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How NSF 350 Helps Plumbing Engineers Address the Growing Concern About Water

The recent *2011 Global Online Environment and Sustainability Survey* by Nielsen says that concern about climate change and global warming among consumers around the world took a backseat to other environmental issues such as water shortages and water pollution. While climate change remains a very important concern, the level of concern for water issues is growing.

Some reasons for this increasing awareness in the United States were realized on August 31, when 81 percent of Texas, 69 percent of Oklahoma, and 17 percent of Kansas were in exceptional drought conditions. In cities, the more pressing problems are due to combined waste and storm water system overflows, known as CSOs. The concerns of rural areas can be illustrated by the actions of King County in Washington state, which approved a measure that allows rainwater captured from roofs to be the sole residential water source. One reason for the measure is that extending public water lines or digging wells is not always an option or even feasible in rural and rugged areas.

To help solve some of these problems, areas are developing new graywater and water-harvesting standards, and a variety of systems already is on the market. At the same time, various regulations exist across the country and around the world. To help regulators, designers, contractors, and users address these different regulations, NSF International developed NSF 350: *On-site Residential and Commercial Reuse Treatment Systems* earlier this year. The purpose of NSF 350 is to establish minimum materials, design and construction, and performance requirements for on-site residential and commercial reuse treatment systems.

WHAT TO KNOW BEFORE DESIGNING A WATER REUSE SYSTEM

If systems are not designed, installed, or maintained properly, they can be more than a nuisance; they can harm the public health. Because of this, the plumbing engineer should do some research before designing a system.

Basic System Design

First, you should know the different types of systems. Rainwater harvesting, sometimes called rainwater catchment, is different than graywater reuse, and both are different than the reuse systems utilized by local utility providers.

The fundamental elements of a system design also are important to know. For example, roofs collect dust, bird droppings, and other contaminants during periods of no rain. As a result, the first flush of water from a roof should not be collected. Many products and methods are available to divert this first flush.

Some states offer free rainwater harvesting manuals, so search the Internet for any applicable references. ASPE and the American Rainwater Catchment Systems Association (ARCSA) offer design guides and informational webinars as well.

Graywater Definition

NSF 350 defines graywater as "wastewater from water-bearing fixtures, including residential clothes washers, bathtubs, showers, or sinks, with the exception of toilets, urinals, bidets, kitchen sinks, and dishwashers." Keep in mind that even though discharge from clothes washers, showers, and bathtubs is acceptable in NSF 350, some local regulatory agencies may exclude wastewater from these fixtures.

Materials

Some areas may require purple pipe markings that meet EPA recommendations on rainwater harvesting and graywater system piping inside and outside the building. Many manufacturers provide this piping with the EPA-required labeling.

Storage Tank Testing

NSF 350 contains testing procedures for belowground tanks, and visual testing is acceptable aboveground. When designing a system, you may want to perform more testing on these tanks than what NSF requires.

Electrical Components

NSF 350 requires NFPA 70: *National Electrical Code* as a minimum. Rainwater harvesting systems are usually installed outside, so you may want to include more electrical provisions to account for wet conditions as well as emergency or backup power for pumping and control systems.

Access Ports

In addition to the NSF 350 requirements, access panels should be located in areas inaccessible to the public so children or pets cannot be trapped.

Sensing and Signaling

NSF 350 requires local high-water signals, as well as a remote telemetry to signal the owner. This is a basic level of sensing that should be installed in a system. All systems will have a filtering system on the discharge, so some way to monitor the filtering system should be included. All sensors

should report to a building management system. Sensors can be included to show when the system is using potable water backup. Water meters should be monitored as well.

Flow Design

NSF 350 requires the system's storage capacity to equal 500 percent of the daily rated treatment capacity. Other important factors regarding flow are as follows.

- Rainwater: The rainwater piping system in a building shall meet code in the event the rainwater collection system is not in operation. When rainwater and storm water flow into a storage tank, the overflow of the tank must be designed to handle the full flow out to the site storm water system. The system cannot overflow inside the building during high rain events. The system should have a bypass to allow the water to flow around the collection system. The bypass and overflow should not rely on mechanical systems.
- Graywater: The same issues as rainwater harvesting apply to graywater systems. The system bypass shall be designed to handle the entire load of the piping system. The overflow shall flow unrestricted to the municipal waste system.
- Pumped discharge: If the overflow or bypass depends on a pumped system to lift the discharge flow to a gravity system, the lift station shall be designed to meet the same regulations as all storm water or waste lift stations.

Water Use

You must be aware of what systems will use the rainwater or graywater. After the water is collected, it can be used for many different purposes, such as landscape irrigation, sidewalk washdown, mechanical makeup, and supply water to flush fixtures. Each system has a different set of conditions that must be met.

Criticality of the Water

Will the water be used for a critical system? For example, will it be used to back up the fire protection sprinkler or hose demand? In such cases, many other standards, including those by NFPA, must be met. The water also can be used as a critical backup to cooling systems, which is particularly important in industrial, laboratory, and healthcare facilities.

Regulations

During the approval process of a new system, many different regulatory agencies may be required to work together, such as the building department, plumbing department, municipal storm water agency, or health department. For example, different agencies may be involved depending on whether the piping is aboveground or belowground. The rules and regulations also vary from jurisdiction to jurisdiction. For instance, when using harvested rainwater or graywater for landscape irrigation, some states require the piping to be sleeved when it crosses a potable water line.

Backup Connection to Potable Water Supply

Most systems will not be isolated without any connection to a public water backup system to supply water until the reuse system refills. The public water supply also can provide water to the system when the alternate water system is out of service. Here are some issues to keep in mind.

- Cross-connections: Most of the time an air gap and/or a backflow preventer is required. Most areas have local regulatory officials who handle cross-connection concerns.
- Dead-end runs: Some systems will operate for long periods without any potable water backup. As a result, the potable line has little or no circulation, which can raise many concerns that include contamination and Legionella growth. The length of the line feeding the system should be decreased as much as possible and dead-ends should be avoided.
- Keeping the line clean: Another measure to keep the supply line clean is to have a system in place that activates the supply water line on a regular basis.

Sizing the System

Using a rainwater system as an example, for the system to operate properly the plumbing engineer will need to conduct a data-balancing act that is as accurate as the weather data on which it is based. The system should collect enough water during rain events to last through dry events. However, the record-breaking rainfalls and droughts of the last few years have made this more difficult. The owner and operator must be aware of the local conditions so they understand the level of risk they are taking with the system. Another important element in sizing the system concerns the budget and the amount of space that is available.

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Water Quality Testing Maintenance

NSF 350 requires startup and testing procedures with a manufacturer's representative when the system is placed in service. It also requires a graywater challenge to test the water quality with water samples. Each type of water going into the system has unique design loading criteria.

Most regulatory agencies will require a test plan to be in place, and local jurisdictions will require testing at different times. Services and electronic data-collection systems are available to help the owner and operator perform the tests and obtain the required data.

Storm Water Retention

Rainwater harvesting systems can incorporate storm water retention in the storage system. This additional load will have to be added to the storage calculation, and it will require an additional discharge to the storage system.

Water Quality in Discharge Areas

Water quality standards and levels must be met for the different types of systems. Here are some hot issues regarding these systems.

- Plumbing flush fixtures: Flushing a fixture will aerate water particles into the air that can be inhaled. As a result, the quality of this water can be near to drinking water quality standards. Another issue is if the water is clear. Some owners do not want the water in their water closet or urinal bowls to be colored. Fixture manufacturers have warranty requirements for the quality of the flushing water, and some manufacturers will not warranty the fixtures if graywater or rainwater is used.
- Irrigation: Similar to flush fixtures, this water vapor can be inhaled, and odors are another concern. Contaminants also can clog sprinkler heads.
- Other systems: An interesting story involves a project in Arizona that plans to use reclaim water from a wastewater treatment plant to make snow for a ski resort. The Hopi Tribe that is located near the resort has sued the city of Flagstaff for maintaining a contract to sell treated wastewater for snowmaking at the Arizona ski resort. They claim that the "snow" will damage their land.

Storage Options

Many locations above- and belowground are available to store rainwater and graywater, and many different types of materials are available for the tank. Designers should be aware of the concerns with the locations and types of materials that can be used. In new construction, the storage tanks can be incorporated into the underground structure of the building.

Energy Use

Some people are concerned that these systems actually use more energy than conventional municipal potable water systems. To alleviate these concerns, you can use energy-efficient motors on pumps, such as variable-speed pump systems to help with efficiencies.

Metering Data Collection

Meters should be installed on the discharge and on the domestic water makeup to the systems.

This is not a comprehensive list of design issues for rainwater, graywater, and alternate water systems. The key is to coordinate all projects with local and state officials and to keep aware of regulatory changes. After long droughts, local officials typically start looking for ways to conserve water. As a result, more areas will be considering these types of systems, so you should be knowledgeable about the issues to take a lead in your area. PSD

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