WATER EFFICIENCY AND SANITATION STANDARD (WE-STAND)

2021 REPORT ON COMMENTS

International Association of
Plumbing and Mechanical Officials

4755 East Philadelphia Street
Ontario, California – USA 91761-2816

Ph: 909.472.4100 | Fax: 909.472.4150
http://www.iapmo.org

To: IAPMO Members and Interested Parties

September 7, 2021

The 202x *WE•Stand* was published in the July 23 ANSI Standards Action Report, with a deadline for comments on Sept. 6 for the development of the 2020 *Water Efficiency and Sanitation Standard (WE•Stand)*.

https://share.ansi.org/Shared%20Documents/Standards%20Action/2021-PDFs/SAV5230.pdf

No comments were received by the posted deadline.

In accordance section 9.1 of the IAPMO Regulations Governing Consensus Development of the Water Efficiency and Sanitation Standard, anyone may appeal to the appeals panel of the WE-Stand. The appellant shall file a written complaint with the Secretariat within 30 days.

The IAPMO Regulations Governing Consensus Development of the Water Efficiency and Sanitation Standard can be obtained at:

https://www.iapmo.org/media/3840/regulations_for_the_consensus_development_of_the_westand.pdf

The deadline to file a written appeal is Oct. 7.

Anyone wishing to submit an appeal may contact Hugo Aguilar at hugo.aguilar@iapmo.org.

For questions about the 2020 WE-Stand, contact Dan Cole, at (708) 995-3009 or dan.cole@iapmo.org or Maria Bazan, at (708) 995-3007 or maria.bazan@iapmo.org.

CHAPTER 1
ADMINISTRATION

101.0 Title, Scope, and General.

101.1 Title. This document shall be known as the "Water Efficiency and Sanitation Standard (WEStand)," shall be cited as such, and will be referred to herein as "this standard."

101.2 Purpose. The purpose of this standard is to provide minimum requirements to optimize water use practices attributed to the built environment while maintaining protection of the public health, safety and welfare. This standard is not intended to circumvent the health, safety and general welfare requirements of the codes referenced in Section 101.6.

101.3 Plans Required. The Authority Having Jurisdiction shall be permitted to require the submission of plans, specifications, drawings, and such other information as the Authority Having Jurisdiction may deem necessary, prior to the commencement of, and at any time during the progress of, any work regulated by this standard. The issuance of a permit upon plans and specifications shall not prevent the Authority Having Jurisdiction from thereafter requiring the correction of errors in said plans and specifications or from preventing construction operations being carried on thereunder when in violation of this standard or of any other pertinent ordinance or from revoking any certificate of approval when issued in error.

101.4 Scope. The provisions of this standard shall apply to the erection, installation, alteration, repair, relocation, replacement, addition to, use, or maintenance of plumbing and mechanical systems covered by the scope of this standard within this jurisdiction.

101.4.1 Repairs and Alterations. In existing buildings or premises in which plumbing and mechanical installations that were designed and installed in accordance with this standard are to be altered, repaired, or renovated, deviations from the provisions of this standard are permitted, provided such deviations are found to be necessary and are first approved by the Authority Having Jurisdiction.

101.4.2 Existing Construction. No provision of this standard shall be deemed to require a change in any portion of a plumbing or mechanical system or any other work regulated by this standard in or on an existing building or lot when such work was installed and is maintained in accordance with law in effect prior to the effective date of this standard, except when any such plumbing or mechanical system is determined by the Authority Having Jurisdiction to be dangerous, unsafe, insanitary, a nuisance or a menace to life, health, or property.

101.5 Appendices. The provisions in the appendices are intended to augment the requirements of this standard and shall not be considered part of this standard unless formally adopted as such.

101.6 Referenced Codes and Standards. The codes and standards referenced in this standard shall be considered part of the requirements of this standard to the prescribed extent of each such reference.

101.6.1 Building. The provisions of the building code shall apply to the construction, alteration, movement, enlargement, replacement, repair, use and occupancy, location, maintenance, removal and demolition of every structure or any appurtenances connected or attached to such buildings or structures.

101.6.2 Electrical. The provisions of the electrical code shall apply to the installation of electrical systems, including but not limited to, alterations, repair, replacement, equipment, appliances, fixtures, fittings, and appurtenances thereto.

101.6.3 Mechanical. The provisions of the mechanical code shall apply to the installation, alterations, repair and replacement of mechanical systems, including equipment, appliances, including ventilating, heating, cooling, air-conditioning and refrigeration systems. Where a mechanical code is not adopted or where the content of the mechanical code adopted by the jurisdiction is not applicable, then mechanical code shall mean the Uniform Mechanical Code (UMC) promulgated by the International Association of Plumbing and Mechanical Officials (IAPMO).

101.6.4 Plumbing. The provisions of the plumbing code shall apply to the installation, alteration, repair and replacement of plumbing systems, including equipment, appliances, fixtures, fittings and appurtenances. Where a plumbing code is not adopted or where the content of the plumbing code adopted by the jurisdiction is not applicable, then plumbing code shall mean the Uniform Plumbing Code (UPC) promulgated by the International Association of Plumbing and Mechanical Officials (IAPMO).

101.6.5 Solar. Solar energy systems shall be installed in accordance with the Uniform Solar Energy Code (USEC) promulgated by the International Association of Plumbing and Mechanical Officials (IAPMO).

101.6.6 Swimming Pool. The provisions of the swimming pool code shall apply to the erection, installation, alteration, repair, relocation, replacement, addition to, use and maintenance of swimming pools, spas, or hot tub systems. Where a swimming pool code is not adopted or where the content of the swimming pool code adopted by the jurisdiction is not applicable, then swimming pool code shall mean the Uniform Swimming Pool, Spa & Hot Tub Code (USPSHTC) promulgated by the International Association of Plumbing and Mechanical Officials (IAPMO).

101.7 Conflicts. Where, in any specific case, different sections of this standard or referenced standards specify different materials, methods of construction, or other require-

ments, the most restrictive shall govern as determined by the Authority Having Jurisdiction. When there is a conflict between a general requirement and a specific requirement, the specific requirement shall be applicable.

102.0 Alternate Materials, Designs, and Methods of Construction Equivalency.

102.1 General. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard. Technical documentation shall be submitted to the Authority Having Jurisdiction to demonstrate equivalency. The Authority Having Jurisdiction shall have the authority to approve or disapprove the system, method, or device for the intended purpose.

However, the exercise of this discretionary approval by the Authority Having Jurisdiction shall have no effect beyond the jurisdictional boundaries of said Authority Having Jurisdiction. Any alternate material or method of construction so approved shall not be considered as in accordance with the requirements, intent or both of this standard for any purpose other than that granted by the Authority Having Jurisdiction when the submitted data does not prove equivalency.

103.0 Plans and Specifications.

103.1 Construction Documents. Construction documents, engineering calculations, diagrams, and other data shall be submitted in two or more sets with each application for a permit. The construction documents, computations, and specifications shall be prepared by, and the plumbing designed by, a registered design professional. Construction documents shall be drawn to scale with clarity to identify that the intended work to be performed is in accordance with the code.

Exception: The Authority Having Jurisdiction shall be permitted to waive the submission of construction documents, calculations, or other data where the Authority Having Jurisdiction finds that the nature of the work applied for is such that reviewing of construction documents is not necessary to obtain compliance with this standard.

103.2 Supplemental Information. Supplemental information necessary to verify compliance with this standard, such as calculations, worksheets, compliance forms, product listings, or other data, shall be made available when required by the Authority Having Jurisdiction.

104.0 Permit Issuance.

104.1 Permit Issuance. The application, construction documents, and other data filed by an applicant for a permit shall be reviewed by the Authority Having Jurisdiction. Such plans shall be permitted to be reviewed by other departments of this jurisdiction to verify compliance with applicable laws under their jurisdiction. Where the Authority Having Jurisdiction finds that the work described in an application for permit and the plans, specifications, and other data filed therewith are in accordance with the requirements of the code and other pertinent laws and ordinances, and that the fees specified in Section 104.3 have been paid, the Authority Having Jurisdiction shall issue a permit therefore to the applicant.

104.2 Approved Plans or Construction Documents. Where the Authority Having Jurisdiction issues the permit where plans are required, the Authority Having Jurisdiction shall endorse in writing or stamp the construction documents "APPROVED." Such approved construction documents shall not be changed, modified, or altered without authorization from the Authority Having Jurisdiction, and the work shall be done in accordance with approved plans.

104.3 Permit Fees. The fees shall be determined and adopted by the Authority Having Jurisdiction.

105.0 Inspections.

105.1 General. Plumbing and mechanical systems for which a permit is required by this standard or the applicable code shall be inspected by the Authority Having Jurisdiction. No portion of any plumbing or mechanical system shall be concealed until inspected and approved. Neither the Authority Having Jurisdiction nor the jurisdiction shall be liable for expense entailed in the removal or replacement of material required to permit inspection. When the installation of a plumbing or mechanical system is complete, an additional and final inspection shall be made.

106.0 Connection Approval.

106.1 Connections. No person shall make connection to any plumbing system regulated by this standard for which a permit is required unless approved by the Authority Having Jurisdiction.

106.2 Energy Connections. No person shall make connections from a source of energy or fuel to any system or equipment regulated by this standard and for which a permit is required until approved by the Authority Having Jurisdiction.

106.3 Temporary Connections. The Authority Having Jurisdiction shall be permitted to authorize temporary connection of the plumbing or mechanical equipment to the source of energy or fuel for the purpose of testing the equipment.

107.0 Maintenance.

107.1 General. Plumbing and mechanical systems, materials, and appurtenances, both existing and new, and parts thereof shall be maintained in proper operating condition in accordance with the original design and in a safe and hazard-free condition. Devices or safeguards that are required by this standard shall be maintained in conformance with the standard edition under which installed. The owner or the owner's designated agent shall be responsible for maintenance of plumbing and mechanical systems and equipment. To determine compliance with this subsection, the Authority Having Jurisdiction shall be permitted to cause a plumbing or mechanical system or equipment to be reinspected.

107.2 Information Required. Information, such as manufacturer's instructions, owner's manuals or other information shall be provided for all products and systems that require regular maintenance to achieve the effective use of energy and water. A maintenance schedule that includes clear instructions of the maintenance action and makes reference to the owner's manual shall be required and made available.

CHAPTER 2
DEFINITIONS

201.0 General. For the purpose of this standard, the following terms have the meanings indicated in this chapter.

No attempt is made to define ordinary words, which are used in accordance with their established dictionary meanings, except where a word has been used loosely and it is necessary to define its meaning as used in this standard to avoid misunderstanding.

The definitions of terms are arranged alphabetically according to the first word of the term.

202.0 Definition of Terms.

203.0 –A–

Accessible. Where applied to a fixture, connection, appliance, or equipment, "accessible" means having access thereto, but which first may require the removal of an access panel, door, or similar obstruction.

Air Gap, Drainage. The unobstructed vertical distance through the free atmosphere between the lowest opening from a pipe, plumbing fixture, appliance, or appurtenance conveying waste to the flood-level rim of the receptor.

Air Gap, Water Distribution. The unobstructed vertical distance through the free atmosphere between the lowest opening from a pipe or faucet conveying potable water to the flood-level rim of a tank, vat, or fixture.

Alternate Water Source. Nonpotable source of water that includes but not limited to gray water, on-site treated nonpotable water, rainwater, and reclaimed (recycled) water.

Authority Having Jurisdiction. The organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, installations, or procedures. The Authority Having Jurisdiction shall be a federal, state, local, or other regional department or an individual such as a plumbing official, mechanical official, labor department official, health department official, building official, or others having statutory authority. In the absence of a statutory authority, the Authority Having Jurisdiction may be some other responsible party. This definition shall include the Authority Having Jurisdiction's duly authorized representative.

204.0 –B–

Blackwater. Waste water containing bodily or other biological wastes discharged from toilets and kitchen sink waste.

Bottle Filling Station. A plumbing fixture that is connected to the potable water distribution and building drainage system that is designed and intended for filling personal use drinking water bottles or containers not less than 10 inches (250 mm) in height. Such fixtures can be separate from or integral to a drinking fountain and can incorporate a water filter and a cooling system for chilling the drinking water.

Branch. A part of the piping system other than a main, riser, or stack.

Building Code. The building code that is adopted by the jurisdiction.

205.0 –C–

Catch Can Test. Method to measure the precipitation rate of an irrigation system by placing catchment containers at various random positions in the irrigation zone for a prescribed amount of time during irrigation application. The volumes of water in the containers are measured, averaged and calculated to determine precipitation rate. Tests are conducted using irrigation industry accepted practices.

Challenge Test. The evaluation of a unit treatment process for pathogen $\log_{10}$ reduction performance using selected surrogate or indigenous constituents. This includes a detailed technology evaluation study conducted to challenge the treatment technology over a wide range of operational conditions.

Combination Ovens. A device that combines the function of hot air convection (oven mode) and saturated and superheated steam heating (steam mode), or both, to perform steaming, baking, roasting, rethermalizing, and proofing of various food products. In general, the term combination oven is used to describe this type of equipment, which is self contained. The combination oven is also referred to as a combination oven/steamer, combi or combo.

Commissioning. The activities associated with bringing a new process into normal working condition.

Commode. The composting toilet fixture for collecting, containing, or transporting excreta to the compost processor.

Compost Additives. Any material such as sawdust, wood shavings, and other compostable material added to the commode or compost processor to maintain operational conditions within the composting toilet system.

Composting Toilet System. A system designed to safely collect and process excreta and compost additives into humus through aerobic decomposition.

Compost Processor. The site of aerobic decomposition transforming excreta and compost additives into humus.

Condensate. Liquid water separated from a gaseous state due to changes in temperature or pressure, or both, and remains liquid at standard conditions.

Conditioned Space. An area, room, or space normally occupied and being heated or cooled for human habitation by any equipment.

Cross-connection. A connection or arrangement, physical or otherwise, between a potable water supply system and a plumbing fixture or a tank, receptor, equipment, or device, through which it may be possible for nonpotable, used, unclean, polluted, and contaminated water, or other

substances to enter into a part of such potable water system under any condition.

206.0 –D–

Debris Excluder. A device installed on a rainwater or stormwater catchment conveyance system to prevent the accumulation of leaves, needles, or other debris in the system.

Dedicated Meter. A water measuring device used at a subsection or end use of a water supply system for any of the following purposes: billing, water management, collecting and analyzing water usage data, detection of leaks, equipment failure, water waste, and irregular or abnormal use for a specific application. Also called a submeter.

Desiccation. The process of dehydrating excreta or leachate.

Disposal Field. An intended destination for gray water, including but not limited to, a mulch basin or receiving landscape feature, gray water leach field, or other approved method of disposal.

Diverted Urine. Urine that is collected and has not made contact with feces.

Dry Weather Runoff. Water that flows along a surface, in a channel or sub-surface including groundwater seepage, and is not associated with a rain event.

207.0 –E–

Energy Star. A joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy. Energy Star is a voluntary program designed to identify and promote energy-efficient products and practices.

ETc. Evapotranspiration rate of the plants derived by multiplying ETo by the appropriate plant factor or coefficient.

ETo. Reference evapotranspiration for a cool-season grass as calculated by the standardized Penman-Monteith equation based on weather-station data.

Evapotranspiration (ET). The water transpired from vegetation, evaporated from the soil, water, and plant surfaces. Evapotranspiration rates are values expressed in inches per unit of time (day, week, month, or year). Evapotranspiration rates vary by components of weather conditions, including insolation, humidity, temperatures and wind, and time of year.

Excreta. Includes but is not limited to urine, feces, menses, toilet paper, and other human body emissions and biodegradable cleaning products.

208.0 –F–

Field Verification. Performance confirmation study conducted using challenge testing, including surrogate microorganisms and/or other non-biological surrogates, usually during startup and commissioning.

Flow-Through Design. A fitting or a fitting configuration with two primary inlet connections and one, or more outlet connections with the purpose to supply water to a fixture fitting.

Food Steamers (Steam Cookers). A cooking appliance wherein heat is imparted to food in a closed compartment by direct contact with steam. The compartment can be at or above atmospheric pressure. The steam can be static or circulated.

209.0 –G–

Gang Showers. Shower compartments designed and intended for use by multiple persons simultaneously.

Geothermal. Renewable energy generated by deep-earth.

Gray Water. Untreated waste water that has not come into contact with toilet waste, kitchen sink waste, dishwasher waste or similarly contaminated sources. Gray water includes waste water from bathtubs, showers, lavatories, clothes washers and laundry tubs. Also known as grey water, graywater, and greywater.

Gray Water Diverter Valve. A valve that directs gray water to the sanitary drainage system or to a subsurface irrigation system.

Ground Source Heat Pump. A heat pump that uses the thermal energy of the ground or groundwater to provide space conditioning or water heating.

210.0 –H–

Humus. The biologically decomposed, soil-like output of the compost processor.

Hydrozone. A grouping of plants with similar water requirements that are irrigated by the same irrigation zone.

211.0 –I–

Irrigation Control System. An irrigation control system consists of a combination of a programmable controller using one or more inputs or sensors that, in combination, estimate or measure the availability of moisture for plants in order to operate an irrigation system, in such a manner that the system replenishes water as needed while minimizing excess water use. A properly programmed irrigation control system requires initial site specific set-up and will make irrigation schedule adjustments, including run times and required cycles throughout the irrigation season without human intervention.

Irrigation Demand. The amount of water not supplied by natural precipitation that is needed to maintain landscape plant life in good condition. Irrigation demand is calculated by subtracting natural effective precipitation from the ET rate adjusted by the landscape coefficient which includes the functional purpose and desired quality of the plant being irrigated.

Irrigation Emission Device. The various landscape irrigation equipment terminal fittings or outlets that emit water for irrigating vegetation in a landscape.

Irrigation Zone. The landscape area that is irrigated by a set of landscape irrigation emission devices installed on the same water supply line downstream of a single valve.

212.0 –J–

No Definitions.

213.0 –K–

Kitchen and Bar Sink Faucets. A faucet that discharges into a kitchen or bar sink in domestic or commercial installations. Supply fittings that discharge into other type sinks, including clinic sinks, floor sinks, service sinks and laundry trays are not included.

214.0 –L–

Lavatory. 1) a basin or vessel, for washing. 2) a plumbing fixture, as defined in (1), especially placed for use in personal hygiene. Principally not used for laundry purposes and never used for food preparation, or utensils, in food services. 3) a fixture designed for the washing of the hands and face. Sometimes called a wash basin.

Lavatory Faucet. A faucet that discharges into a lavatory in a domestic or commercial installation.

Leachate. Liquid draining from the compost processor.

Listed (Third-party Certified). Equipment or materials included in a list published by a listing agency (accredited conformity assessment body) that maintains periodic inspection on current production of listed equipment or materials and whose listing states either that the equipment or material complies with approved standards or has been tested and found suitable for use in a specified manner.

Listing Agency. An agency accredited by an independent and authoritative conformity assessment body to operate a material and product listing and labeling (certification) system and that is accepted by the Authority Having Jurisdiction, which is in the business of listing or labeling. The system includes initial and ongoing product testing, a periodic inspection on current production of listed (certified) products, and that makes available a published report of such listing in which specific information is included that the material or product in accordance with applicable standards and found safe for use in a specific manner.

Log_{10} Reduction. The removal of a pathogen or surrogate in a unit process expressed in log_{10} units of the effluent concentration over the influent concentration.

Note: A 1-log reduction equates to 90% removal, 2-log reduction to 99% removal, 3-log reduction to 99.9% removal, and so on.

Log_{10} Reduction Target (LRT). The log_{10} reduction target for the specified pathogen group (e.g., viruses, bacteria, or protozoa) to achieve the identified level of risk to individuals (e.g., 10^{-4} infection per year).

Low Application Rate Irrigation. A means of irrigation using Low Precipitation Rate Sprinkler Heads or Low Flow Emitters in conjunction with cycling irrigation schedules to apply water at a rate less than the soil absorption rate.

Low Flow Emitter. Low flow irrigation emission device designed to dissipate water pressure and discharge a small uniform flow or trickle of water at a constant flow rate.

Low Precipitation Rate Sprinkler Heads. Landscape irrigation emission devices or sprinkler heads with maximum precipitation rate of 1 inch per hour over the applied irrigation area.

215.0 –M–

Main. The principal artery of a system of continuous piping to which branches may be connected.

Maintenance. The upkeep of property or equipment by the owner of the property in compliance with the requirements of this standard.

Mechanical Code. The mechanical code that is adopted by the jurisdiction. Where a mechanical code is not adopted or where the content of the mechanical code adopted by the jurisdiction is not applicable, then mechanical code shall mean the Uniform Mechanical Code (UMC) promulgated by the International Association of Plumbing and Mechanical Officials (IAPMO).

Metering Faucet. A self-closing faucet that dispenses a specific volume of water for each actuation cycle. The volume or cycle duration can be fixed or adjustable.

Modified Evapotranspiration. Numeric values, expressed in inches/hr., of evapotranspiration rates, derived by altering ETo rates by applying factors of specific needs of the vegetation and local climate conditions. Modified evapotranspiration rates are used as a factor in estimating the irrigation water needs of landscapes. Common usage includes reference evapotranspiration as the base rate, modified by coefficients or factors for specific plant types and densities.

Mulch. Organic materials, such as wood chips and fines, tree bark chips, and pine needles that are used in a mulch basin to conceal gray water outlets and permit the infiltration of gray water.

Mulch Basin. A subsurface catchment area for gray water that is filled with mulch and of sufficient depth and volume to prevent ponding, surfacing or runoff.

Multi-Occupant Spaces. Indoor spaces used as a place of congregation for activities such as presentations and training, including classrooms and conference rooms.

216.0 –N–

Nonwater Urinal with Drain Cleansing Action. A nonwater urinal that conveys waste into the drainage system without the use of water for flushing and automatically performs a drain-cleansing action after a predetermined amount of time.

Non-sewered Sanitation System. A prefabricated integrated sewage treatment unit that is not connected to a public sewer or private sewage disposal system.

217.0 –O–

On-Site Treated NonPotable Water. Nonpotable water, that has been collected, treated, and intended to be used on-site and is suitable for direct beneficial use.

Owner's Manual. A manual provided to the owner containing instructions for all management aspects of that system.

218.0 –P–

Plumbing Code. The plumbing code that is adopted by the jurisdiction. Where a plumbing code is not adopted or where the content of the plumbing code adopted by the jurisdiction is not applicable, then plumbing code shall mean the Uniform Plumbing Code (UPC) promulgated by the International Association of Plumbing and Mechanical Officials (IAPMO).

Potable Water. Water that is satisfactory for drinking, culinary, and domestic purposes and that meets the requirements of the Health Authority Having Jurisdiction.

Precipitation Rate. The sprinkler head application rate of water applied to landscape irrigation zone, measured as inches (millimeters) per hour. Precipitation rates of sprinkler heads are calculated according to the flow rate, pattern and spacing of the sprinkler heads.

Pre-Rinse Spray Valve. A handheld device for use with commercial dishwashing and ware washing equipment that sprays water on dishes, flatware, and other food service items for the purpose of removing food residue before cleaning and sanitizing the items.

Public Water System. A system for the provision to the public of water for human consumption through pipes or other constructed conveyances, if such system has at least fifteen service connections or regularly serves an average of twenty-five individuals daily for at least 60 days per year.

219.0 –Q–

Quick-Disconnect Device. A hand-operated device that provides a means for connecting and disconnecting a hose to a water supply and that is equipped with a means to shut off the water supply when the device is disconnected.

220.0 –R–

Rainwater. Natural precipitation that lands on a man-made, impervious above ground surface and can be collected on-site for beneficial uses.

Rainwater Catchment System. A system that collects and stores rainwater for the intended purpose of beneficial use. Also known as Rainwater Harvesting System.

Recirculation System. A system of hot water supply and return piping with shutoff valves, balancing valves, circulating pumps, and a method of controlling the circulating system.

Reclaimed (Recycled) Water. Nonpotable water provided by a water/wastewater utility that, as a result of treatment of domestic wastewater, meets requirements of the Authority Having Jurisdiction for its intended uses.

Reference Evapotranspiration (ETo). Numeric value, expressed in inches/hr., calculated as the water necessary to produce maximum biomass based upon a cool-season turf grass 4-6 inches tall. Common sources for obtaining local reference evapotranspiration rates are local agriculture extension services, state departments of agriculture, water agencies, irrigation professionals, the United States Geological Survey, and internet websites.

Registered Design Professional. An individual who is registered or licensed by the laws of the state to perform such design work in the jurisdiction.

Reverse Osmosis Reject Water. Water that does not pass through a membrane of a reverse osmosis system.

Roof Washer. A device or method for removal of sediment and debris from a collection surface by diverting initial rainfall from entry into the cistern(s). Also known as a first flush device.

Run Out. The developed length of pipe that extends away from the circulating loop system to a fixture(s).

221.0 –S–

Secondary Composting. Additional retention and continued decomposition of humus removed from compost processors in order to meet a safe retention time.

Self Closing Faucet. A faucet that closes itself after the actuation or control mechanism is deactivated. The actuation or control mechanism can be mechanical or electronic.

Single Occupant Spaces. Private offices, workstations in open offices, reception workstations, and ticket booths.

Site-Built. Constructed at the site of use.

Soil Absorption Rate. The rate of the soil's ability to allow water to percolate or infiltrate the soil and be retained in the root zone of the soil, expressed as inches (millimeters) per hour.

Sprinkler Head. Landscape irrigation emission device discharging water in the form of sprays or rotating streams, not including Low Flow Emitters.

Stormwater. Natural precipitation that has contacted a surface at grade, below grade, or above ground parking surfaces.

Stormwater Catchment System. A system that collects and stores stormwater for the intended purpose of beneficial use. Also known as Stormwater Harvesting System.

Submeter. A meter installed subordinate to a site meter. Also known as a dedicated meter.

Subsoil Irrigation Field. Gray water irrigation field installed in a trench within the layer of soil below the topsoil. This system is typically used for irrigation of deep rooted plants.

Subsurface Irrigation Field. Gray water irrigation field installed below finished grade within the topsoil.

Surge Tank. A reservoir to modify the fluctuation in flow rates to allow for uniform distribution of gray water to the points of irrigation.

Surrogate. A biological, chemical, or physical parameter used to verify pathogen reductions performances.

222.0 –T–

Transfer. The controlled transfer of excreta or partially processed humus between commode and composting processor or between multi-stage composting processors.

223.0 –U–

Urine Diversion. Separation of urine from other excreta that

occurs at the commode.

224.0 –V–

Validation Report. Report documenting the results of a challenge test conducted during field verification.

Vectors. An organism that has the potential to transmit disease.

225.0 –W–

WaterSense. A voluntary program of the U.S. Environmental Protection Agency designed to identify and promote water-efficient products and practices.

Water Closet. A fixture with a water-containing receptor that receives liquid and solid body waste and on actuation conveys the waste through an exposed integral trap into a drainage system. Also referred to as a toilet.

Water Factor (WF). A measurement and rating of appliance water efficiency, most often used for residential and light commercial clothes washers, as follows:

Clothes Washer (residential and commercial). The quantity of water in gallons used to complete a full wash and rinse cycle per measured cubic foot capacity of the clothes container.

Water/Wastewater Utility. A public or private entity which may treat, deliver or do both functions to reclaimed (recycled) water, potable water, or both to wholesale or retail customers.

226.0 –X–

No definitions.

227.0 –Y–

No definitions.

228.0 –Z–

No definitions.

CHAPTER 3
GENERAL REGULATIONS

301.0 Scope. This chapter covers the general requirements for plumbing and mechanical systems covered by this standard. Such systems shall be in accordance with the requirements of this standard, the plumbing code and the mechanical code.

302.0 Approval.

302.1 Minimum Standards. Pipe, pipe fittings, traps, fixtures, material, and devices used in a plumbing system shall be listed (third-party certified) by a listing agency (accredited conformity assessment body) as complying with the approved applicable recognized standards referenced in this standard, and shall be free from defects. Unless otherwise provided for in this standard, materials, fixtures, or devices used or entering into the construction of plumbing systems, or parts thereof, shall be submitted to the Authority Having Jurisdiction for approval prior to being installed.

302.1.1 Plastic Pipe, Plastic Pipe Fittings, and Components. Plastic pipe, plastic pipe fittings, and components other than those for gas shall comply with NSF 14.

302.2 Mechanical Systems. Mechanical equipment and appliances shall be approved by the Authority Having Jurisdiction or comply with the applicable nationally referenced standards as evidenced by the listing and label of an approved agency.

303.0 Installation.

303.1 Plumbing and Mechanical Systems. Plumbing and mechanical systems covered by this standard shall be installed in a manner conforming to the plumbing, mechanical, other applicable codes, and the manufacturer's installation and operating instructions.

303.2 Rehabilitation of Piping Systems. When pressure piping systems are rehabilitated using an epoxy lining system it shall meet ASTM F2831.

303.3 Qualifications. Where permits are required, the Authority Having Jurisdiction shall have the authority to require contractors, installers, or service technicians to demonstrate competency. Where determined by the Authority Having Jurisdiction, the contractor, installer or service technician shall be licensed to perform such work.

304.0 Disposal of Liquid Waste.

304.1 Disposal. It shall be unlawful for any person to cause, suffer, or permit the disposal of sewage, human excrement, or other liquid wastes, in any place or manner, except through and by means of an approved drainage system, installed and maintained in accordance with the provisions of the plumbing code and this standard.

Exception: Composting toilets.

304.2 Connections to Plumbing System Required. Plumbing fixtures, drains, appurtenances, and appliances, used to receive or discharge liquid wastes or sewage, shall be connected properly to the drainage system of the building or premises, in accordance with the requirements of the plumbing code and this standard.

Exceptions:

(1) Composting toilets.

(2) Non-sewered sanitation systems.

305.0 Abandonment.

305.1 General. Every abandoned system or part thereof covered under the scope of this standard shall be disconnected from any remaining systems, drained, plugged, and capped in an approved manner.

305.2 Underground Tank. Every underground water storage tank that has been abandoned or otherwise discontinued from use in a system covered under the scope of this standard shall be completely drained and filled with earth, sand, gravel, concrete, or other approved material or removed in a manner satisfactory to the Authority Having Jurisdiction.

CHAPTER 4
WATER EFFICIENCY AND CONSERVATION

401.0 General.

401.1 Scope. The provisions of this chapter establish the means of conserving potable and nonpotable water used in and around a building.

402.0 Water-Conserving Plumbing Fixtures and Fittings.

402.1 General. The maximum water consumption of fixtures and fixture fittings shall comply with the flow rates specified in Table 402.1 and Section 402.2 through Section 402.10.

402.2 Water Closets. No water closet shall have an effective flush volume exceeding 1.28 gallons (4.8 Lpf) per flush (gpf).

402.2.1 Gravity, Pressure Assisted and Electro-Hydraulic Tank Type Water Closets. Gravity, pressure assisted, and electro-hydraulic tank type water closets shall have a maximum effective flush volume of not more than 1.28 gallons (4.8 Lpf) of water per flush in accordance with ASME A112.19.2/CSA B45.1 or ASME A112.19.14 and shall also be listed to the EPA WaterSense Specification for Tank-Type Toilets. The effective flush volume for dual-flush toilets is defined as the composite, average flush volume of two reduced flushes and one full flush.

TABLE 402.1
MAXIMUM FIXTURE AND FIXTURE FITTINGS FLOW RATES

FIXTURE TYPE	FLOW RATE
Showerheads	2.0 gpm @ 80 psi[1]
Kitchen faucets residential[4]	1.8 gpm @ 60 psi
Lavatory faucets residential	1.5 gpm @ 60 psi
Lavatory faucets other than residential	0.5 gpm @ 60 psi
Metering faucets	0.25 gallons/cycle
Metering faucets for wash fountains	One (1) 0.25 gal per cycle fixture fitting for each 20 inches rim space
Wash fountains	One (1) 2.2 gpm @ 60 psi fixture fitting for each 20 inches rim space
Water Closets	1.28 gallons/flush[2]
Urinals	0.5 gallons/flush[3]
Commercial Pre-Rinse Spray Valves	1.3 gpm @ 60 psi

[1] For multiple showerheads serving one shower compartment see Section 402.6.1
[2] Shall also be listed to EPA WaterSense Specification for Tank-Type Toilets.
[3] Shall also be listed to EPA WaterSense Specification for Flushing Urinals. Nonwater urinals shall meet the specifications listed in Section 402.3.1.
[4] See Section 402.4.

402.2.2 Flushometer-Valve Activated Water Closets. Flushometer-valve activated water closets shall have a maximum flush volume of not more than 1.28 gallons (4.8 L) of water per flush in accordance with ASME A112.19.2/CSA B45.1 and shall be listed to the EPA WaterSense Specification for Flushometer-Valve Water Closets.

402.3 Urinals. Urinals shall have a maximum flush volume of not more than 0.50 gallons (1.9 L) of water per flush in accordance with ASME A112.19.2/CSA B45.1 or CSA B45.5/IAPMO Z124. Flushing urinals shall be listed to the EPA WaterSense Specification for Flushing Urinals.

402.3.1 Nonwater Urinals. Nonwater urinals shall comply with ASME A112.19.3/CSA B45.4, ASME A112.19.19 or CSA B45.5/IAPMO Z124. Nonwater urinals shall be cleaned and maintained in accordance with the manufacturer's instructions after installation. Where nonwater urinals are installed they shall have a water distribution line roughed-in to the urinal location at a height not less than 56 inches (1422 mm) above finished floor to allow for the installation of an approved backflow prevention device in the event of a retrofit. Such water distribution lines shall be installed with shutoff valves located as close as possible to the distributing main to prevent the creation of dead ends. Where nonwater urinals are installed, not less than one water supplied fixture rated at not less than 1 drainage fixture unit (DFU) shall be installed upstream on the same drain line to facilitate drain line flow and rinsing.

Exception: Nonwater urinals used as part of a composting toilet system.

402.3.2 Nonwater Urinals with Drain Cleansing Action. Nonwater Urinals with drain cleansing action shall comply with ASME A112.19.19 and shall be cleaned, maintained and installed in accordance with the manufacturer's installation instructions.

402.4 Residential Kitchen Faucets. The maximum flow rate of residential kitchen faucets shall not exceed 1.8 gallons per minute (gpm) (6.8 L/m) at 60 pounds-force per square inch (psi) (414 kPa). Kitchen faucets are permitted to temporarily increase the flow above the maximum rate, but not to exceed 2.2 gpm (8.3 L/m) at 60 psi (414 kPa), and must revert to a maximum flow rate of 1.8 gpm (6.8 L/m) at 60 psi (414 kPa) upon valve closure.

402.5 Lavatory Faucets. The maximum water flow rate of faucets shall be in accordance with Section 402.5.1 and Section 402.5.2.

402.5.1 Lavatory Faucets in Residences, Apartments, and Private Bathrooms in Lodging Facilities, Hospitals, and Patient Care Facilities. The flow rate for lavatory faucets installed in residences, apartments, and private bathrooms in lodging, hospitals, and patient

care facilities (including skilled nursing and long-term care facilities) shall not exceed 1.5 gpm (5.7 L/m) at 60 psi (414 kPa) in accordance with ASME A112.18.1/CSA B125.1 and shall be listed to the U.S. EPA WaterSense High-Efficiency Lavatory Faucet Specification.

402.5.2 Lavatory Faucets in Other Than Residences, Apartments, and Private Bathrooms in Lodging Facilities. Lavatory faucets installed in bathrooms of buildings or occupancies other than those specified in Section 402.5.1 shall be in accordance with Section 402.5.2.1 or Section 402.5.2.2.

402.5.2.1 Maximum Flow Rate. The flow rate shall not exceed 0.5 gpm (1.9 L/m) at 60 psi (414 kPa) in accordance with ASME A112.18.1/CSA B125.1.

402.5.2.2 Metering Faucets. Metering faucets shall deliver not more than 0.25 gallons (1.0 L) of water per cycle.

402.6 Showerheads. Showerheads shall not exceed a flow rate of 2.0 gpm (7.6 L/m) at 80 psi (552 kPa) and shall be listed to ASME A112.18.1/CSA B125.1 and the EPA WaterSense Specification for Showerheads.

402.6.1 Multiple Showerheads Serving One Shower Compartment. The total allowable flow rate of water from multiple showerheads flowing at any given time, with or without a diverter, including rain systems, waterfalls, bodysprays, and jets, shall not exceed 2.0 gpm (7.6 L/m) per shower compartment, where the floor area of the shower compartment is less than 1800 square inches (1.161 m^2). For each increment of 1800 square inches (1.161 m^2) of floor area thereafter or part thereof, additional showerheads are allowed, provided the total flow rate of water from all flowing devices shall not exceed 2.0 gpm (7.6 L/m) for each such increment.

Exceptions:

(1) Gang showers in non-residential occupanices. Singular showerheads or multiple show outlets serving one showering position in gang showers shall not have more than 2.0 gpm (7.6 L/m) total flow.

(2) Where provided, shower compartments required for persons with disabilities in accordance with Table 1201.1 shall not have more than 4.0 gpm (15.0 L/m) total flow, where one outlet is the hand shower.

402.7 Bath and Shower Diverters. Tub spout bath and shower diverters, while operating in the shower mode, shall perform with zero leakage.

402.8 Shower Valves. Shower valves shall meet the temperature control performance requirements of ASSE 1016/ASME A112.1016/CSA B125.16 when tested for the rated flow rate of the installed showerhead.

402.8.1 Marking. Control valves for showers and tub-shower combinations shall be tagged, labeled, or marked with the manufacturer's minimum rated flow and such marking shall be visible after installation.

402.9 Commercial Pre-Rinse Spray Valves. The flow rate for a pre-rinse spray valve installed in a commercial kitchen to remove food waste from cookware and dishes prior to cleaning shall not be more than 1.28 gpm (4.8 L/m) at 60 psi (414 kPa). Where pre-rinse spray valves with maximum flow rates of 1.0 gpm (3.8 L/m) or less are installed, the static pressure shall be not less than 30 psi (207 kPa). Commercial kitchen pre-rinse spray valves shall be equipped with an integral automatic shutoff.

402.10 Emergency Safety Showers and Eye Wash Stations. Emergency safety showers and emergency eye wash stations shall not be limited in their water supply flow rates.

402.11 Drinking Fountains and Bottle Filling Stations. Bottle filling stations shall be included on or used as a substitute to meet the requirements of drinking fountains in at least 50 percent of the requirements for drinking fountains. Bottle filling stations and drinking fountains shall be self closing.

402.12 Recirculating Shower Systems. Recirculating shower systems shall comply with IAPMO IGC330.

402.13 Installation. Water-conserving fixtures and fixture fittings shall be installed in accordance with the manufacturers' instructions to maintain their rated performance.

403.0 Appliances.

403.1 Dishwashers. Residential and commercial dishwashers shall be in accordance with the Energy Star program requirements.

403.2 Clothes Washers. Residential clothes washers shall be in accordance with the Energy Star program requirements. Commercial clothes washers shall be in accordance with Energy Star program requirements, where such requirements exist.

404.0 Non-Sewered Sanitation Systems.

404.1 General. Non-sewered sanitation systems shall comply with ISO 30500.

404.2 Installation. The installation of non-sewered sanitation systems shall be in accordance with the manufacturer's installation instructions and Section 404.2.1 through Section 404.2.5.

404.2.1 Operating Conditions. A non-sewered sanitation system in either a conditioned or unconditioned space shall be installed where the ambient temperature, ambient humidity, and altitude (atmospheric pressure) are in accordance with the manufacturer's installation instructions or product listing.

404.2.2 Clearances for Servicing and Maintenance. A non-sewered sanitation system shall be located to permit access and sufficient clearance for service and maintenance. Unless otherwise specified by the manufacturer's installation instructions, not less than 30 inches (762 mm) in depth, width, and height of working space shall be provided at any access panel.

404.2.3 Backflow Prevention. A domestic water supply connection to a non-sewered sanitation system shall be protected in accordance with the plumbing code.

404.2.4 Effluent Storage. Any container or vessel for the storage of effluent discharged from a non-sewered sanitation system and not integral to such system shall be installed in accordance with the plumbing code.

404.2.5 Systems Employing Combustion. A non-sewered sanitation system employing combustion shall comply with the mechanical code.

Exception: A non-sewered sanitation system listed for unvented use.

404.3 Operation and Maintenance Manual. Non-sewered sanitation systems shall have an operation and maintenance manual provided by the manufacturer.

404.4 System Output. The use or disposal of all substances exiting the non-sewered sanitation system shall be determined by the Authority Having Jurisdiction.

405.0 Pressure Regulator.

405.1 Installation. Pressure regulators shall be installed in accordance with the plumbing code.

406.0 Water Softeners and Treatment Devices.

406.1 Water Softeners. Water softeners shall be listed to NSF 44. Water softeners shall have a rated salt efficiency exceeding 3400 grains (gr) (0.2200 kg) of total hardness exchange per pound (lb) (0.5 kg) of salt, based on sodium chloride (NaCl) equivalency, and shall not generate more than 4 gallons (15.1 L) of water per 1000 grains (0.0647 kg) of hardness removed during the service cycle.

406.2 Water Softener Limitations. In residential buildings, where the supplied potable water hardness is equal to or less than 8 grains per gallon (gr/gal) (137 mg/L) measured as total calcium carbonate equivalents, water softening equipment that discharges water into the wastewater system during the service cycle shall not be allowed, except as required for medical purposes.

406.3 Point-of-Use Reverse Osmosis Water Treatment Systems. Reverse osmosis water treatment systems shall be equipped with automatic shutoff valves to prevent discharge when there is no call for producing treated water. Reverse osmosis water treatment systems shall comply with NSF58.

406.4 Drinking Water Treatment Systems. Drinking water treatment systems shall be listed to WQA/ASPE S-803.

407.0 Commercial Food Service.

407.1 Ice Makers. Ice makers shall be air cooled and shall be in accordance with Energy Star for energy use for commercial ice machines. Ice makers producing cubed-type ice shall not exceed 20 gallons (76 L) of water per 100 pounds (45 kg) of ice produced. Ice makers producing nugget and flake ice shall not exceed 14 gallons (53 kg) of water per 100 pound (45 kg) of ice produced.

407.2 Food Steamers. Boilerless type steamers shall not consume more than 2.0 gallons (7.6 L) per compartment. Boiler type steamers shall not consume more than 1.5 gallons (5.7 L) per pan per hour.

407.3 Combination Ovens. Combination ovens shall not use water in the convection mode except when utilizing a moisture nozzle for food products in the oven. The total amount of water used by the moisture nozzle in the convection mode shall not exceed a half a gallon per hour per oven cavity. When operating in the steamer mode, combination ovens shall not use more than 1.5 gallons (5.7 L) per hour per pan.

407.4 Grease Interceptors. Grease interceptor maintenance procedures shall not include post-pumping/cleaning refill using potable water. Refill shall be by connected appliance accumulated discharge only.

407.4.1 Temperature. Grease Interceptors shall be designed and installed to maintain a mean temperature not exceeding 95°F (35°C). FOG (fats, oils, and greases) disposal systems in compliance with ASME A112.14.6 using biological cultures shall not exceed 104°F (40°C). Passive or active cooling and heat recovery to be employed where applicable.

407.5 Dipper Well Faucets. Where dipper wells have a permanent water supply, the faucet shall have metered or sensor activated flow. The volume of water dispensed into a dipper well in each activation cycle of a self-closing fixture fitting shall not exceed the water capacity of the dipper well, and the maximum flow shall not exceed 0.2 gpm (0.8 L/m) at a supply pressure of 60 psi (414 kPa).

407.6 Food Waste Devices. Where installed food waste devices shall be in accordance with Section 407.6.1 through Section 407.6.5.

407.6.1 Pulpers and Mechanical Strainers. The water use for the pulpers or mechanical strainers shall not exceed 2 gpm (7.64 L/m). A flow restrictor shall be installed on the water supply to limit the water flow.

407.6.2 Food Waste Disposers. The water use for the food waste grinder shall not exceed the 8 gpm under full load condition and 1 gpm (3.8 L/m) under no-load condition. Flow restrictors shall be installed on the water supply to limit the water flow rate to a maximum of 8 gpm (30 L/m). A load sensing device shall be installed to monitor current demand and regulate water flow.

407.6.3 Time Out and Shut Off. Pulpers, mechanical strainers, and food waste disposers shall have a time out system with push button to reactivate. The maximum allowable run time cycle shall be 10 minutes.

407.6.4 Sink Drain Outlets. Where a strainer or basket is installed they shall be readily removable.

407.6.5 Strainer Baskets. Strainer (scrapper) baskets shall either fit over a sink compartment or be attached to a drain system. The strainer baskets shall be readily removable for emptying.

407.7 Tempering Water. The discharge waste from commercial dishwashers, ware washers, combination ovens, and food steamers that exceeds 140°F (60°C) shall not be tempered with potable water.

408.0 Medical and Laboratory Facilities.

408.1 X-Ray Film Processing Units. Processors for X-ray film exceeding 6 inches (152 mm) in any dimension shall be equipped with water recycling units.

408.2 Exhaust Hood Liquid Scrubber Systems. Liquid scrubber systems for exhaust hoods and ducts shall be of the recirculation type. Liquid scrubber systems for perchloric acid exhaust hoods and ducts shall be equipped with a timer-controlled water recirculation system. The collection sump for perchloric acid exhaust systems shall be designed to automatically drain after the wash down process has completed.

409.0 Leak Detection and Control.

409.1 General. Where installed, leak detection and control devices shall comply with IAPMO IGC115 or IAPMO IGC 349. Leak detection with control devices shall not be installed where they isolate fire sprinkler systems.

410.0 Fountains and Other Water Features.

410.1 Use of Alternate Water Source for Special Water Features. Special water features such as ponds and water fountains shall be provided with reclaimed (recycled) water, rainwater, or on-site treated nonpotable water where the source and capacity is available on the premises and approved by the Authority Having Jurisdiction.

411.0 Meters.

411.1 Required. A water meter shall be required for each building site connected to a public water system, including municipally supplied reclaimed (recycled) water. In other than single-family houses, a dedicated meter shall be installed in accordance to Table 411.1.

411.2 Approval. Dedicated meters other than water utility meters used for billing purposes shall be approved by the Authority Having Jurisdiction for the intended use.

411.3 Remote Data Transfer Requirements. Where more than 10 non-utility-owned water meters are located at a building site, the meters shall include remote data transfer capability to collect and analyze the data at a single location.

412.0 HVAC Water Efficiency.

412.1 Once-Through Cooling. Once-through cooling using potable water is prohibited.

412.2 Cooling Towers and Evaporative Coolers. Cooling towers and evaporative coolers shall be equipped with makeup water and blow down meters, conductivity controllers and overflow alarms. Cooling towers shall be equipped with efficiency drift eliminators that achieve drift reduction to 0.002 percent of the circulated water volume for counterflow towers and 0.005 percent for cross-flow towers.

412.3 Cooling Tower Makeup Water. Water used for air-conditioning cooling towers shall not be discharged where the hardness of the basin water is less than 1500 mg/L.

Exception: Where any of the following conditions of the basin water are present: total suspended solids exceed 25 ppm, $CaCO_3$ exceeds 600 ppm, chlorides exceed 250 ppm, sulfates exceed 250 ppm, or silica exceeds 150 ppm.

412.4 Evaporative Cooler Water Use. Evaporative cooling systems (also known as swamp coolers) shall use less than 3.5 gallons (13.2 L) of water per ton-hour of cooling when system controls are set to maximum water use. Water use, expressed in maximum water use per ton-hour of cooling, shall be marked on the device and included in product user manuals, product information literature, and installation instructions. Water use information shall be readily available at the time of code compliance inspection.

412.4.1 Overflow Alarm. Cooling systems shall be equipped with an overflow alarm to alert building owners, tenants, or maintenance personnel when the water refill valve continues to allow water to flow into the reservoir when the reservoir is already full. The alarm shall have a minimum sound pressure level rating of 85 dBa measured at a distance of ten feet.

412.4.2 Automatic Pump Shut-Off. Cooling systems shall automatically cease pumping water to the evaporation pads when airflow across evaporation pads ceases.

412.4.3 Cooler Reservoir Discharge. A water quality management system (either timer or water quality sensor) is required. Where timers are used, the time interval between discharge of reservoir water shall be set to 6 hours or greater of cooler operation. Where water quality sensors are used, the discharge of reservoir water shall be set for greater 800 ppm or greater of Total Dissolved Solids (TDS). Continuous discharge or continuous bleed systems are prohibited.

412.4.4 Discharge Water Reuse. Discharge water shall be reused where appropriate applications exist on site. Where a nonpotable water source system exists on site, evaporative cooler discharge water shall be collected and discharged to such collection system.

Exception: Where the reservoir water adversely affects the quality of the nonpotable water supply making the nonpotable water unusable for its intended purposes.

412.4.5 Discharge Water to Drain. Where discharge water is not recovered for reuse, the sump overflow line shall not be directly connected to a drain. Where the discharge water is put into a sanitary drain, a minimum 6 inch (152 mm) air gap is required between the termination of the discharge line and the drain opening. The discharge line shall terminate in a location that is readily visible to the building owner, tenants, or maintenance personnel.

412.5 Use of Reclaimed (Recycled) and On-Site Treated Nonpotable Water for Cooling. Reclaimed (recycled) or on-site treated nonpotable water used for industrial and commercial cooling or air-conditioning shall be approved for use by the water/wastewater utility and the Authority Having Jurisdiction.

TABLE 411.1
DEDICATED WATER METERING REQUIREMENTS

APPLICATION	REQUIREMENTS
Cooling Towers	The makeup water supply to cooling towers, evaporative condensers, and fluid coolers. Cooling towers sharing a common basin can be grouped together using one meter.
Evaporative Coolers	The makeup water supply to an evaporative cooler having an air flow exceeding 30 000 cubic feet per minute (ft^3/min) (50 970.3 m^3/hr).
Fluid Coolers and Chillers – Open Systems	The makeup water supply on water-cooled fluid coolers and chillers not utilizing closed-loop recirculation.
Hydronic Cooling Systems – Closed Loop	Systems with 50 ton (175 843W) or greater of cooling capacity and where a make-up water supply is connected.
Hydronic Heating Systems	The makeup water supply to one or more boilers collectively exceeding 1 000 000 British thermal units per hour (Btu/h) (293 071 W).
Industrial Processes	The water supply to an industrial water-using process where the average consumption exceeds 1000 gallons per day (gal/d) (3 785 L/d). Like equipment sharing one common water supply can be grouped together using one meter. **Exception:** Processes using untreated water where the water is directly returned to the original source after use.
Landscape Irrigation	Landscape irrigation water where either of the following conditions exist: 1. Total accumulated landscape area with in-ground irrigation system exceeds 2500 sq. ft. (232 m^2), or 2. Total accumulated landscape area using an automatic irrigation controller exceeds 1500 sq. ft. (139 m^2) **Exception:** Where the water purveyor provides a separate water supply meter that serves only the irrigation system, an additional dedicated meter is not required.
Onsite Water Collection Systems	Potable or reclaimed water supplies for supplementing onsite alternative water collection systems.
Ornamental Water Features	Potable or reclaimed water supplies for ornamental water features where the water feature uses an automatic refill valve.
Pools and Spas	A makeup water supply to a swimming pool or spa. **Exception:** Where the pool or spa has less than 100 square feet (9 m^2) of water surface and is refilled from a hose bibb without an automatic refill valve.
Roof Spray Systems	Roof spray systems for irrigating vegetated roofs or thermal conditioning covering an area greater than 300 square feet (28 m^2). **Exception:** Temporary above-surface spray systems connected to a hose bibb and without an automatic controller are not required to have a dedicated meter
Tenant Buildings - Common Areas	Water supplies used in common areas of a site. The dedicated meter for common area water use shall not include water supplied inside tenant space. Water supplies for sanitary fixtures and other water use in common areas can be grouped together for metering requirements, except where dedicated water meter installations are otherwise required.
Tenant Spaces - Residential	All water supplies to each residential tenant space for indoor water use. **Exception:** Where a water purveyor has individual meters for each tenant space, and the other meter requirements included in Table 411.1 do not apply, no additional dedicated meter is required.
Tenant Spaces - Non-residential, car washes	All water supplies to individual non-residential tenant spaces for indoor water use where any of the following conditions exist: 1. The nominal size of a water supply pipe(s) to the individual tenant space is greater than 1/2”, or 2. Water consumption within in the tenant space is estimated or expected to average greater than 1000 gallons/day (3 785L/d). Where water is supplied to tenant space that is not required to have dedicated meter, the water supply pipe (s) shall be accessible to install a meter. **Exception:** Where a water purveyor has individual meters for each tenant space and the other meter requirements included in Table 411.1 do not apply, no additional dedicated meter is required.

412.5.1 Drift Eliminator. A drift eliminator shall be utilized in a cooling system, utilizing alternate sources of water, where the aerosolized water may come in contact with employees or members of the public.

412.5.2 Disinfection. A biocide shall be used to treat the cooling system recirculation water where the recycled water may come in contact with employees or members of the public.

413.0 Condensate Recovery.

413.1 General. Where condensate is used for on-site treated nonpotable water, it shall be collected, stored, and treated in accordance with Section 604.0.

413.2 Condensate Drainage Recovery. Condensate from air-conditioning, boiler and steam systems used to supply water for nonpotable water systems shall be in accordance with Section 604.0.

414.0 Water-Powered Sump Pumps.

414.1 General. Sump pumps powered by potable or reclaimed (recycled) water pressure shall only be used as an emergency backup pump. The water-powered pump shall be equipped with a battery powered alarm having a minimum rating of 85 dBa at 10 feet (3 m). Water-powered pumps shall have a water efficiency factor of pumping at least 1.4 gallons (5.3 L) of water to a height of 10 feet (3048 mm) for every gallon of water used to operate the pump, measured at a water pressure of 60 psi (414 kPa). Pumps shall be clearly labeled as to the gallons of water pumped per gallon of potable water consumed.

Water-powered stormwater sump pumps shall be equipped with a reduced pressure principle backflow prevention assembly.

415.0 Landscape Irrigation Systems.

415.1 General. Where landscape irrigation systems are installed, they shall comply with Sections 415.2 through 415.16.

415.1.1 Irrigation Design and Installation. The Authority Having Jurisdiction shall have the authority to require landscape irrigation contractors, installers, or designers to demonstrate competency. The system shall be designed and record drawings showing changes during installation shall be made available for the owner and for any required inspections. Where required by the Authority Having Jurisdiction, the contractor, installer, or designer shall be licensed, certified, or both to perform such work.

415.2 Plant and Irrigation System Limitations. Nuisance, invasive and noxious plants as defined by the Authority Having Jurisdiction shall not be used in the landscape. Plants not requiring supplement irrigation shall be used in no less than 60 percent of the landscape that is not principally used as an athletic field or public recreation. In-ground irrigation system shall not be installed in more than 40 percent of the landscaped area.

Exceptions:

a. Where average annual rainfall is less than 12 inches and in landscape areas where the plant materials have an annual ETc of not exceeding 15 inches, an in-ground irrigation system shall be allowed;

b. Where neither potable or reclaimed (recycled) water is used in the irrigation system, an in-ground irrigation system shall be allowed in 100 percent of the landscaped area and vegetative roofs.

c. Drip irrigation and microspray systems are not considered inground systems.

415.2.1 Vegetative Roofs and Walls. Irrigation systems using potable water for vegetative roofs and walls are prohibited.

415.3 Maximum Velocity. Velocity of water flow shall not exceed 5 feet per second (1.5 m/s) for thermoplastic irrigation pipes. Velocity of water flow shall not exceed 7.5 feet per second (2.3 m/s) for metal irrigation pipes.

415.4 Backflow Protection. Potable water and reclaimed water supplies to landscape irrigation systems shall be protected from backflow in accordance with the plumbing code and Authority Having Jurisdiction.

415.5 Use of Alternate Water Sources for Landscape Irrigation. Where available by pre-existing treatment, storage or distribution network, and where approved by the Authority Having Jurisdiction, alternative water source(s) complying with Chapter 6 shall be utilized for landscape irrigation. Where adequate capacity and volumes of pre-existing alternative water sources are available, the irrigation system shall be designed to use minimum of 75 percent of alternative water for the annual irrigation demand before supplemental potable water is used.

Exception: Plants grown for food production for direct human consumption.

415.5.1 Master Valve. Where continuously pressurized alternate water sources supply an existing irrigation system, a master valve shall be installed at the point where the alternate water sources supply piping connects to the existing irrigation system downstream of the backflow preventer where required.

415.5.2 Identification. Where alternate water sources supply an existing irrigation system, the existing sprinkler heads, valve boxes, the continuously pressurized line supplying the irrigation master valve, or any other components required by the Authority Having Jurisdiction, shall be colored purple. The piping supplying the irrigation master valve shall be identified in accordance with Chapter 6.

415.5.2.1 Additional Zones. Newly installed zones shall have purple pipe.

415.6 Irrigation Control Systems. Where installed as part of a landscape irrigation system, irrigation control systems shall:

(1) Automatically adjust the irrigation schedule to respond to plant water needs determined by weather or soil moisture conditions.

(2) Utilize on-site sensors or remote weather data to inhibit or suspend irrigation when adequate soil moisture is present or during rainfall or freezing conditions.

(3) Utilize either one or more on-site sensors or a weather-based irrigation controller listed to the US EPA WaterSense Weather Based Irrigation Controllers Specification to suspend irrigation when adequate soil moisture is present for plant growth.

(4) Have the capability to program multiple and different run times for each irrigation zone to enable cycling of water applications and durations to mitigate water flowing off of the intended irrigation zone.

(5) Be capable of indicating to the user when it is not receiving a signal or local sensor input.

(6) Be capable of allowing for a manual operation troubleshooting test cycle and shall automatically return to sensor input mode within some period of time as designated by the manufacturer, even when the switch is still positioned for manual operation.

(7) The site specific settings of the irrigation control system shall be posted at the control system location. The posted data, where applicable to the settings of the controller, shall include:

(1) Precipitation rate for each zone.

(2) Plant evapotranspiration coefficients for each zone.

(3) Soil type and basic intake rate.

(4) Rain sensor settings.

(5) Soil moisture setting.

(6) Peak demand schedule including run times for each zone and the number of cycles to mitigate runoff and monthly adjustments or percentage change from peak demand schedule.

415.7 Irrigation Flow Sensing System. On commercial landscape irrigation systems, an irrigation flow sensing system shall be installed that shall interface with the control system to suspend irrigation for abnormal flow conditions. If equipped with totalizer capabilities, the irrigation flow sensing system shall also function as a meter for irrigation water.

415.8 Low Flow Irrigation. Irrigation zones using low flow irrigation emitters, with emitter flow rates not to exceed 6.3 gallons (24 L) per hour, shall comply with ASABE/ICC 802 Landscape Irrigation Sprinkler and Emitter Standard and be equipped with filters sized according to manufacturer's recommendation for the specific low flow emitter, and with a pressure regulator installed upstream of the irrigation emission devices as necessary to reduce the operating water pressure meeting manufacturers' equipment requirements.

415.9 Mulched Planting Areas. Only low flow emitters with flow rates not to exceed 6.3 gallons (24 L) per hour are allowed to be installed in mulched planting areas with vegetation taller than 12 inches (305 mm).

415.10 System Performance Requirements. The landscape irrigation system shall be designed and installed to:

(1) Prevent irrigation water from runoff out of the irrigation zone.

(2) Prevent water in the supply-line drainage from draining out between irrigation events.

(3) Not allow irrigation water to be applied onto or enter non-targeted areas including: adjacent property and vegetation areas, adjacent hydrozones not requiring the irrigation water to meet its irrigation demand, non-vegetative areas, impermeable surfaces, roadways, and structures.

Exception: Landscape features outside of the public right of way such as paved walkways, jogging paths, and golf cart paths, are exempted from this requirement where run off drains into the same hydrozone without puddling.

415.11 Narrow or Irregularly Shaped Landscape Areas. Narrow or irregularly shaped landscape areas, less than 4 feet (1m) in any direction across any opposing boundaries shall not be irrigated by any irrigation emission device except sub-surface or low flow emitters with flow rates not to exceed 6.3 gallons (24 L) per hour.

415.12 Irrigation System Inspection and Performance Check. The irrigation system shall be inspected to verify compliance with the irrigation design in accordance with the following:

(1) Inspection and performance check shall be by an independent third party having credentials in accordance with the US EPA WaterSense program or the Authority Having Jurisdiction.

(2) Sprinklers shall be installed as specified with proper spacing and required nozzle.

(3) Sprinklers shall be activated and visually inspected for covering areas without causing overspray or runoff.

(4) Valves shall be installed as specified.

(5) Drip irrigation systems shall be inspected to verify the proper valve, pressure regulation, filtering device, location of flush valves, and that the installed emitters comply with the irrigation plan.

(6) Control system shall be installed as specified and listed as a US EPA WaterSense labeled controller, and all sensors shall be verified for proper installation and operation.

(7) The peak demand irrigation schedule shall be posted near the controller, or the scheduling parameters for the controller shall be listed for each station including cycle and soak times.

(8) Record drawings of the irrigation system shall be completed and provided for the irrigation inspection.

(9) An inspection report shall be provided to the property owner or management company identifying problems and what corrective actions are required.

415.13 Sprinkler Head Installations. All installed sprinkler heads shall comply with ASABE/ICC 802.

415.13.1 Sprinkler Heads in Common Irrigation Zones. Sprinkler heads installed in irrigation zones

served by a common valve shall be limited to applying water to plants with similar irrigation needs, and shall have matched precipitation rates (identical inches of water application per hour plus or minus 7 percent as labeled or declared in manufacturer's published performance data).

415.13.2 Sprinkler Head Pressure Regulation. Sprinkler heads shall utilize pressure regulating devices (as part of irrigation system or integral to the sprinkler head) to maintain manufacturer's recommended operating pressure for each sprinkler and nozzle type.

415.13.3 Pop-up Type Sprinkler Heads. Where pop-up type sprinkler heads are installed, the sprinkler heads shall pop-up to a height above vegetation level and of not less than 4 inches (102 mm) above the soil level when emitting water.

415.13.4 Sprinkler Head Maximum Precipitation Rate. Where the slope of the landscape exceeds 25 percent, the precipitation rate of sprinkler heads shall not exceed 1.75 inches per hour when tested to ASABE/ICC 802.

415.14 Outside Hose Bibbs. Outside hose bibbs shall be allowed on irrigation pipe downstream of the backflow preventer. Hose bibbs supplying water from the irrigation system shall be indicated by posted signs marked with the words: "CAUTION: NONPOTABLE WATER. DO NOT DRINK." and the symbol in Figure 603.9.

415.15 Depth of Irrigation Pipe. Irrigation pipe downstream from the backflow preventer shall be buried at a minimum depth according to Section 415.15.1 and Section 415.15.2.

415.15.1 Landscape Areas. Irrigated landscaped areas not exceeding 10,000 square feet (929 m^2) shall have irrigation main lines buried a minimum of 12 inches (305 mm) and irrigation lateral lines buried a minimum of 8 inches (203 mm). Irrigated landscaped areas greater than 10,000 square feet (929 m^2) shall have irrigation main lines buried a minimum of 18 inches (457 mm) and irrigation lateral lines buried a minimum of 12 inches (305 mm).

415.15.2 Vehicular Surfaces. Irrigation pipe installed under vehicular paving and pervious pavers, including landscaped fire lanes, shall be sleeved with a minimum of one 1-inch pipe (25 mm) size greater than the irrigation pipe and buried at a minimum depth of 24 inches (610 mm) in all cases.

415.16 Backfill. All excavation for irrigation pipe installation shall be backfilled in thin layers to 12 inches (305 mm) with clean earth, which shall not contain stones, boulders, cinderfill, frozen earth, construction debris, or other materials that would damage or break the piping. Fill shall be properly compacted. Suitable precautions shall be taken to ensure permanent stability for pipe laid in filled or made ground.

416.0 Trap Seal Protection.

416.1 Water Supplied Trap Primers. Water supplied trap primers shall be electronic or pressure activated and shall use no more than 30 gallons (114 L) per year per drain. Where an alternate water source, as defined by this code, is used for fixture flushing or other uses in the same room, the alternate water source shall be used for the trap primer water supply.

Exception: Flushometer tailpiece trap primers complying with IAPMO PS 76 are exempted from the provisions of this section.

416.2 Drainage Type Trap Seal Primer Devices. Drainage type trap seal primer devices shall not be limited in the amount of water they discharge.

417.0 Vehicle Wash Facilities.

417.1 Automatic. The maximum make-up water use for automobile washing shall not exceed 40 gallons (151 L) per vehicle for in-bay automatic car washes and 35 gallons (132 L) for conveyor and express type car washes.

417.2 Self-Service. Spray wands and foamy brushes shall use no more than 3.0 gpm (11.36 L/m).

417.3 Reverse Osmosis. Spot-free reverse osmosis discharge (reject) water shall be recycled.

417.4 Towel Ringers. Towel ringers shall have a positive shut-off valve. Spray nozzles shall be replaced annually.

Exemption: Bus and large commercial vehicles washes are exempt from the requirements in this section.

418.0 Swimming Pools, Spas, and Hot Tubs.

418.1 Practices. The following sections outline common practices for reducing energy consumption in regards to pool, spa, and hot tub equipment.

418.2 On and Off Switch. Pool, spa, and hot tub heaters shall be equipped with a readily accessible on and off switch to allow shutting off the heater without adjusting the thermostat setting. Pool heaters fired by natural gas shall not have continuously burning pilot lights. [ASHRAE 90.1:7.4.5.1]

418.3 Covers. Pools and inground permanently installed spas and portable spas shall be provided with a non-liquid vapor retardant cover.

Exception: Where more than 70 percent of the energy for heating, computed over an operating season, is from site-recovered energy such as from a heat pump or solar energy source.

418.3.1 Portable Spas. Portable spa covers shall meet the requirements of APSP-14.

418.4 Time Switches. Time switches shall be installed on swimming pool, spa, and hot tub heaters and pumps.

Exceptions:

(1) Where public health standards require 24-hour pump operation.

(2) Where pumps are required to operate solar and waste heat recovery pool heating systems. [ASHRAE 90.1:7.4.5.3]

418.5 Pool Pumps and Replacement Pool Pump Motors. Pool pumps and replacement pool pump motors shall meet requirements of APSP-15.

CHAPTER 5
COMPOSTING TOILET AND URINE DIVERSION SYSTEMS

501.0 General.

501.1 Applicability. The provisions of this section shall apply to the design, construction, performance, alteration, and repair of composting toilet and urine diversion systems.

502.0 Design and Construction.

502.1 Requirements. Composting toilets, composting toilet systems, and urine diversion systems shall meet the design, construction, and performance requirements of Section 502.1.1 or Section 502.1.2.

502.1.1 Listed Composting Toilets and Composting Toilet Systems. Composting toilets and composting toilet systems shall be listed to NSF 41.

502.1.2 Alternative Design Systems. Where approved by the Authority Having Jurisdiction, composting toilet and urine diversion systems for residential and commercial applications shall comply with the provisions of Section 502.2 through Section 506.1.

502.2 System Materials and Components. Pipe, pipe fittings, traps, fixtures, material, and devices used in composting toilet and urine diversion systems that are expected to contact leachate or diverted urine shall be listed or labeled (third-party certified) by a listing agency (accredited conformity assessment body), unless otherwise approved by the Authority Having Jurisdiction. Materials and components shall comply to approved applicable recognized standards referenced in this standard and the plumbing code, and shall be free from defects. Unless otherwise provided for in this standard, materials, fixtures, or devices used or entering into the construction of plumbing systems, or parts thereof, shall be submitted to the Authority Having Jurisdiction for approval.

502.3 System Design. Composting toilet and urine diversion systems complying with Section 501.0 shall be designed by a person registered or licensed to perform plumbing design work or who demonstrates competency to design composting toilet and urine diversion systems.

503.0 Permits.

503.1 General. It shall be unlawful for any person to construct, install, alter, or cause to be constructed, installed, or altered any composting toilet and urine diversion system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

504.0 Maintenance and Inspection.

504.1 General. Composting toilet and urine diversion systems and components shall be maintained and inspected in accordance with Section 504.1.1 through Section 504.1.3.

504.1.1 Maintenance Responsibility. The required maintenance and inspection of composting toilet and urine diversion systems shall be the responsibility of the property owner, unless otherwise required by the Authority Having Jurisdiction. The property owner is responsible for retaining test result records in accordance with Section 505.6.2 and making them available to the Authority Having Jurisdiction upon request.

504.1.2 Operation. Composting toilet and urine diversion systems shall be operated in a safe and sanitary condition in accordance with the owner's manual in accordance with Section 504.2.

504.1.3 Inspection. In the event of a nuisance complaint or documented system failure, the composting toilet and urine diversion system shall be made available for inspection and the owner or owner's agent shall conduct sufficient repairs or alterations to the composting toilet system. At the request of the Authority Having Jurisdiction, results of all laboratory testing and new tests in accordance with Section 505.6 following repairs to alleviate dangerous or unsanitary conditions shall be provided at the owner's expense.

504.2 Operation and Maintenance Manual. An owner's manual shall present clear instructions for maintenance and be transferred to the new owner upon transfer of property or tenancy. The owner's manual shall include:

(1) Schedule for addition of necessary compost additives.
(2) Source or provider of necessary compost additives. Source may be on-site.
(3) Schedule and instructions for all regular maintenance tasks.
(4) Expected input of and capacity for excreta and compost additives to compost toilet system specifying loading of commode(s) and compost processor(s).
(5) Plan for container transfer and cleaning where transfer is used.
(6) Expected schedule for removing humus from composting processors and where used secondary composting bins.
(7) Plan for on-site disposal of humus or professional removal.
(8) Plan for managing leachate.
(9) Plan for microbial testing in accordance with Section 505.6.2.

505.0 Composting Toilet System Design.

505.1 Requirements. The design and installation of composting toilet systems shall be in accordance with Section 505.2 through Section 505.7.

505.2 Corrosion Resistance. All components expected to contact excreta or leachate shall be constructed of corrosion-resistant material such as stainless steel or durable polymers. Concrete in contact with excreta or leachate shall meet requirements of Section 505.3.

505.3 Concrete Construction. Concrete construction shall be reinforced, watertight and able to withstand loading weight. Where drainage is required, the processor floor shall be sloped not less than ¼-inch per foot (2.0 percent slope). The flange of each sub-drain shall be set level.

505.4 Commodes.

505.4.1 Odor. Commode design or use shall mitigate the infiltration of odors into the building during normal operation and in the event of temporary power failure.

505.4.2 Contact. Commodes shall transport excreta into the compost processor or contain excreta for transfer as designed according to the owner's manual.

505.4.3 Vectors. Commodes shall limit vectors and prevent human contact except for regular maintenance as designed according to the owner's manual.

505.5 Compost Processors. Compost processors shall be designed in accordance with Sections 505.5.1 through 505.5.9 and shall maintain unsaturated aerobic composting conditions within the compost mass, through the drainage, absorption, or desiccation of leachate, and aeration of the processor.

505.5.1 Leachate. Leachate shall be collected for removal or recirculation within the processor, evaporated, or drained to an approved plumbing drainage system or other location approved by the Authority Having Jurisdiction. Leachate storage tanks shall be constructed and installed in accordance with the following:

505.5.1.1 Venting. Leachate storage tanks shall be vented as required for pressure equalization. When required, vents shall be installed on leachate storage tanks and shall extend from the top of the tank. The connection of storage tank vents to the plumbing venting system shall be six inches above the flood level rim of the highest fixture. Vents extending to the outdoor shall terminate no less than 12-inches above grade. The vent terminal shall be directed downward and covered with a 3/32 inch mesh screen to prevent the entry of vermin and insects.

505.5.1.1.1 Vent Size. Pressure equalization vents that prevent nitrogen loss by the use of restrictions, or of piping or tubing that is less than the minimum pipe diameter required in the plumbing code shall be approved by the Authority Having Jurisdiction.

505.5.1.2 Overflow. Where storage tank overflows are installed they shall be connected to the plumbing drainage system.

505.5.1.2.1 Backwater Valve. Storage tank overflows, when subject to backflow, shall be provided with a backwater valve at the point of connection to the plumbing drainage system. The backwater valve shall be accessible for inspections and maintenance.

505.5.1.3 Construction. Leachate storage tanks shall be constructed of polyethylene terephthalate (PET), polyethylene napthalate (PEN), polyamide (Nylon) or a blend of PET, PEN, ethyl vinyl alcohol (EVOH), Nylon, HDPE, or other tanks listed or certified to US 49 CFR Section 178.274 Specifications for UN Portable Tanks.

505.5.1.4 Above Grade. Above grade storage tanks are prohibited where subject to freezing conditions, or shall be provided with an adequate means of freeze protection. The above grade leachate storage tank shall be provided with an audible and visual high-water alarm.

505.5.1.5 Below Grade. Leachate storage tanks installed below grade shall be structurally designed to withstand all anticipated earth or other loads. Tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft^2) (1465 kg/m^2) when the tank is designed for underground installation. Below grade leachate tanks installed underground shall be provided with manholes. The manhole opening shall be a minimum diameter of 20 inches (508 mm) and located a minimum of 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground when empty. The combined weight of the tank and hold down system should meet or exceed the buoyancy force of the tank. The below grade leachate storage tank level shall be provided with an audible and visual high-water alarm.

505.5.1.6 Marking. Where openings are provided to allow a person to enter the tank, the opening shall be marked with the following words: "DANGER-CONFINED SPACE."

505.5.1.7 Openings. All openings shall be covered and secured to prevent tampering. Openings shall be screened or covered to prevent rodent, vermin, and insect infiltration and be protected against unauthorized human entry.

505.5.2 Vectors. The compost processor shall be designed and installed to limit vector access through management as required in the owner's manual.

505.5.3 Transfer. Where unfinished excreta or diverted urine is transferred between processors or from commode to processor, transfer and cleaning of containers and provisions for limiting user exposure shall be according to the owner's manual.

505.5.4 Watertightness. Processors shall be constructed of watertight material in accordance with Section 505.2.

505.5.5 Vermin (Rodent) Proofing. The compost processor shall be protected to prevent the entrance of rodents, vermin, and insects. No unsecured opening other than vents, drainage, or commode may exceed ½-inch (12 mm) in the least dimension.

505.5.6 Active Conditions. The compost processor or processors shall be sized to compost excreta for a minimum of one year of biologically active conditions. Biologically active conditions are at or above a daily average of 42°F (6°C).

Exception: Systems with shorter retention shall be permitted where either,

(a) humus from the compost processor has been tested according to Section 505.6.2 and there is either a secondary composting stage where humus is retained in a well maintained compost bin or other

facility designated for the exclusive purpose of containing humus removed from the compost processor, or

(b) humus is removed off site for processing or disposal at an approved facility.

505.5.7 Secondary Composting. Humus to be transferred to secondary composting shall first be tested according to Section 505.6.2. Secondary composting shall be labeled and protected from human contact. Contact with precipitation and surface waters is prohibited.

505.5.8 Ventilation. Negative ventilation between the commode and compost processor shall be provided when the compost processor is connected directly to the commode without a trap. Commodes that are not connected to the compost processor do not require a vent.

505.5.8.1 Vent Terminals. Vent stacks shall terminate exterior the building as required by the plumbing or mechanical code.

505.5.9 Sizing. The compost processor shall be sized to accommodate the maximum daily adult usage as specified by the manufactures published ratings. Site built compost processors shall be sized to hold a minimum of 10 gallons of material per person per year while allowing for the removal of the humus, or as specified by the system designer.

505.6 Testing. Composting toilet systems shall be tested in accordance with Section 505.6.1 and Section 505.6.2.

505.6.1 Compost Processors. Compost processors shall be tested for water tightness by filling the system to the maximum designed liquid storage capacity of the unit for a duration of 24 hours.

505.6.2 Humus. The owner or owner's agent of the composting toilet system shall verify user's compliance with the manufacturer's maintenance and operation manual in accordance with Section 504.2 by submitting a sample of the humus from the first treatment period after a minimum of one year of biologically active conditions to a certified laboratory before removal of humus from the composting processor. Where multiple compost processors are used, the humus sample shall be removed from the last compost processor. The sample collection shall be tested in accordance with EPA/625/R-92/013, Appendix F, Section 1.2. Humus shall not have a moisture content exceeding 75 percent by weight, and shall not exceed 200 fecal coliforms/gram.

505.7 Humus Removal. Humus shall be removed according to the owner's manual. Humus from the compost processor used around ornamental shrubs, flowers, trees, or fruit trees shall be mixed with soil or mulch and covered with no less than 3 inches (76 mm) of cover material. Depositing humus from any composting toilet system around any edible vegetable or vegetation shall be prohibited.

506.0 Urine Diversion System Design.

506.1 Requirements. The design and installation of urine diversion systems shall be in accordance with Section 506.2 through Section 506.14.

506.2 Purpose. The purpose of this section is to enable the installation of urine diversion and collection systems to improve the function of composting toilet systems and prevent nutrient pollution of ground and surface waters.

506.3 Material Requirements. Material used for urine diversion shall be impermeable and resistant to corrosion from urine.

506.4 Identification. All urine diversion piping shall be identified.

506.5 Change of Direction. Changes in direction of urine diversion piping shall be made by a long-sweep 90 degree fitting or other approved fittings of equivalent sweep.

506.6 Sizing. Pipe sizes shall be in accordance with the plumbing code. Each urine diversion fixture shall be rated as one drainage fixture unit. Piping or tubing for urine diversion that is less than the minimum pipe diameter required in the plumbing code shall be approved by the Authority Having Jurisdiction.

506.7 Traps. Fixtures discharging into urine diversion piping connected to the plumbing drainage system shall be trapped and vented according to the plumbing code.

506.8 Grade of Horizontal Piping. Urine diversion piping shall be installed at a minimum grade of ½-inch per foot, or 4 percent toward the point of disposal.

506.9 Cleanouts. A cleanout shall be provided at the upper terminal of each drain line, every 50 feet (15 m) and at an aggregate horizontal change of direction exceeding 135 degrees.

506.10 Venting. Commode fixtures without traps that require ventilation shall be connected to either a dry toilet ventilation stack or a urine diversion ventilation stack. Nonwater urinals used as urine diversion systems shall be connected to a dry toilet ventilation stack or a urine diversion ventilation stack.

506.11 Discharge. A urine-diversion system shall be diverted to a storage tank or discharge to an approved plumbing drainage system.

506.12 Urine Storage Tanks. Urine storage tanks shall be constructed and installed in accordance with Section 506.12.1 through Section 506.12.8.

506.12.1 Venting. Urine storage tanks shall be vented as required for pressure equalization. When required, vents shall be installed on urine storage tanks and shall extend from the top of the tank. The connection of storage tank vents to the plumbing venting system shall be six inches above the flood level rim of the highest fixture. Vents extending to the outdoor shall terminate no less than 12-inches above grade. The vent terminal shall be directed downward and covered with a 3/32 inch mesh screen to prevent the entry of vermin and insects.

506.12.1.1 Vent Size. Pressure equalization vents that prevent nitrogen loss by the use of restrictions, or of piping or tubing that is less than the minimum pipe diameter required in the plumbing code shall be approved by the Authority Having Jurisdiction.

506.12.2 Traps. Urine storage tanks shall prevent odors and nitrogen loss from the tank inlet by means of a P-trap, mechanical trap, submerged inlet piping, or other means approved by the Authority Having Jurisdiction. Submerged inlet piping shall remain submerged during use and after pumpout.

Exception: Tanks of five gallons or less connected to fixtures with active ventilation or having an integrated seal.

506.12.3 Overflow. Where storage tank overflows are installed they shall be connected to a plumbing drainage system.

506.12.3.1 Backwater Valve. Storage tank overflows subject to backflow shall be provided with a backwater valve at the point of connection to the plumbing drainage system when connected to a public sewer system or on-site wastewater system. The backwater valve shall be accessible for inspections and maintenance.

506.12.4 Construction. Urine storage tanks shall be constructed of polyethylene terephthalate (PET), polyethylene napthalate (PEN), polyamide (Nylon) or a blend of PET, PEN, ethyl vinyl alcohol (EVOH), Nylon, HDPE, or other tanks listed or certified to US 49 CFR Section 178.274 Specifications for UN Portable Tanks.

506.12.5 Above Grade. Above grade storage tanks shall be prohibited where subject to freezing conditions, or shall be provided with an adequate means of freeze protection. The above grade urine storage tank shall be provided with an audible and visual high-water alarm.

506.12.6 Below Grade. Urine storage tanks installed below grade shall be structurally designed to withstand all anticipated earth or other loads. Tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft^2) (1465 kg/m^2) when the tank is designed for underground installation. Below grade urine tanks installed underground shall be provided with manholes. The manhole opening shall be a minimum diameter of 20 inches (508 mm) and located a minimum of 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground when empty. The combined weight of the tank and hold down system should meet or exceed the buoyancy force of the tank. The below grade urine storage tank level shall be provided with an audible and visual high-water alarm.

506.12.7 Marking. Where openings are provided to allow a person to enter the tank, the opening shall be marked with the following words: "DANGER-CONFINED SPACE."

506.12.8 Openings. All openings shall be covered and secured to prevent tampering. Openings shall be screened or covered to prevent rodent infiltration and be protected against unauthorized human entry.

506.13 Maintenance Plan. Every urine diversion system shall have a maintenance plan that includes both a pumpout schedule and contract, or an onsite discharge plan. The maintenance plan shall also include a pipe cleaning schedule.

506.14 Treatment, Reuse, and Disposal. Where urine is to be reused onsite, a treatment method for sanitization shall be included in the owner's manual. Approved methods of treatment shall include:

(1) Retention without addition for six months before usage. Two or more holding tanks shall be required for retention,
(2) Application to the compost processor,
(3) Pasteurization to 158°F (70°C) for thirty minutes, or
(4) Other method approved by the Authority Having Jurisdiction.

CHAPTER 6

ALTERNATE WATER SOURCES FOR NONPOTABLE APPLICATIONS

601.0 General.

601.1 Scope. The provisions of this chapter shall apply to the construction, alteration, and repair of alternate water source systems for nonpotable applications.

601.1.1 Allowable Use of Alternate Water. Where approved or required by the Authority Having Jurisdiction, alternate water sources (reclaimed (recycled) water, gray water and onsite treated nonpotable water) used in lieu of potable water shall be in accordance with the provisions of this chapter.

601.2 System Design. Alternate water source systems shall be designed in accordance with this chapter by a licensed plumbing contractor, Registered Design Professional, or a person who demonstrates competency to design the alternate water source system as required by the Authority Having Jurisdiction. Components, piping, and fittings used in any alternate water source system shall be listed.

Exceptions:

(1) A person registered or licensed to perform plumbing design work is not required to design gray water systems having a maximum discharge capacity of 250 gallons per day (gal/d) (15.77 L/s) for single family and multi-family dwellings.

(2) A person registered or licensed to perform plumbing design work is not required to design an on-site treated nonpotable water system for single family dwellings having a maximum discharge capacity of 250 gal/d (15.77 L/s).

601.3 Permit. It shall be unlawful for any person to construct, install, alter, or cause to be constructed, installed, or altered any alternate water source system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

Exception: For single family dwellings a construction permit shall not be required for a clothes washer only system meeting the requirements of Section 601.3.1. A written notification shall be provided to the Authority Having Jurisdiction in accordance with Section 601.3.1.

601.3.1 Clothes Washer System. A clothes washer system in compliance with all of the following is exempt from the construction permit specified in Section 601.3 and shall be permitted to be installed or altered without a construction permit:

(1) Where required, notification has been provided to the enforcing agency regarding the proposed location and installation of a gray water irrigation or disposal system.

(2) The design shall allow the user to direct the flow to the irrigation or disposal field or the building sewer. The direction control of the gray water shall be clearly labeled and readily accessible to the user.

(3) The installation, change, alteration, or repair of the system does not include a potable water connection or a pump and does not affect other building, plumbing, electrical, or mechanical components including structural features, egress, fire-life safety, sanitation, potable water supply piping, or accessibility. The pump in a clothes washer shall not be considered part of the gray water system.

(4) The gray water shall be contained on the site where it is generated.

(5) Gray water shall be directed to and contained within an irrigation or disposal field.

(6) Ponding or runoff is prohibited and shall be considered a nuisance.

(7) Gray water shall be permitted to be released above the ground surface provided at least 2 inches (51 mm) of mulch, rock, or soil, or a solid shield covers the release point. Other methods which provide equivalent separation are also acceptable.

(8) Gray water systems shall be designed to minimize contact with humans and domestic pets.

(9) Water used to wash diapers or similarly soiled or infectious garments shall not be used and shall be diverted to the building sewer.

(10) Gray water shall not contain hazardous chemicals derived from activities such as cleaning car parts, washing greasy or oily rags, or disposing of waste solutions from home photo labs or similar hobbyist or home occupational activities.

(11) Exemption from construction permit requirements of this code shall not be deemed to grant authorization for any gray water system to be installed in a manner that violates other provisions of this code or any other laws or ordinances of the Authority Having Jurisdiction.

(12) An operation and maintenance manual shall be provided to the owner. Directions shall indicate that the manual is to remain with the building throughout the life of the system and upon change of ownership or occupancy.

(13) Gray water discharge from a clothes washer system through a standpipe shall be properly trapped in accordance with the plumbing code.

601.4 Component Identification. System components shall be properly identified as to the manufacturer.

601.5 Maintenance and Inspection. Alternate water source systems and components shall be inspected and maintained in accordance with Section 601.5.1 through Section 601.5.3, the manufacturer's recommendations, or as required by the Authority Having Jurisdiction.

601.5.1 Frequency. Alternate water source systems and components shall be inspected and maintained in accordance with Table 601.5.1 unless more frequent inspection and maintenance is required by the manufacturer.

TABLE 601.5.1
MINIMUM ALTERNATE WATER SOURCE TESTING, INSPECTION, AND MAINTENANCE FREQUENCY

DESCRIPTION	MINIMUM FREQUENCY
Inspect and clean filters and screens, and replace (if necessary)	Every 3 months
Inspect and verify that disinfection, filters and water quality treatment devices and systems are operational and maintaining minimum water quality requirements as determined by the Authority Having Jurisdiction	In accordance with manufacturer's instructions, and the Authority Having Jurisdiction
Inspect pumps and verify operation	After initial installation and every 12 months thereafter
Inspect valves and verify operation	After initial installation and every 12 months thereafter
Inspect pressure tanks and verify operation	After initial installation and every 12 months thereafter
Clear debris from and inspect storage tanks, locking devices, and verify operation	After initial installation and every 12 months thereafter
Inspect caution labels and marking	After initial installation and every 12 months thereafter
Inspect and maintain mulch basins for gray water irrigation systems	As needed to maintain mulch depth and prevent ponding and runoff
Cross-connection inspection and test*	After initial installation and every 12 months thereafter

* The cross-connection test shall be performed in the presence of the Authority Having Jurisdiction in accordance with the requirements of this Chapter.

601.5.2 Maintenance Log. A maintenance log for gray water and on-site treated nonpotable water systems is required to have a permit in accordance with Section 601.3 and shall be maintained by the property owner and be available for inspection. The property owner or designated appointee shall ensure that a record of testing, inspection and maintenance as required by Table 601.5.1 is maintained in the log. The log will indicate the frequency of inspection and maintenance for each system.

601.5.3 Maintenance Responsibility. The required maintenance and inspection of alternate water source systems shall be the responsibility of the property owner, unless otherwise required by the Authority Having Jurisdiction.

601.6 Operation and Maintenance Manual. An operation and maintenance manual for gray water and on-site treated water systems required to have a permit in accordance with Section 601.3 shall be supplied to the building owner by the system designer. The operating and maintenance manual shall include the following:

(1) Diagram of the entire system and the location of system components.

(2) Instructions on operating and maintaining the system.

(3) Details on maintaining the required water quality for on-site nonpotable water systems.

(4) Details on deactivating the system for maintenance, repair, or other purposes.

(5) Applicable testing, inspection, and maintenance frequencies as required by Table 601.5.1.

(6) A method of contacting the manufacturer(s).

(7) Directions to the owner or occupant that the manual shall remain with the building throughout the life of the structure.

601.7 Minimum Water Quality Requirements. The minimum water quality for alternate water source systems shall meet the applicable water quality requirements for the intended application as determined by the Authority Having Jurisdiction. In the absence of water quality requirements for on-site treated nonpotable systems, the water quality requirements of NSF 350 or the EPA/625/R-04/108 shall apply.

Exception: Water treatment is not required for gray water used for subsurface irrigation.

601.8 Material Compatibility. Alternate water source systems shall be constructed of materials that are compatible with the type of pipe and pipe fitting materials, water treatment, and water conditions in the system.

601.9 System Controls. Controls for pumps, valves, and other devices that contain mercury that come in contact with alternate water source water supply are prohibited.

601.10 Commercial, Industrial, and Institutional Restroom Signs. A sign shall be installed in all restrooms in commercial, industrial, and institutional occupancies using reclaimed (recycled) water and on-site treated water for water closets, urinals, or both. Each sign shall contain letters of a highly visible color on a contrasting background, and letters shall be at least 1/2 inch (12 mm) in height. The location of the sign(s) shall be such that the sign(s) shall be visible to all users. The location of the sign(s) shall be approved by the Authority Having Jurisdiction and shall contain the following text:

TO CONSERVE WATER, THIS BUILDING USES *_____* TO FLUSH TOILETS AND URINALS.

601.10.1 Equipment Room Signs. Each room containing reclaimed (recycled) water and on-site treated water, equipment shall have a sign posted in a location that is visible to anyone working on or near nonpotable water equipment with the following wording in 1 inch (25.4 mm) letters:

CAUTION: NONPOTABLE *_____*, DO NOT DRINK. DO NOT CONNECT TO DRINKING WATER SYSTEM. NOTICE: CONTACT BUILDING MANAGEMENT BEFORE PERFORMING ANY WORK ON THIS WATER SYSTEM.

_____ Shall indicate RECLAIMED (RECYCLED) WATER or ON-SITE TREATED WATER accordingly.

601.11 Inspection and Testing. Alternate water source systems shall be inspected and tested in accordance with Section 601.11.1 and Section 601.11.2.

Exception: Non-pressurized graywater or on-site nonpotable water systems without any connection to a potable water system.

601.11.1 Supply System Inspection and Test. Alternate water source systems shall be inspected and tested in accordance with the plumbing code for testing of potable water piping.

601.11.2 Annual Cross-Connection Inspection and Testing. An initial and subsequent annual inspection and test shall be performed on both the potable and alternate water source systems. The potable and alternate water source system shall be isolated from each other and independently inspected and tested to ensure there is no cross-connection in accordance with Section 601.11.2.1 through Section 601.11.2.4.

601.11.2.1 Visual System Inspection. Prior to commencing the cross-connection testing, a dual system inspection shall be conducted by the Authority Having Jurisdiction as follows:

(1) Meter locations of the alternate water source and potable water lines shall be checked to verify that no modifications were made, and that no cross-connections are visible.

(2) Pumps and equipment, equipment room signs, and exposed piping in equipment room shall be checked.

(3) Valves shall be checked to ensure that valve lock seals are still in place and intact. Valve control door signs shall be checked to verify that no signs have been removed.

601.11.2.2 Cross-Connection Test. The procedure for determining cross-connection shall be followed by the applicant in the presence of the Authority Having Jurisdiction to determine whether a cross-connection has occurred as follows:

(1) The potable water system shall be activated and pressurized. The alternate water source system shall be shut down, depressurized, and drained.

(2) The potable water system shall remain pressurized for a minimum period of time specified by the Authority Having Jurisdiction while the alternate water source system is empty. The minimum period the alternate water source system is to remain depressurized shall be determined on a case-by-case basis, taking into account the size and complexity of the potable and the alternate water source distribution systems, but in no case shall that period be less than 1 hour.

(3) The drain on the alternate water source system shall be checked for flow during the test and all fixtures, potable and alternate water source, shall be tested and inspected for flow. Flow from any alternate water source system outlet indicates a cross-connection. No flow from a potable water outlet shall indicate that it is connected to the alternate water source system.

(4) The potable water system shall then be depressurized and drained.

(5) The alternate water source system shall then be activated and pressurized.

(6) The alternate water source system shall remain pressurized for a minimum period of time specified by the Authority Having Jurisdiction while the potable water system is empty. The minimum period the potable water system is to remain depressurized shall be determined on a case-by-case basis, but in no case shall that period be less than 1 hour.

(7) All fixtures, potable and alternate water source, shall be tested and inspected for flow. Flow from any potable water system outlet indicates a cross-connection. No flow from an alternate water source outlet will indicate that it is connected to the potable water system.

(8) The drain on the potable water system shall be checked for flow during the test and at the end of the test.

(9) If there is no flow detected in any of the fixtures which would indicate a cross-connection, the potable water system shall be repressurized.

601.11.2.3 Discovery of Cross-Connection. In the event that a cross-connection is discovered, the following procedure, in the presence of the Authority Having Jurisdiction, shall be activated immediately:

(1) The alternate water source piping to the building shall be shut down at the meter, and the alternate water source riser shall be drained.

(2) Potable water piping to the building shall be shut down at the meter.

(3) The cross-connection shall be uncovered and disconnected.

(4) The building shall be retested following procedures listed in Section 601.11.2.1 and Section 601.11.2.2.

(5) The potable water system shall be chlorinated with 50 parts-per-million (ppm) chlorine for 24 hours.

(6) The potable water system shall be flushed after 24 hours, and a standard bacteriological test shall be performed. If test results are acceptable, the potable water system shall be recharged.

601.11.2.4 Annual Inspection. An annual inspection of the alternate water source system, following the procedures listed in Section 601.11.2.1 shall be required. Annual cross-connection testing, following the procedures listed in Section 601.11.2.2 shall be required by the Authority Having Jurisdiction, unless site conditions do not require it. In no event shall the test occur less than once in 4 years. Alternate testing requirements shall be approved by the Authority Having Jurisdiction.

601.12 Separation Requirements. All underground alternate water source service piping other than gray water shall be separated from the building sewer in accordance with the plumbing code. Treated nonpotable water pipes run or laid in the same trench as potable water pipes shall have a 12 inch (305 mm) minimum vertical and horizontal separation when both pipe materials are approved for use within a building. Where horizontal piping materials do not meet this requirement the minimum separation shall be increased to 60 inches (1524 mm). The potable water piping shall be installed at an elevation above the treated nonpotable water piping.

601.13 Abandonment. All alternate water source systems that are no longer in use or fails to be maintained in accordance with Section 601.5 shall be abandoned. Abandonment shall comply with Section 305.0.

601.14 Sizing. Unless otherwise provided for in this standard, alternate water source piping shall be sized in accordance with the plumbing code for sizing potable water piping.

602.0 Gray Water Systems.

602.1 General. The provisions of this section shall apply to the construction, alteration, and repair of gray water systems.

602.2 Gray Water Collection Piping. New single-family dwellings shall have the a separate waste piping system for all gray water fixtures per the Plumbing Code. The separate piping system shall be piped to outside the building and terminate into an approved Gray Water Diverter Valve per Section 602.5 before connecting to the waste system from non-gray water fixtures.

Exception: Where ground conditions do not provide percolation or where prohibited by the Plumbing Code.

602.2.1 Diverter. The diverter valve shall be connected and installed in the open position to the building sewer. The gray water diversion port shall remain capped off for future use until a gray water irrigation/reuse system is installed.

602.2.2 Access. The diverter and sewer connection shall be readily accessible for connection, inspection, maintenance, and servicing.

602.2.3 Regulatory. Gray water reuse and irrigation system components shall meet local, and state code and regulatory requirements.

602.3 Discharge. Gray water diverted away from a sewer or private sewage disposal system of single family and multifamily dwellings, shall discharge to a subsurface irrigation or subsoil irrigation system, or to a mulch basin, or disposal field. Gray water shall not be used to irrigate root crops or food crops intended for human consumption that come in contact with soil.

602.4 Surge Capacity. Gray water systems shall be designed to have the capacity to accommodate flow rates entering the system and distribute the total amount of estimated gray water entering the system on a daily basis to a subsurface irrigation field, subsoil irrigation field, or mulch basin without surfacing, ponding, or runoff. A surge tank is required for systems that are unable to accommodate peak flow rates and distribute the total amount of gray water by gravity drainage. The water discharge for gray water systems shall be determined in accordance with Section 602.12.1 or Section 602.12.2. Systems that produce more gray water than needed by the landscape shall discharge excess water into the sewer or private sewage disposal system.

602.5 Diversion. The gray water system shall connect to the sanitary drainage system downstream of fixture traps and vent connections through a diverter valve(s) approved by the Authority Having Jurisdiction. The diverter shall be installed in an accessible location and clearly indicate the direction of flow.

Exception: A clothes washer system in compliance with Section 601.3.1

602.6 Backwater Valves. Gray water drains subject to backflow shall be provided with a backwater valve so located as to be accessible for inspection and maintenance.

602.7 Connections to Potable and Reclaimed (Recycled) Water Systems. Gray water systems shall have no direct connection to any potable water supply, on-site treated nonpotable water supply, or reclaimed (recycled) water systems. Potable, on-site treated nonpotable, or reclaimed (recycled) water is permitted to be used as makeup water for a non-pressurized storage tank provided the connection is protected by an airgap in accordance with the plumbing code.

602.8 Location. No gray water system or part thereof shall be located on any lot other than the lot that is the site of the building or structure that discharges the gray water, nor shall any gray water system or part thereof be located at any point having less than the minimum distances indicated in Table 602.8.

602.9 Plot Plan Submission. No permit for any gray water system shall be issued until a plot plan with appropriate data satisfactory to the Authority Having Jurisdiction has been submitted and approved.

602.10 Prohibited Location. Gray water systems are prohibited where there is insufficient lot area or inappropriate soil conditions for adequate absorption to prevent the ponding, surfacing or runoff of the gray water, or on any property in a geologically sensitive area as determined by the Authority Having Jurisdiction.

602.11 Drawings and Specifications. The Authority Having Jurisdiction shall require any or all of the following information to be included with or in the plot plan before a permit is issued for a gray water system, or at any time during the construction thereof:

TABLE 602.8
LOCATION OF GRAY WATER SYSTEM

MINIMUM HORIZONTAL DISTANCE IN CLEAR REQUIRED FROM:	SURGE TANK (feet)	SUBSURFACE AND SUBSOIL IRRIGATION FIELD AND MULCH BED
Building structures[1]	5[2, 9]	2[3, 8]
Property line adjoining private property	5	5[8]
Water supply wells[4]	50	100
Streams and lakes[4]	50	50[5]
Sewage pits or cesspools	5	5
Sewage disposal field	5	4[6]
Septic tank	0	5
On-site domestic water service line	5	5
Pressurized public water main	10	10[7]

For SI units: 1 foot = 304.8 mm

Note: Where irrigation or disposal fields are installed in sloping ground, the minimum horizontal distance between any part of the distribution system and the ground surface shall be 15 feet (4572 mm).

1 Including porches and steps, whether covered or uncovered, breezeways, roofed carports, roofed patios, carports, covered walks, covered driveways, and similar structures or appurtenances.

2 The distance shall be permitted to be reduced to 0 feet for aboveground tanks when first approved by the Authority Having Jurisdiction.

3 Reference to a 45 degree (0.79 rad) angle from foundation.

4 Where special hazards are involved, the distance required shall be increased as directed by the Authority Having Jurisdiction.

5 These minimum clear horizontal distances shall also apply between the irrigation or disposal field and the ocean mean higher high tide line.

6 Add 2 feet (610 mm) for each additional foot of depth in excess of 1 foot (305 mm) below the bottom of the drain line.

7 For parallel construction or for crossings, approval by the Authority Having Jurisdiction shall be required.

8 The distance shall be permitted to be reduced to 1½ feet (457 mm) for drip and mulch basin irrigation systems.

9 The distance shall be permitted to be reduced to 0 feet for surge tanks of 75 gallons (284 L) or less.

(1) Plot plan drawn to scale and completely dimensioned, showing lot lines and structures, direction and approximate slope of surface, location of all present or proposed retaining walls, drainage channels, water supply lines, wells, paved areas and structures on the plot, number of bedrooms and plumbing fixtures in each structure, location of private sewage disposal system and expansion area or building sewer connecting to the public sewer, and location of the proposed gray water system.

(2) Details of construction necessary to ensure compliance with the requirements of this chapter, together with a full description of the complete installation, including installation methods, construction, and materials as required by the Authority Having Jurisdiction.

(3) Details for all holding tanks shall include all dimensions, structural calculations, bracings, and such other pertinent data as required.

(4) A log of soil formations and groundwater level as determined by test holes dug in proximity to any proposed irrigation area, together with a statement of water absorption characteristics of the soil at the proposed site as determined by approved percolation tests.

Exception: The Authority Having Jurisdiction shall permit the use of Table 602.14.1 in lieu of percolation tests.

(5) Distance between the plot and any surface waters such as lakes, ponds, rivers or streams, and the slope between the plot and the surface water, if in close proximity.

602.12 Procedure for Estimating Gray Water Discharge. Gray water systems shall be designed to distribute the total amount of estimated gray water on a daily basis. The water discharge for gray water systems shall be determined in accordance with Section 602.12.1 or Section 602.12.2.

602.12.1 Single Family Dwellings and Multi-Family Dwellings. The gray water discharge for single family and multi-family dwellings shall be calculated by water use records, calculations of local daily per person interior water use, or the following procedure:

(1) The number of occupants of each dwelling unit shall be calculated as follows:

First Bedroom	2 occupants
Each additional bedroom	1 occupant

(2) The estimated gray water flows of each occupant shall be calculated as follows:

Showers and bathtubs	13 gallons (50 L) per day/ occupant
Lavatories	4 gallons (15 L) per day/ occupant
Laundry	10 gallons (38 L) per day/ occupant

(3) The total number of occupants shall be multiplied by the applicable estimated gray water discharge as provided above and the type of fixtures connected to the gray water system.

602.12.2 Commercial, Industrial, and Institutional Occupancies. The gray water discharge for commercial, industrial, and institutional occupancies shall be calculated by utilizing the procedure in Section 602.12.1, water use records, or other documentation to estimate gray water discharge.

602.13 Gray Water System Components. Gray water system components shall be in accordance with Section 602.13.1 through Section 602.13.7.

602.13.1 Surge Tanks. Where installed, surge tanks shall comply with the following:

(1) Surge tanks shall be constructed of solid, durable

materials not subject to excessive corrosion or decay and shall be watertight. Surge tanks constructed of steel shall be approved by the Authority Having Jurisdiction, provided such tanks comply with approved applicable standards.

(2) Each surge tank shall be vented as required by the plumbing code. The vent size shall be determined based on the total gray water fixture units as outlined in the plumbing code.

(3) Each surge tank shall have an access opening with lockable gasketed covers or approved equivalent to allow for inspection and cleaning.

(4) Each surge tank shall have its rated capacity permanently marked on the unit. In addition, a sign stating GRAY WATER, DANGER — UNSAFE WATER shall be permanently marked on the holding tank.

(5) Each surge tank shall have an overflow drain. The overflow drains shall have permanent connections to the building drain or building sewer, upstream of septic tanks, if any. The overflow drain shall not be equipped with a shutoff valve.

(6) The overflow drainpipes shall not be less in size than the inlet pipe. Unions or equally effective fittings shall be provided for all piping connected to the surge tank.

(7) Surge tank shall be structurally designed to withstand anticipated earth or other loads. Surge tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft^2) (1465 kg/m^2) when the tank is designed for underground installation.

(8) If a surge tank is installed underground, the system shall be designed so that the tank overflow will gravity drain to the existing sewer line or septic tank. The tank shall be protected against sewer line backflow by a backwater valve installed in accordance with the plumbing code.

(9) Surge tanks shall be installed on dry, level, well-compacted soil if underground or on a level 3 inch (76 mm) thick concrete slab if aboveground.

(10) Surge tanks shall be anchored to prevent against overturning when installed aboveground. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground when empty. The combined weight of the tank and hold down system shall meet or exceed the buoyancy forces of the tank.

602.13.2 Gray Water Pipe and Fitting Materials. Aboveground and underground building drainage and vent pipe and fittings for gray water systems shall comply with the requirements for aboveground and underground sanitary building drainage and vent pipe and fittings in the plumbing code.

602.13.3 Subsoil Irrigation Field Materials. Subsoil irrigation field piping shall be constructed of perforated high-density polyethylene pipe, perforated ABS pipe, perforated PVC pipe, or other approved materials, provided that sufficient openings are available for distribution of the gray water into the trench area. Material, construction, and perforation of the pipe shall be in compliance with the appropriate absorption field drainage piping standards and shall be approved by the Authority Having Jurisdiction.

602.13.4 Subsurface Irrigation Field and Mulch Basin Supply Line Materials. Materials for gray water piping outside the building for non-pressure gravity systems shall be ABS, polyethylene, PVC or other approved DWV pipe. Pressure systems shall be pressure rated polyethylene or PVC or other approved pressure rated pipe. Drip feeder lines shall be PVC or polyethylene tubing.

602.13.5 Valves. Valves shall be accessible.

602.13.6 Trap. Gray water piping discharging into the surge tank or having a direct connection to the sanitary drain or sewer piping shall be downstream of an approved water seal type trap(s). If no such trap(s) exists, an approved vented running trap shall be installed upstream of the connection to protect the building from any possible waste or sewer gases.

602.13.7 Backwater Valve. A backwater valve shall be installed on all gray water drain connections to the sanitary drain or sewer.

602.14 Subsurface Irrigation System Zones. Each zone in an irrigation or disposal field having one or more valved zones shall be of adequate size to receive the gray water anticipated in that zone.

602.14.1 Required Area of Subsurface Irrigation Fields, Subsoil Irrigation Fields and Mulch Basins. The minimum effective irrigation area of subsurface irrigation fields, subsoil irrigation fields, and mulch basins shall be determined by Table 602.14.1 for the type of soil found in the excavation, based upon a calculation of estimated gray water discharge pursuant to Section 602.12. For a subsoil irrigation field, the area shall be equal to the aggregate length of the perforated pipe sections within the valved zone multiplied by the width of the proposed subsoil irrigation field.

602.14.2 Determination of Maximum Absorption Capacity. The irrigation field and mulch basin size shall be based on the maximum absorption capacity of the soil and determined using Table 602.14.1. For soils not listed in Table 602.14.1, the maximum absorption capacity for the proposed site shall be determined by percolation tests or other method acceptable to the Authority Having Jurisdiction. A gray water system is prohibited where the percolation test shows the absorption capacity of the soil is unable to accommodate the maximum discharge of the proposed gray water irrigation system.

602.14.3 Groundwater Level. No excavation for an irrigation field, disposal field, or mulch basin shall extend within 3 feet (914 mm) vertical of the highest known

seasonal groundwater level, nor to a depth where gray water contaminates the groundwater or surface water. The applicant shall supply evidence of groundwater depth to the satisfaction of the Authority Having Jurisdiction.

TABLE 602.14.1
SOIL INFILTRATION RATES

SOIL CLASS AND TEXTURES	MAXIMUM ABSORPTION CAPACITY IN GALLONS PER SQUARE FOOT OF IRRIGATION/LEACHING AREA FOR A 24-HOUR PERIOD
Group A: Sandy Loam Textures: sand, loamy sand, sandy loam	11.9
Group B: Loam Textures: loam, silt loam	4.5
Group C: Sandy Clay Loam Textures: Sandy clay loam	3.0
Group D: Clay Loam Textures: clay loam, silty clay loam, sandy clay, silty clay, clay	0.9

For SI units: 1 square foot = 0.0929 m^2, 1 gallon per day = 0.000043 L/s

602.15 Subsurface and Subsoil Irrigation Field, and Mulch Basin Design and Construction. Subsurface and subsoil irrigation field, and mulch basin design and construction shall be in accordance with Section 602.15.1 through Section 602.15.3. Where a gray water irrigation system design is predicated on soil tests, the subsurface or subsoil irrigation field or mulch basin shall be installed at the same location and depth as the tested area.

602.15.1 Subsurface Irrigation Field. A subsurface irrigation field shall be in accordance with Section 602.15.1.1 through Section 602.15.1.6.

602.15.1.1 Minimum Depth. Supply piping, including drip feeders, shall be not less than 2 inches (51 mm) below finished grade and covered with mulch or soil.

602.15.1.2 Filter. Not less than 140 mesh (115 micron) filter with a capacity of 25 gallons per minute (gpm) (1.58 L/s), or equivalent shall be installed. Where a filter backwash is installed, the backwash and flush discharge shall discharge into the building sewer or private sewage disposal system. Filter backwash and flush water shall not be used for any purpose.

602.15.1.3 Emitter Size. Emitters shall be installed in accordance with the manufacturer's installation instructions.

602.15.1.4 Number of Emitters. The minimum number of emitters and the maximum discharge of each emitter in an irrigation field shall be in accordance with Table 602.15.1.4

602.15.1.5 Controls. The system design shall provide user controls, such as valves, switches, timers, and other controllers, to rotate the distribution of gray water between irrigation zones.

602.15.1.6 Maximum Pressure. Where pressure at the discharge side of the pump exceeds 20 pounds-force per square inch (psi) (138 kPa), a pressure-reducing valve able to maintain downstream pressure no greater than the maximum operating pressure of the installed tubing, emitters, or other components shall be installed downstream from the pump and before any emission device.

TABLE 602.15.1.4
SUBSURFACE IRRIGATION DESIGN CRITERIA FOR SIX TYPICAL SOILS

TYPE OF SOIL	MAXIMUM EMITTER DISCHARGE	MINIMUM NUMBER OF EMITTERS PER GALLON OF ESTIMATED GRAY WATER DISCHARGE PER DAY*
	gallon/day	gallon/day
Sand	1.8	0.6
Sandy loam	1.4	0.7
Loam	1.2	0.9
Clay loam	0.9	1.1
Silty clay	0.6	1.6
Clay	0.5	2.0

For SI units: 1 gallon per day = 0.000043 L/s

* The estimated gray water discharge per day shall be determined in accordance with Section 602.8.

602.15.2 Mulch Basin. A mulch basin shall be in accordance with Section 602.15.2.1 through Section 602.15.2.3.

602.15.2.1 Size. Mulch basins shall be of sufficient size to accommodate peak flow rates and distribute the total amount of estimated gray water on a daily basis without surfacing, ponding or runoff. Mulch basins shall have a depth of not less than 10 inches (254 mm) below finished grade. The mulch basin size shall be based on the maximum absorption capacity of the soil and determined using Table 602.14.1.

602.15.2.2 Minimum Depth. Gray water supply piping, including drip feeders, shall be a minimum 2 inches (51 mm) below finished grade and covered with mulch.

602.15.2.3 Maintenance. The mulch basin shall be maintained periodically to retain the required depth and area, and to replenish the required mulch cover.

602.15.3 Subsoil Irrigation Field. Subsoil irrigation fields shall be in accordance with Section 602.15.3.1 through Section 602.15.3.3.

602.15.3.1 Minimum Pipe Size. Subsoil irrigation field distribution piping shall be not less than 3 inches (80 mm) diameter.

602.15.3.2 Filter Material and Backfill. Filter material, clean stone, gravel, slag, or similar material acceptable to the Authority Having Jurisdiction,

varying in size from ¾ of an inch (19.1 mm) to 2½ inches (64 mm) shall be placed in the trench to the depth and grade in accordance with Table 602.15.3.2. The perforated section of subsoil irrigation field distribution piping shall be laid on the filter material in an approved manner. The perforated section shall then be covered with filter material to the minimum depth in accordance with Table 602.15.3.2. The filter material shall then be covered with porous material to prevent closure of voids with earth backfill. No earth backfill shall be placed over the filter material cover until after inspection and acceptance.

602.15.3.3 Subsoil Irrigation Field Construction. Subsoil irrigation fields shall be constructed in accordance with Table 602.15.3.2. Where necessary on sloping ground to prevent excessive line slopes, irrigation lines shall be stepped. The lines between each horizontal leaching section shall be made with approved watertight joints and installed on natural or unfilled ground.

TABLE 602.15.3.2
SUBSOIL IRRIGATION FIELD CONSTRUCTION

DESCRIPTION	MINIMUM	MAXIMUM
Number of drain lines per valved zone	1	-
Length of each perforated line	-	100 feet
Bottom width of trench	12 inches	18 inches
Spacing of lines, center to center	4 feet	-
Depth of earth cover of lines	10 inches	-
Depth of filter material cover of lines	2 inches	-
Depth of filter material beneath lines	3 inches	-
Grade of perforated lines level	level	3 inches per 100 feet

For SI units: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 inch per foot = 83.3 mm/m

602.16 Gray Water System Color and Marking Information. Pressurized gray water distribution systems shall be identified as containing nonpotable water in accordance with the plumbing code.

602.17 Special Provisions.

602.17.1 Other Collection and Distribution Systems. Other collection and distribution systems shall be approved by the local Authority Having Jurisdiction, as allowed by Section 102.0 of this standard and the plumbing code.

602.17.2 Higher Requirements. Nothing contained in this chapter shall be construed to prevent the Authority Having Jurisdiction from requiring compliance with higher requirements than those contained herein, where such higher requirements are essential to maintain a safe and sanitary condition.

602.18 Testing. Building drains and vents for gray water systems shall be tested in accordance with the plumbing code. Surge tanks shall be filled with water to the overflow line prior to and during inspection. Seams and joints shall be left exposed, and the tank shall remain watertight. A flow test shall be performed through the system to the point of gray water discharge. Lines and components shall be watertight up to the point of the irrigation perforated and drip lines.

602.19 Maintenance. Gray water systems and components shall be maintained in accordance with Table 601.5.1.

603.0 Reclaimed (Recycled) Water Systems.

603.1 General. The provisions of this section shall apply to the installation, construction, alteration, and repair of reclaimed (recycled) water and stormwater systems intended to supply uses such as water closets, urinals, trap primers for floor drains and floor sinks, aboveground and subsurface irrigation, industrial or commercial cooling or air conditioning and other uses approved by the Authority Having Jurisdiction.

603.2 Permit. It shall be unlawful for any person to construct, install, alter, or cause to be constructed, installed, or altered any reclaimed (recycled) water system within a building or on a premises without first obtaining a permit to do such work from the Authority Having Jurisdiction.

603.2.1 Plumbing Plan Submission. No permit for any reclaimed (recycled) water system shall be issued until complete plumbing plans, with appropriate data satisfactory to the Authority Having Jurisdiction, have been submitted and approved.

603.3 System Changes. No changes or connections shall be made to either the reclaimed (recycled) water system or the potable water system within any site containing a reclaimed (recycled) water system without approval by the Authority Having Jurisdiction.

603.4 Connections to Potable or Reclaimed (Recycled) Water Systems. Reclaimed (recycled) water systems shall have no connection to any potable water supply or alternate water source system. Potable water is permitted to be used as makeup water for a reclaimed (recycled) water storage tank provided the water supply inlet is protected by an airgap or reduced-pressure principle backflow preventer complying with the plumbing code.

603.5 Initial Cross-Connection Test. A cross-connection test is required in accordance with Section 601.11.2. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.

603.6 Reclaimed (Recycled) Water System Materials. Reclaimed (recycled) water supply and distribution system materials shall comply with the requirements of the plumbing code for potable water supply and distribution systems, unless otherwise provided for in this section.

603.7 Reclaimed (Recycled) Water System Color and Marking Information. Reclaimed (recycled) water systems shall have a colored background in accordance with the plumbing code. Reclaimed (recycled) water systems shall be marked or field-marked, in lettering in accordance with the plumbing code, with the words: "CAUTION: NONPOTABLE RECLAIMED (RECYCLED) WATER, DO NOT DRINK."

603.8 Valves. Valves, except fixture supply control valves, shall be equipped with a locking feature.

603.9 Hose Bibbs. Hose bibbs shall not be allowed on reclaimed (recycled) water piping systems located in areas accessible to the public. Access to reclaimed (recycled) water at points in the system accessible to the public shall be through a quick-disconnect device that differs from those installed on the potable water system. Hose bibbs supplying reclaimed (recycled) water shall be indicated by posted signs marked with the words: "CAUTION: NONPOTABLE RECLAIMED WATER, DO NOT DRINK," and the symbol in Figure 603.9.

FIGURE 603.9

603.10 Required Appurtenances. The reclaimed (recycled) water system and the potable water system within the building shall be provided with the required appurtenances (valves, air/vacuum relief valves, etc.) to allow for deactivation or drainage as required for cross-connection test in Section 601.11.2.

603.11 Same Trench as Potable Water Pipes. Reclaimed (recycled) water pipes run or laid in the same trench as potable water pipes shall have 12 inches (305 mm) minimum vertical and horizontal separation when both pipe materials are approved for use within a building. When piping materials do not meet this requirement the minimum horizontal separation shall be increased to 60 inches (1524 mm). The potable water piping shall be installed at an elevation above the reclaimed (recycled) water piping. Reclaimed (recycled) water pipes laid in the same trench or crossing building sewer or drainage piping shall be installed in accordance with the plumbing code for potable water piping.

603.12 Signs. Rooms and water closet tanks in buildings using reclaimed (recycled) water shall be in accordance with Section 601.10.

603.13 Inspection and Testing. Reclaimed (recycled) water systems shall be inspected and tested in accordance with Section 601.11.

604.0 On-Site Treated Nonpotable Water Systems.

604.1 General. The provisions of this section shall apply to the installation, construction, alteration, and repair of on-site treated nonpotable water systems intended to supply uses such as water closets, urinals, trap primers for floor drains and floor sinks, above and below ground irrigation, and other uses approved by the Authority Having Jurisdiction.

604.2 Plumbing Plan Submission. No permit for any on-site treated nonpotable water system shall be issued until complete plumbing plans, with appropriate data satisfactory to the Authority Having Jurisdiction, have been submitted and approved.

604.3 System Changes. No changes or connections shall be made to either the on-site treated nonpotable water system or the potable water system within any site containing an on-site treated nonpotable water system without approval by the Authority Having Jurisdiction.

604.4 Connections to Potable or Reclaimed (Recycled) Water Systems. On-site treated nonpotable water systems shall have no connection to any potable water supply or reclaimed (recycled) water source system. Potable or reclaimed (recycled) water is permitted to be used as makeup water for a non-pressurized storage tank provided the makeup water supply is protected by an airgap in accordance with the plumbing code.

604.5 Initial Cross-Connection Test. A cross-connection test is required in accordance with Section 601.11.2. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.

604.6 On-Site Treated Nonpotable Water System Materials. On-site treated nonpotable water supply and distribution system materials shall comply with the requirements of the plumbing code for potable water supply and distribution systems, unless otherwise provided for in this section.

604.7 On-Site Treated Nonpotable Water Devices and Systems. Devices or equipment used to treat on-site treated nonpotable water in order to maintain the minimum water quality requirements determined by the Authority Having Jurisdiction shall be listed or labeled (third-party certified) by a listing agency (accredited conformity assessment body) or approved for the intended application. Devices or equipment used to treat on-site treated nonpotable water for use in water closet and urinal flushing, surface irrigation and similar applications shall be listed or labeled to IAPMO IGC207, NSF 350 or approved by the Authority Having Jurisdiction.

604.8 On-Site Treated Nonpotable Water System Color and Marking Information. On-site treated water

systems shall have a colored background in accordance with the plumbing code. On-site treated water systems shall be marked or field-marked, in lettering in accordance with the plumbing code, with the words: "CAUTION: ON-SITE TREATED NONPOTABLE WATER, DO NOT DRINK."

604.9 Valves. Valves, except fixture supply control valves, shall be equipped with a locking feature.

604.10 Design and Installation. The design and installation of on-site treated nonpotable systems shall be in accordance with Section 604.10.1 through Section 604.10.5.

604.10.1 Listing Terms and Installation Instructions. On-site treated nonpotable water systems shall be installed in accordance with the terms of its listing and the manufacturer's installation instructions.

604.10.2 Minimum Water Quality. On-site treated nonpotable water supplied to toilets or urinals or for other uses in which it is sprayed or exposed shall be disinfected. Acceptable disinfection methods shall include chlorination, ultraviolet sterilization, ozone, or other methods as approved by the Authority Having Jurisdiction. The minimum water quality for on-site treated nonpotable water systems shall meet the applicable water quality requirements for the intended applications as determined by the Authority Having Jurisdiction.

604.10.3 Deactivation and Drainage. The on-site treated nonpotable water system and the potable water system within the building shall be provided with the required appurtenances (valves, air/vacuum relief valves, etc.) to allow for deactivation or drainage as required for cross-connection test in accordance with Section 601.11.2.

604.10.4 Near Underground Potable Water Pipe. On-site treated nonpotable water pipes run or laid in the same trench as potable water pipes shall have 12 inches (305 mm) minimum vertical and horizontal separation when both pipe materials are approved for use within a building. Where piping materials do not meet this requirement the minimum separation shall be increased to 60 inches (1524 mm). The potable water piping shall be installed at an elevation above the on-site treated nonpotable water piping.

604.10.5 Required Filters. A filter permitting the passage of particulates no larger than 100 microns (100 µm) shall be provided for on-site treated nonpotable water supplied to water closets, urinals, trap primers, and drip irrigation system.

604.11 Signs. Signs in buildings using on-site treated nonpotable water shall be in accordance with Section 601.10.

604.12 Inspection and Testing. On-site treated nonpotable water systems shall be inspected and tested in accordance with Section 601.11.

CHAPTER 7
ONSITE BLACKWATER TREATMENT SYSTEMS

701.0 General.

701.1 Applicability. The provisions of this chapter shall apply to the water quality, monitoring, design, construction, alteration, repair, and operation requirements of onsite blackwater treatment systems for non-potable reuse.

701.2 Allowable Use of Blackwater. Where approved or required by the Authority Having Jurisdiction, blackwater shall be permitted to be used in lieu of potable water for uses such as, but not limited, to water closets, urinals, clothes washers, ornamental plant irrigation, and dust suppression.

702.0 System Design.

702.1 Requirements. Onsite blackwater treatment systems shall meet the design, construction, and performance requirements of Section 702.1.1 or 702.1.2.

702.1.1 Listed Blackwater Treatment Systems. Onsite blackwater treatment systems shall be listed to NSF 350, installed according to the manufacturer's instructions, and commissioned in accordance with Section 703.0.

702.1.2 Alternative Design Systems. Where approved by the Authority Having Jurisdiction, onsite blackwater treatment systems for residential and commercial applications shall comply with the provisions of Sections 702.2 through 705.0.

702.2 Permit. It shall be unlawful for any person to construct, install, alter, or cause to be constructed, installed, or altered any blackwater treatment system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

702.3 Component Identification. System components shall be properly identified as to the manufacturer.

702.4 Material Compatibility. Blackwater treatment systems shall be constructed of materials that are compatible with the type of pipe and fitting materials, water treatment, and water conditions in the system.

702.5 Log Reduction Targets. Blackwater treatment systems shall be designed to meet the log reduction targets as set forth in Table 702.5. To meet the log reduction targets in Table 702.5, treatment processes used in blackwater systems shall comply with Section 702.7 for validation or be operated according to conditions approved by the Authority Having Jurisdiction.

702.6 Effluent Water Quality Parameters. Blackwater treatment systems shall be designed to meet the effluent water quality parameters for water closet and urinal fixture use listed in Table 702.6.

702.7 Validation. Where required by the Authority Having Jurisdiction, treatment processes shall be tested to verify the pathogen reduction performance. The treatment processes shall be validated through third-party component validation or field verification using the challenge testing. The results of the third-party component validation and/or challenge testing shall be summarized in a validation report prepared by a Registered Design Professional. The validation report shall document the treatment technology's log reduction performance, including information on the operating conditions and surrogate parameters.

Table 702.5
LOG REDUCTION TARGETS FOR 10^{-4} INFECTIONS PER PERSON PER YEAR BENCHMARKS FOR BLACKWATER TREATMENT SYSTEMS

WATER USE SCENARIO	ENTERIC VIRUSES	PARASITIC PROTOZOA	ENTERIC BACTERIA
Ornamental plant irrigation[1]/dust suppression	8.0	7.0	6.0
Indoor Use	8.5	7.0	6.0

[1] Non-food

TABLE 702.6
EFFLUENT WATER QUALITY PARAMETERS FOR WATER CLOSET AND URINAL FIXTURE USE

	MINIMUM	MAXIMUM
Alkalinity mg/L	20	200
TDS mg/L	0	500
Turbidity NTU	0	5
pH	6.0	9.0
Odor	Non-Offensive	
Oily Film and Foam	Visual Non-detectable	
Free Chlorine Residual ppm	NA	4
Combined Chlorine ppm	NA	4
Chloramines mg/L	NA	4

702.8 Health and Safety. Treated blackwater shall not create a nuisance or odor, nor threaten human health, or damage the quality of surface water or groundwater.

702.9 Monitoring Requirements. Monitoring of blackwater treatment systems shall be based on the risk level in accordance with Table 702.9(1). The parameters listed in Table 702.9(2) shall be monitored by sensors placed in the effluent of the system and connected to a smart controller. The smart controller shall activate an alarm when the param-

eters in Table 702.9(2) are outside the specifications and shall shut the system down when the alarm is not acknowledged after a period of 8 hours has elapsed. For Category 2, quarterly grab samples shall be taken out of the effluent and analyzed by an accredited lab. The sensors' accuracy and response shall be validated upon commissioning of the system by an independent third party.

TABLE 702.9(1)
RISK LEVELS

RISK LEVEL	TREATED WATER USAGE[1]
1	Ornamental plant irrigation and dust suppression
2	Water closets, urinals, clothes washers

[1] See Section 701.2 for other uses approved by the AHJ.

TABLE 702.9(2)
MONITORING PARAMETERS

CATEGORY	PARAMETERS TO BE MONITORED	VALIDATION PROCEDURE
1	Turbidity ORP UV intensity (if used)	IGC 324 -Sensor validation procedure using 5.4.1.1 (a), (b), (c), and (d) as applicable
2	Turbidity ORP UV intensity (if used) pH Quarterly lab Sample for Total Coliform	

702.10 System Requirements. The design and installation of onsite blackwater treatment systems shall meet the requirements of Section 702.10.1 through Section 702.10.6.

702.10.1 Connections to Potable or Reclaimed (Recycled) Water Systems. Blackwater treatment systems shall have no direct connection to any potable water supply or reclaimed (recycled) water source system. Potable water or reclaimed (recycled) water shall be permitted to be used as makeup water for a blackwater treatment system provided the potable or reclaimed (recycled) water supply connection is protected by an airgap.

702.10.2 Bypass Connection. A bypass shall be provided for the input connection to the blackwater treatment system. The bypass shall be a diverter valve normally open to the blackwater treatment system. The normally closed port of the diverter valve shall be connected directly to the plumbing drainage system according to the plumbing code.

702.10.3 Overflow Connection. Blackwater treatment overflow shall be connected directly to the plumbing drainage system. The overflow shall be provided with a backwater valve at the point of connection to the plumbing drainage system. The backwater valve shall be accessible for inspection and maintenance.

702.10.4 Fail-safe Mechanisms. Blackwater treatment systems shall be equipped with an automatic shutdown of the treatment process when a malfunction occurs.

702.10.5 Flow Meter Totalizer. Buildings with blackwater treatment systems shall include a flow meter totalizer on the treated blackwater distribution system and a flow meter totalizer on the potable make-up water connection to the blackwater treatment system.

702.10.6 Cross-Connection Inspection and Testing. A cross-connection test is required in accordance with Section 601.11.2. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.

703.0 Commissioning.

703.1 General. Onsite blackwater treatment systems shall be commissioned in accordance with the requirements of Section 703.1 through Section 703.5.

703.2 Requirements. Commissioning for blackwater treatment systems shall be included in the design and construction processes of the project. Commissioning shall be performed by a person who demonstrates competency in commissioning blackwater treatment systems as required by the Authority Having Jurisdiction.

703.3 Plan. The construction documents shall include the commissioning plan for the blackwater treatment system. The commissioning plan shall be approved by the Authority Having Jurisdiction prior to commissioning the blackwater treatment system. The commissioning plan shall include the following:

(1) General project information.
(2) Equipment to be tested, including the test methodology.
(3) Processes to be tested.
(4) Criteria or process for testing.
(5) Criteria for acceptance.
(6) Commissioning team contact information.
(7) Commissioning process activities, schedules, and responsibilities.
(8) Plans for the completion of functional performance testing, post construction documentation and training, and the commissioning report.

703.4 Performance Testing. Performance tests shall verify that the installation and operation of the equipment of the blackwater treatment system is in accordance with the

approved plans and specifications. The performance test report shall include the equipment tested, the testing methods utilized, and proof of proper calibration of the equipment.

703.5 Commissioning Report. The commissioning report shall be submitted to the Authority Having Jurisdiction.

704.0 Operation and Maintenance Manual. An operation and maintenance manual shall be provided in accordance with Section 601.6 and shall also include the following:

(1) Instructions on operating and maintaining the system, including treatment process operations, instrumentation and alarms, and chemicals storage and handling.

(2) Site equipment inventory and maintenance notes.

(3) Equipment/system warranty documentation and information.

(4) As-Built design drawings.

(5) Details on training requirements and qualifications of personnel responsible for operating the system.

(6) Maintenance schedule.

705.0 Inspection. Field inspections shall take place during and after construction while the contractor is on-site to verify that the blackwater treatment system components have been properly supplied and installed according to the plans and specifications used for installation. Record drawings shall be maintained with changes to the approved plans by the contractor and available for periodic inspection as needed.

CHAPTER 8
ONSITE STORMWATER TREATMENT SYSTEMS

801.0 General.

801.1 Applicability. The provisions of this chapter shall apply to the water quality, monitoring, design, construction, alteration, repair, and operation requirements of onsite Stormwater treatment systems for non-potable use.

801.2 Allowable Use of Stormwater. Where approved or required by the Authority Having Jurisdiction, Stormwater shall be permitted to be used in lieu of potable water for uses such as, but not limited to, water closets, urinals, clothes washers, ornamental plant irrigation, and dust suppression.

802.0 System Design.

802.1 Requirements. Onsite Stormwater treatment systems shall meet the design, construction, and performance requirements of Section 802.1.1 or 802.1.2.

802.1.1 Listed Stormwater Treatment Systems. Onsite stormwater treatment systems shall be listed to ARCSA/ASPE 78, installed according to the manufacturer's instructions, and commissioned in accordance with Section 803.0.

802.1.2 Alternative Design Systems. Where approved by the Authority Having Jurisdiction, onsite stormwater treatment systems for residential and commercial applications shall comply with the provisions of Sections 802.2 through 805.0.

802.2 Permit. It shall be unlawful for any person to construct, install, alter, or cause to be constructed, installed, or altered any Stormwater treatment system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

802.3 Component Identification. System components shall be properly identified as to the manufacturer.

802.4 Material Compatibility. Stormwater treatment systems shall be constructed of materials that are compatible with the type of pipe and fitting materials, water treatment, and water conditions in the system.

802.5 Log Reduction Targets. Stormwater treatment systems shall be designed to meet the log reduction targets as set forth in Table 802.5. To meet the log reduction in Table 802.5, treatment processes used in Stormwater systems shall comply with 802.7 for validation or be operated according to conditions approved by the Authority Having Jurisdiction.

802.6 Effluent Water Quality Parameters. Stormwater treatment systems shall be designed to meet the effluent water quality parameters for water closet and urinal fixture use listed in Table 802.6.

802.7 Validation. Where required by the Authority Having Jurisdiction, treatment processes shall be tested to verify the pathogen reduction performance. The treatment processes shall be validated through third-party component validation or field verification using challenge testing. The results of the third-party component validation and/or challenge testing shall be summarized in a validation report prepared by a Registered Design Professional. The validation report shall document the treatment technology's log reduction performance, including information on the operating conditions and surrogate parameters.

Table 802.5
LOG REDUCTION TARGETS FOR 10^{-4} INFECTIONS PER PERSON PER YEAR BENCHMARKS FOR STORMWATER TREATMENT SYSTEMS

WATER USE SCENARIO	ENTERIC VIRUSES	PARASITIC PROTOZOA	ENTERIC BACTERIA
Stormwater greater than 0.1% fecal contamination contribution[2]			
Ornamental plant irrigation[1]/dust suppression	5.0	4.5	4.0
Indoor Use	5.5	5.5	5.0
Stormwater with less than or equal to 0.1% fecal contamination contribution[2]			
Ornamental plant irrigation[1]/dust suppression	3.0	2.5	2.0
Indoor Use	3.5	3.5	3.0

[1] Non-food

[2] Stormwater can contain some quantity of fecal contamination. The extent of fecal contamination present will depend on site-specific conditions. The appropriate LRT to apply for a Stormwater treatment system depend on the site-specific extent of likely contamination of Stormwater with fecal contamination.

TABLE 802.6
EFFLUENT WATER QUALITY PARAMETERS FOR WATER CLOSET AND URINAL FIXTURE USE

	MINIMUM	MAXIMUM
Alkalinity mg/L	20	200
TDS mg/L	0	500
Turbidity NTU	0	5
pH	6.0	9.0
Odor	Non-Offensive	
Oily Film and Foam	Visual Non-detectable	
Free Chlorine Residual ppm	NA	4
Combined Chlorine ppm	NA	4
Chloramines mg/L	NA	4

802.8 Health and Safety. Treated Stormwater shall not create a nuisance or odor, nor threaten human health, or damage the quality of surface water or groundwater.

802.9 Monitoring Requirements. Monitoring of stormwater treatment systems shall be based on the risk level in accordance with Table 802.9(1). The parameters listed in Table 802.9(2) shall be monitored by sensors placed in the effluent of the system and connected to a smart controller. The smart controller shall activate an alarm when the parameters in Table 802.9(2) are outside the specifications and shall shut the system down when the alarm is not acknowledged after a period of 8 hours has elapsed. For Category 2, quarterly grab samples shall be taken out of the effluent and analyzed by an accredited lab. The sensors' accuracy and response shall be validated upon commissioning of the system by an independent third party.

TABLE 802.9(1)
RISK LEVELS

RISK LEVEL	TREATED WATER USAGE[1]
1	Ornamental plant irrigation and dust suppression
2	Water closets, urinals, clothes washers

[1] See Section 801.2 for other uses approved by the Authority Having Jurisdiction.

TABLE 802.9(2)
MONITORING PARAMETERS

CATEGORY	PARAMETERS TO BE MONITORED	VALIDATION PROCEDURE
1	Turbidity ORP UV intensity (if used)	IGC 324 -Sensor validation procedure using 5.4.1.1 (a), (b), (c), and (d)., as applicable
2	Turbidity ORP UV intensity (if used) pH Quarterly lab Sample for Total Coliform	

802.10 System Requirements. The design and installation of onsite Stormwater treatment systems shall meet the requirements of Section 802.10.1 through Section 802.10.6.

802.10.1 Connections to Potable or Reclaimed (Recycled) Water Systems. Stormwater treatment systems shall have no direct connection to any potable water supply or reclaimed (recycled) water source system. Potable water or reclaimed (recycled) water shall be permitted to be used as makeup water for a Stormwater treatment system provided the potable or reclaimed (recycled) water supply connection is protected by an airgap.

802.10.2 Bypass Connection. A bypass shall be provided for the input connection to the Stormwater treatment system. The bypass shall be a diverter valve normally open to the Stormwater treatment system. The normally closed port of the diverter valve shall be connected directly to the storm drainage system or combined sewer system according to the plumbing code.

802.10.3 Overflow Connection. Stormwater treatment overflow shall be connected directly to the storm drainage or combined sewer system according to the plumbing code. The overflow shall be provided with a backwater valve at the point of connection to the storm drainage or combined sewer system. The backwater valve shall be accessible for inspection and maintenance.

802.10.4 Fail-safe Mechanisms. Stormwater treatment systems must be equipped with features that result in a controlled and non-hazardous automatic shutdown of the treatment process in the event of a malfunction.

802.10.5 Flow Meter Totalizer. Buildings with Stormwater treatment systems shall include a flow meter totalizer on the treated Stormwater distribution system and a flow meter totalizer on the potable make-up water pipeline to the Stormwater treatment system.

802.10.6 Cross-connection Inspection and Testing. A cross-connection test is required in accordance with Section 601.11.2. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.

803.0 Commissioning.

803.1 General. Onsite Stormwater treatment systems shall be commissioned in accordance with the requirements of Section 803.1 through Section 803.5.

803.2 Requirements. Commissioning for Stormwater treatment systems shall be included in the design and construction processes of the project. Commissioning shall be performed by a person who demonstrates competency in commissioning Stormwater treatment systems as required by the Authority Having Jurisdiction.

803.3 Plan. The construction documents shall include the commissioning plan for the stormwater treatment system. The commissioning plan shall be approved by the Authority Having Jurisdiction prior to commissioning the Stormwater treatment system. The commissioning plan shall include the following:

1) General project information.
2) Equipment to be tested, including the test methodology.
3) Processes to be tested.
4) Criteria or process for testing.
5) Criteria or process for acceptance.
6) Commissioning team contact information.

7) Commissioning process activities, schedules, and responsibilities.
8) Plans for the completion of functional performance testing, post construction documentation and training, and the commissioning report.

803.4 Performance Testing. Performance tests shall verify that the installation and operation of the equipment of the Stormwater treatment system is in accordance with the approved plans and specifications. The performance test report shall include the equipment tested, the testing methods utilized, and proof of proper calibration of the equipment.

803.5 Report. The commissioning report shall be submitted to the Authority Having Jurisdiction.

804.0 Operation and Maintenance Manual.

804.1 General. An operation and maintenance manual shall be provided in accordance with Section 601.6 and shall also include the following:

1) Instructions on operating and maintaining the system, including treatment process operations, instrumentation and alarms, and chemicals storage and handling.
2) Site equipment inventory and maintenance notes.
3) Equipment/system warranty documentation and information.
4) As-Built design drawings.
5) Details on training requirements and qualifications of personnel responsible for operating the system.
6) Maintenance schedule.

805.0 Inspection. Field inspections shall take place during and after construction while the contractor is on site to verify that the Stormwater treatment system components have been properly supplied and installed according to the plans and specifications used for installation. Record drawings shall be maintained with changes to the approved plans by the contractor and available for periodic inspection as needed.

CHAPTER 9

NONPOTABLE RAINWATER CATCHMENT SYSTEMS

901.0 General.

901.1 Scope. The provisions of this chapter shall apply to the construction, alteration, and repair of nonpotable rainwater catchment systems.

901.1.1 Allowable Use of Rainwater. Where approved or required by the Authority Having Jurisdiction, rainwater used in lieu of potable water shall be in accordance with the provisions of this chapter.

901.2 System Design. Rainwater catchment systems shall be designed in accordance with this chapter by a licensed plumbing contractor, Registered Design Professional, or a person who demonstrates competency to design rainwater catchment systems as required by the Authority Having Jurisdiction. Components, piping, and fittings used in any rainwater catchment systems shall be listed.

Exceptions:

(1) Rainwater catchment systems used for irrigation with a maximum storage capacity of 5 000 gallons (18 927 L) where the tank is supported directly upon grade and the ratio of height to width (or diameter) does not exceed 2 to 1.

(2) Rainwater catchment systems for single family dwellings where all outlets, piping, and system components are located on the exterior of the building.

901.3 Permit. It shall be unlawful for any person to construct, install, alter, or cause to be constructed, installed, or altered any rainwater catchment system in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

Exceptions:

(1) A permit is not required for exterior rainwater catchment systems used for outdoor drip and subsurface irrigation with a maximum storage capacity of 5 000 gallons (18 927 L) where the tank is supported directly upon grade and the ratio of height to width (or diameter) does not exceed 2 to 1 and it does not require electrical power or a make-up water supply connection.

(2) A plumbing permit is not required for rainwater catchment systems for single family dwellings where all outlets, piping, and system components are located on the exterior of the building. This does not exempt the need for permits if required for electrical connections, tank supports, or enclosures.

901.4 Component Identification. System components shall be properly identified as to the manufacturer.

901.5 Maintenance and Inspection. Rainwater catchment systems and components shall be inspected and maintained in accordance with Section 901.5.1 through Section 901.5.3.

901.5.1 Frequency. Rainwater catchment systems and components shall be inspected and maintained in accordance with Table 901.5.1 unless more frequent inspection and maintenance is required by the manufacturer.

901.5.2 Maintenance Log. A maintenance log for rainwater catchment systems is required to have a permit in accordance with Section 901.3 and shall be maintained by the property owner and be available for inspection. The property owner or designated appointee shall ensure that a record of testing, inspection and maintenance as required by Table 901.5.1 is maintained in the log. The log will indicate the frequency of inspection and maintenance for each system.

TABLE 901.5.1
MINIMUM ALTERNATE WATER SOURCE TESTING, INSPECTION, AND MAINTENANCE FREQUENCY

DESCRIPTION	MINIMUM FREQUENCY
Inspect and clean filters and screens, and replace (if necessary)	Every 3 months
Inspect and verify that disinfection, filters and water quality treatment devices and systems are operational and maintaining minimum water quality requirements as determined by the Authority Having Jurisdiction	In accordance with manufacturer's instructions, and the Authority Having Jurisdiction
Inspect and clear debris from rainwater gutters, downspouts, and roof washers	Every 6 months
Inspect and clear debris from roof or other aboveground rainwater collection surfaces	Every 6 months
Remove tree branches and vegetation overhanging roof or other aboveground rainwater collection surfaces	As needed
Inspect pumps and verify operation	After initial installation and every 12 months thereafter
Inspect valves and verify operation	After initial installation and every 12 months thereafter
Inspect pressure tanks and verify operation	After initial installation and every 12 months thereafter
Clear debris from and inspect storage tanks, locking devices, and verify operation	After initial installation and every 12 months thereafter
Inspect caution labels and marking	After initial installation and every 12 months thereafter
Cross-connection inspection and test*	After initial installation and every 12 months thereafter
Test water quality of rainwater catchment systems required by Section 903.4 to maintain a minimum water quality	Every 12 months. After system renovation or repair.

* The cross-connection test shall be performed in the presence of the Authority Having Jurisdiction in accordance with the requirements of this Chapter.

901.5.3 Maintenance Responsibility. The required maintenance and inspection of rainwater catchment systems shall be the responsibility of the property owner, unless otherwise required by the Authority Having Jurisdiction.

901.6 Operation and Maintenance Manual. An operation and maintenance manual for rainwater catchment systems required to have a permit in accordance with Section 901.3 shall be supplied to the building owner by the system designer. The operating and maintenance manual shall include the following:

(1) Detailed diagram of the entire system and the location of system components.

(2) Instructions on operating and maintaining the system.

(3) Details on maintaining the required water quality as determined by the Authority Having Jurisdiction.

(4) Details on deactivating the system for maintenance, repair, or other purposes.

(5) Applicable testing, inspection, and maintenance frequencies as required by Table 901.5.1.

(6) A method of contacting the manufacturer(s).

901.7 Minimum Water Quality Requirements. The minimum water quality for rainwater catchment systems shall meet the applicable water quality requirements for the intended application as determined by the Authority Having Jurisdiction. Water quality for nonpotable rainwater catchment systems shall comply with Section 903.4.

Exceptions:

(1) Water treatment is not required for rainwater catchment systems used for aboveground irrigation with a maximum storage capacity of 360 gallons (1363 L).

(2) Water treatment is not required for rainwater catchment systems used for nonspray irrigation.

901.8 Material Compatibility. Rainwater catchment systems shall be constructed of materials that are compatible with the type of pipe and fitting materials, water treatment, and water conditions in the system.

901.9 System Controls. Controls for pumps, valves, and other devices that contain mercury that come in contact with rainwater supply are prohibited.

901.10 Separation Requirements. All underground rainwater catchment service piping shall be separated from the building sewer in accordance with the plumbing code. Treated nonpotable water pipes run or laid in the same trench as potable water pipes shall have a 12 inch (305 mm) minimum vertical and horizontal separation when both pipe materials are approved for use within a building. Where horizontal piping materials do not meet this requirement the minimum separation shall be increased to 60 inches (1524 mm). The potable water piping shall be installed at an elevation above the treated nonpotable water piping.

901.11 Abandonment. All rainwater catchment systems that are no longer in use or fails to be maintained in accordance with Section 901.5 shall be abandoned. Abandonment shall comply with Section 305.0.

901.12 Sizing. Unless otherwise provided for in this standard, rainwater catchment piping shall be sized in accordance with the plumbing code for sizing potable water piping.

902.0 Nonpotable Rainwater Catchment Systems.

902.1 General. The provisions of this section shall apply to the installation, construction, alteration, and repair of rainwater catchments systems intended to supply uses such as water closets, urinals, trap primers for floor drains and floor sinks, irrigation, industrial processes, water features, cooling tower makeup and other uses approved by the Authority Having Jurisdiction. Additional design criteria can be found in the ARCSA/ASPE 63 Standard.

902.2 Plumbing Plan Submission. No permit for any rainwater catchment system requiring a permit shall be issued until complete plumbing plans, with appropriate data satisfactory to the Authority Having Jurisdiction, have been submitted and approved.

902.3 System Changes. No changes or connections shall be made to either the rainwater catchment system or the potable water system within any site containing a rainwater catchment system requiring a permit without approval by the Authority Having Jurisdiction.

902.4 Connections to Potable or Reclaimed (Recycled) Water Systems. Rainwater catchment systems shall have no direct connection to any potable water supply or alternate water source system. Potable or reclaimed (recycled) water shall be permitted to be used as makeup water for a rainwater catchment system provided the potable or reclaimed (recycled) water supply connection is protected by an airgap or reduced-pressure principle backflow preventer in accordance with the plumbing code.

902.5 Initial Cross-Connection Test. Where any portion of a rainwater catchment system is installed within a building, a cross-connection test is required in accordance with 903.14.2. Before the building is occupied or the system is activated, the installer shall perform the initial cross-connection test in the presence of the Authority Having Jurisdiction. The test shall be ruled successful by the Authority Having Jurisdiction before final approval is granted.

902.6 Sizing. The design and size of rainwater drains, gutters, conductors, and leaders shall be in accordance with the plumbing code.

902.7 Rainwater Catchment System Materials. Rainwater catchment system materials shall be in accordance with Section 902.7.1 through Section 902.7.4.

902.7.1 Water Supply and Distribution Materials. Rainwater catchment water supply and distribution materials shall comply with the requirements of the plumbing code for potable water supply and distribution systems, unless otherwise provided for in this section.

902.7.2 Rainwater Catchment System Drainage Materials. Materials used in rainwater catchment drainage systems, including gutters, downspouts, conductors, and leaders shall comply with the requirements of the plumbing code for storm drainage.

902.7.3 Storage Tanks. Rainwater storage tanks shall be in accordance with Section 903.5.

902.7.4 Collections Surfaces. The collection surface shall be constructed of a hard, impervious material.

902.8 Rainwater Catchment Water System Color and Marking Information. Rainwater catchment systems shall have a colored background in accordance with the plumbing code. Rainwater catchment systems shall be marked or field-marked, in lettering in accordance with the plumbing code, with the words: "CAUTION: NONPOTABLE RAINWATER, DO NOT DRINK."

903.0 Design and Installation.

903.1 Outside Hose Bibbs. Outside hose bibbs shall be allowed on rainwater piping systems. Hose bibbs supplying rainwater shall be indicated by posted signs marked with the words: "CAUTION: NONPOTABLE RAINWATER, DO NOT DRINK" and the symbol in Figure 903.1.

903.2 Deactivation and Drainage for Cross-connection Test. Where any portion of a rainwater catchment system is installed within a building, the rainwater catchment system and the potable water system within the building shall be provided with the required appurtenances (e.g., valves, air or vacuum relief valves, etc.) to allow for deactivation or drainage as required for cross-connection test in Section 903.14.2.

903.3 Rainwater Catchment Collection Surfaces. Rainwater shall be collected from roof surfaces or other manmade, aboveground collection surfaces.

903.3.1 Other Surfaces. Natural precipitation collected from surface water runoff, vehicular parking surfaces or manmade surfaces at or below grade shall comply with the stormwater requirements for on-site treated nonpotable water systems in Section 604.0.

903.3.2 Prohibited Discharges. Overflows and bleed-off pipes from roof-mounted equipment and appliances shall not discharge onto roof surfaces that are intended to collect rainwater without prior approval from the Authority Having Jurisdiction.

903.4 Minimum Water Quality. The minimum water quality for harvested rainwater shall meet the applicable water quality requirements for the intended applications as determined by the Authority Having Jurisdiction. In the absence of water quality requirements determined by the Authority Having Jurisdiction, the minimum treatment and water quality shall also comply with Table 903.4.

Exception: No treatment is required for rainwater used for subsurface or nonsprinkled surface irrigation where the maximum storage volume is less than 360 gallons (1 363 L).

903.4.1 Treatment. If the quality of the tested water cannot consistently be maintained at the minimum levels specified in Table 903.4, then the system shall be equipped with an appropriate treatment device meeting applicable NSF Standard referenced in Table 1201.1.

903.5 Rainwater Storage Tanks. Rainwater storage tanks shall be constructed and installed in accordance with Section 903.5.1 through Section 903.5.8.

903.5.1 Construction. Rainwater storage shall be constructed of solid, durable materials not subject to excessive corrosion or decay and shall be watertight. Storage tanks shall be approved by the Authority Having Jurisdiction, provided such tanks comply with approved applicable standards.

903.5.2 Location. Rainwater storage tanks shall be installed above or below grade.

903.5.3 Above Grade. Above grade storage tanks shall be of an opaque material, approved for aboveground use in direct sunlight or shall be shielded from direct sunlight. Tanks shall be installed in an accessible location to allow for inspection and cleaning. The tank shall be installed on a foundation or platform that is constructed to accommodate all loads in accordance with the building code.

903.5.4 Below Grade. Rainwater storage tanks installed below grade shall be structurally designed to withstand all anticipated earth or other loads. Holding tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft^2) (1465 kg/m^2) when the tank is designed for underground installation. Below grade rainwater tanks installed underground shall be provided with manholes. The manhole opening shall not be less than 20 inches (508 mm) in diameter and located not less than 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground when empty. The combined weight of the tank and hold down system should meet or exceed the buoyancy force of the tank.

903.5.5 Drainage and Overflow. Rainwater storage tanks shall be provided with a means of draining and cleaning. The overflow drain shall not be equipped with a shutoff valve. The overflow outlet shall discharge as required by the plumbing code for storm drainage systems. Where discharging to the storm drainage system, the overflow drain shall be protected from backflow of the storm drainage system by a backwater valve or other approved method.

FIGURE 903.1

TABLE 903.4
MINIMUM WATER QUALITY

APPLICATION	MINIMUM TREATMENT	MINIMUM WATER QUALITY
Car washing	Debris excluder or other approved means in compliance with Section 903.10, and 100 Micron (100 µm) in compliance with Section 903.11 for drip irrigation.	N/A
Subsurface and drip irrigation	Debris excluder or other approved means in compliance with Section 903.10, and 100 Micron (100 µm) in compliance with Section 903.11 for drip irrigation.	N/A
Spray irrigation where the maximum storage volume is less than 360 gallons (1363 L)	Debris excluder or other approved means in compliance with Section 903.10, and Disinfection in accordance with Section 903.8.	N/A
Spray irrigation where the maximum storage volume is equal to or greater than 360 gallons (1363 L)	Debris excluder or other approved means in compliance with Section 903.10.	Escherichia coli: < 100 CFU/100 mL, and Turbidity: < 10 NTU
Urinal and water closet flushing, clothes washing, and trap priming	Debris excluder or other approved means in compliance with Section 903.10, and 100 Micron (100 µm) in compliance with Section 903.11.	Escherichia coli: < 100 CFU/100 mL, and Turbidity: < 10 NTU
Ornamental fountains and other water features	Debris excluder or other approved means in compliance with Section 903.10.	Escherichia coli: < 100 CFU/100 mL, and Turbidity: < 10 NTU
Cooling tower make up water	Debris excluder or other approved means in compliance with Section 903.10, and 100 Micron (100 µm) in compliance with Section 903.11.	Escherichia coli: < 100 CFU/100 mL, and Turbidity: < 10 NTU

903.5.5.1 Overflow Outlet Size. The overflow outlet shall be sized to accommodate the flow of the rainwater entering the tank and not less than the aggregate cross-sectional area of all inflow pipes.

903.5.6 Opening and Access Protection.

903.5.6.1 Animals and Insects. Rainwater tank openings shall be protected to prevent the entrance of insects, birds, or rodents into the tank.

903.5.6.2 Human Access. Rainwater tank access openings exceeding 12 inches (305 mm) in diameter shall be secured to prevent tampering and unintended entry by either a lockable device or other approved method.

903.5.7 Marking. Rainwater tanks shall be permanently marked with the capacity and the language: "NONPOTABLE RAINWATER." Where openings are provided to allow a person to enter the tank, the opening shall be marked with the following language: "DANGER-CONFINED SPACE."

903.5.8 Storage Tank Venting. Where venting by means of drainage or overflow piping is not provided or is considered insufficient, a vent shall be installed on each tank. The vent shall extend from the top of the tank and terminate a minimum of 6 inches (152 mm) above grade and shall be a minimum of 1-½ inches (38 mm) in diameter. The vent terminal shall be directed downward and covered with a $^{3}/_{32}$ inch (2.4 mm) mesh screen to prevent the entry of vermin and insects.

903.6 Pumps. Pumps serving rainwater catchment systems shall be listed. Pumps supplying water to water closets, urinals, and trap primers shall be capable of delivering not less than 15 psi (103 kPa) residual pressure at the highest and most remote outlet served. Where the water pressure in the rainwater supply system within the building exceeds 80 psi (552 kPa), a pressure reducing valve reducing the pressure to 80 psi (552 kPa) or less to all water outlets in the building shall be installed in accordance with the plumbing code.

903.7 Roof Drains. Primary and secondary roof drains, conductors, leaders, and gutters shall be designed and installed in accordance with the plumbing code.

903.8 Water Quality Devices and Equipment. Devices and equipment used to treat rainwater to maintain the minimum water quality requirements determined by the Authority Having Jurisdiction shall be listed or labeled (third-party certified) by a listing agency (accredited conformity assessment body) and approved for the intended application.

903.9 Freeze Protection. Tanks and piping installed in locations subject to freezing shall be provided with an adequate means of freeze protection.

903.10 Debris Removal. The rainwater catchment conveyance system shall be equipped with a debris excluder or other approved means to prevent the accumulation of leaves, needles, other debris and sediment from entering the storage tank. Devices or methods used to remove debris or sediment shall be accessible and sized and installed in accordance with manufacturer's installation instructions.

903.11 Required Filters. A filter permitting the passage of particulates no larger than 100 microns (100 µm) shall be provided for rainwater supplied to water closets, urinals, trap primers, and drip irrigation system.

903.12 Roof Gutters. Gutters shall maintain a minimum slope and be sized in accordance with the plumbing code.

903.13 Signs. Signs in buildings using rainwater water shall be in accordance with Section 903.13.1 and Section 903.13.2

903.13.1 Commercial, Industrial, and Institutional Restroom Signs. A sign shall be installed in all restrooms in commercial, industrial, and institutional occupancies using rainwater for water closets, urinals, or both. Each sign shall contain ½ inch (12.7 mm) letters of a highly visible color on a contrasting background. The location of the sign(s) shall be such that the sign(s) shall be visible to all users. The location of the sign(s) shall be approved by the Authority Having Jurisdiction and shall contain the following text:

TO CONSERVE WATER, THIS BUILDING USES RAINWATER TO FLUSH TOILETS AND URINALS.

903.13.2 Equipment Room Signs. Each room containing nonpotable rainwater equipment shall have a sign posted in a location that is visible to anyone working on or near nonpotable water equipment with the following wording in 1 inch (25.4 mm) letters:

CAUTION: NONPOTABLE RAINWATER, DO NOT DRINK. DO NOT CONNECT TO DRINKING WATER SYSTEM. NOTICE: CONTACT BUILDING MANAGEMENT BEFORE PERFORMING ANY WORK ON THIS WATER SYSTEM.

903.14 Inspection and Testing. Rainwater catchment systems shall be inspected and tested in accordance with Section 903.14.1 and Section 903.14.2. Irrigation systems not connected to a potable water system shall be exempt from testing requirements in Section 903.14.2.

903.14.1 Supply System Inspection and Test. Rainwater catchment systems shall be inspected and tested in accordance with the applicable provisions of the plumbing code for testing of potable water and storm drainage systems. Storage tanks shall be filled with water to the overflow opening for a period of 24 hours and during inspection or by other means as approved by the Authority Having Jurisdiction. All seams and joints shall be exposed during inspection and checked for water tightness.

903.14.2 Annual Cross-Connection Inspection and Testing. An initial and subsequent annual inspection and test shall be performed on both the potable and rainwater catchment system. The potable and rainwater catchment system shall be isolated from each other and independently inspected and tested to ensure there is no cross-connection in accordance with Section 903.14.2.1 through Section 903.14.2.4.

903.14.2.1 Visual System Inspection. Prior to commencing the cross-connection testing, a dual system inspection shall be conducted by the Authority Having Jurisdiction as follows:

(1) Meter locations of the rainwater and potable water lines shall be checked to verify that no modifications were made and that no cross-connections are visible.

(2) Pumps and equipment, equipment room signs, and exposed piping in equipment room shall be checked.

(3) Valves shall be checked to ensure that valve lock seals are still in place and intact. Valve control door signs shall be checked to verify that no signs have been removed.

903.14.2.2 Cross-Connection Test. The procedure for determining cross-connection shall be followed by the applicant in the presence of the Authority Having Jurisdiction to determine whether a cross-connection has occurred as follows:

(1) The potable water system shall be activated and pressurized. The rainwater catchment system shall be shut down, depressurized, and drained.

(2) The potable water system shall remain pressurized for a minimum period of time specified by the Authority Having Jurisdiction while the rainwater catchment system is empty. The minimum period the rainwater catchment system is to remain depressurized shall be determined on a case-by-case basis, taking into account the size and complexity of the potable and the rainwater catchment distribution systems, but in no case shall that period be less than 1 hour.

(3) The drain on the rainwater catchment system shall be checked for flow during the test and all fixtures, potable and alternate water source, shall be tested and inspected for flow. Flow from any rainwater catchment system outlet indicates a cross-connection. No flow from a potable water outlet shall indicate that it is connected to the rainwater catchment system.

(4) The potable water system shall then be depressurized and drained.

(5) The rainwater catchment system shall then be activated and pressurized.

(6) The rainwater catchment system shall remain pressurized for a minimum period of time specified by the Authority Having Jurisdiction while the potable water system is empty. The

minimum period the potable water system is to remain depressurized shall be determined on a case-by-case basis, but in no case shall that period be less than 1 hour.

(7) All fixtures, potable and rainwater, shall be tested and inspected for flow. Flow from any potable water system outlet indicates a cross-connection. No flow from a rainwater outlet will indicate that it is connected to the potable water system.

(8) The drain on the potable water system shall be checked for flow during the test and at the end of the test.

(9) If there is no flow detected in any of the fixtures which would indicate a cross-connection, the potable water system shall be repressurized.

903.14.2.3 Discovery of Cross-Connection. In the event that a cross-connection is discovered, the following procedure, in the presence of the Authority Having Jurisdiction, shall be activated immediately:

(1) The rainwater piping to the building shall be shut down at the meter, and the rainwater riser shall be drained.

(2) Potable water piping to the building shall be shut down at the meter.

(3) The cross-connection shall be uncovered and disconnected.

(4) The building shall be retested following procedures listed in Section 903.14.2.1 and Section 903.14.2.2.

(5) The potable water system shall be chlorinated with 50 parts-per-million (ppm) chlorine for 24 hours.

(6) The potable water system shall be flushed after 24 hours, and a standard bacteriological test shall be performed. If test results are acceptable, the potable water system shall be recharged.

903.14.2.4 Annual Inspection. An annual inspection of the rainwater catchment system, following the procedures listed in Section 903.14.2.1 shall be required. Annual cross-connection testing, following the procedures listed in Section 903.14.2.2 shall be required by the Authority Having Jurisdiction, unless site conditions do not require it. In no event shall the test occur less than once in 4 years. Alternate testing requirements shall be approved by the Authority Having Jurisdiction.

CHAPTER 10

WATER HEATING DESIGN, EQUIPMENT, AND INSTALLATION

1001.0 General.

1001.1 Scope. The provisions of this chapter shall establish the means of conserving potable and non-potable water and energy associated with the generation and use of hot water in a building. This includes provisions for the hot water distribution system, which is the portion of the potable water distribution system between a water heating device and the plumbing fixtures, including all dedicated return piping and appurtenances to the water heating device in a recirculation system.

1001.2 Insulation. Hot water supply and return piping shall be thermally insulated. The wall thickness of the insulation shall be equal to the nominal diameter of the pipe up to 2 inches (50 mm). The wall thickness shall be not less than 2 inches (50 mm) for nominal pipe diameters exceeding 2 inches (50 mm). The conductivity of the insulation [k-factor (Btu•in/(h•ft^2•^{o}F))], measured radially, shall be less than or equal to 0.28 [Btu•in/(h•ft^2•^{o}F)] [0.04 W/(m•k)]. Hot water piping to be insulated shall be installed such that insulation is continuous. Pipe insulation shall be installed to within ¼ inch (6.4 mm) of all appliances, appurtenances, fixtures, structural members, or a wall where the pipe passes through to connect to a fixture within 24 inches (610 mm).

Exceptions:

(1) Where the hot water pipe is installed in a wall that is not of sufficient width to accommodate the pipe and insulation, the insulation thickness shall be the maximum thickness that the wall can accommodate and not less than ½ inch (12.7 mm) thick.

(2) Hot water supply piping exposed under sinks, lavatories, and similar fixtures.

(3) Where hot water distribution piping is installed within attic, crawlspace, or wall insulation.

1001.2.1 Pipe Supports. Pipe supports shall be installed on the outside of the pipe insulation.

Exception: Vertical supports, and horizontal and vertical anchors shall be installed on the pipe inside the pipe insulation.

1001.2.2 Building Cavities. Building cavities used for hot water supply and return piping shall be large enough to accommodate the combined diameter of the pipe plus the insulation, plus any other objects in the cavity that the piping must cross.

1002.0 Recirculation Systems.

1002.1 Pump Operation.

1002.1.1 For Low-Rise Residential Buildings. Circulating hot water systems shall be arranged so that the circulating pump(s) can be turned off (automatically or manually) when the hot water system is not in operation.

1002.1.2 For Pumps Between Boilers and Storage Tanks. When used to maintain storage tank water temperature, recirculating pumps shall be equipped with controls limiting operation to a period from the start of the heating cycle to a maximum of 5 minutes after the end of the heating cycle. [ASHRAE 90.1:7.4.4.4]

1002.2 Recirculation Pump Controls. Pump controls shall include on-demand activation or time clocks combined with temperature sensing. Time clock controls for pumps shall not let the pump operate more than 15 minutes every hour. Temperature sensors shall stop circulation when the temperature set point is reached and shall be located on the circulation loop at or near the last fixture. The pump, pump controls and temperature sensors shall be accessible. Pump operation shall be limited to the building's hours of operation.

1002.3 Temperature Maintenance Controls. For other than low-rise residential buildings, systems designed to maintain usage temperatures in hot-water pipes, such as recirculating hot-water systems or heat trace, shall be equipped with automatic time switches or other controls that can be set to switch off the usage temperature maintenance system during extended periods when hot water is not required. [ASHRAE 90.1:7.4.4.2]

1002.4 System Balancing. Systems with multiple recirculation zones shall be balanced to uniformly distribute hot water, or they shall be operated with a pump for each zone. The circulation pump controls shall comply with the provisions of Section 1002.2.

1002.5 Flow Balancing Valves. Flow balancing valves shall be a factory preset automatic flow control valve, a flow regulating valve, or a balancing valve with memory stop.

1002.6 Air Elimination. Provision shall be made for the elimination of air from the return system.

1002.7 Gravity or Thermosyphon Systems. Gravity or thermosyphon systems are prohibited.

1003.0 Service Hot Water – Low-Rise Residential Buildings.

1003.1 General. The service water heating system for single-family houses, multi-family structures of three stories or fewer above grade, and modular houses shall be in accordance with Section 1003.2 through Section 1003.7. The service water heating system of all other buildings shall be in accordance with Section 1004.0.

1003.2 Water Heaters and Storage Tanks. Residential-type water heaters, pool heaters, and unfired water heater storage tanks shall meet the minimum performance requirements specified by federal law.

Unfired storage water heating equipment shall have a

heat loss through the tank surface area of less than 6.5 British thermal units per hour per square foot (Btu/h•ft^2) (20.5 W/m^2).

1003.3 Recirculation Systems. Recirculation systems shall meet the provisions in Section 1002.0.

1003.4 Central Water Heating Equipment. Service water heating equipment (central systems) that does not fall under the requirements for residential-type service water heating equipment addressed in Section 1003.0 shall meet the applicable requirements for service water-heating equipment found in Section 1004.0.

1003.5 Insulation. Insulation for hot water and return piping shall comply with the provisions of Section 1001.2.

1003.6 Hard Water. Where water has hardness equal to or exceeding 9 grains per gallon (gr/gal) (154 mg/L) measured as total calcium carbonate equivalents, the water supply line to water heating equipment in new one- and two-family dwellings shall be roughed-in to allow for the installation of water treatment equipment.

1003.7 Maximum Volume and Length of Hot Water. The maximum volume of water contained in a hot water branch shall comply with Section 1003.7.1. The maximum length per volume of piping shall comply with Section 1003.7.2.

1003.7.1 Maximum Volume of Hot Water in a Branch. The water volume per foot of piping shall be calculated using Table 1003.7.1. The maximum volume of water in a fixture branch between any source of hot water (water heaters, recirculation loops and electrically heat traced pipe shall be considered sources of hot water) and the fixture fitting shall be:

(1) 24 oz. (0.7 L) where a single branch serves a single fixture.

(2) 40 oz. (1.2 L) where a series branch incorporating one or more Flow-Through Design configurations that serves two or more fixtures.

(3) 60 oz. (1.8 L) where a ring branch incorporating two or more Flow-Through Design configurations that serves two or more fixtures.

Exceptions:

1. The maximum volume of a single branch or series branch between any source of hot water and a kitchen sink and dishwasher located on an island or a peninsula where the floor is a concrete slab shall not contain more than 40 oz. (1.2 L)

TABLE 1003.7.1
WATER VOLUME (OZ/FT) FOR DISTRIBUTION PIPING MATERIALS

NOMINAL SIZE (inch)	COPPER M	COPPER L	COPPER K	CPVC CTS SDR 11	CPVC SCH 40	PEX-AL-PEX	PE-AL-PE	CPVC SCH 80	PEX CTS SDR 9	PE-RT SDR 9	PP SDR 6	PP SDR 7.3	PP SDR 11	CPVC PIPE SDR 11
⅜	1.06	0.97	0.84	0.68	1.17	0.59	0.59	0.85	0.64	0.64	0.85	1.02	NA	1.48
½	1.69	1.55	1.45	1.23	1.89	1.22	1.22	1.44	1.18	1.18	1.35	1.64	NA	2.33
¾	3.43	3.22	2.90	2.52	3.38	3.28	3.28	2.72	2.35	2.35	2.14	2.54	NA	3.68
1	5.81	5.49	5.17	4.24	5.53	5.37	5.37	4.58	3.88	3.88	3.46	4.22	NA	5.83
1¼	8.70	8.36	8.09	6.38	9.66	8.65	8.65	8.23	5.80	5.80	5.47	6.59	NA	9.35
1½	12.18	11.83	11.45	8.95	13.20	13.91	13.91	11.38	8.08	8.08	8.64	10.27	NA	12.27
2	21.50	20.58	20.04	15.38	21.88	23.16	23.16	19.11	13.86	13.86	13.64	16.42	NA	19.19

For SI units: 1 foot = 304.8 mm, 1 ounce = 29.573 mL

TABLE 1003.7.2(1)
LENGTH (FT) PER VOLUME OF PIPING

	COPPER TYPE M			COPPER TYPE L			COPPER TYPE K		
NOMINAL SIZE (inch)	24 OZ	40 OZ	60 OZ	24 OZ	40 OZ	60 OZ	24 OZ	40 OZ	60 OZ
⅜	22.7	37.8	56.7	24.9	41.4	62.1	28.4	47.4	71.1
½	14.2	23.7	35.5	15.5	25.8	38.7	16.5	27.6	41.4
¾	7.0	11.6	17.5	7.5	12.4	18.6	8.3	13.8	20.7
1	4.1	6.9	10.3	4.4	7.3	10.9	4.6	7.7	11.6
1¼	2.8	4.6	6.9	2.9	4.8	7.2	3.0	4.9	7.4
1½	2.0	3.3	4.9	2.0	3.4	5.1	2.1	3.5	5.2
2	1.1	1.9	2.8	1.2	1.9	2.9	1.2	2.0	3.0

For SI units: 1 foot = 304.8 mm, 1 ounce = 29.573 mL

2. The maximum volume of a single branch to a stand-alone tub shall not contain more than 80 oz. (2.4 L)

1003.7.2 Maximum Length per Volume of Water in a Branch. For fixture branches in accordance with Section 1003.7.1, the maximum length of piping shall be calculated using Table 1003.7.2(1) through Table 1003.7.2(4). Where a fixture fitting shut off valve (supply stop) is installed ahead of the fixture fitting, the maximum length is measured between the source of hot water and the fixture fitting shut off valve (supply stop).

TABLE 1003.7.2(2)
LENGTH (FT) PER VOLUME OF PIPING

	CPVC CTS SDR 11			CPVC SCH 40 PIPE			CPVC SCH 80 PIPE			CPVC SDR 11 PIPE		
NOMINAL SIZE (inch)	24 OZ	40 OZ	60 OZ	24 OZ	40 OZ	60 OZ	24 OZ	40 OZ	60 OZ	24 OZ	40 OZ	60 OZ
⅜	35.5	59.1	88.6	20.5	34.2	51.4	28.3	47.2	70.7	16.2	27.0	40.4
½	19.5	32.6	48.8	12.7	21.1	31.7	16.6	27.7	41.5	10.3	17.2	25.7
¾	9.5	15.9	23.8	7.1	11.8	17.8	8.8	14.7	22.0	6.5	10.9	16.3
1	5.7	9.4	14.2	4.3	7.2	10.9	5.2	8.7	13.1	4.1	6.9	10.3
1¼	3.8	6.3	9.4	2.5	4.1	6.2	2.9	4.9	7.3	2.6	4.3	6.4
1½	2.7	4.5	6.7	1.8	3.0	4.5	2.1	3.5	5.3	2.0	3.3	4.9
2	1.6	2.6	3.9	1.1	1.8	2.7	1.3	2.1	3.1	1.3	2.1	3.1

For SI units: 1 foot = 304.8 mm, 1 ounce = 29.573 mL

TABLE 1003.7.2(3)
LENGTH (FT) PER VOLUME OF PIPING

	PEX & PE-RT CTS SDR 9			PEX-AL-PEX (DN)			PE-AL-PE (DN)		
NOMINAL SIZE, inches (DN)[1]	24 OZ	40 OZ	60 OZ	24 OZ	40 OZ	60 OZ	24 OZ	40 OZ	60 OZ
⅜ (12)	37.5	62.5	93.8	40.7	67.8	101.8	40.7	67.8	101.8
½ (16)	20.4	33.9	50.9	19.6	32.7	49.0	19.6	32.7	49.0
¾ (25)	10.2	17.0	25.5	7.3	12.2	18.3	7.3	12.2	18.3
1 (32)	6.2	10.3	15.5	4.5	7.4	11.2	4.5	7.4	11.2
1¼ (40)	4.1	6.9	10.3	2.8	4.6	6.9	2.8	4.6	6.9
1½ (50)	3.0	4.9	7.4	1.7	2.9	4.3	1.7	2.9	4.3
2 (63)	1.7	2.9	4.3	1.0	1.7	2.6	1.0	1.7	2.6

For SI units: 1 foot = 304.8 mm, 1 ounce = 29.573 mL
[1] DN is outside diameter

TABLE 1003.7.2(4)
LENGTH (FT) PER VOLUME OF PIPING

	PP SDR 6 (DN)			PP SDR 7.3 (DN)			PP SDR 11 (DN)[1]		
NOMINAL SIZE, Inches (DN)[2]	24 OZ	40 OZ	60 OZ	24 OZ	40 OZ	60 OZ	24 OZ	40 OZ	60 OZ
⅜ (16)	28.2	46.9	70.4	23.5	39.2	58.8	NA	NA	NA
½ (20)	17.7	29.6	44.3	14.7	24.4	36.6	NA	NA	NA
¾ (25)	11.2	18.7	28.0	9.5	15.8	23.6	NA	NA	NA
1 (32)	6.9	11.6	17.3	5.7	9.5	14.2	NA	NA	NA
1¼ (40)	4.4	7.3	11.0	3.6	6.1	9.1	NA	NA	NA
1½ (50)	2.8	4.6	6.9	2.3	3.9	5.8	NA	NA	NA
2 (63)	1.8	2.9	4.4	1.5	2.4	3.7	NA	NA	NA

For SI units: 1 foot = 304.8 mm, 1 ounce = 29.573 mL
[1] PP SDR 11 products are not typically used or rated at 180°F
[2] DN is outside diameter

1003.7.3 Hot Water System Submeters. Where a hot water pipe from a circulation loop or electric heat trace line is equipped with a submeter, the hot water distribution system downstream of the submeter shall have either an end-of-line hot water circulation pump or shall be electrically heat traced. The maximum volume of water in any branch from the circulation loop or electric heat trace line downstream of the submeter shall not exceed 16 oz (473 mL).

If there is no circulation loop or electric heat traced line downstream of the submeter, the submeter shall be located within 2 feet (610 mm) of the central hot water system; or the branch line to the submeter shall be circulated or heat traced to within 2 feet of the submeter. The maximum volume from the submeter to each fixture shall not exceed 32 oz (946 mL).

The circulation pump controls shall comply with the provisions of Section 1002.2.

1004.0 Service Hot Water – Other Than Low-Rise Residential Buildings.

1004.1 General. The service hot water, other than single-family houses, multi-family structures of three stories or fewer above grade, and modular houses, shall comply with Section 1004.0 through Section 1007.0.

1004.2 New Buildings. Service water heating systems and equipment shall comply with the requirements of this section as described in Section 1004.5. [ASHRAE 90.1:7.1.1.1]

1004.3 Additions to Existing Buildings. Service water heating systems and equipment shall comply with the requirements of this section.

Exception: When the service water heating to an addition is provided by existing service water heating systems and equipment, such systems and equipment shall not be required to comply with this standard. However, any new systems or equipment installed must comply with specific requirements applicable to those systems and equipment. [ASHRAE 90.1:7.1.1.2]

1004.4 Alterations to Existing Buildings. Building service water heating equipment installed as a direct replacement for existing building service water heating equipment shall comply with the requirements of Section 1004.0 applicable to the equipment being replaced. New and replacement piping shall comply with Section 1005.3.

Exception: Compliance shall not be required where there is insufficient space or access to meet these requirements. [ASHRAE 90.1:7.1.1.3]

1004.5 Compliance Path(s). Compliance shall be achieved by meeting the requirements of Section 1004.1, General; Section 1005.0, Mandatory Provisions; Section 1006.0, Prescriptive Path; and Section 1007.0, Submittals. [ASHRAE 90.1:7.2.1]

1004.6 Energy Cost Budget Method. Projects using the Energy Cost Budget Method (Section 11 of ASHRAE 90.1) for demonstrating compliance with the standard shall meet the requirements of Section 1005.0, Mandatory Provisions, in conjunction with Section 11 of ASHRAE 90.1, Energy Cost Budget Method. [ASHRAE 90.1:7.2.2]

1005.0 Mandatory Provisions.

1005.1 Load Calculations. Service water heating system design loads for the purpose of sizing systems and equipment shall be determined in accordance with manufacturers' published sizing guidelines or generally accepted engineering standards and handbooks acceptable to the adopting authority (e.g., ASHRAE Handbook – HVAC Applications). [ASHRAE 90.1:7.4.1]

1005.2 Equipment Efficiency. Water heating equipment, hot-water supply boilers used solely for heating potable water, pool heaters, and hot-water storage tanks shall meet the criteria listed in Table 1005.2. Where multiple criteria are listed, all criteria shall be met. Omission of minimum performance requirements for certain classes of equipment does not preclude use of such equipment where appropriate. Equipment not listed in Table 1005.2 has no minimum performance requirements.

Exceptions: Water heaters and hot-water supply boilers having more than 140 gallons (530 L) of storage capacity are not required to meet the standby loss (SL) requirements of Table 1005.2 when:

(1) The tank surface is thermally insulated to R-12.5.

(2) A standing pilot light is not installed.

(3) Gas- or oil-fired storage water heaters have a flue damper or fan-assisted combustion. [ASHRAE 90.1:7.4.2]

1005.3 Insulation. Insulation of hot water and return piping shall meet the provisions in Section 1001.2.

1005.4 Hot Water System Design.

1005.4.1 Recirculation Systems. Recirculation systems shall meet the provisions in Section 1002.0.

1005.4.2 Maximum Volume of Hot Water. The maximum volume of water contained in hot water distribution lines between the water heater and the fixture stop or connection to showers, kitchen faucets, and lavatories shall be determined in accordance with Section 1003.7.

1005.5 Service Water Heating System Controls.

1005.5.1 Storage Temperature Controls. Temperature controls shall be provided that allow for storage temperature adjustment from 120°F (49ºC) or lower to a maximum temperature compatible with the intended use.

Exception: When the manufacturers' installation instructions specify a higher minimum thermostat setting to minimize condensation and resulting corrosion. [ASHRAE 90.1:7.4.4.1]

1005.5.2 Outlet Temperature Controls. Temperature controlling means shall be provided to limit the maximum temperature of water delivered from lavatory faucets in public facility restrooms to 110°F (43ºC). [ASHRAE 90.1:7.4.4.3]

TABLE 1005.2
PERFORMANCE REQUIREMENTS FOR WATER HEATING EQUIPMENT [ASHRAE 90.1: TABLE 7.8]

EQUIPMENT TYPE	SIZE CATEGORY (INPUT)	SUBCATEGORY OR RATING CONDITION	PERFORMANCE REQUIRED[1]	TEST PROCEDURE[2,3]
Electric Table Top Water Heaters	≤12 kW	Resistance ≥20 gal	See footnote 7	
Electric water heaters	≤12 kW[5]	Resistance ≥20 gal	See footnote 7	
	>12 kW[5]	Resistance ≥20 gal	0.3 + 27/Vm %h	Section G.2 of ANSI Z21.10.3
	≤24 Amps and ≤250 Volts	Heat Pump	See footnote 7	
Gas storage water heaters	≤75 000 Btu/h	≥20 gal	See footnote 7	
	>75 000 Btu/h[6]	<4000 (Btu/h)/gal	80% E_t (Q/800 + 100$\sqrt{V}$)SL, Btu/h	Sections G.1 and G.2 of ANSI Z21.10.3
Gas instantaneous water heaters	>50 000 Btu/h and <200 000 Btu/h	≥4000 (Btu/h)/gal and <2 gal	See footnote 7	
	≥200 000 Btu/h[4, 6]	≥4000 (Btu/h)/gal and <10 gal	80% E_t	Sections G.1 and G.2 of ANSI Z21.10.3
	≥200 000 Btu/h	≥4000 (Btu/h)/gal and ≥10 gal	80% E_t (Q/800 + 100$\sqrt{V}$)SL, Btu/h	
Oil storage water heaters	≤105 000 Btu/h	≥20 gal	See footnote 7	
	>105 000 Btu/h	<4000 (Btu/h)/gal	80% E_t (Q/800 + 100$\sqrt{V}$)SL, Btu/h	Sections G.1 and G.2 of ANSI Z21.10.3
Oil instantaneous water heaters	≤210 000 Btu/h	≥4000 (Btu/h)/gal and <2 gal	See footnote 7	
	>210 000 Btu/h	≥4000 (Btu/h)/gal and <10 gal	80% E_t	Sections G.1 and G.2 of ANSI Z21.10.3
	>210 000 Btu/h	≥4000 (Btu/h)/gal and ≥10 gal	78% E_t (Q/800 + 100$\sqrt{V}$)SL, Btu/h	
Hot-water supply boilers, gas and oil[6]	≥300 000 Btu/h and <12 500 000 Btu/h	≥4000 (Btu/h)/gal and <10 gal	80% E_t	Sections G.1 and G.2 of ANSI Z21.10.3
Hot-water supply boilers, gas[6]	———	≥4000 (Btu/h)/gal and ≥10 gal	80% E_t (Q/800 + 100$\sqrt{V}$)SL, Btu/h	
Hot-water supply boilers, oil	———	≥4000 (Btu/h)/gal and ≥10 gal	78% E_t (Q/800 + 100$\sqrt{V}$)SL, Btu/h	
Pool heaters, oil and gas	All	———	See footnote 7	ASHRAE 146
Heat pump pool heaters	All	50°F db 44.2°F wb Outdoor air 80.0°F entering water	4.0 COP	AHRI 1160
Unfired storage tanks	All		R-12.5	(none)

For SI units: 1 gallon = 3.785 L, 1000 British thermal units per hour = 0.293 kW, °C = (°F-32)/1.8

[1] Thermal efficiency (Et) is a minimum requirement, while standby loss (SL) is maximum Btu/h based on a 70°F temperature difference between stored water and ambient requirements. In the SL equation, V is the rated volume in gallons and Q is the nameplate input rate in Btu/h. Vm is the measured volume in the tank in gallons.

[2] ASHRAE 90.1 Section 12 contains a complete specification, including the year version, of the referenced test procedure.

[3] Section G1 is titled "Test Method for Measuring Thermal Efficiency" and Section G2 is titled "Test Method for Measuring Standby Loss."

[4] Instantaneous water heaters with input rates below 200 000 Btu/h (58.6 kW) must comply with these requirements if the water heater is designed to heat water to temperatures of 180°F (82°C) or higher.

[5] Electric water heaters with input rates less than 40 946 Btu/h (12 kW) shall be in accordance with these requirements where the water heater is designed to heat water to temperatures of 180°F (82°C) or higher.

[6] Refer to ASHRAE 90.1 Section 7.5.3 for additional requirements for gas storage and instantaneous water heaters and gas hot-water supply boilers.

[7] In the U.S., the efficiency requirements for water heaters or gas pool heaters in this category or subcategory are specified by the U.S. Department of Energy. Those requirements and applicable test procedures are found in the Code of Federal Regulations 10 CFR Part 430.

Informative Note: See ASHRAE 90.1 Informative Appendix F for the U.S. Department of Energy efficiency requirements applicable to these water heaters and pool heaters.

1005.6 Heat Traps. Vertical pipe risers serving storage water heaters and storage tanks not having integral heat traps and serving a nonrecirculating system shall have heat traps on both the inlet and outlet piping as close as practical to the storage tank. A heat trap is a means to counteract the natural convection of heated water in a vertical pipe run. The means is either a device specifically designed for the purpose or an arrangement of tubing that forms a loop of 360 degrees (6.28 rad) or piping that from the point of connection to the water heater (inlet or outlet) includes a length of piping directed downward before connection to the vertical piping of the supply water or hot-water distribution system, as applicable. [ASHRAE 90.1:7.4.6]

1006.0 Prescriptive Path.

1006.1 Space Heating and Water Heating. The use of a gas-fired or oil-fired space-heating boiler system otherwise complying with Section 1004.0 to provide the total space heating and water heating for a building is allowed when one of the following conditions is met:

(1) The single space-heating boiler, or the component of a modular or multiple boiler system that is heating the service water, has a standby loss in Btu/h (kW) not exceeding (13.3 × pmd + 400)/n, where (pmd) is the probable maximum demand in gallons per hour, determined in accordance with the procedures described in generally accepted engineering standards and handbooks, and (n) is the fraction of the year when the outdoor daily mean temperature is greater than 64.9°F (18.28ºC).

The standby loss is to be determined for a test period of 24 hours duration while maintaining a boiler water temperature of at least 90°F (50ºC) above ambient, with an ambient temperature between 60°F (16ºC) and 90°F (32ºC). For a boiler with a modulating burner, this test shall be conducted at the lowest input.

(2) It is demonstrated to the satisfaction of the Authority Having Jurisdiction that the use of a single heat source will consume less energy than separate units.

(3) The energy input of the combined boiler and water heater system is less than 150 000 Btu/h (44 kW). [ASHRAE 90.1:7.5.1]

1006.2 Service Water Heating Equipment. Service water heating equipment used to provide the additional function of space heating as part of a combination (integrated) system shall satisfy all stated requirements for the service water heating equipment. [ASHRAE 90.1:7.5.2]

1006.3 Heat Recovery for Service Water Heating.

1006.3.1 Condenser. Condenser heat recovery systems shall be installed for heating or preheating of service hot water provided all of the following are true:

(1) The facility operates 24 hours a day.

(2) The total installed heat rejection capacity of the water-cooled systems exceeds 6 000 000 Btu/h (1758 kW) of heat rejection.

(3) The design service water heating load exceeds 1 000 000 Btu/h (293 kW). [ASHRAE 90.1:6.5.6.2.1]

1006.3.2 Capacity. The required heat recovery system shall have the capacity to provide the smaller of:

(1) Sixty percent of the peak heat rejection load at design conditions.

(2) Preheat of the peak service hot water draw to 85°F (29ºC). [ASHRAE 90.1:6.5.6.2.2]

Exceptions:

(a) Facilities that employ condenser heat recovery for space heating with a heat recovery design exceeding 30 percent of the peak water-cooled condenser load at design conditions.

(b) Facilities that provide 60 percent of their service water heating from site-solar or site-recovered energy or from other sources.

1007.0 Submittals.

1007.1 General. The Authority Having Jurisdiction shall require submittal of compliance documentation and supplemental information, in accordance with Section 103.0 of this standard and the applicable mechanical and building codes.

1008.0 Hard Water.

1008.1 Softening and Treatment. Where water has hardness equal to or exceeding 10 gr/gal (171 mg/L) measured as total calcium carbonate equivalents, the water supply line to water heating equipment and the circuit of boilers shall be softened or treated to prevent accumulation of lime scale and consequent reduction in energy efficiency.

1009.0 Drain Water Heat Exchangers.

1009.1 General. Drain water heat exchangers shall comply with IAPMO PS-92. The heat exchanger shall be accessible.

1010.0 Heat Recovery from Steam Boiler Blowdown.

1010.1 General. Where heat recovery can be used beneficially to heat boiler makeup water or for other purposes, boiler blowdown from steam boilers exceeding 15 psi and 3.4 million BTU's per hour (100 HP) shall be directed to a heat recovery system that reduces the temperature of the blowdown discharge to below 140°F (60°C) without using tempering water.

CHAPTER 11
INSTALLER QUALIFICATIONS

1101.0 General.

1101.1 Scope. The provisions of this chapter address minimum qualifications of installers of systems covered within the scope of this standard.

1102.0 Qualifications.

1102.1 General. Where permits are required, the Authority Having Jurisdiction shall have the authority to require contractors, installers, or service technicians to demonstrate competency. Where determined by the Authority Having Jurisdiction, the contractor, installer, or service technician shall be licensed to perform such work.

CHAPTER 12
REFERENCED STANDARDS

1201.0 General.

1201.1 Standards. The standards listed in Table 1201.1 are intended for use in the design, testing, and installation of materials, devices, appliances and equipment regulated by this standard. These standards are mandatory when required by sections in this standard.

TABLE 1201.1
REFERENCED STANDARDS

STANDARD NUMBER-YEAR	STANDARD TITLE	REFERENCED SECTION
AHRI 1160 (I-P)-2014	Performance Rating of Heat Pump Pool Heaters	Table 1005.2
ANSI/CAN/IAPMO/ISO 30500-2019*	Non-Sewered Sanitation Systems - Prefabricated Integrated Treatment Units - General Safety and Performance Requirements for Design and Testing	404.0
ANSI Z21.10.3-2017*	Gas Water Heaters, Volume III, Storage Water Heaters With Input Ratings Above 75 000 BTU per Hour, circulating and Instantaneous (same as CSA 4.3)	Table 1005.2
APSP-14 2014*	Portable Electric Spa Energy Efficiency	418.3.1
APSP-15a-2013*	Residential Swimming Pool and Spa Energy Efficiency	418.5
ARCSA/ASPE 63-2013*	Rainwater Catchment Systems	902.1, A 104.9.1
ARCSA/ASPE 78-2015	Stormwater Harvesting System Design for Direct End-Use Applications	802.1.1
ASABE/ICC 802-2014*	Landscape Irrigation Sprinkler and Emitter Standard	415.8, 415.13, 415.13.4
ASHRAE 90.1-2016 (I-P)*	Energy Standard for Buildings Except Low-Rise Residential Buildings	1004.6, Table 1005.2
ASHRAE 146-2011*	Method of Testing Pool Heaters	Table 1005.2
ASME A112.14.6-2010 (R2015)	FOG (Fats, Oils, and Greases) Disposal Systems	407.4.1
ASME A112.18.1/CSA B125.1-2018*	Plumbing Supply Fittings	402.5.1, 402.5.2.1, 402.6
ASME A112.19.2/CSA B45.1-2018*	Ceramic Plumbing Fixtures	402.2.1, 402.2.2, 402.3
ASME A112.19.3/CSA B45.4-2017*	Stainless Steel Plumbing Fixtures	402.3.1
ASME A112.19.14-2013 (2018)*	Six-Liter Water Closets Equipped With a Dual Flushing Device	402.2.1
ASME A112.19.19-2016*	Vitreous China Nonwater Urinals	402.3.2
ASSE 1016/ASME A112.1016/ CSA B125.16-2017*	Performance Requirements for Automatic Compensating Valves for Individual Showers and Tub/Shower Combinations	402.8
ASTM F2831-2012 (R2017)*	Standard Practice for Internal Non Structural Epoxy Barrier Coating Material Used in Rehabilitation of Metallic Pressurized Piping Systems	303.2
CFR 10, 430, Subpart B	Energy Conservation Program for Consumer Products — Test Procedures	Table 1005.2
CFR 49, 178.274-2011	Specifications for UN Portable Tanks	505.5.1.3, 506.12.4, Appendix D
CSA B45.5/IAPMO Z124-2017*	Plastic Plumbing Fixtures	402.3, 402.3.1

STANDARD NUMBER-YEAR	STANDARD TITLE	REFERENCED SECTION
CSA B651-2018	Accessible Design for the Built Environment	402.6.1(2)
EPA/625/R-04/108-2004	Guidelines for Water Reuse	601.7
EPA/625/R-92/013-2003	Control of Pathogens and Vector Attraction in Sewage Sludge	505.6.2
EPA WaterSense-2007	High-Efficiency Lavatory Faucet Specification, Version 1.0	402.5.1
EPA WaterSense-2009	Specification for Flushing Urinals	402.3, Table 402.1
EPA WaterSense-2010	Specification for Showerheads	402.6
EPA WaterSense-2011	Specification for Weather-Based Irrigation Controllers	415.6
EPA WaterSense-2014	Specification for Tank-Type Toilets	402.2.1, Table 402.1
EPA WaterSense 2015	Specification for Flushometer Valve Water Closets	402.2.2
IAPMO IGC 115-2013[e1]	Automatic Water Leak Detection and Control Devices	409.1
IAPMO IGC 207-2009a	Reclaimed Water Conservation System for Flushing Toilets	604.7
IAPMO IGC 324-2016[e1]	Alternate Water Source Systems for Single-Family Dwellings	Table 702.9(2), Table 802.9(2)
IAPMO IGC 330-2018	Recirculating Shower Systems	402.12
IAPMO IGC 349-2018	Electronic Plumbing Supply System Integrity Protection Devices	409.1
IAPMO PS 76-2012a	Trap Primers for Fill Valves and Flushometer Valves	416.1
IAPMO PS 92-2013[e1]	Heat Exchangers and Indirect Water Heaters	1009.1
IAPMO UMC 2018*	Uniform Mechanical Code	101.6.3
IAPMO UPC 2018*	Uniform Plumbing Code	103.6.4
IAPMO USEC 2018*	Uniform Solar Energy Code	101.6.5
IAPMO USPSHTC 2018*	Uniform Swimming Pool, Spa, and Hot Tub Code	101.6.6
ICC A117.1-2017*	Accessible and Usable Buildings and Facilities	402.6.1(2)
NSF 14-2018*	Plastics Piping System Components and Related Materials	302.1.1
NSF 41-2018*	Non-Liquid Saturated Treatment Systems	502.1.1
NSF 44-2018*	Residential Cation Exchange Water Softeners	406.1
NSF 53-2018*	Drinking Water Treatment Units – Health Effects	A 104.3.1
NSF 58-2018*	Reverse Osmosis Drinking Water Treatment Systems	406.3
NSF 61-2018*	Drinking Water Systems Components - Health Effects	A 103.2, A 104.5.1
NSF 350-2019*	Onsite Residential and Commercial Reuse Treatment Systems	601.7, 604.7

STANDARD NUMBER-YEAR	STANDARD TITLE	REFERENCED SECTION
NSF P151-2014	Health Effects from Rainwater Catchment System Components	A 103.1, A 103.2
WQA/ASPE S-803-2017*	Sustainable Drinking Water Treatment Systems	406.4
* ANSI Approved		

Abbreviations and Standards Development Organizations in Chapter 12	
AHRI	Air-Conditioning, Heating, and Refrigeration Institute, 2111 Wilson Blvd., Suite 500, Arlington, VA 22201.
ANSI	American National Standards Institute, Inc., 25 W. 43rd Street, 4th Floor, New York, NY 10036.
ARCSA	American Rainwater Catchment Systems Association, 7650 S. McClintock Drive, Suite 103, Tempe, AZ 85284.
APSP	The Association of Pool & Spa Professionals, 2111 Eisenhower Ave., Alexandria, VA 22314.
ASHRAE	The American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., 1791 Tullie Circle, NE, Atlanta, GA 30329-2305.
ASME	The American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016.
ASPE	American Society of Plumbing Engineers, 6400 Shafer Court Suite 350, Rosemont, IL 60018.
ASSE International	American Society of Sanitary Engineering, 18927 Hickory Creek Drive, Suite 220, Mokena, IL 60448.
ASTM International	American Society of Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.
CSA Group	Canadian Standards Association, 178 Rexdale Blvd., Toronto, Ontario, M9W 1R3, Canada.
DOE	US Department of Energy, 1000 Independence Avenue, SW, Washington, DC 20585.
EPA	US Environmental Protection Agency, Municipal Support Division, Office of Wastewater Management, Office of Water, Washington DC
EPA	US Environmental Protection Agency, Office of Research and Development, National Risk Management Research Laboratory, Center for Environmental Research Information, Cincinnati, OH 45268.
EPA WaterSense	US Environmental Protection Agency, Office of Wastewater Management (4204M), 1200 Pennsylvania Avenue, NW, Washington DC 20460.
IAPMO	International Association of Plumbing and Mechanical Officials, 4755 E. Philadelphia Street, Ontario, CA 91761.
ICC	International Code Council, 500 New Jersey Ave, NW, 6th Floor, Washington DC 20001.
NSF International	National Sanitation Foundation, 789 Dixboro Road, Ann Arbor, MI 48113-0140.
WQA	Water Quality Association, 4151 Naperville Road, Lisle, IL 60532-3696.

APPENDIX A
POTABLE RAINWATER CATCHMENT SYSTEMS

A 101.0 General.

A 101.1 Scope. The provisions of this appendix shall apply to the installation, construction, alteration, and repair of potable rainwater catchment systems.

A 101.2 System Design. Potable rainwater catchment systems complying with this appendix shall be designed by a person registered, licensed, or deemed competent by the Authority Having Jurisdiction to perform potable rainwater catchment system design work.

A 101.3 Permit. It shall be unlawful for any person to construct, install, or alter, or cause to be constructed, installed, or altered any potable rainwater catchment systems in a building or on a premise without first obtaining a permit to do such work from the Authority Having Jurisdiction.

A 101.3.1 Plumbing Plan Submission. No permit for any rainwater catchment system requiring a permit shall be issued until complete plumbing plans, with appropriate data satisfactory to the Authority Having Jurisdiction, have been submitted and approved. No changes or connections shall be made to either the rainfall catchment or the potable water system within any site containing a rainwater catchment water system without approval by the Authority Having Jurisdiction.

A 101.3.2 System Changes. No changes or connections shall be made to either the rainwater catchment system or the potable water system within any site containing a rainwater catchment system requiring a permit without approval by the Authority Having Jurisdiction.

A 101.4 Product and Material Approval.

A 101.4.1 Component Identification. System components shall be properly identified as to the manufacturer.

A 101.4.2 Plumbing Materials and Systems. Pipe, pipe fittings, traps, fixtures, material, and devices used in a potable rainwater system shall be listed or labeled (third-party certified) by a listing agency (accredited conformity assessment body) and shall comply with the approved applicable recognized standards referenced in this standard and the plumbing code, and shall be free from defects. Unless otherwise provided for in this standard, all materials, fixtures, or devices used or entering into the construction of plumbing systems, or parts thereof, shall be submitted to the Authority Having Jurisdiction for approval.

A 101.5 Maintenance and Inspection. Potable rainwater catchment systems and components shall be inspected and maintained in accordance with Section A 101.5.1 through Section A 101.5.3.

A 101.5.1 Frequency. Potable rainwater catchment systems and components shall be inspected and maintained in accordance with Table A 101.5.1 unless more frequent inspection and maintenance is required by the manufacturer.

TABLE A 101.5.1
MINIMUM POTABLE RAINWATER CATCHMENT SYSTEM TESTING, INSPECTION AND MAINTENANCE FREQUENCY

DESCRIPTION	MINIMUM FREQUENCY
Inspect and clean filters and screens, and replace (if necessary)	Every 3 months
Inspect and verify that disinfection, filters and water quality treatment devices and systems are operational. Perform any water quality tests as required by the Authority Having Jurisdiction.	In accordance with the manufacturer's instructions, and the Authority Having Jurisdiction.
Perform a water quality test for Total Coliform. If total coliform test is positive, perform test for E.Coli. For a system where 25 different people consume water from the system over a 60 day period, a water quality test for cryptosporidium shall also be performed.	After initial installation and every 12 months thereafter, or as directed by the Authority Having Jurisdiction.
Inspect and clear debris from rainwater gutters, downspouts, and roof washers.	Every 6 months
Inspect and clear debris from roof or other aboveground rainwater collection surface.	Every 6 months
Remove tree branches and vegetation overhanging roof or other aboveground rainwater collection surface.	As needed
Inspect pumps and verify operation.	After initial installation and every 12 months thereafter.
Inspect valves and verify operation.	After initial installation and every 12 months thereafter.
Inspect pressure tanks and verify operation.	After initial installation and every 12 months thereafter.
Clear debris and inspect storage tanks, locking devices, and verify operation.	After initial installation and every 12 months thereafter.
Inspect caution labels and marking.	After initial installation and every 12 months thereafter.

A 101.5.2 Maintenance Log. A maintenance log for potable rainwater catchment systems shall be maintained by the property owner and be available for inspection. The property owner or designated appointee shall ensure that a record of testing, inspection and maintenance as required by Table A 101.5.1 is maintained in the log. The log will indicate the frequency of inspection, and maintenance for each system. A record of the required water quality tests shall be retained for not less than 2 years.

A 101.5.3 Maintenance Responsibility. The required maintenance and inspection of potable rainwater catchment systems shall be the responsibility of the property owner, unless otherwise required by the Authority Having Jurisdiction.

A 101.6 Operation and Maintenance Manual. An operation and maintenance manual for potable rainwater catchment systems shall be supplied to the building owner by the system designer. The operating and maintenance manual shall include the following:

(1) Detailed diagram of the entire system and the location of all system components.

(2) Instructions on operating and maintaining the system.

(3) Details on maintaining the required water quality as determined by the Authority Having Jurisdiction.

(4) Details on deactivating the system for maintenance, repair, or other purposes.

(5) Applicable testing, inspection and maintenance frequencies as required by Table A 101.5.1.

(6) A method of contacting the manufacturer(s).

A 101.7 Minimum Water Quality Requirements. The minimum water quality for all potable rainwater catchment systems shall meet the applicable water quality requirements as determined by the Authority Having Jurisdiction for private wells.

A 101.8 Material Compatibility. In addition to the requirements of this appendix, potable rainwater catchment systems shall be constructed of materials that are compatible with the type of pipe and fitting materials and water conditions in the system.

A 101.9 System Controls. Controls for pumps, valves, and other devices that contain mercury that come in contact with the water supply are prohibited.

A 102.0 Connection.

A 102.1 General. No water piping supplied by a potable rainwater catchment system shall be connected to any other source of supply without the approval of the Authority Having Jurisdiction, Health Department or other department having jurisdiction.

A 102.2 Connections to Public or Private Potable Water Systems. Potable rainwater catchment systems shall have no direct connection to any public or private potable water supply or alternate water source system. Potable water from a public or private potable water system shall be permitted to be used as makeup water to the rainwater storage tank provided the public or private potable water supply connection is protected by an airgap or reduced-pressure principle backflow preventer in accordance with the plumbing code.

A 102.3 Backflow Prevention. The potable rainwater catchment system shall be protected against backflow in accordance with the plumbing code.

A 103.0 Potable Rainfall Catchment System Materials.

A 103.1 Collections Surfaces. The collection surface for potable applications shall be constructed of a hard, impervious material and shall be approved for potable water use. Roof coatings, paints, and liners shall comply with NSF Protocol P151.

A 103.1.1 Prohibited. Roof paints and coatings with lead, chromium, or zinc are prohibited. Wood roofing material and lead flashing are prohibited.

A 103.2 Rainwater Catchment System Drainage Materials. Gutters and downspouts used in rainwater catchment drainage systems shall comply with NSF Protocol P151, and leaders and conductors shall be listed to NSF 61.

A 103.3 Storage Tanks. Rainwater storage shall be in accordance with Section A 104.5.

A 103.4 Water Supply and Distribution Materials. Potable rainwater supply and distribution materials shall be in accordance with the requirements of the plumbing code for potable water supply and distribution systems.

A 104.0 Design and Installation.

A 104.1 Collection Surfaces. Rainwater shall be collected from roof or other cleanable aboveground surfaces specifically designed for rainwater catchment. Rainwater catchment system shall not collect rainwater from:

(1) Vehicular parking surfaces.

(2) Surface water runoff.

(3) Bodies of standing water.

A 104.1.1 Prohibited Discharges. Overflows, condensate, and bleed-off pipes from roof-mounted equipment and appliances shall not discharge onto roof surfaces that are intended to collect rainwater.

A 104.2 Minimum Water Quality. Upon initial system startup, the quality of the water for the intended applications shall be verified at the point(s) of use, as determined by the Authority Having Jurisdiction in accordance with Section A 104.2.1 and Section A 104.2.2. Water quality maintenance shall be according to Section A 104.2.3.

A 104.2.1 Private Potable Water System. In the absence of water quality requirements determined by the Authority Having Jurisdiction, the minimum water quality for a private potable water system at the point of use shall comply with Table A104.2.1.

A 104.2.2 Public Use Occupancies. The minimum water quality for a potable water system for public use

TABLE A 104.2.1
MINIMUM WATER QUALITY

Escherichia coli (fecal coliform):	Non-detectable
Turbidity:	<0.3 NTU

occupancies at the point of use and testing procedures shall comply with the Environmental Protection Agency (EPA) Safe Drinking Water Act for a public water system.

A 104.2.3 Maintenance. Normal system maintenance shall require system testing for Escherichia coli (fecal coliform) and turbidity every 3 months in accordance with Table A 104.2.3. Upon failure of the fecal coliform test, system shall be re-commissioned involving cleaning, and retesting in accordance with section A104.2.

A 104.3 Water Quality Devices and Equipment. Devices and equipment used to treat rainwater to maintain the minimum water quality requirements determined by the Authority Having Jurisdiction shall be listed or labeled (third-party certified) by a listing agency (accredited conformity assessment body) and approved for the intended application.

A 104.3.1 Filtration Devices. Potable water filters shall comply with NSF 53 and shall be installed in accordance with manufacturer's instructions.

TABLE A 104.2.3
MINIMUM SYSTEM MAINTENANCE REQUIREMENTS

Escherichia coli (fecal coliform):	Non-detectable
Turbidity:	<0.3 NTU

A 104.3.2 Disinfection Devices. Chlorination, ozone, and ultraviolet or other disinfection methods shall be approved by an Authority Having Jurisdiction, or the product shall be listed according to a microbiological reduction performance standard for drinking water used to treat harvested rainwater to meet the required water quality permitted. The disinfection devices and systems shall be installed in accordance with the manufacturer's installation instructions and the conditions of listing. Disinfection devices and systems shall be located downstream of the water storage tank.

A 104.3.3 Filtration and Disinfection Systems. Filtration and disinfection systems shall be located after the water storage tank. Where a chlorination system is installed, it shall be installed upstream of filtration systems. Where ultraviolet disinfection system is installed, a minimum of 2 inline filters, one 5 micron (5 µm) filter followed by one 0.5-1 micron (0.5-1µm) filter, shall be installed prior to the disinfection system.

A 104.4 Overhanging Tree Branches and Vegetation. Tree branches and vegetation shall not be located over the roof or other aboveground rainwater collection surface. Where existing tree branch and vegetation growth extends over the rainwater collection surface, it shall be removed as required in Section A 101.5.

A 104.5 Rainwater Storage Tanks. Rainwater storage tanks shall be installed in accordance with Section A 104.5.1 through Section A 104.5.7.

A 104.5.1 Construction. Rainwater storage tanks shall be constructed of solid, durable materials not subject to excessive corrosion or decay and shall be watertight. Storage tanks or storage tank liners and coatings shall be listed to NSF 61 and approved by the Authority Having Jurisdiction for potable water applications, provided such tanks comply with approved applicable standards.

A 104.5.2 Location. Rainwater storage tanks shall be installed above or below grade.

A 104.5.2.1 Above Grade. Above grade storage tanks shall be of an opaque material, approved for aboveground use in direct sunlight, or shall be shielded from direct sunlight. Tanks shall be installed in an accessible location to allow for inspection and cleaning. The tank shall be installed on a foundation or platform that is constructed to accommodate all loads in accordance with the building code.

A 104.5.2.2 Below Grade. Rainwater storage tanks installed below grade shall be structurally designed to withstand all anticipated earth or other loads. Holding tank covers shall be capable of supporting an earth load of not less than 300 pounds per square foot (lb/ft^2) (1465 kg/m^2) when the tank is designed for underground installation. Below grade rainwater tanks installed underground shall be provided with manholes. The manhole opening shall be a minimum diameter of 20 inches (508 mm) and located not less than 4 inches (102 mm) above the surrounding grade. The surrounding grade shall be sloped away from the manhole. Underground tanks shall be ballasted, anchored, or otherwise secured, to prevent the tank from floating out of the ground when empty. The combined weight of the tank and hold down system should meet or exceed the buoyancy force of the tank.

A 104.5.3 Drainage and Overflow. Rainwater storage tanks shall be provided with a means of draining and cleaning. The overflow drain shall not be equipped with a shutoff valve. The overflow outlet shall discharge as required by the plumbing code for storm drainage systems. Where discharging to the storm drainage system, the overflow drain shall be protected from backflow of the storm drainage system by a backwater valve or other approved method.

A 104.5.3.1 Overflow Outlet Size. The overflow outlet shall be sized to accommodate the flow of the rainwater entering the tank and not less than the aggregate cross-sectional area of the inflow pipes.

A 104.5.4 Opening and Access Protection.

A 104.5.4.1 Animals and Insects. Rainwater tank openings to the atmosphere shall be protected to prevent the entrance of insects, birds, or rodents into the tank.

A 104.5.4.2 Human Access. Rainwater tank access openings exceeding 12 inches (305 mm) in diameter shall be secured to prevent tampering and unintended entry by either a lockable device or other approved method.

A 104.5.4.3 Exposure to Sunlight. Rainwater tank openings shall not be exposed to direct sunlight.

A 104.5.5 Inlets. A device or arrangement of fittings shall be installed at the inlet of the tank to prevent rainwater from disturbing sediment as it enters the tank.

A 104.5.6 Primary Tank Outlets. The primary tank outlet shall be located not less than 4 inches (102 mm) above the bottom of the tank, or shall be provided with floating inlet to draw water from the cistern just below the water surface.

A 104.5.7 Storage Tank Venting. Where venting by means of drainage or overflow piping is not provided or is considered insufficient, a vent shall be installed on each tank. The vent shall extend from the top of the tank and terminate a minimum of 6 inches (152 mm) above grade and shall be a minimum of 1 ½" (38 mm) in diameter. The vent terminal shall be directed downward and covered with a 3/32 inch (2.4 mm) mesh screen to prevent the entry of vermin and insects.

A 104.6 Pumps. Pumps serving rainwater catchment systems shall be listed for potable water use. Pumps supplying water to water closets, urinals, and trap primers shall be capable of delivering not less than the minimum residual pressure required by the highest and most remote outlet served. Where the water pressure in the rainwater supply system within the building exceeds 80 psi (552 kPa), a pressure reducing valve reducing the pressure to 80 psi (552 kPa) or less to water outlets in the building shall be installed in accordance with the plumbing code.

A 104.7 Roof Drains. Primary and secondary roof drains, conductors, leaders, overflows, and gutters shall be designed and installed as required by the plumbing code.

A 104.8 Freeze Protection. Tanks and piping installed in locations subject to freezing shall be provided with an adequate means of freeze protection.

A 104.9 Roof Washer or Pre-Filtration System. Collected rainwater shall pass through a roof washer or pre-filtration system before the water enters the rainwater storage tank. Roof washer systems shall comply with Section A 104.9.1 through Section A 104.9.4.

A 104.9.1 Size. The roof washer shall be sized to direct a sufficient volume of rainwater containing debris that has accumulated on the collection surface away from the storage tank. The ARCSA/ASPE 63 Standard contains additional guidance on acceptable methods of sizing roof washers.

A 104.9.2 Debris Screen. The inlet to the roof washer shall be provided with a debris screen or other approved means that protects the roof washer from the intrusion of debris and vermin. Where the debris screen is installed, the debris screen shall be corrosion resistant and shall have openings no larger than ½ of an inch (12.7 mm).

A 104.9.3 Drain Discharge. Water drained from the roof washer or pre-filter shall be diverted away from the storage tank and discharged to a disposal area that does not cause property damage or erosion. Roof washer drainage shall not drain over a public way.

A 104.9.4 Automatic Drain. Roof washing systems shall be provided with an automatic means of self draining between rain events.

A 104.10 Roof Gutters. Gutters shall maintain a minimum slope and be sized in accordance with the plumbing code.

A 104.11 Drains, Conductors, and Leaders. The design and size of rainwater drains, conductors, and leaders shall be in accordance with the plumbing code.

A 104.12 Size of Potable Water Piping. Potable rainwater system distribution piping shall be sized in accordance with the plumbing code for sizing potable water piping.

A 105.0 Cleaning.

A 105.1 General. The interior surfaces of tanks and equipment shall be clean before they are put into service.

A 106.0 Supply System Inspection and Test.

A 106.1 General. Rainwater catchment systems shall be inspected and tested in accordance with the applicable provisions of the plumbing code for testing of potable water and storm drainage systems. Storage tanks shall be filled with water to the overflow opening for a period of 24 hours and during inspection or by other means as approved by the Authority Having Jurisdiction. All seams and joints shall be exposed during inspection and checked for water tightness.

APPENDIX B
VACUUM DRAINAGE SYSTEMS

B 101.0 Vacuum Drainage Systems.

B 101.1 General. This section regulates the design and installation provisions for vacuum waste drainage systems. Plans for vacuum waste drainage systems shall be submitted to the Authority Having Jurisdiction for approval and shall be considered an engineered designed system. Such plans shall be prepared by a registered design professional to perform plumbing design work. Details are necessary to ensure compliance with the requirements of this section, together with a full description of the complete installation including quality, grade of materials, equipment, construction, and methods of assembly and installation. Components, materials, and equipment shall comply with Section 302.1 or approved by the Authority Having Jurisdiction and other national consensus standards applicable to plumbing systems and materials. Where such standards and specifications are not available, alternate materials and equipment shall be approved in accordance with Section 102.0.

B 101.2 System Design. Vacuum waste drainage systems shall be designed and installed in accordance with the manufacturer's installation instructions. A vacuum waste drainage system shall include a vacuum generating system, waste collection center, piping network, vacuum valve, and control components used to isolate the vacuum piping network from atmospheric pressure and to collect waste at its point of origin. Where a vacuum system provides the only means of sanitation, duplicate vacuum generating equipment set to operate automatically shall be installed to allow the system to continue in operation during periods of maintenance.

B 101.2.1 Vacuum Generating System. The vacuum generating station shall include vacuum pumps to create a constant vacuum pressure within the piping network and storage tanks. The discharge from the tank shall be through an air gap in accordance with the plumbing code. Operation of pumps, collection tanks, and alarms shall be automated by controls. The vacuum pumps shall be activated on demand and accessible for repair or replacement. The vent from the vacuum pump shall be provided for vacuum pump air exhaust, and shall be of a size capable of handling the total air volume of the vacuum pump.

B 101.2.2 Waste Collection Center or Storage Tanks. Vacuum collection center or storage tanks shall be of such capacity as to provide storage of waste to prevent fouling of the system. Such collection or storage tank shall be capable of withstanding 150 percent of the rated vacuum (negative pressure) created by the vacuum source without leakage or collapse. Waste collection center or storage tanks shall be accessible for adjustment, repair, or replacement.

B 101.2.3 Piping Network. The piping network shall be under a continuous vacuum and shall be designed to withstand 150 percent of the vacuum (negative pressure) created by the vacuum source within the system without leakage or collapse. Sizing the piping network shall be in accordance with the manufacturer's instructions. The water closet outlet fitting shall connect with a piping network having not less than a 1½ inch (40 mm) nominal inside diameter.

B 101.2.4 Vacuum Interface Valve. A closed vacuum interface valve shall be installed to separate the piping network vacuum from atmospheric pressure. A control device shall open the vacuum interface valve where a signal is generated to remove waste from the plumbing fixture.

B 101.2.5 Control Components. Where a pneumatic signal is generated at the controller, a vacuum from the system to open the extraction valve shall be designed to operate where vacuum pressure exists to remove the accumulated waste. Each tank shall incorporate a level indicator switch that automatically controls the discharge pump and warns of malfunction or blockage as follows:

(1) Start discharge.

(2) Stop discharge.

(3) Activate an audible alarm where the level of effluent is usually high.

(4) Warning of system shutdown where tank is full.

B 101.3 Fixtures. Fixtures utilized in a vacuum waste drainage system shall comply with Section 302.1. Components shall be of corrosion resistant materials. The water closet outlet shall be able to pass a 1 inch (25.4 mm) diameter ball and shall have a smooth, impervious surface. The waste outlet and passages shall be free of obstructions, recesses, or chambers that are capable of permitting fouling. The mechanical valve and its seat shall be of such materials and design to provide a leak-free connection where at atmospheric pressure or under vacuum. The flushing mechanism shall be so designed as to ensure proper cleansing of the interior surfaces during the flushing cycle at a minimum operating flow rate. Mechanical seal mechanisms shall withdraw completely from the path of the waste discharge during flushing operation. Each mechanical seal vacuum water closet shall be equipped with a listed vacuum breaker. The vacuum breaker shall be mounted with the critical level or marking not less than 1 inch (25.4 mm) above the flood-level rim of the fixture. Vacuum breakers shall be installed on the discharge side of the last control valve in the potable water supply line and shall be located so as to be protected from physical damage and contamination.

B 101.4 Drainage Fixture Units. Drainage fixture units shall be determined by the manufacturer's instructions. The pump discharge load from the collector tanks shall be in accordance with this appendix.

B 101.5 Water Supply Fixture Units. Water supply fixture units shall be determined by the manufacturer's instructions.

B 101.6 Materials. Materials used for water distribution pipe and fittings shall be in accordance with the plumbing code. Materials used for aboveground drainage shall be in accordance with the plumbing code and shall have a smooth bore, and be constructed of non-porous material.

B 101.7 Traps and Cleanouts. Traps and cleanouts shall be installed in accordance with the plumbing code.

B 101.8 Testing. The entire vacuum waste system shall be subjected to a vacuum test of 29 inches of mercury (98 kPa) or not less than the working pressure of the system for 30 minutes. The system shall be gastight and watertight at all points. Verification of test results shall be submitted to the Authority Having Jurisdiction.

B 101.9 Manufacturer's Instructions. Manufacturer's instructions shall be provided for the purpose of providing information regarding safe and proper operating instructions whether or not as part of the condition of listing in order to determine compliance. Such instructions shall be submitted and approved by the Authority Having Jurisdiction.

APPENDIX C

PEAK WATER DEMAND CALCULATOR

(This Appendix is based on the technical paper entitled "Peak Water Demand Study."
A copy of the paper is available for download at: www.iapmo.org/WEStand/Pages/default.aspx)

C 101.0 General.

C 101.1 Applicability. This appendix provides a method for estimating the demand load for the building water supply and principal branches for single- and multi-family dwellings with water-conserving plumbing fixtures, fixture fittings, and appliances.

C 102.0 Demand Load.

C 102.1 Water-Conserving Fixtures. Plumbing fixtures, fixture fittings, and appliances shall not exceed the design flow rate in Table C 102.1.

C 102.2 Water Demand Calculator. The estimated design flow rate for the building supply and principal branches and risers shall be determined by the IAPMO Water Demand Calculator available for download at:
www.iapmo.org/Water-Demand-Calculator/

TABLE C 102.1
DESIGN FLOW RATE FOR WATER-CONSERVING PLUMBING FIXTURES AND APPLIANCES IN RESIDENTIAL OCCUPANCIES

FIXTURE AND APPLIANCE	MAXIMUM DESIGN FLOW RATE (gallons per minute)
Bar Sink	1.5
Bathtub	5.5
Bidet	2.0
Clothes Washer[1]	3.5
Combination Bath/Shower	5.5
Dishwasher[1]	1.3
Kitchen Faucet	2.2
Laundry Faucet (with aerator)	2.0
Lavatory Faucet	1.5
Shower, per head	2.0
Water Closet, 1.28 GPF Gravity Tank	3.0

For SI units: 1 gallon per minute = 0.06 L/s

[1] Clothes washers and dishwashers shall have an energy star label.

C 102.3 Meter and Building Supply. To determine the design flow rate for the water meter and building supply, enter the total number of indoor plumbing fixtures and appliances for the building in Column [B] of the Water Demand Calculator and run Calculator. See Table C 102.3 for an example.

C 102.4 Fixture Branches and Fixture Supplies. To determine the design flow rate for fixture branches and risers, enter the total number of plumbing fixtures and appliances for the fixture branch or riser in Column [B] of the Water Demand Calculator and run Calculator. The flow rate for one fixture branch and one fixture supply shall be the design flow rate of the fixture according to Table C 102.1.

C 102.5 Continuous Supply Demand. Continuous supply demands in gallons per minute (gpm) for lawn sprinklers, air conditioners, hose bibbs, etc., shall be added to the total estimated demand for the building supply as determined by Section C 102.3. Where there is more than one hose bibb installed on the plumbing system, the demand for only one hose bibb shall be added to the total estimated demand for the building supply. Where a hose bibb is installed on a fixture branch, the demand of the hose bibb shall be added to the design flow rate for the fixture branch as determined by Section C 102.4.

C 102.6 Other Fixtures. Fixtures not included in Table C 102.1 shall be added in Rows 12 through 14 in the Water Demand Calculator as Other Fixture. The probability of use and flow rate for Other Fixtures shall be added by selecting a comparable probability of use and flow rate from Columns [C] and [E].

C 102.7 Size of Water Piping per Appendix A. Except as provided in Section C 102.0 for estimating the demand load for single- and multi-family dwellings, the size of each water piping system shall be determined in accordance with the procedure set forth in Appendix A of the 2021 UPC. After determining the permissible friction loss per 100 feet of pipe in accordance with Section A 104.0 and the demand flow in accordance with the Water Demand Calculator, the diameter of the building supply pipe, branches and risers shall be obtained from Chart A 105.1(1), Chart A 105.1(2), Chart A 105.1(3), Chart A 105.1(4), Chart A 105.1(5), Chart A 105.1(6), or Chart A 105.1(7) whichever is applicable, in accordance with Section A 105.0 and Section A 106.0. Velocities shall be in accordance with Section A 107.1. Appendix I Installation Standard 31-2014 of the 2021 UPC, Figure 3 and Figure 4 shall be permitted when sizing PEX systems.

TABLE C 102.3
WATER DEMAND CALCULATOR EXAMPLE

[A] FIXTURE		[B] ENTER NUMBER OF FIXTURES	[C] PROBABILITY OF USE (%)	[D] ENTER FIXTURE FLOW RATE (GPM)	[E] MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)
1	Bar Sink	0	2.0	1.5	1.5
2	Bathtub	0	1.0	5.5	5.5
3	Bidet	0	1.0	2.0	2.0
4	Clothes Washer	1	5.5	3.5	3.5
5	Combination Bath/Shower	1	5.5	5.5	5.5
6	Dishwasher	1	0.5	1.3	1.3
7	Kitchen Faucet	1	2.0	2.2	2.2
8	Laundry Faucet	0	2.0	2.0	2.0
9	Lavatory Faucet	1	2.0	1.5	1.5
10	Shower, per head	0	4.5	2.0	2.0
11	Water Closet, 1.28 GPF Gravity Tank	1	1.0	3.0	3.0
12	Other Fixture 1	0	0.0	0.0	6.0
13	Other Fixture 2	0	0.0	0.0	6.0
14	Other Fixture 3	0	0.0	0.0	6.0
Total Number of Fixtures		6		RESET	RUN WATER DEMAND CALCULATOR
99th Percentile Demand Flow =		8.5 GPM			

C 102.8 Examples Illustrating Use of Water Demand Calculator with Appendix A.

Example 1: Indoor Water Use Only – Use the information given below to find the pipe size for the building supply to a residential building with six indoor fixtures as shown in Figure 1 [Pipe Section 4].

Given Information:

Type of construction: Residential, one-bathroom
Type of pipe material: L-copper
Fixture number/type: 1 combination bath/shower
1 lavatory faucet
1 WC
Friction loss per 100 ft: 15 psi
Maximum velocity: 10 ft/s
1 kitchen faucet
1 dishwasher
1 clothes washer

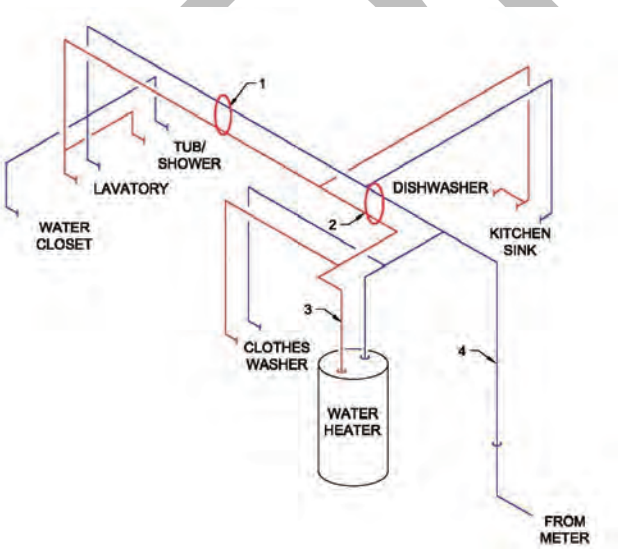

FIGURE 1
RESIDENTIAL BUILDING WITH SIX INDOOR FIXTURES

Solution: Step 1 of 2 – Find Demand Load for the Building Supply

The Water Demand Calculator [WDC] in Figure 2 is used to determine the demand load expected from indoor water use. The WDC has white-shaded cells and gray-shaded cells. The values in the gray cells are derived from a national survey of indoor water use at homes with efficient fixtures and cannot be changed.

The white-shaded cells accept input from the designer. For instance, fixture counts from the given information are entered in Column [B]; the corresponding recommended fixture flow rates are already provided in Column [D]. The flow rates in Column [D] may be reduced only if the manufacturer specifies a lower flow rate for the fixture. Column [E] establishes the upper limits for the flow rates entered into Column [D]. Clicking the Run Water Demand Calculator button gives 8.5 gpm as the estimated indoor water demand for the whole building. This result appears in the dark gray box of the WDC in Figure 2.

[A] FIXTURE		[B] ENTER NUMBER OF FIXTURES	[C] PROBABILITY OF USE (%)	[D] ENTER FIXTURE FLOW RATE (GPM)	[E] MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)
1	Bar Sink	0	2.0	1.5	1.5
2	Bathtub	0	1.0	5.5	5.5
3	Bidet	0	1.0	2.0	2.0
4	Clothes Washer	1	5.5	3.5	3.5
5	Combination Bath/Shower	1	5.5	5.5	5.5
6	Dishwasher	1	0.5	1.3	1.3
7	Kitchen Faucet	1	2.0	2.2	2.2
8	Laundry Faucet	0	2.0	2.0	2.0
9	Lavatory Faucet	1	2.0	1.5	1.5
10	Shower, per head	0	4.5	2.0	2.0
11	Water Closet, 1.28 GPF Gravity Tank	1	1.0	3.0	3.0
12	Other Fixture 1	0	0.0	0.0	6.0
13	Other Fixture 2	0	0.0	0.0	6.0
14	Other Fixture 3	0	0.0	0.0	6.0
Total Number of Fixtures		6		RESET	RUN WATER DEMAND CALCULATOR
99th Percentile Demand Flow =		8.5 GPM			

FIGURE 2
WATER DEMAND CALCULATOR FOR INDOOR USE AT HOME WITH SIX EFFICIENT FIXTURES (EXAMPLE 1).

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply

Chart A 105.1(1) for copper piping systems (from Appendix A of the UPC, shown in Figure 3) is used to determine the pipe size, based on given friction loss, given maximum allowable pipe velocity, given pipe material and the demand load computed in Step 1. In Figure 3, the intersection of the given friction loss (15 psi) and the maximum allowable pipe velocity (10 ft/s) is labeled point A. The vertical line that descends from point A to the base of the chart, intersects four nominal sizes for L-copper pipe. These intersection points are labeled B, C, D, E and correspond to pipe sizes of 1 inch, ¾ inch, ½ inch and 3/8 inch, respectively. A horizontal line from points B, C, D, E to the right-hand side of the chart gives maximum flow rates of 24 gpm, 12 gpm, 4.5 gpm, and 2.3 gpm, respectively. These results are summarized in Table 1 which shows that a ¾-inch L-copper line is the minimum size that can convey the peak water demand of 8.5 gpm.

TABLE 1
PIPE SIZE OPTIONS FOR BUILDING SUPPLY

POINT IN FIGURE 3	PIPE DIAMETER (INCH)	MAXIMUM FLOW (GPM)	OK FOR BUILDING SUPPLY[1]
E	3/8	2.3	No
D	1/2	4.5	No
C	3/4	12	Yes
B	1	24	Yes

[1] For Building in Examples 1, 2, 3, and 4.

CHART A 105.1(1)

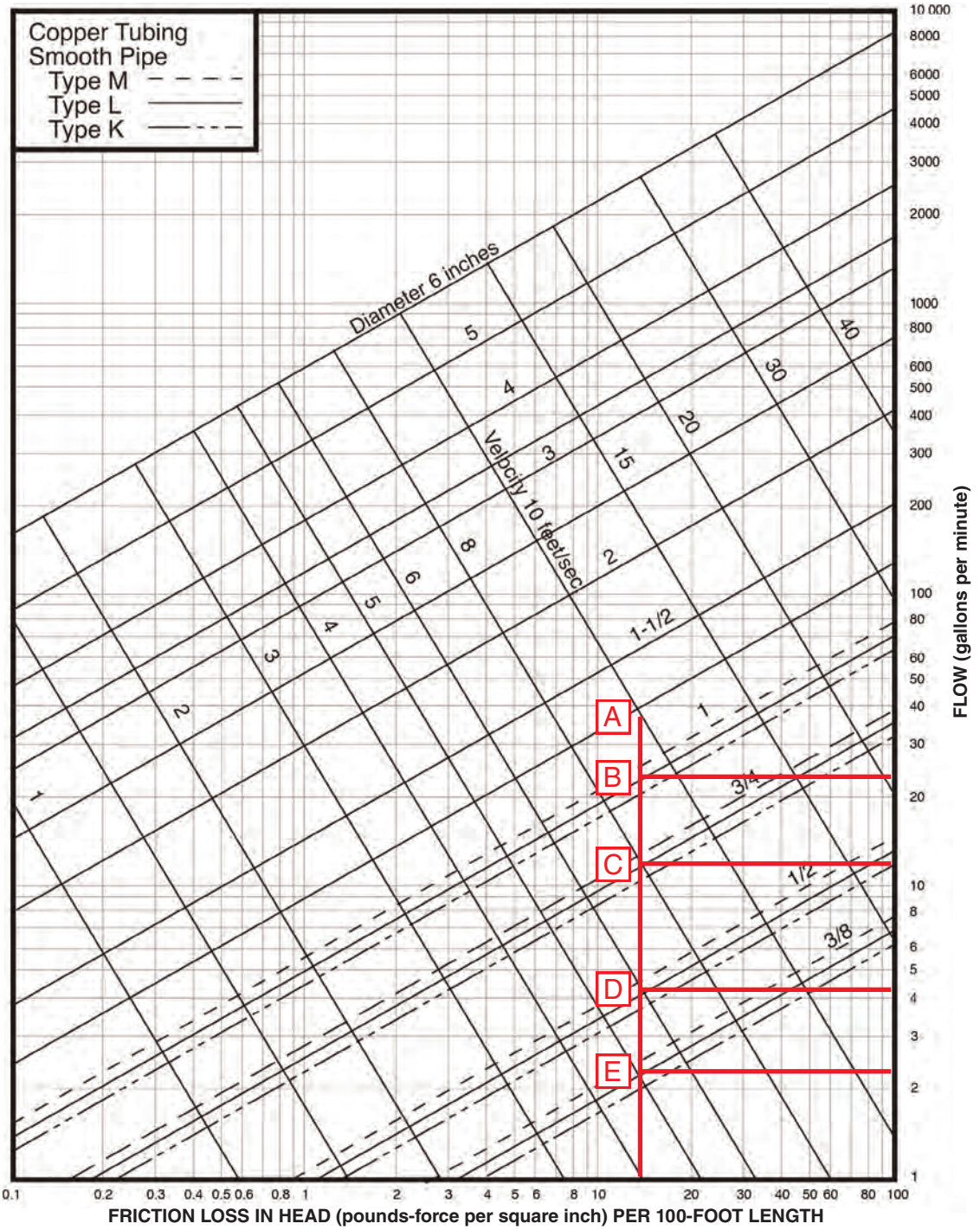

FIGURE 3
CHART A 105.1(1) FOR FINDING PIPE SIZE

Example 2: Indoor and Outdoor Water Use – Find the pipe size for the building supply [Figure 1, Pipe Section 4] if the building in Example 1 adds two outdoor fixtures (hose bibbs, each with a fixture flow of 2.0 gpm).

Solution: Step 1 of 2 – Find Demand Load for the Building Supply

The WDC has been developed exclusively for peak indoor water use which can be viewed as a high frequency short duration process. Because fixtures for outdoor water use may operate continuously for very long periods, they are not included in the WDC. To account for water use from one or more outdoor fixtures, add the demand of the single outdoor fixture with the highest flowrate to the calculated demand for indoor water use. With two hose bibbs, the demand of only one hose bibb is included. Hence, in this example, the total demand for the whole house is 8.5 gpm + 2.0 gpm = 10.5 gpm.

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply

Table 1 shows that at 10.5 gpm the building supply shall be ¾-inch in diameter.

Example 3: Indoor, Outdoor and Other Fixture Water Use – Find the pipe size for the water supply [Figure 1, Pipe Section 4] if the building in Example 2 adds a kitchen pot filler and a dog bath each with a faucet flow rate of 5.5 gpm.

Solution: Step 1 of 2 – Find Demand Load for the Building Supply

The kitchen pot filler and dog bath are not listed in Column [A] of the WDC. To accommodate cases such as this, the WDC provides up to three additional rows for "Other Fixtures." Enter the kitchen pot filler and dog bath in Column [A] of the WDC and enter the fixture count for each in Column [B]. Find an indoor fixture that has a similar probability of use in Column [C] and add that to the column. Finally, enter the flow rate of the kitchen pot filler and dog bath in Column [D]. The estimated indoor water demand for the whole building is 11 gpm, as shown in the WDC in Figure 4. As illustrated in Example 2, the hose bibb will increase the total demand for the whole house to 13 gpm.

Note that a reset button is provided to clear any numbers in Column [B] from a previous calculation.

Solution: Step 2 of 2 – Determine the Pipe Size of the Building Supply

Table 1 shows that at 13 gpm the building supply shall be 1-inch in diameter.

Example 4: Sizing Branches and Risers

For individual hot and cold branches, repeat Steps 1 and 2. For example, for the hot water branch at the water heater [Figure 1, Pipe Section 3], enter all the fixtures and appliances that use hot water into the Water Demand Calculator (toilets will be excluded) as seen in Figure 5. Use the calculated demand load to find the pipe size in Step 2. Table 1 shows that at 7.7 gpm, the hot water branch shall be ¾-inch in diameter.

For each additional hot and cold branch [Figure 1, Pipe Sections 1 and 2], enter the number of fixtures and appliances served by that branch into the WDC and use that demand in Step 2 to determine the branch size. If the branch serves a hose bibb, add the demand of the hose bibb to the calculated demand flow for the branch. As discussed in Example 2, the hose bibb is not to be entered into WDC, since the Calculator is for indoor uses only.

When there is only one fixture or appliance served by a fixture branch, the demand flow shall not exceed the fixture flow rate in Column [E] of the Water Demand Calculator. The fixture flow rate would be used in Step 2 to determine the size of the fixture branch and supply.

[A] FIXTURE		[B] ENTER NUMBER OF FIXTURES	[C] PROBABILITY OF USE (%)	[D] ENTER FIXTURE FLOW RATE (GPM)	[E] MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)
1	Bar Sink	0	2.0	1.5	1.5
2	Bathtub	0	1.0	5.5	5.5
3	Bidet	0	1.0	2.0	2.0
4	Clothes Washer	1	5.5	3.5	3.5
5	Combination Bath/Shower	1	5.5	5.5	5.5
6	Dishwasher	1	0.5	1.3	1.3
7	Kitchen Faucet	1	2.0	2.2	2.2
8	Laundry Faucet	0	2.0	2.0	2.0
9	Lavatory Faucet	1	2.0	1.5	1.5
10	Shower, per head	0	4.5	2.0	2.0
11	Water Closet, 1.28 GPF Gravity Tank	1	1.0	3.0	3.0
12	Kitchen Pot Filler	1	2.0	5.5	6.0
13	Dog Bath	1	1.0	5.5	6.0
14	Other Fixture 3	0	0.0	0.0	6.0
Total Number of Fixtures		8		RESET	RUN WATER DEMAND CALCULATOR
99th Percentile Demand Flow =		11.0 GPM			

FIGURE 4
WATER DEMAND CALCULATOR TO ACCOMMODATE OTHER FIXTURES (EXAMPLE 3).

PEAK WATER DEMAND CALCULATOR

	[A] FIXTURE	[B] ENTER NUMBER OF FIXTURES	[C] PROBABILITY OF USE (%)	[D] ENTER FIXTURE FLOW RATE (GPM)	[E] MAXIMUM RECOMMENDED FIXTURE FLOW RATE (GPM)
1	Bar Sink	0	2.0	1.5	1.5
2	Bathtub	0	1.0	5.5	5.5
3	Bidet	0	1.0	2.0	2.0
4	Clothes Washer	1	5.5	3.5	3.5
5	Combination Bath/Shower	1	5.5	5.5	5.5
6	Dishwasher	1	0.5	1.3	1.3
7	Kitchen Faucet	1	2.0	2.2	2.2
8	Laundry Faucet	0	2.0	2.0	2.0
9	Lavatory Faucet	1	2.0	1.5	1.5
10	Shower, per head	0	4.5	2.0	2.0
11	Water Closet, 1.28 GPF Gravity Tank	0	1.0	3.0	3.0
12	Other Fixture 1	0	0.0	0.0	6.0
13	Other Fixture 2	0	0.0	0.0	6.0
14	Other Fixture 3	0	0.0	0.0	6.0
Total Number of Fixtures		5		RESET	RUN WATER DEMAND CALCULATOR
99th Percentile Demand Flow =		7.7 GPM			

FIGURE 5
WATER DEMAND CALCULATOR FOR THE HOT WATER BRANCH (EXAMPLE 4).

APPENDIX D
COMPOSTING TOILET AND URINE DIVERSION INSPECTION CHECKLIST

D 101.0 General.

D 101.1 Applicability. This appendix provides an inspection checklist for composting toilet and urine diversion systems designed in accordance with Section 502.1.2. This is only a general checklist and is not intended to address all the provisions required by Section 502.1.2.

D 201.0 Composting Toilet and Urine Diversion Inspection Checklist. This section includes the inspection checklist form.

System Materials and Components
☐ Verify that the system is approved by the AHJ as indicated in the approved design.
☐ All components expected to contact excreta or leachate shall be constructed of corrosion resistant material such as stainless steel or durable polymers (ABS, PVC Schedule 40, Polypropylene, High-density polyethylene, Fiber-reinforced polyester, or material of equivalent durability).

Concrete Construction
☐ Verify site built concrete mix, loading weight.
☐ Site built concrete construction shall be reinforced and without cracking, spaulding or other observed faults.
☐ Verify site built concrete watertightness.
☐ Verify site built concrete adequate drainage where required; Floors of processors shall be sloped not less than ¼-inch per foot. Note; The flange of each sub-drain shall be set level.

Commode
☐ If commode uses repurposed container for transporting excreta into compost processor, container meets third part listing by a listing agency, including US 49 CFR Section 178.274 Specifications for UN Portable Tanks.

Compost Processors
☐ Compost processors shall have a leachate collection, recirculation, evaporation, or drainage system. See also Leachate Storage Tank checklist.
☐ Compost processor is rodent proof. No unsecured opening other than vents, drainage, or commode may exceed ½-inch in the least dimension.
☐ All composting processors shall be labeled and protected from human contact, surface water and precipitation.
☐ Compost processor must pass a water tightness test by filling the system to the maximum designed liquid storage capacity of the unit for a duration of 24 hours.
☐ Where unprocessed excreta or diverted urine is transferred from commode to processor(s), provide tools and cleaning materials as described in the owner's manual.
☐ Commodes connected to compost processor without a trap shall maintain negative ventilation. If compost processor is not connected to the commode no vent is required.
☐ Vent stacks terminate at exterior of the building as required by the plumbing or mechanical code.
☐ The compost processor is sized in accordance with the approved design.

Leachate Storage Tanks

- ☐ Leachate storage tanks, where provided, shall be constructed of polyethylene terephthalate (PET), polyethylene napthalate (PEN), polyamide (Nylon) or a blend of PET, PEN, ethyl vinyl alcohol (EVOH), Nylon, HDPE, or other tanks listed or certified to US 49 CFR Section 178.274 Specifications for UN Portable Tanks.
- ☐ Above grade storage tanks are prohibited where subject to freezing conditions or shall be provided with an adequate means of freeze protection. The above grade leachate storage tank shall be provided with a high-water alarm. The alarm shall report when 80 percent volume is reached.
- ☐ Where openings are provided to allow a person to enter the tank, the opening is marked "DANGER-CONFINED SPACE."
- ☐ All openings are covered and secured to prevent tampering. Openings shall be screened or covered to prevent rodent infiltration and be protected against unauthorized human entry.
- ☐ Below grade storage tanks shall be in accordance with the approved design.
- ☐ If pressure equalization vents are specified in the design, they are installed as designed.
- ☐ The connection of storage tank vents to the plumbing venting system shall be six inches above the flood level rim of the highest fixture.
- ☐ Vents extending to the outdoor shall terminate no less than 12-inches above grade.
- ☐ The vent terminal shall be directed downward and covered with a 3/32-inch mesh screen to prevent the entry of vermin and insects.
- ☐ Where storage tank overflows are installed they shall be connected to the plumbing drainage system.
- ☐ All leachate storage tanks shall have a high-water alarm. The alarm shall report when 80 percent volume is reached.
- ☐ Storage tank overflows shall be provided with a backwater valve or check valve at the point of connection to the plumbing drainage system when connected to a public sewer system. The backwater valve shall be accessible for inspections and maintenance.

Urine Storage Tanks

- ☐ Below grade urine storage tanks shall be in accordance with the approved design.
- ☐ Above grade storage urine storage tanks are constructed of polyethylene terephthalate (PET), polyethylene napthalate (PEN), polyamide (Nylon) or a blend of PET, PEN, ethyl vinyl alcohol (EVOH), Nylon, HDPE, or other tanks listed or certified to US 49 CFR Section 178.274 Specifications for UN Portable Tanks.
- ☐ Above grade storage tanks are prohibited where subject to freezing conditions or shall be provided with an adequate means of freeze protection.
- ☐ If a vent is required for pressure equalization, then the vent shall extend above the top of the tank.
- ☐ The connection of storage tank vents to the plumbing venting system shall be six inches above the flood level rim of the highest fixture.
- ☐ Vents extending to the outdoor shall terminate no less than 12-inches above grade.
- ☐ Vent terminal is directed downward and covered with a 3/32-inch mesh screen to prevent the entry of vermin and insects.
- ☐ Pressure equalization vents that prevent nitrogen loss by the use of restrictions or use of piping or tubing that is less than the minimum pipe diameter required in the plumbing code shall be approved by the Authority Having Jurisdiction.
- ☐ If storage tank overflows are installed they shall be connected to a plumbing drainage system.
- ☐ Storage tank overflows have a backwater valve or check valve at the point of connection to the plumbing drainage system when connected to a public sewer system.
- ☐ The backwater valve is accessible for inspections and maintenance.
- ☐ Storage tank trap is a P-trap, mechanical trap, submerged inlet piping, or other means approved by the Authority Having Jurisdiction. Urine storage tanks of five gallons or less connected to fixtures with active ventilation or having an integrated seal do not require traps.
- ☐ If submerged inlet piping is used as trap, the inlet piping must remain submerged during use and after pumpout.

Urine Diversion System

- ☐ Material used for urine diversion shall be stainless steel or non-metallic pipe. Concrete piping is prohibited.
- ☐ Urine diversion piping is identifiable and labeled. Pipe diameters are sized in accordance with AHJ and the plumbing code.
- ☐ Where unprocessed urine is transferred from commode to processor(s), provide tools and cleaning materials as described in the owner's manual.
- ☐ Changes in direction of urine diversion piping shall be made by a long-sweep 90-degree fitting or other approved fittings of equivalent sweep.
- ☐ Fixtures discharging into urine diversion piping connected to the plumbing drainage system shall be trapped and vented according to the plumbing code.
- ☐ Urine diversion piping is installed at a minimum grade of ½- inch per foot, or 4 percent toward the point of disposal.
- ☐ Urine is diverted to a storage tank or an approved plumbing drainage system.
- ☐ A maintenance plan shall be included per the design system.

Cleanouts

- ☐ Cleanouts installed at each aggregate horizontal change of direction exceeding 135 degrees.
- ☐ A cleanout provided at the upper terminal of each drain line every 50 feet.

Venting

- ☐ Commode fixtures connected directly to compost processor(s) without traps require a ventilation system.
- ☐ Nonwater urinals used as urine diversion systems shall be connected to a dry toilet ventilation stack or a urine diversion ventilation stack.

Operation & Maintenance Manual: An owner's manual is on site and accessible to the inspector and includes the following:

Product information

- ☐ Model/Serial number
- ☐ Product certification references
- ☐ Intended treatment capacity with regard to number of users and uses per day
- ☐ Initial setup

Start up and operation

- ☐ Schedule for addition of necessary compost additives.
- ☐ Source or provider of necessary compost additives. Source may be on-site.
- ☐ Schedule and instructions for all regular maintenance tasks.
- ☐ Expected input of and capacity for excreta and compost additives to compost toilet system specifying loading of commode(s) and compost processor(s).

Annual Maintenance

- ☐ Plan for container transfer and cleaning where transfer is used.
- ☐ Expected schedule for removing humus from composting processors and where used secondary composting bins.
- ☐ Plan for on-site disposal of humus or professional removal.
- ☐ Plan for managing leachate.
- ☐ Special conditions; cold climate operation and/or winterization.

Testing

- ☐ Plan for microbial testing.
- ☐ Humus Sampling
  - ☐ A laboratory is under contract to perform testing of finished compost.
  - ☐ A sample of the previous treatment period shall be on-hand with fecal coliform/gram results.

Troubleshooting

- ☐ Guide to troubleshooting basic operating functions.