Lake and Watershed Connections

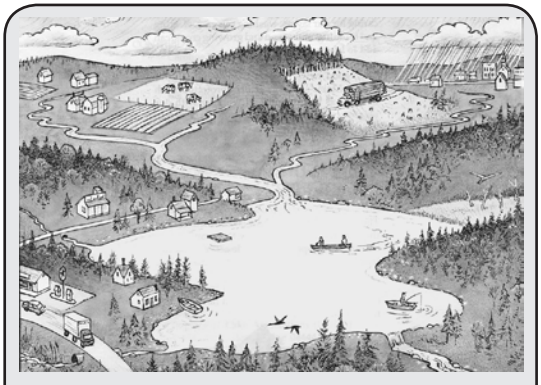
By Scott Williams

The Basics

Every lake and pond has a watershed, which in its most simple form, can be thought of as the bowl-shaped land area surrounding a lake that drains to the low spot in the landscape where all of the water in the bowl eventually flows —the lake.

Watershed boundaries are defined by high points in the terrain surrounding the lake, such as ridges and hilltops. Water that falls on the land on the inner side of the boundary flows toward, and will eventually reach the lake (unless it evaporates along the way). Outside of the watershed boundary, water flows to another body of water—another lake, or a stream or river. All water ultimately flows to the sea.

Our focus is on lake watersheds, because watersheds are an integral component of lake ecosystems, and conditions in the watershed influence conditions in the lake. Watersheds come in a wide range of shapes and sizes, depending entirely on the lay of the land surrounding individual lakes. A watershed boundary may follow the general shape of the lake, extending only a short distance from the shoreline, though that is not generally the case. The surrounding terrain may be such that the watershed extends miles away from the shoreline into nearby communities. For example, the direct watershed for Damariscotta Lake (Figure 1) encompasses an area greater than 75 square miles, extending into five towns.

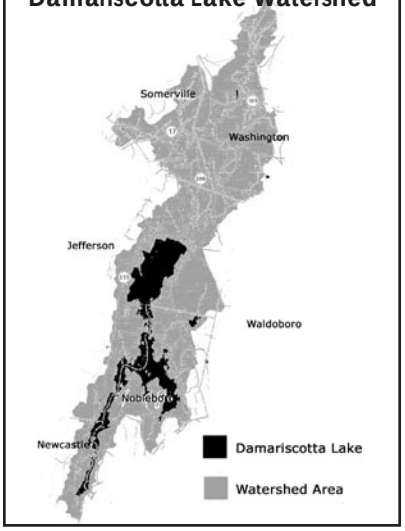


A lake's watershed encompasses all the surrounding land that drains into it. Human activities on the land within the watershed can affect water quality as pollutants such as soil and fertilizers are carried into the lake by stormwater runoff.

Direct and Indirect Watersheds

A *direct* watershed consists of the land area that drains directly to a lake, without first draining to another lake. All lakes have a direct watershed. However, some lakes also have *indirect* watersheds, because one or more upstream (higher elevation) lakes discharge into the direct watershed of the downstream lake. In such cases, the watershed of the upstream lake(s) is the indirect watershed of the downstream lake.

FIGURE 1
Damariscotta Lake Watershed

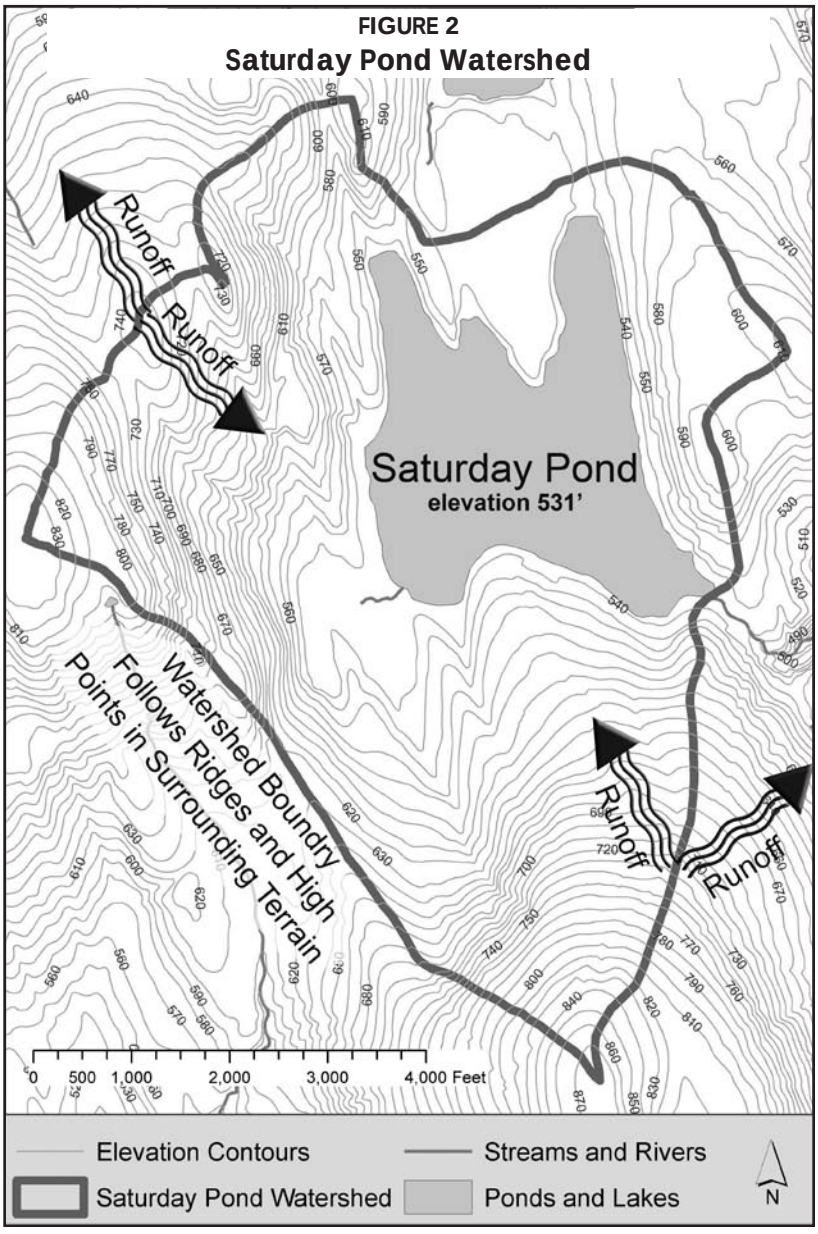


The concept of direct and indirect watersheds is pretty straightforward. Imagine a "chain of lakes", in which the water that flows out of one lake at a higher elevation eventually flows into another lake that is situated lower in the landscape. The chain might consist of just two, or several interconnected lakes. The indirect watershed for the lake at the bottom (lowest elevation) of the chain would include the watersheds of all of the lakes situated at higher elevations (upstream). But the lake at the top of the chain would have only a direct watershed, because there are no further upstream lakes.

Figure 2 illustrates the direct watershed for Saturday Pond in the Town of Otisfield. Saturday Pond has a surface area of about 171 acres. The direct watershed (the boundary of which is drawn with the heavy shaded line that surrounds the pond) encompasses an area of 1.31 square miles. All of the Saturday Pond watershed is situated relatively close to the lake. In this illustration, the boundaries are drawn on a topographic map that shows the contours of the terrain. A close look at the elevation of the contours on the map (numbers drawn on the lines, indicating feet above sea level) shows that the watershed boundary follows the highest points in the terrain surrounding Saturday Pond. The low point in the watershed is Saturday Pond itself, which has an elevation of 531 feet above sea level. All of the terrain in the watershed is higher, as shown by the map contour elevations. Water that falls inside of the boundary of the Saturday Pond watershed will eventually reach the pond, unless it evaporates along the way. Note that the only point where the watershed boundary intersects the shoreline of the pond is where the water is flowing *out* of Saturday Pond, thus leaving the watershed.

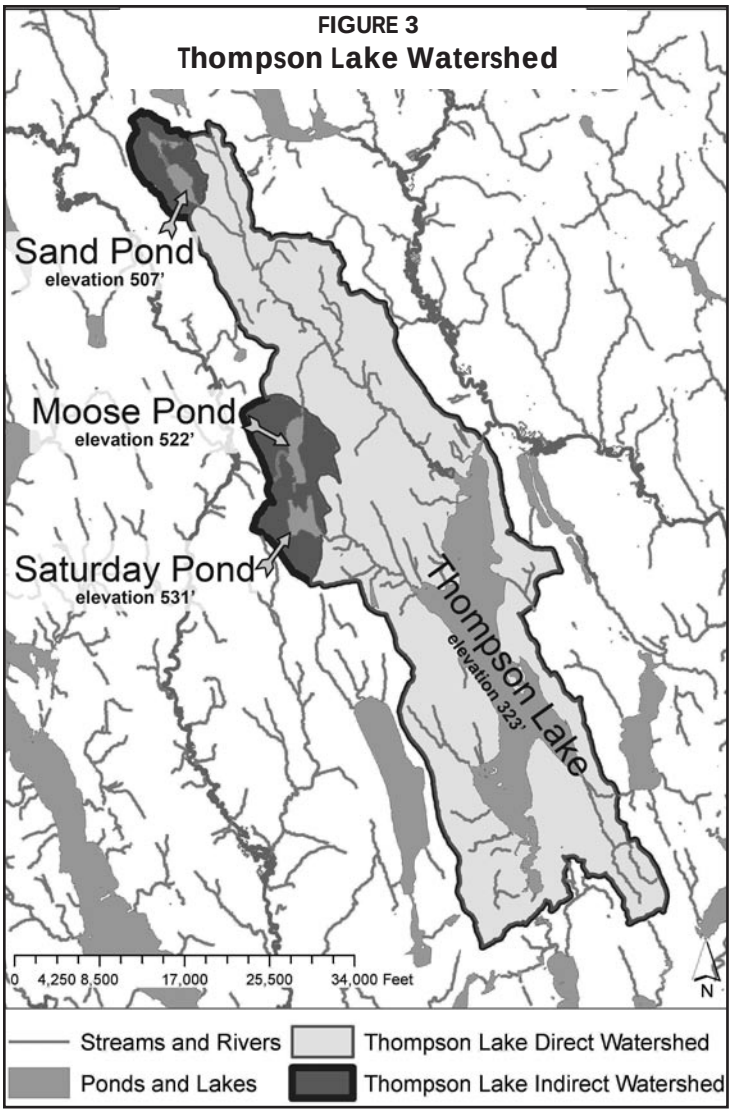
Figure 3 illustrates both the direct and indirect watersheds for Thompson Lake, a much larger lake, with a much larger watershed. The lake is situated in the towns of Oxford, Poland, Casco and Otisfield, but the watershed extends further into the towns of Norway and Raymond. This map does not show topographic contours, but the major streams that flow through the watershed are shown to help illustrate how land that is situated several miles away drains to the lake. If included on this map, the topographic contours would confirm the location of the watershed boundaries, as well as the stream channels, but all of this information would be difficult to sort out in black and white. Thompson Lake has a surface area of 4,225 acres. The *direct* watershed area for the lake, which is the light shaded area that surrounds the lake, measures about 35.3 square miles. The *indirect* watershed, which also includes the watersheds of Saturday, Moose and Sand Ponds, measures 39.3 square miles. The dark shaded area that surrounds these three small ponds denotes their direct watersheds, which are included in the indirect watershed of Thompson Lake, because all three discharge into Thompson Lake. Note that each of the smaller ponds has a surface elevation higher than that of Thompson Lake.

FIGURE 2
Saturday Pond Watershed



Indirect watersheds can be very large. For example, the indirect watershed for Sebago Lake measures 361 square miles, which includes many lakes and ponds, each with their own watershed, eventually draining into Sebago. This watershed includes portions of 23 towns.

FIGURE 3
Thompson Lake Watershed



Watershed Influences on Lakes

Watersheds influence lakes in a number of ways. *Natural* features of lake watersheds have a strong bearing on the basic chemistry of lake water, including the availability of nutrients like phosphorus. The size of the watershed, relative to the volume of water in the lake affects how often the water is exchanged, or "flushed" during the year. Other natural factors include soil types, steepness of terrain, the location of wetlands, the types, density and location of vegetation that absorbs and filters water and recycles nutrients, and the natural pathways (tributaries) by which water travels down through the watershed.

Lake water quality is also strongly affected by *human factors*, because the natural watershed influences described above can be dramatically altered by development. The creation of roads, residential and commercial buildings and other structures, parking areas, agricultural land and virtually everything else associated with all forms of development, changes the ways in which water flows through the watershed. Development typically causes increases in both the volume and the velocity of stormwater runoff, resulting in increased soil erosion, higher concentrations of phosphorus in stormwater runoff, as well as the introduction of other pollutants in the water travelling to lakes.

In addition to the *quantitative* changes (increases in) stormwater runoff from developed areas in lake watersheds, changes in *quality* also occur. When compared to runoff from similar undeveloped areas, stormwater runoff from developed watersheds typically contains higher concentrations of substances that can cause lake water quality to decline, such as phosphorus, and sediment from soil erosion. *A study conducted by the Maine DEP in the 1980's found that stormwater runoff from residential development may contain up to 5-10 times more phosphorus than runoff from similar undeveloped watersheds.* The findings of this Maine study were similar to those of similar research conducted in other areas of the country.

Protecting lake watersheds from the effects of watershed development protects lake water quality because lake ecosystems include the watershed. The use of conservation practices to minimize the effects of both new and existing development is essential to the long-term health of our lakes. For lakes with complex indirect watersheds, the greatest "bang for the buck" can be achieved by addressing issues in the direct watershed. If problems in all of the direct watersheds can be resolved, then the indirect watershed issues are also addressed.

Future articles on this topic will cover more specific information about how both natural and human factors in lake watersheds influence lake quality, and case histories of watershed assessment and stewardship projects, in which volunteer lake monitors have played key roles.

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