponds may contain a number of woodland pond specialist species, especially invertebrates. As a result, ponds in ancient and old woods should not be restored without expert advice. Most ponds in woodland will be naturally shaded to varying degrees. Large ponds surrounded by trees will still have open water in the centre which receives sunlight. Some woodland ponds are located alongside edges, rides or glades, allowing light to reach the water. Others may be more heavily covered in scrub and trees.

Heavily shaded farmland ponds

When farmland ponds are not managed by people or grazing animals, tree and scrub encroachment can eventually lead to ponds becoming heavily shaded. They can have deep accumulations of leafy sediment, and few if any remaining emergent or submerged plants (Fig. 14). Shaded ponds can support specialist species that use leaf litter and dead wood and so some should be present in the landscape. However, if many ponds are heavily shaded, it can be very valuable to restore a proportion by scrub and/or sediment removal.

Figure 15. This small wooded pond in the Hampshire and Isle of Wight Wildlife Trust Roydon Woods nature reserve has a diverse invertebrate assemblage benefiting from dense stands of Bog Pondweed.

Figure 16. This is a peat stained pond within Delamere Forest. Brown water stained by peat is natural within peat catchments. Ponds in Delamere are home to the White-faced Darter dragonfly, a species that lives amongst sphagnum moss (common in bog pools) during its larval stage which requires woodland as an adult for feeding and roosting.

Seasonal or Temporary Ponds

Seasonal or temporary ponds (Fig. 17 & 18) naturally dry up in summer and refill in autumn. In most cases they tend to have a solid base over much of their area, allowing you to walk through the pond without sinking into the mud. Some temporary ponds are ancient and support exceptionally high diversity and many rare specialist species of water plant and invertebrate. This is particularly true if the ponds are not heavily shaded and are surrounded by low intensity land-use such as grazed unimproved grassland, heathland or woodland. Old temporary ponds should not be deepened to try and make them contain water all year round as this is detrimental to the species they support. However, scrub management at such ponds may be appropriate.

Figure 17. The exceptionally rare Grass-poly (a) forms a dense sward in this Thriplow (Cambrideshire) SSSI temporary pond (b).

Figure 18. Temporary pond supporting the locally uncommon plants Orange Foxtail and Golden Dock in otherwise unremarkable Leicestershire grassland.

2. How to decide what to do

Having a variety of different pond types in the landscape is best for wildlife and it is important to have a good number of open ponds filled with water plants. It is also essential that ponds are protected from pollution as clean water is key to good pond health. To achieve this a number of approaches are available that can work together, depending on local circumstances; namely pond creation, pond restoration, and the resurrection of ghost ponds. Management regimes are often required to maintain good existing ponds and critically, to ensure that any ponds that are created, restored or resurrected do not all progress to tree and scrub-dominance.

Pond management regimes could include natural management by grazing stock or periodic physical management by hand or machine (note: important to clarify that management includes grazing). A margin of natural vegetation is also required around the pond both to act as a buffer against spray drift and surface water pollution and to provide habitat for species that use both the pond and surrounding terrestrial habitat such as amphibians and dragonflies.

The first step in deciding what to do for your ponds is to understand the current situation on your land. This section considers ponds at the landscape scale. The landscape unit can be whatever is practical: a catchment, a farm or landholding or a farm cluster could all work. If you are only responsible for one or two ponds, it is still worth considering what other ponds occur in the surrounding landscape.

Making plans for pond work

A good overall ambition is to increase the number and variety of ponds in the landscape so that fewer ponds are dominated by scrub or subject to pollution. Species can also benefit when ponds are connected to hedgerows and other high quality habitats such as meadows and woodlands, as a number of species (such as bats and amphibians) require good quality ponds as well as suitable terrestrial habitat.

Looking at maps and visiting existing ponds and other freshwaters is the best way to find out how to proceed at a landscape scale. The following questions and suggestions will help you decide the best course of action for your land holding.

Questions to consider when planning to improve pond habitat

Questions	Suggestions
How many ponds are there in the landscape?	If ponds are rare, pond creation (see section 5) or potentially ghost pond resurrection (see section 7) will be important. If ponds are very abundant then pond restoration (see section 6) or management (see section 8) is probably more important. However, pond creation can also play a role in pond-rich landscapes, to create more clean water ponds and replace losses.
How many ponds are of each type?	Try and have a variety of pond types within the landscape. For example, if most of the ponds are heavily shaded some should be restored to open-canopy conditions (see section 6). If most of your existing ponds are deep consider creating some shallow ponds. If a good mix of pond types are already present you could consider what management (see section 8) would be beneficial to maintain them.
Are there ponds in different habitat types e.g. grassland, woodland, heathland or near different natural features e.g. near an old tree or hedgerow?	A number of species, such as amphibians, dragonflies, birds and bats, use both terrestrial habitats and ponds. Consequently, the terrestrial habitat that a pond sits in is important. Connecting features such as hedgerows can also be important to permit easy species movement between ponds. The distance between ponds also matters for this reason. If you have a range of habitats and features on your land you could create (see section 5) or restore ponds (see section 6) in different habitat types or close to existing features. Equally, you may consider establishing natural habitat to better link ponds to surrounding good quality terrestrial habitats.

Are your ponds buffered and surrounded by some natural vegetation?	If ponds are not surrounded by some semi-natural vegetation, they are more likely to become polluted and support fewer species due to a lack of terrestrial habitat. It is important to have some semi-natural vegetation around your pond to act as a buffer and to provide habitat (see section 9).
Is the pond receiving polluted water? If the pond receives water from field drains or a ditch, poor water quality is often an issue. This negatively affects a pond, often making the water green with algae, which stops water plants from growing.	If the pond is receiving polluted water, can this be prevented? If not, it is best to concentrate pond restoration efforts on other ponds that receive clean water. Where polluted pond water is widespread creating new ponds (see section 5) in areas where water pollution is less likely to be an issue will be the best approach.
What will the pond be used for?	The best ponds for wildlife do not have other uses, for example: • they will not be stocked with ducks and ducks will not be fed. • they will not be stocked with fish. • they will not be used for pollution interception, irrigation, sustainable urban drainage or natural flood management purposes; 'multi-purpose' ponds often bring only limited wildlife benefits, despite assertions to the contrary, especially where they are polluted. • they will not be used regularly by dogs because this damages water quality. If your pond is used in one of these ways it is best to create (see section 5) or restore (see section 6) another pond for wildlife purposes, or to consider removing these pressures.

3. Non-native invasive species

There are a number of non-native invasive species (Fig. 19 & 20) that can colonise ponds potentially outcompeting other native species and taking over the pond. Up-to-date information on species to look out for can be found at www.nonnativespecies.org.

The best way to avoid the presence of invasive species in your pond is to prevent their arrival in the first place. Three important measures will help in this respect:

- Make sure that digger drivers and workers who are involved in pond restoration, management and creation activities do not bring a non-native invasive species on to site.
- Let nature naturally colonise your pond after any works. Introducing plants and animals from elsewhere risks bringing in invasive non-native species as well as parasites and diseases.
- If your pond will have visitors after the works such as anglers or walkers it is important they follow biosecurity advice. The UK "Check Clean Dry" campaign provides useful information on how to prevent the undesired arrival of non-native invasive species to a site.

Figure 19. New Zealand Pigmyweed (the spikey plant) is an invasive alien plant that can cover entire ponds and grows from small fragments that are easily spread by a digger or a wellington boot. Photo courtesy of Julia Mumford

Figure 20. A pond full of New Zealand Pigmywort.

If you spot any invasive non-native species in your pond and they have yet to become properly established, they can be removed manually. They should then be disposed of so that they cannot enter any other water body. If the non-native invasive species has become well established, take further advice on the latest eradication methods. If eradication of a non-native invasive species is impossible it is important to employ good biosecurity measures to reduce the likelihood of it spreading to other water bodies. Consequently, it is good to keep an eye on your pond and to act very quickly if an invasive non-native species is seen.

4. Other activities that can damage ponds

Ponds that support the most wildlife generally do not have other uses as these can have negative impacts. This includes introducing fish or wildfowl (Fig. 21 & 22), adding feed to ponds, using ponds for pollution interception, irrigation, sustainable urban drainage or for natural flood management purposes. Ponds frequently used by dogs (Fig. 23) also do not make good wildlife ponds. It is best to keep wildlife ponds just for wildlife.

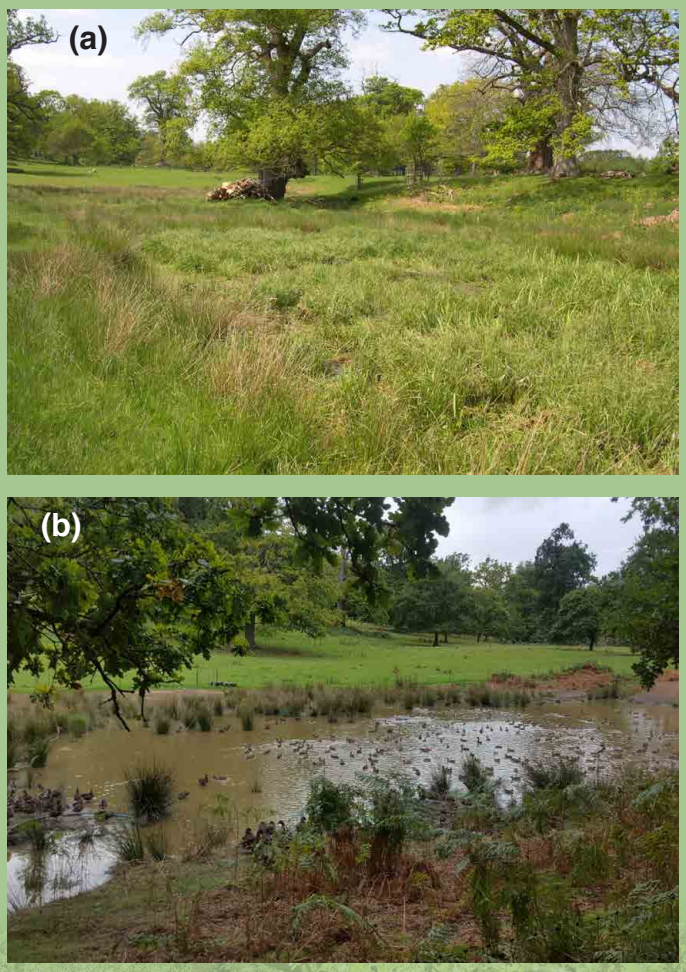


Figure 21. A marshy pond full of wildlife (a), the same pond after duck stocking with brown turbid water and low wildlife value (b).

Figure 23. The fence that crosses this pond prevents dog access to the left-hand side of the pond. The left-hand side of the pond with no dogs is well vegetated, whilst the right-hand side of the pond, where dogs have access, is turbid.

Figure 22. Ponds heavily stocked with fish, particularly species such as Common Carp, often have brown murky water and support few plants other than water-lilies. Hence ponds used for intensive angling are often poor for wildlife.

5. Pond creation

Creating high quality ponds from scratch provides an opportunity to make wonderful new wildlife habitats. In the past, ponds were much more common in all natural landscape types. Making new ponds in woodland, heathland, grassland, coastal systems and in wetland areas is an important part of restoring the beautiful patchy habitat diversity that is so characteristic of natural landscapes. High quality pond creation (Fig. 24, 25 & 26) should form part of habitat restoration in most semi-natural landscapes including nature reserves and should be promoted in areas with both few and many ponds to increase biodiversity at the landscape scale.

Creating new ponds in farmland and urban areas is also very valuable, but in these situations ponds should be very carefully sited to avoid pollution and should have plenty of semi-natural vegetation around them (see section 9).

Figure 24. Two new ponds in farmland. Creating 20 clean-water ponds across this Leicestershire landscape has increased wetland plant species by 25% and tripled the number of rare plants - an exceptional improvement!

New ponds make a big difference

Recent research shows why pond creation is so important: doubling the number of new clean water ponds in an area or region has been shown to substantially increase freshwater biodiversity across the whole landscape and to protect against future species declines.

You can create new ponds just by excavating a hole in the ground in a place where it will fill with water, but effective pond design will ensure you get the best results.

Figure 25. A new pond created at Tadnoll, Dorset (a) – now densely colonised by the rare, and unusual, grass-like aquatic fern, Pillwort (b), which readily colonises new high quality ponds.

In some places it is possible to create or restore whole wetland systems of which ponds are a natural component. This can be done by restoring water levels by stopping artificial drainage and enabling pre-existing natural depressions to naturally fill with water. Equally, complete restoration of river systems has the capacity to create ponds as channels move and become cut-off, forming ponds. Such schemes can bring amazing benefits to wildlife and are worth pursuing but are beyond the scope of this guidance.

Figure 26. New temporary ponds being created at Altcar on the Sefton Coast for Natterjack Toad.

Where to create ponds

- Ponds can be created in clay, sand, gravel, peat or rock, but is important to think about where the water will come from to fill the pond and whether the pond will be able to retain water.
- Ponds do not need to hold water all year round. Seasonal ponds are great wildlife habitat. You generally want ponds to hold water through winter and into spring and it is fine if they are dry by summer.
- Ponds in clay will be fed by rain and surface water and will be able to retain this water.
- Ponds in sand, gravel and peat will hold water if the pond reaches the water table for at least part of the year.
- To work out what sort of pond you can create, where the water will come from and how long it is likely to hold water for, you can look at nearby ponds and ditches and see how they work or dig excavation pits and see how they fill up and retain water.
- For further information you can read a factsheet on locating ponds and finding a water source on Freshwater Habitats Trust web pages.

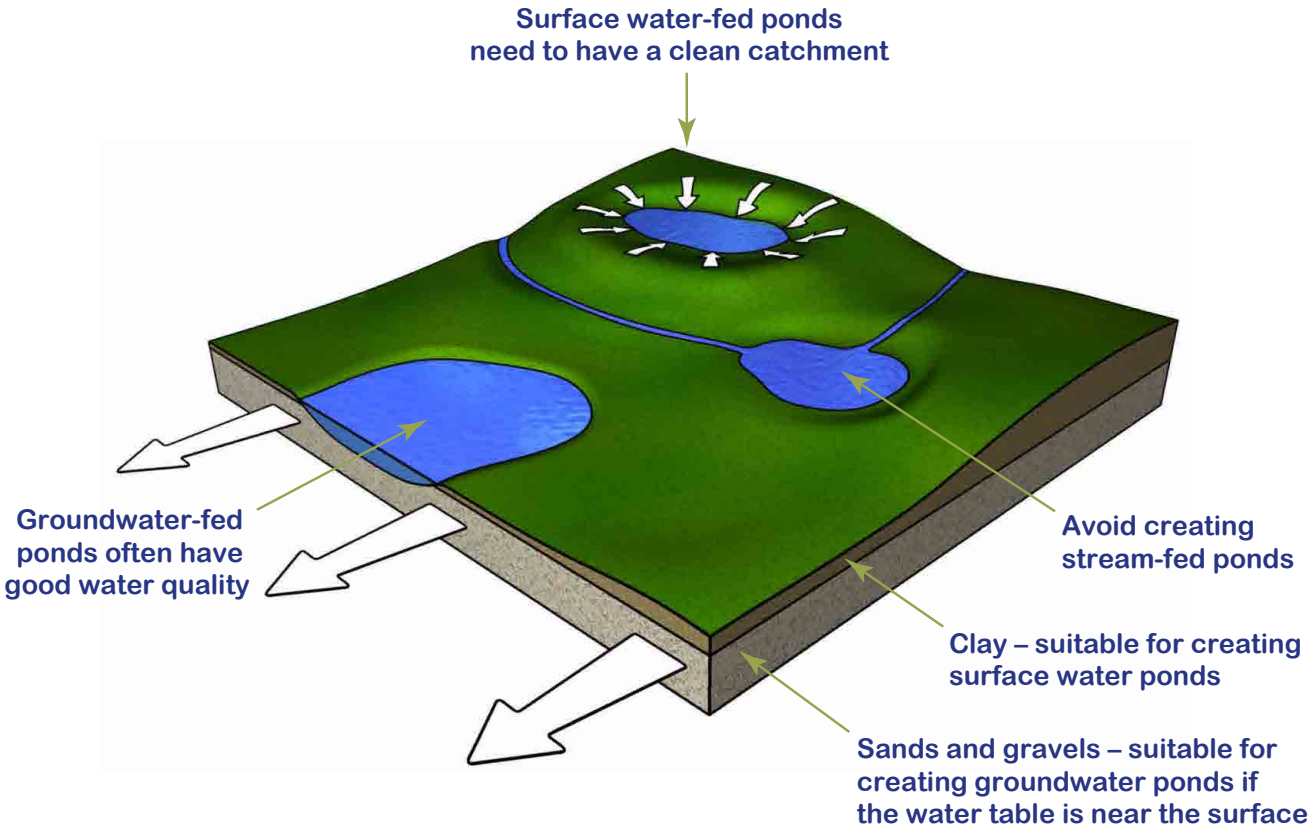


Figure 27. Water sources for ponds. In general, the cleanest water sources are (i) groundwater, and (ii) surface water that drains from unpolluted areas.

How to make high quality wildlife ponds

- Ensure the pond's water source will be clean. In general, the cleanest water sources for ponds are either (i) groundwater, or (ii) surface water that drains unpolluted areas up-hill of the pond (Fig. 27). Do not link ponds to streams or drains (see below).
- Create ponds in areas where they will be surrounded by semi-natural habitats like unimproved grassland, heathland or woodland. These will provide clean water and excellent wildlife habitat (Fig. 28).
- Create some ponds close to other waterbodies and wetlands – this provides easy stepping-stones that help aquatic plants and animals move around the landscape.
- When creating ponds in intensively managed landscapes, such as arable or urban areas, find field corners or other areas where the ponds can be well buffered by rough grassland or low scrub.
- Wherever possible incorporate ponds into new woodland creation and other habitat creation schemes before work commences (see further advice about surrounding vegetation in section 9).
- If you want to make a wildlife pond – make it just for wildlife. Do not create ponds that are multifunctional e.g. ponds that are used for pollution interception, irrigation, sustainable urban drainage or natural flood management purposes or those which are stocked with wildfowl or fish. All these uses will significantly compromise a pond's potential as a wildlife habitat.

Figure 28. A new pond created specifically for Great Crested Newt in Bernwood Forest, Oxfordshire. Note the naturally patchy slow-growing vegetation on the banks, indicative of low nutrient levels and good water quality in the area.

Places to avoid

- Do not connect new ponds to streams, ditches or drains that will usually bring in polluted water and silt, which fills the pond up reducing its lifespan by an order of magnitude.
- As far as possible, make sure that no surface-water can drain into the pond from arable or from other land where the ground is regularly disturbed e.g. yards, roads, spoil and manure heaps.
- Avoid areas close to footpaths or other places that would mean that the pond would be frequently disturbed by dogs or duck feeding.
- Works must avoid impacting protected habitats and species, or those listed under Section 41 of the NERC Act 2006 (Priority Species & Habitats). If in doubt, ask for advice.
- Ensure that digging new ponds does not destroy existing high quality habitats, unusual geology or archaeology. For example, do not dig ponds in existing high quality wet features of limited extent – places like springs or damp depressions (Fig. 27). Temporary ponds are important and of value in their own right and should not be deepened. If in doubt, ask for advice.
- Planning permission may be required for new ponds, so it is advisable to enquire with the local planning authority (see https://freshwaterhabitats.org.uk/wp-content/uploads/2013/09/planningpermission.pdf)
- The Environment Agency should be consulted if the site is close to a main river or on a floodplain, or if a waste transfer note (licence) is needed to remove spoil from the site

This field (Fig. 29) looks like a good place to dig ponds: there is water around near to the surface and ponds have been dug in the past. BUT **don't dig up the existing wet bits** - places like springs, flushes and temporary ponds are important and of value in their own right.

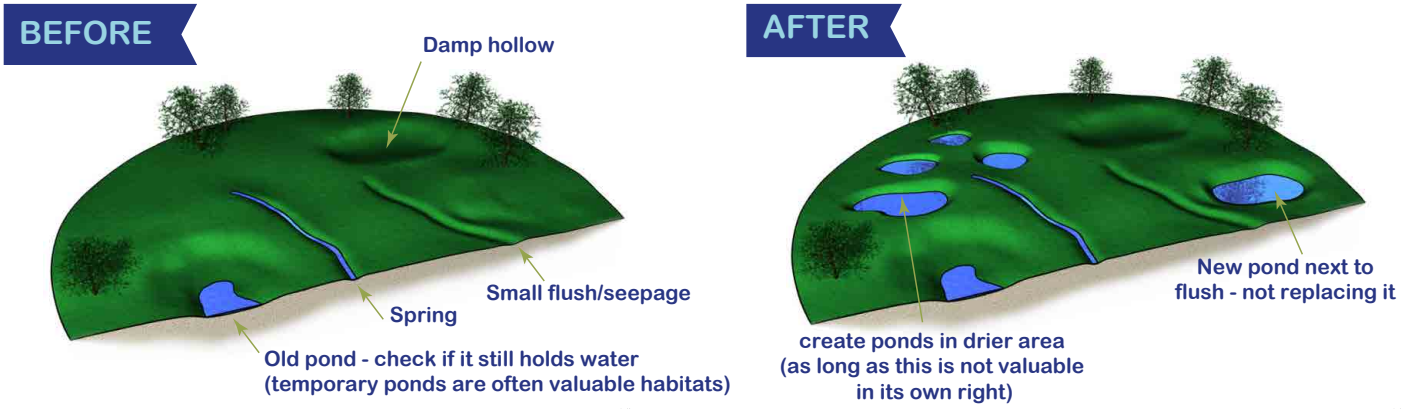


Figure 29. Think carefully where to locate your pond.

Create ponds for your landscape type

Think about how the pond will develop:

- The landscape type in which you create a pond will fundamentally affect how your pond develops. You can use design to make sure that ponds work well in any landscape.
- Ponds that are not in grazing units will rapidly develop a fringe of trees, so either plan for regular scrub and tree management (see section 8) or create larger waterbodies which will not become completely over-shaded.
- If the new pond can be grazed by stock any small pools or undulations you create will persist for many years. They can create wonderful wildlife habitats - just make sure that stocking densities are not too high (see section 9).
- Create multiple ponds of different shapes sizes and depths rather than a single waterbody. If you have the space to do this, creating a wider variety of pond habitats will support a wider variety of species.

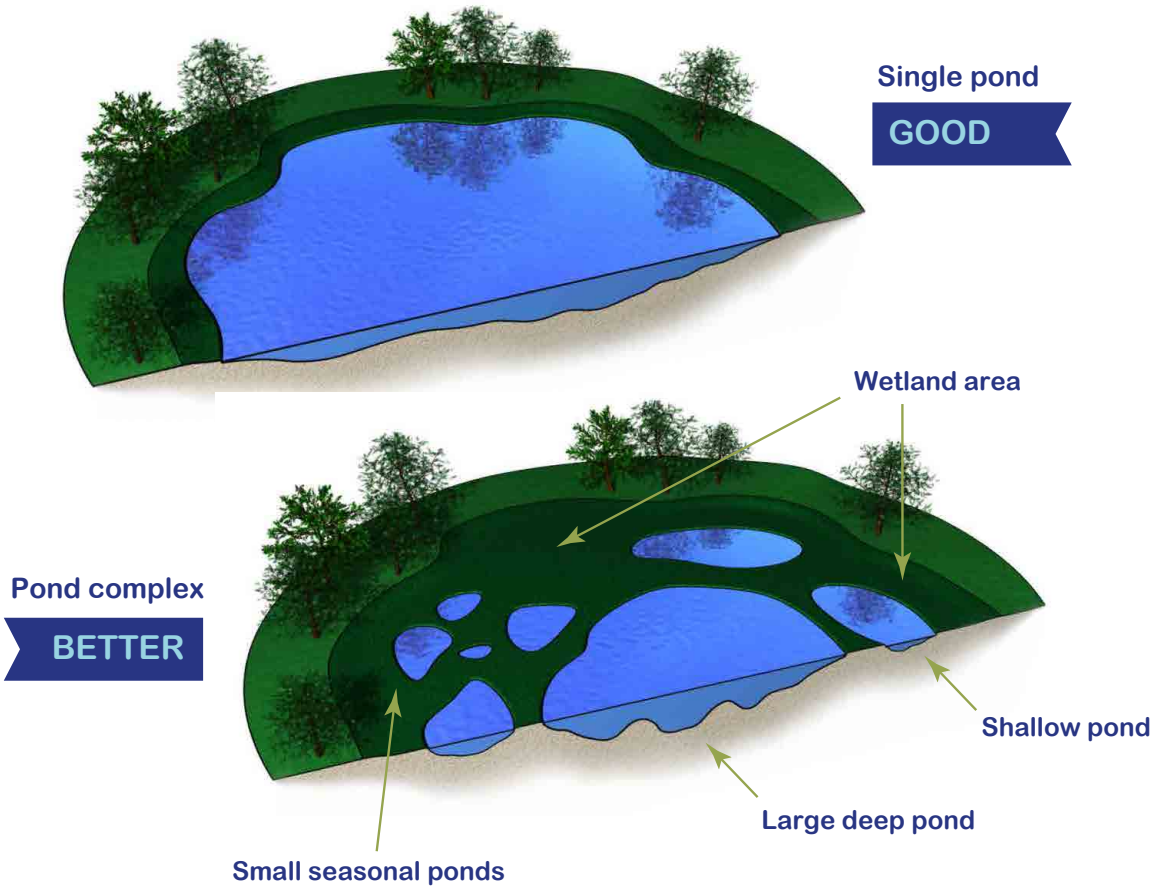


Figure 30. Create complexes of ponds with different depths and surface areas to increase the range of wildlife and provide habitats.

Pond design

When designing a new pond, focus on the edges because this is where most pond wildlife lives.

- The edge drawdown zone, which is wet in winter, and dry in summer, is a very important part of the pond habitat. Do create long undulating drawdown areas and irregular margins (Fig. 30).
- Create plenty of very shallow water (less than 10 cm deep) and wet ground because this is important for many pond species – suitable water's edge slopes are less than 1:5 (12°) and preferably less than 1:20 (3°).
- Create a variety of depths, including some deeper and shallower ponds (Fig. 30). Larger ponds can have deep and shallow water within them. The pond base does not have to be uniform and can undulate creating a variety of depths within a pond.
- A wide range of advice on designing ponds in different landscape types is available from the Pond Creation Toolkit at www.freshwaterhabitats.org.uk

Spoil and topsoil

- Do not spread topsoil in or around the pond. Topsoil is very rich in nutrients: it pollutes ponds and encourages growth of rank vegetation.
- If your pond needs to be fed by surface water draining into the pond from its surrounds, do not build spoil banks uphill of the pond because this will block surface water, thus eliminating a key water source (Fig. 31). Spoil can be spread thinly over ground on land which is not of conservation importance.
- It can be useful to remove the topsoil from the pond site first (Fig. 32) and then you can dig your pond and potentially use some of the subsoil to create, for example, undulating pond bases and wiggly edges without bringing in any of the nutrients from the topsoil.

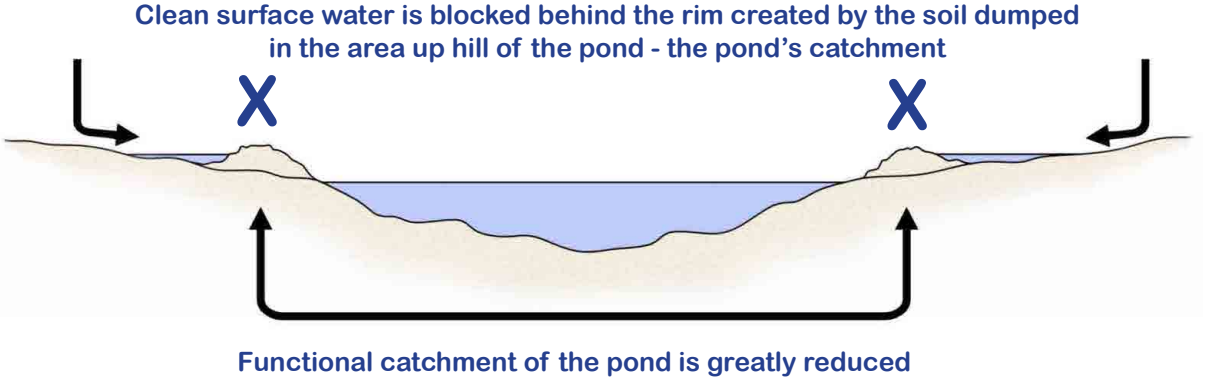


Figure 31. Do not create a rim around the pond with excavated soil (X) as this prevents surface water reaching the pond. If the soil placed next to the pond is nutrient rich it can also lead to nutrient enrichment problems.

Figure 32. New shallow temporary pond in Buckinghamshire, being created to provide additional habitat for a small isolated population of Fairy Shrimp (a). The first stage of many pond creation jobs will be to remove topsoil as this can be re-used elsewhere if kept separate from subsoil and underlying material (b). Once machinery is on site 2 ponds of 200-500 m² area can be created in a day, though an extra day needs to be allowed for fine-tuning. Spoil will often need to be temporarily stockpiled, although if double handling can be avoided the work will cost less.

(c)

(c) Medium sized ponds of 200-500 m² can be excavated using 15 tonne machines. Larger ponds are more efficiently created with larger machines.

(d) A new pond, created for Great Crested Newt. (e) demonstrates many of the benefits of high quality pond creation: it is located close to existing high quality terrestrial habitat (woodland), it has a clean catchment so is unpolluted and has excellent extensive shallows combined with deep water, both of which are needed for Great Crested Newt.

After creation - what to expect

- A new pond with clean water and plenty of shallows will quickly become extremely rich in wildlife.
- Leave the pond to colonise naturally. Do not add plants, fish or other animals. The bare muddy substrates that dominate new ponds in the first few years create a very special wildlife habitat.
- Freshwater animals and plants will find their own way to the new pond (they have a range of remarkable adaptations for this). Introducing species is unnecessary and risks introducing non native species and disease.
- The early bare stage of a pond is fleeting enough - enjoy it. It is essential to check ponds in the first few years and to take any management action required. For example removing invasive species which are most likely to colonise when the pond is bare (see section 3).
- Maintain or create some semi-natural vegetation surrounding the pond (see section 9).
- Fencing around ponds is not always good for wildlife (see section 9).
- Groundwater-fed ponds usually fill up within days or weeks. If your pond is fed by surface water (draining from the surrounds) it may take a couple of years for it to fill to its final level.
- Pond creation is not an exact science and sometimes ponds do not turn out exactly as planned - especially if water levels are higher or lower than expected. If so, it can be really worth bringing back a small digger for half a day to re-sculpt the margins and create your perfect pond.

Figure 33. The New Pill in Oxfordshire created in 1995 is now one of southern England's richest ponds, with three priority and Red Data Book water plants and a rich fen-associated water beetle fauna.

6. Pond Restoration

The UK supports many old ponds dug for a variety of reasons over the centuries. Today, however, many old ponds are in a poor state. Traditional scrub management around ponds, which likely kept them open to the sun for centuries, petered out after the 1960s/1970s and as a result much of the English countryside, especially farmland, is dominated by ponds that are shrouded by trees and scrub that are generally poor habitats for aquatic species (Fig. 34 & 35a). Where most ponds in a landscape are heavily shaded and scrubbed over, restoration is a good way of increasing the range of pond types present. Careful restoration, involving major scrub and sediment removal can also bring back some of the wonderful plants that ponds supported centuries earlier, including many currently rare species. This is because restoration opens up the pond to the sun and exposes long-buried but still viable seeds.

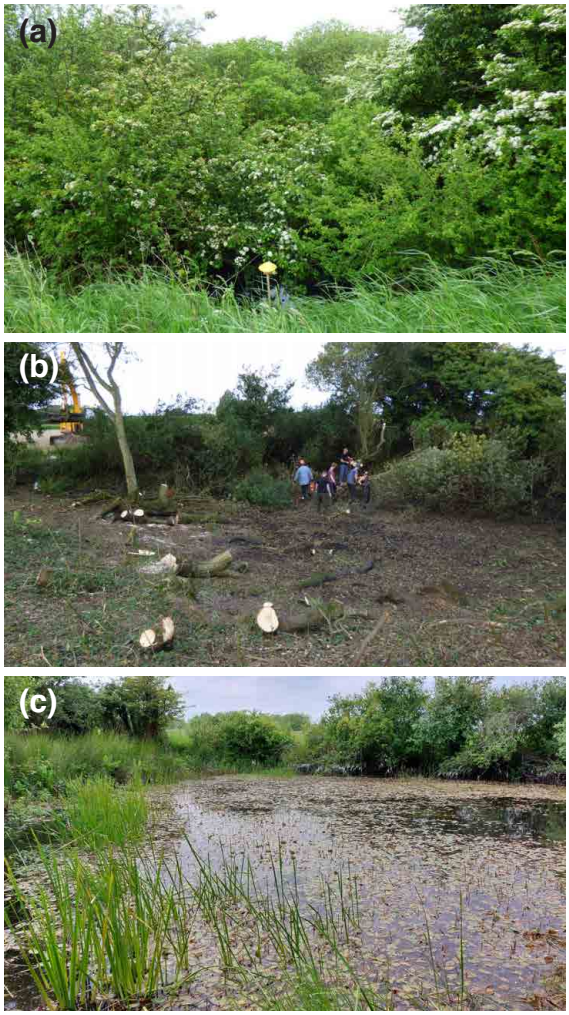


Figure 35. Before (a), during (b) and four years after (c) restoration by major scrub and sediment removal for a North Norfolk pond.

Figure 34. Three heavily shaded ponds located in an arable landscape identified as clusters of scrub and trees. Restoring some overgrown ponds has been shown to majorly increase biodiversity in the landscape.

When not to restore a pond?

Pond restoration undertaken in the wrong place has the capacity to damage existing wildlife and there are some places where it should be undertaken with care, or not at all (Fig. 36).

- Table 2 lists the ponds that have the potential to be damaged by restoration. At such sites restoration should only be undertaken following expert advice.
- If your pond type is included in Table 2 lighter touch management (see section 8) may be more appropriate than restoration.
- If the pond is not on the list in Table 2, particularly if it is in intensive agricultural or urban land and looks like a dark, dry habitat with few if any plants, then the risks to species are generally small and the major benefits that can be realised by restoring these ponds far outweigh any risks.
- To protect the historic integrity of old, existing ponds, many of which can be many centuries old, it is important not to alter the size, shape or profile of the original pond. Indeed, re-excavating a pond to its old profile tends to lead to all sorts of pond shapes and sizes in the landscape which enhances species diversity.

- Pond located in semi-natural habitat
  e.g. woodland, unimproved grassland, heathland or wetlands
- Pond on the pond priority habitat map
- Pond has abundant wetland plants
- Pond is known to contain rare or protected species
- Pond is in a nature reserve or Site of Special Scientific Interest (SSSI)
- Pond is a scheduled monument
- Pond is a listed structure or located within the curtilage of a listed structure

Table 2. Ponds which should NOT be restored without expert advice, although management (see section 8) may be appropriate.

Figure 36. Photo (a): a pond in an arable field with no aquatic plants that is not protected and has no records of rare or protected species - this pond could be a prime candidate for restoration. Photo (b): a wooded pond in the New Forest which supports nationally rare fungi on its trees and Pond Mud Snail in the water, a rare Red Data Book mollusc. After this photo was taken, unplanned tree and scrub removal eliminated both the fungi and the snail from the pond. Do not restore wooded or heavily shaded ponds in semi-natural landscapes without expert advice.

How to plan pond restorations

If you have identified a large number of heavily shaded ponds in your landscape, it is worth restoring a proportion, but not all of them. Shaded ponds, can still have a particular value for aquatic life, so it is beneficial to leave maybe 20-30% of ponds untouched. Restoration should ideally be staggered with a few ponds restored each year. This creates mosaics of ponds, at different developmental stages, so that mobile species can find the pond environment that is most ideal for them in any one year.

If you have multiple ponds on your land Table 3 demonstrates how thinking about the existing pressures impacting the ponds can be used to help decide which of your ponds to restore and which to avoid. Table 3 gives you enough space to consider up to five different ponds. Be aware that you will need to be familiar with your ponds so you may want to go and look at them first to refresh your knowledge. Use Table 3 to answer each statement for each pond, ticking it if the statement is true. Next add up the total number of ticks for each pond. Ideally, choose those ponds that have the LEAST ticks to prioritise restoration because these should give the best outcomes for wildlife. For example, a restored pond with an inflow ditch may rapidly become polluted and re-fill with sediment, so it would be better to choose another pond. You will also need to consider accessibility to the pond for groundworks and the impact that this will have on the surrounding land (for example, where any dredged spoil will be spread).

Table 3. Environmental and human pressures impacting ponds. Consider the following questions for each of your scrubbed over ponds. Ideally, choose the ponds that have the *least* number of ticks against them to prioritise restoration.

Tick the box for each pond if the statement below is true	*Potential impact of this feature or action*	*1st Pond*	*2nd Pond*	*3rd Pond*	*4th Pond*	*5th Pond etc.*
The pond is fed by a major inflow pipe or ditch	Inflows increase nutrient and silt levels in the pond resulting in algal blooms and terrestrialisation.					
The pond is fed by road run-off	Road run-off contains pollutants that will negatively impact the ecology of the pond.					
The pond has had waste dumped in it in the past	Waste can be difficult to dredge-out completely and so may continue to pollute the pond.					
The pond will not have any buffer around it	Buffers are important to prevent pollutants entering the pond. They also provide valuable wildlife habitats.					
There is a large mature tree that shades a large proportion of the pond for most of the day	Large, mature trees are valuable habitats in their own right. Rather than removing them – choose another pond.					
The pond is stocked or fed for wildfowl shooting	Disturbance and defecation by wildfowl can quickly degrade pond quality.					
The pond is stocked for angling	Fish such as Common Carp can degrade the quality of a pond.					
The pond is used by dogs	Dogs swimming and paddling in a pond churn up the mud leading to a loss of pond plants and animals.					
TOTAL NUMBER OF TICKS PER POND:						

Undertaking pond restoration works

The aim of restoration works is to open up ponds, so that they are no longer completely shaded and to remove sediment to restore something close to the original pond profile. This does not mean removing all trees and scrub and does not necessarily mean removing mud from all over the pond basin. It is particularly important to leave some scrub and bramble habitat close to a pond as essential local terrestrial habitat for birds, pollinators and amphibians. However, enough work needs to be undertaken to have the required impact of opening up the canopy and letting light in to stimulate wetland plant recovery from buried, often ancient, wetland seedbanks. Under good working conditions, for a typical small pond less than 20 m in maximum diameter, the work required can often be achieved in one to two days with a chain saw operator and digger working together. Volunteers can also greatly help with transferring cut wood to wood piles.

Timing pond restoration

The optimal timing for pond works involving scrub and mud removal is usually between September and November when water levels are low (some ponds may be dry at this time), and dry ground conditions make it easy to work in and around ponds. Pond restoration can be undertaken at other times of year. However the period from the end of January to August should be avoided so that amphibians and birds are not disturbed during their breeding season.

Tree and scrub removal

The condition, number and size of ponds and what features are nearby will affect how much tree and scrub cover you choose to remove or maintain. It is important to retain hedges, some mature trees, scrub and also bramble-habitat around the pond as many species (especially amphibians and farmland birds) greatly benefit from terrestrial habitat that is close to an open pond (Fig. 37). However, it is equally important to have a **major impact** and to open up the pond sufficiently so that shading of the water is low. Trees and scrub should generally be removed from around at least 50% of the pond margin. These can be coppiced down low to stumps, using a chain saw. Where large willow and alder trees are present within the wet pond basin (as opposed to the dry banks) they can be removed using the digger, once coppiced off. It is important not to pull out trees from the dry original banks of a pond as it destroys the banks as well as a pond's historic integrity.

Traditionally many ponds have been managed so that trees and scrub are removed especially from the south and west sides of the pond, thus maximizing the light and warmth reaching the pond. Such an approach has been used successfully in many pond restorations in Norfolk and Suffolk, for example. If this is how your pond has traditionally been managed it is appropriate to continue to do so, with scrub retained on the north side in particular. If the south side of the pond is a hedge or a roadside, or where the aforementioned approach has not traditionally been applied, the decision on where to remove and retain trees and scrub at a pond should be driven by local circumstances and access issues.

In larger ponds where areas of open water are beyond the shade cast by trees, it is valuable to create a variety of shading conditions, including dappled shade as well as open sunny marginal areas (Fig. 37).

Figure 37. A larger pond with some tree lined and some more open shoreline providing a range of shaded and open habitats in a single pond.

Tree and scrub disposal

- Piles of brash and larger cut wood pieces should be kept in separate piles. Brash piles (Fig. 38b), if they can be left in close proximity to a pond (but don't let them shade the pond), afford good over-wintering habitat for amphibians and as a good nesting place for birds, and will rot and drop down in a few years. Some cut wood pieces can also be used to make on-site amphibian hibernacula (Fig. 38c).

- If possible AVOID BURNING brash next to a pond as wind-blown ash can act as an unwanted fertiliser leading to algal blooms. Plus burning results in undesirable carbon emissions. It is better to squash down brash piles with a digger to create a low shrubby pond side habitat.

Mud removal

- Prior to works it is important that the digger driver is given a clear plan of what to do. Getting advice from an agri-environment advisor or local pond project expert can be helpful in this respect. Ideally an advosor will supervise the works.

- Note that many ponds are very old and have an enormous amount of history attached to their original shape, depth and profiles and may support rare terrestrial plants on thier banks and edges. The size, shape and profile of historic ponds should not be altered. Only soft mud should be removed and not clay or hard bankside material (Fig. 38d). DO NOT scrape down the hard banks of an old pond.

- When excavating ponds to remove the soft sediment that has accumulated, work with your excavator driver to carefully look for any buried sediment layers that were laid down when the pond contained lots of water plants and animal life in the past. These muds will be very fine when rubbed between your fingers and often contain aquatic snail shells and seed remains (Fig. 38e). Aim to leave some of this kind of sediment in the pond bottom. It may harbour long-lived seeds (>100 years) that will re-supply your pond with wonderful water plants present in the distant past, such as rare stoneworts (Fig. 38f & 38g).

- To have a major beneficial effect, aim to remove mud from at least 2/3 or more of the pond's area (but note the points on pond depth above). It is important to have a MAJOR IMPACT when it comes to mud removal however; do remove as much of the dark organic leafy muds laid down under trees as possible. If you start seeing clay on the digger bucket this is usually a good sign that you have gone deep enough and that you should stop. Do remove the majority of old dumped tree stumps (often thrown in due to hedgerow tree removal in the past) and rubbish placed in the pond as well as the majority of dead and rotting wood.

- Excavated surfaces should be left rough which improves plant colonisation. If available, toothed buckets on diggers can can create a roughness on the pond bed.

Mud disposal

- The ideal place to put the sediment is on a nearby arable field (stubble is ideal) where it can be spread out as thinly as possible (Fig. 38h), left to dry and subsequently ploughed in. The highly organic pond mud makes for a good soil improvement agent.

- Dredgings and spoil must not be used to fill in or to level adjacent wet areas or be placed on top of any areas of archaeological or ecological importance such as agri-environment margins. Before disposing of silt excavated from ponds please refer to 'Waste exemption: u10 spreading waste to benefit agricultural land.'

Figure 38. a) Cutting and removing trees and brash that have grown over a pond, b) Creating piles of brash, c) Piles of wood make great amphibian hibernacula, d) Removing the soft mud that has accumulated in the pond, e) Old pond sediments containing water snail shells and plant seeds, f) Dense beds of different stonewort species in a recently restored farmland pond - stoneworts are good indicators of water quality and their oospores can remain viable in pond muds for centuries allowing them to take advantage of improved conditions, g) Close up of the rare Clustered Stonewort *Tolypella glomerata*, h) Mud that has been removed from a pond and spread thinly on an adjacent stubble.

Figure 39. A Norfolk farmland pond, set in arable, in an overgrown state prior to restoration (a) and photographed again one year (b) and 2 years (c & d) following restoration by major scrub and mud removal. A rapid colonisation of the pond by wetland plants is clearly evident as driven by the exposure of long-lived seedbanks during the restoration.

After restoration and what to expect

- Expect to see algal blooms and discoloured water for a good few months following restoration, but after 6 months and sometimes less than this, the water should start to clear and water plants will usually be seen. In old ponds the colonisation of native wetland plants can be very fast and within two years it can be near impossible to know that any restoration works took place (Fig. 39). Where water quality is good, spectacularly high biodiversity is possible, even in the centre of an arable field.
- Leave the pond to colonise naturally. Do not add plants, fish or other animals. The bare substrates that dominate restored ponds in the first few years (Fig 39b) act as a very special wildlife habitat and in particular may be the only time that very rare stoneworts are able to thrive (Fig. 38f). Freshwater animals and plants, through a range of remarkable adaptations, will find their own way to the restored pond and others will re-establish from the pond mud, so introducing species is unnecessary and risks bringing in non-native species and disease.
- After just a few years restored pond landscapes have been shown to support substantially more species than they did prior to restoration with major benefits demonstrated for wetland plants, invertebrates, amphibians, farmland birds, bats and pollinators.
- It is essential to check ponds in the first few years and take any management action required to either deal with any non-native species (see section 3) or to prevent scrub taking over restored ponds by regularly managing scrub on a rotational basis (see section 8).
- Maintain some semi-natural vegetation surrounding the pond (see section 9).
- Fencing around ponds is not necessarily good for wildlife (see section 9).

7. Ghost pond resurrection

Ghost ponds are old pond sites that have been deliberately filled in. They can appear as depressions or damp patches of ground, or as crop marks in farmland (Fig. 40). However, sometimes they can only be identified from memory or from old maps. Re-excavating a ghost pond can bring a wonderful high quality pond back to life very quickly and in some cases rare plants, long lost from the landscape can re-appear.

Resurrecting a ghost pond can be a relatively easy way to increase the number of ponds within the landscape. As for restored ponds, ghost ponds recolonise rapidly with water plants, often within six-months, due to long-lived (>100 years) seedbanks that survive in pond sediment, even when buried underneath intensely farmed fields. Excavating a ghost pond allows you to unearth a time capsule of species! Ghost ponds can be excavated cheaply and quickly within, depending on old pond size, 1-2 days. It is important to allow some natural vegetation to develop around the pond (see section 9). This land will provide important habitat and act as a buffer to protect the pond from farmland activities and agro-chemical applications. It is important to consider if this will be possible before any works take place, as without a buffer pond water quality will be reduced.

Figure 40. Ghost ponds in farmland appearing as puddles (a), dark patches on the land surface (b), as patches of poor crop growth (c), and as a shallow depression in a ploughed field (d).

Locating ghost ponds

- Ghost ponds can be easily located by overlaying recent maps with different editions of historic maps, using satellite imagery or aerial photography, many of which can be obtained online. The Webpages of the National Library of Scotland provide a great means of finding ghost ponds from old Ordnance Survey maps: https://maps.nls.uk/os/. Map evidence that a pond was present is important as not all depressions or hollows in fields are ghost ponds; dry pits, collapsed field drains, or natural changes in elevation also occur.

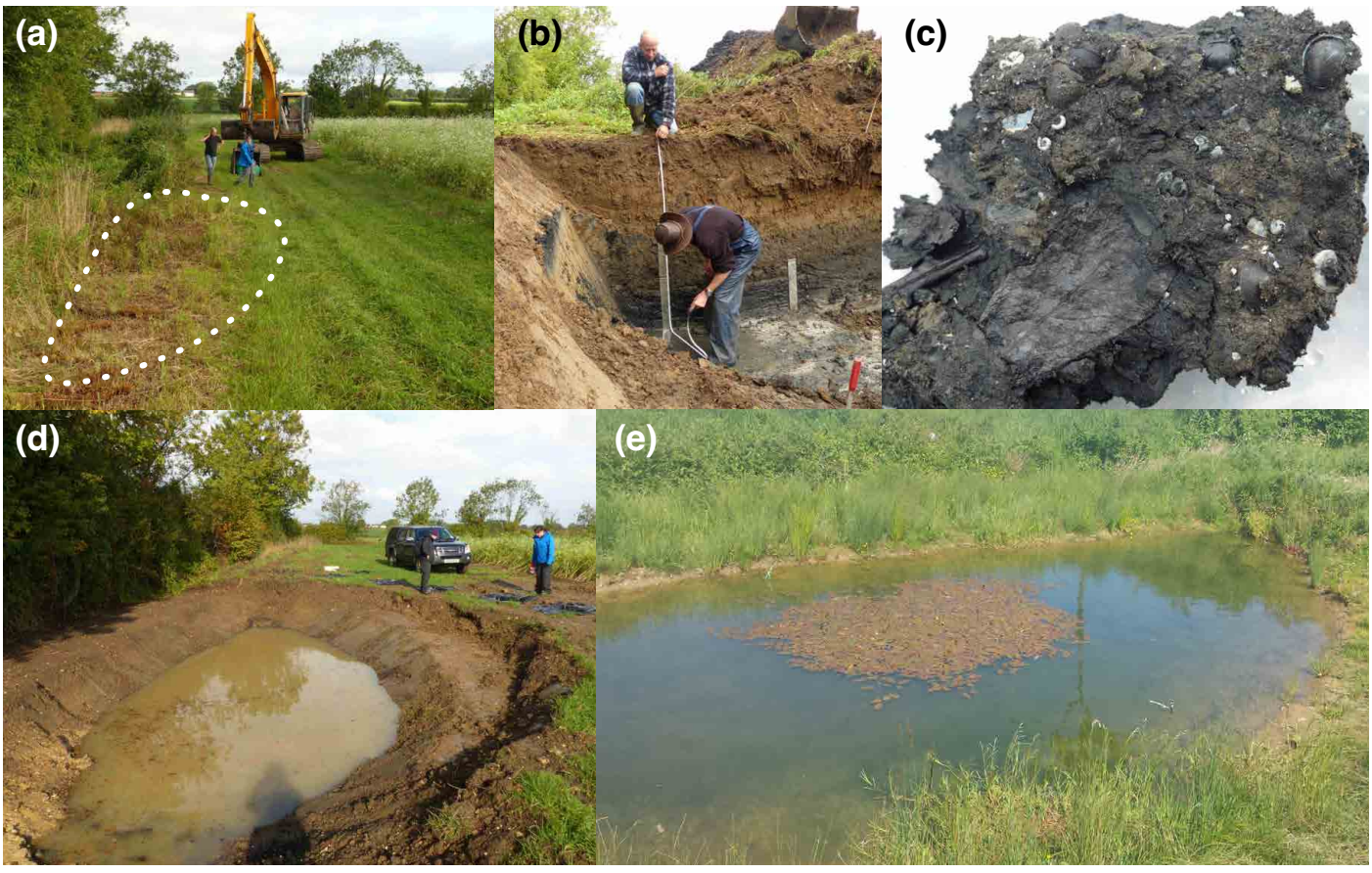
- Local knowledge is valuable, so it is a good idea to talk to older farm workers and land managers who may have been involved with ponds being in-filled in the past. It is important to avoid the excavation of ghost ponds where agricultural or other waste is known to have been used to fill in a pond.

- After locating ghost ponds on the map, their exact position should be confirmed on the ground. Ghost ponds may be visible as damp depressions in fields particularly during winter when a low crop cover coincides with high water tables, or as crop marks due to differing soil moisture content and quality which leads to differing rates of crop maturation (Fig. 40).

- Before a ghost pond is re-excavated it is important to know exactly where it was (Fig. 41a). When the location of a ghost pond remains unclear, digging test pits to look at the soil profile across the area where the pond is suspected to have been can help reveal its location.

- It is often useful to dig a trench well away from the suspected pond site to determine the approximate vertical position of natural clays, relative to the land surface. Ths information can help with understanding what you are seeing in the ghost pond excavation itself and cant ell you (if clay does not appear where it should) whether you are working in an in-filled pit.

Figure 41. A ghost pond resurrection before (a), and during resurrection (b). A close up of old pond sediment (c) and of the same pond immediately after resurrection (d), and one year following resurrection (e).



Once a ghost pond has been located, excavation can begin. Ghost ponds should ideally be resurrected from August to November, when the water table is low, so it is easier to work with heavy machinery and inspect soil profiles. To avoid conflicts with farm work, pond resurrection should ideally be completed post-harvest or during fallow field years. It is important to stay faithful to a pond's history and excavate a ghost pond, as far as possible, to its original dimensions.

- Mud can be removed using a 14-tonne tracked 360 excavator or other appropriate kit.
- A first trench should be dug through the suspected centre of the ghost pond (based on map demarcation and field measurements).
- Dig slowly and carefully and observe the sediments that you are exposing at regular intervals. The search for historic pond sediments (often dark and very fine to the touch when rubbed between the fingers and often full of leafy material and aquatic mollusca - Fig. 41c) can lead to much questioning: Are we in the right place? Have we gone deep enough? A key tip is to keep an eye out for materials that can indicate that you are still digging enough infill (e.g. bits of field drain, rubble, bailer twine, old bottles, burnt woody material). This trash layer can sometimes be deep (>2 m). Be bold and keep digging down until you find the pond's buried muds.
- Once you have found the original pond sediment continue a localised dig through it to guage its depth but do keep this material in a separate spoil heap. This layer can sometimes be more than 1 m thick.
- The next stage is to dig a second trench at right angles to the first (forming a cross, Fig. 42). Once you have found the old pond in both directions working outwards from the two trenches, the pond should be carefully excavated following as far as possible, its original dimensions.
- Working outwards from the two trenches with the digger, the pond should be carefully excavated following as far as possible the contours of the historic sediment profile, so that the resurrected pond is as similar in shape and size as the original. Care should be taken not to remove too much of the historical pond sediment by gradually excavating deeper soil layers
- Dig down through the historic pond sediment, but don't remove it all and any old pond sediment that is dug out should be kept and spread around the edges of the pond (especially over areas with exposed sub-soil) which helps with wetland plant colonisation.
- Any field drains at pond locations should be removed or broken during excavation so that the pond does not receive water from these sources and water does not quickly drain out via these structures.
- Following excavation (Fig. 41d), the pond's buffer (see section 9) should be marked out and both the pond and its margin should be left to colonise naturally by plants. Note that weedy species will quickly be replaced by wetland species in a few years.
- Newly excavated ghost ponds should be left to fill naturally with water through the winter.

Figure 42. Finding the location of a ghost pond by digging two parallel trenches.

After restoration and what to expect

- Expect to see algal blooms and discoloured water for a good few months following restoration, but after 6-12 months and sometimes less than this, the water should start to clear and water plants will usually be seen. Due to the persistence of wetland plants seeds, even when buried beneath cultivated fields for centuries, the colonisation of native wetland plants can be very fast (Fig. 41e & 43).

- Do not add plants, fish or other animals. The bare substrates that dominate resurrected ponds in the first few years act as a very special wildlife habitat. Freshwater animals and plants, through a range of remarkable adaptations, will find their own way to the pond very quickly and others will re-establish from the pond mud so introducing species is unnecessary and risks the arrival of non-native species and disease.

- It is essential to check ponds in the first few years and take any management action required (see section 8).

- Maintain some semi-natural vegetation surrounding the pond (see section 9).

- Fencing around ponds is not necessarily good for wildlife (see section 9), but is essential for at least two years to allow a ghost pond to recover.

Figure 43. Colonisation of pondweeds in a ghost pond shortly after restoration.

8. Pond management

Management is about maintaining the sort of pond that you want. It differs from restoration in being less extensive and invasive. Management is used for two purposes:

- to maintain ponds in good condition including ponds you have recently restored, resurrected or created or existing good quality ponds.
- to improve ponds where restoration is not recommended (due to their existing high conservation value), but where more gentle management may be beneficial.

Management aims to maintain/create pond variety in the landscape and to prevent the mass scrubbing over of ponds. Management can involve the introduction or re-instatement of appropriate grazing, cutting back of scrub and trees and removal of some plants (e.g. Bulrush) and sediment where it is needed to maintain a pond in good condition.

Figure 44. Ponds kept open by grazing. Both (a) and (b) show how trampling has led to some bare patches around the pond edge. This does not necessarily lead to a complete absence of trees which can provide shade over part of the pond creating variety in pond habitat. Photo credit: Tim Bernhard (b).

Pond management was once a traditional part of the farming calendar, like the maintenance of hedges, with ponds kept open by periodic scrub removal, because open ponds were useful, especially for watering livestock. This type of management is not onerous and can often be undertaken once a year in a rotational manner at different ponds.

Grazing

An excellent way to maintain ponds is through grazing. Ponds that are grazed are often richer than other pond types, have more uncommon species and need less management.

Grazing does three important things; (i) it creates different pond habitats; poaching by animal hooves creates uneven muddy ground which many wetland plants love (Fig. 44). Whilst deeper water areas with restricted access can have taller vegetation; (ii) it reduces the growth of trees around ponds, keeping them open; (iii) it helps species spread from one pond to another - spores and seeds of wetland plants can be moved from pond to pond on hooves.

Optimal levels of grazing are quite broad: enough to stop extensive tree and scrub growth, but not so many animals so that there is a year-round mud bath.

If necessary, temporary fencing or fencing with a gate for stock access can be used to adjust grazing and poaching levels (see section 9 for more information on fencing).

The extent to which physical management is needed or not needed will depend on the pond, its surroundings and how quickly the pond changes. Generally speaking, you can be quite robust in your efforts at sites which are recently restored, resurrected or created or at sites located in areas dominated by intensive agricultural or urban development. By contrast, when sites have the possibility of holding rare species or of being of exceptional individual value for nature conservation you need to act more cautiously as described in Table 4.

Table 4. How to manage ponds dependent on pond setting.

Pond setting or protection	Advice section to use
Ponds that have recently been created, restored or resurrected. Existing ponds in landscapes dominated by intensive agriculture and urban areas.	Use the advice below in section 8.1.
Ponds in semi-natural areas e.g. non-intensively managed grasslands, heathlands, woodlands, coastal habitats or wetlands or ponds on the priority habitat map.	Use the advice below in section 8.2.
Ponds which are part of a SSSI.	Advice in section 8.2 may be relevant but seek advice from Natural England.

8.1 Management of newly created, restored and resurrected ponds and ponds in areas dominated by intensive agriculture and urban development

Tree and scrub removal

In arable or other landscapes where grazing livestock are absent, it is important to cut back scrub on a regular basis, so that all ponds do not quickly revert to becoming overgrown with trees again. However, it is also important to maintain some scrub and bramble due to its value, especially for birds and because dappled shade is valuable for many pond species. Management action is best informed by watching how the pond develops and taking action as required. Action might ideally take place every 3-10 years at a pond depending on its size and the rapidity with which scrub returns. This type of management can be undertaken with chainsaws, strimmers or other suitable machinery. The job should not take too long - half a day per pond perhaps - allowing a number of ponds to be managed each autumn-winter. It is important, not to manage all ponds in the landscape in one year, in order to maintain variety. Instead, a small proportion of ponds should ideally be managed at a time in rotation (e.g. a landowner with 10 ponds could manage 2 ponds per year). Such an approach to pond management will result in a landscape supporting ponds at different stages of succession with scrub of different ages, which is known to be important for the maintenance of biodiversity in the landscape.

Emergent plant and mud removal

Even if the aim is to maintain an open pond it is valuable to have some emergent plants. However, some newly created, restored, resurrected and even old established ponds can quickly become dominated by one or two very vigorous growing emergent plants. Equally, over a number of years, in the presence of some trees, pond sediment may start to become dominated by decaying leaf material, leading to a loss of water plants. In these situations, some emergent plant and/or mud removal will help maintain an open pond in good condition. If both actions are needed, they can be undertaken at the same time.

- If the pond risks becoming overrun by a single "thuggish" species - particularly Bulrush (Fig. 45), then it is worth thinking about early management - perhaps before it occupies more than 10% of the pond.
- Where different emergent plant species are mixed together, this can be a very rich habitat. So you might want to wait until there is well over 50% emergent cover before removing any.
- When removing plants, a rough rule of thumb is to retain around 20% of the marginal and emergent vegetation in the pond even after management and to ensure that management does not completely remove any single plant species.
- Gentle, rotational "patch-scraping" of ponds may be the most appropriate on-farm approach to emergent plant and mud removal. By simply taking an occasional shallow scrape off a pond margin (<10% in any year) that removes a small proportion of invasive vegetation, scrub seedlings and surface mud species that favour open water can be safeguarded. This can be undertaken in winter, perhaps taking advantage of ditching or other maintenance works which mean that a digger is on site. Such an approach can often lead to the re-occurrence of rare underwater plants such as stoneworts (Fig. 38f & 38g).
- Particular care should be taken if the pond is lined to prevent this from being breached.
- If there are multiple ponds in the landscape that have become dominated by emergent plants, spread your management work out so that not all ponds are managed in the same year, thus creating variety in pond habitat across the landscape whilst reducing the annual workload.

Figure 45. A pond dominated by Bulrush (also known as Reedmace) that has quickly invaded all areas. With a thuggish plant like this you may want to get in early and stop its spread.

8.2 Management of ponds with rare species and/or ponds situated in semi-natural habitat or protected areas

Ponds situated outside of intensive agricultural or urban land uses should be managed more cautiously than those described above. This includes ponds in non-intensively managed grasslands, heathlands, woodlands, coastal habitats or wetlands. Ponds that are in protected sites such as nature reserves or SSSIs also need to be treated more cautiously regardless of their landscape setting. The reason for this more careful treatment is because these ponds are more likely to support rare species associated with their current conditions and therefore changing these conditions via management has a greater chance of being detrimental, but this does not mean they should not be managed.

Recent research shows that, due to a lack of traditional scrub management and grazing, even our best ponds are in decline. This is because ponds that were once traditionally managed by grazing, are now often fenced, or insufficiently grazed and physical traditional pond management practices have faded away over time. Growth of new secondary woodland and scrub around what would traditionally be grazed or managed open ponds is a particular problem in the lowlands and has led to a decline in many freshwater species. Management can take the form of scrub removal, re-instatement of appropriate grazing and very occasionally careful sediment and plant removal.

Tree and scrub removal in semi-natural areas

There is a balance between managing and damaging sensitive ponds:

- If rare or protected species are (or have been) present in a pond, or if it is within a SSSI or another protected site, management should only be undertaken after expert advice.
- Generally speaking, removing new trees and scrub (under 50 years old) will be beneficial for pond wildlife.
- Consider leaving some of the edges shaded as dappled shade is an excellent habitat.
- If there are multiple ponds in the landscape, spread management out so that all ponds are not managed in the same year, thus creating a variety of pond habitats in the landscape.
- Mature trees and hedgerows should be retained.
- Where grazing occurs, it is important to get the levels of grazing right and this is about keeping an eye on your pond and adjusting grazing as required. Optimal levels of grazing will be enough to stop tree and scrub growth but will not create a year-round mud bath.
- Temporary fencing or fencing with a gate for stock access can be used to adjust grazing and poaching levels (see section 9 for more information on fencing).

Sediment and plant removal in semi-natural areas

If mature ponds are full of a mix of emergent species this can provide an excellent habitat and generally the pond does not need further management beyond that for trees and scrub described above. If, the pond is becoming dominated by a single species such as Bulrush (Fig. 45) and if this is outcompeting other plants, you may wish to undertake management to remove some.

- If rare or protected species are (or have been) present in a pond, or if it is within a SSSI or another protected site, management should only be undertaken after expert advice.
- A suitably cautious approach to the management of sensitive ponds would be to remove no more than ¼ of the plants over a three-year period.
- If there are multiple ponds in the landscape, spread management out so they are not all managed in the same year, thus promoting pond variety in the landscape.

Figure 46. Management of scrub around a pond.

9. The land surrounding ponds

What is the surrounding land?

The land surrounding a pond includes both wetland and terrestrial areas. In intensively farmed systems this may be restricted to a narrow ring of land (Fig. 47), but in semi-natural and nature reserve settings it can encompass considerable areas of wild, non-farmed land.

Why is it important?

The land immediately surrounding a pond should be thought of as an integral part of the pond habitat. It is essential for many of the species that use ponds and often forms an important transition between the open water and dry surrounding land, supporting a range of wetland and terrestrial species. When ponds are linked up with other landscape features, such as hedges, terrestrial species are more able to take advantage of the pond as a vital source of food, shelter and water, while amphibians associated with ponds, have better over-wintering habitat. Farmland birds and pollinators have also been found to benefit from ponds with varied semi-natural vegetation surrounding them in the farmed landscape.

Wide non-cropped pond margins (Fig. 48), where a mix of plants can grow, also helps to protect ponds from the harmful effects of agricultural pollution including spray drift, surface run-off and leaching of pollutants through the soil. Pond margins help to protect water quality by acting as a buffer between the pond and farmed areas where fertilisers and pesticides are used. However, pond margins cannot perform miracles; where the water supply to a pond is polluted or the site is vulnerable to episodes of polluted run-off from other sources, a narrow pond margin is not likely to be sufficient to protect water quality. It will also be less effective where field drainage effectively by-passes the pond margin and discharges directly into the pond via an inflow pipe. It is recommended, therefore, that field drains that discharge into wildlife ponds are blocked or diverted and if this is not possible it is important to choose other pond sites for conservation purposes.

Figure 47. The wide margin (in this case 10 m) around this pond set in arable helps protect it from spray drift and surface run-off. Photo credit: Sacha Dench

Figure 48. A messy, wildflower rich margin at a Norfolk farmland pond. Heaven for pollinating insects in particular.

What should pond surroundings look like?

The land surrounding a pond should ideally support semi-natural vegetation including tussocky grasses, flowering plants, and scrub (Fig. 48, 49, 50). The presence of bramble around ponds in arable landscapes is particularly important for birds and pollinators. In general the messier the pond margin the better, with a mixture of plant types and plant heights being ideal (Fig. 49). Trees will also naturally grow in the margins (section 8 provides advice on managing trees that overshade ponds). Bare ground is also a valuable habitat in pond margins as it provides habitat for less competitive, often annual species, to grow in summer. Bare mud is also great for mason bees, swallows, and basking dragonflies. Open margins are often created by the actions of grazing animals or fluctuations in water levels and open patches around ponds can also be maintained by periodic mowing and topping of the tall grasses and scrub.

Fig. 49. Messy pond edges in arable fields showing a mix of scrub and tall grasses. In photo a) a brash pile (as a result of restoration works a few years previous) has dropped down and become colonised with bramble. Aged wood piles are often packed full of birds nests. In photo b) a range of pond margin habitat structures are evident including long grass, bramble and low scrub.

Where ponds are located in existing semi-natural habitats such as heathlands, non-intensive grasslands, woodlands, wetlands and coastal systems the terrestrial pond margin will be indistinguishable from the rest of the semi-natural habitat in which it sits so pond margin management can usually fit in with existing nature reserve or habitat management. There may still be a terrestrial to aquatic transition that often supports wetland plants between the terrestrial habitat and the pond itself. Areas of bare ground are also valuable in ponds in semi-natural habitats.

What nature needs is a variety of pond types in the landscape and this includes variety in surrounding pond marginal land too.

Figure 50. A variety of vegetation structures surrounding ponds including tall grasses, scrub and bramble (a) as well as bare mud created by grazing cattle or management is ideal (b). Both these situations provide good wildlife habitat.

How big should the area of semi-natural vegetation surrounding a pond be?

A simple message here is "the bigger the better". We know that ponds surrounded by lots of semi-natural habitat are much better for wildlife. If ponds are set in intensive farmland we recommend a margin width of 30 m and a minimum margin width of 10 m. Although the latter is unlikely to be sufficient to eliminate all nutrient and pesticide inputs from agriculture, it will still benefit the pond and its wildlife. This natural vegetation zone around the pond does not have to be uniform in width and, where a pond is fed by surface water runoff, it is beneficial to maximise the area of semi-natural vegetation upslope of the pond to provide as much protection from polluted water as possible. To improve connectivity for aquatic and terrestrial species in the landscape, pond margins can be used to connect a pond to habitat features such as a hedgerow or a woodland edge. This can be particularly valuable in the farmed landscape (Fig. 51).

Figure 51. A Suffolk farmland pond that has been created next to good existing semi-natural habitat.

How to establish and manage the vegetation surrounding ponds

The vegetation around a pond should not normally be sown or planted and can naturally colonise. The aim is to create a naturally varied vegetation, and management involving cutting is only required to manage woody growth or non-native invasive species. Herbicides, pesticides and fertilizers or manures should not be used in pond margin as this is an area that protects the pond from these substances. The exception to this is the treatment of injurious weeds (such as Common Ragwort) which may sometimes need to be controlled. Such weeds can be controlled by herbicide spot treatment or weed wipe, but not by the wider application of herbicides.

Where possible, grazing is an excellent way to manage ponds. Many pond plants and animals thrive in the messy mix of mud and vegetation that grazing animals create, and grazed ponds tend to be diverse, self-sustaining and long-lived. There is no ideal grazing regime or stocking level, although it is clearly best to avoid stocking densities that lead to completely bare pond edges and permanently muddy water. Grazing in winter and early spring followed by exclusion in summer works well to keep woody plants at bay whilst allowing species to take advantage of open pond margins in the growing season without disturbance. However, different grazing regimes favour different species and will be appropriate in different circumstances.

Fencing

Fencing a pond is not generally desirable, particularly if it stops stock from grazing and poaching pond edges. There are exceptions where it is unavoidable to prevent excessive disturbance by people, dogs, or stock. Fencing or marker posts may also help prevent unintentional encroachment of agricultural practices such as fertiliser use into pond margins. However, these are not issues at every pond and fencing can also make it difficult to allow stock or wild animals such as deer to maintain the variety of vegetation and open ground that is desirable in pond margins. Ponds are also enjoyed by people and can be important for educational purposes so, unless public access is causing an issue fencing is unnecessary.

In situations where high stock numbers make the pond into a year-round mud bath, fencing can be used strategically to reduce their pressure whilst still enabling the benefits of some grazing and poaching by hooves. For example, temporary electric fencing, or creating gate access to fenced areas can allow seasonal access for animals at suitable times of year. Traditional conservation fencing, where half of the pond is permanently fenced and half is left open, is often not a successful strategy. A better option is to offset the fencing to create a patchwork of different grazed, ungrazed, damp and wet habitats (Fig. 52).

If ponds are to be managed by machinery (e.g. grass-cutting), sufficient space is needed to enter and manoeuvre within the fenced area. Where public (or dog) access is a problem, multiple ponds can be created, some near to public access points and others further away, to benefit both public enjoyment and wildlife.

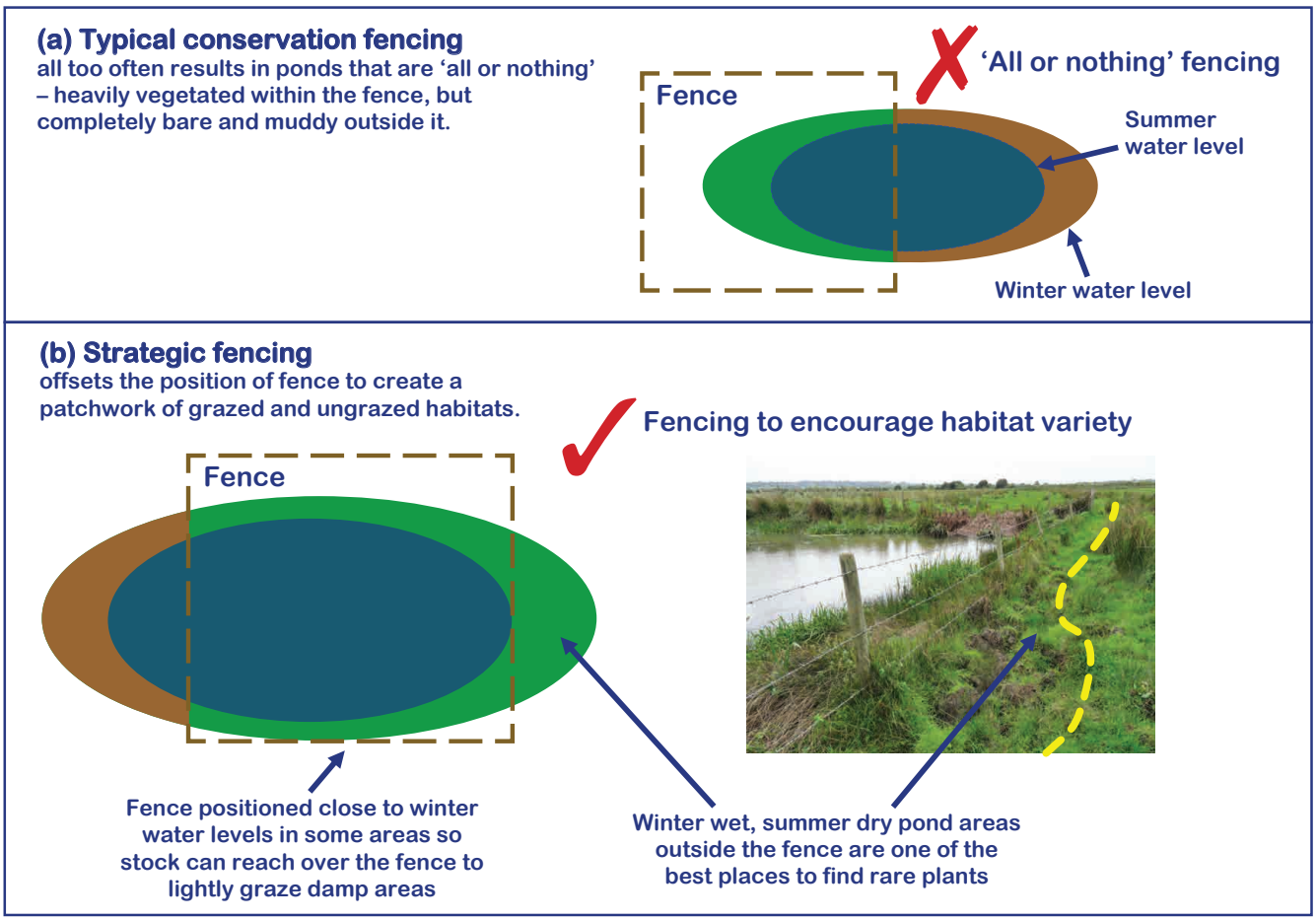


Figure 52. Fencing for areas with heavy stocking. Ideally ponds should not be fenced against grazing animals. However, if high stocking rates make fencing necessary, one option is to strategically place the fence to create zones of different grazing intensity as in (b).

Final considerations

The authors of this report have worked on ponds for many decades, and have shown, through scientific research, that good pond conservation, if undertaken at scale can help to reverse freshwater wildlife declines in the English countryside. Results from pond creation, restoration and resurrection come quickly (Fig. 53) and it can be very satisfying to see the benefits before your eyes after relatively modest amounts of work. So please help to save our precious, much loved ponds.

Figure 53. A Norfolk pond before (a) and two years after restoration (b) by scrub and mud removal that took just one day of work.

10. Further Reading

Pond creation

Pond Creation Toolkit. Available from: https://freshwaterhabitats.org.uk/projects/million-ponds/pond-creation-toolkit/

The Pond Book: a guide to the management and creation of ponds. 3rd Edition, Freshwater Habitats Trust, Oxford.

Factsheet on pond design. Available from:
https://freshwaterhabitats.org.uk/wp-content/uploads/2013/09/pond-design.pdf

Factsheet on locating ponds and finding a water source. Available from:
https://freshwaterhabitats.org.uk/wp-content/uploads/2013/09/locating-ponds-and-finding-a-water-source.pdf

Pond management and restoration

The Pond Book: a guide to the management and creation of ponds. 3rd Edition, Freshwater Habitats Trust, Oxford.

See 'Restoring Norfolk Ponds' guidance at https://norfolkponds.org

Pond Restoration Research Group underpinning pond research:
https://www.geog.ucl.ac.uk/research/research-centres/pond-restoration-research

Important forms and other advice

Waste exemption: u10 spreading waste to benefit agricultural land. Available from:
https://www.gov.uk/guidance/waste-exemption-u10-spreading-waste-to-benefit-agricultural-land

Science behind the guidance

Alderton, E., Sayer, C.D., Davies, R., Lambert, S.J. & Axmacher, J.C. (2017) Buried alive: Aquatic plants survive in 'ghost ponds' under agricultural fields. Biological Conservation, 212, 105-110.
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Sayer, C.D. & Greaves, H. (2020). Making an impact on UK farmland pond conservation. Aquatic Conservation: Marine and Freshwater Ecosystems, 30, 1821-1828. https://doi.org/10.1002/aqc.3375

Sayer, C.D., Hawkins, J. & Greaves, H. (2022) Restoring the ghostly and the ghastly: A new golden age for British lowland farm ponds? British Wildlife, 33 (7) 477-487.

Walton, R.E., Sayer, C.D., Bennion H. & Axmacher, J.C. (2021). Improving the pollinator pantry: Restoration and management of farmland ponds enhances the complexity of plant-pollinator networks. Agriculture, Ecosystems & Environment 320, 107611.

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https://freshwaterhabitats.org.uk/wp-content/uploads/2013/09/Williams-et-al-1997-Design-new-ponds.pdf

Williams, P. (2018) What's happening to the quality of our best ponds? A re-survey of National Pond Survey sites after 24 years. Freshwater Habitats Trust. https://freshwaterhabitats.org.uk/research/latest-research/

Williams, P., Biggs, J., Stoate, C., Szczur, J., Brown, C. & Bonney, S. (2020) Nature based measures increase freshwater biodiversity in agricultural catchments. Biological Conservation, 244, 108515.

Norfolk Ponds Project: @norfolkponds
UCL Pond Restoration Research Group: @uclponds
Freshwater Habitats Trust: @pondriverstream

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