High Capacity Well Impacts on Wisconsin Lakes, Streams, and Wetlands

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Summary

Wells pump groundwater, which in Wisconsin is usually strongly connected to local lakes, streams, and wetlands. When groundwater is pumped, water levels in aquifers (the rock and soil that holds groundwater) drop, as do the levels of water in connected surface waters and the groundwater flows that support them. The effects of pumping are a matter of degree. A little pumping may make a small, barely perceptible impact with no apparent harms to public rights, fish, and wildlife, but larger amounts of pumping can be, and have been, devastating.

A high capacity well is defined in Wisconsin statutes as a well with a "… capacity to withdraw more than 100,000 gallons [of groundwater] per day…" or that "… together with all other wells on the same property, has a capacity of more than 100,000 gallons per day."[1] Wisconsin has some 7,700 wells capable of pumping more than 100,000 gallons per minute, and a total of nearly 13,000 statutory high capacity wells.[2] Only a handful of high capacity wells were evaluated for impacts on lakes, streams, and wetlands prior to receiving regulatory approval.

High capacity well pumpage amounts to about 250 billion gallons per year (as reported for 2013, a fairly typical year), with roughly 40% of pumping attributable each to agricultural irrigation and municipal use, and lesser amounts attributable to industrial, stock watering, mining, and other uses.[3]

Wisconsin has been struggling since the 1950s to develop a framework that recognizes and manages pumping impacts, without success. Lately, courts have been asserting constitutional protections for surface waters from high capacity wells, while legislative and administrative actions seek to streamline processes for high capacity well owners.

Groundwater in the Water Cycle

"Groundwater" is the water beneath the earth's surface that saturates pore spaces between sand grains and the cracks in bedrock. This saturated geology is called an "aquifer." Water in a saturated geology is distinguished as groundwater, while water in unsaturated geologic materials, where pore spaces contain both water and air, is termed "vadose water." (Vadose water is experienced in daily life as the moisture contained in garden and field soil.) Groundwater flows naturally under the influence of gravity and pressure, and it can also be pumped by wells.

Groundwater has its ultimate origins from local precipitation, which in Wisconsin averages about 32 inches annually. Generalizing, only a couple inches of precipitation run overland directly to surface waters and depart a watershed, with the remainder soaking into the soil. Plant roots take up most of the soil water, and much of this water, along with any precipitation that was intercepted by leaves and impermeable surfaces, is lost to the atmosphere in a process termed "evapotranspiration." This evapotranspired water will eventually fall to the earth as precipitation on land or seas. Evapotranspired water amounts to about 22 inches of water a year, which leaves about 8 inches or so of the original 32 inches of precipitation to seep beyond plant roots and become groundwater.

Groundwater is not stagnant, but rather flows through aquifers ultimately to discharge at a surface water and leave a watershed (Figure 1, top). Most often discharge is to a local stream, but sometimes to large lakes (Lakes Winnebago, Michigan, and Superior, for example) or to smaller lakes that have exit streams. Visible discharge points are colloquially referred to as "springs." Seepage lakes and wetlands are formed where the land elevation surface dips below the groundwater elevation surface.

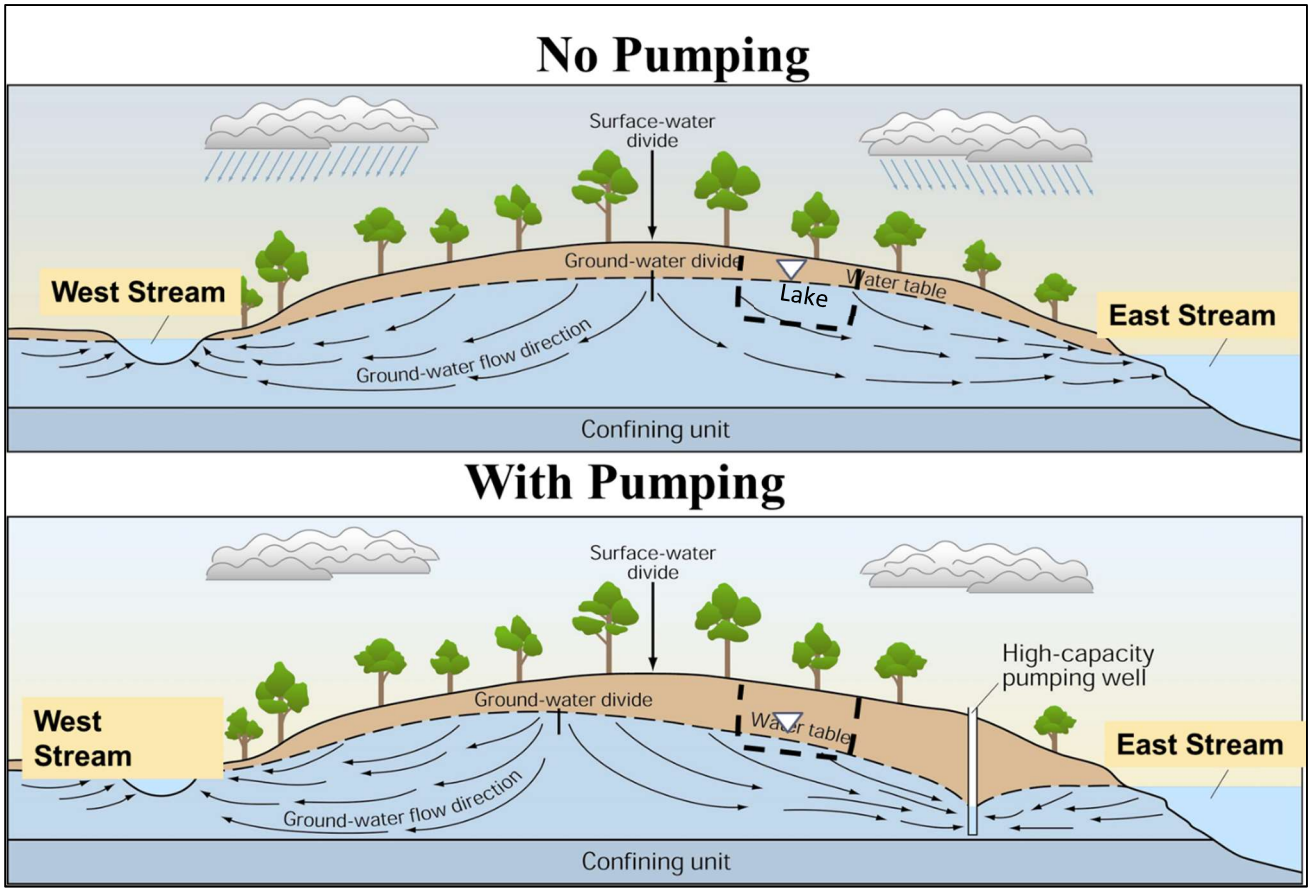

Figure 1. A groundwater flow system under natural (top) and pumping conditions (bottom). Note that the lake is a depression that extends below groundwater levels. The pumping well intercepts water that was going to the East Stream and captures some water from the West Stream as well. Because pumping lowers water levels in the aquifer, lake levels have declined. When wells are located near a stream, the flow of groundwater might be reversed. (Figure modified from Grannemann et al.[4])

Aquifers in Wisconsin generally range in thickness from tens to hundreds of feet. From recharge to discharge point, groundwater might travel laterally only a few feet to 30 miles or more. Common flow distances are 10 miles and less.

Groundwater levels as well as the water levels in groundwater-connected lakes, streams, and wetlands fluctuate over time. Weather and well pumping are two main drivers of water levels. Weather variability through seasons or years causes water level highs and lows. Pumping affects the natural fluctuations by lowering both the highs and the lows.

High Capacity Wells and Impacts on Surface Waters

High capacity wells usually remove groundwater from aquifer storage and discharge it to a locale other than where it was naturally heading. Pumped groundwater may be used "consumptively," i.e., lost into the atmosphere, or "nonconsumptively," i.e., discharged to a surface water.

Figure 1 (bottom) illustrates the twin effects of groundwater pumping: water level decline and diversion from surface waters. Water levels in aquifers distinctly decline around a pumping well, forming a so-called "cone of depression." This cone is particularly pronounced when a well is actively pumping, and it dissipates when a well is turned off. But even if a well is off for some time and the "cone" has become indiscernible, less water and lower water levels persist in the aquifer compared with pre-pumping times. And because surface waters are often well-connected to groundwater, the lowering of water levels in aquifers may also lower the depths of lakes, streams, and wetlands and reduce groundwater discharge to these features. Years or even decades may be needed for water levels in an aquifer to achieve a new equilibrium level with a new pumping well.

Well pumping diverts water from surface waters because wells intercept and remove groundwater otherwise destined to discharge to surface water. More subtly, a well pumping strongly and near enough to a stream can reverse the flow of water, from into the stream to out of the stream. Not only are surface waters downstream of a pumping well affected by pumping, but surface waters upstream as well.

Wisconsin Central Sands

The Wisconsin Central Sands is the most prominent, but not the only, area of Wisconsin where surface waters have been greatly diminished by groundwater pumping. Conflict regarding high capacity well pumping and surface water impacts goes back 60 years,[5] and is mainly centered on extraordinary amounts of irrigation pumping for field corn, potato, and processing vegetables.

The Central Sands extends across parts or all of seven counties[6,7] spanning 80 miles north-south and 50 miles west-east. The geology characterizing the region comprises a mantle of sandy and gravelly glacial deposits that ranges from 0 to 200 feet. These contain the region's principal aquifer. The coarse soils percolate a large fraction of local precipitation through overlying soils to the aquifer, and this water is in turn transmitted through the aquifer and discharged to local streams. The Central Sands contains some 200 groundwater-connected lakes over 10 acres in size, and over 600 miles of groundwater-connected streams, many of them trout streams.

The same sandy and gravelly geology that contributes to the region's rich hydrology also created droughty soils that can benefit from irrigation, and it provides a productive aquifer that can be easily tapped by high capacity wells to supply irrigation water. Thus, the area has become highly developed for irrigation. The Central Sands accounts for more than a quarter of all the groundwater pumped in Wisconsin and contains about 2,500 high capacity wells. About 85% of high capacity well pumping in the Central Sands is for irrigation, with smaller amounts for municipal, industrial, and other purposes.

The groundwater - surface water – pumping connection in the Central Sands has been well studied since the 1960s,[8,9] when researchers warned that surface waters could suffer catastrophically in the absence

of a groundwater management plan. These warnings mainly went unheeded, while high capacity well numbers increased (and continue to increase) dramatically over time.

Both the research conducted in the 1960s[8,9] as well as modern-day forensic hydrology[6,7,10] identified pumping-induced water level and streamflow impacts going back more than 50 years. But catastrophic drying during a modest dry-spell during 2005-2010 brought the pumping issue to the forefront of public discussion. Substantial surface water drying was experienced in many lakes, streams, and wetlands; to name a few, the Plainfield area lakes, Hancock area lakes, Portage County's Pickerel and Wolf Lakes, Adams County's Patrick Lake, the Little Plover River, and Stoltenburg Creek. Deeper water bodies sometimes only experienced water level losses and wider beaches, but shallower lakes reverted to wetlands or dried, some wetlands dried completely, and fish kills were sometimes catastrophic. Public uses for parks, fishing, and hunting were diminished, as reportedly were property values and property taxes.

The future for many Central Sands surface waters is dim if groundwater management strategies are not enacted, as high capacity well numbers continue to increase. A study in the upper Tomorrow River region in Portage County found that the high capacity well numbers and irrigated acres there have the potential to quadruple, and will cause lakes and streamflows to continue their decline.[11]

Groundwater Pumping Management Framework

The current state of high capacity pumping management has been shaped by the courts, legislature, and executive administrative actions. Wisconsin statutes provide only minimal protections for a minority of Wisconsin lakes, streams, and wetlands. Court actions offer some protections from new wells, but thus far little guidance on managing pumping where existing wells are causing significant impacts. Executive and legislative actions appear to favor unlimited and unmanaged groundwater pumping.

Legislative activity

Protections for surface waters from high capacity well pumping were already being debated during the 1950s. An especially intense period of legislative deliberation prevailed during 1957-1959 and resulted in several legislative proposals, including 1959 Assembly Bill 64, which would have required high capacity wells to be permitted and permitting to be made contingent on protecting public rights in waterways. It failed.

For the next 40 years, discussions on groundwater pumping management lagged. New interest was piqued by the well-known 1999 Perrier proposal to bottle spring water at the headwaters of the Mecan River in Waushara County and at Big Springs in Adams County, laying bare the weaknesses of Wisconsin's groundwater pumping laws. Concerns about the statutory weaknesses triggered discussions in the legislature, and the convening of a stakeholder group led by Rep. Dwayne Jonsrud and Sen. Neil Kedzie. The result was 2003 Wisconsin Act 310, which accomplished little for surface water protection (essentially only offering a few protections to a minority of the state's lakes, streams, and surface waters), but was billed as a "first good step," onto which additional steps would be added.[12]

Attempts to take "second good steps" have thus far failed. After a lengthy process of working with scientific and stakeholder groups, Rep. Corey Mason and Sen. Mark Miller proposed 2009 AB 844 / SB 620, which offered some protections for all surface waters as well as a framework for managing

groundwater in areas where pumping from multiple wells was impacting water resources. The bill failed for not being brought for a floor vote.

Legislative efforts since have mainly been aimed at streamlining processes for high capacity well applications and well owners, with less consideration for protecting ground and surface waters. Motion 375, a measure prohibiting citizens from challenging applications or permits for high capacity wells based on their cumulative environmental impacts, was introduced into the state budget process in 2013 by Rep. Daniel LeMahieu. It passed.

Newly passed 2017 Wisconsin Act 10[13] contains a number of groundwater pumping provisions, most notably making high capacity well approvals effectively permanent. Department of Natural Resources (DNR) staff previously represented that approvals for high capacity wells that were harming lakes, streams, and wetlands could be modified when a well needed replacement or reconstruction or when a property transfer was occurring. 2017 Act 10 eliminated this ability. Act 10 also allows high capacity well approvals to be bought and sold with property, effectively allowing groundwater resources to be privatized.

Another provision of 2017 Wisconsin Act 10 called for DNR to study three specified lakes plus other water bodies

> "… for which the department seeks to determine whether existing and potential groundwater withdrawals are causing or are likely to cause a significant reduction of the navigable stream's or navigable lake's rate of flow or water level below its average seasonal levels."

Existing work showed some 20 lakes and tens of miles of streams are likely significantly impacted in the study area, but DNR has not sought to study these waters, and instead is limiting their efforts to the minimal three lakes and no streams. No explanation was provided.

Courts

The Wisconsin Supreme Court in 2011 decided that DNR is required, when presented with sufficient concrete, scientific evidence,

> "to consider whether a proposed high capacity well may harm waters of the state" (*Lake Beulah v. State of Wisconsin DNR*).[14]

This reversed DNR's long-held position that it lacked authority and responsibility for evaluating and managing harms that accrue from groundwater pumping (with the exceptions noted above for well replacement, reconstruction or transfer).

Executive and administrative actions

Recent executive actions have mainly sought to limit court-won protections for surface waters.

After the *Beulah* decision, DNR downplayed the impacts of pumping and held it was not required to consider the cumulative impacts of multiple pumping wells in a 2011-2014 case involving two high capacity wells for a dairy in Adams County. The effect of DNR's position was that any single high capacity

well was not permitted to dry a water body, but if one well on top of another on top of another, etc., dried a lake or stream, that was permissible. DNR's position was reversed in an administrative law process, as outside experts showed that DNR inadequately considered existing pumping impacts. In his 2014 decision, the administrative law judge found that DNR has an obligation to consider cumulative impacts:[15]

> "The DNR possesses the authority to consider cumulative impacts to the waters of the state caused by high capacity well pumping … when assessing applications for high capacity wells. The failure to consider these impacts is a gap in public trust enforcement…"

More recently, in a 2016 response to a request by Rep. Robin Vos, Attorney General Brad Schimel opined that 2011 Wisconsin Act 21 precludes DNR from considering pumping impacts as prescribed under *Beulah*.[16] DNR quickly adopted Schimel's opinion and issued approvals for high capacity wells previously deemed too impactful of surface waters. The Circuit Court has ruled that DNR's action (and the Attorney General's opinion) ran afoul of the state constitution[17]. This puts DNR back into a position of having to review high-capacity wells with a view toward their impacts on surface waters. However, the circuit court decision is being appealed, and while the appeal is ongoing, DNR has decided to approve high capacity wells with no review for significant impact to surface waters.

About Wisconsin's Green Fire:

Wisconsin's Green Fire, Voices for Conservation (WGF), is an independent nonpartisan organization formed in 2017. WGF supports the conservation legacy of Wisconsin by promoting science-based management of its natural resources. Members represent extensive experience in natural resource management, environmental law and policy, scientific research, and education. Members have backgrounds in government, non-governmental organizations, universities and colleges and the private sector. More information about WGF can be found at www.wigreenfire.org.

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