
**Revised 2020**

***"The frog does not drink up the pond in which he lives."*** ***Native American proverb***


## *Adams County Conservation District*

**670 Old Harrisburg Road, Suite 201**
**Gettysburg, PA 17325**
**Phone: 717- 334-0636**
**Fax: 717-334-0786**
**www.adamscounty.us**

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## Basic Checklist for Informing the Public about Requirements Pertaining to Pond Installation in PA

Revised 1/2014

1. Are there wetlands present? If yes, contact PA Department of Environmental Protection (DEP). (See wetlands determination section of this packet for info.)

2. Do you need a Dam permit? If yes, contact DEP. (See DEP Fact Sheet about Dam permits in this packet.)

3. You should contact the municipality to see if they require anything.

4. Will the project involve an earth disturbance activity? **YES** **NO**

    a. If **YES**, what is the approximate size of the earth disturbance activity in sqft? _____** A plan should be provided which depicts to scale, the limits of earth disturbance boundary over the life of the project.

    **b.** Does the project involve earth disturbance activities greater than 5000 sqft but below one acre? **YES** **NO**

        i. If **YES,** a written E&S plan is required. Refer to "typical" for general guidance.

    **c.** Could the project have a sum total of one or more acres of earth disturbance over the entire life of the project? **YES** **NO**

        i. If **YES**, a NPDES construction permit is required. Contact the Conservation District.

5. Does the project involve earth disturbance activities in, along, or adjacent to Waters of this Commonwealth? **YES** **NO**

    a. If **YES**, contact the Conservation District.

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**Definitions – taken from Ch. 102 (erosion and sediment control regulations):**

**Earth disturbance activity** – a construction or other human activity which disturbs the surface of the land, including, but not limited to, clearing and grubbing, grading, excavations, embankments, land development, agricultural plowing or tilling, timber harvesting activities, road maintenance activities, mineral extraction, and the moving, depositing, stockpiling, or storing of soil, rock or earth materials.

**Waters of this Commonwealth** – rivers, streams, creeks, rivulets, impoundments, ditches, watercourses, storm sewers, lakes, dammed water, wetlands, ponds, springs and other bodies or channels of conveyance of surface and underground water, or parts thereof, whether natural or artificial, within or on the boundaries of this Commonwealth.

**** For earth disturbance activities of less than 5000 sqft, erosion and sediment control best management practices shall still be incorporated into the project.**

## § 105.12. Waiver of permit requirements.

(a) Under section 7 of the act (32 P. S. § 693.7), the requirements for a permit are waived for the following structures or activities, regardless of when commenced. If the Department upon complaint or investigation finds that a structure or activity which is eligible for a waiver, has a significant effect upon safety or the protection of life, health, property or the environment, the Department may require the owner of the structure to apply for and obtain a permit under this chapter.

(1) A dam not exceeding 3 feet in height in a stream not exceeding 50 feet in width, except wild trout streams designated by the Fish Commission.

(2) A water obstruction in a stream or floodway with a drainage area of 100 acres or less. This waiver does not apply to wetlands located in the floodway.

(3) An aerial crossing of a nonnavigable stream or wetland by electric, telephone or communications lines which are not located in a Federal wilderness area or watercourse or body of water designated as a wild or scenic river under the Wild and Scenic Rivers Act of 1968 (16 U.S.C.A. §§ 1271—1287) or the Pennsylvania Scenic Rivers Act (32 P. S. §§ 820.21—820.29). This waiver applies to one or more wires attached aboveground to single poles. This does not apply to the maintenance and construction of towers, roads or other water obstructions or encroachments.

(4) A dam subject to the requirements of the Mine Safety and Health Administration, 30 CFR 77.216-1 and 77.216-2 (relating to water, sediment or slurry impoundments and impounding structures; identification; and water, sediment, or slurry impoundments or impounding structures; minimum plan requirements; changes or modifications; certification), if the Department determines on the basis of preliminary data submitted by the applicant that the dam is of Size Classification C and Hazard Potential Classification 3 as defined in § 105.91 (relating to classification of dams and reservoirs) and is not located in a watercourse or body of water designated as a wild and scenic river under the Wild and Scenic Rivers Act of 1968 or the Pennsylvania Scenic Rivers Act.

(5) A water obstruction or encroachment located in, along, across or projecting into a wetland or impoundment, constructed and maintained for the purpose of treating acid mine drainage, sewage or other waste, if the wetland or impoundment is a treatment facility constructed under a valid permit issued by the Department under the Surface Mining Conservation and Reclamation Act (52 P. S. §§ 1396.1—1396.31), The Clean Streams Law (35 P. S. §§ 691.1—691.1001), the Noncoal Surface Mining Conservation and Reclamation Act (52 P. S. §§ 3301—3326), the Solid Waste Management Act (35 P. S. §§ 6018.101—6018.1003), the Oil and Gas Act (58 P. S. §§ 601.101—601.605) and the Pennsylvania Sewage Facilities Act (35 P. S. §§ 750.1—750.20).



(6) A water obstruction or encroachment located in, along, across or jecting into a stormwater management facility or an erosion and sediment pollution control facility which meets the requirements in Chapter 102 ( ing to erosion control), if the facility was constructed and continues maintained for the designated purpose.

(7) Maintenance of field drainage systems that were constructed and tinue to be used for crop production. Crop production includes:

(i) Plowing, cultivating, seeding, grazing or harvesting.

(ii) Crop rotation.

(iii) Government set aside programs.

(8) Plowing, cultivating, seeding or harvesting for crop production.

(9) Construction and maintenance of ford crossings of streams for individual private personal use which require only grading of banks for approach roads and the placement of not more than 12 inches of gravel for roadway stability. Fords may not be used for commercial purposes and shall cross the regulated waters of this Commonwealth in the most direct manner. This waiver does not apply in exceptional value streams as listed under Chapter 93 (relating to water quality standards) or in wild trout streams.

(10) A navigational aid or marker, buoy, float, ramp or other device or structure for which a permit has been issued by the Fish Commission under 30 Pa.C.S. § 5123(a)(7) (relating to general boating regulations).

(11) The removal of abandoned dams, water obstructions and encroachments if the Department determines in writing on the basis of data, information or plans submitted by the applicant that the removal of the abandoned dam water obstruction or encroachment cannot imperil life or property, have significant effect on coastal resources or have an adverse impact on the environment, and the plans provide for restoration and stabilization of the project area.

(12) The construction, operation or removal of staff gages, water recording devices, water quality testing devices, including, but not limited to, sensors, intake tubes, weirs and small buildings which contain required instruments and similar scientific structures.

(13) A bridge or culvert purchased from an operating railroad company subsequent to the abandonment of the railroad line, track, spur or branch pursuant to the approval of the Interstate Commerce Commission. Major maintenance or reconstruction, or stream dredging may not be undertaken until the new owner obtains a permit under this chapter.

(14) The maintenance of an artificial pond or reservoir to its original storage capacity where:

(i) The contributory drainage area is less than or equal to 100 acres.

(ii) The greatest depth of water at maximum storage elevation is less than or equal to 15 feet.

(iii) The impounding capacity at maximum storage elevation is less than or equal to 50 acre feet.

NOTE



9-10-2012

Updated: September 2012

The Army Corps of Engineers should be contacted whenever a project results in any of the following activities in waterways or wetlands:

- ✓ Excavation
- ✓ Mechanical land clearing
- ✓ Discharge of fill
- ✓ Construction of any type of structure
- ✓ Maintenance of existing structures, including dam maintenance of existing ponds, lakes, or other waterbodies and maintenance of swales through wetlands or conveying waterways

The Corps will determine if the project requires USACE authorization.

U.S. Army Corps of Engineers
Attn.: Deborah Nizer
Baltimore District
CENAB-OP-RPA
Baltimore, Maryland 21201
Phone: (410) 962-6085
http://www.nab.usace.army.mil/

Revised: 9/2012

# Consultants List

The following consultants perform wetland delineations and/or are familiar with state and federal permitting processes for stream and wetland encroachments. This list is not exhaustive, and the District does not guarantee the competence, experience, or qualification of any listed consultant, nor is any recommendation implied.

Roemer Ecological
Services
Attn.: John Roemer IV
2334 Traceys Store Road
Parkton, MD 21120-9640
(410) 357-9420
FAX: (410) 357-9421

Soil Resources Limited
Attn.: Mark S. Mills
2801 Paxton Church Road
Harrisburg, PA 17110-9640
(717) 652-4605

Vortex Environmental
521 Beaver Valley Pike
Lancaster, PA 17602
(717) 509-3934
www.vortexenvironmental.
com

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# DAM PERMITS IN PENNSYLVANIA

**What is a dam?**

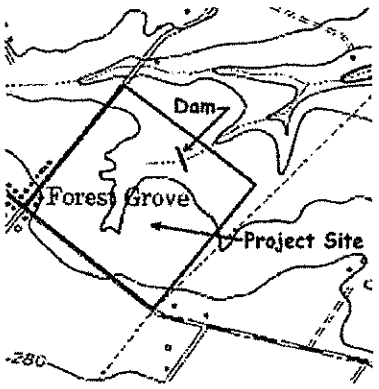
A dam is any artificial barrier, such as an earthen embankment or concrete structure, built for the purpose of impounding or storing water or another fluid or semi-fluid.

**When does a dam need a permit?**

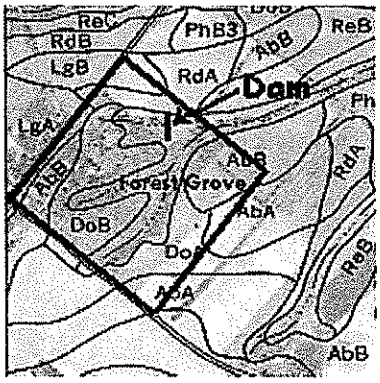
1. A dam permit is required if the proposed dam will be built across a stream and it meets one of the following criteria:
   a. The contributory drainage area is greater than 100 acres. The drainage area is the land area that during a storm event contributes water runoff to the impounding area.
   b. The maximum depth of water, measured from the upstream toe of the dam to the top of the dam at maximum storage elevation, is greater than 15 feet.
   c. The impounding capacity (storage volume) at maximum storage elevation is greater than 50 acre-feet.
2. A dam permit is required if the proposed dam is not located across a stream and criteria 1.b **AND** 1.c listed above are met.
3. A dam permit is required if the dam will store a fluid or semi-fluid other than water that may result in pollution or danger to persons or property if it escapes.

**Who makes the determination of the need for a permit for a proposed dam?**

A determination of the need for a permit can be requested from the Department of Environmental Protection's (DEP's) Division of Dam Safety. The following information is necessary for a jurisdictional determination:

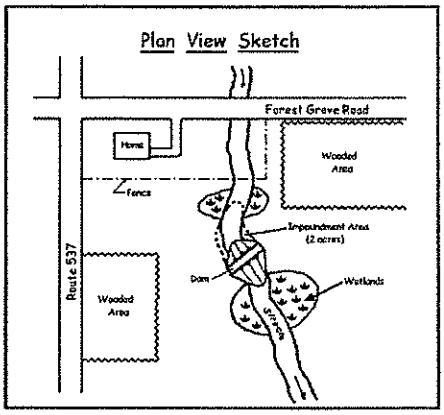



*1. The location of the proposed project site, indicated on a copy of a United States Geological Survey Topographic Map.

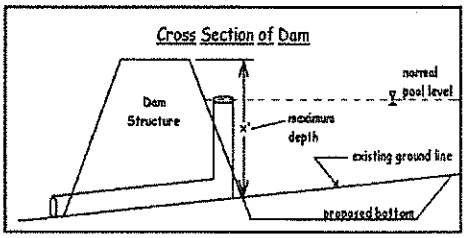



*2. A copy of the Soil Survey Map for the project area.

* Copies of these maps may be obtained from your County Conservation District Office.




3. A plan view sketch, indicating the proposed surface area of the impoundment and its proximity to streams, wetlands and other structures at the site.




4. A cross-section of the dam (or embankment) indicating the maximum depth.

5. Color photographs of the site.

To request a determination of the need for a permit, send the information described in this fact sheet to:

Department of Environmental Protection
Bureau of Waterways Engineering and Wetlands
Division of Dam Safety
P.O. Box 8460
Harrisburg, PA 17105-8460
(717) 787-8568

**What if wetlands or a stream exist at the site?**

1. If the proposed dam does not require a dam permit, but is located in, along or projecting into a wetlands or across a stream, DEP approval of an Environmental Assessment is required. (An Environmental Assessment is an evaluation of the potential impacts that a project may have on aquatic resources.) DEP will provide an Environmental Assessment form with the notification of the determination of the need for a permit or other approvals.
2. In addition, if the proposed dam does not require a dam permit, but is located in an exceptional value watershed, DEP approval of an Environmental Assessment is required.
3. Any excavation of wetlands, stream or floodway within the impoundment area would require an encroachment permit from DEP. DEP, upon receipt of the information discussed above, will make this determination.

For more information, visit www.dep.state.pa.us, keyword: Dam Safety.

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# BASIC NOMENCLATURE OF A DAM

These terms and definitions are frequently used to describe physical characteristics of a dam. This is an abridged version of the glossary of terms in Appendix D of "The Inspection, Maintenance and Operation of Dams in Pennsylvania."

**ABUTMENT** - That part of the valley side against which the dam is constructed. An artificial abutment is sometimes constructed where there is no suitable natural abutment. Right and left abutments are those on respective sides of an observer when viewed looking downstream.

**APPURTENANT STRUCTURES** - Ancillary features of a dam, e.g. gates, valves, spillway, outlet conduit, tunnels.

**AXIS OF DAM** - The plane or curved surface, arbitrarily chosen by a designer, appearing as a line, in plan or in a cross section, to which the horizontal dimensions of a dam can be referred.

**BOIL** - An upward disturbance in the surface layer of soil caused by water escaping under pressure from behind or under a water-retaining structure such as a dam or a levee. The boil may be accompanied by deposition of soil particles (usually silt) in the form of a ring (miniature volcano) around the area where the water escapes.

**BREACH** - An opening or a breakthrough of a dam sometimes caused by rapid erosion of a section of earth embankment by water. Dams can be breached intentionally to render them incapable of impounding water.

**CONDUIT** - A closed channel to convey the discharge of water through or under a dam.

**CORE** (IMPERVIOUS CORE/IMPERVIOUS ZONE) - A zone of material of low permeability in an embankment dam.

**COREWALL** - A wall built of impervious material, usually of concrete or asphaltic concrete in the body of an embankment dam to prevent leakage.

**CREST LENGTH** - The measured length of the top of the dam from abutment to abutment. This includes the length of spillway, powerhouse, navigation lock, fish ladder, etc, where these structures form part of the length of the dam. If detached from the dam, these structures should not be included.

**CREST OF DAM** - The crown of an overflow section of the dam. In the United States, the term "crest of dam" is often used when "top of dam" is intended. To avoid confusion, the terms crest of spillway and top of dam should be used in referring to the overflow section and dam proper, respectively.

**CUTOFF** - An impervious barrier to reduce or prevent seepage through the foundation under the dam.

**CUTOFF WALL** - A wall of impervious material (e.g., concrete, asphaltic concrete, steel sheet piling) built into the foundation to reduce seepage under the dam.

**DAM** - An artificial barrier and its appurtenant works constructed for the purpose of impounding or diverting water.

**DRAINAGE AREA** - The area that drains naturally to a particular point on a river or stream.

**DRAWDOWN** - The resultant lowering of water surface level due to the release of water from the reservoir.

**EMBANKMENT DAM (EARTH DAM/EARTHFILL DAM)** - Any dam constructed of excavated natural materials, usually earth or rock, placed with sloping sides.

**EMERGENCY ACTION PLAN (EAP)** - A predetermined plan of action to follow in emergency situations.

**EMERGENCY GATE** - A stand-by or reserve gate used only when the normal means of water control is not available.

**ENERGY DISSIPATOR** - Any device constructed in a waterway to reduce or destroy the energy of fast-flowing water.

**FAILURE** - An incident resulting in the uncontrolled release of water from an operating dam.

**FOUNDATION OF DAM** - The natural material on which the dam structure is placed.

**FREEBOARD** - The vertical distance between a stated water level and the top of a dam.

**GABION** - A prefabricated basket of rock within a wire cage that is free draining and capable of being stacked.

**GATE** - A device, usually a plate, that is moved across a pipe or channel to restrict or stop flow.

**GRAVITY DAM** - A dam constructed of concrete and/or masonry that relies on its weight for stability.

**GROIN** - That area along the contact (or intersection) of the face of a dam with the abutments.

**HEIGHT OF DAM** - The vertical measurement expressed in feet as measured from the downstream toe of the dam at its lowest point to the elevation of the top of the dam.

**INTAKE** - Any structure in a reservoir, dam or river through which water can be drawn into an aqueduct.

**INUNDATION MAP** - A map delineating the area that would be inundated in the event of a dam failure.

**MASONRY DAM** - Any dam constructed mainly of stone, brick, or concrete blocks that may or may not be joined with mortar. A dam having only a masonry facing should not be referred to as a masonry dam.

**MAXIMUM WATER LEVEL** - Maximum water level a dam is designed to withstand, including the flood surcharge.

**NORMAL WATER LEVEL (NORMAL POOL)** - The lowest level of a dam's fixed overflow spillway crest.

**ONE HUNDRED YEAR (100-YEAR) FLOOD** - The flood magnitude expected to be equaled or exceeded on the average of once in 100 years. It may also be expressed as an exceedance frequency with a 1 percent chance of being exceeded in any given year.

**OUTLET** - An opening in which water can be freely discharged for a particular purpose from a reservoir.

**PIPING** - The progressive development of internal erosion by seepage appearing downstream as a hole or seam discharging water that contains soil particles.

**PLUNGE BASIN (PLUNGE POOL)** - A natural or artificial pool that dissipates energy of free-falling water. The basin is located at a safe distance downstream of the structure from which the water is being released.

**PROBABLE MAXIMUM FLOOD (PMF)** - The flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are possible in the region.

**RIPRAP** - A layer of large uncoursed stones, broken rock or precast blocks placed in random fashion on the slope of an embankment dam, a reservoir shore, or the sides of a channel to prevent erosion by wave and ice action.

**SCARP** - The nearly vertical, exposed earth surface remaining at the upper edge of a slide on an embankment slope.

**SEEPAGE** - The movement of water through the dam, its foundations or its abutments.

**SLIDE** - The movement of a mass of earth down a slope. In embankments and abutments, this involves the separation of a portion of the slope from the surrounding material.

**SPILLWAY** - A structure over or through which flood flows are discharged. If the flow is controlled by gates, it is called a controlled spillway; if the elevation of the spillway crest is the only control, it is called an uncontrolled spillway.

- **AUXILIARY SPILLWAY (EMERGENCY SPILLWAY)** - A secondary spillway designed to operate only during exceptionally large floods.
- **OGEE SPILLWAY (OGEE SECTION)** - An overflow weir in which in cross section the crest, downstream slope, and bucket have an "S" or ogee form of curve. The shape is intended to match the underside of the nappe at its upper extremities.
- **PRIMARY SPILLWAY (PRINCIPAL SPILLWAY)** - The principal or first used spillway during flood flows.
- **SERVICE SPILLWAY** - A principal spillway used to regulate reservoir releases additional to or in lieu of the outlet.

**SPILLWAY CHANNEL** - A channel conveying water from the spillway crest to the river downstream.

**SPILLWAY DESIGN FLOOD (SDF)** - The largest flood that a dam is designed to pass safely. The reservoir inflow discharge hydrograph used to estimate the spillway discharge capacity requirements and corresponding maximum surcharge elevation in the reservoir.

**STILLING BASIN** - A basin constructed so as to dissipate the energy of fast-flowing water, e.g., from a spillway or bottom outlet, and to protect the riverbed from erosion.

**STOPLOGS** - Logs, timbers or steel beams placed on top of each other with their ends held in guides on each side of a channel or conduit, which provide an easy, inexpensive means of temporary closure.

**STORAGE** - The retention of water or delay in runoff either by planned operation, as in a reservoir, or by temporarily filling the overflow areas, as in the progression of a flood crest through a natural stream channel.

**TAILWATER LEVEL** - The level of water in the discharge channel immediately downstream of the dam.

**TOE OF DAM** - The junction of the face of a dam with the ground surface. An embankment dam has an "upstream" toe and a "downstream" toe.

**TOP OF DAM** - The elevation of the uppermost surface of a dam excluding any parapet wall, railings, etc.

**TOP WIDTH (TOP THICKNESS)** - The thickness or width of a dam at the level of the top of the dam. In general, the term thickness is used for gravity and arch dams and width is used for other dams.

**TRASH RACK** - A screen or grid usually of metal bars attached to an intake so as to keep out debris.

**VALVE** - In general, a device fitted to a pipeline or orifice in which the closure member is either rotated or moved transversely or longitudinally in the waterway so as to control or stop the flow.

**WEIR** - A structure built across a stream or channel to measure flow. Sometimes called a measuring weir or gauging weir. A low dam or wall built across a stream to raise the upstream water level. Types of weirs include broadcrested, sharp-crested, ogee and V-notch weirs. Called a "fixed-crest" weir when uncontrolled.

**For more information contact:**

Department of Environmental Protection, Bureau of Waterways Engineering and Wetlands, Division of Dam Safety, P.O. Box 8460, Harrisburg, PA 17105-8460, Telephone: (717) 787-8568

Or, visit DEP's website at www.dep.state.pa.us, keyword: Dam Safety.

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# CONSERVATION RELEASES FROM DAMS IN PENNSYLVANIA

**What is a conservation release?**

A conservation release is the minimum flow of water from a dam or reservoir that must be maintained at all times in the stream channel immediately downstream of the dam or reservoir. Some releases must be constant throughout the year while others may vary depending on the time of year and reservoir levels. Dam permits issued by the Department of Environmental Protection (DEP) require minimum release rates when deemed necessary.

**Why are releases required?**

DEP can require a minimum flow release from a dam to serve public health, environmental quality, aquatic life, and recreational or other uses of a stream. Regulations governing the rationale, flow rates, and scheduling for a required minimum release are detailed in 25 Pa. Code §105.113.

Releases are required from dams to maintain the minimum amount of water needed in the stream below the dam to support fish and aquatic life and to maintain water quality criteria established by DEP's water quality standards. Conservation releases are most often required for dams with consumptive water uses, for example, withdrawals for irrigation or industrial or public water supply. These uses do not return the water directly to the stream at the point of withdrawal.

**How is the amount of release determined?**

Releases can be based on several factors, such as watershed size, historical stream flows, the storage capacity of the dam, and the impact to wetland hydrology above or below a dam.

For dams built before Aug. 28, 1978, many release rates were established by simply multiplying the drainage area above the dam by 0.15 cubic feet per second per square mile. The current dam safety regulations provide an empirical formula for determining the release rate:

**Release Rate = $Q_{7\text{-}10}$ + PDF (0.25 CSM - $Q_{7\text{-}10\ CSM}$)**

Where: $Q_{7\text{-}10}$ is the average 7-day low flow in stream on the 10-year internal.

PDF is a percentage factor based on the storage capacity of the reservoir measured as a percent of average annual runoff retained in the reservoir.

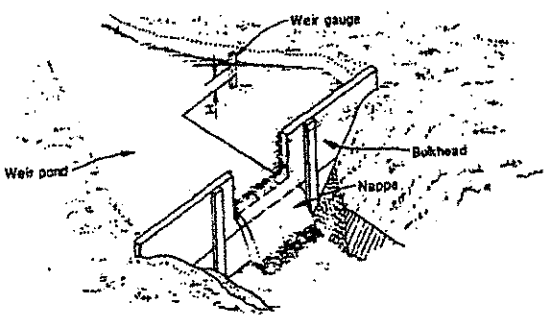
$Q_{7\text{-}10\ CSM}$ is the 7-day, 10-year flow in cubic feet per second per square mile.

The release rate determined by this formula would not be more than 0.25 cubic feet per second per square mile of watershed.

The release rate may be modified from this formula and in recent years several methods such as IFIM (Instream Flow Incremental Methodology) and Wetted Perimeter Studies have been used to determine minimum release rates. These methods more directly relate release rates to site-specific biology and habitat of the stream.

**Measuring and recording releases**

To assure compliance with dam permit conditions, measurement and reporting of releases may be required. Flow measurement can be done by using a fixed orifice, a stream gage that continually measures the flow, or a staff gage read manually. The owner must keep records of the readings, and in some cases must submit the records to DEP. Compliance is verified by DEP personnel as a part of the dam inspection program.




FACT SHEET

For more information about dams in Pennsylvania and DEP's Dam Safety Program, contact:

Department of Environmental Protection
Bureau of Waterways Engineering and Wetlands
Division of Dam Safety
P.O. Box 8460
Harrisburg, PA 17105-8460
717-787-8568

## DEP's Watershed Management Program
## Regional Offices

**Northwest Region**
230 Chestnut St.
Meadville, PA 16335-3481
814-332-6984

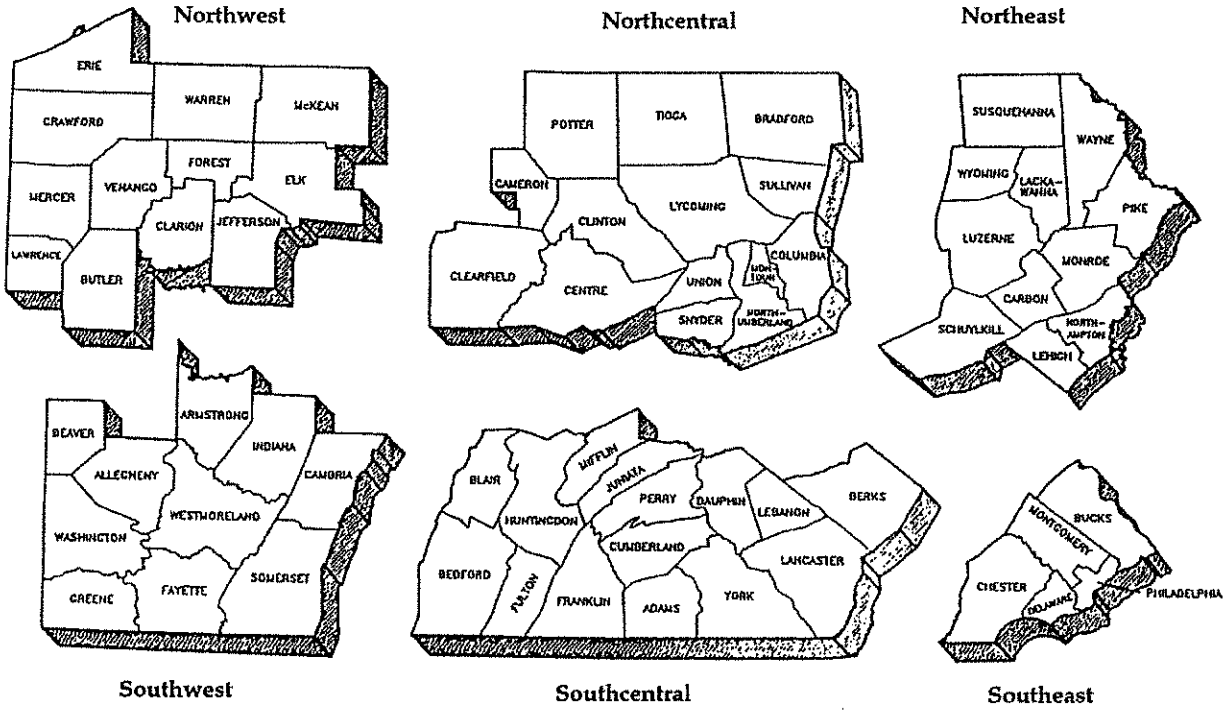
***Counties:*** *Butler, Clarion, Crawford, Elk, Erie, Forest, Jefferson, Lawrence, McKean, Mercer, Venango and Warren*

**Northcentral Region**
208 W. Third St., Suite 101
Williamsport, PA 17701-6448
570-327-0529

***Counties:*** *Bradford, Cameron, Clearfield, Centre, Clinton, Columbia, Lycoming, Montour, Northumberland, Potter, Snyder, Sullivan, Tioga and Union*

**Northeast Region**
2 Public Square
Wilkes-Barre, PA 18701-1915
570-826-2511

***Counties:*** *Carbon, Lackawanna, Lehigh, Luzerne, Monroe, Northampton, Pike, Schuylkill, Susquehanna, Wayne and Wyoming*




**Southwest Region**
400 Waterfront Dr.
Pittsburgh, PA 15222-4745
412-442-4000

***Counties:*** *Allegheny, Armstrong, Beaver, Cambria, Fayette, Greene, Indiana, Somerset, Washington and Westmoreland*

**Southcentral Region**
909 Elmerton Ave.
Harrisburg, PA 17110-8200
717-705-4707

***Counties:*** *Adams, Bedford, Berks, Blair, Cumberland, Dauphin, Franklin, Fulton, Huntingdon, Juniata, Lancaster, Lebanon, Mifflin, Perry and York*

***Southeast Region***
2 East Main Street
Norristown, PA 19401-4915
484-250-5970

***Counties:*** *Bucks, Chester, Delaware, Montgomery and Philadelphia*

For more information, visit www.dep.state.pa.us, keyword: Dam Safety.

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# DAM INSPECTIONS BY OWNERS

Although all Hazard Potential Category 1 or 2 (i.e., "High Hazard") dams must be inspected annually by a registered professional engineer, dam owners in Pennsylvania are required to inspect their dam(s) at least once every three months. A manual entitled *The Inspection, Maintenance and Operation of Dams in Pennsylvania* is available upon request from the Division of Dam Safety.

## The Inspection

It is helpful to prepare an inspection route in advance to assure that every part of the dam will be observed. The following is a recommended sequence to assist you in your inspection:

CREST - Walk across the crest from abutment to abutment.

UPSTREAM/DOWNSTREAM SLOPE - Walk across the slope in an up and down or zigzag pattern from abutment to abutment.

EMBANKMENT-ABUTMENT CONTACTS - Walk the entire length of the embankment-abutment contacts (groin).

OUTLET CONDUIT - Observe all accessible features of the outlet conduit.

SPILLWAY - Walk along the entire length of the spillway in a back and forth manner.

ABUTMENTS - Traverse abutments in a practical manner so as to gain a general feel for the conditions which exist along the valley sidewalls.

DOWNSTREAM CHANNEL - Travel the route of the stream below the dam to maintain familiarity with locations of residences and property which can be affected by dam failure.

DOWNSTREAM TOE - Walk the entire length of the downstream toe.

RESERVOIR SLOPES - Scout the reservoir perimeter in an effort to develop an overall familiarity with its conditions.

## What To Look For

The following is a partial list of some of the conditions a dam owner may discover. This list does not cover all of the problems which may be encountered.

| | | |
|---|---|---|
| SETTLEMENT | STRUCTURAL CRACKING | EROSION |
| SINKHOLES | ANIMAL BURROWS | DEPRESSIONS |
| SEEPS | EXCESSIVE VEGETATION | BOILS |
| TURBID DISCHARGE | FOUNDATION MOVEMENT | VANDALISM |

## Keeping Records

It is important for the dam owner/operator to keep records throughout the existence of the dam. Accurate records can better illustrate the dynamic nature of the structure.

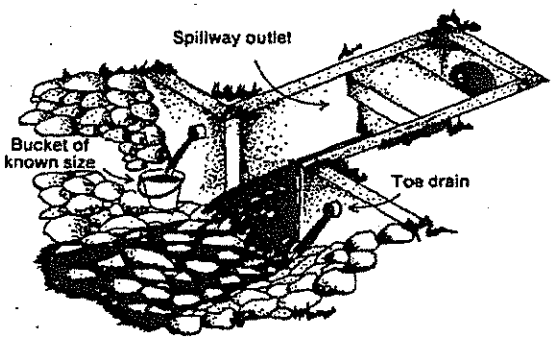
The Department of Environmental Protection (DEP) requires the dam owner to establish a permanent file to retain inspection records including records of actions taken to correct conditions found in such inspections. The following items will aid the dam owner/operator in keeping good records.

**Inspection Checklist** - A convenient way of compiling inspection observations is by recording them directly onto an inspection checklist. The checklist should be attached to a clipboard and carried by the dam inspector as he/she traverses the entire structure. Copies of the checklist can be obtained by contacting DEP.

A good practice to follow along with filling out the inspection checklist is to draw a field sketch of observed conditions. The field sketch is intended to supplement the information recorded on the inspection checklist; however, it should never be used as a substitute for clear and concise inspection checklists.

**Photographs** - Inspection photographs can be vitally important. Over time, photographs serve to provide a pictorial history of the evolving characteristics of a dam. The dam owner/operator often finds them to be great money savers because they can illustrate that some observed conditions (seepage, foundation movement, etc.) have existed for many years and may have reached a state of equilibrium. With this knowledge, quick and economical remedial actions can be developed and implemented. Photographs should be dated on the back and provided with brief descriptions of the locations shown in the pictures.

**Monitoring Data** - As previously indicated, it may become necessary to make measurements of various items during the course of a dam inspection. This may include measurements of seepage rates, spillway discharge rates, settlement, and for some dam owners, readings from instruments such as piezometers. It is important that this data also be compiled in a systematic manner and placed in a permanent file.




**Accompany Your Engineer During Annual Inspections**

Many engineers encourage dam owners or operators to accompany them, or even assist them, on annual dam inspections. Also, many owners accompany DEP engineers during our periodic inspections. Owners can learn many things from experienced inspectors such as:

- What to look for;
- How to photograph certain features of a dam;
- What records to keep; and
- How to read different types of instrumentation.

**For more information contact:**

Department of Environmental Protection
Bureau of Waterways Engineering and Wetlands
Division of Dam Safety
P.O. Box 8460
Harrisburg, PA 17105-8460
(717) 787-8568

For more information, visit www.dep.state.pa.us, keyword: Dam Safety.

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College of Agricultural Sciences • Cooperative Extension

School of Forest Resources

Pond Facts #1

# Pond Assessment and Inspection

Proper pond management practices should always start with an assessment and inspection of the current conditions in the pond. This fact sheet discusses some of the critical components of a typical pond that should be identified and inspected before tackling pond management issues.

**Pond Objectives**

An important first step in assessing your pond is to determine the primary objectives for your pond and understand the limitations this will place on other uses. Ponds are frequently used in several ways to satisfy more than one objective. For example, having water available in the pond for fire protection may satisfy one objective without interfering or conflicting with other objectives such as swimming or fishing. Multiple-use ponds are fine as long as the uses are compatible. When conflicting or incompatible uses are desired, it is necessary to assign priorities to the owner's objectives. For example, the objective of providing for swimming may conflict directly with the objective of having water available for irrigation. Irrigation needs may lower the water level to a point where swimming is impossible, at a time when swimming is most wanted. For this reason, you should list and prioritize specific objectives for your pond. Assessing the pond resources is a critical component of setting objectives. Through inspection and assessment of the pond structure, watershed, water sources, and ecology, you can ensure that the pond resources are adequate for your objectives.

**The Pond Watershed and Sources of Water**

Many pond uses and management strategies will require an understanding of the pond watershed and sources of water. The pond watershed includes the area of land surrounding the pond that contributes water to it. Identifying the pond watershed is important because anything that occurs within this area can impact the pond. Locating a pond in an undisturbed area or minimizing disturbance and land use changes within the pond watershed are important components of protecting a pond.

Many ponds have been constructed where groundwater comes to the surface as springs or seeps. Ponds fed by these groundwater sources may stay cooler during the summer, especially if the flow from the springs is persistent. If possible, the land area contributing water to the springs should be identified and protected to ensure adequate quantity and quality of water for the pond.

Sometimes ponds are constructed on or near a surface stream. The stream may simply flow through a constructed pond or a portion of the stream may be diverted into the pond. In this case, the pond's health relies entirely on the quality and quantity of stream water. The entire land area draining the surface stream becomes critical to the health of the pond.

Where groundwater or streams are not available, a pond may be located to capture surface runoff from the surrounding land (Figure 1). Surface runoff ponds are normally found in depressions often draining 10 to 20 acres of land for a one-acre pond. Land use activities around these ponds is especially critical since water flows directly over the land to the pond. Care should be taken to avoid polluting activities on the land around these ponds.

**Figure 1. A pond that collects surface runoff from the surrounding land.**

Regardless of the water source, it is a good idea to establish a buffer strip of vegetation around the pond to trap sediment, nutrients, and other pollutants before they enter the pond. The buffer strip should range in width from 10 feet (for a gentle slope) to 50 feet (for a steep slope around the pond).

**Inspecting Your Pond**

At least once each year you should take some time to inspect the pond structure. Routine inspection and frequent maintenance protect a pond, keep it attractive, and extend its useful life. Lack of inspection and prompt repair of problems may cause more severe damage that is either irreparable or more expensive to fix.

***Dam and Banks***

The dam and any exposed banks should be checked to ensure that they have complete grass cover and no erosion. Grass, weeds, brush, and small trees should be occasionally cut from the dam and banks. Trimming smaller vegetation allows for a visual inspection of the surface to check for signs of leaks or burrowing animals. Also inspect and repair any fences that are used to keep livestock from accessing the dam or pond embankments. Large trees already existing along the dam or banks should be left alone. Cutting or killing large trees may cause leaks to develop around their decaying roots.

***Overflow Pipe***

It is especially important to inspect the overflow pipe and remove debris in or near the pipe (Figure 2) Obstructions of this pipe may result in water breaching the dam or continually flowing through the auxiliary spillway (if one exists). The auxiliary spillway should also be inspected to remove debris and repair any obvious erosion.

**Figure 2. Inspect the overflow pipe and remove any debris in or near the pipe.**

***Pond Access***

Be sure that any roads to the pond are maintained to allow access for safety vehicles. This is especially important if a dry hydrant exists to allow access for fire trucks. To maximize fire protection benefits from a pond, fire trucks must have access to the pond during all seasons of the year and the dry hydrant should be readily accessible.

***Check for Signs of Leaks***

The pond water level should be routinely observed to monitor for early signs of leakage. Most ponds lose some water to underground seepage and evaporation. Ponds with little water inflow may lose several inches per day to evaporation in the summer. Losses greater than this may be attributed to a significant leak that is often visible as a wet area outside the pond. Leaks may originate from muskrat burrows, decaying roots, or debris left in the pond dam. If you suspect your pond is leaking, consult the fact sheet titled *Pond Facts #3: Fixing a Leaking Pond* to learn more about methods to fix leaks.

***Pond Sediment***

A common problem among older ponds is sedimentation. Depending on the source of water, ponds may fill up over time with sediment. As sediment fills in the pond, growth of aquatic plants and algae will generally increase due to increased sunlight penetrating the shallower water.

Sediment levels in the pond should be observed and monitored. If sedimentation is noticeable, steps should be taken to reduce sediment entering the pond. Inspect the pond water source to determine if exposed banks or upstream activities are causing increased sediment. If the pond receives excessive amounts of silt, erosion control practices should be implemented in the watershed. If you do not own upstream land, a small settling basin just upstream from your pond could be built to intercept silt or debris. Sediment can be removed from the pond through dredging but this process is usually time-consuming, expensive, and destructive to pond ecology.

***Safety Equipment***

Ponds, like any body of water, attract both invited and uninvited people. As part of your pond inspection, consider safety features and equipment to protect visitors. Remove trees, stumps, and brush, which may be a hazard to swimmers. Keep the pond and banks free of rubbish, wire, cans, bottles, and other debris. Mark the swimming area and post safety rules for all permitted water uses. Place

warning signs at all known danger spots. If boating and swimming are permitted, consider building a dock or pier. Attach lifesaving devices such as ring buoys, ropes, or long poles to a safety post located near swimming areas. For more information on pond safety issues and equipment, consult the fact sheet titled *Farm Pond Safety*.

In addition to safety equipment, many pond owners choose to carry comprehensive liability insurance on their property. You should consult with an attorney and an insurance agent for proper interpretation and protection for the specific circumstances involved with your pond

### *Area and Volume*

Other areas of pond assessment include careful measurement of pond area and volume. For more details on how to do this, consult the fact sheet titled *Pond Facts #4: Measuring Pond Area and Volume.*

### *Water Quality*

Pond assessment should include routine testing of the pond water quality. Water tests are helpful for documenting existing problems and monitoring for important changes in water quality. The parameters that should be tested in your pond will depend on your intended uses for the pond. For more details on pond water quality, consult the fact sheet titled *Pond Facts# 5: Water Quality Concerns for Ponds.*

### *Aquatic Plants and Algae*

Identifying and inventorying the aquatic plants and algae growing in the pond during the summer is valuable to determine the existing health of the pond and potential problems in the future. Consult the pond management Web site (www.sfr.cas.psu.edu/water) for pictures and drawings of common aquatic plants and algae that may help identify plants in your pond. You can also e-mail digital photos of plants that you would like identified to Bryan Swistock at brs@psu.edu.

### *Fisheries*

Assessment of existing fisheries in the pond is important for future management decisions regarding stocking, harvest, and habitat requirements. Fisheries assessment is accomplished mostly by records kept by fishermen and visual observations of numbers and sizes of fish from the pond bank. Professional fisheries biologists can also be hired to conduct electrofishing surveys of ponds and lakes to provide more detailed assessment information and management plans. For more information on pond fisheries management consult the fact sheets titled *Pond Facts #11: Fish for Pennsylvania Ponds* and *Pond Facts #12: Managing Your Pond Fishery.*

### More Information

To access the fact sheets referenced above along with other pond management information, consult the Penn State pond management Web site at www.sfr.cas.psu.edu/water or contact the Penn State Cooperative Extension office in your county .

Prepared by Bryan R. Swistock, extension associate; William E. Sharpe, professor of forest hydrology; and Tom McCarty, extension educator in Cumberland County.

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CODE XH0012

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

# LIABILITY AND RESPONSIBILITY OF DAM OWNERS

Dam ownership carries significant legal responsibilities. Dam owners should be aware of the responsibilities and know how to deal with potential liabilities.

This fact sheet addresses general legal matters to help you minimize exposure to liability resulting from dam ownership and/or operation. This fact sheet does not answer specific legal issues. It is in the dam owner's/operator's best interest to obtain competent legal counsel when dealing with specific issues.

## POTENTIAL LIABILITY PROBLEMS FOR DAM OWNERS

A dam owner should first be familiar with the legal obligation to maintain the dam in a safe condition.

The general rule is that a dam owner is responsible for the dam's safety and liable for damages caused by its failure. And, a dam owner is responsible for flood damage caused to upstream properties by the storage of floodwaters, as well as damage caused by the sudden release of stored water by failure of the dam or intentional rapid draining of the impoundment. Courts usually look sympathetically on the claims of those injured by a dam's failure.

Since the dam owner is responsible for dam safety, it is important to note what is done to comply with that legal duty. The concept of strict liability holds the dam owner liable for damages regardless of the cause of failure. The theory of negligence may impose a degree of liability on a dam owner, depending on how careful the dam owner was to maintain, repair and operate the dam. Liability could also extend to former owners and permittees, or any person who operates or maintains the dam. One must carefully inspect the structural integrity of any dam prior to purchase and then perform routine inspection, maintenance and repair thereafter.

The dam owner must do whatever is necessary to prevent injury to people or damage to property. This usually applies to foreseeable circumstances and situations, which can be anticipated with reasonable certainty. A dam owner would generally not be responsible for those circumstances that a reasonable person could not anticipate.

In order to assure that owners meet their responsibility to maintain their dams according to regulatory minimums, dam owners in Pennsylvania must periodically inspect their dams and correct deficiencies and problems. The owner of a high hazard dam must annually have a qualified professional engineer inspect the dam and report its condition to the Department of Environmental Protection (DEP).

## POTENTIAL PERSONAL INJURY LIABILITY

Dams and impoundments are popular places, even in remote areas. The dam owner is responsible for making and keeping the premises safe. The general rule is that a dam owner must avoid conduct or conditions that could injure any person, even a trespasser. If the dam owner knows that an unsafe condition exists, he is responsible to correct it and/or post warnings.

The presence of employees, contractors, invited visitors or a trespasser is a potential liability to the dam owner. Liability or worker's compensation insurance should cover employees, contractors or invited guests. However, the trespasser presents a different problem.

A dam can be an attractive nuisance. Most trespassers at a dam site probably want to use the water for recreation — fishing, boating or swimming. While they mean no harm, their presence is a significant potential liability problem for the dam owner. A prudent owner will install warning signs to advise the unwary and security fencing to prevent the curious trespasser from accidental injury.

Typical dangers at a dam site include fast moving water, open spillways or pipes, structures to climb on and thin ice in winter. The base of the spillway is particularly dangerous; violent currents and eddies can trap boaters, fishermen and swimmers.

A dam owner is expected to protect children from the dangers of a dam site, regardless of the reason for their presence. In effect, this requires the owner to anticipate what parts of the facility would be particularly attractive to children. Since signs may not adequately warn children, security fencing may be necessary.

Dam sites located near roads, campgrounds and picnic areas or near populated areas will attract many people. Security measures at such sites require frequent inspections by the dam owner to assure safety.

## POTENTIAL LIABILITY DUE TO OPERATION OF A DAM

In addition to liability problems arising out of dam ownership, operation of the dam can be a significant legal issue. First and foremost is the simple right to operate a dam and impound water.

Pennsylvania law requires a permit to construct, operate and maintain a dam. DEP's Division of Dam Safety has the authority for permitting, inspection, and compliance and enforcement of state dam safety laws. In addition, operation of a dam on a navigable stream may involve federal government regulations. A dam operated to generate electricity is subject to federal law and regulation by the Federal Energy Regulatory Commission (FERC).

Beyond the basic permitting question, all dam owners must consider the effect of dam operation on the rights of other water users, whether they are upstream or downstream of the dam. This responsibility includes a duty to avoid negligent flooding of properties upstream or downstream of the dam.

In times of high runoff, the dam owner must assess the effects of operation that would alter conditions. Increasing discharge may create flooding downstream while decreasing discharge may protect downstream property but cause flooding or other damage upstream. The dam owner must always consider the maximum discharge capacity of the structure relative to prevailing hydrologic conditions and weather forecasts. Overtopping of a dam due to insufficient or untimely operations must be avoided.

In situations where there is no specific law to protect downstream landowners from flooding, the dam owner must still operate the dam conscientiously. As a dam owner, you must be in a position to clearly show that your dam did not increase flooding.

Upstream users may also have the right to be protected from damage caused by operation of the dam. Therefore, the dam owner is advised to assess the legal as well as physical impact of any change in the level of the impoundment, even if removing a dam.

## A FINAL WORD ABOUT LIABILITY

This fact sheet is only a general introduction to the issues of a dam owner's liability. As the owner of a dam, you must consider your liability potential, and seek competent legal counsel and technical assistance to help to protect yourself as well as others. Where the ownership and operation of dams and impoundments are concerned, the old saying "an ounce of prevention..." is appropriate. Following it will truly save you the "pound of cure."

**For more information contact:**

Department of Environmental Protection
Bureau of Waterways Engineering and Wetlands
Division of Dam Safety
P.O. Box 8460
Harrisburg, PA 17105-8460
(717) 787-8568

For more information, visit www.dep.state.pa.us, keyword: Dam Safety.

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ENVIRONMENTAL PROTECTION

# DAM SAFETY EMERGENCY ACTION PLANS

**What is an Emergency Action Plan?**

An Emergency Action Plan (EAP) is a formal document that describes procedures to minimize the risk of loss of life and property damage when potential emergency conditions threaten a Hazard Potential Category 1 or 2 dam. The dam owner must prepare an EAP to conform to the law and guidelines established by Pennsylvania's Department of Environmental Protection (DEP) and Pennsylvania's Emergency Management Agency (PEMA). The owner submits the Emergency Action Plan to DEP for review and approval by both agencies.

An emergency at a dam is any condition that endangers the structural integrity of the dam which might result in the dam's failure, thus unexpectedly inundating downstream areas. Such threatening conditions demand immediate action on the part of the owner. Those actions are described beforehand in an approved EAP.

Every EAP is tailored to site specific conditions, as well as the requirements of the owner, agency or organization that operates or regulates use of the dam, and to the emergency response organizations that will respond to the emergency.

**What is a Hazard Category 1 or 2 Dam?**

Pennsylvania's "Dam Safety and Encroachments Act" defines a high hazard dam as "any dam so located as to endanger populated areas downstream by its failure." Practically, the term "high hazard" refers to a dam whose sudden failure would put the occupants of residential, commercial, or industrial structures at risk. The extent of potential loss or damage is determined by a hydraulic engineer's analysis of dam breach scenarios, translated into an inundation map. The inundation map is the most significant feature of an EAP.

Category 1 Hazard potential describes a "high-hazard" dam that could cause substantial loss of life, excessive economic loss, or substantial public inconvenience by its sudden failure. A Category 2, "high-hazard" potential dam is one that, in the event of operational or structural failure, could result in the loss of a few lives. Failure of a Category 2, "non-high-hazard" dam, would not likely endanger human life, but could result in appreciable property damage or short duration public inconvenience. Public inconvenience could result from flooding of important roads, washout of a bridge, destruction or disruption of public utilities, etc.

**Why Must You Have an EAP?**

An EAP is needed for three reasons:

1. To plan the coordination of necessary actions and resources by the dam owner and the responsible local, state and federal emergency organizations.
2. To provide for timely notification or warning for evacuation in the event of an emergency situation at the dam.
3. **It's the law!** Requirements for the design, construction, operation, maintenance and inspection of dams are intended to prevent dam failures. Despite these efforts, abnormal conditions sometimes develop that could threaten a dam's safety. Therefore, Pennsylvania's Dam Safety and Encroachments Act (Act 325 and Act 70) mandates Emergency Action Plans for Hazard Potential Category 1 and 2 dams.

   Regulations in Title 25 of the Pennsylvania Code detail the conditions and requirements of emergency procedures and emergency action and operation plans (25 Pa. Code, Chapter 105 Dam Safety and Waterways Management, Sections 105.63 and 105.134).

The Emergency Management Services Code (35 Pa. C.S. Section 7101 et seq.), as amended, authorizes the Pennsylvania Emergency Management Agency (PEMA) to implement a comprehensive emergency management program of prevention, mitigation, preparedness, response and recovery activities for any kind of man-made or natural disaster or emergency.

**Your responsibilities as a dam owner:**

1. **Operation** - Quarterly inspections of the dam by the owner or operator with a written, dated log of conditions.
2. **Maintenance** - Cutting vegetation on embankments and within 10 feet of the downstream toe of the dam, checking the dam's appurtenances and operating valves, and performing timely repairs when needed.
3. **Annual dam inspection** (of a "high-hazard" dam) - Annual inspection by an experienced registered, professional engineer, including a field review of the downstream inundation map. This Owner's Annual Inspection Report must be submitted to DEP by December 31 every year.
4. **Developing an EAP**, with assistance by your engineer, local emergency personnel, and county emergency management office. You must develop an acceptable EAP and update it every five years. When complete, the EAP will be reviewed by PEMA before being approved by DEP.
5. **Review and update EAP.** Every five years a dam owner must thoroughly review and update the EAP as needed. This includes revising the inundation map, obtaining new concurrence signatures, and submitting the revised plan to DEP for review and approval.
6. **Comply with the law!** DEP has the authority to issue Dam Permits and to enforce compliance with Pennsylvania's dam safety laws. The owner's attention to the laws and the dam is the key element of maintaining a dam in safe condition.

For more information contact:

Department of Environmental Protection
Bureau of Waterways Engineering
Division of Dam Safety
P.O. Box 8554
Harrisburg, PA 17105-8554
(717) 787-8568

For more information, visit www.depweb.state.pa.us, keyword: Dam Safety.

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E 27

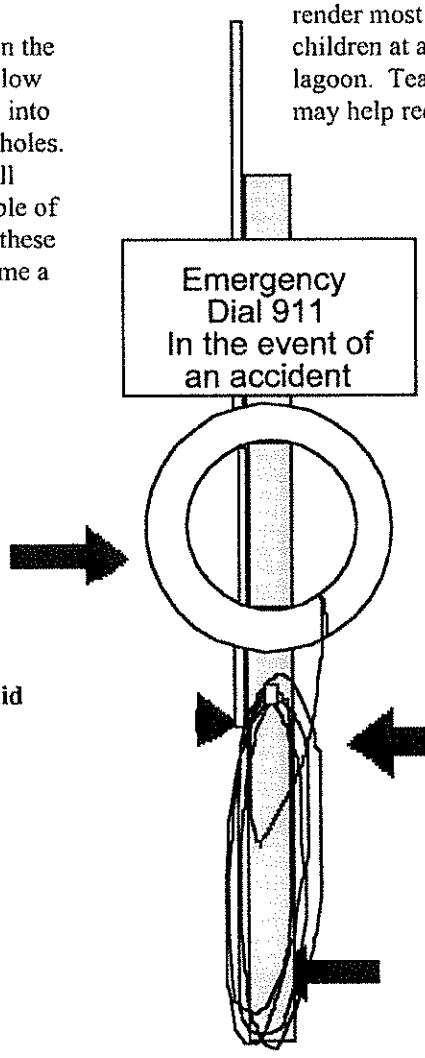
# Farm Pond Safety

**Dennis J. Murphy, Professor, Agricultural Engineering**
**Sam Steel, Project Associate, Agricultural Engineering**

Farm ponds, lagoons and water wells are often found on Pennsylvania farms and all have contributed to accidental drownings. Most victims range in age from toddlers to young adults and sometimes are not residents of the farm where the incident occurred.

Children under the age of four make up the largest group of victims in farm pond drownings. Small children may get too close to the water's edge, lose their balance in the soft earth and then drown in shallow water. Other children may wade into shallow water and fall into deep holes. Winter drowning victims may fall through thin ice and not be capable of pulling themselves to safety. In these incidents, hypothermia can become a problem and must be treated appropriately.

Lack of close supervision, underestimating the curiosity of children, and adults who overestimate their child's sense of judgment all contribute to young children drowning in farm ponds. Even though a child verbally acknowledges a warning or word of caution, this does not mean that they understand the hazard or risk of farm ponds. Children's short attention span, plus the attractiveness of pond water as a play area, render most verbal instructions ineffective. Watch children at all times when they are near a pond or lagoon. Teaching children to swim at an early age may help reduce this concern.




**Emergency sign noting local emergency number in the event of an accident.**

**Life ring or buoy tied to nylon rope for tossing to potential drowning victims.**

**Thin 12-14 foot pole used to aid victims in exiting the water.**

**Nylon rope long enough to reach across the width of pond's surface.**

**Rescue pole inserted firmly into soil at pond's edge.**

Adults are also drowning victims in farm ponds. Data show that accidents most often occur when people use farm ponds for recreational swimming. Most victims are in their late teens or early twenties and are visitors on the farm. Sharp drop-offs on the pond floor and leg cramps may cause even good swimmers to experience problems. Multiple deaths have occurred when one person attempts to rescue another individual who is in trouble.

There are other dangers associated with farm ponds, including contamination by agricultural fertilizer and pesticide runoff. Livestock waste and other pollutants present special health problems. If the water is cloudy, has a foul odor, or is covered with algae, it should not be used for swimming, because of possible human infectious agents. Ponds used for swimming should be sampled every spring for water quality by a certified laboratory. Other dangers lurking beneath farm pond surfaces include jagged rocks, broken bottles, animal bones, and other miscellaneous items common to farm ponds.

In general, it is recommended that all ponds and lagoons be fenced and posted with No Trespassing signs to keep trespassers out. Non-posted, non-fenced ponds increase the risk of a lawsuit if uninvited swimmers are injured or drown. Restrict entrance to your pond to keep out uninvited guests.

To make your farm pond safe for swimming, eliminate all physical hazards. This may include: grading of slopes for easy entrance; dragging shallow areas for dangerous objects; marking drop-offs; and roping off unsafe areas. Use markers and signs to identify the depth of the pond at different spots.

*"Kids will be kids." Children playing around farm ponds is a common occurrence often resulting in a tragedy.*

Every farm pond used for swimming should have a rescue post inserted firmly in the ground near the water's edge. Secure a nylon rope to the post which is long enough to reach across the pond. Attach one end of the rope to a buoy and the other end to a wood block. Then hang these on the rescue post. A gallon plastic milk jug containing a pint of water can also serve as a buoy. A thin, 12-14 foot pole should also be kept at the rescue post for assisting victims out of the pond. A sign printed with emergency phone numbers should also be attached to the rescue post.

Individuals should never swim alone even if they are expert swimmers. Persons who swim in farm ponds should be trained on water rescue procedures and CPR, similar to those taught by the American Red Cross and other swimming instruction programs.

Some farm drownings result from falls into wells, particularly those no longer in use. When abandoned, most wells are covered by wooden planks or other types of capping devices. Wooden planks may rot over a period of time and caps may get removed for a variety of reasons. Sometimes older children or pranksters will open up wells not realizing the seriousness of these actions. Old wells should have solid covers which cannot be easily removed and they should be checked regularly. It may be practical to fence off a well to keep children away. The safest bet is to remove the hazard by filling an old well with concrete or fill material.

*Parents and other adults should take the time to educate their children about the dangers associated with ponds and structures holding liquids on farms.*

PSU/95

For a copy of our Fact Sheet Listing contact: Agricultural Engineering Department, 246 Agricultural Engineering Building, University Park, PA 16802, Telephone: 814-865-7685 FAX: 814-863-1031

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DEPARTMENT OF ENVIRONMENTAL PROTECTION

# BURROWING ANIMALS AND DAMS

Water impounded by a dam is a habitat ideally attractive to muskrats and beavers. Burrowing animals see the slopes of an earthen dam as an ideal location for their homes. These rodents can cause serious damage to a dam. Beavers will sometimes block a spillway or outlet structure with a 'beaver dam,' thus raising the water level and diminishing spillway capacity. Muskrats and other burrowing animals dig tunnels that could create pathways for water to seep or flow through the dam, which could lead to sudden failure. A dam owner must pay attention for signs of animal habitation or damage, and control or eliminate animal activity that could damage or interfere with proper operation of the dam's features.

## Beavers

Beavers instinctively try to dam up flowing water; they will often block a dam's spillway and intake structure with logs and sticks. Such a beaver dam can raise the water level in a reservoir, reduce the spillway discharge capacity, or result in a sudden discharge of water should a beaver dam in a spillway suddenly fall apart. Beaver activity upstream of a dam can reduce or even stop the flow of water to a dam. A beaver dam upstream can produce lots of floating debris that can clog a dam's intake and outlet structures. Beaver activity downstream of a dam can raise the level of the tailwater, which in turn can reduce the discharge from the dam, or saturate and erode the downstream toe of the dam. Beavers have also been known to burrow into the upstream face of an earthen dam, below the waterline.

Beavers can block the control section of a spillway, thus reducing freeboard and spillway capacity.

The owner of a dam with beavers in the vicinity must inspect the dam's spillway and outlets frequently and clean out the accumulated debris or 'beaver dam' as soon as it appears. Frequent inspection and maintenance to remove debris dams may discourage beaver activity on and near the dam.

## Groundhogs

Groundhogs, or woodchucks, like to burrow into hillsides, such as the downstream face of an earthen dam. A groundhog burrow is usually a network of tunnels and chambers, with multiple entrances. Groundhogs dig into dry soil and stay above the saturated zone (phreatic surface), which is the upper boundary of seepage or saturation in the earthen dam. Fresh dirt at burrow entrances is a telltale sign of an active groundhog burrow. Other indicators of groundhog habitation are worn paths connecting a burrow to nearby fields, and clawed or girdled trees and shrubs nearby.

Frequent mowing and clearing brush, saplings and weeds that provide cover from predators will discourage groundhogs from trying to make their home in your earthen dam.

## Muskrats

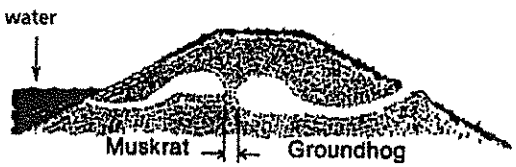
A muskrat will burrow into a dam's upstream face, starting six to 18 inches below the water surface and slant the tunnel upward into the embankment. The muskrat will hollow out a chamber above the water level, as far as 15 feet from the burrow entrance. If the water level then rises, the muskrat will dig higher into the embankment to excavate a new dry chamber.

If a muskrat's tunnel from the upstream face gets close enough to a groundhog's burrow from the downstream slope and the water level rises, then water can easily seep through the remaining wall of earth and quickly erode a passage for direct piping of water through the dam. Such piping will erode the dam internally, which could lead to catastrophic failure when the embankment collapses at that spot.

The owner of an earthen dam can discourage habitation by muskrats by eliminating vegetation (cover and food) along the shoreline. And, a properly constructed riprap and sand/gravel filter, extending at least three feet below the water surface, will also discourage muskrats from burrowing into the dam.

## Eliminating a Burrow

Backfilling an animal's burrow must be done to ensure safety and proper operation of an earthen dam. Animal dens should be eliminated immediately because damage from just one hole can lead to failure of the dam. Fortunately, repairing an animal burrow in a dam is easy and inexpensive.




Dangerously close burrows

The burrow should be excavated to eliminate all voids. Then backfill should be placed loosely in four- to six-inch lifts and well compacted with a hand or mechanical tamper. The surface of each compacted lift should be loosened to a depth of one to two inches before the next lift of material is placed. After all voids and entrances are backfilled, seed and mulch the repaired area to grow new grass and protect the slope from erosion.

## Hunting, Trapping, and Wildlife Regulations

In Pennsylvania, shooting or trapping beaver, groundhog or muskrat is generally subject to restrictions and seasons, however dam safety does take priority. Before taking any action against these rodents, a dam owner should consult the local wildlife conservation officer or call the local office of the Pennsylvania Game Commission.

PA Game Commission Regional Offices

| *Region* | *City* | *Phone* |
|---|---|---|
| Northwest | Franklin | 814-432-3187 |
| Southwest | Bolivar | 724-238-9523 |
| Northcentral | Jersey Shore | 570-398-4744 |
| Southcentral | Huntingdon | 814-643-1831 |
| Northeast | Dallas | 570-675-1143 |
| Southeast | Reading | 610-926-3136 |

For more information on Dam Safety in Pennsylvania, contact:

Department of Environmental Protection
Bureau of Waterways Engineering and Wetlands
Division of Dam Safety
P.O. Box 8460
Harrisburg, PA 17105-8460
717-787-8568

For more information, visit www.dep.state.pa.us, keyword: Dam Safety.

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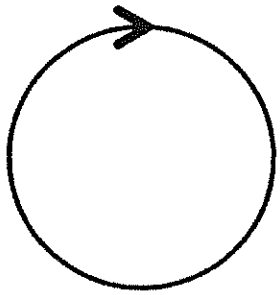
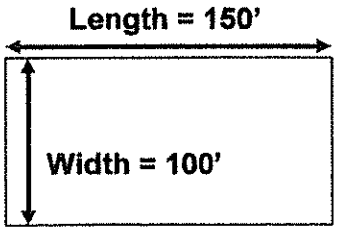
### Pond Facts #4

# Measuring Pond Area and Volume

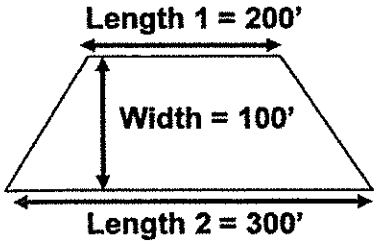
The importance of getting an accurate estimation of your pond surface area cannot be overestimated. The majority of pond owners visually estimate their pond area, which usually results in an overestimate of the true pond surface area. Pond area and water volume should be calculated based on some simple measurements. The effort necessary to estimate pond surface area is directly related to your pond's shape and uniformity. The simplest method—using basic equations for common shapes—can be applied if your pond closely resembles a circle, square, rectangle, or trapezoid in shape.



**Circular pond shape** can be estimated by measuring the distance around the pond shoreline in feet. Square the shoreline distance and divide by 547,390 to get the pond area in acres. For example, a pond that is 450 feet around the shoreline would have an area = $(450 \text{ feet})^2$ / 547,390 or 0.37 acres.




**Rectangular or square shape** area is estimated by simply measuring the length and width of the pond sides in feet. Multiply the length times the width to get the square feet of surface area. This value can be converted to acres by dividing by 43,560 $ft^2$/acre. So, a pond that measures 150 feet long and 100 feet wide would have an area = 150 feet X 100 feet = 15,000 $ft^2$ or 0.34 acres.

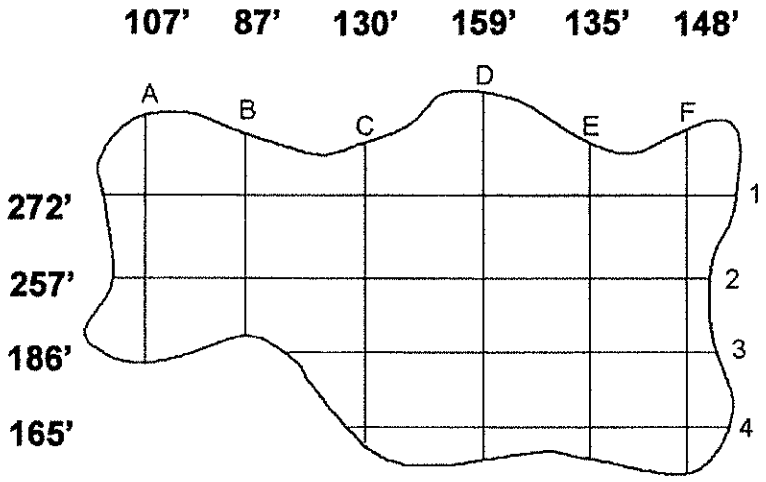



**Trapezoid**—Many ponds may be roughly rectangular in shape, but one side may be significantly shorter than the other. The area of this shape is best estimated using a formula for a trapezoid by taking the average length of the two unequal sides and multiplying by the width of the pond. For example, a pond that is 200 feet long on one side, 300 feet long on the opposite side, and 100 feet wide would have an area = 250 feet X 100 feet = 25,000 $ft^2$ or 0.57 acres.

Many ponds have an irregular shape where the surface area cannot be adequately estimated using the formulas for common geometric shapes. Three methods can be used in this case depending on the degree of accuracy you desire. Keep in mind that the accuracy of your pond surface area estimate may be very important, especially for the safe use of aquatic herbicides. The three methods are described in order from least to most accurate. You should strive to use the most accurate method that you can reasonably accomplish.

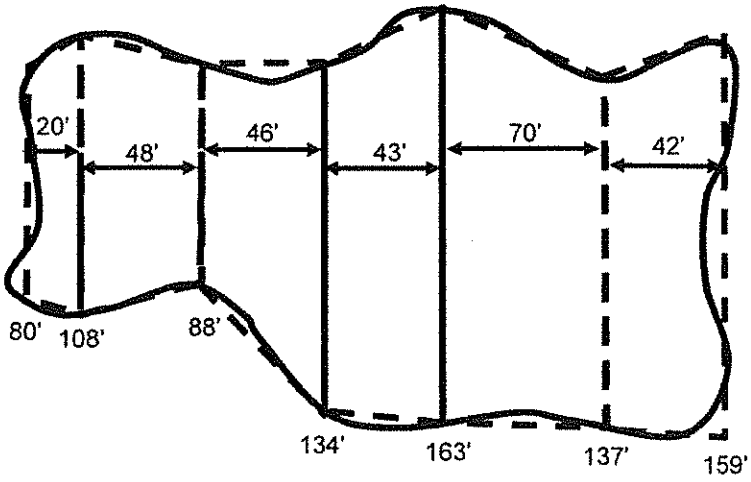
**(1) Average Length and Width Method:** Take numerous measurements to determine the average length and average width. Make certain you get both the longest and shortest distances in calculating the average length, and the widest and narrowest distances for determining the average width. The more measurements that you make, the more accurate your result will be. The area is then calculated by multiplying the average width times the average length. If you do your measurements in feet, your result will be in square feet. You can convert square feet into acres by dividing it by 43,560 $ft^2$ per acre. Depending on the number of width and length measurements made, the final area will probably be within about ±20 percent of the actual pond surface area.

In the example below, the area of an odd-shaped pond is measured by taking six widths (Lines A–F) and four lengths (Lines 1–4).




The average width is (107' + 87' + 130' + 159' + 135' + 148') / 6 = 128 feet
The average length is (272' + 257' + 186' + 165') / 4 = 220 feet
Therefore, the area of the pond can be estimated by multiplying the average width and length.
Surface area = 128 feet x 220 feet = 28,160 $ft^2$ or 0.65 acres

**(2) Multiple Trapezoids Method:** A more accurate method to determine the area of an odd-shaped pond is to divide the pond into multiple trapezoid shapes. A new trapezoid is defined anywhere the shoreline makes a rapid change in direction. The illustration on the opposite page shows the same pond from above divided into seven trapezoids (shown in dotted lines). Note that instead of horizontal transects, this method requires measurement of the distance between each vertical transect. This would be most easily done during winter when the pond is frozen and the transects could be easily laid out and measured. This method requires more measurement and effort, but the final area estimate will probably be within ±5 to 10 percent of the actual pond area.




The individual trapezoid areas can be calculated from left to right as:

Area 1 = (80' + 108' / 2) X 20' = 1,880 $ft^2$
Area 2 = (108' + 88' / 2) X 48' = 4,704 $ft^2$
Area 3 = (88' + 134' / 2) X 46' = 5,106 $ft^2$
Area 4 = (134' + 163' / 2) X 43' = 6,386 $ft^2$
Area 5 = (163' + 137' / 2) X 70' = 10,500 $ft^2$
Area 6 = (137' + 159' / 2) X 42' = 6,216 $ft^2$

Summing the trapezoid areas gives a total pond area of 34,792 $ft^2$ or about 0.80 acres.

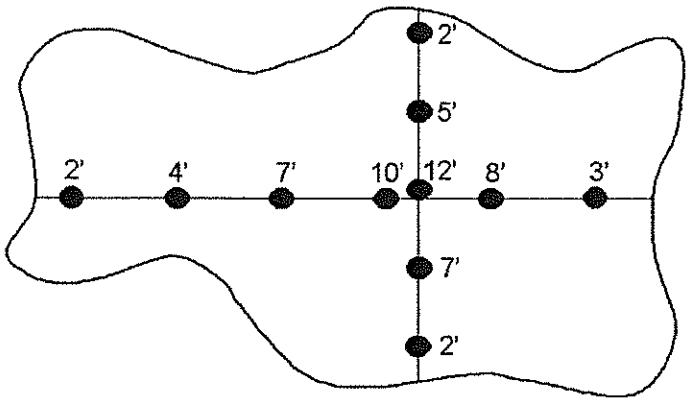
**(3) Handheld Global Positioning Systems (GPS):** Handheld GPS systems have become quite common over the past five years as they have become more affordable. They are now routinely used for outdoor recreation (hunting, hiking, camping, etc.) and navigation. GPS units allow you to determine your exact location on earth using multiple satellites in space. Various locations, or "waypoints," can be stored in the GPS unit for use with mapping software that either accompanies the unit or can be purchased separately. The software can connect the waypoints and calculate the area inside the resulting shape.

A pond surface area could be estimated by walking the perimeter of the pond and stopping at various waypoint locations along the pond shoreline. If waypoints are stored at each location where the pond shape changes, the resulting area will be extremely accurate, probably within 1 percent of the actual pond area. Even if you do not own a GPS system, friends or family members that enjoy outdoor recreation may own a unit that could be used to estimate your pond surface area.

## Pond Depth and Volume Measurement

The volume of water in ponds is often expressed in units called "acre-feet." An acre-foot represents one surface acre that is one foot deep. To calculate the acre-feet of water in a pond, you'll need the surface area in acres as calculated above and an average depth of water in the pond. For a typical bowl-shaped pond the average depth can be estimated as 0.4 times the maximum depth. So, a pond with a maximum depth of 12 feet would have an average depth of about 4.8 feet.

A more accurate method for calculating average depth is to make many measurements and calculate an average. This is most often done by measuring the pond depth along two transects—one along the width and one along the length. Make sure to pick transects that represent the shallow and deep portions of the pond. Depths can be measured easily from a canoe or boat using a weight and a string marked in feet. The more depth measures that you make, the more accurate your final average will be. In the example shown on the next page, pond depths were taken at six locations across the pond length and five locations across the pond width. The average pond depth can be calculated as the average of all of these measurements.




The average of the eleven depth measurements made in this example is 5.64 feet.

The volume of water in the pond (in acre-feet) is calculated by simply multiplying the pond area (0.80 acres using the trapezoid method) by the average pond depth in feet (5.64 feet). Thus, this pond has about 4.5 acre-feet of water. One acre-foot of water is equal to 325,851 gallons, so this pond is storing about 1.47 million gallons of water.

An even better way to calculate an average pond depth is to divide the pond into numerous (at least four) sub-areas (much like we did in the trapezoid method). Take at least one depth within each of the sub-areas and use these to calculate the overall average pond depth. This method is especially good if the pond bottom is irregular rather than bowl shaped.

## A Final Word

Using the methods described in this fact sheet will allow you to calculate the surface area and volume of water in your pond with reasonable accuracy. These numbers are critical for the safe and proper use of various pond management activities such as using aquatic herbicides, liming, fish stocking, and using aeration devices.

## Additional Resources

For further information and publications on pond management in Pennsylvania visit our Web page at:

**www.sfr.cas.psu.edu/water**

or contact your local cooperative extension office.

Prepared by Bryan R. Swistock, extension associate, and Tom McCarty, extension educator in Cumberland County.

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Pond Facts #5

# Water Quality Concerns for Ponds

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 ponds, 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 influences. 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 but 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 often 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. Table 1 summarizes the important water quality parameters and pond uses that are described in this fact sheet.

## 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 will have colder water that can support cold-water 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 alter the temperature of pond water. Groundwater may be pumped into the pond to create cold-water 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. Cold-water fish prefer maximum water temperatures below 70°F, while warm-water fish like bass and bluegill prefer summer temperatures in the 80s. Water temperature is also important when using aquatic herbicides to treat plant or algae growth. 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 6 mg/L can

**Table 1. Important water quality parameters and criteria for common pond uses in Pennsylvania. Missing values represent parameters that are not important for that use.**

| Parameter | Primary Pond Use | | | | |
|---|---|---|---|---|---|
| | Animal Drinking | Swimming | Fishing | Irrigation | Beauty |
| Fecal coliform bacteria | Less than 10 colonies per 100 mL | Less than 200 colonies per 100 mL | | | |
| *E. coli* bacteria | 0 colonies per 100 mL | Less than 150 colonies per 100 mL | | | |
| pH | 5.5 to 8.5 | | 6.0 to 9.0 | 6.5 to 8.4 | |
| Copper | < 1 mg/L | | < 1 mg/L | | |
| Iron | < 0.3 mg/L | | | < 0.3 mg/L | |
| Manganese | < 0.05 mg/L | | | < 0.05 mg/L | |
| Nitrate-Nitrogen | < 23 mg/L | | | | < 3 mg/L |
| Phosphorous | | | | | < 0.01 mg/L |
| Ammonia-Nitrogen | | | < 0.1 mg/L | | |
| Blue-green algae | None | | | | None |
| Pesticides | See pesticide label for information on harmful effects in water. | | | | |
| Turbidity | | Secchi disk > 3' | Secchi disk > 1' | | Secchi disk > 5' |
| Parasites | None | None | | | None |
| Summer Maximum Water Temperature | | | Less than <70° F for trout and smallmouth bass | | |
| Dissolved oxygen | | | Trout > 6 mg/L<br>Bass > 5 mg/L | | > 5 mg/L |
| Aquatic herbicides | See herbicide label for water use restrictions and concentrations for different pond uses. | | | | |

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 carefully using aquatic herbicides to prevent excessive plant and algae growth in the pond. Ponds that frequently have reduced dissolved oxygen concentrations could benefit

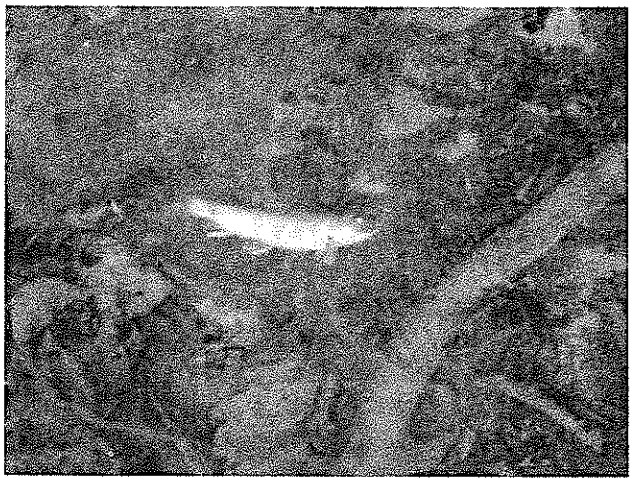

**Figure 1. Low dissolved oxygen is the most common cause of fish kills in ponds.**

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. Zooplankton can be distinguished from sediment in water by holding a clear glass of pond water up to a bright light. If most of the particles in the water move erratically, the pond is experiencing a zooplankton bloom. If the particles do not move, sediment is the cause of the water discoloration. 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 almost always be traced to a preventable source.

Sediment or turbidity in pond water can be measured using a simple device called a Secchi disk. This black and white weight is lowered into the water until it is barely visible and the depth of water is recorded. Recommended Secchi disk values for various pond uses are given in Table 1 with larger values representing clearer water.

***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 separate water tests for fecal coliform bacteria or *E. coli* 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 and less than 150 *E. coli* bacteria per 100 mL of water. Pond waters used for livestock watering should contain less than 10 fecal coliform bacteria per 100 mL and no *E. coli* bacteria, especially 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 ammonia or nitrate, while phosphorous occurs as phosphate. Ammonia usually originates from animal or human wastes directly entering the pond. It is extremely toxic to fish and other aquatic life and any measurable amount of ammonia-nitrogen above 0.1 mg/L can be detrimental to the pond's health. Both nitrogen and phosphorous 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. The death of large amounts of aquatic plants or algae, whether naturally or as a result of herbicide use, will consume dissolved oxygen from the water and may lead to fish kills.

Nitrate-nitrogen concentrations above 3 mg/L are indicative of pollution. Phosphate concentrations as low as 0.01 mg/L may be sufficient to increase plant and algae growth. Excessive amounts of nitrate can also be dangerous for drinking water. Dairy cows should not drink water with nitrate concentrations in excess of about 23 mg/L measured as nitrate-nitrogen.

**Figure 2. Excessive nutrients cause abundant plant growth (like duckweed in this picture) than can result in reduced dissolved oxygen in the pond.**

Nitrate and phosphate can both 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 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 then 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 5.5 or above 8.5 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 limestone. This is most easily done by broadcasting one to two tons of pulverized limestone over the pond ice during

the winter. Repeated applications are often necessary to maintain a high 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.

### *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 filamentous algae that produce long strands or mats are not harmful to animals.

### *Metals*

Metals such as iron, manganese, and copper in ponds can produce offensive tastes that 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 and may cause problems with irrigation injury to plants. 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.

### *Protozoan Parasites*

Various protozoa or parasites can occasionally affect ponds. *Giardia* and *Cryptosporidium* are protozoa that can occur in any surface water and 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 red-ear sunfish in the pond; however, they 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 online. 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 online at http://www.dep.state.pa.us/labs/.

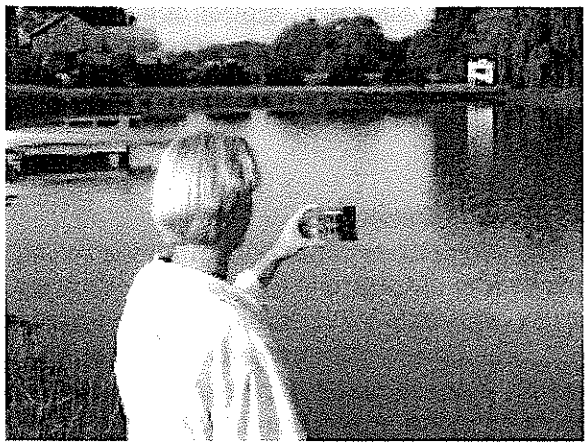

**Figure 3. Simple water test kits, available from many pet stores or online retailers, are adequate for most water quality pa-**

## 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 nonvisible 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 near the pond or in areas that drain into the pond.
- Maintain a vegetated buffer strip around the pond. For gentle slopes around a pond, a buffer four to ten feet wide of unmowed grass will suffice. A wider buffer would be needed if the land slopes more steeply around the pond.
- Use ditches and grading to divert polluted 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* available from your county Penn State Cooperative Extension office or online at: http://pubs.cas.psu.edu/FreePubs/uh137.html

For further information and publications on pond management visit our Web page at: http://www.sfr.cas.psu.edu/water/ or contact your local cooperative extension office.

Prepared by Bryan R. Swistock, extension associate; William E. Sharpe, professor of forest hydrology; and Tom McCarty, extension educator in Cumberland County.

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Pond Facts #6

# Pond Ecology

## Introduction

Pond ecology is best described as the interaction of the life in your pond with the environment that exists there. A shallow, nutrient-rich pond exposed to sunlight with little water flowing through it will be teeming with algae and aquatic plants. It may have very little animal life present because of low oxygen levels. In contrast, a newly created, deep, spring-fed pond may have little life of any kind in it because of low temperatures and lack of food supply.

All ponds age. A pond begins with mostly water, few nutrients, and little aquatic life. Over time, the pond accumulates nutrients through an enrichment process called eutrophication. The addition of nutrients stimulates the growth of aquatic life. These organisms live, grow, and die. Their remains decay in the pond and the nutrients it took to grow them are released back into the water of the pond to keep the cycle going. Eventually, though, there will be an accumulation of material that resists decay and the pond will fill up. It will become a bog and someday will resemble dry land. The process of return to dry land can happen in a decade or may take centuries. As a pond owner, your job is to slow the process down as much as possible. Some of the principles you can employ are described below.

## Exclude Nutrients

Four basic elements are required to make aquatic organisms: carbon, oxygen, nitrogen, phosphorous. Of course, it takes more than these to make even the simplest organism, but these are the materials required in abundance. To prevent the rapid aging of a pond (eutrophication), aim to exclude the rapid introduction of these, especially nitrogen and phosphorous. Three practices are particularly helpful in slowing the aging process.

**Animal access to ponds or streams that feed ponds should be restricted to limit inputs of nitrogen and phosphorous from their wastes.**

## Buffers

Maintaining vegetation in all areas through which water must flow to reach the pond is very beneficial to the pond. Such buffers both slow water down and filter it. Slow-moving water allows sediment to drop out of the water. A lot of phosphorous is attached to soil particles, so sedimentation is effective in keeping phosphorous out of the pond. Keeping sediment out of the pond also prevents the pond from being made shallow by filling it with sediment. This contributes directly to our primary objective—keeping the pond from returning to dry land.

A deeper pond will also be a cooler pond. A general principle of biology is that lower temperatures slow the growth of organisms. So again the buffer area contributes to conditions that help slow the aging process for the pond.

## Sedimentation

Another method of keeping sediment out of ponds is to provide a shallow pool at the inlet of

the pond. Water passing through this pool on its way to the pond will have an opportunity to drop its sediment load in the pool. This pool should be of such dimensions that it can be easily cleaned with a backhoe from the shore of the pool. A sedimentation pool helps the pond in the same way that sediment removal by buffer strips does.

**Limit Fertilization**

When decreasing the use of fertilizer is possible on turf or crops grown in the watershed area of the pond, the pond benefits. One of the reasons for this is that plants are never 100 percent efficient in their use of fertilizer elements. So even applying fertilizers at appropriate rates results in some elements, particularly nitrogen, remaining unused and moving off site. Reductions in fertilizer rates will decrease the amounts getting off site.

**Maintain Ecological Balance**

Ponds are most satisfactory when a complete and balanced food web is in place. Starting at the top, this means that planktonic algae are present in sufficient quantity to feed some zooplankton. The zooplankton in turn provide food for the smallest fish and aquatic insects. These in turn become prey for larger fish, which finally may be taken by raccoons, bears, or anglers.

Another part of ecological balance involves the higher plant community. Too many plants are discouraging to the pond owner and are also detrimental to the food side of the ecology just described. From the pond owner's point of view, a pond full of vegetation presents a poor appearance and interferes with fishing, swimming, and boating. From the view point of aquatic life, there are problems too. Some aquatic plants are valuable in providing shade, hiding places for small fish, habitat for some aquatic insects and animals, as well as being a food source for some fish and animals. When the vegetation becomes excessive, not only does the angler's hook get entangled, the bait is hidden from that trophy bass. The vegetation that hides the bait also hides his prey, making the hunt unsuccessful. Such a pond decreases its capacity to produce fish.

**Aquatic vegetation, like this elodea, provides habitat for fish but may grow abundantly when nutrients are out of balance.**

Two other examples of excessive vegetation will serve to illustrate undesirable consequences than can occur. A pond completely covered with water lilies or lotus will so shade the pond that no other vegetation will grow under the water. Nor will there be enough light to grow planktonic algae. This will be a very unproductive pond for anything besides lilies. The other example is excessive growth of duck weed or watermeal. When the whole pond surface is covered with these plants, again the light is shut off and the pond will contain little life beneath the surface. These plants also virtually eliminate oxygenation of the water by maintaining a complete separation of the water surface from the atmosphere. As a result, such a pond becomes oxygen deficient to such an extent that any fish present are killed from lack of oxygen.

A seldom-discussed problem in the management of aquatic vegetation is the potential to eliminate too much vegetation or to eliminate beneficial plants along with the targeted weeds. This is something to remember when considering weed control in ponds. Some helpful tips are to treat the pond in parts over time, to use mechanical methods, or perhaps to use an appropriate number of grass carp to keep things "pruned up" instead of wiped out.

**Maintain Water Flow**

A discussion that occurs when a new pond is planned concerns the water supply for the pond.

A pond with a continuous supply of water is almost always going to be a more satisfactory pond than one with an intermittent water supply. Ponds lose significant water by evaporation during the summer. Ponds with sufficient inflow stay full while the water level in others declines, exposing an unattractive muddy beach around the perimeter of the pond. The nutrient conditions in a pond with a continuous overflow are likely to be better because excess nutrients will leave with the overflow water. In contrast, the pond having intermittent flows only has a chance to purge excess nutrients during storm events. Such ponds are prone to accumulate nutrients much more rapidly than their overflowing cousins. The accumulation of nutrients leads to excessive vegetative growth of all kinds as was noted above.

**Ponds with little water flow, like this surface drainage pond, are more likely to accumulate nutrients and excessive aquatic plants.**

### Encourage Aeration

Oxygen in pond water is very beneficial to the overall health of the pond. The value to fish is obvious. Less obvious, but of great importance, is the ability of the pond to get rid of waste. The waste that occurs in the pond includes "deposits" from its animal life (fish and geese), waste material that enter with stormwater runoff, as well as from plant and animals that die in the pond. Aerobic bacteria work about 20 times faster than anaerobic bacteria in breaking this waste down and putting it into solution. Once in solution it can be flushed out or is available to grow new life.

Oxygenation of ponds is quite interesting and happens in two major ways. Plants and algae do photosynthesis during the day and wind adds oxygen at night. The oxygen plants produce is released into the pond water and remains high at high levels in the pond. That's why conditions that prevent light from entering the pond have to be monitored or disaster can occur such as the complete cover by watermeal mentioned earlier. All the oxygen manufactured by the watermeal is released to the atmosphere rather than into the pond water. Any part of the pond that is too dark for photosynthesis to occur is also likely to be oxygen deficient unless the pond is being mixed from top to bottom. A Secchi disk can be lowered into the water to check for visibility. The depth of disappearance is noted. The surface water above this disappearance depth will be oxygenated by photosynthesis while water below that depth must be mixed to receive oxygen.

The other method of getting oxygen into pond water occurs by oxygen exchange with the atmosphere at the surface of the pond. The rougher the surface, the more rapid the exchange. Also, the more deficient the oxygen content of the water, the faster the exchange occurs. This process is important at night and is critical for the pond with a heavy load of plants and animals. At night the plants perform respiration instead of photosynthesis—the same as the animals. By dawn, the pond may be oxygen deficient if atmospheric aeration is impeded by lack of wind or especially by a covered surface.

### Winter Pond Ecology

In the winter, water gets much colder and ice may cover the top of the pond for an extended period of time. How do these factors affect the animals living in the pond?

Fish, frogs, and turtles are amphibians with adaptive features to accommodate this less friendly environment. Their body temperature falls with the water temperature, decreasing their respiration rate and energy needs. Frogs and turtles burrow into the mud at the bottom of the pond and hibernate there. They are able to do this by breathing through their skin.

Since ice cuts off the entry of oxygen into the pond water through the surface, you may wonder how even the low level of oxygen

needed is supplied during this time. Enough light gets through the ice to cause some photosynthesis among aquatic plants. A completely snow-covered pond can cause "winter kill," the death of fish, frogs, and turtles. However, hand plowing lanes across a pond to clear the snow from about half the ice prevents that from happening.

A winter management consideration is to keep about 30 percent of the ice free of extended snow cover. Be sure that the ice is safe for the method of snow removal proposed. An alternative is to use a diffuser-type aerator to add oxygen and keep a small area free of ice.

## Summary

Ponds have a life cycle. A long life is best achieved by limiting the inputs of nutrients to the pond. Capture sediment before it enters the pond, limit the use of fertilizers within the pond's watershed to the extent possible, limit animal access when possible, and prevent the addition of organic matter. Flushing nutrients from the pond is encouraged by a clean, year-round water supply. Mechanical removal of plant vegetation is also a method of eliminating significant nutrients from a pond. Finally, the values of aeration in both supporting aquatic life and promoting the decay of waste material were noted. Keeping the surface clear of plant cover and open to wind action are aids to better aeration.

## More Information

More detailed information on all aspects of pond management can be found at your local Penn State Cooperative Extension office or on our Web site at http://water.cas.psu.edu/ponds.

Prepared by Thomas McCarty, extension educator in Cumberland County.

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This publication is available in alternative media on request.



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School of Forest Resources

Pond Facts #15

# Filamentous Algae

## Description

Many different species of filamentous algae exist, but all have a similar appearance and growth habit. These algae colonies begin their growth in the late winter and early spring on the bottom of the pond as warmer temperatures and sunlight activate the spores and surviving cells. Most filamentous algae growth begins in less than 3 feet of water where sunlight penetrates to the pond bottom. Algae growth is sometimes referred to as a "bloom" because the algae grow so quickly. In the case of filamentous algae, single-cells reproduce and join together into long hair-like strands or colonies that grow toward the water surface. By mid-summer, these strands form large mats that trap gases and float to the surface. These floating mats normally begin to appear in July and may cover the entire pond by late summer (Figure 1). Different varieties of filamentous algae may be favored by early, mid-, or late-season conditions. Most forms of filamentous algae prefer stagnant, nutrient-rich, warm water conditions found in many of Pennsylvania's ponds and lakes.

**Figure 1. A picture of a filamentous algae as it typically appears in July or August after forming floating mats.**

## Value and Concerns to the Pond Ecosystem

All types of algae are important to pond and lake ecology because they serve as food sources for protozoans, insects, and fish. As such, they serve as a vital component of the pond food web that will always be present at some level. However, filamentous algae frequently reach nuisance levels. Their abundant growth can result in a number of management concerns, including aesthetics, swimming nuisance, and interference with fishing. Abundant algae can also cause fish kills in late summer and fall as the dying algae consume oxygen from the pond water. Where algae levels interfere with your pond uses and goals, various control strategies can be used to prevent or reduce algae growth.

## Preventing Filamentous Algae Problems

Any overabundant plant growth is a symptom of excessive nutrients (phosphorus and nitrogen) in the pond water. These nutrients may come from runoff from barnyards, crop fields, septic systems, lawns, and golf courses. Long-term control of overabundant aquatic plants is best accomplished by reducing or redirecting nutrient sources from the pond. This can be done by reducing fertilizer applications near the pond, maintaining septic systems properly, redirecting nutrient-rich runoff away from the pond, and maintaining vegetative buffer strips around your pond. If you fail to recognize and address the

underlying nutrient causes of aquatic plant and algae growth, you will probably encounter a perpetual need to control overabundant plant growth using the methods described below.

**Filamentous Algae Control**

Multiple methods of control are available for filamentous algae that generally fall into physical, biological, or chemical categories. Combining and using multiple management methods is recommended.

***Physical/Mechanical Control***

Mechanical control of filamentous algae usually involves netting or raking the algae mats from the pond surface. If this method is used, it is important to dispose of the algae mats away from the pond edge to prevent nutrients from re-entering the pond as the algae decays. While this method is labor intensive and time consuming, it can be very effective on small ponds. It is also advantageous because it results in a removal of nutrients from the pond, which may help to prevent future algae growth. Mechanical removal may also be used in combination with biological and chemical approaches to maximize success.

Aeration has also been used as a mechanical approach to control algae. Adding oxygen to the bottom layers of the pond can encourage phosphorous to bind within pond sediments. This prevents phosphorous from becoming available within the water column for algae use and growth. While aeration may have some impact on filamentous algae growth, it is generally more suited to controlling planktonic algae, which are tiny floating algae cells.

***Biological Controls***

The use of barely straw has been shown to reduce filamentous algae growth in some ponds. Barley straw does not kill existing algae colonies. It must be added to the pond in late winter or early spring to prevent algae growth. About three to five bales of straw should be used per surface acre of pond. The bales should be separated and the straw submerged in loose bundles within wire or cloth. Ideally, the submerged barley straw should be placed where pond water will flow through it (i.e., near the source of pond water). Keep in mind that results using barley straw have been very inconsistent. For more details on barley straw use, consult the fact sheet titled *Pond Facts #8: Using Barley Straw to Control Algae.*

Grass carp often become a topic of discussion when dealing with aquatic plant management in Pennsylvania. Grass carp do not find filamentous algae palatable and are **not** a primary management strategy for filamentous algae. Grass carp will eat algae if preferred plants are not available, but this is not a recommended control strategy. More details on grass carp are available in *Pond Facts #10: Using Grass Carp to Control Aquatic Plants.*

Water additives are also sold to reduce algae growth. These products usually contain bacteria and/or enzymes that reduce algae growth by consuming nutrients in the pond water. Results from the use of these additives have been inconsistent and they are costly to use on larger ponds. Additives are more often used in conjunction with other control methods to increase effectiveness. These products should not be used in a pond or lake with an overflow of water.

***Chemical Controls***

When used carefully according to the label instructions, aquatic herbicides can be safe and effective management tools. Table 1 lists the most common aquatic herbicides that are available to control filamentous algae. Keep the following points in mind when considering the use one of these aquatic herbicides:

- *Positively identify the target plant.* The chemicals listed in Table 1 are targeted at algae control. They are generally not effective on other types of aquatic plants.
- *Carefully measure the pond area and/or volume.* The dosages for each chemical listed in Table 1 are based on the pond area (acres) or water volume (acre-feet). Improper calculation of pond area or volume may lead to incorrect dosing of the chemical. If the

**Table 1. Common aquatic herbicides used to control filamentous algae in Pennsylvania ponds and lakes.**

| Trade Name | Active Ingredient | Dosage Rate |
|---|---|---|
| Algae Pro | Copper, elemental 7% (triethanolamine complex) | 0.75 gal/acre-ft to 1.5 gal /acre-ft |
| Aquashade/Lesco Hydroblock | Acid blue 9 dye 23.6%, Acid yellow dye 2.4% | 1 quart/acre-ft |
| Copper Sulfate | CuSO4 99% | 0.68 to 1.36 lbs/acre-ft |
| Cutrine-Plus | Copper, elemental 9% (triethanolamine complex) | 0.6 gal/acre-ft to 1.2 gal/acre-ft |
| Cutrine-Plus (granular) | Copper, elemental 3.7% (ethanolamine complex) | 60 lbs/acre |
| Hydrothol 191 | Monopotassium salt of endothall | 0.6 to 2.2 pts/acre-ft |
| GreenClean | Sodium carbonate peroxhydrate | 30 to 170 lbs/acre-ft |

pond area or volume is underestimated, insufficient chemical may be applied resulting in little algae control. If the pond size is overestimated (more common), too much chemical may be applied, resulting in a fish kill and other environmental damage. Consult the fact sheet titled *Pond Facts #4: Measuring Pond Area and Volume* for information on how to properly measure pond area and volume.

- *Obtain the required state permit.* You must complete and submit a two-page permit titled *Application and Permit For Use of an Algaecide, Herbicide or Fish Control Chemical in Waters of the Commonwealth.* This permit is required for any chemical application to any private pond or lake. The permit can be obtained from your local Pennsylvania Fish and Boat Commission office, county extension office, or online from www.sfr.cas.psu.edu/water. Once the application is submitted, the permit is usually issued within 2 to 4 weeks.
- *Purchase the herbicide.* Common herbicides can be purchased at home and farm supply stores, hardware stores, or from various online suppliers. Most algaecides will cost between $50 and $200 to apply per acre of pond area.
- *Follow the herbicide label carefully.* The herbicide label gives specific instructions on when and how to apply the chemical. An aquatic herbicide should not be applied to the entire pond during one application. Killing all of the pond algae with one treatment may cause oxygen depletion and fish kills due to the decay of the large amount of algae. Instead, treatments should be restricted to one-half or one-third of the pond at one time with a two-week delay between treatments. Many herbicide labels also include restrictions on water use after treatment. For example, the treated water may be unsuitable for swimming, irrigation, or animal watering for some period of time after the chemical application.

### *Additional Notes about Algaecides*

- Most of these chemicals work to kill existing filamentous algae by disrupting the cell wall and inhibiting photosynthesis. The notable exceptions are the dye products, which color the water to prevent sunlight penetration and subsequent growth of algae. The dyes should be used early in the season when the algae first appears on the pond bottom. A permit is not typically issued for application of a dye to a pond that drains into a stream.

- A permit is not typically issued for application of a copper or endothall product to a pond that drains into a trout stream. The copper and endothall products are toxic to some fish, especially trout and carp. They should be used with great care or not at all if these fish are present in the pond. The dosage for copper sulfate is dependent on the pond water hardness (high dose for high hardness and vice versa). Water hardness should be tested before applying copper sulfate.
- It is best to treat filamentous algae early in the summer when they first appear on the pond bottom and before they form large floating mats. This will reduce the amount of plant material that must be killed and, thus, reduce the chance of a fish kill due to low dissolved oxygen from decaying algae.

## A Final Word

Many ponds suffer from filamentous algae problems. Where possible, you should strive to reduce nutrients entering the pond to prevent or reduce excessive algae growth. Chemical treatments for algae are inexpensive and effective but usually must be repeated annually or even multiple times per year to keep algae under control.


**Figure 2. Application of liquid Cutrine to a pond to kill algae.**

## Additional Resources

For further information and publications on pond management in Pennsylvania visit our Web page at www.sfr.cas.psu.edu/water or contact your local Penn State Cooperative Extension office.

Prepared by Bryan Swistock, extension associate, Mark Hartle, fisheries biologist, Pennsylvania Fish and Boat Commission, and Andrew Curtis, environmental manager, The H&K Group, Skippack, PA.

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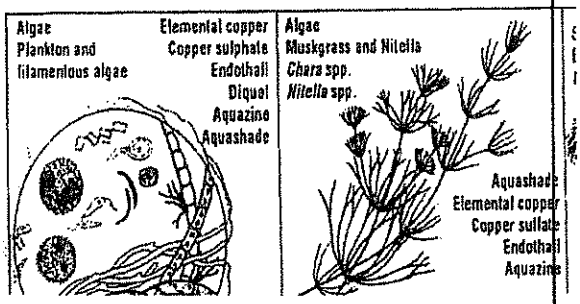
CODE XH0013

# Algae Control

Algae are a very abundant form of aquatic plant because they are at the base of the aquatic food web. They can be classified into three types: plankton, filamentous and muskgrass. **Plankton** algae are single-celled plants, suspended in water, and give the water pea-soup green, reddish, or brown color. **Filamentous** algae are usually mistaken for moss or slime due to their fur-like appearance on rocks and other underwater objects. **Muskgrass** algae do not have any roots but they resemble some flowering plants.




**Problems:** Despite the necessity for aquatic life of a pond, an excessive amount of algae could become undesirable. Often an overabundance of algae would reduce the oxygen stock of a pond, clog up pumps in ponds that are used for irrigation, cause odor problems and are generally considered to be aesthetically unpleasant.

**Causes:** Improper disposal of human and animal wastes or common agricultural activities would enter water through surface runoffs and percolation and provide nutrients for algae.

**Management:** The optimal method of avoiding algae accumulation would be to prevent fertilizers from entering the water but if a surplus forms there are three ways of removing and controlling them.

**Mechanical and physical control:** A low cost removal method would be to physically control algae growth through cutting, mowing, raking, digging, or pulling. It is most effective when applied to small, vegetated areas near the shoreline.
Algae could also be removed by plant harvesters since filamentous algae is collected along with other vegetation. These machines require limited operating experience or permit and are most appropriate for large lakes.

**Biological control:** Vegetation-eating fish such as grass carp can be introduced for the removal of filamentous and muskgrass algae. The fish is triploid instead of normal diploid, and sterile due to genetic alteration. Permits from Pennsylvania Fish and Boat Commission is needed before the fish can be stocked in ponds.
The usage of barley straw is a newly found method that controls filamentous algae. Research is still conducted on the mechanism behind the action of barley straw but thus far there has been no reported negative side effects. Barley straw acts as a preventive rather than a removing agent since it will not kill algae that are already in the pond.

**Chemical control:** Although an effective method, it should only be used as a last resort. Extreme caution is needed since not only would the chemicals affect the algae, they could also harm fish and other valued plants in the pond. EPA certified products are tested and found to be both effective and safe. Nevertheless, permits from the Pennsylvania Fish and Boat Commission are needed and the exact directions on the label need to be followed. There are two types of herbicides that are employed for algae control: dyes that block sunlight penetration to stop photosynthesis, and copper compounds that are effective but could kill fish.

# Additional References

**Revised 2020**

**Ponds–Planning, Design, Construction**–(1997) United States Department of Agricultural, Natural Resources and Conservation Service
https://www.wcc.nrcs.usda.gov/ftpref/wntsc/H&H/TRsTPs/ponds.pdf

**Ponds and Permits**

https://extension.psu.edu/pond-agencies-and-permits-in-pennsylvania

**CAUTION! Prior to applying algicides, herbicides or fish control chemicals to your pond, please check out the information at the following PA DEP link below. Permits are likely required from PADEP and PA Fish and Boat Commission.**

http://www.depgreenport.state.pa.us/elibrary/GetFolder?FolderID=3677

**Pond Management and Aquatic Plant Control**–Penn State College of Agricultural Sciences, University Park, PA
https://extension.psu.edu/catalogsearch/result/?keyword=ponds&q=free+pond+publications
https://www.fishandboat.com/LearningCenter/FAQs/Pages/PondManagement.aspx
http://www.dnrec.state.de.us/FW/warmwater/BestManagementPractices.pdf
http://www.killlakeweeds.com/index.cfm

***Mid-Atlantic Pocket Guide to Water Garden Species*:**

http://extension.psu.edu/natural-resources/water/ponds/aquatic-invasive-species-water-gardens/Water-Garden-Pocket-Guide/at_download/file

Information on **Barley Straw**

https://extension.psu.edu/barley-straw-for-algae-control
https://www.pondalgaesolutions.com/articles/barley-straw-effectiveness.html
https://pondinformer.com/how-to-use-pond-barley-straw/

**Sodium Bentonite**–Can be used as a pond sealant. Any well driller should have it.
efotg.sc.egov.usda.gov/references/Agency/MW/Archived_MD521C_03_111221.pdf

Revised 1/2019

# WETLAND DETERMINATION

If the following soils are present on your site, wetlands may exist:

| MAP SYMBOL | SOIL NAME | MAP SYMBOL | SOIL NAME |
|---|---|---|---|
| Ba | Baile | Lc | Lamington |
| Bo | Bowmansville | WaA | Watchung |
| CrA | Croton | WaB | Watchung |
| CrB | Croton | WbB | Watchung |
| Dy | Dunning | | |
| Hc | Hatboro | | |

This list does not include the numerous soils with hydric inclusions. **Wetlands may still exist on sites that are not mapped with any of the soils listed above**. If the site contains areas that remain ponded or saturated with water for long periods of time or contains vegetation typical of wetlands (i.e. cattails, skunk cabbage, willows etc.), wetlands may exist. **An in-field investigation is the only definitive way to determine the presence of wetlands.**

Listed below are the agencies that, upon request, will perform a wetland determination. A wetland determination is just a yes/no answer as to whether wetlands exist. A wetland delineation, which is required for permit applications if wetlands are present, is a process where by the wetland area is identified and flagged/staked out. A private consultant is required for a wetland delineation.

Provide the following information:

1. Cover letter stating proposal/use and request for a jurisdictional wetland determination.
2. U.S. Topographical map with approximate location shown.
3. Name, address, and daytime phone number.
4. Specific location of proposed area of work on a map.

U.S. Army Corps of Engineers
Attn: Deb Nizer
Baltimore District
CENAB-OP-RPA
Baltimore, MD 21201
(410) 962-6085

Dept. of Environmental Protection
Soils & Waterways Section
909 Elmerton Avenue
Harrisburg, PA 17110
(717) 705-4802

Natural Resources Conservation Service
670 Old Harrisburg Rd., Suite 202
Gettysburg, PA 17325
(717) 334-2317
**Only for USDA Program Participants or land that is in current ag production**

**Wetland Determination (yes/no answer) and/or Delineation (actual survey of boundary)**

The following definition of wetland is the regulatory definition used by the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers (Corps.)

**"Those areas that are inundated or saturated by surface or ground water (hydrology) at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation (hydrophytes) typically adapted for life in saturated soil conditions (hydric soils). Wetlands generally include swamps, marshes, bogs, and similar areas" (40 CFR 232.2(r))**

**There are several "tools" available to property owners to determine whether or not the property in question has wetlands.**

1. **National Wetland Inventory Maps - http://www.fws.gov/wetlands/**
2. **Soils survey – Are hydric soils mapped? Are soils with hydric inclusions mapped? Refer to Adams County hydric soils list.**
3. **Did the subdivision or land development show or mention the presence of wetlands? This work may have been required during the subdivision and land development process through the local municipality.**

**The truly best method to determine the presence of wetlands is done by hiring a professional. That professional should perform an actual on site investigation. That investigation will involve vegetation sampling and soils probes. The Conservation District is not aware of the pricing for such services.**

# WETLAND NURSERIES

**Sylva Native**
3815 Roser Road
Glen Rock, PA 17327
Phone: 717-227-0486
Fax: 717-227-0484
sylvanat@aol.com
www.sylvanative.com

**Octoraro Native Plant Nursery**
6126 Street Road
Kirkwood, PA 17536-9647
Phone: 717-529-3160
Fax: 717-529-4099
www.octoraro.com

**Wetland Supply Company**
194 Goodview Drive
Apollo, PA 15613
Phone: 724-727-3772
Wetplants@aol.com
www.wetlandsupply.com

**Ernst Conservation Seeds**
9006 Mercer Pike
Meadville, PA 16335
Phone: 1-800-873-3321
Fax: 814-336-5191
www.ernstseed.com

**Musser Forests, Inc.**
PO Box 340
Route 119 North
Indiana, PA 15701-0340
Phone: 412-465-5685
Fax: 412-465-9893
www.musserforests.com

**Maryland Aquatic Nurseries**
3427 North Furnace Road
Jarrettsville, MD 21084
Phone: 410-692-4171
info@marylandaquatic.com
www.marylandaquatic.com

**Environmental Concern, Inc.**
PO Box P
201 Boundary Lane
St. Michaels, MD 21663
Phone: 410-745-9620
www.wetland.org

Revised 2019

# FISH HATCHERIES/POND SUPPLIES

## Aquatic Environment Consultants
**Algae control/pond plants control/ pond management, etc.**
**PO Box 307**
**Scotland, PA 17254**
**717-264-9778**
**www.aeclakes.com**

## Frey's Fish Ponds
**Grower/hatchery/fingerlings**
**820 Pine Hill Road**
**King of Prussia, PA 19406**
**610-995-2700**
**or 888-740-2700**

## Keystone Aquaculture, Inc.
**(Formerly Sproch Fish Hatchery)**
**Grower/hatchery/eggs/fry**
**John Sproch, President**
**309 Prospect Avenue**
**Duncannon, PA 17020**
**717-834-6772**
**www.fishhatchery.com**

## Kurtz Fish Hatchery & Kurtz's Live Bait Vending
**Grower/pond stocking/fry**
**153 Isabella Road**
**Elverson, PA 19520**
**610-286-9250**
**www.kurtzlivebaitvending.com**

## Rainbow Paradise Trout Farm
**Grower**
**1660 East 2nd Street Route 6**
**Coudersport, PA 16915**
**814-274-8309**
**www.rainbowparadisetroutfarm.com**

## Susquehanna Aquacultures, Inc. aka Brunner Island Fish Farm
**Grower/pond stocking**
**PO Box 306**
**1400 Wago Road**
**York Haven, PA 17370**
**717-266-4577**
**www.susquaqua.com**

## Zetts Fish Farm & Hatcheries
**Grower/hatchery/pond stocking/fry/fingerlings**
**PO Box 239**
**7580 Kylertown-Drifting Hwy.**
**Drifting, PA 16834**
**814-345-5357**
**gazetts@zettsfish.com**
**www.zettsfish.com**