Highland Park’s Non-Traditional Design Includes Geo

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Planning for the Future

We enter a new year with a strong commitment to transition IGSHPA to realize its full potential to serve the ground source heat pump industry. By the end of the third quarter of this year, we will have re-established our deliverables to the industry by re-examining roles, responsibilities and expected outcomes with industry advisors.

We have started and will continue new partnerships to improve the overall marketing of the industry. An example being our work with the Western Farmer’s Cooperative “Go Go Geo Challenge.” This effort, led by Mark Faulkenberry, is a sponsored program approach that utilizes IGSHPA developed software to calculate an individual homeowner’s potential savings from their current HVAC systems to GSHP. The benefits to Western Farmers and other energy producers/distributors is demand management. The benefits to the sponsors are individual homeowner leads who have been informed about GSHP and have indicated an interest to be contacted by the industry sponsors. The Go Go Geo Challenge has a goal to reach 25,000 individual homeowners.

This issue of Geo Outlook focuses on the implementations GSHP designs for schools. Articles are presented for installations at two elementary schools in Stillwater, Okla.; a high school in Warrenton, Va.; and a new campus building at Montana State University. The benefits estimated or measured for these facilities are at the 50% energy reduction level with LEED silver certification. IGSHPA’s CGD course trains commercial GSHP designers in executing such economic benefits to the consumer. Please visit our website, IGSHPA.org, or call for new developments or schedules in CGD training.

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Borefield temperature on the rise?
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As seen below, maintaining the borefield temperature can gain huge cooling efficiency.
Grunseth Has Close Relationship with Industry
By Kaylie Lathe

Dean Grunseth

“In 1989, Grunseth started the job that would eventually lead to his career in geothermal.

Grunseth joined Snyder General as a water-source heat pump application engineer, but was unfamiliar with the heat pump technology.

“I had no idea what a heat pump was,” Grunseth said. “I spent the next five years learning all about the equipment and very little about geothermal.”

While his time as an application engineer was beneficial to his knowledge of heat pumps, Grunseth knew little about their application in geothermal. He had become interested in the use of heat pumps in the geothermal industry and wanted to learn more.

Grunseth found what he was looking for at WaterFurance International as the commercial business manager. WaterFurnace had a strong residential market and Grunseth aimed to build an equally strong commercial market for its heat pumps. During his four years with WaterFurnace, he not only built the commercial department, but also increased sales 20 fold.

“I was, along with a great group of people, able to train the market in commercial geothermal applications, develop products specifically for the commercial market and the sales tools needed with them, and team up with designers on some of the largest geothermal heat pump projects in the world at the time,” Grunseth said.

In 1999, McQuay International, formerly known as Snyder General, was becoming interested in the use of its heat pumps for geothermal. Grunseth rejoined the company where his journey with heat pumps began as senior marketing manager. He teamed up with designers in developing the first commercial water-source heat pump line that uses non-CFC, R410 refrigerant. Grunseth was pleased with the market reaction to the new refrigerant.

“Our biggest hurdle was introducing a new refrigerant, but with a new product designed around market needs and with the price, it didn’t take long to increase sales and market share,” Grunseth said.

Grunseth’s next step was to become the regional sales manager for Florida Heat Pump in 2007. Upon returning to the sales side of the industry, he again worked to transition a primarily residential company more into the commercial market.

After a short two years with Florida Heat Pump, Grunseth seized the opportunity to work with Bosch as the vice president of commercial sales. This included the sales of not only heat pumps, but also solar units, boilers and tankless water heating units. Grunseth developed new methods to meet the...
recently elected to the IGSHPA Advisory Council.

When asked what he sees in the future for geothermal, Grunseth sees IGSHPA as having a major role in the growth of the industry.

“I think IGSHPA will play a very large part in where the future of the industry goes,” Grunseth said.

Throughout his career, Grunseth and his close customer relationships have not only met the needs of the geothermal market, but exceeded them through innovation and staying receptive to, as he puts it, the “voice of the customer.”

In addition to holding positions with some of the top heat pump manufacturers in the industry, Grunseth has also been involved with IGSHPA, both directly and through manufacturers, since 1994 and was recently elected to the IGSHPA Advisory Council.

Grunseth acquired his current position as general manager of Mammoth, one of seven commercial manufacturers that make up CES Group, in 2012. Mammoth has been providing the heat pump market with high-end products for more than 50 years. Grunseth is working to grow the heat pump market by making new roads with both current and new product offerings and trends that have not previously been used in the heat pump market.

Grunseth has held many titles in his 20-year career and has furthered the geothermal industry by building the heat pump market with several companies. From product development, to training, to sales management, Grunseth has worked with many areas of the heat pump market to grow the industry. He prides himself most on the work he has done with the commercial market and the teams he has been able to work with.

“I would say my biggest accomplishment for the geothermal industry has been assembling the best commercial heat pump teams in the market,” Grunseth said. “I have had the pleasure of working with the best design teams, system experts and technical sales managers in the industry.”

In addition to holding positions with some of the top heat pump manufacturers in the industry, Grunseth has also been involved with IGSHPA, both directly and through manufacturers, since 1994 and was recently elected to the IGSHPA Advisory Council.

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The striking exterior appearance of the one-story school is supported by the use of different facades on each part of the building.

(Photograph by Janet F. Reeder)
Highland Park's Non-Traditional Design Includes Geo

By Linda Allen
The original Highland Park Elementary School, in Stillwater, Okla., was constructed in 1950. Like many schools from that time frame, the building’s function had been stretched beyond its physical capacity. Several teachers held classes in the enclosed breezeway. The building had been added on through the years to the point that it was a maze to get from one point to another. A shortage of playground and parking spaces required the district to rent and maintain the parking lot of a neighboring church for these spaces.

Land space at the original location was insufficient for any new construction. District property located about one mile east was chosen for the new school. With 24 acres to work with, Highland Park incorporated a nontraditional design that welcomes students with a circular drive and a 40-foot clock tower that marks the main entrance. A soccer field located in the center of the circle also provides storm water detention.

Highland Park goes beyond Stillwater Public School District goals of creating an eco and student-friendly learning environment with its emphasis on nature. Set in a wooded area, “the positioning of the school was intentional to maximize natural daylight,” said principal Kurt Baze.

The site adjoins the high school’s agricultural education farm, which allows students to learn about horticulture and animal husbandry. SPSD also owns a house and wooded area behind the school for outdoor days to enjoy Oklahoma’s seasonal mild weather.

Glass is a defining feature of the building, and provides ample natural lighting and blends the indoor/outdoor environment to foster students’ connection with nature. The cafeteria, located in the center of the building, showcases a glass “tree well” – a large cylindrical cut-out that encloses two living trees. Students and teachers
enjoy watching the seasonal changes and growth of the trees.

The 92,000-square-foot building houses 28 classrooms and additional special-use rooms in two grade-level wings: Pre-K, kindergarten and first grade together in one wing and second through fifth grades in a separate wing. Glass corridors link colorful, glazed brick “school houses.” Each color designates a specific grade.

Classrooms in each wing open to an enclosed courtyard. Younger grades enjoy a trike track and giant letters for climbing during breaks. The courtyard for older students incorporates an Oklahoma history theme using Route 66 to teach geography and history. Cisterns in each courtyard collect rainwater for irrigation.

A central core links the two wings. Administration offices, the cafeteria and gymnasium are located in this area, which is available to the community after school hours. The separate community use area helps regulate security and energy costs.

Ross-Barney Architects of Chicago, Ill., and Selser-Schaefer Architects of Tulsa, Okla., the architectural design team, worked with the district to solicit teacher, staff, student and community input for the new schools. Security and sustainability were major considerations in the building design.

Located in “Tornado Alley,” Oklahoma frequently makes headline news with destruction, injuries and deaths. The Highland Park design addressed weather security with five corridors, each with 8-inch, steel-reinforced concrete walls and 12-inch ceilings and hurricane-resistant doors as designated safe areas for students and staff.

District research and community input ranked geothermal high on the desired green components for the new construction. Air Comfort, Inc., Jenks, Okla., installed the geothermal system. Cecil Crain, president and owner, has 45 years of HVAC experience. He became involved with geothermal in 1978 in a class at Oklahoma State
University. With that experience, he has become an advocate for the technology and its environmental conservation value.

Crain described the Highland Park installation as a low-temperature, high efficiency, two-stage heat and cooling system with an 8-inch mono-loop inside the building. Total tonnage is 226 tons with 62 WaterFurnace heat pumps. Each classroom has an individual, designated heat pump and thermostat, with remote control from a central administration site.

“We had to value engineer part of the project to get in budget. With five storm shelter corridors in the building, we had to locate several dozen block outs for ductwork to get them in the correct places,” said Crain. “Because of the varying, zigzag roofline, we had to take special care in the installation to avoid penetrating the corridor walls and being above the roof. That’s just part of our goal for consistent, quality installations for dependable systems.”

The Highland Park campus contains two geothermal bore fields with 121 boreholes at 390 feet deep. One field
of 56 boreholes is located under a playground and the second larger field of 64 boreholes is located beneath the teachers’ parking lot. The fields contain 93,600 feet of pipe, including headers. Environmental Loop Service, Tulsa, Okla., which specializes in the “ground-source” portion of a ground-source heat pump system, was the driller and installed the closed loops and inside piping work.

The mechanical room features an observation window where students, teachers and community can view the geothermal equipment. Signage will include basic information about how the geothermal system operates. The window also supports the district’s efforts to use the school as a teaching...
model for sustainability and energy conservation in the community. Curriculum plans will use the building as a practical example of how geothermal affects the environment to teach basic geothermal concepts in the upper grades.

Initial data indicates an approximate fifty percent energy cost reduction with the new construction compared to the old building. Anticipated pay back for the geothermal system is within five to ten years.

Additional green features include motion and daylight sensors for energy conservation, insulation, low-V paint and native landscaping. The building is targeted to achieve LEED silver certification.

The best endorsement for green construction is the end users. Principal Baze is particularly impressed with the geothermal system, listing “its flawless running, environmental conservation, cost savings and educational component for students” as the system’s strongest features.

Classes started in the new building in August 2013. A tour of the building allows visitors to feel the open space and sense the pride of ownership of the school’s occupants. Interior walls, intentionally left blank, are beginning to fill up with students’ creativity and projects.

From design to delivery, students and the community had the option to keep up with the progress of the construction. Students signed the last piece of steel erected on the building, an 18-foot, 300-pound beam on top of the clock tower, for the “topping out” ceremony. The beam was left unpainted so their names will be up there until the ink washes away.

Those students and students for decades to come will prepare for a creative future in a sustainable building that reflects Stillwater’s education priority and concern for the environment. Stillwater patrons invested well in the future of their students, community and the environment.
Montana State University Gets Connected to Geothermal

By Janet F. Reeder

All of the trades worked together to coordinate and schedule the equipment and materials on the tight building site.

(Photo courtesy of Energy 1)
Montana State University in Bozeman, has begun their first venture into geothermal with a new campus building to house the Jake Jabs College of Business and Entrepreneurship, named after and financed by alumnus Jake Jabs, president and CEO of American Furniture Warehouse.

“The decision to go geothermal dates back to a project with an existing laboratory building called Leon Johnson Hall. We were doing a major HVAC retrofit of that building in 2009,” said MSU Assistant Director of Facilities Services, Dan Stevenson.

“We designed Leon Johnson with a simultaneous heating and cooling plant,” Stevenson says. “And we designed it to be geothermal ready.” Leon Johnson Hall utilizes a ClimaCool plant with about 640-ton capacity to produce heating and cooling. It is also designed to be expandable.

A rendering of the Jake Jabs College of Business and Entrepreneurship shows the design of the new Montana State University building. (Courtesy of Comma-Q Architecture)

Drilling of the borefield commenced early in the project, before the site became quite as crowded. (Photo courtesy of Energy 1)
Materials had to be brought in as needed and thoughtfully placed on site in order to allow the workspace needed for the project to stay on schedule.

( Photo courtesy of Energy 1)
“We didn’t even know the JJCBE project was going to happen when we designed this plant,” Stevenson said. “But we designed the plant with enough flexibility and we have a wonderful tunnel system here on campus,” he adds. “That allowed us to extend the heating and cooling and the geo source loops to the JJCBE where we are installing the first borefield we have here on campus. When we get the geothermal on, since this is our first one—we are going to run it hard and see what it will do,” Stevenson says.

Geothermal energy from that borefield is moved to the Leon Johnson plant to produce heating and cooling streams. “From there, we take that out to a district of buildings. It is not just the JJCBE and Leon Johnson. It will be sized to take on five of our main campus buildings,” he said.

“It has worked out very, very well. And it is the kind of future plant type that we are focused on developing here on campus,” Stevenson says. He says the integration of waste heat, solar thermal and large-scale geothermal resources are all possible. Stevenson credits the forward thinking of MSU in the 1990s, for the success of the district plant concept.

Erik Renna with Morrison-Maierle, Inc.’s, Bozeman office, is the overall project manager and the lead mechanical on the JJCBE project.

Contractors were allowed only one vehicle or piece of equipment on site at a time because of space considerations between existing buildings.

(Photo courtesy of Energy 1)

M-M has operations in five states and is headquartered in Helena, Mont. M-M designed the loop field.

“Very early in the process we started working with LEED consultant Kath Williams+Associates,” Renna said. “We called a LEED charrette to identify interest in sustainability throughout the project from the university side, from the design team and the contractor’s side to
see the interest from all the stakeholders on the project,” Renna says.

“At least at Montana State, there is a district steam plant that serves all of campus. So the majority of buildings on campus are heated by steam from the district heat plant. The cooling systems tend to be conventional systems with water-cooled chillers with evaporative style cooling towers,” Renna said.

Construction on the JJCBE project is currently about a third into the steel erection and about a third of the way through the schedule as a whole, says Jake Van Dusen, project engineer with general contractor, Dick Anderson Construction’s Bozeman office.

“During design we went through many design discussions about function, sustainability and budget,” Van Dusen said. The state of Montana mandates a LEED Silver certification for the JJCBE building. “The project is obligated to reach silver, but we are cautiously optimistic that we have the ability to reach a higher LEED standard.”

Van Dusen commented on a recent article in the Bozeman Chronicle highlighting MSU student disappointment that initial plans for solar panels had been scrapped. He says that was part of the decision making process.

“We found that putting resources towards PV did not show the same return for the project as other sustainable features. For example,

**Trenching and pipe runs to tie the 52 vertical 500-foot boreholes together progressed early in the project.**

(Photocourtesy of Energy 1)
we’ve been able to add more natural materials, ‘smarter’ HVAC systems, more natural lighting and generally a more livable building as a result of many collaborative design efforts.” Van Dusen says that PV could be facilitated at a later date, while many of the other sustainable design features could not easily be retrofitted to the building in the future. MSU Planning, Design and Construction Project Manager, Sam Des Jardins, agrees with Van Dusen, that solar panels could conceivably be added later.

“In this case,” Des Jardins says, “I think our geothermal is going to do a lot more for filling the needs of this campus than solar panels would have.”

He thinks the JJCBE building has many sustainable features that commend the building and show the university’s efforts to be sustainably responsible. He admits that once the geothermal is in the ground, it becomes an invisible technology.

“Geothermal is definitely an interesting feature,” Des Jardins says. “It is almost like you have to continually remind people about it, or they forget it is there.” He says they are looking at signage and ways to highlight the geothermal aspects and educate the community about the sustainable efforts the university is making. He also sees the university’s first geothermal effort as just a beginning.

“This is really a stepping stone for tying one piece of campus into another piece of campus,” Des Jardins said. “Essentially we can continue to grow as we continue this new network to improve our overall campus.”

The university’s mechanical engineering technology program, led by Kevin Amende, saw students assisting in managing the pilot bore installation and establishing the thermal conductivity data. “That information directly informed the JJCBE project,” Stevenson said.

Energy 1, of Bozeman, installed the heat exchange system for the 52 vertical 500-foot boreholes. The drilling process was completed in cooperation with Bertram Drilling Inc., out of Billings, Mont.
“We were approached by the MSU facility’s office a few summers ago to begin discussion of geothermal integration on campus,” Energy 1’s Leon Crane says. Crane says the goal was to assess campus wide geothermal tie-in for both existing buildings and new construction.

“We have done so much work with the university, it was pretty exciting to get to do the test borings,” says Mike Foran, also of Energy 1. “It was especially important to us to see geothermal happen for the university because we believe in it so much,” Foran said.

The HVAC system is a single-duct VAV system with reheat. All offices and classrooms will have low temperature fin-tube heaters that operate with 130-degree entering water. The main lobby entry has in-floor radiant heat in approximately 3,000 sq. ft. A heat recovery ventilator will be used to recover heat from the bathroom exhaust. The air-handling unit that serves the classrooms includes an energy recovery wheel.

A passive solar collector located on the south wall of the penthouse is used to pre-heat outside air in the winter. An alternate intake for the air handling system on the north side of the building allows for extended economizer hours.

“It was great for us to see a university that we have so many ties to, move in this direction with smart energy efficiency integration on campus for not only the existing structures but also the new structures,” Crane said. He says it really fit in line with how Energy 1 likes to do business in terms of testing, planning, design and delivery—just making sure everything is very well thought out.

Architectural support for the project comes from Ben Lloyd of Comma-Q Architecture of Bozeman, Mont., and Hennebery Eddy Architects of Portland, Ore.

Construction on Montana State University’s JJCBE building is set for construction completion and occupancy by July 2015.

“It will be a prominent center piece on campus,” Van Dusen says.
Will Rogers Elementary
Again State-of-the-Art

By Linda Allen
The North-facing backside of the new Will Rogers Elementary School shows the gentle curve of the two-story structure. The thoughtful design feature mirrors the curve of a creek on the site.

(Photo by Janet F. Reeder)
Stillwater, Okla., a Midwestern community of 45,000 and home of Oklahoma State University and the Oklahoma Department of Career and Technology Education, is often touted as Oklahoma’s Education Community. Its coordination of education resources to develop a work-ready population has earned the community accolades.

Stillwater Public School District has been rated among the Top 100 districts in the U.S., and Stillwater High School received a Gold Medal rating for workforce preparation by Expansion Magazine. SPSD annually recognizes numerous National Merit Scholars.

In 2011, Stillwater voters invested their money on continued education priorities by approving a $61.5 million bond issue to build two new elementary schools to replace ones that had outlived their functionality: Will Rogers and Highland Park. The bond issue allocated $18.375 million to the construction of each school. The remaining funds were designated for renovation of eight other schools and site maintenance.

Built in 1950, the original Will Rogers featured an L-shaped design. Classroom windows opened to a breezeway, making easy access for students, parents and visitors. But, times and the world changed. Renovations enclosed the breezeway for security and weather safety. The tops of the walls were lined with mesh instead of glass, and one end of the

Until deconstruction of the old school on the North side of the new building is done and the access drive for the front entrance is built, buses, students, teachers and visitors enter the school from the rear.

(Photo by Janet F. Reeder)

Ample use of glass at the new Will Rogers School provides for day lighting throughout the building,

(Photo by Janet F. Reeder)
breezeway was left open, creating a new set of problems. Leaves, dirt and trash collected in the area; birds damaged fiber optic cables strung across tops of the walls and students were still exposed to the elements when walking through the area.

Student population exceeded the building’s capacity of 350, creating safety concerns. Every available space had been converted to classroom space. Bringing the building up to par would be a severe financial cost to the district. The building had become a money pit.

The new two-story building was constructed on the same property as the original school. While two-story elementary schools are not uncommon, in the case of Will Rogers, the design allowed more space on the 12-acre site for playgrounds and green areas.

The design is a linear flow that mirrors the curve of a small creek on the site. Shades of blues and greens on the exterior wall panels mimic the color of water.

Architect, Carol Ross Barney of Ross Barney Architects, Chicago, Ill., and Selser-Schaefer Architects, Tulsa, Okla., worked with parent and teacher committees at each school to solicit input for the design. Community input determined green features, including geothermal, a community use wing for community activities, security and weather safety as high priorities.

After the 2013 Oklahoma City and Moore tornados that destroyed two schools, killed seven students and injured several teachers, the State of Oklahoma began a push to make sure every school has a safe room or area for its students. Stillwater was ahead of the effort with safe areas designed for both new schools. Two central corridors, one on each floor are constructed with 8-inch, steel-reinforced concrete walls and 12-inch ceilings. Hurricane-resistant doors seal the areas to protect students and staff.

Building the new school right behind the old school allowed for classes to transition easily. The front entrance and an additional playing field will wrap up the Will Rogers project.
The 92,000-square-foot building serves 524 students and 80 teachers and staff with 28 traditional classrooms, 14 special classes, two computer labs and health and wellness offices. Student capacity for the new building is 600. The first floor serves Pre-K, kindergarten and first grades for easy access and exit from the building in case of fire. Second through fifth grades are located on the second floor. The community use rooms include the cafeteria and gymnasium, which are located in the center of the building and can be shut off to help with security and energy savings.

“We are honored and privileged to have this building. It’s like being in a castle,” said Principal Cherron Ukpaka. “I asked the students, ‘Can you believe the community believes in you so much they would build a castle for you?’”

To celebrate their first day in the new building day, each staff member wore a tiara.

Lambert Construction, Stillwater, Okla., was the project manager for both schools and contracted with Geo Enterprises of Catoosa, Okla., for the geo system designs of Will Rogers and Highland Park. Founded by IGSHPA Advisory Board member, Phil Schoen, Geo-Enterprises is well respected in the industry for quality installations, innovations and training.

Driller-Operator, Chris Hayes, runs one of two rigs brought to the Will Rogers site by Lake Country Drilling out of Ardmore, Okla.

(Photo by Janet F. Reeder)

Jody Morgan, owner of Lake Country Drilling, checks the operation of his rig while working on the geothermal installation at Will Rogers Elementary.

(Photo by Janet F. Reeder)
Lake Country Drilling brought two rigs to the site to put in two borefields for Will Rogers new school.

(Photo by Janet F. Reeder)
The location of the Will Rogers geothermal field created challenges for locating and drilling the wells. The site is located in a flood plain, and a silt wall was required to protect the creek from drilling mud and debris. Schoen located boreholes to maximize efficiency and the thermal benefit of the site and to better coordinate construction. The closed loop system is located under the playground with 82 wells at 400 feet deep. Two separate valve vaults were used to bring the field together.

“We designed a heat rejection system to manage any seasonal changes,” Schoen said. “The thermal management cooler will manage the well field for any excess heat due to changes in usage.” Schoen said the dispersed bore field operates with individual valve controls for grouping the control of the well circuit.

Mechanical contractor, Co-9 Air Control, also of Catoosa, Okla., oversaw the inside installation of pumps. WaterFurnace manufactured the 72 heat pumps installed overhead above ceilings. Interior piping work installed by Geo Enterprises included two circulating main pumps in the mechanical room, risers and entry lines from the borefield.

The layout of the mechanical room at Will Rogers gives easy access to check or do maintenance on the geothermal system.

The mechanical room includes an observation window where viewers can see the circulating pumps and piping into the building. The window and signage are part of SPS’s intention to use both Will Rogers and Highland Park schools as working examples of geothermal technology and sustainability.
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9
Fauquier High Moves to Geothermal

By Kaylie Lathe
The ability to schedule temperature points for different parts of a building and significant energy savings were the driving factors for the new ground-source heat pump installation in a Virginia high school.

Fauquier High School of Warrenton, Va., recently completed renovations and a new facility with ground-source heat pump technology and other energy efficient features that meet LEED standards, says Warren Darrell, construction director for Fauquier County Public Schools. In addition to a GSHP system, energy efficient lighting and recycled materials were used in the buildings.

The renovated buildings were originally built in 1965 and 1979. The GSHP system will heat and cool about 144,000 square feet of new and renovated space. Construction and renovations began in 2011. The building addition was partially occupied in February 2013 and fully occupied by August 2013. Renovations will be completed during summer 2014.

The geothermal field for Fauquier High School is located beneath a parking lot with a 380-foot base and a width that varies from 90-150 feet. Northern Virginia Drilling of Manassas, Va., dug 16 trenches and drilled 160 boreholes at 550 feet deep with a diameter of 6 inches each for the system. Each borehole contains two

Careful planning went into the placement of the piping that would later be enclosed by the manifold building. (Courtesy of Warren Darrell, Fauquier High School)
1-1/4 inch HDPE pipes, joined by a U-bend. Thermally enhanced bentonite grout was chosen to surround the pipes. Lawrence Perry and Associates of Roanoke, Va., designed the closed loop system that uses only potable water.

The piping for each loop is connected to 1-1/4 to 3-inch supply and return pipes, which run to supply and return manifolds in an above ground building. Water flows from the manifold building to the high school building mechanical room through underground 8-inch supply and return pipes.

Darrell remembers the challenges of the installation. “Our site was very rocky,” Darrell said. “It had metamorphic rock, a lot of fractured rock and groundwater.” Scott Miller, owner of Northern Virginia Drilling, also recalls how groundwater presented challenges. “We were hitting anywhere between 125 and 175 GPM in each borehole, so we had to use large sediment pumps and filter bags to clean the water to acceptable standards,” Miller said.

An advantage of the abundant groundwater, Darrell says, is good thermal performance of the below ground heat exchange field. “Our pre-development average below ground temperature was 57 degrees all year around, enabling our heat pumps to operate very efficiently.”

“The borefield was more remote from the building than what we typically design,” Richard Hughes said. “There was a little more distance for the piping to run from the borefield to the main mechanical room.” Hughes is the lead mechanical engineer from Lawrence Perry and Associates.

“The contractor did a good job of directional underground boring beneath a stream to route the main supply and return pipes from the (Opposite) Northern Virginia Drilling of Manassas, Va., dug 16 trenches for 160 boreholes to be drilled. (Courtesy of Warren Darrell, Fauquier High School)
To complete the system, WaterFurnace and AAON heat pumps were installed in the building. These included 96 ceiling hung and floor mounted water-source heat pumps inside, 10 rooftop water-source heat pumps and 6 rooftop ventilation units. All heat pumps use R-410A, a non-ozone depleting refrigerant. The total cooling capacity tonnage is 392 tons with a rated cooling capacity at 90 degrees Fahrenheit entering water temperature. The total heating capacity is 4,392 MBH.

The renovation and installation were completed in August 2013, but this was only phase one of three for Fauquier High School, Hughes explains.

“We’ve designed two additional phases of the project,” Hughes said. “A renovation of the performing arts wing that includes the band and choral rooms, renovation of the science wing and arts wing. All of these additional phases have been added on to the original project.”

The decision to make Fauquier High School the first school in the district to have a geo installation came after Darrell and school officials researched ground-source technology. Darrell spoke with several school districts and others who have used GSHPs, including York County Public Schools in Virginia and Montgomery Public Schools in Maryland. He also spoke to the City of Charlottesville in Virginia.

Industry publications, including those from IGSHPA, were also consulted during the research period. While many resources were used, Darrell found speaking with other schools to be the most beneficial in the decision that ground-source heat pump technology was the best option.

“Before we started renovating Fauquier High School, the entire building used 68,300 BTU per square foot per year, including electricity, natural gas, oil and propane,” Darrell said. “During the period November 2012 through October 2013, the separately metered addition and renovation used 31,000 BTU per square foot, mostly in the form of electricity.”

While Darrell and officials believe the
energy monitoring will show even better results, they are hesitant to say anything definite until they have monitored their energy bills further.

“It appears that our new efficient systems will result in considerably reduced energy consumption and cost, however, since our new building was only partially occupied until August 2013, we are cautious about the results and will continue to monitor energy consumption and cost,” Darrell said. He is enthusiastic about the lower maintenance cost that will come as a benefit from the installation.

Students gain access to all classrooms and office areas using the large open stairway. (Courtesy of Stephanie Rollow, Whiting-Turner Contracting Company)
“We will get lower total energy bills and lower maintenance costs because most of the equipment is indoors and we don’t have a cooling tower,” Darrel said. “We find cooling towers to be very maintenance intensive and problematic.” Darrell’s enthusiasm continues when speaking about room-by-room temperature control, another huge advantage with GSHP systems.

“The system lends itself quite well to room-by-room temperature control, which is important in a school, especially a high school because of different schedules and events that happen in the evenings and on weekends,” Darrell said.

Water flows from the manifold building to the high school mechanical room through underground 8-inch supply and return pipes. (Courtesy of Warren Darrell, Fauquier High School)

Trenching progressed nicely despite the difficulties presented by rocky terrain. (Courtesy of Warren Darrell, Fauquier High School)
Making the energy saving features visible to the students was important for Fauquier High School. Signs can be found all over the school explaining the sustainable features, such as the energy saving lighting and the recycled materials used in construction. Diagrams and signs also explain how the ground-source heat pump system works and the efficiency it brings. A learning session was conducted during construction for the science teachers and any other faculty who were interested and two presentations about the system have been given to science classes.

While this is Fauquier County’s first encounter with geothermal in schools,

Piping in the mechanical room for the supply and return needs of the geothermal system allows for needed access.

(Courtesy of Warren Darrell, Fauquier High School)
others involved in the project were more experienced. Schools have been a major part of business for Lawrence Perry and Associates, Hughes says. Northern Virginia Drilling, the driller for FHS’s project, does both commercial and residential installations, and has experience in other educational projects.

Officials at Fauquier High School plan to continue monitoring the energy bills in order to get a more accurate reading on the energy savings. Darrell remains optimistic that geothermal was the right choice for Fauquier High School.

*Editor’s note:* Virginia’s York County Schools were highlighted in the 2013 Geo Schools issue, Volume 10, Number 1.
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Over the holiday season a water source heat pump system deficiency hit me right between the eyes – almost literally. My wife Nita experienced a detached retina over the holidays, had surgery on Christmas Eve and ongoing check-ups at various locations on holidays and weekends because of the timing of her surgery and follow-up check-up schedule. She’s great, the eye is doing fine, but I am still VERY disappointed in a mechanical contractor that did the installation in this almost new facility and the owner that hasn’t gotten this resolved for his tenants.

The visit was progressing nicely until the technician said she though the office was getting warm and “stuffy” – and it was (another tough winter day in Texas – clear, sunshine, light breezes, and about 60-65º F and we were in the core of the building). While she left to turn on their HVAC system, Nita and I were discussing the progress her eye was making when suddenly, I couldn’t hear her. That’s right – I couldn’t hear my wife talking – and she was next to me. I’ve heard some “noisy” systems before, but nothing like this!

Some of you have probably guessed by now – it was one of the distributed heat pumps in a California loop (boiler/cooling tower) water source heat pump system that served the multi-story building. Typical of many commercial facilities, the distributed heat pump units were horizontal units above the dropped ceilings – a good plan if you do it right, a problem if you don’t.

I was stunned. During the compressor start ramp-up the unit was so poorly installed/ accessorized that the noise/vibration was transferred directly into the examination room at a noise level that drowned out our conversation. As the unit progressed into normal operation, the noise level dropped somewhat, but was still far too noisy to be acceptable in a professional environment – we, the technician, and doctor who had just come in all had to talk louder than normal to communicate.

After the examination was completed and recovery status discussed, I asked the doctor if it had always been that noisy, and he said “YES!” “It’s been that noisy since we moved in, many of the other rooms have the same problem, and they can’t solve the problem.” However, he did say it is “much better during the winter because the unit doesn’t run a lot”, but “during summer when the system runs most of the time, it’s awful.” As we discussed further, he indicated that they had approval to move to a new location and would be doing so shortly – not because they needed more space (there was additional adjoining space available – wonder why?), but because of the noise.

What a terrible testimony for this owner and the contractor – a multi-facility eye surgical specialist is moving one of their locations out of this medical building campus building because of the noise and the contractor can’t solve the problem!! The doctor was clueless on the system, so he couldn’t answer any questions.

On the drive home, I ran through the many possible causes for something like this (and the often simple solutions), wondered why the contractor couldn’t or wouldn’t solve the problem, and about an owner that will lose this class of tenant because he doesn’t solve problem. At least it wasn’t a geothermal project…

Mr. Rawlings has more than 35 years experience in the geothermal industry. He is the Director of Geothermal Services for Trison Construction, a Certified GeoExchange Designer (CGD) and an IGSHPA Accredited Installer and Trainer.
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