Virginia Rainwater Harvesting & Use Guidelines

Developed by

VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment

March 31, 2011

PREFACE

This document provides guidance for the use of water collected through a rainwater harvesting system. This guidance is NOT regulation but does reference Virginia and other states' guidance and regulations relating to the use of rainwater.

DISCLAIMER

The mention of brand names or products in this report does not constitute an endorsement of those products by the Virginia Department of Health, Virginia Department of Environmental Quality, Department of Conservation and Recreation, Department of Housing and Community Development, or the Commonwealth of Virginia.

This document does not include local ordinance information, and any entity implementing a rainwater harvesting solution is responsible for assuring compliance with all local, state, and federal requirements.

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Chapter 1: Introduction

1.1 Purpose and Scope

The harvesting of rainwater has a number of benefits, including but not limited to:

- Supplementing the use of groundwater and surface water sources,
- Reducing the load to stormwater collection systems,
- Improving stormwater quality by reducing potential pollutants associated with runoff,
- Easing demand on public water facilities,
- Reducing potential soil erosion and increase soil infiltration.

The General Assembly of Virginia has directed the Virginia Department of Health (VDH) to develop guidelines regarding the use of gray water and rainwater (Va. Code § 32.1-248.2). This document is not regulation; it provides *guidance* for the harvesting and use of rainwater only.

1.2 Terms

"Rainwater Harvesting," as used in this document, refers to the collection, conveyance, and storage of precipitation from roof surfaces. Harvested Rainwater is not "gray water" or "reclaimed water." Rainwater Harvesting may be a part of an overall stormwater management program, but harvested rainwater is not intended for release into a waterway. Subsequent treatment of harvested rainwater may be employed to remove impurities and inactivate disease-causing microorganisms.

Several terms that are used throughout this document are defined in the *Virginia Administrative Code* (*VAC*) and are repeated below to clarify interpretation of this guidance:

"Auxiliary water system" means any water system on or available to the premises other than the waterworks. The auxiliary water may include water from a source such as wells, lakes, or streams; or process fluids; or used water. (12VAC5-590-10)

"Gray water" means untreated wastewater from bathtubs, showers, lavatory fixtures, wash basins, washing machines, and laundry tubs. It does not include wastewater from toilets, urinals, kitchen sinks, dishwashers, or laundry water from soiled diapers. (9VAC25-740).

"Potable water" means water fit for human consumption and domestic use that is safe and normally free of minerals, organic substances, and toxic agents in excess of reasonable amounts for domestic usage in the area served and normally adequate in quantity and quality for the minimum health requirements of the persons served. (Va. Code § 32.1-167 *et seq*., 9VAC25-740, and 12VAC5-590-10)

"Reclaimed water" means water resulting from the treatment of domestic, municipal or industrial wastewater that is suitable for a water reuse that would not otherwise occur. Specifically excluded from this definition is "gray water." (4VAC50-60)

"Stormwater" means precipitation that is discharged across the land surface or through conveyances to one or more waterways and that may include stormwater runoff, snow melt runoff, and surface runoff and drainage. (4VAC50-60)

"Stormwater management facility" means a device that controls stormwater runoff and changes the characteristics of that runoff, including but not limited to, the quantity, quality, the period of release or the velocity of flow. (4VAC50-60)

"Waterworks" means a system that serves piped water for drinking or domestic use to (i) the public, (ii) at least 15 connections, or (iii) an average of 25 individuals for at least 60 days out of the year. The term "waterworks" shall include all structures, equipment and appurtenances used in the storage, collection, purification, treatment and distribution of pure water except the piping and fixtures inside the building where such water is delivered. (12VAC5-590-10)

1.3 Related Virginia Regulations and Guidance

Rainwater harvesting, as described in this guidance, is addressed in the *Virginia Uniform Statewide Building Code* (VUSBC). The VUSBC is administered by the Department of Housing and Community Development (DHCD).

The *Water Reclamation and Reuse Regulations* (9VAC25-740) address the reclamation of wastewater and water reuse, taking into account environmental and public health protection. These regulations specifically exclude the use of gray water. The regulations also prohibit direct potable reuse of reclaimed water, the use of reclaimed water for food preparation or in food or beverage products, swimming pools, hot tubs or wading pools, or any purpose inside a residential or domestic dwelling. These regulations are administered by the Virginia Department of Environmental Quality (DEQ).

Virginia's Stormwater Management Regulations (4VAC50-60) specify minimum technical criteria and administrative procedures for stormwater management. The regulations cover administration, implementation and enforcement of a permit program authorized by the federal *Clean Water Act* and the Virginia *Stormwater Management Act*. These regulations are administered by the Department of Conservation and Recreation (DCR). The DCR has developed the *Virginia DCR Stormwater Design Specification No.6, Rainwater Harvesting* (Version 1.9 dated April 26, 2010). It contains design information for non-potable water use and on-site stormwater disposal/infiltration, including components, configurations, and a cistern design spreadsheet.

The following regulations are administered by the VDH:

The *Waterworks Regulations* (12VAC5-590) address the location, construction and operation of public water systems. These regulations require every waterworks to establish and enforce a program of cross connection control and backflow prevention.

The *Private Well Regulations* (12VAC5-630) address the location and construction of private wells. Subsequent operation of private wells and their water delivery systems is not covered by this regulation.

Sewage Handling and Disposal Regulations (12VAC5-610) includes construction requirements for nonpublic water supplies, other than a private well, that might be used in conjunction with an onsite sewage disposal system for new construction. Section 1170 specifies location, protection, and construction standards for cisterns. The regulation allows cisterns when there is no other feasible source of potable water. Adequate treatment and continuous disinfection are required to insure potability. Section 1140 specifies that the system must be capable of supplying an adequate quantity of water at all times.

Chapter 2: Water Source, Use & Quality

2.1 Uses and Water Quality Requirements

Harvested rainwater systems may be installed in a variety of situations. These situations may be grouped by available water supply:

- Dual water supplies (public and private)
- Private water supplies

And also by water use and delivery:

- Single interior plumbing system
- Separate plumbing system for non-potable water use

The operational criteria for the type of application vary. Design and operation features, safeguards, and water quality considerations are described in the following sections.

2.1.1. Cross Connection Control

The International Plumbing Code (§ 608.6.1.) prohibits cross connections between private and public water supplies.

12VAC5-590-590 of the *Waterworks Regulations* prohibits any connection whereby water from an auxiliary water system may enter a waterworks. Waterworks customers having an auxiliary water source, such as rainwater harvesting system, may be classified as "high hazard" under the *Waterworks Regulations.* Backflow prevention for these customers is required.

The *Waterworks Regulations* require every waterworks to have an active cross-connection control and backflow prevention program, approved by the VDH. This program must include the inspection and testing of all backflow prevention devices annually, at a minimum. In accordance with 12VAC5-590-590 B: each auxiliary water system, its method of connection, and use of water must be approved by the waterworks and the VDH.

If a Reduced Pressure Zone (RPZ) device is used, it should meet American Water Works Association standards and be approved by the American Society of Sanitary Engineering (ASSE) and the USC-FCCC (University of Southern California Foundation for Cross Connection Control and Hydraulic Research). An RPZ device must be installed and tested by a Backflow Prevention Device Worker certified by Virginia Department of Professional and Occupational Regulation.

2.1.2. Water Supplement and Use

Review of applicable guidance from other states has shown that non-potable uses account for a significant majority of the overall water use. This guidance recommends that harvested rainwater be restricted to non-potable uses. Fluctuations in rainfall patterns, available storage, and intended use are all key factors that affect the design of rainwater harvesting systems. Guidance from a number of different sources generally

include a means for the user to supplement the harvested rainwater during high demand or low precipitation periods.

Harvested rainwater systems are dependent on the precipitation patterns and may not be able to provide adequate water supply during all parts of the year. Supplementing the harvested rainwater requires an appropriate level of cross connection control and protection for the private or public water system that supplies the supplemental water. Public water systems are regulated and continually tested to ensure that the water is safe for human consumption. They are the recommended source of potable water whenever possible.

2.1.3. Separate Plumbing for Non-Potable Water Use

Separate plumbing systems for non-potable water within a building are governed by the requirements of the VUSBC. Harvested rainwater may be used solely or in conjunction with another water source in separate interior, non-potable plumbing systems. The VDH does not regulate the water quality of these installations.

2.2 Factors Effecting Harvested Rainwater Quality

2.2.1. Component Materials: Roof Surface, Piping, Storage

The pH of rainwater in Virginia tends to be acidic, ranging from 4.5 to 5.0. Other chemical characteristics of harvested rainwater will depend on the water temperature, roof material over which it flows, and the pipe, storage and appurtenances that come in contact with the collected water. Undesirable contaminants, such as asbestos, lead and copper, may be imparted to the captured rainwater when roof surfaces and plumbing contain these elements (*VA DCR Stormwater Design Specification No. 6*). Further information on these topics is available in the *Virginia Rainwater Harvesting Manual*, and other references listed in Chapter 6.

2.2.2. Collection Site: Air Quality, Overhead Vegetation, Animal Access

Dirt, bacteria, molds, algae, fecal matter, and organic matter from vegetation are contaminants that may be imparted to the collected rainwater. The cleanliness of the roof catchment surface will directly affect the water quality. The longer the span of dry days, the more debris is washed off from roof surfaces by a rainfall.

Additional contaminants that may be captured by rainwater include, but are not limited to, dust, smoke, and soot suspended in the atmosphere. The local air quality and prevailing winds will impact the total dissolved solids in rainwater. This depends on the rainwater harvesting site location and air emissions (particulate and gaseous) in the proximity.

Chapter 3: Rainwater Harvesting System Components & Sizing

Rainwater harvesting systems should be designed and sized based on a number of factors that are specific to the site, structure(s) and use(s). The design should include an evaluation of the catchment surfaces, gutters, pre-treatment devices, storage, pumps, piping and appropriate treatment. There are a number of resources that can be used to guide individuals in this process.

3.1 Catchment Surfaces

Rainwater is typically captured from a structure or building roof. Rainwater can also be captured from a constructed conveyance specifically designed to intercept the rainwater for collection. Other impervious surfaces, such as driveways, parking areas, etc. are generally not suitable for rainwater harvesting but may be appropriate for stormwater management.

The roof material will impact the quality and quantity of captured rainwater. Smooth metal or slate surfaces are most efficient. Clay and concrete tiles may collect less rainwater due to porosity, inefficient flow and evaporation. Calculators used to estimate quantity and component sizes may include a "Rooftop Runoff Coefficient" (as described in The Cabell Brand Center's *Virginia Rainwater Harvesting Manual*, and used in DCR's Rainwater Harvesting Spreadsheet) to account for differences in catchment surface materials. Composite shingles, wood shingles, and tar and gravel roofing may leach chemicals into the water, so these should be considered as a part of the design and intended use of the harvested rainwater.

3.2 Gutters, Downspouts & Drains

Gutters are used to capture rainwater at the eaves of a building, and should be sloped towards the downspouts. Their size depends on the roof configuration, surface area, roof slope, number of downspouts and intensity of rainfall. Gutters and downspouts are commonly constructed of PVC, vinyl, aluminum, and galvanized steel.

3.3 Pre-Treatment: Screens, Strainers, First-Flush Diverters, Roof Washers

Leaves and other debris can be prevented from entering the collected rainwater along the gutters using leaf screens or "gutter guards", or in the downspouts with downspout filters or strainer baskets. Other pretreatment devices such as cylindrical screens and filter socks may be installed at the outlet of the downspout or inlet to the storage tank.

A first flush diverter is designed to re-route the initial rainwater runoff that may contain contaminants such as dust, pollen, bird and rodent feces from the harvested water storage tank. One diverter is recommended for each downspout, and there are several designs available. The diverted water should ideally be routed to a pervious area to allow for filtration. The recommended amount of rainwater diverted depends on roof surface, amount of debris, and number of antecedent dry days.

A roof washer is another device for filtering small debris just ahead of the storage tank. Roof washers are commercially available and consist of a 30-50 gallon box or tank, which are usually equipped with a 30-micron filter or other strainer.

There are also devices which combine the functions of first flush diversion and a roof washer. All pretreatment devices require regular maintenance and cleaning.

3.4 Storage Tanks

Storage tanks or cisterns are selected based on size, location, and material of construction. These elements are discussed in detail in the *Virginia DCR Stormwater Design Specification No.6*, which also provides a cistern Design Spreadsheet, and in the *Virginia Rainwater Harvesting Manual*, compiled by The Cabell Brand Center.

Algae growth should be prevented by using opaque tanks, and minimizing light penetration from any openings. Proper screening of all inlets, outlets and overflows is necessary to protect from vectors such as mosquitoes, insects and rodents.

3.5 Pumps & Controls

Submersible pumps, suction or jet pumps are common in rainwater harvesting systems. They are often used in conjunction with a pressure tank and switch for pump control. A floating pump intake equipped with a filter is recommended to withdraw water a few inches below the water surface.

Chapter 4: Treatment

4.1 Treatment Goals & Water Quality Standards

The federal *Safe Drinking Water Act* has established chemical, physical, radiological and microbiological standards for public drinking water. These standards have been adopted by the VDH in the *Waterworks Regulations* (12VAC5-590-340 through 440.) The public drinking water standards cover contaminants that pose acute and chronic health concerns. These guidelines recommend that harvested rainwater be restricted to non-potable activities. In settings with a high potential for human exposure or contact, the primary area of concern is microbial contamination. The public health goal in these settings is to maintain an absence of:

- Bacteria, including *Escherichia coli, Legionella*
- Protozoans, including *Giardia lamblia, Cryptosporidium*
- Viruses

4.2 Treatment Processes

It is important that potential users understand the need for treatment in order to minimize the risk to those that may come in contact with harvested rainwater. Pretreatment devices described in the previous section are recommended for all rainwater harvesting systems. Additional treatment processes may be necessary, depending on the intended use. Treatment effectiveness can only be established through a regular water testing program, in conjunction with routine maintenance of the rainwater harvesting system.

4.2.1. Filtration

Filtration devices are used to remove particulate matter that may clog piping valves, plumbing fixtures and irrigation devices, stain sinks, toilets and tubs, and harbor pathogenic microorganisms. Cartridge filters of synthetic fiber, ceramic media filters, and activated carbon filters should be used as appropriate. Filters that are certified to meet American National Standards Institute (ANSI)/NSF Standard 61 help ensure that the filter does not impart undesirable contaminants into the water.

The efficiency of the filter is related to the opening size. A recommended size for non-potable use often cited is 5 microns. The intended use of the harvested rainwater should determine the type and opening size of the filter.

Granular Activated Carbon (GAC) Filters provide an additional benefit in adsorbing organic compounds, some which may impart undesirable water characteristics, such as odor. GAC filters are generally used in series with another sediment filter. GAC filters must be installed upstream of chlorine disinfection.

Synthetic membrane filters with smaller openings, such as reverse osmosis units, may also be considered, depending on the proposed use.

4.2.2. Neutralization

Neutralization of acidic rainwater may be necessary to raise the pH to acceptable levels. This is particularly important if the water will contact metal surfaces, pipe, etc. to prevent corrosion. A neutralizing agent, such as lime or soda ash, may be added to the storage tank. Neutralizing filters/contactors with calcium carbonate media, sometimes blended with magnesium oxides, can also be used to raise the pH.

4.2.3. Disinfection

Non-potable water used indoors should be disinfected. Disinfection of non-potable water prevents microbial growth (such as *Legionella* and *E. coli*), odors and fouling of fixtures. All disinfection methods shall follow filtration. The disinfection methods most commonly referenced are: Chlorine, Ultraviolet (UV) Light, and Ozone. VDH recommends that a qualified professional engineer design the system and provide operational recommendations for the appropriate treatment and delivery of harvested rainwater.

- Chlorine is a powerful oxidant chemical that is generally used in conventional drinking water disinfection. Chlorine disinfection may be achieved in various ways, and generally leaves a residual in the finished water to inhibit growth of bacteria. Chlorine disinfection can be achieved through the use of flow-through chlorinators using calcium hypochlorite tablets or pellets. An automated, sodium hypochlorite solution feed system using a metering pump and injector may also be used. Chlorine compounds having ANSI/NSF Standard 60 certification are recommended. Do not use commercial bleaches or chlorine products that contain fragrances or UV stabilizers (particularly cyanide-based UV stabilizers designed for swimming pools). A total chlorine residual of 0.2 mg/L is recommended.
- UV Light disinfection devices for potable water must meet NSF/ANSI Standard 55, Class A. Non-potable water disinfection devices should meet NSF/ANSI Standard 55, Class B, as a minimum. UV light system must be rated for the system design flow rate.
- Ozone is a powerful oxidant that is highly reactive and does not leave a residual disinfectant in the water. In addition to disinfecting microorganisms, it also reduces color, taste and odors. Ozone gas can be a health hazard if inhaled, and accumulation of ozone may pose a risk of explosion.

4.3 Testing

Harvested rainwater should be tested at the storage unit (cistern or tank) to determine the microbial and chemical quality of the water, prior to any subsequent treatment. If treatment is installed, then the harvested water should also be tested downstream of all treatment units to ensure that the treatment is working.

Chapter 5: Operation & Maintenance

The owner of a rainwater harvesting system is responsible for the ongoing operation and maintenance. Duties may include any of the following:

- Monitor tank levels
- Clean gutters and pre-treatment devices
- Repair leaks
- Repair and maintain mechanical and electrical equipment
- Remove sediment buildup in tanks
- Periodically backwash filters or replace filter media
  - Replenish neutralizing filter media as it is absorbed
  - Replace spent GAC media
- Clean UV light bulb and quartz sleeve, replace bulbs as needed
- Replenish chlorine disinfectant (tablets, pellets or solution)
- Regularly test bacteriological water quality.

Owners of rainwater harvesting systems with extensive water treatment equipment may consider contracting maintenance oversight from the system designer or equipment supplier. At a minimum, specific manufacturer's literature should be consulted for more detailed operation and maintenance information.

Chapter 6: References

The following references are recommended for further information on rainwater harvesting:

Managing Wet Weather through Green Infrastructure: Municipal Handbook: Rainwater Harvesting, USEPA, 2008, Doc # EPA-833-F-08-101.

Point-of-Use or Point-of-Entry Treatment Options for Small Drinking Water Systems, USEPA, April 2006, Doc # EPA 815-R-06-010

National Sanitation Foundation (NSF)

- Protocol P151: Health Effects from Rainwater Catchment System Components
- Standard 42: Drinking Water Treatment Units – Aesthetic Effects,
- Standard 53: Drinking Water Treatment Units – Health Effects,
- Standard 55: Ultraviolet Microbial Water Treatment Systems,
- Standard 58: Reverse Osmosis Drinking Water Systems
- Standard 60: Drinking Water Treatment Chemicals – Health Effects
- Standard 61: Drinking Water System Components – Health Effects

Virginia Rainwater Harvesting Manual, compiled by the Cabell Brand Center, www.cabellbrandcenter.org.

Georgia Rainwater Harvesting Guidelines, 2009, developed pursuant to the 2009 Georgia State Amendments to the International Building Code.

Georgia State Amendments to the International Plumbing Code, revised January 1, 2010.

The Texas Manual on Rainwater Harvesting, Texas Water Development Board, 3rd edition, 2005.

Virginia Stormwater BMP Clearinghouse, www.vwrrc.vt.edu/swc/, administered by the Virginia Department of Conservation and Recreation and the Virginia Water Resources Research Center.

American Rainwater Catchment Systems Association, www.arcsa.org.

APPENDIX – RAINWATER HARVESTING APPLICATION MATRIX

Level	Proposed Application	Served by Public Water?	Considerations
1	Indoor: Non-potable	Yes	Approved Cross-Connection Control Local building code requirements System design approved by Waterworks, Compliance with applicable laws, regulations and ordinances. Pre-Treatment (1st flush diverter, etc.) Storage Filtration pH Adjustment Disinfection Operational and maintenance requirements
2	Indoor: Non-potable	No	Approved Cross-Connection Control Local building code requirements Compliance with applicable laws, regulations and ordinances Pre-Treatment (1st flush diverter, etc.) Storage Filtration pH Adjustment Disinfection Operational and maintenance requirements
3	Outdoor: Non-potable, High Contact (swimming pools, showers, etc.)	Yes or No	Approved Cross-Connection Control Local building code requirements System design in compliance with or approved by waterworks Pre-Treatment (1st flush diverter, etc.) Storage Filtration Disinfection
4	Outdoor: Landscape Irrigation	Yes or No	Approved Cross-Connection Control Local building code requirements System design in compliance with or approved by waterworks Pre-Treatment (1st flush diverter, etc.) Storage Filtration