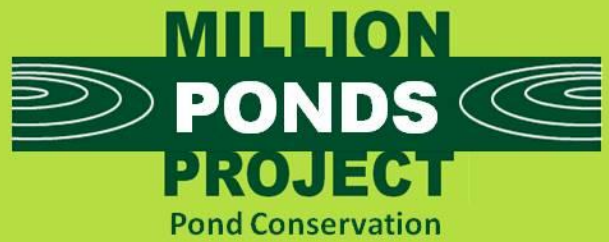


Designing wildlife ponds in the river floodplain



A 50-YEAR PROJECT TO CREATE A NETWORK OF CLEAN WATER PONDS FOR FRESHWATER WILDLIFE

1. Why add ponds to the floodplain?

In natural floodplains, ponds are a common and abundant habitat. Indeed, the area of ponds often exceeds the area of the main river on the floodplain. As the river moves across the landscape, large linear ponds form as cut-off backwaters. Whilst in winter, small seasonal pools appear in shallow natural depressions. All of these pool types are important habitats. They can be exceptionally wildlife rich, and are particularly likely to support rare species.

Today, most of our rivers, streams and ditches are no longer clean water habitats because of nutrient enrichment and other pollution. Ponds connected to the river have declined in quality and many floodplain species are now under threat. This factsheet explains how, by following a few simple design rules, we can create wildlife rich floodplain ponds (Figure 1).

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Figure 1. Ponds in Boardwalks LNR, Peterborough (left) - created for amphibians. Temporary ponds in the River Gowy floodplain, Cheshire (right), habitat for the rare Lesser Silver Water Beetle *Hydrochara caraboides*.

2. Design principles for floodplain ponds

The key to creating wildlife rich ponds in the floodplain is to ensure that they have clean water. It also helps if they form part of a wetland complex that includes both permanent and seasonal water.

- **Don't connect ponds directly to the river.** Because most streams and rivers are polluted, create ponds which will not be regularly flooded. Ponds fed by groundwater or surface water will have cleaner water.
- **Individual pond designs can be very simple.** Wetland complexes with ponds of different surface area, depth and seasonality will support many more species than a single isolated pond.
- **Create ponds adjacent to other wetland habitats.** Animals and plants will move to new habitats as part of the natural process of pond succession.
- **Ponds in the floodplain which are regularly flooded need to be shallow.** Most submerged plants cannot grow in deeper water so deep polluted ponds tend to be rather barren habitats. If water quality is poor, create shallow pools less than 0.5m deep which will fill with emergent plants. If ponds are connected to the river, be prepared to create new ponds every 5-10 years, because they will quickly fill with sediment.

What's in this factsheet?

- Why add ponds to the floodplain?
- Design principles for floodplain ponds
- Choosing pond location and finding a clean water source
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 - Pond location
 - Avoiding sensitive areas
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 - Pond profiles
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- Designing floodplain ponds for rare species
- Case study: Shrike Meadow and Pinkhill Meadow, River Thames floodplain, Oxford
- Further reading

3. Choosing pond location and finding a clean water source

Deciding where to put a pond will be the most important decision you take when creating a floodplain pond. It will determine how good the pond will be for wildlife, which species the pond will support and the future management needs of the pond.

Water sources for ponds on the floodplain

The floodplain is not always a good source of unpolluted water for your pond. There are four main ways that the pond could receive water and each has its pros and cons (Figure 2). Water quality will depend on the surrounding land use and how the floodplain is managed.

Figure 2: Water sources for ponds on the floodplain

	PROS	CONS
<p>Surface water and direct rainfall</p> <p>Water collects in ponds which are perched above the natural aquifer.</p>	<p>These ponds will have very clean water provided the surface water drains from an unpolluted catchment, e.g. woodlands, heathlands or low intensity grasslands.</p>	<p>Surface water fed ponds need an impermeable barrier such as a clay substrate to hold water.</p> <p>Test holes may be required in areas of variable geology to determine whether ponds will hold water.</p>
<p>Groundwater</p> <p>Water seeps into the pond from sub-surface water. The pond can be permanent or temporary.</p>	<p>Groundwater levels are often close to the surface in the floodplain; therefore it is easy to create ponds which will hold water for part of the year.</p> <p>These ponds will often have very clean water provided the groundwater is fed from a largely unpolluted catchment.</p>	<p>If the surrounding catchment is very intensively managed (e.g. under arable), groundwater fed ponds can suffer from high levels of fertilizer nutrients.</p>
<p>Floodwater</p> <p>During the winter, ponds in the floodplain may become inundated with flood water.</p>	<p>Many species in the floodplain disperse to new habitats during times of flood.</p> <p>Ponds may flood and become connected as groundwater levels rise. They don't have to be connected to the river during flooding - if not connected to the river they will still have clean water, even after flooding.</p>	<p>Rivers may breach their banks annually or only sporadically. The more frequent the inundation and the greater the disturbance (agriculture/development) in the catchment, the lower the water quality in the pond.</p>
<p>Connected to the river</p> <p>Ponds can also be connected directly to the river or ditch network.</p>	<p>Ponds connected to the river and ditch network as part of a pond complex can provide nurseries for fish and support bird populations which feed on them. Connected ponds can also be useful refuges for mammals like water vole, and otter which are not too worried by water pollution.</p>	<p>Most streams and rivers in the UK are now significantly polluted.</p> <p>Ponds connected to these water courses will quickly become polluted, often more so than the stream because the pond fills rapidly with polluted sediment. Often these ponds are poor in species and are dominated by a few tolerant species, e.g. Reed Sweet-grass <i>Glyceria maxima</i>.</p>



Where to locate ponds in the floodplain

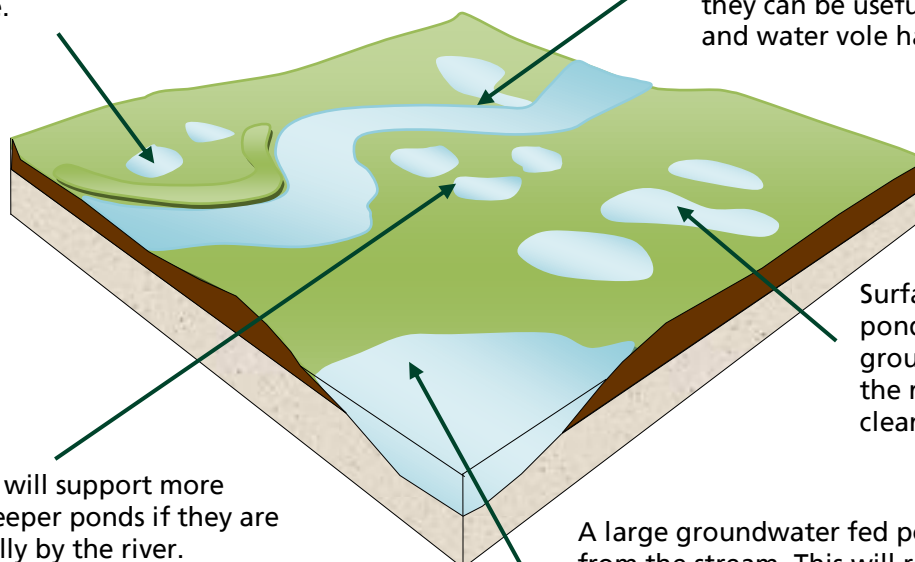
The source of water can make a big difference to water quality (see [Pond Creation Toolkit Factsheet 2](#) for more information on creating clean water ponds for wildlife). With this in mind there are some basic principles for creating ponds in the floodplain to increase their wildlife value (Figure 3 and 5):

- **Avoid areas which are regularly flooded by the river.** Flooding will not usually occur over the whole floodplain every year. Flooding may only happen once every 100 years or even once every 1000 years. To identify where your site is on the floodplain check the 'extreme flooding' zone on Environment Agency flood maps (www.environment-agency.gov.uk).
- **Locate ponds on slightly higher ground within the floodplain.** These ponds will flood less frequently and will receive the majority of their water from surface water, not the river. If the surrounding landuse is low intensity, e.g. heathland, woodland or species rich grassland, the water quality is likely to be high.
- **Put ponds behind natural levees.** Some rivers have developed natural levees (flood deposition mounds which create a barrier between the river and the floodplain). These can reduce the frequency of flood events and increase the chance of ponds being fed predominantly by clean surface water or groundwater.
- **Think about wildfowl.** They often use river floodplains as migration corridors. Large numbers of gulls and wildfowl can degrade floodplain ponds and considerably reduce their wildlife value. Smaller ponds, particularly those created adjacent to woodland or hedgerows will be more sheltered and avoided by large numbers of wildfowl, whilst still providing valuable habitats for many plant, insect and mammal species.

Figure 3. Choosing the right location in the river floodplain can make a big difference to water quality

High quality, low lying ponds in the floodplain are fed by groundwater and protected from regular flooding by a natural or artificial levee.

Ponds linked to rivers or ditches and ponds flooded by the river annually will usually be polluted and have a shorter life than surface-fed or groundwater-fed ponds. However they can be useful as fish nurseries and water vole habitats



Surface-water fed ponds on higher ground, further from the river often have the cleanest water quality.

Shallow ponds will support more species than deeper ponds if they are flooded annually by the river.

Some shallow water emergent plants are not fussy about water quality so can grow irrespective of water quality, providing a habitat for invertebrates, amphibians and birds.

A large groundwater fed pond set away from the stream. This will receive cleaner water than a pond linked directly to the river.

Groundwater is a good water source for deeper ponds, especially in less intensive catchments.

Figure 4: Opportunities for pond creation in the floodplain

Create ponds:

- as part of floodplain restoration to increase the variety of clean freshwater habitats in the floodplain.
- to increase the diversity of uniform areas, such as stands of Common Reed *Phragmites australis* or Purple Moor-grass *Molinia caerulea*.
- in semi-improved habitats, e.g. grasslands which are no longer fertilised or in arable field corners from which nutrient-enriched soil has been stripped.
- In areas where they won't cause an obstruction to future land-use changes, e.g. along the margins of fields or by sectioning off a river meander.



The RSPB reserve at Otmoor, Oxfordshire is a restored wetland complex of ponds, ditches, wet grassland and grazing marsh created on former arable land. These floodplain habitats are not directly connected to the river - retaining high water quality and supporting many rare species such as Tassel Stonewort *Tolypella intricata*.

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Avoiding sensitive areas

Creating new ponds in the river floodplain has many benefits, and there are many opportunities to do this (Figure 4 and 5), but it shouldn't be at the expense of valuable existing wetland habitats. Make sure you carry out a risk assessment before digging new ponds (see [Pond Creation Toolkit Factsheet 6](#) for more information).

- **Create ponds adjacent to rather than instead of other wetland habitats.** Fens, swamps and marshes are rare habitats supporting important plants and animals. Consider creating ponds in these habitats only after careful assessment (see [Supplementary Habitat Factsheet: Wetlands and Reedbeds](#) for more information).
- **Avoid areas with high archaeological value.** River valleys often have a long history of human occupation and a high archaeological value. It is important to check with the county archaeologist early in the planning stage.

Legal issues dealing with spoil

- The Environment Agency will be concerned to ensure that any excavated spoil (a) does not reduce the floodplain's capacity to store floodwater and (b) is not piled up causing an obstruction to floodwater movement. This often means that spoil will need to be removed from the floodplain to another disposal site - a process that can be expensive. Check the Environment Agencies flood map to ensure the site is technically in the floodplain www.environment-agency.gov.uk. If so, contact the Environment Agency directly for further advice.



4. Floodplain pond designs

Pond size and shape

Natural ponds in the floodplain can be very variable in size, ranging from small natural depressions just a few metres in width, to oxbow lakes and cut-off meanders which can be greater than 2ha in surface area. The ponds can also vary in the length of time they hold water, from just a few months to fully permanent waterbodies. In a complex of ponds, these gradients of size and water permanence will add greatly to the wildlife value of the site.

- **Temporary ponds** overlying the groundwater aquifer can be shallow (<40cm deep) and simple in profile.
- **Medium sized ponds** are usually up to 50cm or at most 1m deep, depending on local hydrology. Deeper ponds will only be successful when they are created in clean water areas. They can be very valuable for submerged and floating-leaved plants, and can be used strategically to prevent complete colonisation of the site by plants such as Common Reed *Phragmites australis*.
- **Linear ponds**, less than 3m in width and up to 50cm deep, can replicate the cut-off meanders and ditch habitats found in floodplains .
- **Large deep ponds** (<0.5ha and up to 2.5m deep). Ponds in the floodplain which are deeper than about 50cm will need to have a clean water source to support submerged aquatic species. They should include some large shallow undulating drawdown zones (i.e. a slope less than 1:20 (3°) to provide bare ground for marginal plants and feeding areas for wading birds. Consideration of birdstrike risk to aircraft will be needed for large wetland areas (see [Supplementary Advice Factsheet: Pond designs to reduce the risk of birdstrike](#) for more information).

If you do create deeper areas of water, you can make things more interesting for wildlife by creating a series of underwater bars and shoals. These will increase the shallow water habitat of the pond and prevent bare substrates becoming smothered by silty deposits, which is important for species such as stoneworts. Wave-wash in larger ponds can also help to maintain bare areas (see [Pond Creation Toolkit Factsheet 4](#) for further information).

Floodplains are also naturally dynamic places, so staggering pond creation (for example, creating new ponds every 5 years or so) will create a gradient of pond ages, mimicking the natural periodic creation of ponds on floodplains.

Pond profiles

In general, very shallow pond profiles are best for wildlife. The pond edge area is particularly important, because shallow water supports the greatest number of wetland species (see [Pond Creation Toolkit Factsheet 4](#) for more information).

It is also worth thinking about the 'drawdown zone': the area of mud and vegetation which is flooded in winter and spring, and progressively dries as water levels fall in summer. This is a very important habitat for wetland species. Drawdown zones don't need to slope down evenly to deeper water: they can undulate, creating pools, spits and marshy areas around the pond edge. These wet areas create a patchwork mosaic of small-scale habitats which can be exceptionally rich in plants and invertebrates (see Figure 5 and [Pond Creation Toolkit Factsheet 4](#)).

Not all pools **have** to have extensive shallows however, and there are sometimes situations where steep banks are an advantage (Figure 6). This is particularly true of ponds where space is limited and steep sided ditch-like ponds need to be created. As noted above, on floodplains, such pools mimic the natural morphology of cut-off channels. And particularly if they are fed by good quality groundwater, these waterbodies provide excellent freshwater habitats for many deeper water plants and animals.

Figure 5. Example of a pond complex with undulating drawdown zone and lots of shallow water

A large pond (15 x10m) is created with a deeper centre (max. 1m) and undulating pond profile. This creates small shallow ponds in the pond margin as the water levels fall during the summer. Other ponds in the complex are perched above the groundwater level and are fed by surface water only.

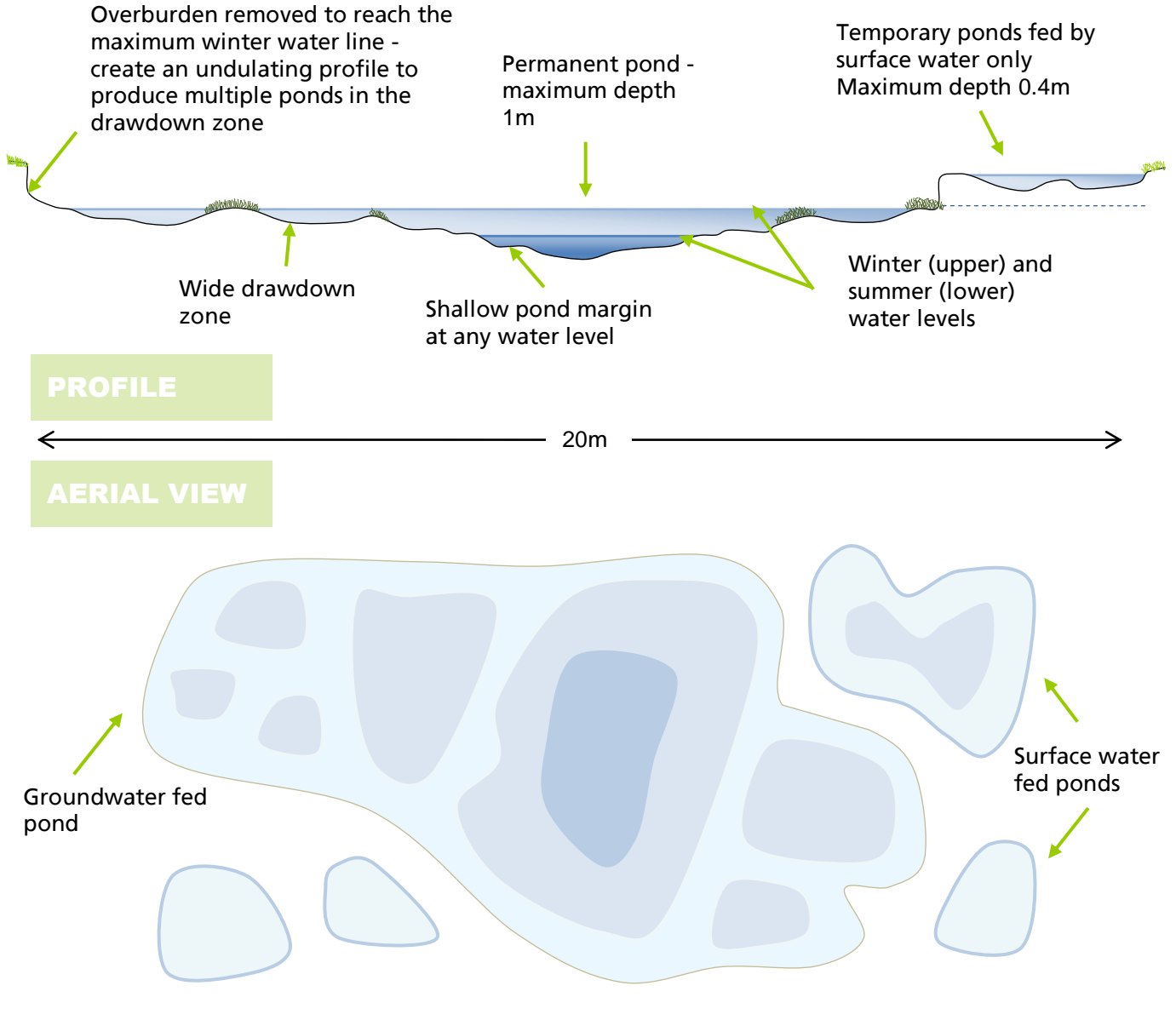
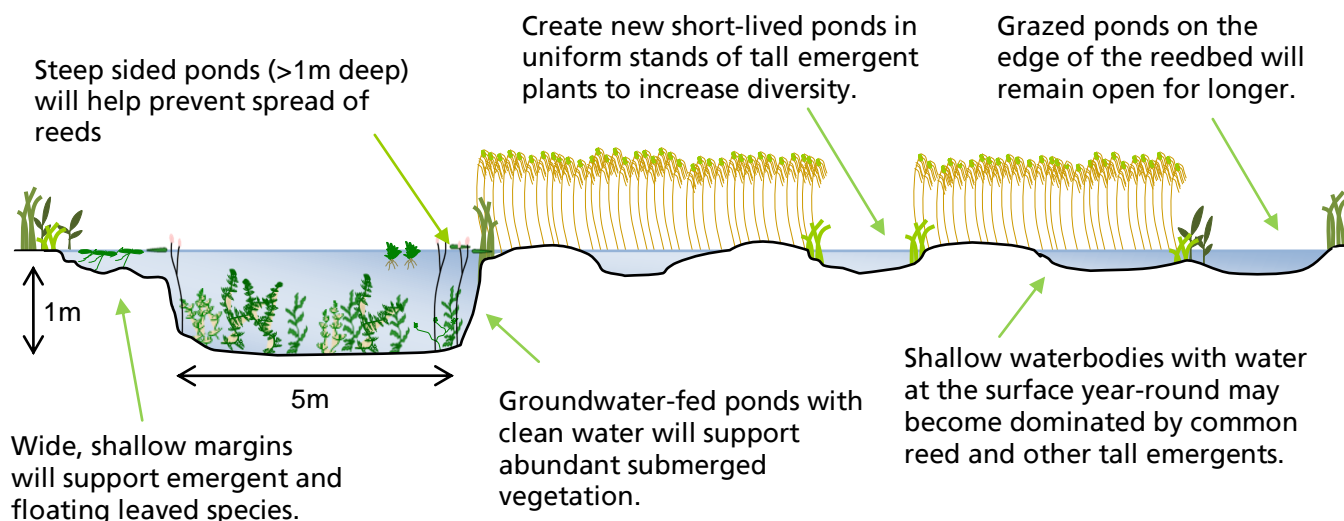




Figure 6. Example profile of a steep-sided linear pond fed by high quality groundwater, with adjacent reedbed

Ponds which are relatively steep sided can prevent colonisation of dominant wetland plants such as Common Reed *Phragmites australis*. Steep-sided ponds will also provide excellent habitat for invertebrates, amphibians, birds and water vole. If some of the pond margin has a shallow profile it can also support important emergent, submerged and floating leaved species.

To increase diversity in the reedbed include ponds with different depths and profiles. Whilst some may become dominated by reed, others will remain open, creating a succession of habitat types.



5. Management of floodplain ponds

Adjacent habitats

Identifying which habitats surround the pond can make a big difference to its wildlife value, so it is important to establish the aim and target species (if any) of the pond creation scheme before work begins.

- **Scrub and trees** adjacent to the pond will provide valuable habitats for amphibians and many bat species, and shelter for many insect species. Wading birds prefer open vistas, as trees next to the ponds will provide perches for raptors and corvids (crow family).
- **Reedbeds** are valuable for many bird and insect populations and can act as a screen to protect floodplain ponds from disturbance. Shallow water ponds can quickly become smothered by common reeds and without management the number of species they can support will be reduced.
- **Floodplain grazing marsh** can be a very good location for pond creation because the grassland itself often supports few species of conservation concern. However, stocking levels need to be managed to ensure that ponds are not damaged by high levels of nutrients or excessive trampling. The exact number of cattle or other stock per ha is difficult to determine because the number of ponds on the site will also affect grazing pressure in and around the ponds. In general, stock poaching which creates bare ground along the pond margin can be very beneficial, because it reduces the cover of more dominant plants. As long as trampling does not reduce the entire pond to a mud bath all year round, you have probably found a good level. Some species may require late successional habitats and if you are creating ponds for these species it may be worth restricting grazing from part of the site to allow taller emergent plants to develop. New ponds will need to be created to replace the early bare ground habitats which are being lost by natural processes.
- **Rivers.** Floodplain ponds will usually naturally support native fish species if they hold water year round. However, wildlife ponds cannot support large stocked populations of fish without this having a detrimental effect on the plants and invertebrates. If fishing is being considered as a recreational activity on the site it's best to allocate separate ponds for fishing and ponds for wildlife.

The early years

If your pond is fed by a clean water source, you should need to do very little in the way of management. However there are a few steps you can take in the first few years of a pond's life to iron out any future problems.

- **Don't plant up ponds.** Native plants will begin to colonise your pond in the year following their creation. Floodplain ponds are particularly good at colonising quickly. Rushing things will reduce the area available for specialist plant and animal species which like barer habitats and may increase the risk of bringing in invasive non-native species.
- **Keep an eye on which plants colonise the pond in the early years.** Invasive species can be removed manually if you spot them early on. Most native species will be welcome but in wetland sites you may want to remove uniform stands of single species, such as Bulrush *Typha latifolia* in the early years, to allow space for other plants to colonise. Grazing will also reduce the cover of these species.

6. Designing floodplain ponds for BAP species

Over 40% of Biodiversity Action Plan (BAP) pond species can be found in floodplain ponds (e.g. Figure 7) and many are restricted to this habitat type. Most require good water quality, and creating new clean water ponds in the floodplain can significantly improve the habitat available for these threatened species.

- **Find out about the specific requirements of the target species.** Many rare species have poor powers of dispersal and will need new habitat to be created close to existing populations. Some also require grazing animals to disturb the pond edges and to move eggs, seeds, spores and plant fragments to new habitats. However, although some species have very exacting habitat requirements (see individual [Species Dossiers](#) for more information) others, including wading birds can be less fussy and are easy to cater for.
- **Create a complex mosaic of ponds** to provide a gradient of water depths, size and flooding regimes. This will increase the likelihood that suitable conditions for target species will occur somewhere in any one year. Ponds in the floodplain are often highly dynamic and many species are specially adapted to this way of life, appearing only when conditions are suitable.
- **Create some ponds with direct connection between ponds** at high water level – even if this is only in very wet years. This can benefit species which rely on flooding for dispersal, e.g. True Fox Sedge *Carex vulpina*. Traditionally this process would be done by river flooding, but these days because rivers are so polluted, the connecting water should be from groundwater or surface water and ideally not river flood water.
- **Rare species are often early pond colonisers**, e.g. stoneworts, so it is important to allow new ponds to develop naturally, i.e. without planting-up. Because other species require late successional habitats e.g. Scarce Emerald Damselfly *Lestes dryas*, it is worth creating new ponds periodically, whilst leaving others to silt up. Providing a landscape with a range of different pond ages and habitat types.



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Figure 7. BAP species associated with floodplain ponds. From top: Oxbow Diving Beetle *Hydroporus rufifrons*, True Fox Sedge *Carex vulpina* and Eel *Anguilla anguilla*.

7. Case study: Shrike Meadow and Pinkhill Meadow, River Thames Floodplain, Oxford

These two wetland creation schemes were created in the 1990s in the floodplain of the River Thames at Farmoor Reservoir, Oxfordshire by Thames Water and the Environment Agency. At Pinkhill Meadow, ponds were designed to maximise plant, animal and bird diversity by creating a variety of pond types based on the principle of clean water ponds. Here the ponds were not connected to the river. At Shrike Meadows the ponds were created to provide an off-river flood refuge for fish, and a habitat for water vole and wetland birds. Some ponds were connected to the river by a ditch which flooded during the winter months.

The Pinkhill Meadow pond complex was created in 1990/1991 in degraded grassland. The site was designed as an **off-river** enhancement, and comprises a mosaic of approximately 40 permanent, semi-permanent and seasonal ponds together with associated areas of wet meadow and reed bed. The site developed to become exceptionally rich in both plants and aquatic animals.

Shrike Meadow created in 1999/2000, lies 200m south of Pinkhill and occupies a similar riverside location. The pond complex includes a reed lagoon semi-permanently **linked** to the Thames by a channel, together with a large scrape and around 11 ponds of varying sizes and depths. The site is very rich but the poorer water quality means this site only supports around half the number of species found at Pinkhill.



8. Further reading

This factsheet concentrates on the issues of pond creation in the floodplain. We have also created *Supplementary Habitat Factsheets* for [Designing ponds in grasslands](#) and [Designing ponds in wetlands and reedbeds](#).

- RSPB (1997) *The Wet Grassland Guide: Managing Floodplain and Coastal Wet Grasslands for Wildlife*. Eds. Treweek, J., Drake, M., Mountford, O., Newbold, C., Hawke, C., Jose, P., Self, M. and Benstead, P.
- RSPB (1994) *The new rivers and wildlife handbook*. Eds. Ward, D., Holmes, N. and Jose, P.

For further information about the Million Ponds Project and to consult other factsheets in the Pond Creation Toolkit, please visit www.pondconservation.org.uk/millionponds or email enquiries to info@pondconservation.org.uk

