TCEQ REGULATORY GUIDANCE

Water Supply Division
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Rainwater Harvesting: Guidance for Public Water Systems

Preface

This is a guide for public water systems (PWSs) that collect and treat rainwater and distribute it as potable water. A PWS is defined as any system that serves at least 25 people per day for at least 60 days each year or that serves at least 15 service connections. To assure that the water produced by a PWS is chemically and biologically safe to drink, the Texas Commission on Environmental Quality has adopted regulations regarding the design, operation, and maintenance of public water systems and the quality of the water they produce. These regulations can be found in Title 30 of the Texas Administrative Code (30 TAC) and include:

- **30 TAC Chapter 290, Subchapter D: Rules and Regulations for Public Water Systems.** Requirements related to the design, operation, and maintenance of public water system facilities.
- **30 TAC Chapter 290 Subchapter F: Drinking Water Standards Governing Drinking Water Quality and Reporting Requirements for Public Water Supply Systems.** Monitoring and reporting requirements for public water systems and minimum water quality standards that the systems must meet when supplying drinking water to the public.

This regulatory guide does not take the place of the full, official TCEQ rules. It is intended only as a general explanation about selected parts of 30 TAC Chapter 290 (or any other referenced TCEQ rules.) If you have questions about any information contained in this manual, contact the TCEQ's public drinking water program at 512-239-4691.

"We," "Our," and "You" in This Guide

"We" and "our" as used in this guide refer to the Texas Commission on Environmental Quality—specifically, the Public Drinking Water Section of the TCEQ's Water Supply Division.

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In this guide, "you" refers to the person or entity that is developing or using a rainwater collection and treatment system to produce potable drinking water for public consumption.

Introduction

Rainwater and snow melt are the primary sources of all drinking water on earth. Rainwater harvesting is the practice of collecting water that falls as rain before it has a chance to soak into the ground and become groundwater or run off into a watercourse and become surface water. Rainwater harvesting can be classified into two broad categories: *land-based* and *roof-based*. Land-based rainwater harvesting occurs when rainwater runoff from the land is collected in ponds and small impoundments before it has a chance to reach a watercourse, river or stream. Roof-based harvesting, on the other hand, involves collecting the rainwater that falls on a roof before the water reaches the ground.

Although roof-based systems generally produce water with lower levels of chemical and biological contaminants, the water produced by both systems is classified as surface water and must be properly treated before you can use it. The level of treatment needed depends, to a great extent, on whether the intended uses require potability (such as drinking, food preparation, bathing, and washing dishes or hands) or do not (such as toilet flushing, laundry, and irrigation). Obviously, rainwater that is used for potable purposes must receive a higher level of treatment than water that is harvested for irrigation.

From a regulatory perspective, the TCEQ's rules for public drinking water only apply to a supplier of rainwater as potable water for a public water system.[1] The TCEQ does not set minimum

If you have access to a public water system, we encourage you to collect rainwater for nonpotable use only. This approach will:

- reduce your construction, treatment, and operational costs because less treatment is required for nonpotable than for potable uses;
- eliminate the direct and indirect costs associated with a public water system;
- lower your monthly water bill because you will need to buy less of the public water system's drinking water for nonpotable water; and
- conserve the natural resources being developed and consumed by your public water system.

[1] A public water system (PWS) is any system that serves at least 25 people per day for at least 60 days each year or that serves at least 15 service connections such as a home, apartment, or business. See 30 TAC 290.38(47) for the complete PWS definition.

treatment requirements for rainwater that will be used for drinking water at a single household, nor does it regulate nonpotable uses of rainwater. However, the TCEQ rules do apply if you are planning to bottle the water for sale or operate a public water system.

This regulatory guide offers a general overview of the TCEQ rules that apply to public water systems that use rainwater as a drinking water source and to systems that use it as a source for a commercial bottling operation. It does not address the nonpotable uses nor does it address the additional regulations of the Texas Department of State Health Services that apply after the potable water enters a commercial bottling operation.

Design and Construction

Public water systems must be able to supply their customers with adequate quantities of potable drinking water at flow rates that meet their needs. To achieve this goal, a variety of industry standards and TCEQ regulations have been adopted to assure that public water system facilities are properly designed and constructed.

General Requirements

You must notify us, in writing, if you are planning to use rainwater as drinking water. Your letter should contain a brief description of your proposed public water system and where it will be located. This information will help us decide what regulations will apply to your proposed system so that we can provide an accurate list of things that you need to do before you begin design and construction.

The collection, treatment, storage, and distribution facilities at a public water system must be designed by a professional engineer licensed to practice in Texas. This requirement applies to all PWSs, including those that use rainwater as their primary drinking water source, as well as those that use it to supplement their other sources. We require your engineer to submit his or her engineering report and plans and specifications because we need to determine if the facilities can reliably supply adequately treated drinking water.

Detailed information about the general requirements which you must meet before beginning construction of public water system facilities can be found in 30 TAC 290.39.

Collection and Treatment

The size and design of a rainwater-collection system depends on how much water your system requires, how much rainfall you expect to receive, and how much untreated water you need to store. Because rainfall varies so significantly across Texas, we must evaluate the design of each collection system on a site-specific basis. However, some general guidelines apply to all systems. For example:

- The collection system must be designed so that the first part of each rainfall is collected in a separate storage tank (for nonpotable use) or flushed to waste. This feature is needed so that debris and chemical and biological contaminants do not reach the tank that stores the untreated water used for making your drinking water.
- The roof and storage reservoir must be large enough to capture and store enough untreated water to provide an adequate supply during seasons when rainfall is less.

The rainwater collected from a roof-based collection system is classified as surface water. However, it should contain much less particulate matter than the surface water obtained from lakes, reservoirs, and ponds that are subject to land-based runoff. As a result, specialized treatment facilities are needed to treat rainwater. Since these treatment facilities will not meet the conventional design standards contained in our regulations, your engineer must obtain an exception, or waiver, to our standard design requirements. In order to obtain this exception, your engineer must specify treatment technologies which achieve the required level of public health protection. Although there are other ways to meet the requirement, most designs will:

- use a filter (usually a cartridge or membrane filter) that is capable of removing at least 99% of the particles that are 3.0 microns or larger in diameter;
- include a disinfection system (such as chlorine, ozone, or ultraviolet light) that is capable of inactivating (or killing) at least 99.99 percent of the viruses that might be present in the untreated water; and
- be large enough to treat an adequate quantity of water to meet your customers' maximum daily demands at any time of the year.

In 2006, the Texas Water Development Board published a report to the legislature titled *Rainwater Harvesting Potential and Guidelines for Texas* which may prove helpful as you and your engineer prepare the plans and specifications for your rainwater collection and treatment system.

If you are bottling your rainwater, you must meet all of our treatment requirements before the water enters the bottling process. Our jurisdiction ends (and the Department of State Health Services' jurisdiction begins) only after the water has already been treated and meets our drinking water standards. Any treatment that occurs during the bottling operation must occur after the water has already been deemed fit for human consumption.

Storage and Distribution

The tanks for storing treated water and pressure-maintenance and distribution facilities for rainwater harvesting systems are identical to

those used in any other potable-water system. The materials used to construct the storage and distribution facilities must be rated for potable water use and meet the requirements of ANSI/NSF Standard 61.[2] The design of the facilities must meet the standards adopted by the American Water Works Association and our other regulatory requirements. Our design requirements for storage and distribution systems are located in 30 TAC 290.43 and 290.44, respectively.

We require you to disinfect all treated water before it enters the storage tank and to maintain a disinfectant residual in the tank and throughout the distribution system. Rainwater usually contains very few disinfection by-product (DBP) precursors. Therefore, few DBPs will form in rainwater regardless of which disinfectant you use. If your rainwater system is your only source of treated water, we recommend that you disinfect your water with a chlorine bleach solution because it is the least expensive alternative and is very effective against viruses and most other common bacteria. If you are blending your treated rainwater with other treated water that contains chloramines, you may need to use another disinfectant (or combination of disinfectants) in order to avoid taste and odor problems that can occur when chlorinated and chloraminated waters are mixed. Your engineer will help you select a disinfection process that meets your site-specific needs.

The storage and distribution system must be sized so that they can supply adequate amounts of water to your customers during the times when they use the most water during the day. This means that the storage and distribution facilities must be sized so that they are capable of meeting demands during the worst part of the day on the worst day of the year.

Minimum Capacity Requirements

To assure that public water systems are able to provide adequate quantities of drinking water, we have established minimum capacity requirements for the production, treatment, storage, and pressure maintenance facilities, These capacity requirements are found in 30 TAC 290.45. This regulation includes standard design criteria for the various types of public water systems. However, since some systems use less potable water than others, the regulation allows systems to meet an Alternative Capacity Requirement (ACR) that is based on their site-specific demands.

We expect that most of the public water systems that rely on rainwater as their primary source of drinking water will fall into this special ACR group because they will use less water than a typical public water system. Most public water systems experience wide

[2] Standard 61 is the performance standard for materials that come into direct contact with potable water. This standard was developed by the American National Standards Institute, Inc (ANSI). and the National Sanitation Foundation (NSF).

fluctuations in water use because they supply water for both indoor and outdoor use. Systems which rely entirely on rainwater will probably have much lower demands because the treated water will not be used for irrigation and other outdoor uses.

There are some underlying principles that will control the capacity of your rainwater collection, treatment, storage, and pressure maintenance facilities. These principles are:

- The roof and storage reservoir must be large enough to capture and store enough untreated water to provide an adequate reserve during periods when there is limited rainfall.
- The treatment facilities must be capable of treating enough water to meet your customer's maximum daily demands on the day of the year when they use the most water. If your system will be using rainwater to supplement your other sources of treated water, the combined capacity of all the treatment facilities must be able to meet your maximum daily demand.
- The treated water storage and pressure maintenance facilities must be capable of meeting your customer's peak demand during the time of the day when they use the most water.

Operations and Maintenance

After the public water system has been constructed, it must be properly operated and maintained to assure that it continues to provide reliable service. Although a more comprehensive list of our operational requirements can be found in 30 TAC 290.46, the following items are a few of the more important issues that you will need to address as you operate your new system.

Licensed Operators

All public water systems that treat surface water, including those that treat rainwater, must be under the direct supervision of a water-works operator who holds a Class C or higher Surface Water license. If your treatment system uses cartridge or membrane filters, we will also accept other Class C water works licenses as long as the operator has completed surface water training and is familiar with the monitoring and reporting requirements for surface water systems.

The licensed operator at a surface water treatment plant must be at the plant whenever it is treating water or the plant must be equipped with continuous monitors, alarms, and shutoffs to assure that a malfunction does not occur when the operator is not present. However, the operator does not have to be at the plant when rainwater is being harvested from the roof or when treated water is being delivered to the customers.

Monitoring and Reporting

Systems that harvest and treat rainwater must meet the same monitoring and reporting requirements as systems that use other surface water sources such as lakes and rivers. A few of the special monitoring and reporting requirements that apply only to surface water treatment systems include:

- The operator must monitor the turbidity level of the treated water at least once each day that the plant treats any water and more frequent monitoring is required if the system serves more than 500 people.
- The operators must test the pH, temperature, and disinfectant residual of the water at least once each day that the plant treats any water and calculate the amount of Giardia and viral inactivation achieved. Additional monitoring is required if the plant fails to achieve the required level of disinfection.
- The operators must monitor the chlorine residual of the water leaving the treated water storage tank at least once each day that treated water is used by the customers and more frequent monitoring is required if the system serves more than 500 people.
- The operators must submit a six-page Surface Water Monthly Operating Report (SWMOR).

You and the operators will also need to meet the monitoring and reporting requirements that apply to all public water systems. These requirements include submitting samples of treated water for bacteriological analysis each month.

Other Operational Issues

There are a variety of other matters that you must address when developing and operating a public water system. For example:

- You must develop and implement an effective cross-connection control program to ensure that your drinking water is not recontaminated after it has been treated. This is especially important if your system collects rainwater for both potable and nonpotable uses.
- You must maintain a complete record of operations. You will need to maintain copies of SWMORs, the results of any bacteriological and chemical tests conducted, calibration records for laboratory instruments, flushing records, and maintenance records.
- You must prepare a monitoring plan that identifies where compliance samples are to be collected, how frequently the tests must be conducted, who will run the tests, the analytical methods and equipment used, and how compliance will be determined.

- You or your engineer must write an an operations and maintenance (O&M) manual that describes how your system is designed, operated, and maintained.
- You and the operator must implement an effective corrosion-control program. This program is particularly important when treating rainwater since rainwater contains very few dissolved materials and can be extremely corrosive if not properly treated.
- You must maintain a supply of critical parts, equipment, and reagents. These materials typically include backup chemical-feed equipment, replacement cartridges for the cartridge filter, a spare turbidimeter, other essential laboratory equipment, calibration standards and reagents for laboratory instruments.

Drinking Water Quality

Rainwater is a relatively pure substance. Although it can absorb small quantities of airborne contaminants in the atmosphere, most of the contaminants present in rainwater harvested from roof-based systems are introduced during its collection, storage, and distribution. Pure water is sometimes considered to be the "universal solvent" because it can strip, or leach, a wide variety of minerals, metals, and organic material from materials it comes in contact with. This is particularly true for rainwater because it contains so few naturally occurring materials.

In order to assure that that public drinking water does not pose a public health threat, the TCEQ regulates more than 100 different constituents and requires public water systems to monitor for these and other contaminants that can be present in drinking water. Although we currently pay a contractor to collect and submit many of the required chemical samples, your operator is responsible for collecting many others. In some cases, the operator will run the tests using an approved method and laboratory equipment you must buy. In other cases, the operator will send the samples to a certified laboratory for analysis. Regardless of whether the samples are collected by our contractor or your operator, you will be responsible for paying all the costs associated with having the sample tested. All sampling must be performed in accordance with your system's monitoring plan.

Although this guidance contains a very brief summary of some tests that must be run, the complete list of the regulated chemicals and their monitoring and testing requirements are contained in 30 TAC Chapter 290, Subchapter F.

Organic and Inorganic Chemicals

There are two major regulated categories of organic chemicals: volatile organic chemicals (VOCs) and synthetic organic chemicals (SOCs). VOCs are contaminants that are typically introduced when water comes into contact with materials containing refined organic

products. These VOC sources include materials such as plastics, glues, and solvents as well as gasoline, greases, and oils. Synthetic organic chemicals (SOCs) are chemicals typically found in pesticides, herbicides, and similar manufactured products.

The inorganic chemicals we regulate fall into two general categories—*minerals* and *metals*. Minerals include compounds such as calcium carbonate, magnesium sulfate, and sodium bicarbonate. Metals include elements such as mercury, arsenic, iron, and manganese. Minerals and many metals such as iron and manganese do not pose a public-health threat but are regulated because they degrade aesthetic qualities such as taste and odor and may stain fixtures and laundry. Other metals, such as arsenic and mercury, do pose public-health threats if their concentrations reach certain levels.

Coliform Bacteria

Coliform bacteria are commonly found in the environment but not in properly treated and disinfected drinking water. Although most coliform bacteria do not pose a threat to public health, they are easy and inexpensive to test for and they are present in much higher concentrations than disease-causing bacteria. Therefore, you can assume that your drinking water does not contain any pathogenic bacteria if it is free of coliform bacteria.

Disinfectant and Turbidity Monitoring

Although coliform tests are a sensitive indicator of whether or not other bacteria, viruses, or parasites could be present, they may not do a good job of detecting pathogenic viruses or parasites. Since it is difficult and expensive to test for these types of pathogens, minimum treatment-technique requirements have been established that help assure that the treated drinking water is also free of these public-health threats. These requirements, which were covered in "Operations and Maintenance," help assure that the treatment processes are effective against pathogens that can be introduced during the collection and storage of rainwater.

Disinfection By-Products

Disinfection by-products (DBPs) form when water that contains naturally occurring organic matter, such as decayed vegetation, is exposed to a chemical disinfectant, such as chlorine. Naturally occurring organic matter (NOM) is measured using total organic carbon (TOC). One of the main advantages of using a properly designed roof-based rainwater-harvesting system is that it minimizes the amount of TOC present in the untreated water. Low TOC levels reduce the possibility of higher concentrations of DBPs that form when the water is treated and distributed.

Lead and Copper

Rainwater is considered to be very "soft" water because it contains so few dissolved minerals. One of the problems with extremely soft water is that it tends to be corrosive. Corrosive water can leach lead and copper from the metal pipes and fittings used to distribute your drinking water and from the copper pipes and brass fittings that your customers use. As stated earlier, implementation of an effective corrosion-control program by you and the operator will adequately address this concern.

Other Applicable Rules

You should also be aware that other rules about drinking water appear in other parts of the TCEQ regulations. A public water system must comply with all the applicable requirements. Some examples of additional rules, and their locations, are given below:

- **30 TAC Chapter 30, Subchapters A and K: requirements for certification of water-works operators.** TCEQ's Operator Licensing Section can answer questions about these requirements at 512-239-6133.
- **30 TAC Chapter 291: rules and regulations for water utilities related to requirements for rates, capacity development, and Certificates of Convenience and Necessity for utilities.** Contact the Water Utilities Rates and Districts Section by phone at 512-239-4691 or by e-mail at <uds@tceq.state.tx.us> if you have questions about these requirements.
- **30 TAC Chapter 293: requirements for water districts.** Contact the Water Utilities Rates and Districts Section by phone at 512-239-4691 or by e-mail at <uds@tceq.state.tx.us> if you have questions about these requirements.
- **30 TAC Chapter 290: Subchapter E: fees for public water systems.** Contact the public drinking water program at 512-239-4691 or by e-mail at <uds@tceq.state.tx.us> for more information.
- **30 TAC Chapter 297: requirements for water-rights permits.** Call the Water Rights Permitting Team at 512-239-4691

You can find links to the Secretary of State's official version of all TCEQ rules at our web site at <www.tceq.state.tx.us/rules>.

There are additional regulations that will apply to you if you are going to bottle your rainwater for commercial purposes. In Texas, the manufacturing of foods and beverages is regulated by the Environmental and Consumer Safety Section at the Texas Department of State Health Services. The regulations related to bottling operations are contained in 25 TAC Chapter 229, Subchapter F: Production, Processing, and Distribution of Bottled and Vended Drinking Water.

Other Guidance

We have published a number of other regulatory guides to help you comply with our monitoring and reporting requirements. These publications can also be downloaded from our web site and include:

- **RG-195, *Rules and Regulations for Public Water Systems*:** a more user-friendly format of the rules contained in 30 TAC Chapter 290, Subchapter D.
- **RG-346, *Drinking Water Standards Governing Drinking Water Quality and Reporting Requirements for Public Water Supply Systems*:** a more user-friendly format of the rules contained in 30 TAC Chapter 290, Subchapter F.
- **RG-211, *Monthly Testing and Reporting for Surface Water Treatment Plants*:** detailed instructions for completing a variety of monthly operating reports that must be submitted by a PWS that is treating surface water sources, including systems that treat rainwater.
- **RG-384, *How to Develop a Monitoring Plan for Public Water Systems*:** describes how a PWS should select the sites where its regulatory compliance samples are collected.
- **RG-421, *Coliform Sampling for Public Water Systems*:** summarizes the procedures that a PWS uses to identify suitable coliform sampling sites and the process it should use to collect and submit samples to a certified laboratory.
- **RG-407, *Disinfection Residual Reporting for Public Water Systems*:** explains the monitoring and reporting requirements for disinfectant residuals in distribution systems.

You can get printed copies of these guides by e-mailing your request to <puborder@tceq.state.tx.us> or by calling 512-239-0028.