January 2008 Water Fact Sheet 2008-6

IOWA'S WATER
Ambient Monitoring Program

Groundwater Quality – Dakota Aquifer

Dakota Sandstone outcrops along the Middle Raccoon River in Guthrie County. Rivers are often the surface expression of groundwater.

Why should I care about groundwater quality?

Although groundwater by its very nature is hidden and not easily accessible for sampling, there are still plenty of reasons to be concerned about groundwater quality. You may swim or fish in one of Iowa's surface water bodies during the summer, but there is a high probability that you drink groundwater almost every time you fill your cup with tap water. It is estimated that 80% of Iowans get their water from a groundwater source. The sources of drinkable groundwater can vary from shallow sand and gravel adjacent to a river to deep sandstone layers over 2,000 feet below the land surface. Although groundwater is usually more protected from contamination than surface water, groundwater contamination can be much more difficult to clean up.

Is groundwater quality different from surface water quality?

In a word, yes. Surface water and groundwater share some similar concerns such as the influence of human contamination, but groundwater quality is also affected by the age, the type of geologic unit, and the way it is retrieved from the ground (Figure 1). Groundwater contamination levels are different due to groundwater's prevalent use as drinking water. Because of these issues, groundwater often contains different constituents in different concentrations than surface water. Constituents such as total dissolved solids (TDS), sulfate, and iron are three of the more prevalent groundwater quality concerns.

Is Iowa's groundwater quality being measured?

Iowa's groundwater quality has been sampled nearly as long as there have been wells drilled in the state. Since the early 1900s, thousands of water quality samples have been collected and catalogued

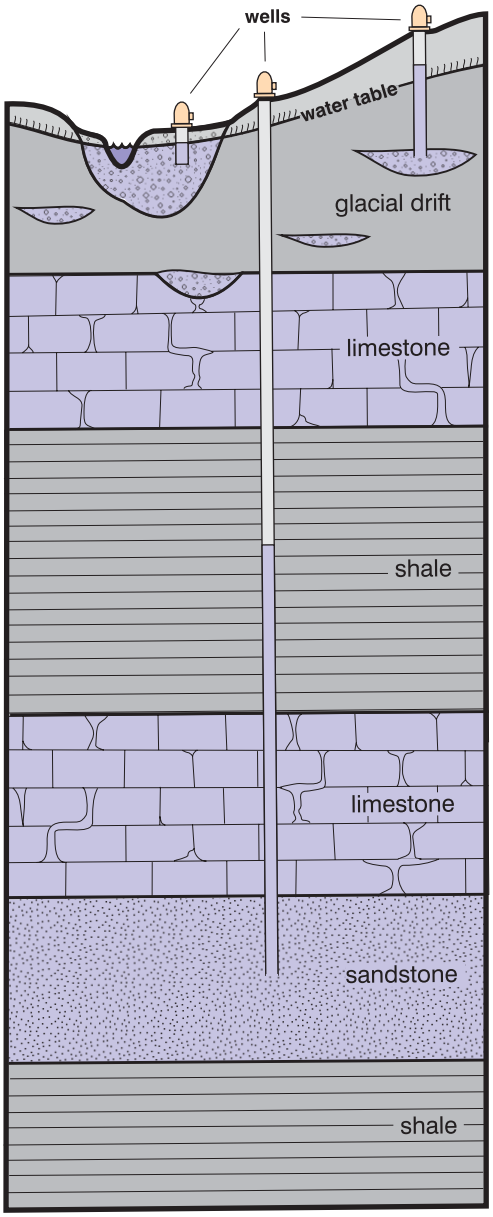


Figure 1. *A cross-section of wells using different types of groundwater. Geologic units such as sand, limestone, and sandstone are made from porous materials that allow groundwater to flow freely. Geologic units such as glacial drift and shale are dense and slow the passage of water.*

for various projects, including aquifer and water characterization, contaminant plume mapping, and maximum contaminant level (MCL) compliance monitoring. Most of these samples have come from public wells that supply cities, towns, or communities. In the past, data gathered from these projects were often kept in separate project files and databases, both electronic and paper. Despite the fact that numerous, often similar samples have been analyzed and studied, most of these samples have remained in their separate databases and files. Recently, several of the electronic groundwater databases were combined into a single database. This groundwater quality database includes parameters that may affect aesthetics, and those that may pose a public health concern.

Where can I find the groundwater quality sample results?

All of the collected groundwater quality data is available in the Iowa Department of Natural Resources' (IDNR) GIS library (www.igsb.uiowa.edu/nrgislibx/) as a downloadable shapefile. This GIS database was constructed to better characterize Iowa's aquifers (water bearing rock formations) and determine if human contamination has increased in any of the aquifers in recent years. The groundwater quality database is divided into two separate files: "General" and "Contaminant." The General shapefile includes metals, physical characteristics (TDS, pH, etc.), and radionuclides. The Contaminant shapefile includes nutrients, volatile organic compounds, and pesticides. All data in both datasets have been geo-referenced (i.e., put on a map). Both datasets have over 8,000 water quality samples taken from over 2,000 unique wells, with a combined total of over 300 sampled parameters. All of Iowa's major groundwater aquifers are represented in the database.

Water Resource Program – Water Quality of the Dakota Aquifer

The first of Iowa's regional aquifers being studied using the groundwater quality database is the Dakota aquifer (Figure 2), which provides water for many rural and public water supplies in northwest and west-central Iowa. The Dakota aquifer is a sandstone unit formed in riverine environments about 100 million years ago. The thickness of the sandstone varies, but it is usually 200-300 feet thick. The

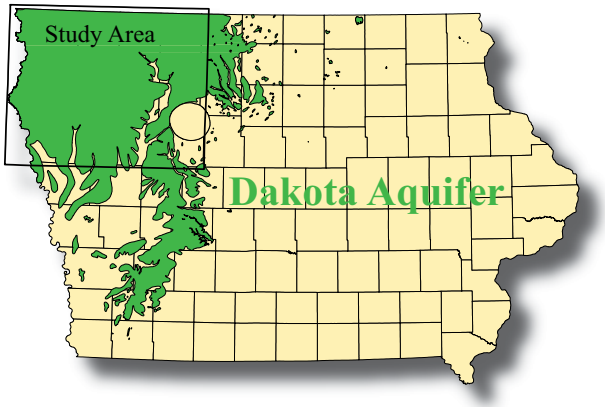


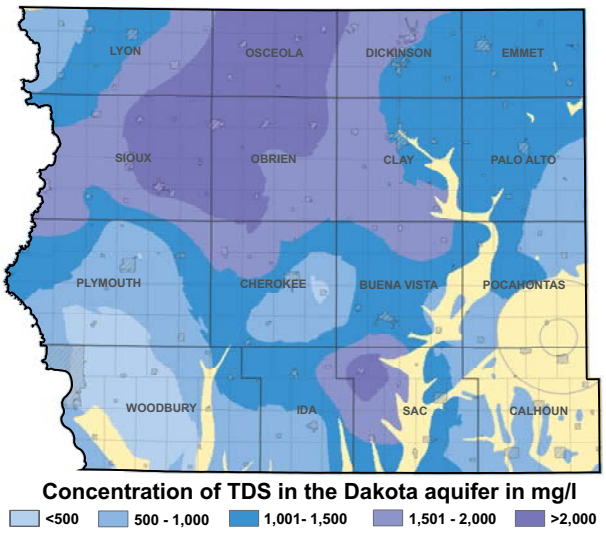
Figure 2. *The Iowa map above shows the location of the Cretaceous-age bedrock in Iowa (green area) which comprises the Dakota aquifer. The 16-county study area is outlined. Yellow represents area where the Dakota aquifer is not present.*

The maps of the 16-county study area (to the right) show general water quality information for the Dakota aquifer. Source: Groundwater quality database.
A. *Concentration of total dissolved solids.*
B. *Concentration of sulfate.*
C. *Concentration of iron.*

Dakota aquifer is generally overlain by thick deposits of glacial till and shale, but occasionally it reaches the land surface (see photo, page 1). Due to the depth of the sandstone units, wells are typically 100 to 600 feet deep. The Dakota aquifer has over 160 wells with water quality information throughout the study area. These wells were used to categorize the Dakota aquifer for commonly occurring and important drinking water constituents.

Total Dissolved Solids (TDS; Fig. 2A) is a measure of all dissolved organic and inorganic material in water. High concentrations of TDS can lead to objectionable taste, problems with scaly buildup in pipes, and reduced efficiency in hot water heaters. Due to the problems associated with high TDS, a recommended maximum level of 500 mg/l has been set by the Environmental Protection Agency (EPA). Figure 2A shows contoured TDS values in the Dakota aquifer derived from the groundwater quality

A.



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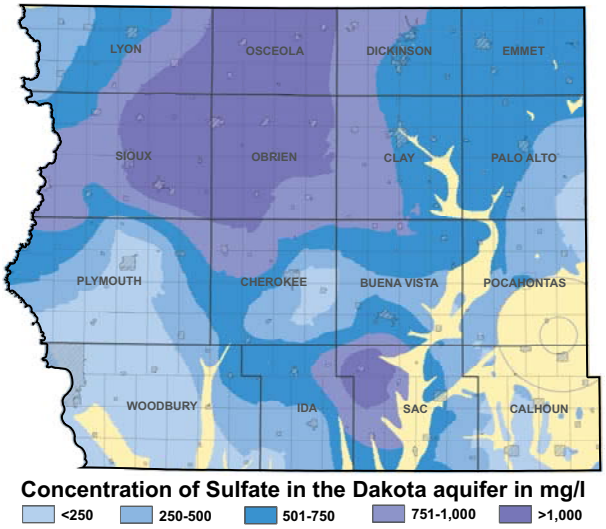

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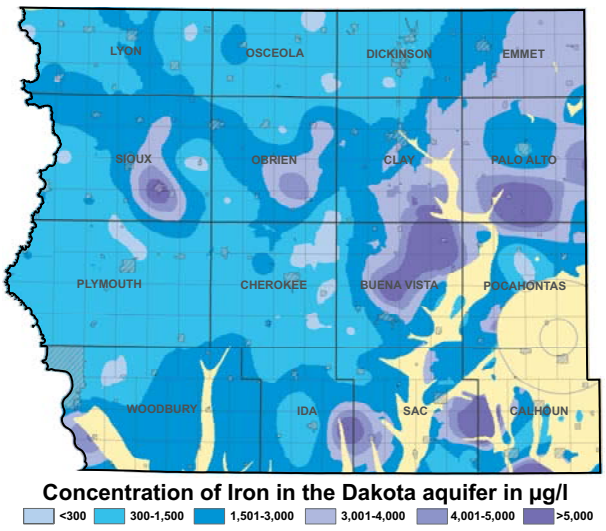

database. TDS values can range from less than 500 to over 2,400 mg/l; the highest values are located in the north-central part of the Dakota aquifer. These are also the deepest portions of the aquifer.

Sulfate (SO_4; Fig. 2B) is also a concern with drinking water due to its objectionable taste, smell, and laxative effects. The EPA has determined a recommended maximum level of 250 mg/l for sulfate in drinking water. Figure 2B shows concentrations of sulfate in the Dakota aquifer. Sulfate values range from less than 250 to over 1,200 mg/l and, like TDS, tend to be higher in the deeper north-central portion of the aquifer. Sulfate tends to be a large part (~ 50%) of TDS concentrations in the Dakota aquifer.

Iron (Fe; Fig. 2C) in drinking water has objectionable taste and can settle out to form small iron flakes. Iron can also stain laundry and porcelain (e.g., bathtubs, sinks, toilets). The EPA has set a recommended maximum level of 300 μg/l for iron in drinking water. Throughout the Dakota aquifer, iron tends to exceed the recommended level and is only consistently near the recommended maximum level in the southwest corner and north-central portion of the study area. Iron concentrations varied from less that 300 to over 5,000 μg/l.

Overall, general water quality in the Dakota aquifer tends to be fair to poor, with only the southwest and southeast portions of the study area having slightly better water quality because TDS, sulfate, and iron are consistently lower than EPA's recommended maximum levels. The major factor influencing Dakota TDS and sulfate concentration appears to be the depth of the aquifer. However many communities still use the Dakota aquifer, since water from the Dakota can be easily treated or mixed with groundwater from another aquifer. There are still large gaps in our sampling distribution and hence there are gaps in our understanding of water quality in the Dakota aquifer, sometimes ranging over a county in size. The groundwater quality database can be used to find existing gaps and help target future water quality testing efforts.

Acknowledgements

Greg Littin with the U.S. Geological Survey, Mary Howes with IDNR's GIS Section, and Hal Frank with IDNR's Water Supply Engineering section all graciously contributed their time, expertise, and data for this project.

The Iowa groundwater quality database can be found on the IDNR's GIS Library – www.igsb.uiowa.edu/nrgislibx/

Funding

Water monitoring activities of the Iowa Department of Natural Resources are funded by Iowa Infrastructure - Environment First Fund appropriations, as well as grants provided by the U.S. Environmental Protection Agency from Sections 106 and 319 of the Clean Water Act and the Regional Environmental Monitoring and Assessment Program.

Iowa Watershed Monitoring and Assessment Program Web Site – wqm.igsb.uiowa.edu

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