



The Lake CONNECTION

Why lake levels matter

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Why are lake levels important?

Lake levels are important because they affect many things, from how we get to the lake, to what we can do around the lake, to the quality of water in the lake.

Recreation is one of the main reasons people choose to live on or visit a lake. High lake levels can flood nearby houses and cottages, cause our favorite picnic area to be submerged, and create prolonged periods with no-wake zones. Low lake levels can make it difficult for boaters to access the lake from both public landings and private piers.

Whether your interests lie in fishing or bird-watching, lake levels can affect these, too. High lake levels are usually the result of increased runoff from more frequent or intense storms or increased ground-water recharge from prolonged periods of high rainfall. Wide fluctuations in water level and runoff can affect the species of plants and animals that can survive in and near a lake. Many plants, for example, cannot withstand being flooded for several years and then being



Figure 1. High water levels in Silver Lake, Barron County, flood a picnic area near the lake.

without water for several more, whereas some plants and animals have adapted to these fluctuations.

Are the recent large yearly fluctuations in precipitation and runoff typical of Wisconsin's climate, or are they something new as a result of climate change?

That is difficult to answer, but there have been large fluctuations in precipitation and runoff throughout history.

For example, in the early 1930s (the dust bowl years), precipitation and water levels were low for lakes throughout the state, whereas in the late 1930s and 1940s there was abundant precipitation and high lake levels. During the years with low water levels, many lakes had extensive beach areas and some lake bottoms were actually used for agriculture. Within a few years, increased precipitation and runoff caused these areas to be flooded again.

Water-level studies by the U.S. Geological Survey (USGS) have demonstrated that there have been as many as eight large fluctuations in water level over the past 100 years. Over the past few years, precipitation patterns in Wisconsin have varied considerably. During the early 2000s, many lakes in the northwest part of the State experienced high precipitation and very high lake levels; however, after a few years of below normal precipitation this area experienced below-normal streamflow and very low lake levels. While lakes in the northwest experienced low water levels, lakes in the southern part of the State experienced extensive precipitation, record floods, and very high lake levels.

Which lakes are most affected by changes in precipitation, and would most likely experience wide fluctuations in water level?

There are many types of lakes in Wisconsin, and in turn, different factors affect their levels. Closed-basin lakes, or lakes without an outlet, are thought to be most strongly affected by changes in precipitation and experience the largest fluctuations in water level. Anvil Lake, in Vilas County, is a closed-basin lake with no inflows or outflow, and is one of a few lakes in the state with long-term water-level data. Precipitation and ground water are its main sources of water. From the 1930s to the mid-1990s, the data showed a steady decline in lake levels. But in the mid-1990s and again in 2002, the lake had very high water levels.



Long-term water levels for Shell Lake, Washburn County. Water-level data are available at http://www.shelllakeonline.com/the_lake_h.htm

Silver Lake, in Barron County, is another type of closed-basin lake with tributary inflows. Runoff and precipitation are its main sources of water. In the early 2000s, residents around Silver Lake were concerned about high lake levels flooding homes, causing erosion, and degrading the water quality of the lake (see inset). To better understand the effects of water level on the lake's water quality, Barron County began a cooperative study with the USGS. Results of the study demonstrated that increased precipitation led to increased runoff and high water levels. The increased runoff increased the phosphorus loading from the watershed, and the high water levels caused erosion and additional phosphorus loading from around the periphery of the lake, causing degradation in the lake's water quality. Since then, the precipitation, runoff, and water levels have all declined, and water quality has improved.

Fish Lake, in Dane County, is another closed-basin lake with no inflows or outflow

and experiences severe water-level problems. A USGS study demonstrated that the lake's dramatic increases in water levels were caused by increases in the regional ground-water table due to increased precipitation and possibly due to changes in agricultural practices that may have increased ground-water recharge. The increases in water level flooded the houses and cottages of many residents around the lake and caused a dramatic decrease in water quality.

Many lakes in Wisconsin are regulated by man-made structures or diversions. One example is Lake Mendota, in Dane County, which has lake-level data since the early 1900s. Control structures provide a means to moderate extreme lake-level fluctuations during typical climatic cycles, but many of the same impacts from flooding and droughts are still felt when the cycles or storms are more extreme. This could be seen with the flooding in June 2008 that caused many homes along the lakeshore to be flooded. Because of the

control structures, long-term water-level data often exist for regulated lakes; however, because the control structures modify water levels, the long-term climatic effects are difficult to determine.

So, what does all of this information tell us?

We know there are different types of lakes, and that each type responds differently to weather extremes and climatic cycles based on their hydrology. Unfortunately, very few lakes in Wisconsin have reliable long-term water-level data. Shell Lake, a closed-basin lake in Washburn County, is one of the few exceptions (see inset). Shell Lake's long-term data are being used in a USGS study to help identify trends and to relate such trends to factors such as climate change, land-use change, natural lake hydrology, and anthropogenic sources of contaminants like septic systems.

How does one monitor the water level of their lake to enable long-term trends to be evaluated?

When monitoring lake levels, first a datum, or a reference point, must be established to which the future water levels can be compared. It is crucial that this datum be checked—by surveying—over time to ensure



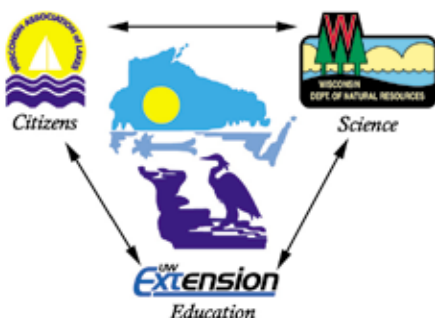
Low water levels on Crystal lake.

its accuracy. If the datum is not maintained from year to year, the data can only be used to describe how much a lake fluctuates in one year, but not how it compares with other years. The water-level data also need to be evaluated for accuracy and maintained in a reliable database. The USGS maintains a database of water levels on several lakes in Wisconsin. Quality assurance and long-term archival of water-level data provide an invaluable resource for research and the management of our lakes in the future.

More information

The USGS Wisconsin Water Science Center website (<http://wi.water.usgs.gov/>) is full of good information for those interested in water levels. You can download published reports and papers, learn about ongoing research projects, and check out water data.

Wisconsin Lakes Partnership



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