Moorhead Balances Uses of Surface Water and Ground Water

The City of Moorhead, Minnesota, operates a regional water supply system. Its approach is the conjunctive use of surface water and ground water to address water supply issues for the Moorhead area and is a significant effort toward resource sustainability.

Moorhead obtains its water from two primary sources, the Red River of the North and the Buffalo aquifer. The Buffalo aquifer (Figure 1) is a narrow, elongated band of sand and gravel near the land surface oriented north and south about 5 miles east of Moorhead. Recharge is directly from exposure at the land surface. In places, the aquifer is directly connected to the South Branch of the Buffalo River as a source of recharge. According to estimates by the U.S. Geological Survey, more than 60 percent of the water in the Moorhead wellfield comes from the Buffalo River.

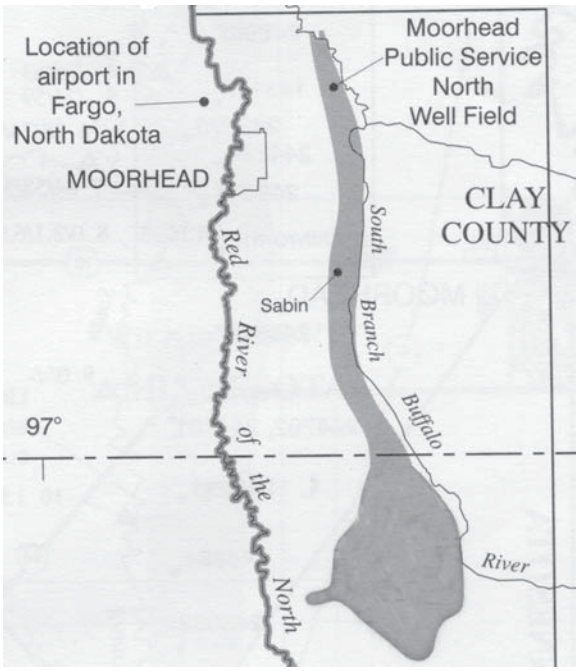

FIGURE 1. The Buffalo aquifer mapped in Clay and Wilkin counties.

Adapted from USGS Water-Resources Investigations Report 97-4084

Historically, the impact of the city wellfield on the Buffalo aquifer has been monitored using a ground-water-level monitoring well in the DNR Waters network. Until 1994, monitoring results showed a steady decline in water levels with pumpage (see Figure 2). In 1994, Moorhead opened a new water treatment plant and began taking more water from the Red River of the North. The main supply, when available, now comes from the Red River. Ground-water withdrawals from the aquifer were 600–700 million gallons per year (mgy) during the 1980s and are now down to less than 200 mgy. Figure 2 indicates that the change positively affected water levels in the Buffalo aquifer. Normal year use of the aquifer by Moorhead is for summer demand. Moorhead now supplies the nearby town of Dilworth and the urban area of Oakport Township; Sabin and Glyndon still have separate wells in the aquifer. Altogether, 75 percent of Clay County residents (36,000 customers) obtain water from the Buffalo aquifer.

FIGURE 2. A general decline in water levels changed after 1994 when Moorhead began taking more water from the Red River of the North (data from ground-water-level monitoring well 14001 in the Buffalo aquifer).

Estimates of water demand during drought indicate that the Buffalo aquifer has the potential to supply enough water for existing users and the Moorhead system without using water from the Red River of the North, although that amount of pumpage will

cause major water-level declines. Concerns remain that contamination will limit the usable supply because the aquifer has a high potential for contamination. Gravel mining is removing aquifer material that can filter contaminants and is exposing the aquifer to direct runoff.

There is already one toxic waste site at a truck stop along the Interstate 94 corridor, and there is pressure to develop more land along major highways that cross the aquifer. No major problems have been observed because of agricultural operations, including irrigation wells. Highway corridors along the aquifer are viewed locally as optimal sites for commercial development.

If Moorhead is to rely on the Buffalo aquifer for its sole supply during drought, it will need more wells distributed along the length of the aquifer to provide the desired amount of water. The city is working toward an aquifer management plan by integrating information from state agencies with local zoning, conservation and emergency planning, and wellhead protection. The Clay County Commission has recently adopted a revised development code that provides for resource protection: it incorporates a wellhead protection district overlay that matches the DNR aquifer sensitivity map. The new code includes all seven land use measures from the Moorhead wellhead protection plan. For example, the code requires new development around gravel pits to include dikes to prevent runoff into the pits.

FIGURE 2. Drilling ground-water-level monitoring wells is an important step in monitoring ground-water levels in aquifers.

Moorhead is able to pursue sustainable management of its water supply, in part, because of the many technical studies and the monitoring that characterize the Buffalo aquifer and document the water supply it can provide. The city has augmented earlier technical studies with its own monitoring and sampling that built on the prior work. Beyond technical studies, the city has recognized the need to engage landowners and managers in a cooperative effort to maintain this water supply. Some of the significant studies of the Buffalo aquifer in increasing levels of detail and sophistication are listed below with the approximate costs.

- Regional Hydrogeologic Assessment of the Southern Red River Valley, Minn.: DNR and Minnesota Geological Survey, 1995-1998. Cost: $500,000

- Hydrogeology and Sources of Recharge to the Buffalo and Wahpeton Aquifers in the Southern Part of the Red River of the North Drainage Basin, West-Central Minnesota and Southeastern North Dakota (M.E. Schoenberg, 1998, U.S. Geological Survey Water-Resources Investigations Report 97-4084, 35 p.): U.S. Geological Survey (USGS) and DNR cooperative project, 1998. Cost: $330,000

- Hydrogeology of the Buffalo Aquifer, Clay and Wilkin Counties, West-Central Minnesota (R.J. Wolf, 1981, U.S. Geological Survey Water-Resources Investigations Report 81-4): USGS-DNR-counties cooperative project, 1981. Cost: $200,000

- Basic Geologic and Ground Water Data for Clay County, Minnesota (USGS-DNR, 1960)

- Geology and Ground-Water Resources of parts of Cass and Clay Counties, North Dakota and Minnesota (USGS, states, counties, cities, 1949)

At least $2 million (in today's dollars) has been invested in this aquifer system to investigate the quantity and quality of ground-water resources and the amount of use the aquifer can support. This example is presented to illustrate the combined use of surface water and ground water, as well as a regional water supply system that is directly confronting risks to its water supply.