

33 47 00 RAINWATER HARVESTING SYSTEMS

1. Applicability

- 1.1. The installation, construction, alteration, and repair of stormwater collection systems intended to supply water closets, urinals, trap primers for floor drains and floor sinks, industrial processes, water features, vehicle washing facilities, cooling tower makeup, and irrigation.

2. General

- 2.1. Designs must be approved by the UMN Civil Engineer.
- 2.2. All stormwater utility systems shall meet the requirements set forth in 33 40 00 - Stormwater Utilities standards.
- 2.3. Post construction permanent stormwater treatment systems shall meet the requirements set forth in 33 46 00 - Permanent Stormwater Treatment System standards.
- 2.4. For any project with proposed permanent stormwater treatment systems, regardless of project size, the Engineer of Record shall complete the Stormwater Treatment System Design Worksheet (Appendix M) during design.

3. Sizing

- 3.1. The storage capacity should be calculated as an instantaneous volume.

4. Contributing Runoff

- 4.1. Rainwater may be collected from areas as provided in the table below:

System Type	Runoff Surface
Irrigation	Prohibited: Surfaces with vehicular use and where winter maintenance includes chloride application
Industrial Process Vehicle Washing Cooling Tower Makeup Water Closets	Impervious and pervious surfaces including roof, vehicular parking, plazas, and other surface runoff

5. Acceptable Materials

- 5.1. Inlets, pipes, and structures that are part of the stormwater collection system
 - 5.1.A. Follow requirements set forth in 33 40 00.
- 5.2. Pipes carrying reclaimed water
 - 5.2.A. All pipes used for reclaim shall be purple in color.
 - 5.2.B. All pipes to be Schedule 40 PVC.
 - 5.2.B.1. Refer to 33 40 00, Section 4.2 for acceptable materials.
- 5.3. Cistern
 - 5.3.A. Precast concrete box culvert systems with integral or field installed end caps
 - 5.3.B. Cast-in-place concrete (CIP)

- 5.3.C. Other precast concrete systems
- 5.3.D. Steel reinforced high-density polyethylene pipe (SRPE)
- 5.3.E. Dual-wall high-density polyethylene pipe (HDPE)
 - 5.3.E.1. Allowed for pipe diameters 60" and smaller
- 5.3.F. **PROHIBITED:** Corrugated Metal (CMP)

6. Joints and Connections

- 6.1. All joints shall be watertight.
- 6.2. All connections shall be watertight.
- 6.3. Inlets, pipes, and structures that are part of the rainwater harvesting system
 - 6.3.A. Follow requirements set forth in 33 40 00.
- 6.4. Cistern joints
 - 6.4.A. HDPE/SRPE
 - 6.4.A.1. Fusion weld joints
 - 6.4.B. Box Culvert
 - 6.4.B.1. See UMN standard plate STM-0020 Box Culvert Watertight Joint.
 - 6.4.C. Other methods by design per the Engineer of Record.

7. Design Loading

- 7.1. The structural design of the cistern shall be appropriate for the anticipated soil loads and other dead loads.
- 7.2. Live load design shall accommodate HL93.
- 7.3. The design load shall not be less than 300 pounds per square foot for the top surface of the cistern.

8. Anchoring

- 8.1. Certain materials may require anchoring to avoid uplift/floating.
- 8.2. The combined weight of the cistern and hold system shall exceed the buoyancy force of the cistern.

9. Access

- 9.1. Cisterns shall be provided with structures for maintenance and access.
- 9.2. Access structures shall follow the requirements in 33 40 00, Section 8.
 - 9.2.A. Structures shall be a minimum of 48" diameter.
 - 9.2.A.1. The cistern opening shall be a minimum 27" diameter and tangential to the inside of the cistern to allow for aligned steps to the bottom of the cistern.
 - 9.2.B. Structure shall have steps meeting requirements in 33 40 00.
- 9.3. Access Structure Locations
 - 9.3.A. Access structures are preferred in level areas so that proper confined space entry equipment can be safely used. The surrounding grade should be sloped away from the structure opening.
 - 9.3.B. A minimum of two access structures are required with one proximate to each drain-down/overflow piping location(s).

- 9.3.C. A minimum of one access structure shall be placed along each pipe run.
- 9.3.D. Access spacing and location shall consider maintenance limitations.
 - 9.3.D.1. Confined space entry shall be considered.
 - 9.3.D.2. Vacuum truck limitations shall be considered.

10. Draining, Overflow, and Supply

10.1. Drain-Down Pipe

- 10.1.A. Drain-down pipe shall be provided and sized to allow the complete discharge of a full cistern to the storm sewer system within 24 hours.
- 10.1.B. Shall be gravity drained.
- 10.1.C. The drain-down pipe shall be controlled by a valve in a structure outside of the cistern.
 - 10.1.C.1. Valve shall be operated from the surface.
- 10.1.D. The drain-down pipe shall be ductile iron pipe not less than 6" diameter.

10.2. Overflow

- 10.2.A. Cistern overflow shall be controlled by a weir and the overflow shall be sized to be not less than the aggregate cross-sectional area on the inflow pipes to the cistern.
- 10.2.B. Shall be gravity drained.

10.3. Supply Pipe to Reuse Application

- 10.3.A. The supply pipe shall be controlled by a valve.
 - 10.3.A.1. Valve shall not be located inside the cistern and operable without confined space entry.
- 10.3.B. Design of this pipe shall be coordinated with the Mechanical Engineer of Record, if applicable.

10.3.C. At the discretion of the UMN Civil Engineer, metering may be required depending on the application.

11. Inlets

- 11.1. Site and exterior storm sewer appurtenances such as catch basins, area drains, and structures shall be configured to minimize direct connections to the cistern.
- 11.2. Appurtenances directly upstream of the cistern shall be constructed as pretreatment structures.
 - 11.2.A. Exemption: Building rain leader ONLY connections
 - 11.2.B. **PROHIBITED:** Grated inlets directly connected to the cistern

12. Venting

- 12.1. A vent shall be installed on each cistern.
- 12.2. Down-turned U-shaped vents
 - 12.2.A. Shall extend from the top of the cistern and terminate a minimum of 12" above grade.
 - 12.2.B. Shall be a minimum of 1½" diameter.
- 12.3. Riser with grated lid
 - 12.3.A. Casting shall extend 4" above the finished grade.
 - 12.3.B. Cannot be used where pedestrian traffic is anticipated.
 - 12.3.C. May be used as an access riser.

12.3.D. Shall not be located directly above a cistern.

13. Acceptance Testing

13.1. Precast Concrete

13.1.A. Per MNDOT Standard Specification 3238, precast concrete products will be inspected and tested at the plant. Field personnel such as contractors and inspectors, are responsible for checking for the plant inspector's stamp, for shipping/handling damage or defects, and dimensions.

13.1.B. Per MNDOT Standard Specification 3728, bituminous mastic joint sealer shall be visually inspected for defects.

13.2. Cast-In-Place Concrete (CIP)

13.2.A. The Engineer of Record shall develop acceptance testing specifications.

13.3. Steel reinforced high-density polyethylene pipe (SRPE) and dual-wall high-density polyethylene pipe (HDPE)

13.3.A. Visual inspection of the joints

13.4. Watertight

13.4.A. Cistern shall hold water for 72 hours.

13.4.A.1. Losses due to evaporation will be considered.

END OF SECTION