



# The HVAC REVOLUTION Gains (GEOHERMAL) Heat

The nation's newest lake-coupled geothermal system is under construction outside Chicago

When Great River Medical Center's new 700,000 square foot Greenfield Replacement Hospital and Medical Complex opened in Burlington, Iowa in 2000, it was immediately a trendsetter. It was the only hospital in the U.S. to be heated and cooled by a lake-coupled geothermal system. It was also the largest lake-coupled geothermal system in the country—a system that can produce more than 1,500-tons of cooling.

The best aspect may have been how the system exceeded the forecasted fuel cost savings. Current estimates show the geothermal system nets a savings of nearly \$1 million a year in fuel costs.

"Our goal when we opened Great River Medical Center in April 2000 was to be the most energy-efficient hospital in the country, and it didn't take us long to achieve this," said John Mercer, director of facilities.

But after nearly half a decade, no other hospital project had been undertaken to match or better the results at Great River Medical Center, even though the next facility promised to exceed the benefits of the first.

Until now, that is.

In the Chicago suburb of Elgin, Ill., Sherman Health has commissioned a 645,000-square-foot replacement hospital that will house 255 beds in six-floors. This new facility looks to be the next most energy-efficient hospital in the United States thanks to the "mach 2" coupling of hospital and geothermal HVAC.

For those at Sherman, foraying into the geothermal HVAC arena was a virtual no-brainer.

"We chose to go with the geothermal lake for its green qualities, as well as the money saving qualities. The lake is a renewable source and we expect to save



**Great River Medical Center will lose its status as the nation's only geothermal hospital when Sherman Health's replacement hospital opens in 2009.**

\$1 million a year in energy costs," said Dawn Stoner, project specialist at Sherman Health. "The lake and surrounding forest preserve also offers our patients a beautiful view and wonderful place to heal."

There are many similarities between GRMC and Sherman and perhaps the most important is KJWW—the engineering design firm which planned the systems at both hospitals. Warren Lloyd, vice president of KJWW and project manager for the Great River Medical Center project, said geothermal HVAC grew from the center's management team asking if they could use the lake feature incorporated into the project for anything besides cosmetic purposes.

"The project was to have a natural lake feature and they asked us if it could be used for heating and cooling," he said. "Great River Medical Center initially had more lake than they needed for the system because they were readying for additional building which they have already added and the system is also heating and cooling those buildings."

The biggest factor in utilizing geothermal HVAC is the availability of a lake, wells or digging deep into the earth to cool or heat the water used in heat

## FAST FACTS

### **Great River Medical Center — completed 2000** **15 acre geothermal lake**

**Lake depth:** 13 feet

105 geothermal grids, 100 miles of pipe

800 (approximate) heat pumps, 1,500 tons of capacity

**Geothermal HVAC design:** KJWW Engineering Consultants; Rock Island, Ill.

**Mechanical contracting:** Brockway Mechanical & Roofing; Burlington, Iowa

### **Sherman Health replacement hospital** **— estimated completion late 2009**

**15 acre geothermal lake**

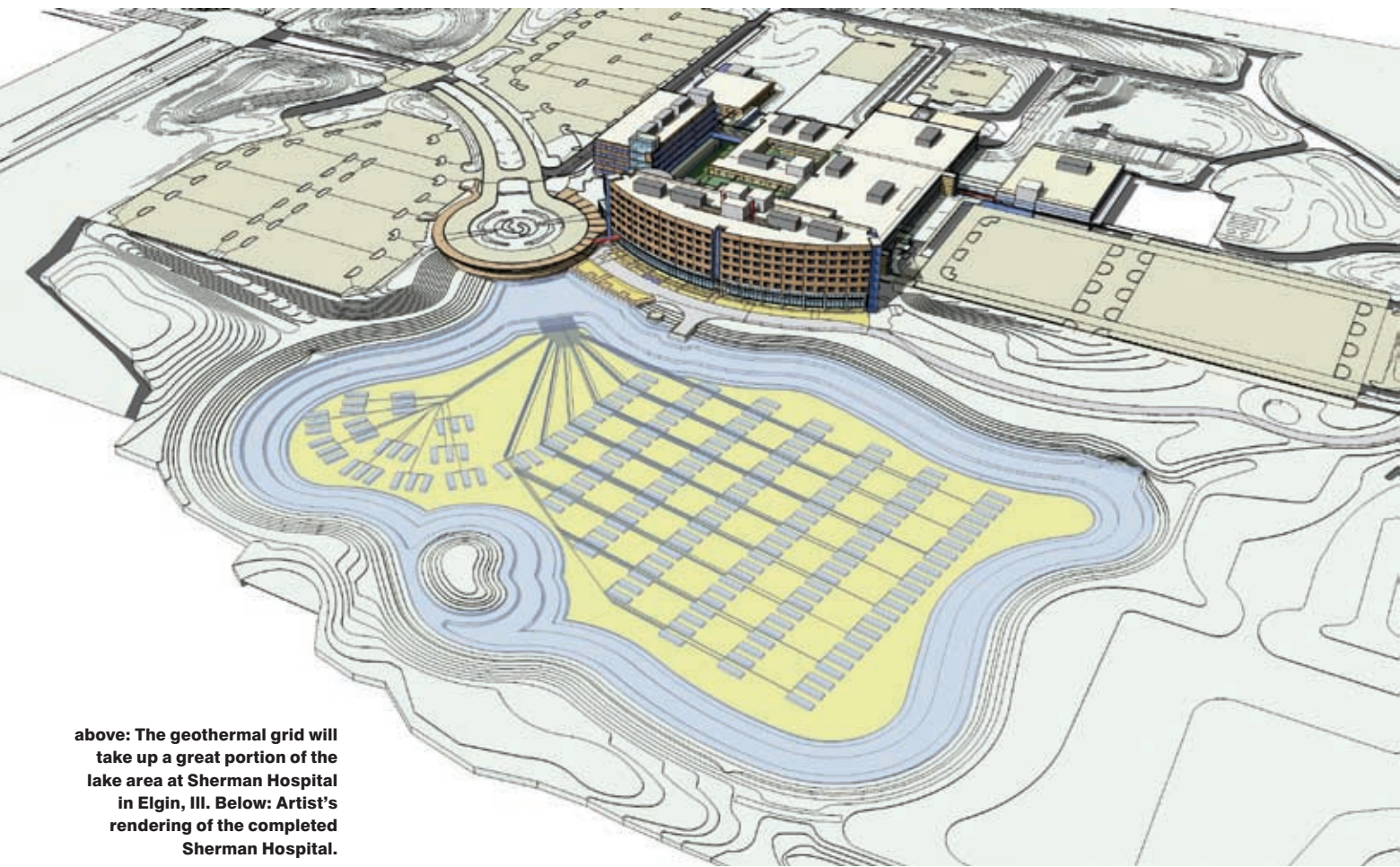
**Lake depth:** 18 feet

175 geothermal grids, 140 miles of pipe

1,000 (approximate) heat pumps, 2,450 tons of capacity

**Geothermal HVAC design:** KJWW Engineering Consultants; Rock Island, Ill.

**Mechanical contracting:** Mechanical Inc.; Chicago



**above: The geothermal grid will take up a great portion of the lake area at Sherman Hospital in Elgin, Ill. Below: Artist's rendering of the completed Sherman Hospital.**



“We chose to go with the geothermal lake for its green qualities, as well as the money saving qualities. The lake is a renewable source and we expect to save \$1 million a year in energy costs.”

—Dawn Stoner, project specialist at Sherman Health

pumps. At both projects, a lake-coupled geothermal system was a good fit.

“What prohibits doing a geothermal system is the capability of the ground to give the properties you need,” Lloyd said. “We used a lake which makes it viable.”

Though both facilities are using 15 acre lakes, surface area is at an elevated premium in Elgin. So, they sunk the polypropylene lake grids about 5 feet deeper in the Sherman project.

“We invented a manifold structure that has become a cornerstone of how this thing works,” Lloyd said. “Sherman did not want to use additional surface area, so we have a deeper lake.”

And, while construction and development is a massive undertaking, once installed, maintenance of the grid system is at a minimum since each of the grids can be brought to the surface if leaks occur.

“The grids are made of polypropylene pipe and are made so that they will float when filled with air and sink when filled with water,” Lloyd said. “There is really no other structure. Once the system is installed and pressurized, that is it.”

Lloyd said the task of designing the first geothermal lake project at GRMC was especially daunting

because of a 22 month design to completion building schedule. Unique attributes of the hospital energy profile raised issues that hadn't been presented in schools or office buildings: around the clock activity and a need to adjust heating and cooling on a room-by-room basis.

"Every patient room or bunch of offices needs to have a thermostat. In geothermal, you need a heat pump in every room and office," Lloyd said.

At Great River, that meant a total of about 800 heat pumps. Approximately 1,000 will be installed in Sherman hospital. When factored in with a failure rate of 2 to 3 percent each year, approximately 24 could fail over the course of 12 months. But since these are heat pumps, virtually any trained refrigeration and heating technician can switch it out—the same guy you would call to a residential home.

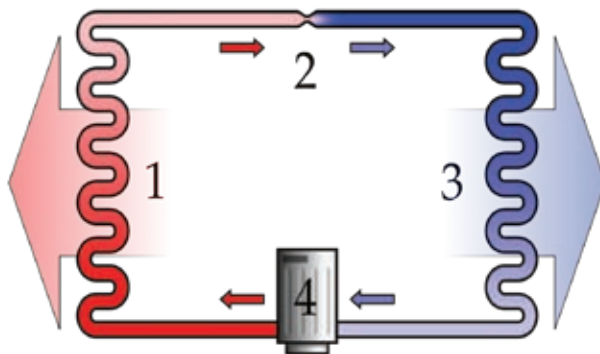
The advantages of a geothermal HVAC system extend beyond what can be measured and minded. Since geothermal is clean and efficient, it can also serve as a model for the future. Sherman will even use their geothermal system to educate.

"The lake is 15 acres (originally slated to be 10; 5 additional acres added for geothermal technology) and is 18 feet deep. We'll also be able to offer our community educational benefits of the lake," said GRMC's Stoner. "As you enter our lower level from the parking lot, you'll be able to view the interior Manifold room that will house all the piping for the lake. There will be educational signs placed in this area to describe how the system works."

Will geothermal become the standard method for heating and cooling America's hospitals? Only time will tell. But there is no doubt that any hospital that wants to be among the most energy efficient will take a long, hard look at geothermal HVAC.

"There have been other lake-coupled geothermal systems in the past, but none that were used for medical centers," Lloyd said. "Most of the systems we design are not geothermal. The reason that you do it is to make it the most efficient hospital there can be." ■

## How geothermal heating and cooling works



**A simple stylized diagram of a simple heat pump's vapor-compression refrigeration cycle: 1) condenser, 2) expansion valve, 3) evaporator, 4) compressor.**

Geothermal systems work by using the Earth's constant 55 degree temperature as a heating and cooling source.

### Heating mode

In heating mode, water is pumped through the grid and passes through the heat exchange unit. Within the heat exchanger, the refrigerant expands and changes from liquid into gas. This absorbs heat from the water and consequently cools it. Meanwhile the refrigerant is pumped to the compressor where it is pressurized and becomes superheated. This 'hot gas' releases the heat and warms the air of the building.

### Cooling mode

The cooling cycle is very similar except a valve on the internal refrigerant loop reverses the direction of flow. The compressed refrigerant coming from the compressor then heats the water before passing through the evaporator where it vaporizes, taking up heat from the air in the building. The heated water is pumped back to the grid where it is cooled and re-circulated.

*Source: Wikipedia and Warren Lloyd, KJWW*