

## **GROUNDWATER/SURFACE WATER INTERACTIONS**

Groundwater pumping is substantially impacting streamflows and water levels in lakes and wetlands in parts of Wisconsin. This issue differs from the large regional drawdown issues in the northeast and southeast, where water level declines are mainly in the confined or semi-confined systems not well connected to surface waters.

### ***Central Sands***

The Central Sands region lies east of the Wisconsin River and encompasses 1.75 million acres in parts of Adams, Marathon, Marquette, Portage, Shawano, Waupaca, Waushara and Wood counties. The 800 miles of trout stream and 300 lakes are generally well connected to the sand and gravel aquifer and provide recreation and tourism value including hunting, fishing, canoeing and kayaking. The productive sand and gravel aquifer also supports groundwater withdrawals from water use sectors including irrigated agriculture, municipalities and industry. Within this region 25% of the state's groundwater is pumped from several thousand high capacity wells, predominantly for irrigation. The number of high capacity wells and reduced water levels in some areas has caused concerns about the potential impacts of groundwater withdrawals on water resources. One example of the impact of groundwater withdrawals on water resources is the Little Plover River in Portage County. The Little Plover River, a Class I trout stream and Exceptional Resource Water in Portage County, has dried in parts during various years since 2005.

[2017 Wisconsin Act 10](#), referred to by the DNR as the Central Sands Lakes Study, provides the basis for the DNR to define significant impacts on three Central Sands lakes (Plainfield, Long and Pleasant) in Waushara County and quantify the relationship between groundwater withdrawals, lake levels and significant impacts. The lakes have been of keen interest to stakeholders in Central Wisconsin, particularly in the last decade. The key findings from the three year study are that groundwater withdrawals cause reductions in Pleasant, Long, and Plainfield Lakes. The reductions are significant and impact the lakes' ecosystems in Long and Plainfield Lakes. The study findings show that the reduction caused by groundwater withdrawals to study lake levels are a result of the collective impact from many high-capacity wells rather than any specific high-capacity well. As a result, the DNR recommends a regional framework, such as a water use district, to implement measures to reduce significant impacts from groundwater withdrawals. Learn more at: <https://dnr.wi.gov/topic/Wells/HighCap/CSLStudy.html>.

### ***Dane County***

Although groundwater and surface water resources are plentiful in Dane County, there are several well documented cases of impacts to surface water due to groundwater withdrawals. Just as regional drawdowns have developed across Dane County in response to high-capacity pumping of groundwater for municipal and industrial supply ([see Regional](#)

[Drawdowns section of the report](#)), several smaller streams and spring systems have also been impacted over the past several decades resulting in reduced flow rates.

Some of the most significant impacts have been to Starkweather Creek on the east side of Madison as well as springs along the south shore of Lake Mendota, north shore of Lake Wingra and around lake Monona. Baseflow in Starkweather Creek has decreased as stormwater is diverted from impervious areas to drainage ditches and high-capacity pumping lowers water levels. At Springhaven Pagoda, which was built in the late 1800's to house a spring near the shore of Lake Monona, the spring has stopped flowing entirely. At Merrill Springs, near Spring Harbor along the south shore of Lake Mendota, a spring pool that was built in the mid-1930s has decreased its flow by upwards of 90% (<http://www.springharboronline.com/where-are-the-springs-in-spring-harbor.html>). The reduction in these surface water flows is considered to be due to decreases in recharge from urbanization and, even more importantly, the result of regional drawdowns from pumping high-capacity wells.

The Dane County groundwater flow model, which is calibrated based on observed water levels in wells and lakes, as well as flow rates in streams and springs, has provided further evidence of impacts to surface water along the Yahara River corridor. Model simulations over the past decades have consistently shown a reversal in groundwater flow along the southern two-thirds of Lake Mendota and all of Lake Monona. The result is that lakes that historically gained groundwater now lose water to the groundwater system. This reversal, which is due primarily to the concentration of high-capacity wells in the greater Madison area, has effectively drawn groundwater levels down in wells and impacted flows in sensitive stream and spring systems which are replenished by shallow groundwater supplies.

### ***Springs Inventory***

[Groundwater springs \[video link\]](#) are special places where the water table reaches the land surface and overflows into streams and wetlands. Springs are critical natural resources since they supply cool, oxygen-rich water for trout and often harbor threatened and endangered species. Springs are also a window into the groundwater below the surface and they can provide a great deal of information about the chemical composition and flow of local groundwater. Springs are often well loved for their scenic beauty at public parks.

Because these special natural resources are vulnerable to groundwater pumping, the Department of Natural Resources (DNR) reviews high capacity well applications involving wells constructed near springs for adverse environmental impacts. Springs, for the purpose of a high capacity well review are defined in statute as "... an area of concentrated groundwater discharge occurring at the surface of the land that results in a flow of at least one cubic foot per second at least 80 percent of the time." There are over

10,000 known springs in Wisconsin, and it is not a simple task to determine, given a proposed high capacity well, which nearby springs need to be assessed. Correct information about the location and flow rate of each spring is critically important to have, and ongoing springs monitoring efforts have improved Wisconsin's spring's inventory. Springs can also be used as easy sampling points for indicators of groundwater quality.

In keeping with the stated mission of the GCC to assist in the efficient management and exchange of groundwater data, GCC agencies and researchers have worked together to gather data about Wisconsin's springs into a centralized inventory for Wisconsin. In 2007, the establishment of a statewide springs database<sup>1</sup> was a major step forward in pulling together data from disparate sources. In 2017 researchers at Beloit College and WGNHS completed a three-year springs inventory for the State of Wisconsin<sup>2</sup>. This inventory created a springs database by conducting field surveys of springs with historical flow rates of 0.25 cfs or more and established reference springs in representative hydrogeological and ecological settings for long-term monitoring. Accessible to scientists, water resources managers and the general public the springs inventory is available on the DNR [Wisconsin Water Quantity Data Viewer](#). DNR continues the springs inventory monitoring project by identifying new springs, continue monitoring of reference spring sites, and revisiting previously identified springs in the springs inventory.

### ***Wisconsin Stream Model***

DNR researchers have developed a [detailed model](#) that predicts streamflows in ungaged streams using identify factors (such as land use, groundwater recharge and climatic elements). The model also links these variables to the abundance of fish species in Wisconsin's streams. This project helps determine what hydrologic changes are likely to cause significant *environmental impacts* to Wisconsin streams.

### **References:**

1. Macholl, J.A. 2007. Inventory of Wisconsin's springs. Wisconsin Geological and Natural History Survey Open-File Report 2007-003. Available at <http://wgnhs.uwex.edu/pubs/wofr200703/>
2. Swanson, S. et al. 2017. An updated Springs Inventory for the State of Wisconsin. Project ID 15-HDG-01. Available at <https://www.wri.wisc.edu/wp-content/uploads/FinalDNR224.pdf>