The Many Worlds of District 1

Part II: Down Under

People usually rummage for history in the attic. District 1 keeps much of it in the basement. Millions of years of fire and ice left layers of rock and water below ground as well as above, and the ones down under, though not shown on typical maps of St. Paul, are assets as valuable as those we see on the surface.

The greater Twin Cities lies in a gigantic platter-shaped bowl called the Twin Cities Basin. According to the late Paul Farnham, in 2005 a retired professor of geology at the University of St. Thomas, this bowl-shaped section of sedimentary rock contains several layers, called aquifers, which are so porous and permeable that water can easily move between them. These aquifers are sandwiched between other, denser layers of rock that act as confining units. A typical "aquifer" is not a huge cavern containing water, but rather an intricate web of tiny pockets, each filled with trapped moisture that has migrated from the recharge area at the rim of the bowl. The deeper the aquifer, the more filtration has taken place.

The Jordan

The chief source of underground water for District 1, as well as for the entire Twin Cities, is the Jordan aquifer, contained in Jordan Sandstone set down 500 to 570 million years ago during the Cambrian Period of earth history. Professor Farnham described this fine to coarse-grained quartzose sandstone, averaging 80 to 100 feet thick in Ramsey County, as so poorly cemented together that it transmits water in large quantities, but ever so slowly. The water in the Jordan aquifer is several hundred years old and moves at a snail's pace through tiny spaces between the grains of sandstone. The rock above an aquifer does lose water to gravity, but most of the water in an aquifer enters from its recharge area, where the rock layer is exposed to the surface. The recharge area for the Jordan aquifer, the rim of the basin, is a ring some 40 miles in diameter that runs through the city of Jordan.

Clifton Aichinger of the Ramsey-Washington Metro Watershed District pointed out that drinking water for many residents in District 1 comes not from underground aquifers but directly from the Mississippi River, just north of Fridley. The river water is channeled through a chain of lakes located in suburbs north of St. Paul to the St. Paul Regional Water Services Treatment Plant in Roseville. Only those District 1 households with private wells get their water from directly beneath their property.

Stewardship and safety

To prevent contamination, new wells in District 1 must go deep enough to enter the Jordan aquifer, where the water is incredibly pure---with only 324 parts per million of dissolved minerals, according to Professor Farnham---because it has been filtered over centuries in its leisurely trip from the recharge area. It does, however, contain more hardness (calcium and magnesium carbonate) and iron than the municipal water provided by the city of St. Paul.

According to Patrick Sarafolean, in 2005 an hydrologist with the Well Management Division of the Minnesota Department of Health, "The well casing is placed down to the Jordan formation, and the annular space surrounding the case is filled with neat cement grout from the bottom of the casing back to the surface. This prevents surface contaminants from migrating down the annular space to the Jordan aquifer."

Closer to the surface

The Jordan aquifer is connected in places to aquifers above it in the Prairie du Chien formation, a 120' to 130' rock mixture primarily composed of dolomite, a very common mineral---calcium magnesium carbonate. Unlike the other aquifers, the Prairie du Chien is not entirely composed of small pockets of water and does hold caverns.

In the western portion of District 1, the Prairie du Chien formation is less than 50 feet from the surface and actually outcrops at the surface in some places. Water entering the Prairie du Chien in this area is not adequately filtered to render it a safe, long-term water supply. Consequently the State well code prohibits construction of new Prairie du Chien wells in most parts of District 1.

Above the Prairie du Chien aquifer, a 50' to 60' deep layer of mostly dolomite acts as a ceiling, separating it from the St. Peter sandstone aquifer, which is unconfined under District 1 and lies directly beneath glacial drift. The St. Peter aquifer contains little or no water in this area.

[photo of surface land]

Quaternary deposits: 10,000 to 2 million years ago

water-table and isolated aquifers		mostly unconfined, 0-100'

Ordovician deposits: 500 million years ago

Decorah Shale	confining unit	mostly nonaquifer, 60'
Platteville Formation	confining unit	mostly nonaquifer, 30'
Glenwood Formation	confining unit	mostly nonaquifer, 4'
St. Peter Sandstone	confined and unconfined	aquifer, 125'

Prairie du Chien Group:

1) Shakopee Dolomite	confining unit	mostly nonaquifer, 100'
2) Oneota Dolomite	confining unit	mostly nonaquifer, 100'

Cambrian deposits: 500 to 570 million years ago

Jordan Sandstone		ideal aquifer, 100'
St. Lawrence Formation	confining unit	nonaquifer, 30'
Franconia Formation	confining unit	nonaquifer, 290'
Dresbach Formation		

1) Galesville Sandstone aquifer, 50’
2) Eau Claire Formatin confining unit 200’
3) Mt. Simon Sandstone aquifer, 200’

Precambrian deposits:

More than 570 million years ago:

Hinckley Sandstone aquifer, 200’
Fond du Lac Formation confining unit nonaquifer,

at least a billion years ago:

Duluth Gabbro igneous rock [of volcanic origin or crystallized from molten magma] more than 5 miles thick

[thick line to indicate 5 miles of rock]

Deep and deeper

There are several aquifers and confining layers below the Jordan Sandstone. They are very deep, and few wells go down far enough to reach them, probably none in District 1. Below the Jordan aquifer is the St. Lawrence confining layer, the Franconia and Ironton-Galesville sandstone aquifers, the Eau Claire confining layer and finally the Mount Simon-Hinckley sandstone aquifer.

Galesville Sandstone is nearly 700 feet below the surface, and the Mt. Simon Sandstone is about 900 feet deep. The deepest aquifer in the Twin Cities Basin, the real “bottom” of the platter, is in Hinckley Sandstone at more than 1100 feet below the surface. It contains super-old water, a product of more than a thousand years of purification. The recharge area of the Hinckley Sandstone is the rim of a bowl 120 miles in diameter---considerably larger than the Jordan Sandstone---and includes the point where it actually reaches the surface in — the town of Hinckley. It reaches its lowest point at the center of the Twin Cities Basin, which is under the Mississippi River near the Franklin Avenue bridge and was used in the pure water brewing of Hamm’s beer fame. Another low point of the Hinckley aquifer, almost as far down, lies beneath the area at Pig’s Eye Lake. Pig’s Eye extends into Minnesota’s Sky Blue Waters, the deepest water “down under.”