Groundwater Drawdowns

Large-scale withdrawals of groundwater are adversely affecting the environment, economy and public health in large areas of Wisconsin. These drawdowns can cause the water level in wells, lakes, streams and wetlands to drop or cause them to dry up entirely. Drawdowns can also cause the levels of arsenic, radium, and salinity in drinking water to increase.

State-supported research is using groundwater information and groundwater flow models developed at a regional scale and adapting it for use at the local level. In Washington County, researchers worked with the city of Richfield to develop a protocol for quantifying its groundwater budget (Cherkauer and LaCosse, 2001). That information will be coupled with projected changes in land use and pumping demand to define the effects of several development scenarios on the community's water supply. This protocol is being applied to the entire 7-county SEWRPC region of Southeast Wisconsin.

Regional studies have identified central Waukesha County as an area where continued deep groundwater pumping might be causing the deep aquifers to become unconfined as water levels fall (Eaton, 2004). A 2004 project installed one deep piezometer near Pewaukee for use as a monitoring point to document water-level declines.

The Maquoketa shale forms an important aquitard, or low permeability geologic layer, in eastern Wisconsin. Restriction of recharge to the deep sandstone aquifer by the Maquoketa is the major reason that drawdowns in the deep sandstone aquifer in Southeast Wisconsin are so severe. Hart and others (2007) investigated groundwater flow across the Maquoketa and in particular studied how cross-connecting wells and fractures control flow across the shale. Cross connecting wells are generally older wells that are open to aquifers both above and below the shale. These wells form conduits from one aquifer to another and can cause drawdown in the upper aquifer while also causing water-quality degradation in the lower aquifer. The investigators searched state records and discovered that approximately 170 such wells exist in Southeast Wisconsin. They also investigated faults and fractures through the Maquoketa and discovered that such features, although sparse, also can have a major impact on the overall rate of flow across the shale. The implication is that naturally occurring low-permeability formations, such as the Maquoketa, may transmit more water than originally thought due to the presence of cross-connecting wells and fractures.

Another project investigated the sources of high salinity and radium in the deep sandstone aquifer that supplies water to residents of eastern Wisconsin (Grundl and Bradbury, 2000). This project examined the chemistry of the groundwater and the rock formations of this complex aquifer to determine the causes behind rising salinity and radium levels to help city planners and water utility directors better understand the relationship between well operations and water quality in this region, and evaluate effects of urban growth on water supplies. Results showed that radium in excess of the EPA drinking water limit occurred in a band located just inside the western edge of the Maquoketa Shale. As groundwater in the deep sandstone aquifer transitions from unconfined conditions to confined conditions beneath the Maquoketa Shale, geochemical interactions with aquifer minerals, primarily sulfate minerals, cause radium levels to rise. A more complete understanding of geochemical processes occurring in the deep sandstone aquifer is hindered by the paucity of data points, in particular the complete lack of vertically discrete data.

In late 2007, several suburban communities in the Lower Fox Valley reduced consumption of groundwater by switching to surface water supplied by pipeline from Lake Michigan. As a result, water levels in the deep sandstone aquifer near Green Bay in Central Brown County have begun to recover. In mid-2007 the WGNHS began an effort to monitor the water level recovery in the deep sandstone aquifer near Green Bay with the objective of documenting the recovery and improving our understanding of the deep hydrogeologic system in this region of the state (Luczaj and Hart, 2009). Since 2007, as part of a regional study, water levels have been monitored and collected into a database. As of spring 2009, water levels had risen by 100 feet in much of the region and, in some wells, by more than 150 feet. In 2011, the rate of recovery has significantly slowed. The water levels are still rising but more slowly and are expected to level off in the next several years but it’s not clear exactly how soon or at what level (Luczaj, 2011, and Maas, 2010). Another result of the decrease in pumping and increasing water levels is that some wells in the northwestern part of the GMA near Howard and Suamico have begun flowing. The highest level since recording began in 1952 was recorded in a USGS monitoring well in April 2012. This well is located on the southern shore of Green Bay in the deep sandstone aquifer. In addition to water levels, the pumping rates of current groundwater users in the region have also been collected.

The study also identified a smaller cone of depression near Little Chute, Kaukauna, and Kimberly where water use has remained steady. The water levels there were not affected by the decreased pumping to the north and have remained relatively steady since 2005.

These projects illustrate the importance of monitoring the resource. We now know that if the pumping around Little Chute, Kaukauna, and Kimberly does not impact the Central Brown County cone of depression. We also know that a further decrease in pumping will cause more wells to flow along the western edge of the Central Brown County cone of depression and that if pumping stays below 4-7 mgd that the St Peter sandstone will likely remain saturated and will pose less risk for release of arsenic.

Other State-supported research has investigated the viability of aquifer storage and recovery (ASR) for Wisconsin, where excess water is stored in aquifers when demand is low and withdrawn for use when demand increases (Anderson, 2004). Computer models of groundwater flow and transport in ASR systems have been developed for two representative groundwater systems in Wisconsin. A better understanding of pumping rates, storage times and other factors that affect recovery efficiency of ASR systems has helped guide decision-making about using these systems in Wisconsin.

For more information on regional drawdowns see Regional Drawdowns in the Groundwater Quantity section of the GCC report.

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