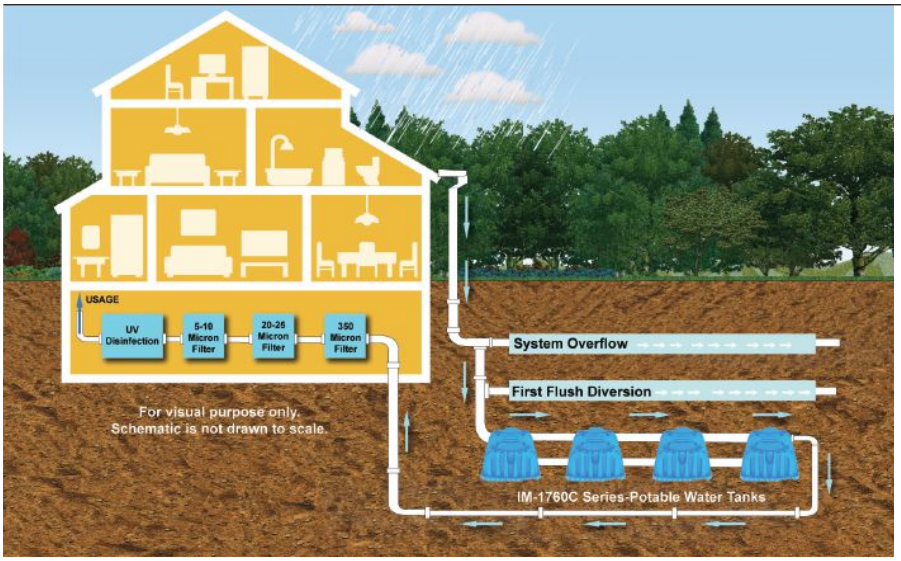

Economics and Need Catalyze Rainwater Harvesting and Water Reuse

North Carolina homebuilder pursues alternative water source for LEED Platinum Certified home when well drilling to 605 feet yielded no water.

THE INCREASE IN ADOPTION of rainwater capture and reuse strategies is largely driven by economics. In the past, residential and commercial property owners in the US and Canada were generally blessed with low water rates and what they believed was an ample supply of potable water resources. But those accustomed to opening the faucet, irrigating landscaping, flushing toilets, and regular high water use activities without worry are now experiencing a crunch of higher rates for a dwindling natural water resource.

And, it's not just in the arid west. The lack of groundwater recharge is a national and international problem. One reason is the extensive centralized wastewater treatment boom where water is taken from the aquifer, used, and disposed of through discharge far away from the source, leaving local aquifer supplies diminished. Another is the siphoning of natural water supplies upsteam or even in other states to provide for the exorbitant water needs of population centers. These activities coupled with lean rainfall amount, and in some cases drought conditions, are extracting a water resource toll in unexpected areas.

With higher water rates, surcharges for excess water usage, and extensive local and regional droughts stressing water supplies, the past darling of environmentalists: rainwater harvesting and reuse, has become more common in a worldwide effort to tap alternative sources of water for potable as well as nonpotable uses.

As Mark Twain was purported to say, "Whiskey is for drinking; water is for fighting over."

THE CHALLENGE: HOW LOW CAN YOU GO?

One would tend to think that in the humid, wet, East Coast, water is readily available everywhere; however, a homeowner outside of Raleigh, NC, was in for a surprise. The project, a 4,800-square-foot home with a closely coupled 3,200-square-foot shop, designed to achieve LEED Platinum Certification, is under construction in an area that is not served by public water. The drill location was just over a half mile away from Falls Lake, Raleigh's water supply reservoir. And it was also only about 150 feet away from an old dug well that is on an adjacent property. Thus confident that a drilled well could provide ample water to supply all of the resident's needs, the homeowner began drilling only to find that even at a depth of 605 feet no water was evident.

The search for a solution landed with Mike Stroud and Rain Pro of High Point, NC. Rain Pro investigated the feasibility of installing a standalone potable water system for the home with water supplied from the roof surfaces. With a total roof surface area of 11,000 square feet available from the home and garage structures, a 1-inch rain event would yield 6,860 gallons—ample water supply for the homeowners needs. Based on the average daily water consumption at the homeowner's previous house, this is enough to supply three months' worth of water. Rainfall averages are 40–45 inches per year in the region, which is a sufficient supply to meet the needs of the

home. The roofs for both structures are single slope standing seam metal roofs, making them ideal for collecting rainwater by minimizing any contaminants picked up from the roof.

THE SOLUTION

Stroud designed a whole house potable water system that collects rainwater from the roofs via leaders and piping and directs it to a series of storage tanks. The water is piped from the buildings in Schedule 40 PVC piping and then through a filter (rated for up to 16,000-square-foot roof area) that will allow nothing larger than 350 microns to enter the tanks. Because the first flush typically includes higher levels of contaminants, prior to entering the tanks the first 120 gallons of water is diverted away from the tanks, into a pipe, which discharges to a separate location. Once the pipe is filled, a valve closes and the remaining flow from the rain event enters the storage tanks. The first flush outlet is designed to slowly drain itself before the next rainfall.

The system is designed with four Infiltrator IM-1760C, 1787-gallon potable water tanks installed in series and connected at the bottom to function as one large tank and to yield a total storage volume of over 7,000 gallons. The Infiltrator tanks are NSF/ANSI Standard 61 (NSF 61) certified for potable water storage meeting a rigorous set of national standards to ensure potable water storage safety.

The tanks are buried outside the home and a submersible pump in the last tank in the series supplies water into the home. Prior to consumption, the water is pumped out of the tank and is treated via a set of three filters in an assembly; the first is a 20-micron filter, then a 5-micron filter, and finally with a 1-micron carbon filter. Following the filtration process, the water is disinfected via ultraviolet (UV) light. At this point the water quality exceeds all applicable Wake County and North Carolina potable water standards and is ready for home use.

The IM-tanks were specified due to the ability to install them in a shallow, low profile configuration to leverage the available space while avoiding rock or problematic soil conditions that are prevalent on the project site. This also resulted in reduced excavation costs. Because the tanks were delivered unassembled and then assembled onsite, there were substantial freight cost savings because all four tanks could be delivered on a single 16-foot trailer. The lightweight tanks were easily installed by conventional construction equipment, eliminating the cost of a large crane. Another reason the Infiltrator tanks

were selected is that the inlet and outlet ports are on both sides of the tanks as well as the ends, which required much less piping for the configuration used for the tank installation.

SYSTEM OPERATION

Rainwater travels from the roofs to the inground filter with the first 120 gallons diverted to fill the first flush tank. The following water will enter the cisterns through a calming inlet, which prevents disturbing any fine sediment that may be on the cistern floor. The four cisterns are interconnected at their base on alternating ends to keep the freshest water moving through to the last tank. The last tank has overflow pipes equal in size to the inlet pipes. Both overflows are fitted with an overflow siphon (p-trap) and rodent guard.

The submersible pump in the last tank has a floating extractor filter, which consists of an air-filled ball, which suspends the floating inlet filter 4 inches below the water's surface where the cleanest and most oxygenated water resides. The pump is controlled by a pressure tank and pressure switch, similar to a well system. Water will be pumped from the cisterns and then through the filters and finally the UV sterilizer. The system also will have a Rainwater System Controller that will show the water depth in the cisterns and operate a rinse head on the first filter to flush debris off the filter.

SYSTEM MANAGEMENT

The system design will enable the homeowner to do most of the system management. The pre-filter has a self-cleaning feature that minimizes required maintenance; any maintenance that is does require is fairly simple because the filter assembly is easily removed. The cartridge filters enable easy filter changes—there are shut off valves planned for on both sides of the filter assembly. The UV filter is also designed for easy maintenance; the bulb can be changed without having to disconnect any water lines. The UV bulb will be changed annually and the other filters will need cleaning or replacement every four to eight months depending on the conditions.

CONCLUSION

Innovative solutions abound for those who are up-to-date about the products that are available to us. This site was located in a wet region and in close proximity to water sources, and yet the wells came up dry. Water availability is no longer to be taken for granted. A potable system was installed to serve a single family home rendering the project feasible. Look for projects like this to become more common as the designers become more familiar with the solutions available. WE

Dennis Hallahan, *P.E., is the technical director of Infiltrator Water Technologies LLC, and has over 25 years of experience with onsite wastewater treatment systems' design and construction. He holds several patents for onsite wastewater products.*