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RESERVOIR RISK MANAGEMENT SYSTEM BUILT USING CORRUGATED HDPE PIPE

Relieves Upward Pressure on Underwater Liner

CHARLOTTE, N.C. - For a new 250-million gallon capacity water reservoir here, dual wall, corrugated high-density polyethylene (HDPE) pipe is being used as a safety system to protect the liner that covers the entire reservoir bed. The six-, eight-, 12-, and 18-inch diameter perforated pipe collects water seepage to reduce the pressure underneath the liner and prevent it from floating. More than 14,640 linear feet of pipe was used for the system that sits under 35 feet of water and four feet of fill.

Started in January 2010 and completed in May 2011, the Franklin Water Treatment Plant Reservoir Expansion project combined two existing reservoirs built in the early 1900's and rebuilt the area to become compliant with current dam safety regulations. Water from Mountain Island Lake is pumped from the Catawba River Pump Station to the reservoirs at Franklin Water Treatment Plant in north Charlotte. The raw water is then gravity fed to both the Franklin facility and to the Vest Water Treatment Plant.

Cost of the reservoir improvement project was $18.7 million, managed by Thalle Construction Company, Inc. (Hillsborough, N.C. office) and designed by the engineering firm of Hazen & Sawyer, P.C. (Charlotte and Raleigh, N.C. offices).

"The goal of the pipe is to protect the liner," explained George Eller, P.E. the design engineer of Hazen & Sawyer. "The pipe will catch any water coming to the bottom of the liner including leakage and groundwater, and reduce the upward pressure on the liner that the excess water would exert. The pipe system will prevent the liner from floating. It basically operates like a French drain."

The Class II perforation pattern enables water to enter the corrugated HDPE pipe from any direction and be conveyed to a central collection point and then into twin lines of solid wall HDPE pipe that run under the dam and to a manhole.

Eller selected the HDPE pipe from Lane Enterprises (Camp Hill, Pa). "There could be other options," he allowed, "such as vitrified clay pipe, but for this type of drainage collection everybody uses HDPE perforated pipe. It's economical and the other types of pipe have fallen by the wayside over the years."

Photo by Steve Montgomery, Skyshots.net 800/656-8888

"We excavated about 27 acres. The system covers the circumference of the new single reservoir along with a grid pattern of pipe on

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the inside," explained Charles da Silva, project engineer for Thalle. "We moved a lot of dirt to mostly a depth of 30 feet.

"This is a relatively new way of using HDPE pipe and also an excellent concept for reservoir or pond underdrain systems. It's easy to work with and we've worked with it many times before in other types of projects. The installation here went pretty smoothly and the HDPE pipe went in well."

The corrugated HDPE pipe's bell and spigot configuration provides a secure joint between pipe sections and can be quickly installed with minimum labor due to the pipe's weight and length. Each section is 20 feet long, which minimizes the number of joints to reduce installation time and costs. Compared to other products and materials, such as concrete pipe, HDPE pipe's favorable weight makes for efficient shipping to the site and easy handling when on site. The 20-foot length of the pipe and the ability to 'nest' smaller diameters into larger ones also helps to improve shipping efficiency.

Corrugated HDPE pipe with a Class II perforation pattern enables water to enter the long-life system and be conveyed to a central collection point.

"There could be other pipe choices for this particular job," da Silva continued. "The big thing that we have to remember is that the pipe is about 35 feet down and you don't want something that will deteriorate over time. HDPE pipe is the most viable product for this application. I'm sure you'll be seeing a lot more of the HDPE pipe being used for this type of project."

"Managing risk is critically important today when it comes to any of our water systems," observed Tony Radoszewski, executive director of the Plastics Pipe Institute, Inc. (PPI), the major trade association representing all segments of the plastic pipe industry. "This includes drinking water, sanitary systems and storm water. For decades, fusible, solid wall HDPE pipe has provided leak-free joints, and corrugated HDPE pipe has provided the strength for underground burial. And now corrugated HDPE pipe, because of its years of confident performance, was selected for use in this safety system that will protect the integrity of a very large reservoir. Because of its versatility, 100-year life expectancy, ease of installation and lower costs, we fully expect more new applications for corrugated HDPE pipe to be designed and constructed."

Industry Standards and Deep Burial Concerns

"Corrugated HDPE pipe's unique ability to support and distribute live and dead loads enables it to meet most installation conditions. While there is a significant amount of research and many actual deep burial installations, cover depths of more than 20 feet, however, are not typical and usually require consultation with the manufacturer of the pipe," Radoszewski continued.

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"The amount of cover in this installation will not cause the pipe to exceed any strength or service limits provided the appropriate backfill material selection and compaction levels are attained. Lane recommended a well-graded crushed stone backfill compacted to a minimum 95 percent density per ASTM D698 or AASHTO T99," Radoszewski continued. "Additionally, the installation conformed to the requirements of ASTM D2321." Lane Enterprises is a member company of the PPI.

"The underdrain does a couple of things," said Tony Greiner, P.E., Certified Construction Manager (CCM) of Hazen & Sawyer and the project manager. "There is an impermeable membrane 30 mil liner so it shouldn't leak but if there was a leak, we would not want the water to build up under there. Plus we don't want the groundwater underneath building up so it also has to drain off. When the reservoir water level is lower or the reservoir is emptied for periodic maintenance, the hydrostatic pressure from the groundwater could build up under the liner, which the underdrain system will prevent from happening."

The corrugated HDPE pipe sits in cut and covered trenches and is enveloped in a geotextile fabric that enables water to enter the perforated pipe while keeping sand and other fine particles out of the system. Some 3,500 feet of six-inch and 5,400 feet of eight-inch diameter corrugated HDPE pipe meeting AASHTO M-252 and 1,780 feet of 12-inch and 3,900 feet of 18-inch diameter corrugated HDPE pipe meeting AASHTO M-294 was used.

For the runs under the dam from the collection point to the catch basin, solid wall HDPE pipe was used. "Whenever we run pipe for a reservoir project we are very concerned about the dam and any undermining," said Greiner. "It's an embankment dam so any corrosion of the pipe that is being used would be a problem. With HDPE we don't have to worry."

PPI's Radoszewski explained the high confidence level of using HDPE pipe. "Because of the material's durability and inherent resistance to abrasion and chemicals, HDPE pipe's life-cycle savings over alternative drainage systems are significant. Users can expect a service life of 100 years in many typical drainage applications."

An overview of the industry's progress was offered by da Silva. "During the past 15 years, solid wall HDPE pipe has been sweeping the nation as far as directional drilling goes. This is especially true in sensitive areas where there was a time when you'd use ductile iron pipe, assemble the line, float it across, sink it and when it hits bottom that would create a terrible disturbance to the eco-structure. With HDPE you start on one side, directionally bore to the other side, hook on to it, pull it back through your bore hole and your only disturbance is a receiving pit and a bore pipe on each side of the waterway. As far as the damage to the eco-system, there is none. Solid wall HDPE pipe has a lot of different applications that are pretty awesome."

Installed using cut and cover, the solid wall pipe is the outlet pipe from the corrugated HDPE pipe and goes through the dam. The solid pipe was encased in Bentonite cement grout to provide a seal underneath the bottom of the earthen dam that has a structural height of about 45 feet from the reservoir bed to its crest. "You can't have anything that is porous down there that would allow water to migrate or

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a product that could compromise the dam," da Silva said.

Greiner explained other benefits of the project. "There are two other reasons why this new reservoir system is good for the water plant. If there's some sort of spill out in the river where they draw the raw water, this gives them some holding capacity and a supply of water until the contamination has passed. The other is to reduce operating costs."

The reservoir enables the utility to take advantage of lower power rates, which are better at different times of the day or night depending on the time of year. Water is pumped from the river which is about three or four miles away for the next day's requirement during the lowest rate time.

Additional information about corrugated HDPE pipe can be found at the Plastics Pipe Institute's website: www.plasticpipe.org.

The Franklin Water Treatment Plant Reservoir Expansion project used corrugated HDPE pipe to create an underdrain system that will protect the geotextile liner. The 27-acre site was excavated to a depth of 30 feet. More than 14,600 feet of pipe was used for the project which was recently named Project of the Year by the Plastics Pipe Institute.

About PPI:

The Plastics Pipe Institute Inc. (PPI) is the major trade association representing all segments of the plastic pipe industry and is dedicated to promoting plastics as the material of choice for pipe applications. PPI is the premier technical, engineering and industry knowledge resource publishing data for use in development and design of plastic pipe systems. PPI collaborates with industry organizations that set standards for manufacturing practices and installation methods.