

# CHAPTER VI

## POTABLE WATER STORAGE FACILITIES

### VIA LOCATION AND PROTECTION

- New facilities are to be located:
  - (A) Above the level of the one hundred year flood.
  - (B) Where chlorine gas will not be stored or used within three hundred feet of any residence.
  - (C) Where the facility is not likely to be subject to fires or other natural or manmade disasters.

PHC 19-13-B102(d)(1)

- Protection of Distribution System.

PHC 19-13-B102(f)(3)

All water storage tanks connected to a public water distribution system shall be constructed and located so as to adequately protect the water from contamination. Tanks and basins must be covered and vents and overflow pipes screened. They shall not be directly connected to sanitary sewers or to storm drainage systems. In-ground basins or tanks shall be at least fifty feet from any part of the nearest subsurface sewage disposal system and twenty-five feet from any part of the nearest subsurface sewage disposal system and twenty-five feet from the nearest watercourse or storm drain. They shall be at least fifty feet from the nearest sanitary sewer unless the sewer is constructed of ductile or cast iron or prestressed concrete pressure pipe, steel cylinder type with a gasketed joint, in which case it may be no closer than twenty-five feet. Exemptions may be sought for existing structures which do not conform to these requirements.

#### **VI.A.1 Location of Ground-level Reservoirs**

- a. The bottom of reservoirs and standpipes should be placed at the normal ground surface and shall be above maximum flood level.
- b. When the bottom must be below normal ground surface, it shall be placed above the groundwater table. At least 50 per cent of the water depth should be above grade. Sewers, drains, standing water and similar sources of possible contamination must be kept at least fifty feet from the reservoir. Water main pipe, pressure tested in place to 50 psi (340 kPa) without leakage, may be used for gravity sewers at distances greater than 20 and less than 50 feet.
- c. The top of a reservoir shall not be less than two feet above normal ground surface. Clearwells constructed under filters may be excepted from this requirement when the total design gives the same protection.

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#### **VI.A.2 Hydropneumatic (pressure) Tanks**

The tank shall be located above normal ground surface and be completely housed.

RSWW 7.2.1

### VIB MATERIALS

- **Materials:**

DPUC 16-262-m8(j1)

(1) Metallic and non-metallic materials may be used to construct component parts of a water system including, but not limited to, conduits, pipes, couplings, caulking materials, protective linings and coatings, services, valves, hydrants, pumps, tanks, and reservoirs; provided:

- A) The materials shall have reasonable useful service life.
- B) The material shall be capable of withstanding the internal and external forces to which it may be subjected while in service;
- C) The material shall not cause the water to become impure, unwholesome, nonpotable, or unhealthful
- D) Materials and equipment shall be designed and selected with factors of safety included and installed as to mitigate corrosion, electrolysis, and deterioration. When the possibility of a near future interconnection with another utility exists, some components such as pressure tanks and compressors may be designed for limited service life;
- E) Use of non-metallic pipe shall require a suitable tracer wire for pipe location;
- F) No material shall be allowed which does not meet standards established by the American Water Works Association or other comparable standards;

- *Conformance with NSF Standards*

NSF 61

The following components should conform with applicable NSF standards, most current revision:

1. Flexible Liners and Covers
2. Coating Systems for Tank Interiors
3. "Bladder" Pressure Tanks

- *Conformance with AWWA Standards*

AWWA

Tanks should conform with the following AWWA standards, most current revision:

- D100-96            Welded Steel Tanks for Water Storage
- D102-97            Coating Steel Water-Storage Tanks
- D103-97            Factory Coated Bolted Steel Tanks for Water Storage (Revised)
- D104-97            Automatically    Controlled,            Impressed-Current Cathodic Protection for the
- D110-95            Wire and Strand-Wound, circular, Prestressed Concrete Water Tanks
- D115-95            Circular Prestressed Concrete Water Tanks With

AWWA (continued)

	Circumferential Tendons
D120-84 (R89)	Thermosetting Fiberglass-Reinforced Plastic Tanks
D130-96	Flexible Membrane Lining and Floating Cover Materials for Potable Water

**VI.C GENERAL DESIGN CONSIDERATIONS**

The materials and designs used for finished water storage structures shall provide stability and durability as well as protect the quality of the stored water. Steel structures shall follow the current AWWA standards concerning steel tanks, standpipes, reservoirs, and elevated tanks wherever they are applicable. Other materials of construction are acceptable when properly designed to meet the requirements of this section.

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**VI.C.1.a Sizing**

Storage facilities should have sufficient capacity, as determined from engineering studies, to meet domestic demands, and where fire protection is provided, fire flow demands.

RSWW 7.0.1

- a. Fire flow requirements established by the appropriate state Insurance Services Office should be satisfied where fire protection is provided.
- b. The minimum storage capacity (or equivalent capacity) for systems not providing fire protection shall be equal to the average daily consumption. This requirement may be reduced when the source and treatment facilities have sufficient capacity with standby power to supplement peak demands of the system.
- c. Excessive storage capacity should be avoided where water quality deterioration may occur.

Atmospheric storage tank capacity shall be at least 200 gallons per residential customer or equal to the average daily demand of the system, whichever is the greater number. If commercial or industrial customers are included, additional storage shall be provided based on reasonable average day estimated water usage thereof.

**VI.C.1.b Location of Ground-Level Reservoirs**

- a. The bottom of the reservoirs and standpipes should be placed at the normal ground surface and shall be above maximum flood level.
- b. When the bottom must be below normal ground surface, it shall be placed above the groundwater table. At least fifty per cent of the water depth should be above grade. Sewers, drains, standing water and other sources of possible contamination must be kept at least fifty feet from the reservoir. Water main pipe, pressure tested in place to 50 psi (340 kPa) without leakage, may be used for gravity sewers at distances greater than 20 feet and less than 50 feet.
- c. The top of a reservoir shall not be less than two feet above normal ground surface. Clearwells constructed under filters may be excepted from this requirement when the total design gives the same protection.

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**VI.C.1.c Protection**

All finished water storage structures shall have suitable water-tight roofs which exclude birds, animals, insects, and excessive dust.

RSWW 7.0.3

**VI.C.1.d Protection from Trespassers**

Fencing, locks on access manholes, and other necessary precautions shall be provided to prevent trespassing, vandalism, and sabotage.

RSWW 7.0.4

**VI.C.1.e Drains**

No drain on a water storage structure may have a direct connection to a sewer or storm drain. The design shall allow draining the storage facility for cleaning or maintenance without causing loss of pressure in the distribution system.

RSWW 7.0.5

**VI.C.1.f Inlet/Outlet and Baffle Wall**

System should be designed to facilitate turn over of water in the reservoir.

RSWW 7.0.6

**VI.C.1.g Overflow**

All water storage structures shall be provided with an overflow which is brought down to an elevation between 12 and 24 inches above the ground surface, and discharges over a drain inlet structure or a splash plate. No overflow may be connected directly to a sewer or a storm drain. All overflow pipes shall be located so that any discharge is visible.

RSWW 7.0.7

- a. When an internal overflow pipe is used on elevated tanks, it should be located in the access tube. For vertical drops on other types of storage facilities, the overflow pipe should be located on the outside of the structure.
- b. The overflow of a ground-level structure shall open downward and be screened with twenty-four mesh noncorrodible screen installed with the pipe at a location least susceptible to damage by vandalism.
- c. The overflow pipe shall be of sufficient diameter to permit waste of water in excess of the filling rate.

**VI.C.1.h Access**

Finished water storage structures shall be designed with reasonably convenient access to the interior for cleaning and maintenance. At least two (2) manholes shall be provided above the water line at each water compartment where space permits.

RSWW 7.0.8

- a. shall be framed at least four inches, and preferably six inches above the surface of the roof at the opening; on ground-level structures

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(continued)

- the surface of the roof at the opening; on ground-level structures, manholes should be elevated 24 to 36 inches above the top or covering sod;
- b. shall be fitted with a solid watertight cover which overlaps the framed opening and extends down around the frame at least two inches,
  - c. should be hinged at one side,
  - d. should have a locking device.

#### **VI.C.1.i Vents**

Finished water storage structures shall be vented. Overflows shall not be considered as vents. Open construction between the sidewall and roof is not permissible. Vents

RSWW 7.0.9

- a. shall prevent the entrance of surface water and rain water,
- b. shall exclude birds and animals,
- c. should exclude insects and dust, as much as this function can be made compatible with effective venting. For elevated tanks and standpipes, four mesh noncorrodible screen may be used;
- d. shall on ground-level structures, terminate an inverted U construction with the opening 24 to 36 inches above the roof or sod and covered with 24 mesh noncorrodible screen installed with pipe at a location least susceptible to vandalism.

#### **VI.C.1.j Roof and Sidewall**

The roof and sidewalls of all structures must be watertight with no openings except properly constructed vents, manholes, overflows, risers, drains, pump mountings, control ports, or piping for inflow and outflow.

RSWW 7.0.10

- a. Any pipes running through the roof or sidewall of a finished water storage structure must be welded, or properly gasketed in metal tanks. In concrete tanks, these pipes shall be connected to standard wall castings which were poured in place during the forming of the concrete. These castings should have seepage rings imbedded in the concrete.
- b. Openings in a storage structure roof or top, designed to accommodate control apparatus or pump columns, shall be curbed and sleeved with proper additional shielding to prevent the access of surface or floor drainage water into the structure.
- c. Valves and controls should be located outside the storage structure so that valve stems and similar projections will not pass through the roof or top of the reservoir.
- d. The roof of concrete reservoirs with earthen cover shall be sloped to facilitate drainage. Consideration should be given to installation of an impermeable membrane roof covering.

#### **VI.C.1.k Drainage of Roof**

The roof of the storage structure shall be well drained. Downspout pipes shall not enter or pass through the reservoir. Parapets, or similar construction which would tend to hold water and snow on the roof, will not be approved unless adequate waterproofing and drainage are provided.

RSWW 7.0.11

**VI.C.1.l Safety**

The safety of employees must be considered in the design of the storage structure. As a minimum, such matters shall conform to pertinent laws and regulations of the area where the reservoir is constructed.

RSWW 7.0.12

- a. Ladders, ladder guards, balcony railings, and safely located entrance hatches shall be provided where applicable.
- b. Elevated tanks with riser pipes over eight inches in diameter shall have protective bars over the riser openings inside the tank.
- c. Railings or handholds shall be provided on elevated tanks where persons must transfer from the access tube to the water compartment.
- d. Confined space entry requirements shall be considered.

**VI.C.1.m Freezing**

All finished water storage structures and their appurtenances, especially the riser pipes, overflows, and vents shall be designed to prevent freezing which will interfere with proper functioning.

RSWW 7.0.13

**VI.C.1.n Internal Catwalk**

Every catwalk over finished water in a storage structure shall have a solid floor with raised edges so designed that shoe scrapings and dirt will not fall on top the water.

RSWW 7.0.14

**VI.C.1.o Silt Stop**

The discharge pipes from all reservoirs shall be located in a manner that will prevent the flow of sediment into the distribution system. Removable silt stops should be provided.

RSWW 7.0.15

**VI.C.1.p Grading**

The area surrounding a ground-level structure shall be graded in a manner that will prevent surface water from standing within 50 feet of it.

RSWW 7.0.16

**VI.C.1.q Painting and/or Cathodic Protection**

Proper protection shall be given to metal surfaces by paints or other protective coatings, by cathodic protective devices, or both.

RSWW 7.0.17

- a. Paint systems shall meet NSF standard 61 and be acceptable to the reviewing authority. Interior paint must be properly applied and

RSWW 7.0.17  
(continued)

cured. After curing, the coating shall not transfer any substance to the water which will be toxic or cause tastes or odors. Prior to placing in service, an analysis for volatile organic compounds is advisable to establish that the coating is properly cured. Consideration should be given to 100% solid coatings.

- b. Wax coatings for the tank interior should not be used on new tanks. Recoating with a wax system is discouraged; however, the old wax coating must be completely removed to use another tank coating.
- c. Cathodic protection should be designed and installed by competent technical personnel; a maintenance contract should be provided.

**VI.C.1.r Provisions for Sampling**

Appropriate sampling tap(s) shall be provided to facilitate collection of water samples for both bacteriologic and chemical analyses.

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**VI.D PLANT STORAGE**

The applicable design standards of Section VI.C of this report shall be followed for plant storage.

RSWW 7.1

**VI.D.1.a Washwater Tanks**

Washwater tanks shall be sized, in conjunction with available pump units and finished water storage, to provide the backwash water required by Section IV.F.2.k of this document. Consideration must be given to the backwashing of several filters in rapid succession.

RSWW 7.1.1

**VI.D.1.b Clearwell**

Clearwell storage should be sized, in conjunction with distribution system storage, to relieve the filters from having to follow fluctuations in water use.

RSWW 7.1.2

- a. When finished water storage is used to provide contact time for chlorine. See Section IV.G.3 of this document. Special attention must be given to size and baffling.
- b. To ensure adequate chlorine contact time, sizing of the clearwell should include extra volume to accommodate depletion of storage during the nighttime for intermittently operated filtration plants with automatic high service pumping from the clearwell during non-treatment hours.
- c. An overflow and vent shall be provided.
- d. A minimum of two clearwell compartments shall be provided.

**VI.D.1.c Adjacent Compartments**

Finished water must not be stored or conveyed in a compartment

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adjacent to unsafe water when the two compartments are separated by a single wall.

**VI.D.1.d Basins and Wet-wells**

Receiving basins and pump wet-wells for finished water shall be designed as finished water storage structures.

RSWW 7.1.4

**VI.E HYDROPNEUMATIC TANKS**

Hydropneumatic (pressure) tanks, when provided as the only storage facility, are acceptable only in very small water systems. When serving more than 150 living units, ground or elevated storage designed in accordance with Section VI.C.1.a of this report should be provided. Pressure tank storage is not to be considered for fire protection purposes. Pressure tanks shall meet ASME code requirements or an equivalent requirement of the state and local laws and regulations for the construction and installation of unfired pressure vessels.

RSWW 7.2

**VI.E.1 Location**

The tank shall be located above normal ground surface and be completely housed.

RSWW 7.2.1

**VI.E.2 Sizing**

Hydropneumatic tank and transfer pumps

DPUC 16-262m-8(g)

- A. A hydropneumatic tank and transfer pump arrangement, used in tandem with the atmospheric tank, shall be sized to accommodate the peak hour demand. A minimum of two (2) transfer pumps shall be installed to operate alternately, each capable of providing water to the system at the peak hour demand rate;
- B. The transfer pumps shall be installed between the atmospheric tank and the hydropneumatic tank;
- C. The required gross volume of the hydropneumatic storage tank shall be calculated using the following equations:

Hydropneumatic tank and transfer pumps

$$\text{Usable volume} = 5 \text{ minutes} \times \text{Largest transfer pump capacity}$$

$$\text{Gross volume} = 100\% \times \text{Usable volume} / \% \text{ usable volume}$$

- D. Transfer pumps shall be protected by low water level shutoff controls in the storage tank.

The capacity of the wells and pumps in a hydropneumatic system should be at least ten times the average daily consumption rate. The gross volume of the hydropneumatic tank, in gallons, should be at least ten times the capacity of the largest pump, rated in gallons per minute. For example, a 250 gpm

RSWW 7.2.2

pump should have a 2,500 gallon pressure tank.

Sizing of hydropneumatic storage tanks must consider the need for chlorine detention time, as applicable, independent of the requirements of the previous paragraph.

**VI.E.3 Piping**

The tank shall have bypass piping to permit operation of the system while it is being repaired or painted.

RSWW 7.2.3

**VI.E.4 Appurtenances**

Each tank shall have an access manhole, a drain, and control equipment consisting of pressure gauge, water sight glass, automatic or manual air blow-off, means for adding air, and pressure operated start-stop controls for the pumps. Where practical, the access manhole should be 24 inches in diameter.

RSWW 7.2.4

**VI.F DISTRIBUTION STORAGE**

The applicable design standards of Section VI.C of this document shall be followed for distribution system storage.

RSWW 7.3

**VI.F.1 Pressures**

The maximum variation between high and low levels in storage structures providing pressure to a distribution system should not exceed 30 feet. The minimum working pressure in the distribution system should be 35 psi (240 kPa) and the normal working pressure should be approximately 60 to 80 psi (410-550 kPa). When static pressures exceed 100 psi (690 kPa), pressure reducing devices should be provided on mains in the distribution system.

RSWW 7.3.1

**VI.F.2 Drainage**

Storage structures which provide pressure directly to the distribution system shall be designed so they can be isolated from the distribution system and drained for cleaning or maintenance without necessitating loss of pressure in the distribution system. The drain shall discharge to the ground surface with no direct connection to a sewer or storm drain.

RSWW 7.3.2

**VI.F.3 Level Controls**

Adequate controls shall be provided to maintain levels in distribution system storage structures. Level indicating devices should be provided at a central location.

RSWW 7.3.3

- a. Pumps should be controlled from tank levels with the signal transmitted by telemetering equipment when any appreciable head loss occurs in the

RSWW 7.3.3  
(continued)

- distribution system between the source and the storage structure.
- b. Altitude valves or equivalent controls may be required for a second and subsequent structures on the system.
- c. Overflow and low level warnings or alarms should be located at places in the community where they will be under responsible surveillance 24 hours a day.

**VI.G CONSTRUCTION**

**VI.G.1 Atmospheric Storage Tanks**

The atmospheric storage tank shall be equipped with a properly bolted entry hatch to allow access for cleaning and painting of the tank and a filler pipe to provide for water to be trucked in. The filler pipe must be capped and locked. The tank shall also be equipped with a sight glass gauge, a screened vent pipe and a high and low water level signal system. There shall be a drain valve at the bottom of the accessible face of the tank. Drain lines must discharge to the ground. No direct connection to a sanitary sewer will be permitted;

DPUC 16-262-m8g

**VI.H DISINFECTION**

After November 15, 1948, in the case of construction of or repairs to any system of water supply furnished to the public, precautions shall be exercised in the handling, laying, or installing of water pipe, valves, or other structures through which water for potable purposes is delivered, so as to reduce to a minimum the entrance of foreign material and contamination, before such pipe, valves, or other structures are placed in service. After said date, no new main, standpipe, reservoir, tank or other pipe or structure through which water is delivered to consumers for potable purposes shall be put into service on any system of water supply furnished to the public, nor shall the use of any such structure or main be resumed after it has been cleaned or repaired, until such structure or main has been effectively disinfected; provided this shall not apply to mains, tanks, reservoirs or structures, the waters from which are subsequently adequately treated or purified.

PHC 19-13-B47

Upon completion of the construction of the community water supply system, the well(s), storage tank(s), and appurtenances must be disinfected, in accordance with procedures established by the Department of Health Services.

DPUC 16-262-m8(j)(3)

Finished water storage structures shall be disinfected in accordance with current AWWA Standard C652, most current revision. Two or more successive sets of samples, taken at 24-hour intervals, shall indicate microbiologically satisfactory water before the facility is placed into operation.

RSWW 7.0.18

- b. Disposal of heavily chlorinated water from the tank disinfection process shall be in accordance with the requirements of the state pollution control authority.
- c. The disinfection procedure (AWWA C652 chlorination method 3, section 4.3) which allows use of the chlorinated water held in the storage tank for disinfection purposes is not recommended. When that procedure

RSWW 7.0.18  
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is used, it is recommended that the initial heavily chlorinated water be properly disposed in order to prevent release of water which may contain various chlorinated organic compounds into the distribution system.