

8. Pond and Lake Ecology and Management

Protecting Community Water Resources

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(Adapted from *Reflecting on Lakes: A Guide for Watershed Partnerships*, a publication of the Pennsylvania Association of Conservation Districts)

“We, as adults, have recently begun to realize that the future we are building is one in which our children will live.”

~ Lakeline Magazine of the North
American Lake Management Society

Pike County’s abundant ponds and lakes are a highly valued natural resource offering numerous recreational opportunities, aesthetic value and critical habitat for plants and animals, while playing

a vital role in the Northeast Region’s economy. Many lake-based recreational pursuits, including swimming, skiing, boating and fishing, are enjoyed by residents and visitors alike. Lakes figure prominently in the regional tourism sector by providing a destination for thousands of visitors annually, resulting in millions of dollars entering the local economy. In addition, property values not only on the lakeshore, but also throughout a watershed, can benefit from a healthy lake.

Lakes, along with adjacent wetlands and forests, provide critical habitat areas for a variety of wildlife including several species of birds, reptiles and amphibians. Among the high diversity of aquatic plants found in Pike County lakes are PA threatened and endangered species.

Lakes can also provide an escape from the stresses of modern life. Last but not least, where supplies are limited, lakes provide a source of water for fighting fires. Taking into account the numerous benefits that lakes and ponds provide for Pike County communities, their conservation for long-term sustainable use becomes essential.

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How it All Started

Over the past three and half decades, Pike County has remained the most rapidly developing county in Pennsylvania. By providing a focal point around which Pike County's numerous lake-based communities have grown, the abundance of both naturally occurring and human-made lakes has played a pivotal role in the history of the County's development, particularly through the 1970s to the present. Many communities have developed to the point where hundreds of homes are now found within the watersheds (Chapter 1) surrounding local lakes.

Ironically, residents are finding that Pike County's numerous lakes, so highly valued by those relocating here, are becoming increasingly degraded from the environmental impacts of both already existing and continued residential and commercial development. This deterioration in lake quality comes in the form of decreased water quality, degraded wildlife and fish habitat, and a loss of lake-based recreational activities.

Predictions that the county's rapid rate of development will continue provide all the more reason to increase efforts to protect lakes as community resources. This chapter will focus on what residents can do as individuals, and together as a community, to work toward restoring degraded lakes as well as maintaining the quality of healthy lakes.

Lake Ecology: the "In-lake Environment"

Understanding lake ecology can be helpful in understanding measures that need to be taken to protect lakes. The ecological or "in-lake environment" is influenced by many factors including the following:

- Size, shape and depth of a lake
- The volume of water going into and leaving a lake, which will affect the concentration of nutrients, soil sediments and other potential pollutants
- How long it takes for a lake to completely renew its water volume, which affects nutrient concentrations and, in turn, aquatic plant growth
- The seasonally occurring stratification or layering of



White Deer Lake, Blooming Grove Township

water in a lake that results from differences in water temperature from the top to lake bottom

- The types and density of aquatic plants
- The biological productivity of a lake controlled largely by the availability of plant nutrients

A basic understanding of these ecological factors can be very helpful in making lake management decisions. However, lake ecology is a complex topic, and space limitations of this publication prohibit a more in-depth discussion. Readers interested in increasing their knowledge of lake ecology are encouraged to utilize the additional resource materials listed at the end of this chapter.

The Lake-Watershed System

Piecemeal efforts at controlling stormwater runoff, soil sediment pollution, and other threats to lake quality, can be financially intensive and are often ineffective over the long-term because they frequently fail to address the larger picture taken into account through management of a lake on



Painted turtles are commonly found in lakes that support abundant, aquatic plant growth

a watershed level. Understanding and incorporating the relationship between a lake and its watershed – the land area draining into a lake – is essential to providing effective, long-term management. So closely related are they that it is very useful to look at them as a **lake-watershed system**.

Indeed, the condition of a lake is largely a reflection of its surrounding watershed, including the human land use activities taking place there. In Pike County, the primary land use activities of concern are residential and commercial development as well as the daily activities of residents that can affect lake quality (See Chapter 2, Non-point Source Pollution).

The characteristics of a particular lake-watershed system depend on a number of variables including the ratio of drainage area to lake area, how the land is used, human population density, climate, soils and vegetation, the presence or absence of wetlands, as well as existing or absent conservation measures. The interplay between these and other variables varies from region to region and even from lake to lake.

The importance of the relationship between a lake and its water-

shed cannot be overemphasized. The characteristics of a particular lake, and its associated watershed, will become the basis for developing the most appropriate and effective lake management strategies.

Threats to Pike County Lakes and Ponds: Non-point Source Pollution

While some sources of pollution originating outside of a lake's watershed are more difficult to control, including atmospheric forms of pollution such as acid rain, much of the pollution that affects lakes originates from within contributing watershed drainage areas. In Pike County, this pollution occurs primarily in the form of **non-point source pollution** (Chapter 2).

Ongoing residential and commercial land development creates increasing levels of stormwater runoff (Chapter 4), along with the many pollutants carried in this runoff into lakes, including soil sediment (Chapter 5) from construction sites, bacteria and other microorganisms, and petroleum products from automobiles. On-lot sewage treatment systems and leaking underground storage tanks can also impact lake quality when contaminated groundwater flows beneath the surface and eventually into lakes.

Other Threats to Lakes and Ponds

Removal of aquatic plants growing from lake bottoms by lakeshore homeowners, or as a result of wave action from boats, degrades fish and wildlife habitat and releases soil sediments by removing root systems that hold lake-bottom sediments in place.

Sewage treatment plants, discharging directly to lakes or indirectly through releases to streams that feed into lakes, can contribute to lake pollution. Whenever feasible, outdated or poorly functioning treatment equipment should be repaired or replaced and facilities should be upgraded to include more advanced treatment options to further reduce pollutant levels in treated wastewater.

Residents served by central sewage can contribute to lake protection by avoiding pouring household hazardous wastes (Chapter 2) down household drains. When these wastes reach treatment plants, they can inhibit the process of decomposition and can also pass through a treatment



A lakeside buffer of tall grass, shrubs, and trees provides many benefits including intercepting pollutants carried in stormwater runoff

plant and be released to a stream or lake.

Clearing of shoreline vegetation removes a naturally occurring buffering system. If left intact, shoreline vegetation is very effective at stopping and absorbing many non-point source pollutants, including excess nutrients and sediment carried in stormwater runoff. Generally, the wider a buffer of shoreline vegetation, the greater the level of protection it provides.

Motorboats, particularly when traveling at high speeds, can churn up lake bottom sediment. Not only can sediment smother fish and amphibian eggs and clog fish gills, accompanying the release of sediments is the potential for the release of excess nutrients and toxic substances such as

The Effects of Excess Nutrients in Lake Ecosystems

Among the many forms of non-point source pollution, excess nutrients, particularly **nitrogen** and **phosphorus**, are often of primary concern in lake management. Typically, in sparsely developed watersheds, the existing low levels of these nutrients act as a **limiting factor** to the growth of aquatic plants.

However, excess amounts of nitrogen and phosphorus, released with soil sediments during land development activities and carried in stormwater runoff into lakes, can lead to a state of nutrient enrichment or **eutrophication** of a lake ecosystem (other sources of these nutrients include eroding stream banks, lawn and garden fertilizers and on-lot sewage treatment systems). Under these conditions, the growth of aquatic vegetation, no longer inhibited by a lack of nitrogen and phosphorus, can result in nuisance algal blooms and excessive growth of other aquatic plants, which in turn can lead to depleted oxygen supplies for fish and other aquatic life, nuisance issues for recreational pursuits, clogged spillways of dams, and aesthetically unappealing lake conditions.

Lake eutrophication is a naturally occurring process. However, excess nutrients released as a result of human activities in a watershed can greatly accelerate the rate at which this process occurs in local lakes and ponds.

Some lakes will more naturally and more quickly become eutrophic. Conditions conducive to eutrophication include shallow water depths and lakes that were created by flooding wetland areas. Under these conditions, attempts to control aquatic plant growth often result in prolonged, financially-intensive efforts. The result is often an uphill battle as efforts are made to reverse a naturally occurring process.

heavy metals.

Boats also leak fluids and produce exhaust that can contaminate lakes. This becomes a problem particularly with improperly maintained gas powered engines. Options for communities include requiring the use of electric motors in place of gas-powered motors and enacting speed limits for boating activity.

Perspectives in Lake and Pond Conservation

Conservation efforts are designed to protect natural resources to the greatest extent possible. This applies to the conservation of Pike County's numerous lakes and ponds. Both existing and future residential and commercial land development will continue to affect these community water resources. However, residents and communities as a whole can work toward sustaining and even improving lake quality to the greatest extent possible.



Along with preventative measures to lessen future impacts to lakes, remedies for existing lake management concerns can often be found. Lakes, however, are complex ecological systems. Efforts to address existing problems can create additional unintended problems and can have unforeseen environmental consequences. In addition, when the underlying causes of a particular problem are not effectively addressed, management of a lake can become an ongoing and costly venture.

Environmental Regulations for Lake Protection: Lakes, as water resources, are protected by law. Community, municipal, state and federal regulations may apply. Before undertaking any activities that involve construction adjacent to a lake or any activity that could involve "encroachment" into a lake or adjacent wetlands, such as modification of or construction of docks, building a lakeside structure or installation of beaches, check with your local conservation district to find out what permits, plans or approvals may be required.

Getting Assistance

A professional aquatic consultant can provide expertise in identifying the source(s) of problems for a lake and finding effective, environmentally-sound solutions. Check your local phone book, the references listed at the end of this chapter or contact the Pike County Conservation District for a list of consultants.

Another source of assistance for community associations is the **PA DEP Citizens' Volunteer Monitoring Program (CVMP)**, which provides



information and technical support for citizen-based, volunteer lake-monitoring programs. On-demand programs and lake monitoring training are available. (See Resources for More Information at the end of this chapter).

Partnerships in Lake Management

Another challenge often encountered by communities and lake management professionals is meeting the needs of the varied uses that lakes are valued for, including sport fishing, water skiing, swimming, plant and wildlife habitat and aesthetic values. One of the most effective means to meeting this challenge is through a **cooperative effort** that brings all stakeholders, including residents, into the process of developing a lake management plan. Involving all key players in the initial planning stages, and continuing to seek active participation through implementation of a plan, will help to identify and avert future conflicts and can be the key to success in lake management.



Community Association Codes and Covenants, Municipal Ordinances and Forestlands Conservation

Through the implementation of restrictions, codes and covenants, community associations have a number of options available in lake protection. An on-lot sewage treatment system inspection and maintenance program, requirements for setbacks and buffers, not only for lakes, but also along streams that contribute to lakes, and land preservation programs, along with numerous options for regulating how building lots are developed, are all considerations for community associations to improve protection of lakes.

In Pennsylvania, municipal governments, through the enactment of land use regulations designed to protect community water resources, can play a significant role in conservation of local lakes. Protection of forestlands can also contribute to long-term conservation of a lake by reducing levels of non-point source pollution that would otherwise be created by residential and commercial development within a lake's contributing watershed. Private land owners, community associations and municipalities all have options available to them to conserve forestland in Pike County. See Chapter 11 and Appendix D, Delaware Highlands Conservancy, for more information.

Summary

Conservationist Luna Leopold once said, "Water is the most critical resource issue of our time. The health of our waters is the principle measure of how we live on the land." What Mr. Leopold was referring to is the direct connection that exists between how we develop and live in our



watersheds, and what happens to our water resources, including the numerous lakes and ponds of Pike County. Ultimately, how well residents, local officials, conservation organizations, governmental agencies and the development community recognize and respect this connection will be the legacy they leave behind for future generations that will rely on these water resources for the many benefits they provide, including recreational opportunities, aesthetic values, plant and wildlife habitat, and regional economic benefits.

Action Steps for Protecting Ponds and Lakes

- ☞ Get to know your particular lake and not only what is happening right around the lake, but also throughout the lake's contributing watershed.
- ☞ Voice support for community association efforts in the development of an overall lake management plan that incorporates the relationship between a lake and its watershed and provides a blueprint for long-term management.
- ☞ Support the formation of an environmental committee that can facilitate the development and implementation of a lake management plan for your community association. Associations that already have an environmental committee can consider a sub-committee for lake management oversight.
- ☞ Join or start a community lake-monitoring program. The information provided by a monitoring program can be very useful in assessing current factors affecting lake health, identifying measures that may be required to correct existing problems as well as measuring the effectiveness of future efforts to improve lake quality.
- ☞ Form a partnership among all interested parties. This provides many benefits including combining financial resources, expertise and getting all stakeholders involved.
- ☞ Take steps to reduce non-point source pollution (Chapter 2), particularly nutrients, as an essential component of any lake protection plan.
- ☞ Support community association efforts to implement restrictions, codes and covenants designed to protect lakes.
- ☞ Attend meetings of local municipal officials and voice sup-

port for any conservation efforts they undertake to benefit community lakes.

☞ Support wetlands conservation, particularly wetlands adjacent to lakes for wildlife species dependent on both types of habitat to complete their life cycles. Wetlands also help with the removal of non-point source pollutants as well as controlling stormwater runoff and flooding of lakes.

Resources for More Information

Consortium for Scientific Assistance to Watersheds (C-SAW): pa.water.usgs.gov/csaw/. Find information on services provided, eligibility and a downloadable application for assistance. Comprised of a team of specialists, sponsored by the PA DEP Growing Greener Program, who provide program management and scientific technical assistance, including support for lake assessment and management initiatives.

Illinois Environmental Protection Agency, Lake Fact Sheets: www.epa.state.il.us/water/conservation-2000/lake-notes/

PA Association of Conservation Districts, Water Pollution Fact Sheets: pacd.org/resources/print.htm

PA DEP, CVMP: www.depweb.state.pa.us/dep/site/default.asp. Select “Search” and “Citizens’ Volunteer Monitoring Program.” A state-sponsored program providing information and technical support for citizen-based, volunteer lake-monitoring programs. CVMP also provides technical assistance in lake management to private lake owners, lake managers and organizations (including community associations, resorts, hunting and fishing clubs, and summer camps). For more information telephone: 1-717-772-5651.

PA Lake Management Society, Fact Sheets: www.palakes.org/publications.htm

Penn State Cooperative Extension and PA Fish and Boat Commission, Pond Management: www.sfr.cas.psu.edu/water/pond%20management.htm

US EPA, Monitoring and Assessing Water Quality: www.epa.gov/owow/monitoring/

US EPA, Watershed Academy Web, on-line training in watershed management: www.epa.gov/watertrain/