



## Water Quality Concerns for Ponds

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A 1998 survey of 557 pond owners in Pennsylvania found that about 10 percent had experienced water quality problems in their ponds, ranging from muddy water to fish kills. Unfortunately, most pond owners have never tested their pond, and water quality problems are usually only detected after they cause a problem. This fact sheet discusses some common water quality parameters that may cause problems in ponds and how to detect and treat them.

Water quality conditions in a pond are controlled by both natural processes and human influence. Natural factors such as the source of the pond water and the types of rock and soil in the pond watershed will influence some water quality characteristics. These factors are difficult to control and usually cause few problems. Instead, most serious water quality problems originate from land uses or other activities near or in the pond. The effects of these activities can usually be minimized through proper management and early detection of problems through testing.

### Pond Uses and Water Quality Concerns

Concerns about pond water quality are directly related to the use(s) of the pond. As with all pond management decisions, consider the primary uses of your pond to determine which water quality parameters are of greatest concern. For example, a pond used to supply drinking water for animals should be tested for different parameters than a pond used exclusively for fishing. Listed below are some of the common uses of ponds and the water quality parameters of greatest concern.

Pond Use	Important Water Quality Parameters
Animal drinking water	Bacteria, pH, metals, nitrate, blue-green algae, pesticides
Swimming	Bacteria, turbidity, parasites
Fishing	Temperature, dissolved oxygen, pH, pesticides
Irrigation	Aquatic herbicides, pH, metals
Aesthetic beauty	Turbidity

## **Common Water Quality Parameters**

### Temperature

Temperature is most important for fish and other aquatic life in the pond. Ponds that are generously fed from underground springs tend to have colder water that can support coldwater fish such as trout. Temperature can vary greatly throughout the pond, with surface water affected more by air temperature than deeper water. Thus, the top of the pond will be slightly warmer in the summer and colder in the winter than deeper portions of the pond.

Little can be done to greatly alter the temperature of pond water. In some cases, groundwater may be pumped into the pond to create coldwater ponds during the summer. In most cases, however, it is best to match the types of fish stocked in a pond with the existing temperature regime. Coldwater fish like trout prefer maximum water temperatures below 70°F, while warmwater fish like bass and bluegill prefer summer temperatures in the 70s and 80s.

Water temperature is also important when using aquatic herbicides to treat plant or algae growth. Most aquatic herbicides are most effective when water temperatures are between 60 and 75°F. Consult the herbicide label for details.

### Dissolved Oxygen

The amount of oxygen that is dissolved in the water is critical for fish and other pond life. The maximum amount of oxygen that can be dissolved is controlled by the water temperature. Warmer water can hold less dissolved oxygen than colder water. In general, most pond water can hold about 10 to 12 mg/L of oxygen. Dissolved oxygen is reduced by the biological decay of organic material such as decaying plants and animals or animal and human wastes. Dissolved oxygen levels below about 5 mg/L can begin to have detrimental effects on pond life.

A lack of dissolved oxygen is the most common cause of fish kills in ponds. This occurs frequently when aquatic plants and algae die in the summer or when they are treated with aquatic herbicides. Fish kills due to low oxygen are most common during hot, dry spells when algae grow and then die quickly. The organisms that decompose the dead algae may use so much oxygen that what remains is insufficient for fish. In very deep ponds, the deepest portions of the pond may have very low dissolved oxygen concentrations due to poor aeration.

Problems with dissolved oxygen can usually be controlled by the careful use of aquatic herbicides to prevent excessive plant and algae growth in the pond. Ponds that frequently have reduced dissolved oxygen concentrations could benefit from commercially available continuous aeration devices.

### Muddy Water (Turbidity)

Muddy or turbid pond water is usually only an aesthetic problem. It is frequently caused by runoff from disturbed areas around the pond or from bottom-dwelling fish and muskrats. Muddy water is best solved by eliminating the source of the problem. This might include planting grass or other vegetation on exposed areas, putting a layer of rocks over exposed banks, or removing muskrats or bottom-dwelling fish. Persistent muddy water problems can be treated with additions of ground limestone, hydrated lime, gypsum, or alum. Ponds that are only turbid or colored during the summer are probably experiencing zooplankton blooms. Zooplankton are small animals that serve as a food source for fish and other aquatic life. These zooplankton blooms can be eliminated with copper sulfate, but in most cases the health of the pond is best served if they are left untreated.

Muddy water is very common in new ponds and usually disappears as vegetation grows around the pond. In established ponds, muddy water can nearly always be traced to a preventable source.

### Coliform Bacteria

Coliform bacteria are a large group of many different bacteria, some of which can cause waterborne illnesses. Some coliform bacteria will occur in all ponds, but dangerously high levels may occur in ponds that receive animal wastes from barnyards or wildlife or human wastes from septic systems. Large numbers of waterfowl will increase bacterial contamination in small ponds. Coliform bacteria from human or animal wastes can be identified through a separate water test for "fecal coliform bacteria." A certified water-testing laboratory should do this test. These bacteria are generally only a concern if the water will be used for animal drinking water or for swimming. It is recommended that ponds used for swimming contain less than 200 fecal coliform bacteria per 100 mL of water. Pond waters used for livestock watering should contain less than 10 fecal coliform bacteria per 100 mL for adult animals and zero fecal coliform bacteria for calves and other young livestock.

### Nutrients

Many ponds suffer from excessive amounts of nitrogen and phosphorous from barnyards, crop fields, septic systems, lawns, golf courses, and waterfowl. Nitrogen is usually present in ponds as nitrate, and phosphorous occurs as phosphate. Both of these nutrients can be readily used by aquatic plants and algae, which may lead to excessive growth. Long-term control of overabundant plants is best accomplished by reducing or redirecting nutrient sources to the pond. This may be done by reducing fertilizer use near the pond, maintaining, improving or relocating septic systems, directing nutrient-laden runoff away from the pond, or maintaining buffer strips around the pond. If you fail to address the underlying cause of plant growth, you must rely on continuous control of the plants using mechanical, biological, or chemical techniques.

Excessive amounts of nitrate can also be dangerous for drinking water. Dairy cows should not drink water with nitrate concentrations in excess of 100 mg/L measured as

nitrate-nitrogen. Nitrate can be measured with simple water test kits or through certified commercial water testing laboratories.

### Pesticides

Pesticides in ponds may result from their use on nearby land areas or from aquatic herbicides used to reduce plant and algae growth. When using aquatic herbicides, make sure you obtain the required state permit, and read and follow the herbicide label instructions carefully. In some cases, the pond water should not be used for swimming, irrigation, livestock watering, or fish consumption for a specified period of time. Many aquatic herbicides are also toxic to fish and should be used carefully in ponds with fish.

Pesticides applied to the land surrounding a pond may occasionally reach the pond, especially on windy days or when heavy rain occurs shortly after application. Excessive concentrations are usually short-lived, but they may result in fish kills, waterfowl death, animal sickness, and plant injury if the pond water is used for irrigation. Insecticides are especially problematic and have occasionally caused fish kills in ponds. These problems are rare and short-lived but underscore the importance of careful use of pesticides both in and around ponds.

### pH

The pH of a pond is a measure of the acidity of the water. Farm ponds in valleys underlain by limestone will usually have a pH of 7.0 to 8.5. Higher elevation ponds or those located in the Poconos or northern Pennsylvania tend to have a lower pH often less than 7.0. The pH of pond water is important for a number of pond uses. Different types of fish tolerate different pH levels but, in general, most fish will do better in ponds with a pH near 7.0. Ponds with a pH less than 6.0 may result in stunted or reduced fish populations. Ponds with a pH less than 5.0 or above 9.0 should not be used for dairy cows. Very low pH may be found in ponds in mining areas that are affected by acid mine drainage. In this case, the pH may be too low to support fish life, and the water also may be unusable for livestock watering.

Low-pH ponds are often treated by applying ground limestone. This is most easily done by broadcasting the limestone over the pond ice during the winter. Repeated applications will often be necessary to maintain a higher pH in acidic ponds.

### Hardness

Hardness is a measure of calcium and magnesium concentration in water and is controlled by the source of the pond water. Ponds in limestone areas will generally have harder water than those in areas underlain by sandstone or shale. The hardness of pond water is usually unimportant except when using some aquatic herbicides. Hardness concentrations above 50 mg/L can reduce the effectiveness of some copper-based herbicides. Consult the label of aquatic herbicides to see if water hardness needs to be considered to determine application rates or herbicide effectiveness.

### Algae

Some types of blue-green algae are a water quality concern in ponds used for livestock watering. Although they are very rare in Pennsylvania, some of these algae can produce toxins that may sicken or quickly kill animals that drink the water. These toxins are produced during or following excessive growth or “blooms” which usually occur after extended periods of hot weather. Testing for toxic blue-green algae is difficult and not commonly available. Thus, farmers using a pond for livestock watering should prevent excessive algae growth or limit animal access to these ponds during and immediately after algae blooms. The common types of green filamentous algae that produce long strands or mats in ponds are not harmful to animals.

### Metals

Metals such as iron, manganese, and copper in ponds can produce offensive tastes which may affect animal intake. Iron and manganese are most common in ponds in coal mining areas in western Pennsylvania. While these metals are not harmful, they may cause offensive tastes that will cause animals to limit or refuse intake of the water. High iron concentrations may also adversely affect pond aesthetics by precipitating as an orange coating on the pond bottom, docks and vegetation. Iron concentrations above 0.3 mg/L and manganese concentrations above 0.05 mg/L will impart a metallic taste to water. Similarly, copper concentrations above 1.0 mg/L can cause an offensive metallic taste. High copper concentrations may result from repeated use of copper-based algaecides in a pond.

### Protozoans

Various protozoans or parasites can occasionally affect ponds. *Giardia* and *Cryptosporidium* are protozoans that can occur in any surface water and that may cause severe gastrointestinal problems if ingested. Even if they are present, they are unlikely to cause a problem for animal consumption or for humans swimming in the water. Another rare parasite in ponds may cause “swimmer’s itch.” This parasite burrows into the skin of swimmers where it dies, causing an itchy feeling after leaving the water. While rare, this problem can occur occasionally in ponds especially those with low fish populations. The parasite requires snails in the pond to complete its life cycle. It can be controlled by reducing the snail population by treating the water with copper sulfate. Snail populations may also be reduced by stocking redear sunfish in the pond; however, these fish may compete with other fish in the pond.

### **Water Testing Options**

Testing your pond’s water quality is relatively simple and inexpensive. Identify the uses of your pond, then test the water for the parameters that are important for that use. Inexpensive water testing kits are available at many pet stores and also on-line. Two large manufacturers of water testing kits are:

LaMotte Company: <http://www.lamotte.com>

Hach Company: <http://www.hach.com>

Water testing can also be accomplished by dozens of certified commercial water testing laboratories in Pennsylvania. A list of these laboratories is available at your local Penn State Cooperative Extension Office or on-line at: <http://www.dep.state.pa.us/labs/>.

### **Preventing Water Quality Problems**

Water quality problems in ponds can usually be prevented with some proper management techniques. Here are some tips:

- Test the pond water periodically to determine bacteria levels and to monitor the presence of any other non-visible problems.
- Match fish to the natural temperature regime of the pond.
- Prevent overabundant growth of aquatic plants and algae.
- Never treat more than half of the pond with aquatic herbicides.
- Carefully read and follow label directions when using aquatic herbicides.
- Strictly limit polluting activities in areas that drain into the pond and especially near the pond.
- Maintain a vegetated buffer strip around the pond.
- Use diversion ditches and land grading to divert contaminated surface water away from the pond.

### **More Information**

More detailed information on pond water quality and other aspects of pond management can be found in Management of Fish Ponds in Pennsylvania. This 30-page publication is available from your county Penn State Cooperative Extension office or on-line at:

<http://pubs.cas.psu.edu/FreePubs/uh137.html>

Penn State College of Agricultural Sciences research, extension, and resident education programs are funded in part by Pennsylvania counties, the Commonwealth of Pennsylvania, and the U.S. Department of Agriculture.

Where trade names appear, no discrimination is intended, and no endorsement by the Penn State College of Agricultural Sciences is implied.

Issued in furtherance of Cooperative Extension Work, Acts of Congress May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture and the Pennsylvania Legislature. T. R. Alter, Director of Cooperative Extension, The Pennsylvania State University.

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