



## Commercial Case Study

### Strip Mall Mines Energy from Subterranean Power Plant

For the owners of a new Rockford, Illinois strip mall, maintaining a low carbon footprint was the key to unlocking profit. Higher initial costs were overcome by the long-term benefit of reduced energy need and the promise of continually climbing energy rates.

“The mall owners wanted to get as close to LEED specifications as possible,” said Bill Sprague, project manager Area Mechanical. The 28-person firm is based in Rockford, and has concentrated on design/build commercial work, from grocery store refrigeration to hospital and school HVAC systems, for the past 20 years.

To provide high efficiency HVAC to the 12-business suburban complex, the owners approved a plan to install a network of water-to-air geothermal systems, each piped to a large main serving as the “thoroughfare.” This allows each system to pull and deposit BTU-rich fluids as needed. With a total capacity of 90 tons, the strip mall project called for an extensive geo-exchange field.

So, long before the framers and electricians appeared, three large drilling rigs rolled onto the jobsite to punch a field full of holes. They set to work, drilling 64 closed-loop vertical bore holes were drilled in an area now covered by asphalt, the strip mall’s parking lot.

To retain all that green, energy-efficient heating and cooling, a tight building envelope was designed. The building was heavily insulated and high-quality, low-E windows were specified. Awnings are installed over all the windows and doors, and the flat roof is white to reflect the majority of the sun’s radiant energy in the summer.

“We were under the gun for most of the project,” said Sprague. The slab for the 12-shop building was poured in August of ‘09, and the geo-exchange field needed to be complete by October, leaving just enough time to pave the parking lot before asphalt plants closed for the year.

“The geo-exchange field takes up the entire parking lot,” said Ryan Kerry, who, along with his brother, is part owner of Great Lakes Geothermal. As the drilling subcontractor, Great Lakes spent three-and-a-half months on the job to drill all of the bore-holes and trench the lines to the building. Great lakes also installed the U-tubes, and filled the bore holes with bentonite grout.

“Bore-holes for the Rockford mall average 250 feet in depth,” said Kerry. “We would normally go deeper, but we kept hitting gravel. Most likely, it’s loose conglomerate from an old, now-dormant underground river bed.” According to Kerry, the soil makeup was great for heat transfer until the rigs hit the gravel veins.

Average loop temperatures in the winter are in the low 40s, and in the 60s to 70s throughout the summer. The bore-holes were set at about 20 feet from each other. This allowed greater-than-average distance between holes, and yet would over time help to stabilize ground loop temperatures year-round, providing sufficiently cool temperatures for summer operation, and would also serve as a heat source with plentiful BTUs to be tapped for winter operation.

For each ton of heating and cooling capacity, there’s about 180 feet of bentonite grout-filled borehole. “Illinois state code mandates that all geothermal boreholes are grouted,” said Kerry.

Area Mechanical started the project with a thorough conductivity test. Nobody was looking to waste money by drilling an oversized exchange field, or worse yet, come up short on capacity if the field was undersized.

### On the Inside

The first shop to move into the mall was a large Subway restaurant. The 2,800 square-foot Subway eatery is heated and cooled by two ClimateMaster Tranquility geothermal systems suspended above the finished ceiling. One is a three-ton Tranquility® 30 vertical unit, and the other is a four-ton Tranquility® 30 horizontal unit, both hung from the roof trusses.



“Initially, we considered having a primary pumping system with continuous flow through all the wells and all the units, but later discarded the idea, even though we knew there’d be greater overall system efficiency if we circulated fluids that way,” explained Sprague. “But the owner of the building insisted on having the ability to split up the utility bills. A primary pumping arrangement would have allowed for only one power meter.



“There’s a total of eight circuits, each comprised of eight, two-inch geothermal loops. These are connected, or fused together, in the geo-exchange field,” explained Jeff Hurst, geothermal product manager at Connor Company, Area Mechanical’s geothermal equipment supplier.

Area Mechanical heat-fused all of the geothermal lines. Reverse return piping was used to run each circuit into the building. The tubing starts at an inch-and-a-quarter at the first well, and steps up as it joins the other wells. Two-inch tubing is used to run from the last well into the building. On the return side, the same tapering process is used, only in reverse order. This assures an even draw from all eight wells connected to the circuit. The geo-exchange medium – 1,800 gallons for the entire geo field and strip mall – is a 20% methanol mix.

“Once the circuits reach the building, they join a four-inch main, or header, that all the units individually draw from. It’s not a continuously-running body of fluid. Fluids circulate only when there’s a call for BTUs,” continued Hurst

To make sure that the heating and cooling costs were distributed fairly, each shop has its own flow center. It is wired to that tenant’s power meter. Each tenant simply pays for their own energy use.

"The pump arrangement we ended up using gives each tenant the ability to monitor their own energy use, hopefully making them a little more energy-wise. That was the building owner's intent and it appears that it's worked very well," added Sprague.

"There was another key advantage for the building owner: it saved a good deal of drilling expense," continued Hurst. "Since all the geothermal units share all the holes, each hole is being used to its' full capacity. We were able to save about 20 ft. of vertical bore hole per ton of capacity on this project because of the way the system is piped."

With an average flow rate of three GPM per ton, the Subway's seven-ton heating and cooling systems, when running at full tilt, requires up to 21 GPM.

The exchange field feeds numerous ClimateMaster water-to-air units throughout the mall. Not all have been installed yet, because not all the spaces are currently rented. "We use ClimateMaster systems routinely; it's been that way for about the past ten years," said Sprague. "Besides having a good product, we really trust and rely on the supply house. Connor Company's advice and expertise have been extremely valuable to us as we move into new and different uses of geothermal technology."

"Jeff Hurst has been a great guide and source of insight; he really keeps us in the loop. He and others there helped us with a system design for the Rockford mall that exceeded the building owner's needs and kept us on schedule with a tight building timeline."

"The complex in Rockford was our first geothermal strip mall, but it wasn't our first commercial geothermal rodeo," quipped Mike Sabin, secretary, Area Mechanical, partner in the firm with Gene Mead, president. Area has taken on and successfully completed fire houses, libraries and schools all around the greater Chicago area. Those experiences helped them put this job together in short order.

Area Mechanical has been a union shop since its inception and is affiliated with Local 23 Plumbers and Pipefitters.



### Every System Needs a Good Flush

To prevent problems an entire, piped geothermal system is flushed rigorously before antifreeze solution is introduced and before geothermal equipment is activated. This eliminates all debris and foreign matter, typically sand, grout, or plastic shavings that remain in manufactured pipes.

Here are some key insights, useful in performing the task well:

Geo systems need a forceful, thorough flushing. Area Mechanical chose to build their own, gas-powered flushing systems. One of their mobile units has a five HP Honda motor. The other – used for larger, commercial systems – has a seven HP Honda motor.

Each wheeled unit has a gas-powered motor, a 100-gallon poly tank and a filter to catch particulates.

"We must meet the minimum need of two feet per second when flushing as recommended by IGSHPA," said Area Mechanical's Bill Sprague. "But with commercial systems, where larger pipes are used, we often need a larger motor and pump to meet the volume we need to push through larger pipes. Our seven horsepower unit is well-suited for that."

"Once we were called in to push debris out of a large geo-exchange field that we weren't involved with," continued Sprague. "They couldn't move the sand and grit out of it with a standard-sized flushing unit. We cranked-up our seven horsepower unit and got the job done. There were gallons of stuff in the pipe that didn't belong in there."

Sprague explained that, for flushing, the strip mall's entire ground loop system was divided into eight circuits, each with the equivalent of about 5,000 lineal feet of pipe to clear during the flushing process. They divide the number 5,000 by two (for two ft./sec.) = 2,500. Then that number is divided by 60 which tells them the minimum number of minutes to flush.

So, for each of the eight circuits:  $5,000 \div 2 = 2,500$   $\div 60 = 42$  minutes. "We usually double it to be safe," added Sprague.



Rockford Strip Mall  
Rockford, IL

**Contractor:**  
Area Mechanical, Rockford, IL

**Driller:**  
Great Lakes Geothermal, West Chicago, IL

**HVAC Manufacturer:**  
ClimateMaster, Inc.  
climatemaster.com

**Equipment:**  
Tranquility® 30 Units



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