

CHAPTER 11

STORM DRAINAGE

1101.0 General.

1101.1 Where Required. All roofs, paved areas, yards, courts, and courtyards shall be drained into a separate storm sewer system, or into a combined sewer system where a separate storm sewer system is not available, or to some other place of disposal satisfactory to the Authority Having Jurisdiction.

1101.1.1 Disposal. All points of disposal shall meet with the provisions of this code and those of the department having jurisdiction. Such drainage shall not be discharged to any subsurface sewage disposal system, foundation or footing drain or to any location which could contribute to a nuisance or to conditions detrimental to the well being of persons or property. The disposal of all such drainage shall be in compliance with local ordinances, state rules and regulations.

1101.2 Storm Water Drainage to Sanitary Sewer Prohibited. Storm water shall not be drained into sewers intended for sanitary drainage only.

1101.2.1 Traps Required for Combined Sewers. Storm water from an exterior area drain, catch basin, or from a roof and discharging to a combined sewer shall be trapped. The trap shall be of approved design and located in the storm drain line between the sanitary sewer connection and the inlet opening into which storm is discharged.

More than one roof drain or other storm receptor drain may be served by a single trap when the trap is located so as to receive, through its inlet side, all drainage from roof drains and receptors.

Storm water drainage traps shall be below the frost line or within the building. An accessibly located cleanout not smaller than the size of the trap, shall be extended to grade from the inlet side of each such trap with approved piping and fittings. When the cleanout is installed on the exterior of the building, it shall extend at least six (6) inches (150 mm) above grade and be within twenty-four (24) inches (609.6 mm) of the foundation unless otherwise approved by the Authority Having Jurisdiction.

Exception: When a roof drain is located not less than ten (10) feet (3 m) from, or at least three (3) feet (0.9 m) above any openable window, door, opening, air intake, or vent shaft, or not less than three (3) feet (0.9 m) in every direction from any lot line, road, ally and street lines excepted, no trap is required.

Traps, trap primers and vents for exterior area drains and catch basins when located less than ten (10) feet

(3 m) from any building, shall be the same as for floor drains and catch basins located within a building when such drains are connected to a combined sewer as required by this code.

1101.3 Material Uses. Rainwater piping placed within the interior of a building or run within a vent or shaft shall be of cast iron, galvanized steel, wrought iron, brass, copper, lead, Schedule 40 ABS DWV, Schedule 40 PVC DWV, stainless steel 304 or 316L (stainless steel 304 pipe and fittings shall not be installed underground and shall be kept at least six inches (152 mm) aboveground), or other approved materials. Fittings shall be the same as that specified for sanitary drainage pipe, except that ninety (90) degree sanitary tee branch fittings may be used in lieu of combination wye and one-eighth (1/8) bends. Short-turn ninety (90) degree bends may be substituted for long-turn ninety (90) degree bends. Fittings installed in a storm drain between a trap and a connection to a combined sewer shall be the same as those for sanitary drainage work. Inside conductors shall connect to an approved roof or deck, or overflow drain. ABS and PVC DWV piping installations shall be installed in accordance with IS 5, IS 9, and Chapter 15 "Firestop Protection." Except for individual single-family dwelling units, materials exposed within ducts or plenums shall have a flame-spread index of not more than 25 and a smoke-developed index of not more than 50, when tested in accordance with the Test for Surface-Burning Characteristics of the Building Materials (see the Building Code standards based on ASTM E-84 and ANSI/UL 723.).

Exterior storm drainage piping and fittings may be CPE as listed in Table 14-1.

1101.3.1 The installation of building storm sewers shall conform to all requirements applicable under this code.

1101.3.2 Building storm sewers located two (2) feet (1.5 m) or more away from any building or property line, except roads, streets or alleys, shall be of cast iron, vitrified clay, concrete, asbestos cement, ABS, PVC, CPE, or other pipe meeting standards approved by the Authority Having Jurisdiction.

1101.3.3 Fittings shall be the same as specified for sanitary sewers in Section 715 of this code.

Exception: Approved taps may be installed as per manufacturer's listing when first approved by the Authority Having Jurisdiction.

1101.3.4 Cleanouts shall be required and shall be installed as per Section 707 of this code.

1101.3.5 Joints and connections shall be as prescribed in Section 715.2 of this code.

1101.3.6 All pipe or other products or appurtenances incidental to the installation of building storm sewers shall conform to the requirements for approval of Chapter 3 of this code and shall be identified in a manner satisfactory to the Authority Having Jurisdiction.

1101.4 Expansion Joints Required. Expansion joints or sleeves shall be provided where warranted by temperature variations or physical conditions.

1101.4.1 Connections. Connections between inside conductors and roof, deck and overflow drains shall be made with approved adapter fittings as required by this code. Such connectors shall be provided with an expansion or approved swing joint. All rain or storm water piping within a building shall be watertight and shall be tested pursuant to Section 1109.0 of this code.

1101.5 Storm and Groundwater Drainage.

1101.5.1 Prohibited Use. No conductor pipe shall be used as a sanitary drain or vent; nor shall any sanitary drain or vent pipe be used as a conductor. Subsoil drains under and around buildings shall be used only to collect and drain groundwater.

1101.5.2 Subsoil, Foundation and Absorption Tile Drains. Groundwater collected or drained from under or around buildings shall be disposed of through approved pipe material, as follows:

- (1) **Disposal.** When practical, such groundwater shall be drained by gravity to a natural surface drainage course or other approved disposal site.
- (2) **Sump.** When groundwater is drained by gravity to a combination sewer or storm sewer system, the groundwater shall be drained into an accessible trapped sump or catch basin.

Exception: Subsoil drain lines covered with an approved filter fabric may connect to a combination sewer trapped as per Section 1101.2.1. Subsoil drain lines covered with an approved filter material may directly connect to the storm sewer.

All drainage pipe on the discharge side of such sump, trap or catch basin shall be tested as per Section 1109.0.

- (3) **Backwater Valves.** Subsoil, foundation, and absorption drains that are subject to reverse

flow shall be equipped with approved, accessible backwater valves as required by the Authority Having Jurisdiction.

- (4) **Ejectors.** Subsoil drains which cannot remove groundwater by gravity shall have the storm water lifted by means of an approved ejector. The discharge shall be drained into the building storm sewer, or an open drainage course, or other suitable disposal facility at least ten (10) feet (3 m) beyond the exterior of the building.
- (5) **Valves and Connections.** The discharge pipe from a pump or ejector used to lift groundwater shall be equipped with a swing check or backwater valve and a gate valve. If the gravity drainage line to which such discharge line connects is horizontal, the method of connection shall be from the top through wye branch fitting. The gate valve shall be located on the discharge side of the backwater or check valve.
- (6) **Venting.** Gastight and watertight receiving tanks or sumps shall be vented by means of an approved pipe not less than two (2) inches (5.8 cm) in size. All such vents must be properly terminated as required by the applicable section of this code.
- (7) **Tracer Wire.** All nonmetallic piping for yard, ground or storm water for building sewers shall have an electrically conductive tracer wire (18-gauge, insulated copper, or heavier, green in color or other approved materials) installed in the trench for locating the pipe in the future. The tracer wire shall run the full length of the installed pipe, with one end left above the finished grade at the building end of the pipe, or at a cleanout next to the building wall, and shall be clearly marked. The other end of the tracer wire shall be spliced into the serving utilities tracer wire, when present.
- (8) **Materials.** Storm drainage, groundwater drainage, rainwater piping systems, exterior building drains, subsurface, foundation, footing, under-slab and absorption drains shall be of materials approved by and specified in Section 701 of this code, except for corrugated metal storm sewers installed as per Oregon IS 29-04.

1101.5.3 Dry Wells; Construction, Use and Limitations.

1101.5.3.1 Construction. Where permitted by the Authority Having Jurisdiction, dry wells may be used. The Authority Having Jurisdiction may

require soil percolation tests. When authorized, dry wells may be of reinforced concrete rings with an inside diameter of not less than twenty-eight (28) inches (0.7 m) with a minimum depth of five (5) feet (1.5 m), measured from the bottom to the top of the reinforced concrete cover and set on undisturbed soil. All dry wells shall be covered with at least two (2) feet (0.6 m) of compacted earth when measured from the top of the lid to the finished grade. When first approved by the Authority Having Jurisdiction, dry wells may be constructed of brick or other approved material in of not less than four (4) inches (0.1 m) thickness. Brick or block may be assembled with or without openings, provided the openings on the outside of the dry well are not greater than three (3) inches (7.5 cm). This type of dry well shall have a brick arched top or an arched top of other approved materials.

1101.5.3.2 Location. No dry well shall be located closer than five (5) feet (1.5 m) of a property line nor closer than ten (10) feet (3 m) to any building unless approved by the Authority Having Jurisdiction. Each drainage connection to a dry well shall be made at the top center of the lid by the use of an approved ninety (90) degree waste fitting. Support of piping shall be as required by Chapter 3 of this code. Special permission may be granted to enter the side of the dry well when grade and structural conditions make top entrance impractical.

1101.5.3.3 Backfill. The particle size of the backfill surrounding a dry well shall be of sufficient size to prevent its incursion into the interior of the dry well. The backfill shall form a continuous layer around the dry well not less than six (6) inches (150 mm) in thickness and shall extend to the full height of the dry well.

Exception: When the dry well is installed in sandy-type soil an approved filter material shall be placed around the exterior of the liner to prevent infiltration of sand. The backfill shall be of native soil properly compacted.

1101.5.3.4 Abandonment. When required by the Authority Having Jurisdiction, every drywell which has been abandoned or has been otherwise discontinued from further use shall be completely filled with earth, sand, gravel, concrete, or other approved material.

1101.6 Building Subdrains. Building subdrains located below the public sewer level shall discharge into a sump or receiving tank, the contents of which shall be automatically lifted and discharged into the drainage system as required for building sumps.

1101.7 Areaway Drains. All open subsurface space adjacent to a building, serving as an entrance to the basement or cellar of a building, shall be provided with a drain or drains. Such areaway drains shall be two (2) inches (50 mm) minimum diameter for areaways not exceeding one hundred (100) square feet (9.3 m²) in area, and shall be discharged in the manner provided for subsoil drains. Areaways in excess of one hundred (100) square feet (9.3 m²) shall not drain into subsoil. Areaway drains for areaways exceeding one hundred (100) square feet (9.3 m²) shall be sized according to Table 11-2.

1101.8 Window Areaway Drains. Window areaways not exceeding ten (10) square feet (0.9 m²) in area may discharge to the subsoil drains through a two (2) inch (50 mm) pipe. However, window areaways exceeding ten (10) square feet (0.9 m²) in area shall be handled in the manner provided for entrance areaways (see Section 1101.7).

1101.9 Filling Stations and Motor Vehicle Washing Establishments. Public filling stations and motor vehicle washing establishments shall have the paved area sloped toward sumps or gratings within the property lines. Curbs not less than six (6) inches (152 mm) high shall be placed where required to direct water to gratings or sumps.

1101.10 Paved Areas. Where the occupant creates surface water drainage, the sumps, gratings, or floor drains shall be piped to a storm drain or an approved water course.

1101.10.1 Catch Basin Specifications.

1101.10.1.1 General. Catch Basins shall be made of approved material and sized to carry the designed capacity. Catch basins shall have an inside dimension of not less than twenty-four (24) inches (609.6 mm) and extend not less than twenty-four (24) inches (609.6 mm) below the water line. The catch basin can be either square or round and shall be provided with a top turned out flange of not less than two (2) inches (50.8 mm) and the outer edge raised to a height of a top edge of the grate. Catch basins made of cast iron shall have a wall thickness of not less than one-quarter (1/4) inch (6.4 mm) with sleeves attached for connecting the storm drain line, or have other attachment means. Cast iron and steel catch basins shall be asphalt coated inside and outside.

Steel-plate catch basins shall not be less than ten (10) gauge, joined with welded seams with sleeves attached for connecting the storm drain line or have other attachment means.

Concrete catch basins shall have a wall thickness of not less than four (4) inches (100 mm) and be reinforced with number four (4) steel rod installed at

intervals not to exceed six (6) inches (150 mm) on center. The inside surface shall have a trowel finish, constructed so as to be water tight. The size shall be the same as for cast-iron and steel catch basins.

1101.10.1.2 Trap. All catch basins shall be trapped by using an inverted one-quarter (1/4) bend or welded baffle. Traps so constructed shall provide no less than a six (6) inch (150 mm) water seal. When other than a turned down one-quarter (1/4) bend is provided, a cleanout shall be required as per Section 719 of this code.

1101.10.1.3 Outlets. Outlets installed in standard twenty-four (24) inch catch basins shall be at least three (3) inches (75 mm) and not larger than six (6) inches (150 mm). When outlets larger than six (6) inches (150 mm) are provided, a drawing and specifications shall be submitted to the Authority Having Jurisdiction for approval of the alternate sizing. All connections to catch basin outlets shall be made by approved methods.

1101.10.1.4 Catch Basin Grates. Grates for catch basins shall be made of approved materials and shall be capable of supporting the anticipated load. Grates shall be designed to prevent bicycle and wheelchair tires from entering or becoming entrapped.

1101.10.1.5 Protection of Piping; Structural Integrity. When drainage piping to or from any catch basin is subject to heavy vehicular traffic or other excessive loads, such piping shall be structurally designed to withstand all anticipated loads and shall be installed on a firm bed throughout its entire length.

1101.11 Roof Drainage.

1101.11.1 Primary Roof Drainage. Roof areas of a building shall be drained by roof drains or gutters. The location and sizing of drains and gutters shall be coordinated with the structural design and pitch of the roof. Unless otherwise required by the Authority Having Jurisdiction, roof drains, gutters, vertical conductors or leaders, and horizontal storm drains for primary drainage shall be sized based on a storm of sixty (60) minutes duration and 100-year return period. Refer to Table D-1 (in Appendix D) for 100-year, 60-minute storms at various locations.

1101.11.2 Secondary drainage. Secondary (emergency) roof drainage shall be provided by one of the methods specified in Section 1101.11.2.1 or 1101.11.2.2.

1101.11.2.1 Roof Scuppers or Open Side. Secondary roof drainage shall be provided by an open-sided roof or scuppers where the roof perimeter construction extends above

the roof in such a manner that water will be entrapped. An open-sided roof or scuppers shall be sized to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1101.11.1. Scupper openings shall be a minimum of 4" high and have a width equal to the circumference of the roof drain required for the area served, sized by Table 11-1.

1101.11.2.2 Secondary Roof Drain. Secondary roof drains shall be provided. The secondary roof drains shall be located a minimum of 2 inches above the roof surface. The maximum height of the roof drains shall be a height to prevent the depth of ponding water from exceeding that for which the roof was designed as determined by Section 1101.11.1. The secondary roof drains shall connect to a piping system conforming to Section 1101.11.2.2.1 or 1101.11.2.2.2.

1101.11.2.2.1 Separate Piping System.

The secondary roof drainage system shall be a separate system of piping, independent of the primary roof drainage system. The discharge shall be above grade, in a location observable by the building occupants or maintenance personnel. Secondary roof drain systems shall be sized in accordance with Section 1101.11.1 based on the rainfall rate for which the primary system is sized.

1101.11.2.2.2 Combined System. The secondary roof drains shall connect to the vertical piping of the primary storm drainage conductor downstream of any horizontal offset below the roof. The primary storm drainage system shall connect to the building storm water that connects to an underground public storm sewer. The combined secondary and primary roof drain systems shall be sized in accordance with Section 1106.0 based on double the rainfall rate for the local area.

1101.12 Cleanouts.

1101.12.1 Cleanouts for building storm drains shall comply with the requirements of Section 719.0 of this code.

1101.12.2 Rain leaders and conductors connected to a building storm sewer shall have a cleanout installed at the base of the outside leader or outside conductor before it connects to the horizontal drain.

Exception: Rain leader and conductors serving residential structures.

1101.13 All rainwater sumps serving “public use” occupancy buildings shall be provided with dual pumps arranged to function alternately in case of overload or mechanical failure.

1102.0 Materials.

1102.1 Conductors.

1102.1.1 Conductors installed aboveground in buildings shall be constructed of materials specified in Table 14-1.

1102.1.2 The inside of conductors installed above ground level shall be of seamless copper water tube, Type K, L, or M; Schedule 40 copper pipe or Schedule 40 copper alloy pipe; Type DWV copper drainage tube; service weight cast-iron soil pipe or hubless cast-iron soil pipe; standard weight galvanized steel pipe; stainless steel 304 or 316L (stainless steel 304 pipe and fittings shall not be installed underground and shall be kept at least 6 inches (152 mm) aboveground); or Schedule 40 ABS or Schedule 40 PVC plastic pipe.

1102.3 Underground Building Storm Drains. All underground building storm drains shall be constructed of materials specified in Section 701.0.

1102.4 Building Storm Sewers. Building storm sewers shall be constructed of materials specified in Section 715.0.

1102.4.1 Fittings. Fittings for exterior storm sewers shall be as required for drainage piping in Section 706.0.

1103.0 Traps on Storm Drains and Leaders.

1103.1 Where Required. Leaders and storm drains, when connected to a combined sewer, shall be trapped. Floor and area drains connected to a storm drain shall be trapped.

Exception: Traps shall not be required where roof drains, rain leaders, and other inlets are at locations allowed under Section 906.0, Vent Termination.

1103.2 Where Not Required. No trap shall be required for leaders or conductors that are connected to a sewer carrying storm water exclusively.

1103.3 Trap Size. Traps, when installed for individual conductors, shall be the same size as the horizontal drain to which they are connected.

1103.4 Method of Installation of Combined Sewer. Individual storm-water traps shall be installed on the storm-water drain branch serving each storm-water

inlet, or a single trap shall be installed in the main storm drain just before its connection with the combined building sewer. Such traps shall be provided with an accessible cleanout on the outlet side of the trap.

1104.0 Combining Storm with Sanitary Drainage.

The sanitary and storm drainage system of a building shall be entirely separate, except where a combined sewer is used, in which case the building storm drain shall be connected in the same horizontal plane through single wye fittings to the combined building sewer at least ten (10) feet (3,048 mm) downstream from any soil stack.

1105.0 Roof Drains.

1105.1 Material.

1105.1.1 Roof drains shall be constructed of materials specified in Table 14-1.

1105.1.2 Roof drains shall be of cast iron, copper or copper alloy, lead, or plastic.

1105.2 Dome or Strainer for General Use. All roof drains and overflow drains, except those draining to hanging gutters, shall be equipped with strainers extending not less than four (4) inches (102 mm) above the surface of the roof immediately adjacent to the drain. Strainers shall have a minimum inlet area above the roof level of not less than one and one-half (1-1/2) times the area of the conductor or leader to which the drain is connected.

1105.3 Strainers for Flat Decks. Roof drain strainers for use on sun decks, parking decks, and similar areas that are normally serviced and maintained may be of the flat surface type. Such roof drain strainers shall be level with the deck and shall have an available inlet area of no less than two (2) times the area of the conductor or leader to which the drain is connected.

1105.4 Roof Drain Flashings. Connection between the roof and roof drains that pass through the roof and into the interior of the building shall be made watertight by the use of proper flashing material.

1105.4.1 Where lead flashing material is used, it shall be a minimum of four (4) pounds per square foot (19.5 kg/m²).

1105.4.2 Where copper flashing material is used, it shall be a minimum of twelve (12) ounces per square foot (3.7 kg/m²).

1106.0 Size of Leaders, Conductors, and Storm Drains.

1106.1 Vertical Conductors and Leaders. Vertical conductors and leaders shall be sized on the basis of

the maximum projected roof area and Table 11-1.

1106.2 Size of Horizontal Storm Drains and Sewers. The size of building storm drains or building storm sewers or any of their horizontal branches shall be based upon the maximum projected roof or paved area to be handled and Table 11-2.

1106.4 Side Walls Draining onto a Roof. Where vertical walls project above a roof so as to permit storm water to drain to the roof area below, the adjacent roof area may be computed from Table 11-1 as follows:

- (1) For one (1) wall – add fifty (50) percent of the wall area to the roof area figures.
- (2) For two (2) adjacent walls – add thirty-five (35) percent of the total wall areas.
- (3) Two (2) opposite walls of same height – add no additional area.
- (4) Two (2) opposite walls of differing heights—add fifty (50) percent of the wall area above the top of lower wall.
- (5) Walls on three (3) sides – add fifty (50) percent of the area of the inner wall below the top of the lowest wall, plus allowance for the area of the wall above the top of the lowest wall, per (2) and (4) above.
- (6) Walls on four (4) sides – no allowance for wall areas below the top of the lowest wall – add for areas above the top of the lowest wall per (1), (2), (4), and (5) above.

1107.0 Values for Continuous Flow.

Where there is a continuous or semi-continuous discharge into the building storm drain or building storm sewer, as from a pump, ejector, air-conditioning plant, or similar device, one (1) gpm (3.8 L/min.) of such discharge shall be computed as being equivalent to twenty-four (24) square feet (2.2 m²) of roof area, based upon a rate of rainfall of four (4) inches (102 mm) per hour.

1108.0 Controlled-Flow Roof Drainage.

1108.1 Application. In lieu of sizing the storm drainage system in accordance with Section 1106.0, the roof drainage may be sized on the basis of controlled flow and storage of the storm water on the roof, provided the following conditions are met:

- (1) The water from a 25-year-frequency storm shall not be stored on the roof for more than twenty-four (24) hours.
- (2) During the storm, the water depth on the roof shall not exceed the depths specified in Table 11-4.

TABLE 11-3

Controlled-Flow Maximum Roof Water Depth

| Roof Rise,* | | Max Water Depth at Drain, | |
|-------------|--------|---------------------------|-------|
| Inches | (mm) | Inches | (mm) |
| Flat | (Flat) | 3 | (76) |
| 2 | (51) | 4 | (102) |
| 4 | (102) | 5 | (127) |
| 6 | (152) | 6 | (152) |

*Vertical measurement from the roof surface at the drain to the highest point of the roof surface served by the drain, ignoring any local depression immediately adjacent to the drain.

- (3) No less than two (2) drains shall be installed in roof areas of ten thousand (10,000) square feet (929.0 m²) or less, and no less than one (1) additional drain shall be installed for each ten thousand (10,000) square feet (929.0 m²) of roof area over ten thousand (10,000) square feet (929.0 m²).
- (4) Each roof drain shall have a precalibrated, fixed (nonadjustable), and proportional weir (notched) in a standing water collar inside the strainer. No mechanical devices or valves shall be allowed.
- (5) Pipe sizing shall be based on the precalibrated rate of flow (gpm) of the precalibrated weir for the maximum allowable water depth, and Tables 11-1 and 11-2.
- (6) The height of stones or other granular material above the waterproofed surface shall not be considered in water depth measurement, and the roof surface in the vicinity of the drain shall not be recessed to create a reservoir.
- (7) Roof design, where controlled-flow roof drainage is used, shall be such that the minimum design roof live load is thirty (30) pounds per square foot (146.5kg/m²) to provide a safety factor above the fifteen (15) pounds per square foot (73.2kg/m²) represented by the depth of water stored on the roof as indicated in Table 11-3.
- (8) Scuppers shall be provided in parapet walls. The distance of scupper bottoms above the roof level at the drains shall not exceed the maximum distances specified in Table 11-4

TABLE 11-4
Distance of Scupper Bottoms Above Roof

| Roof Rise,* Inches (mm) | | Maximum Distance of Scupper Bottom Above Roof Level at Drains, | |
|----------------------------|--------|--|---------|
| | | Inches | (mm) |
| Flat | (Flat) | 3 | (76.2) |
| 2 | (51) | 4 | (102.0) |
| 4 | (102) | 5 | (127.0) |
| 6 | (152) | 6 | (152.0) |

*Vertical measurement from the roof surface at the drain to the highest point of the roof surface served by the drain, ignoring any local depression immediately adjacent to the drain.

- (9) Scupper openings shall be a minimum of 4 inches high and have a width equal to the circumference of the roof drain required for the area served, sized by Table 11-1.
- (10) Flashings shall extend above the top of the scuppers.
- (11) At any wall or parapet, forty-five (45) degree (0.79 rad) cants shall be installed.
- (12) Separate storm and sanitary drainage systems shall be provided within the building.
- (13) Calculations for the roof drainage system shall be submitted along with the plans to the Authority Having Jurisdiction for approval.

1108.2 Setback Roofs. Drains on setback roofs may be connected to the controlled-flow drainage systems provided:

- (1) The setback is designed for storing water, or
- (2) The square footage of the setback drainage area is converted as outlined in Section 1108.0 to gpm, and the storm-water pipe sizes in the controlled-flow system are based on the sum of the loads.
- (3) The branch from each of the roof drains that are not provided with controlled flow shall be sized in accordance with Table 11-1.

1109.0 Testing.

1109.1 Testing Required. New building storm drainage systems and parts of existing systems that have been altered, extended, or repaired shall be tested as described in Section 1109.2.1 to disclose leaks and defects.

1109.2 Methods of Testing Storm Drainage Systems. Except for outside leaders and perforated or open-jointed drain tile, the piping of storm drain

systems shall be tested upon completion of the rough piping installation by water or air, and proved tight. The Authority Having Jurisdiction may require the removal of any cleanout plugs to ascertain whether the pressure has reached all parts of the system. Either of the following test methods shall be used:

1109.2.1 Water Test. After piping has been installed, the water test shall be applied to the drainage system, either to the entire system or to sections. If the test is applied to the entire system, all openings in the piping shall be tightly closed except for the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except for the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a ten (10) foot (3,048 mm) head of water. In testing successive sections, at least the upper ten (10) feet (3,048 mm) of the next preceding section shall be tested so that no joint of pipe in the building (except the uppermost ten (10) foot (3,048 mm) of a roof drainage system, which shall be filled with water to the flood level of the uppermost roof drain) shall have been submitted to a test of less than a ten (10) foot (3048 mm) head of water. The water shall be kept in the system or in the portion under test for at least fifteen (15) minutes before inspection starts; the system shall then be tight at all points.

1109.2.2 Air Test. The air test shall be made by attaching an air compressor testing apparatus to any suitable opening after closing all other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of five (5) psi (34.5 kPa) or sufficient pressure to balance a column of mercury ten (10) inches (254 mm) in height. This pressure shall be held without introduction of additional air for a period of at least fifteen (15) minutes.

1110.0 Abandoned Storm Sewers. Every abandoned storm sewer system or any parts thereof, shall be plugged or capped in an approved manner as determined by the enforcing agency.

TABLE 11-1
Sizing Roof Drains, and Vertical Rainwater Piping^{1,2,3}

| Size of Drain, Pipe, Inches | Flow, gpm | Maximum Allowable Horizontal Projected Roof Areas Square Feet at Various Rainfall Rates | | | | | |
|-----------------------------------|--------------|--|---------|---------|---------|---------|---------|
| | | 1 in./h | 2 in./h | 3 in./h | 4 in./h | 5 in./h | 6 in./h |
| 2 | 23 | 2,176 | 1,088 | 725 | 544 | 435 | 363 |
| 3 | 67 | 6440 | 3,220 | 2,147 | 1,610 | 1,288 | 1,073 |
| 4 | 144 | 13,840 | 6,920 | 4,613 | 3,460 | 2,768 | 2,307 |
| 5 | 261 | 25,120 | 12,560 | 8,373 | 6,280 | 5,024 | 4,187 |
| 6 | 424 | 40,800 | 20,400 | 13,600 | 10,200 | 8,160 | 6,800 |
| 8 | 913 | 88,000 | 44,000 | 29,333 | 22,000 | 17,600 | 14,667 |

TABLE 11-1 (Metric)
Sizing Roof Drains, and Vertical Rainwater Piping^{1,2,3}

| Size of Drain Pipe, mm | Flow, L/s | Maximum Allowable Horizontal Projected Roof Areas Square Meters at Various Rainfall Rates | | | | | |
|------------------------------|--------------|--|---------|---------|----------|----------|----------|
| | | 25 mm/h | 50 mm/h | 75 mm/h | 100 mm/h | 125 mm/h | 150 mm/h |
| 50 | 1.5 | 202 | 101 | 67 | 51 | 40 | 34 |
| 80 | 4.2 | 600 | 300 | 200 | 150 | 120 | 100 |
| 100 | 9.1 | 1,286 | 643 | 429 | 321 | 257 | 214 |
| 125 | 16.5 | 2,334 | 1,117 | 778 | 583 | 467 | 389 |
| 150 | 26.8 | 3,790 | 1,895 | 1,263 | 948 | 758 | 632 |
| 200 | 57.6 | 8,175 | 4,088 | 2,725 | 2,044 | 1,635 | 1,363 |

Notes:

1. The sizing data for vertical conductors, and drains are based on the pipes flowing 7/24 full.
2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch/hour (25 mm/hour) column by the desired rainfall rate.
3. Vertical piping may be round, square, or rectangular. Square pipe shall be sized to enclose its equivalent round pipe. Rectangular pipe shall have at least the same cross-sectional area as its equivalent round pipe, except that the ratio of its side dimensions shall not exceed 3 to 1.

TABLE 11-2
Sizing of Horizontal Rainwater Piping^{1,2}

| Size of Pipe, Inches | Flow at 1/8 in./ft. Slope, gpm | Maximum Allowable Horizontal Projected Roof Areas Square Feet at Various Rainfall Rates | | | | | |
|----------------------|--------------------------------|---|---------|---------|---------|---------|---------|
| | | 1 in./h | 2 in./h | 3 in./h | 4 in./h | 5 in./h | 6 in./h |
| 3 | 34 | 3,288 | 1,644 | 1,096 | 822 | 657 | 548 |
| 4 | 78 | 7,520 | 3,760 | 2,506 | 1,880 | 1,504 | 1,253 |
| 5 | 139 | 13,360 | 6,680 | 4,453 | 3,340 | 2,672 | 2,227 |
| 6 | 222 | 21,400 | 10,700 | 7,133 | 5,350 | 4,280 | 3,566 |
| 8 | 478 | 46,000 | 23,000 | 15,330 | 11,500 | 9,200 | 7,670 |
| 10 | 860 | 82,800 | 41,400 | 27,600 | 20,700 | 16,580 | 13,800 |
| 12 | 1,384 | 133,200 | 66,600 | 44,400 | 33,300 | 26,650 | 22,200 |
| 15 | 2,473 | 238,000 | 119,000 | 79,333 | 59,500 | 47,600 | 39,650 |

| Size of Pipe, Inches | Flow at 1/4 in./ft. Slope, gpm | Maximum Allowable Horizontal Projected Roof Areas Square Feet at Various Rainfall Rates | | | | | |
|----------------------|--------------------------------|---|---------|---------|---------|---------|---------|
| | | 1 in./h | 2 in./h | 3 in./h | 4 in./h | 5 in./h | 6 in./h |
| 3 | 48 | 4,640 | 2,320 | 1,546 | 1,160 | 928 | 773 |
| 4 | 110 | 10,600 | 5,300 | 3,533 | 2,650 | 2,120 | 1,766 |
| 5 | 196 | 18,880 | 9,440 | 6,293 | 4,720 | 3,776 | 3,146 |
| 6 | 314 | 30,200 | 15,100 | 10,066 | 7,550 | 6,040 | 5,033 |
| 8 | 677 | 65,200 | 32,600 | 21,733 | 16,300 | 13,040 | 10,866 |
| 10 | 1,214 | 116,800 | 58,400 | 38,950 | 29,200 | 23,350 | 19,450 |
| 12 | 1,953 | 188,000 | 94,000 | 62,600 | 47,000 | 37,600 | 31,350 |
| 15 | 3,491 | 336,000 | 168,000 | 112,000 | 84,000 | 67,250 | 56,000 |

| Size of Pipe, Inches | Flow at 1/2 in./ft. Slope, gpm | Maximum Allowable Horizontal Projected Roof Areas Square Feet at Various Rainfall Rates | | | | | |
|----------------------|--------------------------------|---|---------|---------|---------|---------|---------|
| | | 1 in./h | 2 in./h | 3 in./h | 4 in./h | 5 in./h | 6 in./h |
| 3 | 68 | 6,576 | 3,288 | 2,192 | 1,644 | 1,310 | 1,096 |
| 4 | 156 | 15,040 | 7,520 | 5,010 | 3,760 | 3,010 | 2,500 |
| 5 | 278 | 26,720 | 13,360 | 8,900 | 6,680 | 5,320 | 4,450 |
| 6 | 445 | 42,800 | 21,400 | 14,267 | 10,700 | 8,580 | 7,140 |
| 8 | 956 | 92,000 | 46,000 | 30,650 | 23,000 | 18,400 | 15,320 |
| 10 | 1,721 | 165,600 | 82,800 | 55,200 | 41,400 | 33,150 | 27,600 |
| 12 | 2,768 | 266,400 | 133,200 | 88,800 | 66,600 | 53,200 | 44,400 |
| 15 | 4,946 | 476,000 | 238,000 | 158,700 | 119,000 | 95,200 | 79,300 |

Notes:

1. The sizing data for horizontal piping are based on the pipes flowing full.
2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch/hour (25 mm/hour) column by the desired rainfall rate.

TABLE 11-2 (Metric)
Sizing of Horizontal Rainwater Piping^{1,2}

| Size of Pipe, mm | Flow at 10 mm/m Slope, L/s | Maximum Allowable Horizontal Projected Roof Areas Square Meters at Various Rainfall Rates | | | | | |
|------------------|----------------------------|---|---------|---------|----------|----------|----------|
| | | 25 mm/h | 50 mm/h | 75 mm/h | 100 mm/h | 125 mm/h | 150 mm/h |
| 80 | 2.1 | 305 | 153 | 102 | 76 | 61 | 51 |
| 100 | 4.9 | 700 | 350 | 233 | 175 | 140 | 116 |
| 125 | 8.8 | 1,241 | 621 | 414 | 310 | 248 | 207 |
| 150 | 14.0 | 1,988 | 994 | 663 | 497 | 398 | 331 |
| 200 | 30.2 | 4,273 | 2,137 | 1,424 | 1,068 | 855 | 713 |
| 250 | 54.3 | 7,692 | 3,846 | 2,564 | 1,923 | 1,540 | 1,282 |
| 300 | 87.3 | 12,375 | 6,187 | 4,125 | 3,094 | 2,476 | 2,062 |
| 375 | 156.0 | 22,110 | 11,055 | 7,370 | 5,528 | 4,422 | 3,683 |

| Size of Pipe, mm | Flow at 20 mm/m Slope, L/s | Maximum Allowable Horizontal Projected Roof Areas Square Meters at Various Rainfall Rates | | | | | |
|------------------|----------------------------|---|---------|---------|----------|----------|----------|
| | | 25 mm/h | 50 mm/h | 75 mm/h | 100 mm/h | 125 mm/h | 150 mm/h |
| 80 | 3.0 | 431 | 216 | 144 | 108 | 86 | 72 |
| 100 | 6.9 | 985 | 492 | 328 | 246 | 197 | 164 |
| 125 | 12.4 | 1,754 | 877 | 585 | 438 | 351 | 292 |
| 150 | 19.8 | 2,806 | 1,403 | 935 | 701 | 561 | 468 |
| 200 | 42.7 | 6,057 | 3,029 | 2,019 | 1,514 | 1,211 | 1009 |
| 250 | 76.6 | 10,851 | 5,425 | 3,618 | 2,713 | 2,169 | 1807 |
| 300 | 123.2 | 17,465 | 8,733 | 5,816 | 4,366 | 3,493 | 2912 |
| 375 | 220.2 | 31,214 | 15,607 | 10,405 | 7,804 | 6,248 | 5202 |

| Size of Pipe, mm | Flow at 40 mm/m Slope, L/s | Maximum Allowable Horizontal Projected Roof Areas Square Meters at Various Rainfall Rates | | | | | |
|------------------|----------------------------|---|---------|---------|----------|----------|----------|
| | | 25 mm/h | 50 mm/h | 75 mm/h | 100 mm/h | 125 mm/h | 150 mm/h |
| 80 | 4.3 | 611 | 305 | 204 | 153 | 122 | 102 |
| 100 | 9.8 | 1,400 | 700 | 465 | 350 | 280 | 232 |
| 125 | 17.5 | 2,482 | 1,241 | 827 | 621 | 494 | 413 |
| 150 | 28.1 | 3,976 | 1,988 | 1,325 | 994 | 797 | 663 |
| 200 | 60.3 | 8,547 | 4,273 | 2,847 | 2,137 | 1,709 | 1,423 |
| 250 | 108.6 | 15,390 | 7,695 | 5,128 | 3,846 | 3,080 | 2,564 |
| 300 | 174.6 | 24,749 | 12,374 | 8,250 | 6,187 | 4,942 | 4,125 |
| 375 | 312.0 | 44,220 | 22,110 | 14,753 | 11,055 | 8,853 | 7,367 |

Notes:

1. The sizing data for horizontal piping are based on the pipes flowing full.
2. For rainfall rates other than those listed, determine the allowable roof area by dividing the area given in the 1 inch/hour (25 mm/hour) column by the desired rainfall rate.