Groundwater conditions allowed the use of large chambers, which provide an 18-in. gap between the bottom of the system and the groundwater.

Choosing Chambers

Underground storm water system saves valuable space in housing complex

By Gina Carolan

Nationwide, Americans face a shortage of affordable housing, according to the Department of Housing and Urban Development. Generally, housing is considered affordable if it costs no more than 30% of a household's annual income. An estimated 12 million renter and homeowner households now pay more than 50% of their annual incomes for housing. To address the need for affordable housing in Wilmington, N.C., the Wilmington Housing Authority (WHA) completed New Brooklyn Homes at Robert R. Taylor Estates.

The housing complex was named after Wilmington native Robert R. Taylor, the first black student to attend the Massachusetts Institute of Technology. Armed with a degree in architecture, Taylor designed most of the Tuskegee University campus buildings completed prior to 1932. To kick off the construction of the new affordable housing complex, the WHA applied for and received $6.7 million in Low Income Housing Tax Credits from the North Carolina Housing Finance Agency.

Located less than one mile north of downtown, New Brooklyn Homes consists of 12 multi-family buildings and a community center situated on a 4.5-acre site. Designed by Tise-Kiester Architects of Pennsylvania, the complex features 32 townhomes and 16 apartments, offering a total of 48 rental units to the local residents. The amenities include ample parking, a playground, a picnic area with tables and a grill, park benches, bike racks and a gazebo. Additionally, the design retained a few old oak trees, preserving a touch of greenery for the benefit of the community.

Storm Water Requirements

North Carolina's regulations require developments to store and treat 100% of storm water runoff on site, and local engineers often use detention ponds to comply with the requirement. At New Brooklyn Homes, there was not enough room for an aboveground storm water solution due to the buildings, amenities and two large-diameter public water mains, and the need to construct new underground water, sewer and electrical utilities. To preserve as much space for development as possible, the engineers at ESP Associates decided on Cultec's subsurface infiltration chamber system in lieu of a pond.

"We came up against two main challenges: The first was horizontal site constraints, and the second was fitting the system on site to accommodate the proposed buildings and eight oak trees," said Terry Boylan, landscape architect with ESP Associates. "We would have had to lose a number of residential units if we had used the aboveground storm water control option."

Storage & Treatment Solution

Cultec's high-density polyethylene chambers can be used as subsurface retention and detention systems, or as replacements for ponds, concrete structures, and pipe and stone installations. The chambers feature a unique internal manifold, eliminating the need

for costly fabricated pipe manifolds and allowing for extra design flexibility and decreased installation footprint.

The system already had proved to be an effective and successful storm water management method during Robert R. Taylor Estates' first construction phase, which was completed about two years earlier. During that stage, another affordable housing complex was built featuring 48 apartment units in two buildings and a 96-unit senior living center.

"[The company] offered several chamber sizes for the first project phase, which helped solve the challenge of different water table elevations on site," said John DiTullio, vice president of sales for Cultec.

Sites for the system's five beds were planned carefully to avoid disturbing building foundations and old oak trees.

At New Brooklyn Homes, the system can handle a 25-year storm event and was designed to retain and treat up to 24,100 cu ft of storm water. Although a limited amount of post-development storm water discharges off site, most runoff is captured by the system. The combined peak discharge to the areas where it was installed is about 28 cu ft per second for the 25-year storm.

The sandy soil was conducive to installation of an infiltration system, allowing storm water to infiltrate back into the ground, thus removing pollutants from runoff and recharging groundwater. This infiltration system also might detain storm water after heavy rainfall due to Wilmington's low-elevated coastal plain location.

Selection Process

To select a chamber that would be the best fit for New Brooklyn Homes, ESP Senior Engineer Neal Kochis worked closely with Cultec technicians, who provided free design assistance, including preliminary calculations and job-specific CAD details. The groundwater was deep enough to allow the use of one of the company's largest chambers, the Recharger 330XL, leaving about an 18-in. distance between the groundwater and the bottom of the system. The model is 30.5 in. high, 52 in. wide, 8.5 ft long, and it has a capacity of 7.5 cu ft per linear foot. Each chamber holds nearly 475 gal and provides a minimum of 80 cu ft of storage per unit when surrounded in stone.

"Engineers and contractors should always select the tallest chamber possible because using the largest unit typically results in the lowest cost per cubic foot," DiTullio said.

Installation & Results

The system's installation began with excavating five beds—11,500 sq ft in all. The beds had to be located at least 10 ft away from the foundations of the adjacent buildings and could not disturb the oaks. Cultec's non-woven polypropylene filter fabric was laid along the sides and the bottom of each bed and a 6-in. layer of crushed stone was added. The chambers were arranged in the beds and fed using the internal manifold. After the units were in place and covered with the crushed stone and a layer of filter fabric, the ground was prepared for landscaping and asphalt.

The WHA is seeking a U.S. Green Building Council Leadership in Energy and Environmental Design certification for New Brooklyn Homes. The storm water system was able to contribute four points to the Surface Water Management portion of the Sustainable Sites Credit by infiltrating the storm water on site.

Hidden from sight beneath grassy areas, a playground, parking lots and driveways, the underground system allowed engineers to use the space above the chambers for development purposes while satisfying federal and state storm water requirements. The site's storm water solution now works to capture high-volume runoff and infiltrate it into the ground, eliminating pollutants and preventing groundwater contamination. WWD

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