Palmate newt (Fred Holmes)

4. Pond Creation

4.1. Benefits of pond creation

Creating a pond is one of the most cost effective steps that can be taken to benefit wildlife. Ponds support similar or greater aquatic diversity compared with other wetland habitats such as rivers. Carefully designed wildlife ponds rapidly become rich in species. Ponds are also central to amphibian ecology and so their creation is key to improving amphibian conservation status.

Our widespread amphibians have relatively broad requirements for breeding ponds but there is a great deal of overlap between the needs of amphibians and the features recommended for wildlife ponds in general. The principles for creating wildlife ponds (e.g. Williams *et al.* 2010) also apply well to amphibian breeding sites.

4.2. Pond location

There are a number of factors to consider when planning a new pond. These include:

- Water source
- Flooding
- Warmth
- Public access
- Location of neighbouring amphibian populations
- Habitat connectivity (*9. Landscape Ecology)*
- Functionality: if for example the pond is created for some other primary purpose, e.g. a fire pond or part of a Sustainable Urban Drainage Scheme (*10.2 Sustainable Urban Drainage Systems*)

4.3. Water source

Water quality is critical to the wildlife value of a pond. High water quality, or 'clean water', supports a great abundance and diversity of aquatic life. Clean water is simply water that is unpolluted. Common sources of pollution are agro-chemicals and run-off from roads. Of these the former are particularly significant. A large proportion of the countryside is farmed so most rural ponds are affected by agro-chemicals. It is not just pesticides that affect water quality but also fertilisers. Ponds thrive best with low-nutrient input so fertilisers are a pollutant in ponds.

Some of our amphibians can survive and breed in relatively poor water quality. Nevertheless, clean-water ponds provide better habitat so ponds should be sited to optimise water quality within the constraints imposed by the local environment. What this means in practice is that new ponds should be created in locations where they are filled by rain and ground water rather than road run-off or water drained from land subject to agro-chemical application. In some parts of the country this can be difficult, especially where groundwater is contaminated with nitrates. However, if these impacts can be minimised, amphibians may still benefit.

Where possible, ponds should be located in semi-natural habitats such as heath, downs and woodland, where pollution inputs are likely to be minimal.

Water from ditches and streams should be avoided. Ponds on farmland are often fed by ditches that receive water from arable fields, which is effectively polluted. The temptation to use ditches to maintain a constant water level in ponds should be avoided for the same reason. Varying water levels help to create a more natural pond ecosystem anyway. Ditches and streams may also carry fine particles which cause rapid silting. Further, ponds which receive their own independent water supply will develop their own unique character. If connected to a stream or ditch, this will be compromised.

Care should also be taken in using water from springs to feed a pond. There is a misconception that spring water is always pure but in reality, in some parts of England, it contains high levels of nitrates from agricultural fertilisers.

On farmland, buffer strips (areas surrounding a pond where agro-chemicals are not applied) may provide a degree of protection. Research has not identified the width of buffer needed but the greater the width, the more effective it is likely to be. Buffer zones have the additional benefit that they can provide good terrestrial habitat for amphibians.

4.4. Flooding

New ponds should be sited in locations free from the risk of flooding from nearby rivers or the sea. Seasonal flooding may introduce fish while inundation with seawater will harm most freshwater pond life. The natterjack is a special case as it can exploit ponds that experience seasonal flooding by salt water if the pond is freshened up with rain water prior to the breeding season (see *11. Natterjack Toad)*. The Environment Agency provides maps on the Internet that indicate areas at risk of flooding.

4.5. Warmth

Warm ponds are favourable for amphibian growth and development, hence new ponds should be located in sunny locations. A belt of trees or scrub several metres to the north of a pond can act as a windbreak and create a warm microclimate around the pond. The long-term management of the pond site should incorporate measures to control scrub and trees to avoid excessive shading. No more than 60% of the pond shoreline, or 25% of the surface of smaller ponds, should be shaded and in most cases less shading is preferable. The southern shoreline is best unshaded.

4.6. Public access

The greater the public access, the greater the chances of negative impacts on the pond. Harmful consequences of public access include:

- Disturbance by dogs
- Introduction of fish
- Introduction of non-native plants and animals
- Vandalism (e.g. damage to pond liner)
- Killing amphibians

Experience has shown that ponds constantly disturbed by dogs have a significantly lower wildlife value than those which are undisturbed, largely due to high turbidity of the water. This problem is greater on clay soils.

The degree of public access should be considered when planning a new pond. To minimise disturbance a new pond should be sited away from access points, footpaths and bridleways.

If it is not possible to locate a new pond away from areas that are heavily used by the public, it may not be worth creating a pond at all. Alternatively, such ponds could be seen as 'sacrificial', where activities such as dog swimming are tolerated in order to protect other more sensitive ponds.

As a last resort, fencing can be erected to keep the public away from pond edges. This can be unsightly but it may be essential to ensure that a good wildlife pond can develop.

4.7. Will the new pond hold water?

On soils where an impermeable clay layer can be found close to the surface, ponds can be created simply by digging holes in the ground. However, most of the time things are not so straightforward.

There is no foolproof way of predicting how well a pond will hold water, so the best advice is to carefully assess the evidence:

- Look at the surrounding landscape. Are ponds a common feature? If so it is a good indication that new ponds will hold water.
- If ponds are present nearby, how far below ground is the water level? If the highest water level is 50 cm below ground level, a hole 100 cm deep will only retain 50 cm of water at that time of year.
- Examine the terrestrial vegetation. The type of plants present will indicate whether the site is well drained or not.
- Check for evidence of previous disturbance to the ground. If brick rubble or the remains of land drains are present, the pond may not hold water even on wet sites. Such factors make the hydrology of brownfield sites difficult to assess.
- Ask for advice and speak to site managers; they may know the locations of land drains.

Sensitive ponds can be fenced off to protect them from disturbance, such as these ponds at Havannah Nature Reserve, Newcastle-upon-Tyne (David Orchard)

To determine whether a proposed pond is likely to hold water, it is advisable to dig a number of test holes and observe them for a period of time. Test holes of any convenient size can be dug to check the water-holding potential of a particular site. Ideally, such test holes should be 1 m deeper than the deepest part of the proposed pond. Check for services (buried cables or pipelines) before digging a test hole.

Test holes (and newly excavated ponds) sometimes take a while to seal themselves as the small soil particles fill the spaces between the bigger ones. Ideally, test holes should be monitored for up a year to find out how water levels fluctuate. Digging a test hole also allows inspection of the soil profile. For reasons of safety test holes should have gradually sloping sides.

A large test hole allows water levels to be monitored for up to a year, during which it may function as an amphibian breeding pond and should not be filled in. This one is 7 m in diameter and 1.2 m deep (David Orchard)

In the German state of Schleswig-Holstein over 1400 ponds have been created for nature conservation since 2004. This has generated a wealth of experience. Instead of test holes, trenches are dug the length and breadth of the proposed pond to check for the presence of land drains. An assessment is then made, based on the soil profile, as to whether the planned pond will retain water.

A trench excavated in Schleswig-Holstein to determine pond creation potential (David Orchard)

4.8. Lined ponds

On permeable substrates such as chalk, sand or limestone new ponds will probably need some form of liner to retain water. A variety of materials is available including:

- EDPM rubber
- Butyl rubber
- Bentonite clay

Rubber pond liners are relatively easy to use, but prone to puncture. To reduce the risk of this:

- Carefully remove any sharp objects from the excavated hole.
- Line the hole with a commercially available geotextile or polypropylene underlay. Sand may also be used, but is more difficult to work with than manufactured underlay, so is best used in conjunction with the latter.
- Place the liner on top of the underlay.
- Place a second layer of geotextile or polypropylene on top.
- Cover with a protective layer of either subsoil or sand (10-30 cm).

Butyl liner laid over geotextile underlay, Portal Woodlands, Ipswich. This liner required four people to lay (Duncan Sweeting)

As well as protecting the liner from puncture, the uppermost layer of underlay also stabilises the sand or subsoil on top of the liner to create a natural looking pond basin. The underlay should be unrolled in sheets that overlap approximately 25-30% of their width, with the overlapping edges facing towards the deeper part of the pond, so that overlaid sand or subsoil runs off it rather than raises its edges.

Installation guidance is sometimes provided with purchased liners.

Here the butyl liner has been covered with a geotextile layer, topped with a 30 cm depth of sand from the excavation site (Duncan Sweeting)

Bentonite clay is a fine powder that expands on contact with water. When sandwiched between two geotextile layers it produces a very effective pond liner. Bentonite liners are more robust than rubber and have a more natural appearance.

Bentonite based liners are available under several different trade names, such as Bentomat and RAWMAT, and they are purchased in large rolls or strips. Correct installation is the key to their success and manufacturers' guidelines must be strictly followed.

Although a bentonite liner should remain functional after a period when a pond dries, it does not withstand excessive drying. Hence bentonite liners are best used on damper substrates rather than sandy soils which may dry out completely, making the liner prone to cracking.

Pond liners are heavy. Small ponds, such as typical garden ponds can be lined by hand but for bigger ponds machinery will be needed to deliver, manoeuvre and roll out the liner which may weigh several tons.

Lined ponds lose water via capillary action (i.e. water is soaked up and away from the pond by soil around the edge). This effect has a relatively greater impact on smaller ponds.

4.9. Pond design

This section focuses on the individual pond. Landscape considerations are covered in section *9. Landscape Ecology.*

Amphibian ponds should ideally contain a range of microhabitats. To create microhabitat diversity within a pond, the design should incorporate:

- Gently sloping sides
- A range of pond depths
- An irregular shape

Gently sloping pond edges (gradient of 1 in 10 or if possible 1 in 20) create a wide drawdown zone which encourages a diversity of plants and invertebrates. However, if pond-dipping is planned designing a section of the pond edge with vertical sides facilitates netting access.

Shallow areas, less than 10 cm and certainly less than 30 cm deep, support the greatest range of pond plants which in turn create the habitat for most of the pond's invertebrates. Beds of submerged aquatic vegetation provide egg-laying substrates for newts, microhabitat for prey species and refuge from predators. For amphibian ponds it is not necessary for the greatest water depth to exceed 1.2 m.

Frogs spawn in the warmest part of the pond, which is usually found in shallow margins (ARC)

4.10. Excavation

A 21-ton excavator used to create amphibian ponds in Schleswig-Holstein, Germany (David Orchard)

If space allows, large excavators are best for pond creation work as they allow greater flexibility and they are more cost effective.

Spoil excavated during pond construction can be used to create a bund or raised pond edge to avoid run-off from a potential nearby source of pollution.

Topsoil removed from a site during pond creation (or from any other source) should not be added to the pond after construction, as this is nutrient-rich pollutant. If creating a lined pond, sand or sub-soil should be used instead to cover the liner.

A toothed bucket on a mechanical digger leaves an uneven finish which increases microhabitat diversity in non-lined ponds (David Orchard)

4.11. Planning permission

In some areas pond creation may require planning permission, but local authority planning departments differ in how they address this issue. If planning permission is required a fee will be charged and this varies according to planning authority and the size of the proposed pond(s). In some areas these charges can be significant and the amount of time needed to complete the necessary paperwork can be daunting.

If you think that planning permission may be required for your project, speak with your local authority's ecologist or biodiversity officer and ask for advice on the best approach. Alternatively, contact the relevant planning officer and explain why your project will help to achieve local and national biodiversity targets. Planners sometimes show discretion when interpreting planning laws and they may not insist on a planning application for your project, especially if it is small scale.

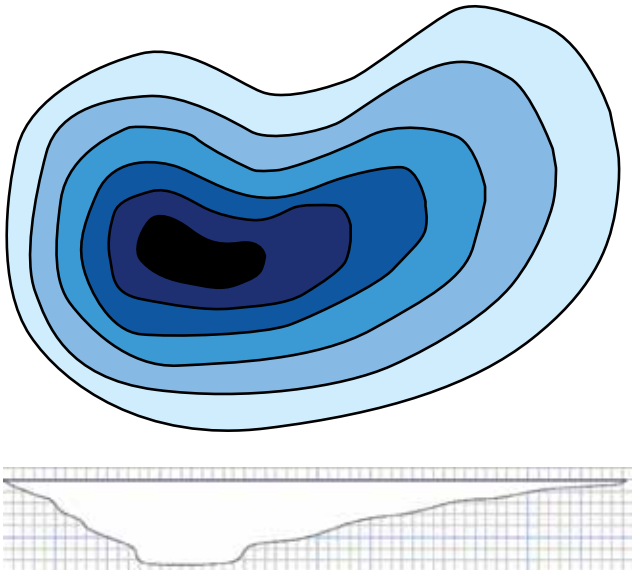
If proposed ponds will be used to water livestock, they will not need planning permission.

4.12. Working with contractors

Ideally a contractor will have experience of wildlife pond creation but this is not always the case. Regardless of previous experience, a contractor should be provided with a specification for the proposed work and a simple diagram showing the contours of each proposed pond.

It is highly advisable to be on site to supervise pond creation work to:

- Make the most of any opportunities that arise to create better ponds.
- Resolve problems that may arise while the machine is on site.
- Ensure that the contractor follows the specification as intended.
- Ensure that valuable habitats (such as hibernacula) are not damaged by machinery.



Plans of pond outlines and profiles provide a useful guide for contractors who may not be used to wildlife pond specifications (Pond Conservation)

Such supervision may sound unnecessary, but some aspects of new amphibian ponds (irregular outline, gently sloping sides and rough finish to the pond base) are contrary to the training and working practices of plant operators. Experience has shown that on-site supervision by suitably experienced staff is often the key to a successful pond creation project.

4.13. Stocking the pond

Many pond plants and animals, including amphibians, have evolved strategies for moving between water bodies and colonising new sites. Hence, there is no need to stock a well-designed pond with amphibians, other pond animals or plants.

In addition to being unnecessary (and potentially costly), stocking ponds can jeopardize the wildlife value of a pond due to the risk of introducing non-native, pest pond plants (see *6.5 Non-native invasive plants*) Furthermore, concerns about threats posed by amphibian disease (see *7.1 Disease*) have resulted in a cautious approach to moving any material between one pond and another.

If there is overwhelming pressure to 'plant up a pond', for example on sites frequented by the public, best practice is to avoid using plants from private gardens or garden centres. To minimise the risk of introducing non-native plants or amphibian disease, the alternative could be to translocate plants from nearby ponds, as long as landowner's permission to do this has been granted and provided that absence of pest plant species can be confirmed.

Pond creation checklist

- Ensure a source of clean water.
- Choose a location unlikely to be flooded.
- Choose a warm location.
- Consider public access.
- Consider connectivity with other amphibian sites (*9. Landscape Ecology*)
- Check that proposed pond location does not already support valuable habitat/species.
- Check that the site holds no archaeological interest (contact county archaeologist).
- Check for the presence of services (cables or pipelines) underground.
- Check the water-holding potential of the site.
- Apply for planning permission if required.

4.14. Literature

Environment Agency. Flood Maps.
www.environment-agency.gov.uk/homeandleisure/37837.aspx

Linewatch (website). Pipeline enquiry service.
www.linewatch.co.uk

Williams, P., Biggs, J., Whitfield, M., Thorne, A., Bryant, S., Fox, G and Nicolet, P. (2010). The Pond Book: A Guide to the Management and Creation of Ponds. Pond Conservation, 2nd edition. Pond Conservation, Oxford.