WATER USE RESEARCH & MANAGEMENT TOOLS

Water Use research informs Wisconsin's water quantity management program. The following examples highlight different projects undertaken by the Wisconsin DNR, Wisconsin Geological and Natural History Survey, the U.S. Geological Survey, municipalities and other partners to improve our understanding and management of water quantity issues in different parts of Wisconsin.

County Scale Groundwater Flow Models

County scale groundwater flow models are available for Dane, Chippewa, and Columbia Counties. These models were developed or updated in the past ten years to answer county scale questions. The 2016 Dane County model[1] has focused on increasing the spatial resolution of the model grid, better simulating surface water groundwater interactions, and introducing transient flow capabilities, all while upgrading the computer codes and calibration methods. Each of these model improvements provides new insights into the groundwater system within Dane County and a greater understanding of regional scale drawdowns.

Concerns about the impacts of industrial sand mining and irrigated agriculture led the USGS, WGNHS, and Chippewa County to develop the 2019 Chippewa County Groundwater Flow Model[2]. The MODFLOW-based model was built and calibrated to average conditions to simulate groundwater and groundwater/surface water interactions in the western portion of the county. Then two scenarios were run through the model to look at impacts to the groundwater and surface water systems – one with an expansion of industrial sand mining in the county, and one with an expansion of irrigated agriculture in the county. The scenarios found that increasing either of these industries could result in streamflow depletion and groundwater drawdown, but the magnitude of those impacts is highly dependent on where the expansions occur.

Groundwater quality and quantity concerns led Columbia County and the DNR to fund the 2021 Columbia County groundwater flow model[3]. The modeling effort, led by WGNHS and USGS, gathered new and existing information about the County's geology, and established that hydrogeology in a 3-dimensional groundwater flow model in MODFLOW. The modeled groundwater flow helps define where precipitation enters the groundwater system as recharge, where that groundwater winds up flowing to and discharging, and how high-capacity wells can capture some of that groundwater and reducing the among of discharge. The regional model can be used to estimate zones-of-contribution for particular wells (which identifies parts of the landscape that are more likely to cause contamination to that particular well), and to simulate the impacts of existing and proposed high-capacity wells on the groundwater system and nearby streams.

These county-scale groundwater flow models help resource managers understand the hydrogeology and how groundwater is moving through the subsurface. Many of these models estimate impacts of pumping from high-capacity wells at a regional scale and provide a starting point for the DNR to assess impacts from individual wells at a site-specific scale.

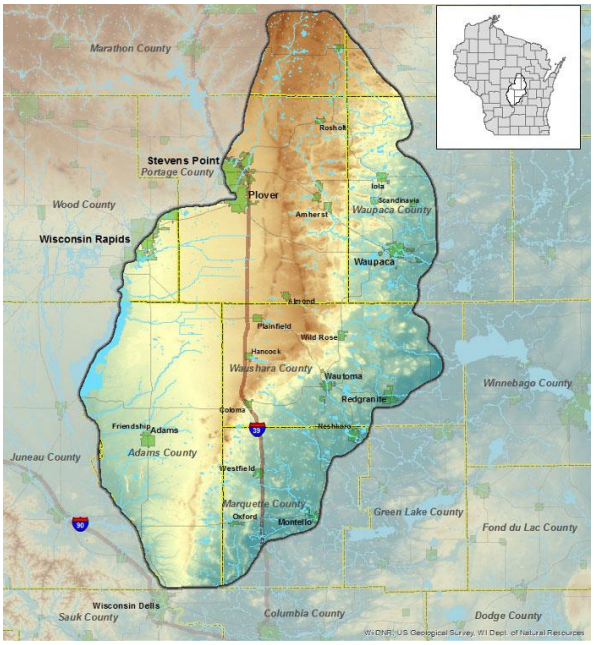
Central Sands Lakes Study

The Central Sands Region spans portions of Adams, Marathon, Marquette, Portage, Shawano, Waupaca, Waushara and Wood Counties. The DNR defines the Central Sands as a contiguous area east of the Wisconsin River with sand and gravel deposits greater than

50 feet deep. These deposits create a productive aquifer that is used for irrigation, public and private water supplies, industry, and commercial uses. The Central Sands region also contains over 300 lakes and thousands of miles of streams.
Over the past 60 years, we have observed low water levels in lakes and streams in Wisconsin's Central Sands Region. Various researchers have studied the relationship between land use and impacts to water resources in the Central Sands Region. Their work has shown that the two main causes of water level changes are weather and the pumping of high capacity wells. Weather varies considerably from place to place and from year to year. The number of high capacity wells in the Central Sands Region have increased over the past few decades, which has raised concerns about pumping of groundwater and the impacts on water levels. In response to these concerns, the DNR evaluated and modeled Pleasant, Long, and Plainfield Lakes in Waushara County to determine whether groundwater withdrawals cause a significant reduction in lake levels below their average seasonal levels, as directed by the Wisconsin State Legislature, specifically Wis. Stat. § 281.34(7m)(2017 Wisconsin Act 10).

The DNR, in collaboration with the Wisconsin Geological and Natural History Survey (WGNHS), United States Geological Survey (USGS) and the University of Wisconsin System, completed the $887,000 Central Sands Lakes Study using an approach that involved data collection and groundwater flow modeling.

The key findings 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. The DNR recommends a regional framework, such as a water use district, for addressing impacts to water resources from high-capacity well pumping.



The Central Wisconsin Sand and Gravel Aquifer is defined as a contiguous area east of the Wisconsin River with sand and gravel surficial deposits greater than 50 feet deep.

Additional information on the study is available through the study reports, appendices and recorded presentations. The DNR held a public hearing and comment period in Spring 2021 and submitted their findings and recommendations to the Wisconsin Legislature on May 27, 2021.

Little Plover River Model And Watershed Enhancement Project

With financial support from DNR, the Wisconsin Geological and Natural History Survey and the United States Geological Survey constructed a groundwater flow model for the Little Plover River watershed in Portage County. This model is a scientific tool for understanding the complexities of geology, groundwater recharge and discharge, surface-water flow, well development and use and water balance. The model simulates the complex temporal and

spatial interactions among streamflow, pumping, and climate and provides users "what-if" evaluations of possible decisions involving management of water use or land-use changes. The Little Plover River Basin was chosen for this pilot study because the river has been the focus of recent management concern and because a great deal of hydrogeologic data already exists for this area. Learn more at: fyi.uwex.edu/littleplovermodel/files/2014/08/Little-Plover-River-handout.pdf.

Beginning in 2017 stakeholders including the Village of Plover and agricultural producers in conjunction with DNR, consultants, and the Wisconsin Wetland Association, formed the Little Plover River Watershed Enhancement project with the goal of achieving sustained flow and aquatic health within the river. The stakeholders are utilizing the groundwater flow model as one tool to assist with establishing land and water best management practices. Learn more about the collaborative restoration effort at www.ploverwi.gov/328/Little-Plover-River-Watershed-Enhancemen.

The Village of Plover received a DNR grant in FY23 to continue improvements to the Little Plover River. Through this grant, the Village of Plover, NRCS, Portage Co. and other partners will fill a ditch and restore a wetland. This project will contribute to continuing efforts in the watershed to restore wetlands, thereby improving river baseflow, and reduce surface water runoff, decreasing the flashiness of the river. These efforts to restore the river hydrology are intended to improve habitat in the river.

High Capacity Well Decision Support Tool

The USGS Upper Midwest Water Science Center and DNR Water Use Section have developed a decision support tool for reviewing impacts of high capacity wells. The tool allows for efficient calculations of streamflow depletion and groundwater drawdown using analytical equations in a framework that is flexible, scalable, and reproducible. The tool is already being used to review for potential harm from proposed and existing high-capacity wells in Wisconsin, with the power to predict potential impacts from hundreds of wells at a time. This flexibility allows for more efficient exploration of uncertainty of our drawdown and depletion predictions, ensuring a more thorough review of potential harm and a more robust decision without increased workloads or delays for additional analysis. USGS is working with others states to use the decision support tool to review for impacts to water resources from high capacity wells.

References:

1. Parsen, M.J., Bradbury, K.R., Hunt, R.J., and Feinstein, D.T., 2016, The 2016 groundwater flow model for Dane County, Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 110, 56 p.
2. Parsen, M.J., Juckem, P.F., Gotkowitz, M.B., and Fienen, M.N., 2019, Groundwater flow model for western Chippewa County, Wisconsin - including analysis of water resources related to industrial sand mining and irrigated agriculture: Wisconsin Geological and Natural History Survey Bulletin 112, 74 p.
3. Gotkowitz, M.B., Leaf, A.T., and Sellwood, S.M., 2021, Hydrogeology and simulation of groundwater flow in Columbia County, Wisconsin: Wisconsin Geological and Natural History Survey Bulletin 117, 51 p., https://wgnhs.wisc.edu/pubs/000985.