How do I assess and manage pollution in ponds?

Assessing whether a pond is polluted can be surprisingly difficult. Quick methods (Is the water green? Is there a lot of duckweed?) can sometimes be misleading, whilst chemical samples are highly variable. New biological assessment methods are probably best, but need to be undertaken at a professional level.

This factsheet sets out the different options including:

- 'Quick and dirty' methods
- Chemical analysis
- Conductivity
- Biological assessment

The second half of the factsheet briefly describes how to control pollution in ponds.

Figure 1: Origin of pond pollutants

Source	Pollutants produced
Arable farmland	Nutrients (from fertilisers), herbicides, pesticides, sediment from bare fields after ploughing.
Intensively farmed grassland	Fertilisers and herbicides applied to grassland, pesticides used to worm livestock, or to dip sheep.
Farmyards	Organic matter and nutrients from cattle sheds, silos etc.
Roads and car parks	Oils, sediment and heavy metals from tyre and engine wear; detergents and solvents e.g. from car washing, screen wash etc.
Urban areas	Road run-off pollutants, organic matter and pathogens (from dog faeces), pesticides and nutrients (from gardens and parks) and various chemicals (from decay of urban materials).
Inflow streams	Any of the pollutants above, depending on the stream's catchment.
Conifer plantations	Fertilisers and pesticides and often high rates of sediment run-off. Leading to more acidified surface waters.
Waterfowl	Duck faeces, and uneaten food stuffs (e.g. corn, bread).
Fish	Fish stir up bottom sediments causing cloudy water and releasing pollutants, faeces and uneaten food.
Litter and rubbish	Depends on materials dumped e.g. 'empty' chemical containers.

'Quick and dirty' methods

The typical indications of pollution are listed below. However, none is infallible, and it is always best to use combined evidence:

- Extensive growths of filamentous algae, duckweed or Water Fern (covering more than about 50% of the pond).
- The water is coloured green by planktonic algae.
- Few or no submerged native plants are present (with the exception of shaded ponds, seasonal ponds and some naturally turbid ponds).
- Cloudy water: as well as suspended algae, cloudiness can also be caused by fish or ducks stirring up bottom sediments, and new ponds located on clay and ponds with watering cattle, may also be quite turbid. Pools dug into peat or overhung by trees may naturally have brown tinted water.

Chemical Analysis

Although this would, at first sight, appear to be the preferred method, in practice, chemical samples may not tell you much unless the water is very heavily polluted. A quick review is given below, but the most useful measures in the majority of cases are nutrients and to some extent heavy metals. There are also some practical difficulties in taking samples, as in some cases, the analysis has to be conducted on a sample that is either fresh, or rapidly frozen.

- ***pH, calcium***: these vary naturally in ponds across the country and the local wildlife will be adapted to these variations.
- ***Pesticides***: many hundreds of pesticides exist so are usually too difficult or expensive to measure, unless a specific pesticide is suspected. Many pesticides are short-lived so, even if they have damaged a pond, will have degraded and won't be detectable.
- ***Heavy metals***: metals such as copper, zinc and lead can be moderately useful. Interpreting the results however, normally requires expert knowledge.
- ***Dissolved oxygen***: the oxygen levels in ponds naturally fluctuate (in rivers they should be high and stable) and can vary from one area of the pond to another, so results should be treated with caution.
- ***Nutrients***: these can be some of the most useful substances to measure in ponds. However, they will vary by season, depending on plant up-take.

Nutrients

As a very rough guide, Figure 2 shows the range of values which have been measured for a variety of chemical variables in sites which have had a relatively low exposure to pollutants. If values in a pond are similar to, or lower than these (for samples collected in the late winter/early spring) the pond is probably not too badly affected by pollution.

Figure 2: Water chemistry of minimally impaired ponds in Britain

Parameter	Levels
Conductivity	Up to 500 μS/c
Sodium	Up to 50 mg/l
Potassium	0-10 mg/l
Nitrate	0-100 μg/l
Total Nitrogen	0-500 μg/l
Soluble Reactive Phosphorus	0-100 μg/l
Total Phosphorus	0-150 μg/l

Conductivity

Measuring conductivity (in micro Siemens per cm) is a useful and reliable test which measures the total quantity of chemicals dissolved in the water: both natural substances (e.g. calcium) and undesirable substances (e.g. too many nutrients). This makes conductivity a relatively cheap and quick test, which is why we use it so much, but it doesn't tell you exactly what proportion of *each* chemical is in the water. We can make assumptions from our experience, but to be completely certain about the level of each pollutant you need to do laboratory tests.

To give a bit of background on interpreting conductivity: rainwater normally has a reading of around 50-100 in central southern England, and unpolluted ponds are usually below about 300. Tap water is usually around 500-600 in the south of England but is often lower in the north or west where water drains from moorland or mountains. So we tell people to aim for a magic figure of 100 or less. Where conductivity is 500-1000+ µS/cm this is usually a sign of some kind of pollution.

Conductivity is a helpful measurement, but needs to be used with care since it is affected by natural chemicals, particularly calcium, not related to pollution. In coastal areas, conductivity may also be high if the water is brackish.

Total Phosphorus (TP)

As a rough guide, the Total Phosphorus (TP) concentrations proposed by the OECD can be used as a measure of pollution. These are:

- oligotrophic (very low nutrient status): less than 12 µg TP/l;
- mesotrophic (intermediate nutrient status): 12-40 µg TP/l;
- eutrophic (naturally nutrient rich): 40-100 µg TP/l; and
- hypereutrophic (often, but not always, due to pollution): greater than 100 µg TP/l.

The first three (oligotrophic, mesotrophic, eutrophic) are natural states for ponds. Hypereutrophic ponds tend to result from human activity that causes nutrient pollution. Problems will also occur when ponds move from a low nutrient status to a higher one which can have a major impact on the pond's natural fauna and flora.

Biological assessment of water quality

Biological surveys often provide the best way of determining whether a pond is degraded. The PSYM method combines a number of aquatic plant and invertebrate measures to give a single value representing the waterbody's overall ecological quality.

The PSYM method involves the following steps:

1. Environmental data are gathered for each waterbody from map or field evidence
2. Biological surveys of the plant and animal communities are undertaken using standard methods.
3. Data are entered into the PSYM computer programme which: (i) uses the environmental data to predict the plants and animals that *should* be present in the pond if it is undegraded, (ii) takes the real plant and animal lists and calculates a number of measures of how much or little the pond is degraded.
4. The programme compares the predicted plant and animal measures with the real survey metrics to see how similar they are (i.e. how near the waterbody currently is to its ideal/undegraded state). This gives a pollution score.

If the ecological quality is less than the expected value, this indicates that the pond may be suffering from pollution or other damaging impacts and that further investigation is necessary.

Survey forms and information about the PSYM methodology are available from the Freshwater Habitats Trust website.

Controlling pollution

Prevent pollution occurring in the first place – this is the best method!

- **Buffer the catchment** – ensure that as much as possible of the land that drains water into the pond (i.e. the land uphill of the pond) has semi-natural vegetation and is not intensively managed farmland or urbanised. A buffer zone of 30m is likely to provide reasonable protection against nutrients and many modern pesticides (which become inert on contact with soils), but, the bigger the better.
- **Create a physical barrier** – such as a bank or subsurface interceptor, to block polluted water draining into the pond from its catchment (i.e. anywhere uphill from the pond).
- **Re-route or remove piped inflows if possible** – agricultural drains can be re-routed, broken or taken out; road drains, unfortunately, are more expensive to re-route.

Try to reduce or localise the pollutants reaching the pond by:

- **'Polishing' the inflow** by running it first through soil and/or vegetation.
- **Creating small horseshoe-shaped wetlands** where pipes enter ponds.
- **Creating a vegetated silt trap to contain sediments** (but note that unless quite extensive, wetland interceptors and silt traps often don't work very well).
- **Cleaning up stream inflows.** Most stream water in lowland Britain will be polluted by run-off from farmland and urban areas, but it is still worth checking upstream for major 'point sources' of pollution.

Dealing with pollutants if they get to ponds

If pollutants still reach the pond edge, then there are a number of methods which can sometimes help to ameliorate their impact. These rely mainly on the filtering and cleansing properties of plants.

- **Reed beds and other natural filters:** There is currently an enormous interest in using reedbeds and marshes to help clean up polluted water. This works best for nitrogen because tall vegetation-rich wet areas around pond margins can convert nitrate to oxygen and nitrogen gases.

  Unfortunately, there is no simple way of getting rid of phosphorus because it cannot be converted into a gas that plants or bacteria vent to the atmosphere. Dense stands of plants may bind it into their tissues, but the plants must then be harvested and removed. Silt traps - especially if they are vegetated - can help to trap phosphorus but, to be effective, the nutrient rich silt still needs to be regularly removed and taken elsewhere when they fill-up.

  Overall then, although reedbeds and marshes are an attractive idea for localising or removing pollutants, they inevitably require significant effort and management to work effectively.
- **Submerged plants:** Adding submerged plants can help to reduce nutrient levels because they soak-up nutrients from the water in plant growth. Unfortunately, this method often fails because the pollutant levels are usually too high for submerged plants to thrive, and they are easily out-competed by the nuisance species.
- **Digging-out ponds:** Where ponds are very badly polluted it may be best to completely remove the sediments from the bottom in order to see any noticeable improvement in pond quality.

- **Design options:** Where polluted water inputs are unavoidable, it may be best to concentrate efforts into creating shallow ponds, with good drawdown zones and marshy margins.
- **Protective pond networks:** Location can ameliorate some of the impacts of pollution - ponds in areas of long-established wetlands, or with other pools nearby, often have richer communities of plants and animals. Creating new, unpolluted, ponds near to older but polluted ponds may also help to raise the standard of the more degraded sites.
- **Other methods:** Treatments, such as using barley straw to control algal growth and manipulating fish numbers to reduce turbidity and allow plant growth, are sometimes effective. However, note that neither of these methods by themselves reduces nutrient levels.

If all else fails – relocate!

There is no doubt that it can be soul-destroying to struggle with a pond that has insoluble pollution problems. Sometimes, it is better simply to change the location of the pond and create a new pond (or complex of ponds) with a good design, in an area where it is possible to keep the pond pollutant-free throughout its lifetime.