

MADISON AQUIFER

What Is The Madison Aquifer?

The Madison aquifer is that part of the Madison Limestone that is saturated with *ground water*. The Madison Limestone is a rock formation, composed of limestone, that is exposed in the Black Hills area. It is sometimes called Pahasapa Limestone. It is a hard, crystalline rock that is composed of calcium carbonate and calcium-magnesium carbonate. This rock is slightly soluble in rainwater, enough so that caves and passageways have been dissolved in the Madison Limestone by infiltrating *ground water*. Well-known caves, such as Wind Cave and Jewel Cave, were formed in this way in the Madison Limestone. Water in the Madison aquifer is contained in these underground caves and fractures. Because the Madison aquifer contains drinking-quality water in the Black Hills area, many wells are drilled into it for water supplies in places such as Rapid City and Spearfish.

Where Is The Madison Aquifer Found?

The Madison Limestone is exposed in a band around the Black Hills uplift (shown as limestone plateau and limestone in Figure 1), but it is also present in the subsurface beneath the ground in parts of Wyoming, Montana, North Dakota, South Dakota, and

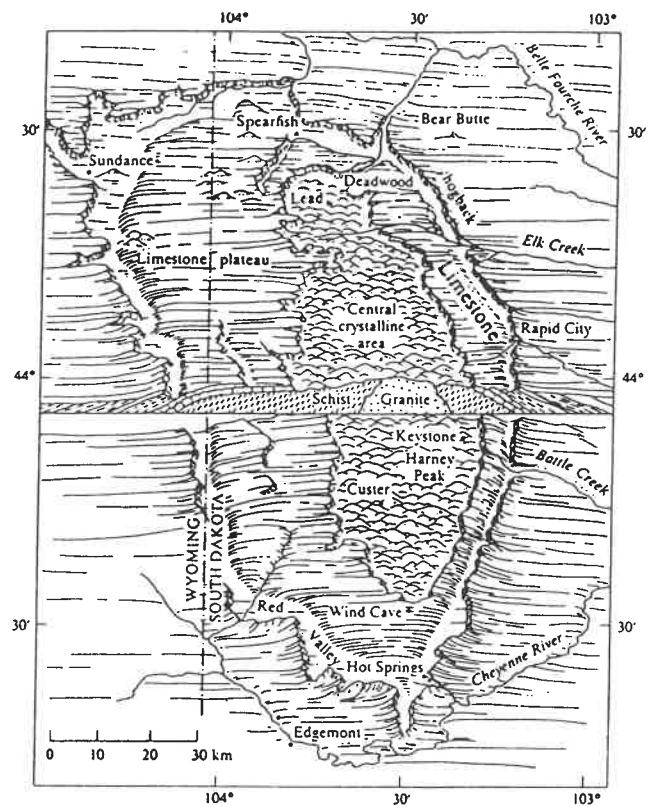


Fig. 1. Madison Aquifer Outcrop

Nebraska. It extends into the region of South Dakota east of the Missouri River. It is not present in the higher Black Hills in the area of Mount Rushmore and Harney Peak, because the limestone layer has been eroded away in these locations.

Why Is It Important?

About 90% of South Dakota's population relies on *ground water* from aquifers such

as the Madison for drinking water supplies. The Madison aquifer is vitally important because it contains approximately 66 million *acre-feet* of drinking-quality water in South Dakota. Cities such as Rapid City use water from wells drilled into the Madison aquifer. Unfortunately, in some places the aquifer is too far beneath the surface for the water to be economically pumped for use. The water in the Madison will become more important in the future, as South Dakota's population grows and more people require water from scarce and dwindling supplies.

Heat in the Earth's interior, where the Madison is deep below the ground, causes some of the water in the aquifer to be very warm. Near Philip and Midland, the Madison contains water that is almost 160 degrees Fahrenheit (71 degrees C). This makes the Madison a valuable *geothermal* resource, although this hot water is often unsuitable for drinking because of its high mineral content. This heat is used to warm a school and some municipal buildings and homes.

How Productive Are Wells In The Madison Aquifer?

The Madison is one of South Dakota's most productive aquifers, but well yields can vary tremendously. Some wells in the Rapid City and Spearfish areas can produce more than 1,000 gallons (about 3800 liters) per minute. Some of these are flowing *artesian wells* that will produce more than 500 gallons (almost 1900 liters) per minute without pumping. Other wells sometimes are less productive and might yield only 20 to 30 gallons (75 to 113 liters) per minute.

Conservation Measures

The outcrop area where the Madison Limestone is exposed around the Black Hills is the *recharge zone* of the aquifer, where rainwater and snowmelt infiltrate into the rock and replenish this underground reservoir. Water in the Madison aquifer flows through fractures, pores, and caves in the rock, and usually does not receive the natural filtering that most *ground water* undergoes as it seeps through soil and sediments. Some streams, such as Boxelder Creek and Spring Creek, lose their flow to *sinkholes* in the Madison. Protection of the aquifer's recharge areas from pollution by sewage, gasoline, and industrial activities can help preserve the water quality of the aquifer.

Glossary

Acre-foot - the amount of water that will cover one acre of land to a depth of one foot.

Artesian well - a well in which the water is under sufficient pressure that it rises partway up in the well without the assistance of pumping. A flowing artesian well will flow at the surface.

Geothermal - referring to the heat from the earth's interior.

Ground water - all water below the land surface.

Recharge zone - that area through which water in an aquifer is replenished either by runoff, by infiltration from precipitation, or by underground flow from connected aquifers.

Sinkhole - a funnel-shaped depression in the land surface through which surface water drains into underground channels.

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