South Dakota's Aquifers

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Text books tell us that ground water represents 0.63 percent of the world's total water, 25.7 percent of the world's fresh water, and 98.4 percent of the world's unfrozen, fresh water. In other words, ground water makes up nearly all of the world's water that is suitable for human consumption. In South Dakota, approximately 52 percent of the public drinking water systems rely solely on ground water and approximately 74 percent of South Dakota's citizens use ground water as their source of drinking water. Of the 33 rural water systems which are either in the planning/construction phase or are presently providing water to South Dakotans, 16 of them are using, or will use, only ground water, and 3 utilize a combination of ground water and surface water. Ground water is, without question, an important part of South Dakota's economy and is integral to the daily pursuits of the majority of South Dakota's citizens.

There are many aquifers, or subsurface water-bearing units, in South Dakota including, but not limited to, the following.

- igneous or metamorphic rocks in the Black Hills, near Milbank, and near Sioux Falls
- Deadwood Formation
- Winnipeg Formation
- Red River Formation
- Pahasapa Limestone of the Madison Group
- Minnelusa Formation
- Minnekahta Limestone
- Fall River and Lakota Formations of the Inyan Kara Group
- Newcastle/Dakota Sandstones
- Codell Sandstone
- Niobrara Formation
- Fox Hills Sandstone
- High Plains aquifer (includes the Ogallala Group and Arikaree Group)
- terrace sands and gravels on the flanks of the Black Hills
- glacial outwash (sands and gravels deposited by glacial meltwater)

The surface geology of South Dakota (figure 1) is sometimes complex and difficult to map but the subsurface can be even more difficult to understand and map because it is hidden from view. Decades of work by many individuals, however, reveals that every part of South Dakota is underlain by one or more of the units listed above.

South Dakota does not suffer from a lack of ground water. The problems are that the water-producing units may be deep (very expensive drilling and well installation), may have undesirable water quality, or may not yield the desired quantity of water where it is needed.

Western South Dakota has been impacted by drought in recent years resulting in publicized water shortages. But Harding County, for example, is underlain by all but four of the aquifers listed above. Thus, a lack of water is not the issue. The water-shortage issue may be, of course, significantly affected by drought, but it is also affected by the problems of aquifer depth, water quality, and water-yielding properties of an aquifer.

The Deadwood Formation, which occurs at land surface or at relatively shallow depths around the periphery of the Black Hills, is a source for private water wells there. The Deadwood Formation dips quickly below land surface, however, away from the Black Hills and in northwest Harding County this unit is nearly 9,000 feet deep (figure 2) and the quality of water it contains there is highly mineralized. In this example, the depth and water

Figure 1: Surface Geology of South Dakota. *Map available at: http://jurassic2.sdgs.usd.edu/pubs/pdf/G-10-text.pdf*

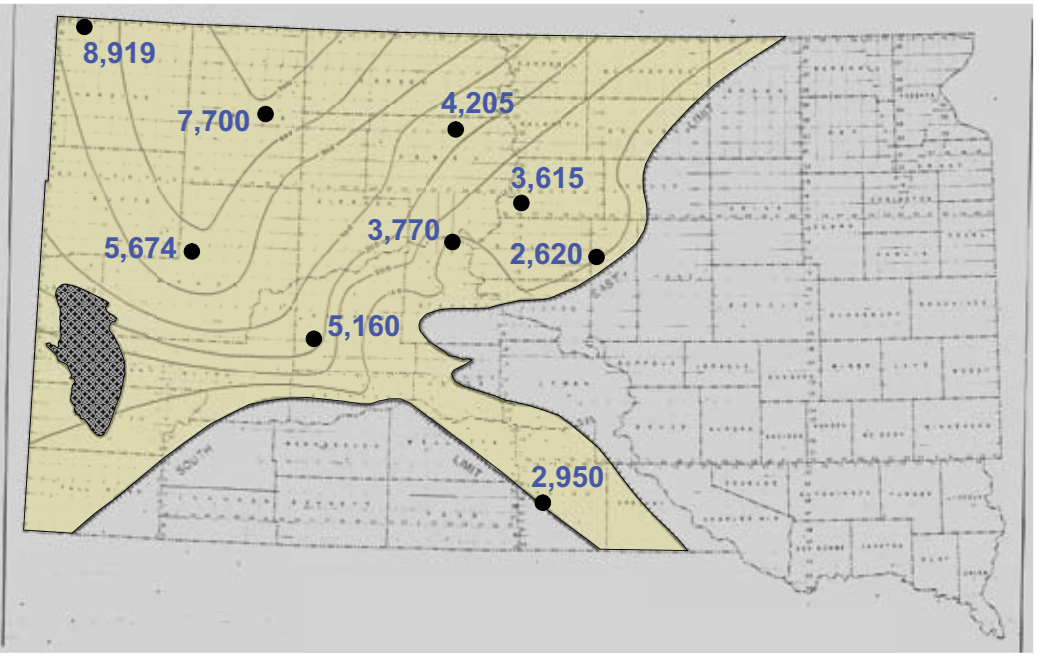

Figure 2: Approximate extent and depth, in feet, of the Deadwood-Winnepeg Formations. *Aquifer extent taken from a map prepared by J.P. Gries. Depths are from the files of the Department of Environment and Natural Resources.*

quality would prevent the average consumer from utilizing this water source. Even the Dakota Sandstone, which is the source of water for the flaming well at Capitol Lake in Pierre and which is a major regional aquifer, is more than 1,000 feet deep in the Pierre area and is nearly 4,000 feet deep in northwest Harding County.

In eastern South Dakota, glacial outwash aquifers are very important. Figure 3 shows an unsaturated portion of a glacial outwash in a quarry. There are approximately 444 public water supply systems east of the Missouri River and 392 of them utilize glacial outwash aquifers. In contrast with the bedrock-type aquifers such as the Deadwood Formation and Dakota Sandstone, glacial outwash aquifers are extremely difficult to predict in the subsurface. The glacial outwash aquifers commonly possess water quality which is better than more deeply buried bedrock-type aquifers, but not always.

Figure 3: Glacial Outwash (sand and gravel)

The Geological Survey Program has been performing exploratory drilling for roughly half a century, primarily related to ground-water resources. Most of the drilling has been performed in eastern South Dakota (the glaciated area) in an attempt to understand and map the glacial outwash aquifers. Figure 4 shows where the drilling has occurred.

A single map showing all of South Dakota's aquifers does not exist. Most areas of the state are underlain by more than one aquifer which is a situation not conducive to illustration on a 2-dimensional map. Also, the boundaries of an aquifer may be uncertain due to the aquifer's depth or the complexity of the glacial sediments.

Work to further understand South Dakota's aquifers and to provide that information to the public is a priority activity at the Geological Survey Program. All of the reports and maps published by the Geological Survey Program are available for free download from the Geological Survey's web site (http://www.sdgs.usd.edu). Additionally, databases of test-hole and well information (lithologic logs database) and water-quality information are available to the public on the web site. Geologists or hydrologists at the Geological Survey are also available to assist with ground-water related questions.

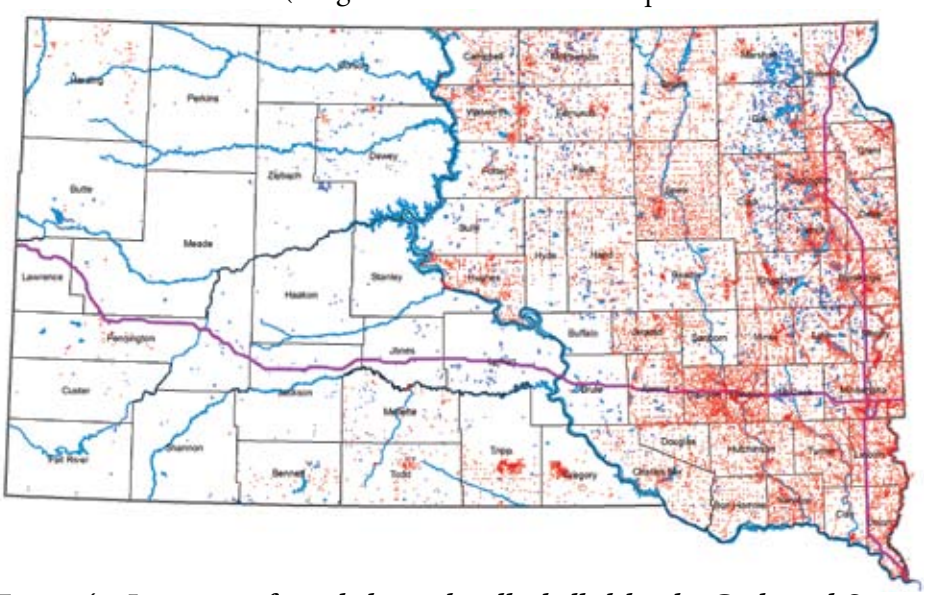

Figure 4: Locations of test holes and wells drilled by the Geological Survey Program. *Each red dot indicates a test hole or well. More than 22,600 test holes and wells have been drilled by the Geological Survey Program.*