F.11 Cisterns

F.11.1 Cistern plan standards

1. Verify that the plans include an appropriate sequence of construction that is specific to the construction of the cistern. Refer to Section 4.5.5 for guidance. [Section 2.3.1]
2. Verify that the plans include an appropriate cross-sectional detail for the cistern. [Section 2.3.1]

F.11.2 Cistern design standards

1. Verify that irrigation as a use for runoff stored in a cistern is not a proposed strategy for meeting the Stormwater Regulations. [Section 4.5.1]
2. Verify that the time for drain down/withdrawal from the cistern for any portion of storage intended to meet the Water Quality requirement is within the acceptable 72-hour period after the 24-hour storm event. If the water demand fluctuates seasonally, verify that the cistern drains within 72 hours based on usage in all seasons. [Section 4.5.3, 1]
3. Verify that positive overflow is provided for large storm events, up to and including the 100-year, 24-hour storm event, or, if the project is exempt from Flood Control, the ten-year, 24-hour storm. [Section 4.5.3, 2]
4. Verify that overflow structures and pipes are designed to convey at least the ten-year, 24-hour storm event. [Section 4.5.3, 2]
5. Verify that the minimum allowable freeboard above maximum ponding depth is four inches or the diameter of the outlet pipe, whichever is greater. [Section 4.5.3, 3]
6. Verify that the proposed indoor uses and pipe labeling and routing (i.e., separate stud bays) are allowable per the City's Building and Plumbing Codes (administered by the City of Philadelphia Department of Licenses and Inspections (L&I)). [Section 4.5.3, 5]
7. Verify that appropriate treatment and management of harvested rainwater is proposed per State and Federal codes. [Section 4.5.3, 5]
8. In cases where a municipal backup supply is used, verify that rainwater harvesting systems propose backflow preventers or air gaps to keep non-potable harvested water separate from the potable water supply. Distribution and waste pipes, internal to the building, must be designated as such per the City's Building and Plumbing Codes (administered by L&I). [Section 4.5.3, 6]
9. Verify that pretreatment is provided for all runoff entering the cistern, including pretreatment of runoff from all inlets. At a minimum, this can be achieved through the use of sumps and traps for inlets, sump boxes with traps downstream of trench drains, and filter strips for overland flow. [Section 4.5.3, 8]
10. Verify that gutters and downspouts are fitted with leaf/debris screens along the entire length of the gutter leading to the cistern tank. Leaf/debris screens must be made from a corrosion-resistant material with screen openings in the range of 0.25 inches to 0.50 inches. Leaf screens must be inspected on a regular basis to prevent accumulated leaves and debris from clogging the gutter openings. [Section 4.5.3, 9a]
11. Verify that all inlets and vents to a cistern are protected by 1/6-inch stainless steel mesh screens, which keep insects, vermin, leaves and other debris from entering the cistern. [Section 4.5.3, 9b]

12. Verify that approximately one to two gallons of water per 100 square feet of roof collection surface are diverted to a first-flush chamber instead of the cistern tank. [Section 4.5.3, 10a]
13. Verify that, once the first-flush chamber is full, the remainder of the stormwater is directed to the cistern tank. A slow release control valve or drip system is typically included in the design to empty the first-flush chamber automatically in between storm events. [Section 4.5.3, 10b]
14. Verify that the first-flush diverter system includes an accessible cleanout. [Section 4.5.3, 10c]
15. Verify that the storage area provides adequate storage for the Water Quality Volume (WQv) between the overflow elevation and the controlling low flow orifice elevation. If the water reuse demand is less than the WQv, and only a portion of the WQv drains down or is withdrawn in 72 hours, only that portion of volume will be considered for compliance, and the remainder of the WQv must be managed by an additional SMP in series. Refer to Section 3.2.3 for information on using SMPs in series. Any portion of the storage that will not drain down or be withdrawn within 72 hours must be excluded from the system's storage volume estimation. [Section 4.5.3, 12]
16. Verify that, when SMPs are used in series, the storage areas for all SMPs provide cumulative static storage for the WQv. [Section 4.5.3, 13]
17. Verify that detailed calculations to demonstrate the anticipated daily, 72-hour, and monthly water use are provided. For toilet use, volume must be calculated based on the number of flushes per day multiplied by gallons per flush. [Section 4.5.3, 15]
18. If volume in excess of the WQv is proposed for on-site reuse and the volume is estimated by a weekly water balance of rainfall and water reuse, verify that the difference on a weekly basis between rainfall depth (in Table 4.5-1 of the Manual) and water depth is estimated. This deficit must be multiplied by the roof drainage area to obtain an estimate of the cistern volume needed. [Section 4.5.3, 16]
19. Verify that the cistern is watertight and sealed using a water-safe, non-toxic substance. [Section 4.5.3, 17]
20. Verify that cistern storage areas are adequately bedded with stone to prevent settling or subsidence. [Section 4.5.3, 18a]
21. Verify that bedding thickness is not less than six inches. [Section 4.5.3, 18b]
22. Verify that foundations/footers are provided as warranted by system loading, geotechnical conditions, and manufacturer's recommendations. Foundation designs must be performed by an appropriate design professional. [Section 4.5.3, 18d]
23. Verify that the storage design for subsurface cisterns accounts for potential loading from vehicles, as appropriate, based on expected maximum active loading, including consideration for emergency vehicles. [Section 4.5.3, 19]
24. Verify that the overflow conveyance has a capacity equal to or greater than the inflow pipe(s) and has a diameter and slope sufficient to drain the cistern while maintaining an adequate freeboard height. [Section 4.5.3, 20]
25. Verify that the overflow conveyance is screened to prevent access to the cistern by small mammals and birds. [Section 4.5.3, 20]
26. Verify that the discharge from the overflow is directed to an acceptable flow path that will not cause erosion. [Section 4.5.3, 20]
27. Verify that an adequate number of appropriately placed cleanouts, manholes, access panels and other access features are provided to allow unobstructed and safe access to the cistern for routine maintenance and inspection of inflow, outflow, underdrains, and storage systems. [Section 4.5.3, 22]
28. Verify that access features are provided for all subsurface cisterns. [Section 4.5.3, 23a]

29. Verify that a sufficient number of access points in the subsurface cistern are provided to efficiently inspect and maintain the storage area. [Section 4.5.3, 23b]
30. For cast-in-place vault systems, verify that access features consist of manholes or grated access panels or doors. Grated access panels are preferred to maintain airflow. [Section 4.5.3, 23c]
31. For manufactured systems, verify that the manufacturer's recommendations are followed. [Section 4.5.3, 23d]
32. Verify that ladder access is proposed for vaults greater than four feet in height. [Section 4.5.3, 23e]
33. Verify that the access opening for a subsurface cistern is installed in such a way as to prevent surface or groundwater from entering through the top of any fittings, and verify that it is secured/locked to prevent unwanted entry. [Section 4.5.3, 23f]

F.11.3 Cistern material standards

1. Verify that the cistern is not constructed of non-galvanized steel, wood, or other products prone to environmental corrosion/decay. [Section 4.5.4, 3]
2. Verify that the cistern is opaque or otherwise shielded to prevent the growth of algae. [Section 4.5.4, 5]
3. Verify that cleanouts are made of material with a smooth interior having an inner diameter that is no less than six inches. If the connecting pipe is eight inches in diameter or larger, verify that the cleanout is eight inches in diameter. [Section 4.5.4, 7]
4. Verify that the first-flush diverter system includes an accessible cleanout. [Section 4.5.4, 8]
5. Verify that serviceways consist of manhole openings with lockable manhole covers. Depending on the size of the cistern, multiple serviceway openings are recommended to support inspection, repair, and cleaning. [Section 4.5.4, 9]