Recognizing and Reporting Water Quality Problems

January 2006

THE SONG OF A RIVER ORDINARILY MEANS THE TUNE THAT WATERS PLAY ON ROCK, ROOT AND RAPID. THE LIFE OF EVERY RIVER SINGS ITS OWN SONG, BUT IN MOST THE SONG IS LONG SINCE MARRED BY THE DISCORDS OF MISUSE.

– Aldo Leopold, *A Sand County Almanac*

Before monitoring your stream, review this background information about various types of water quality problems. Each water quality problem is described, and potential sources of pollution are listed. Please note that many of these water quality problems may also occur in wetlands.

LOW pH LEVELS

pH is a logarithmic scale (increasing exponentially) that measures the acid or base concentration of the water. In a range of 1 to 14, pH of 1 is most acidic, pH of 7 is neutral, and pH of 14 is least acidic, or most basic. It is important to remember that for every one-unit change on the pH scale, there is approximately a ten-fold change in how acidic or basic the water is. For example, water with a pH of 5 is roughly ten times more acidic than water with a pH of 6, while water with a pH 4 is roughly one hundred times more acidic than water with a pH of 6. Normal rainfall is actually slightly acidic, with a pH ranging from 5.6 to 5.7. Most organisms have adapted to life in water of a specific pH. Therefore, any change in a water's pH level can harm aquatic life. The majority of freshwater fish require pH levels ranging from 6.0 to 8.5. At a pH value of 6.5, brook and brown trout numbers are severely reduced. In addition, rainbow trout eggs have a much-reduced hatching rate. At a pH value of 5.5, smallmouth and largemouth bass are unable to survive. Below pH 5, most species of fish are absent. Highly acidic or basic water also can kill the fishes' food sources.

One reason for high acidity is acid rain. "Acid rain" is a broad term used to describe several ways that acids fall out of the atmosphere. A more precise term is acid deposition, which has two parts—wet and dry. Wet deposition refers to acidic rain, fog, and snow. Wet deposition occurs when sulfur dioxide and nitrogen oxides in the atmosphere become sulfuric acid and nitric acid. Dry deposition refers to acidic gases and particles. About half of the acidity in the atmosphere falls back to earth through dry deposition. The wind blows these acidic particles and gases onto buildings, cars, homes, and trees. Dry-deposited gases and particles can also be washed from trees and other surfaces by rainstorms. Prevailing winds blow the compounds that cause both wet and dry acid deposition across state and national borders and sometimes over hundreds of miles. In addition, acids can be released suddenly during the spring thaw when snowmelts occur, freeing the acids concentrated in the ice during the winter months.

In the United States, about two-thirds of all sulfur dioxide and one-quarter of all nitrogen oxides are generated by electric utilities that rely on burning fossil fuels such as coal. Automobile emissions also are a significant source of these acids. Another source is coal mine drainage. Rain and groundwater leach sulfuric acid from abandoned underground mines into nearby waterways, harming the aquatic life.

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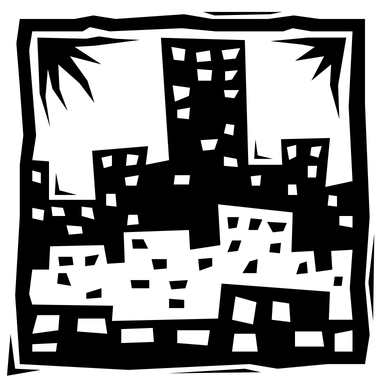
Changes in acidity can also be caused by plant and animal decomposition and by the weathering of surrounding rock. How an acidic input affects a body of water depends on several factors: the initial pH of the affected waterway, the surrounding geology, and the normal pH of the rainfall itself. Limestone, a basic rock, neutralizes the effect of acids on local waterways.

High acidity levels in a water body are not detectable with the naked eye. Fortunately, the pH level of the water is relatively easy to test. You can purchase small sampling kits to determine the pH. Since pH fluctuates daily and seasonally, it is best to sample pH throughout the year, at the same time of day, and at the same location. Also, you should test the stream after heavy rainfalls or large snowmelts. Compare this data with types and numbers of fish and aquatic insect populations observed.

Thermal Pollution

Thermal, or heat, pollution occurs when water temperature is elevated. Elevated temperatures can decrease the capability of water to hold dissolved oxygen, which is crucial to the survival of aquatic organisms. Thermal pollution can impair feeding, growth, and reproduction of aquatic organisms and can cause death. Fish species vary in the level of thermal pollution they can withstand. Fish can adapt to gradual seasonal temperature changes, but not to an abrupt temperature increase. Even a small change in temperature can affect a fish's life cycle drastically. Spawning activities, metamorphosis, and migration can be triggered at the wrong time of year by a slight change in temperature. This, in turn, can decrease or destroy a species's chance for survival.



We all contribute to thermal pollution. Water heats up as it runs over hot pavement and rooftops and then into waterways. Other sources of thermal pollution are power plants and factories that take water from nearby waterways for cooling, then discharge heated water back into the local waterway. An obvious sign that water temperature has been drastically altered is a sudden fish kill. To discover whether or not thermal pollution is occurring, first determine the stream's normal temperature by taking regular temperature measurements. Starting at the mouth of the stream, measure the temperature every ten miles and along any tributaries. An abrupt increase of five degrees Fahrenheit or more could indicate a thermal pollution problem. If an abrupt increase is found, look for discharge pipes entering the stream upstream of the point of increase. The pipes might be supplying heated water and raising the stream's temperature.

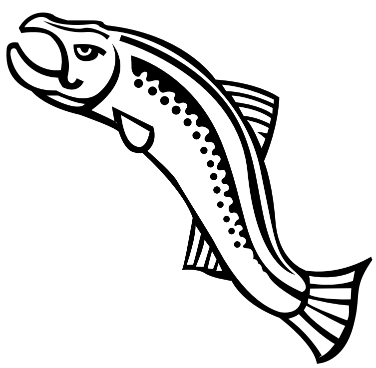
Also, look for dams or stretches of poorly shaded areas, which would allow increased exposure to the sun. Streams that flow through a dam have banks that are not shaded by trees and other overhanging vegetation, flow slowly, and are subjected to much more direct sunlight than normal.

Nutrients and Oxygen Depletion

Excess organic matter causes many problems in streams, including blocking light from reaching submersed aquatic plants, odor and surface scum, clogged irrigation systems, competition for natural fish food sources, interference with spawning areas, disappearance of native fish populations, and limited opportunities for recreational water use. In addition, an increase in the level of organic matter in a stream can cause a rise in the biochemical oxygen demand. This is a measurement of the oxygen required to carry out the stream's natural processes, such as decomposition. There is a limited supply of oxygen in the water. Therefore, oxygen supplies will decrease as increased amounts of organic matter decompose. Native fish populations are thus deprived of oxygen and cannot survive. Low oxygen levels in an aquatic environment provides conditions for growth of waterborne diseases, which can be toxic to people and wildlife. Nutrients such as nitrogen, phosphorus, carbon, and other elements entering the aquatic environment can encourage excessive algae growth, which lowers oxygen available for other aquatic life.

Sewage from broken sewer lines, wastewater treatment plant overflows, or septic tank failures may also cause waterborne diseases. In addition, sewage contains excess nutrients that cause excessive growth and decay of organic matter in streams. This, in turn, lowers dissolved oxygen levels and may harm fish and other aquatic life. Other potential sources of organic waste enrichment are manure from livestock feedlots; fertilizer from farms, lawns, and gardens; pet waste, grass clippings, or leaves dumped into a gutter or stream.

Direct observation of the types and numbers of aquatic organisms present can provide a good indication of a stream's oxygen level. For example, trout have a high oxygen requirement. Trout may be replaced by carp, which have a lower oxygen requirement and can survive in more polluted water. It is important to note that the eggs and recently hatched young of some species have a greater oxygen demand than the adult fish. This makes species regeneration impossible when the available oxygen supply is lowered. Insect species also provide a good indicator. For example, midge and blackfly larvae can survive in a stream with low oxygen levels, while stonefly larvae require a higher dissolved oxygen level.



A chemical testing kit is another method to measure nitrogen and phosphorus levels in the stream or to determine the level of dissolved oxygen. Generally, the oxygen level should not go below 6.0 mg/liter in trout streams. In other streams, the concentration should remain above 5.0 mg/liter. The amount of oxygen water can hold diminishes with increasing water temperature, yet fish require more oxygen as water temperatures rise and respiration increases. This correlation between temperature and the water's ability to hold dissolved oxygen makes it important to measure temperature as well as dissolved oxygen to determine the actual oxygen level of a water body. Ask the supplier of the chemical testing kit for a chart that relates temperature to dissolved oxygen. After testing for dissolved oxygen and reading the temperature, consult the chart to determine if oxygen levels are adequate.

Toxic Substances

Toxic substances can bioaccumulate, or increase in concentration, and become more dangerous as they move up the food chain, beginning with microorganisms and continuing up to humans. An element is considered toxic if it injures the growth or metabolism of an organism above a certain concentration. Toxic substances can poison aquatic life, destroy aquatic food supplies, and deform fish larvae. If the discharge is acute (of high intensity but lasting for a short duration), it may not last long enough to produce long-term effects on aquatic life. But if the discharge is chronic (of long duration over an extended period of time), its effects may take longer to become apparent, but will be easier to measure. Toxic substances have both natural and man-made sources. Natural sources of toxic substance include rocks, volcanoes, sediments, and soils. Human activities that add toxic substances to the environment include smelting, manufacturing, refining, chemical processing, fertilizer application, irrigation, and waste disposal.

Although there are hundreds of toxic chemicals released into the environment through industrial effluents, legal limits exist on only a small proportion. The U.S. Environmental Protection Agency has classified only a fraction of these toxic substances, and many chemical compounds are only now being recognized as harmful. In addition, many chemicals become toxic only in combination with the presence of other chemical compounds or under certain environmental conditions, making measurements of their effects and the setting of acceptable concentration limits difficult.

Unusual Stream Color

Unusual stream color caused by industrial discharge can block light to aquatic plants and prevent growth. A variety of activities can contribute to a change in water's normal coloration. Algae growth and decaying plants are natural processes that can cause water color to become green, brown or yellow. Others include industries such as pulp and paper mills, textile mills, refineries, manufacturers of chemicals and dyes, nail-works, and tanneries. Also, slaughterhouses, construction sites and mine drainage can contribute light-blocking colors.

SEDIMENTATION

Excess soil erosion can cause serious problems for a stream or waterway. Sediment suspended in a stream can smother bottom-dwelling aquatic life and clog the gills of fish, as well as block light that underwater plants need to grow.

A healthy stream will have naturally suspended sediment because the stream acts as a large conveyor belt, carrying sediment, silt, and organic matter while carving out valleys and shaping the landscape. Although erosion is a natural process, an unnatural acceleration of erosion levels can be caused by land-disturbing activities. One major source of excess sediment is construction sites where erosion barriers are improperly maintained or not in place. Agriculture is another major source of excess sedimentation. This results from poor farming practices such as farming on highly erodible land or hillsides, overplanting, or allowing livestock to graze along streambanks. Surface mines, logging operations, and excess water runoff from paved urban areas all contribute to erosion. When these sources of excess erosion are not abated or prevented, a stream can be seriously degraded for three to five years and recovery may take as long as fifty years.

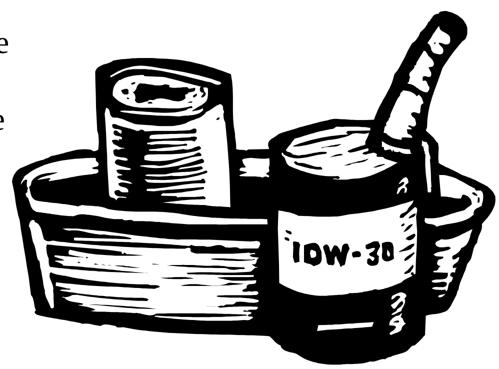
OIL

Petroleum products severely affect all types of aquatic life in streams. Free-floating oil and emulsions can coat the membrane surface of a fish's gills and interfere with respiration. Petroleum products can destroy the fish's food sources by coating and destroying algae and other plankton. Additionally, the flesh of the fish can be tainted when contaminated algae and plankton are ingested. If the oily substance settles, it can coat the waterway bottom, destroying bottom-dwelling organisms and interfering with spawning areas. Films of oil on the water's surface can interfere with plant photosynthesis and respiration. Surface films also destroy algae and reduce the oxygen level.

Sources of oil pollution include industrial plant wastes, grease and fats from lubrication of machinery, the manufacturing process of hydrogenated glycerides, rolling mills, stormwater overflows, gas stations, and car oil dumped into storm drains by homeowners.

REPORTING STREAM POLLUTION

Each of us can play a vital role in the discovery and abatement of poor water quality simply by being aware of potential problems and ensuring they are reported. If a water quality problem is discovered, attempt to trace the pollution to its source. Then inform your local water pollution officials.



Remember, you may know your stream and be able to identify changes in the water quality much better than anyone who is not familiar with the stream. If you identify a possible source when you report a problem, it is more likely the local authorities will be able to investigate and take action.

For state and local environmental agencies and their contact information, look in the telephone book under your county, city, or state listings. Report the name of the stream and its exact location, the problems you found, and the possible causes. When speaking with government officials, ask them how you can help to remedy this problem.

The following are a few tips to keep in mind when reporting pollution problems to your state or local agencies:

- Keep accurate records of the dates and times you contact government agencies as well as the names of the officials with whom you speak.

QUICK REFERENCE FOR STREAM CONDITIONS AND POSSIBLE CAUSES

Condition	Possible Cause
Muddy water	May be caused by the erosion of soil in upstream areas. In tidal areas, could also be caused by high winds.
Greenish water	May result from microscopic cells called algae. Algae growth may exceed normal limits due to excessive amounts of nutrients entering the water. Nutrient sources include fertilizers, pet waste, grass clippings, and leaves.
Yellow-brown to dark brown water	May be caused by acids released from decaying plants. Naturally occurs each fall when dead leaves collect in streams. Also common in streams draining marshes or swamplands.
Colored sheen on water surface	May indicate oil has entered the stream, particularly if it also has an oily odor.
Orange to red coating on streambed	Can result from bacteria consuming iron. May indicate a high erosion rate or industrial pollution.
Yellowish coating on streambed	May indicate polluted water draining from a coal mine.
White cottony masses on stream bed	May indicate "sewage fungus." The presence of this growth indicates sewage or other organic pollution.
Foam	When foam occurs in a few scattered patches, is less than three inches high, and is cream colored, it is probably natural. If the foam is extensive, white in color, or greater than three inches high, it may be caused by detergents in the stream.
Rotten egg odor	Often indicates sewage pollution. Odor may also be present naturally in marshes or swamplands.
Musky odor	May indicate presence of untreated sewage, livestock waste, algae, or other conditions.
Blue-green algae	May indicate sewage or other organic pollution if growth is excessive.

- Record any comments the agency makes about state, county, or city regulations or proposed actions.
- Call the agency back to find out if and when action was taken. If no action was taken, continue to follow up.
- Revisit the site to look for signs of improvement.

We urge you to call for environmental action and answers. If you get no results from the state or local government, you may want to involve the media to gain public support for your problem. Often when the community becomes aware of a problem, officials are forced to take corrective measures. Listed below is additional information about regulations governing particular water quality problems and additional action you can take to become a good watershed steward.

Water Quality Regulations

Familiarize yourself with federal, state, and local regulations governing the various potential sources of watershed degradation. With this knowledge, you will be able to judge if there are violations and present an informed description of the problem to state authorities.

Under the Clean Water Act, all point-source pollution discharges require a National Pollutant Discharge Elimination System (NPDES) permit. Point-sources of pollution include any pollution discharged through a pipe, ditch, conduit, or other discrete conveyance. NPDES permits set requirements for the maximum amount of pollution allowed from each source. The Clean Water Act also addresses nonpoint-source pollution by requiring states to designate Total Maximum Daily Loads (TMDLs) for waterways. A TMDL is a calculation of the maximum amount of a single pollutant that a water body can receive from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the water body can be used for the purposes designated by the state. Also, each TMDL further divides this maximum allowed amount of a specific pollutant into the amounts that can come from each source of the pollutant in the watershed. States also may have regulations that govern logging operations, mining sites, landfills, construction sites, and handling and storage of oil. For more information on the Clean Water Act, read the factsheet "Understanding and Using the Clean Water Act" in this publication or contact the Izaak Walton League.

State and local governments may also have additional regulations to protect waterways. For more information about state and local regulations, contact your state or local environmental protection office.