

GENERAL:

1. To provide minimum standards for Storm Drainage systems.
2. This section applies to stormwater conveyance systems outside the footprint of buildings. Building systems are covered in Section 22 0100.
3. All projects causing increases in impervious surface area shall employ methods to retain and treat additional storm runoff caused by the increase. Coordinate methods with Project Manager (PM) and local governing regulations.

DESIGN GUIDELINES:

1. Stormwater systems shall be designed using the actual time of concentration. The worst case of complete development, per current planning, or current conditions shall be used for calculation of offsite flow.
2. Generally, the Rational Formula shall be used for areas under 200-acres. Runoff coefficients shall consider percentage of impervious area and average site grade (slope).
3. Design Return Periods:
 - 3.1. 10 years for parking lots, park space, and open areas.
 - 3.2. 25 years for all building sites, pedestrian malls, streets, quadrangles, and storm sewer piping.
 - 3.3. 100 years for all buildings and structures such that no entry of water is allowed through entrances, window wells, area ways, basements, drains, etc. Design shall maintain positive drainage away from building entrances.
 - 3.4. Project Manager (PM) will establish "return periods" for all other areas.
 - 3.5. Return period must satisfy governing municipality's regulations. Designer will compare above return periods with those required by the local municipality. Coordination with municipality may be required and should be reviewed with the PM. Any discrepancies will be discussed with the project manager.
4. Piping size shall be designed using Manning's Equation. Minimum slope of storm piping shall be .5% and minimum velocity 2 ft/sec.
5. Pipe Size:
 - 5.1. Building downspout drains shall be 4" minimum.
 - 5.2. Area drains shall be 8" minimum.
 - 5.3. Storm sewer piping shall be 12" minimum.
 - 5.4. Standard sizes (inches); 4, 8, 12, 15, 18, 24, 30, 36, 42

6. Drain tiles shall be installed at footings and tied to sanitary or storm sewer system as allowed by local municipalities.
7. Downspouts shall be tied into storm sewers (in lieu of foundation drain tiles) and cannot discharge on grade.
8. Storm junction boxes shall be installed at all connections to storm sewer piping.
9. No ponding is allowed on paved areas.
10. Detention basins shall be labeled on the drawings.
11. Sidewalk grade shall be set to prevent surface from collecting and channeling surface drainage.
12. Particular attention will be paid to bicycle and wheelchair safety in the design of storm drainage systems. Grate bars will be placed perpendicular to direction of traffic flow. Grates in pedestrian areas should be sized to avoid catching heels of shoes.
13. **MU only**, The City of Columbia standard “Type M” curb inlet used for all work not in the public right-of-way, shall be modified to remove setbacks, and gutter deflectors.
14. Storm sewer piping less than 36” in diameter shall run on a straight line and grade between structures. Horizontal and vertical bends are permitted in less than 12” lines, provided a cleanout is included. The deflection should utilize a wye with the cleanout as an upstream extension of the downstream line’s alignment.
15. Bury and backfill:
 - 15.1. Minimum and maximum pipe backfill coverage limits shall be per pipe manufacturers installation requirements.
 - 15.2. Maximum depth of fill above HPP pipe shall not exceed 9 feet.
 - 15.3. Backfill methods that vary from the manufacturer’s installation requirements shall be approved by the “Engineer of Record”.
16. Tracer wire shall be installed for all new or fully replaced sewer installations in public right of way.

SPECIFICATION REQUIREMENTS:

1. Drain Tiles
 - 1.1. Perforated pipe for subgrade drains shall be SDR-35 or Schedule 40 PVC.

- 1.2. Pipe shall be installed in a geotextile envelope with clean rock. Perforated pipe in a 'sock' is not acceptable.
2. Downspouts Drainage (4" minimum)
 - 2.1. Preferred Material - Polyvinyl chloride (PVC) pipe conforming to ASTM D3034. Pipe compound ASTM D1784. Gasket ASTM F477. Integral Bell Joint: ASTM D3212. SDR 26. Color: Green.
 - 2.2. PVC fittings shall conform to ANSI D3034/F1336 SDR 26 PSM PVC, with solvent welded joints.
 - 2.3. Ductile iron conforming to ASTM A746 with cement interior lining and asphaltic coating on the interior and exterior conforming to ANSI/AWWA C104/A21.4. ANSI/AWWA C111/A21.11 rubber gaskets.
 - 2.4. Ductile Iron fittings shall conform to ANSI/A21.10 with the joint meeting the requirements of ANSI/A21.11 for push-on joints.
 - 2.5. Ductile iron pipe shall be encased V-Bio polyethylene wrap conforming to ANSI/AWWA C105/A21.5
 - 2.6. Couplings shall be shielded with stainless steel shear rings to prevent pipe dislocation. Fernco Strong Back 1000 or approved equal.
3. Area Drain Piping, (8" & under)
 - 3.1. Preferred Material - Polyvinyl chloride (PVC) pipe conforming to ASTM D3034. Pipe compound ASTM D1784. Gasket ASTM F477. Integral Bell Joint: ASTM D3212. SDR 26. Color: Green.
 - 3.2. PVC fittings shall conform to ANSI D3034/F1336 SDR 26 PSM PVC.
 - 3.3. Ductile iron conforming to ASTM A746 with cement interior lining and asphaltic coating on the interior and exterior conforming to ANSI/AWWA C104/A21.4. ANSI/AWWA C111/A21.11 rubber gaskets.
 - 3.4. Ductile Iron fittings shall conform to ANSI/A21.10 with the joint meeting the requirements of ANSI/A21.11 for push-on joints.
 - 3.5. Ductile iron pipe shall be encased V-Bio polyethylene wrap conforming to ANSI/AWWA C105/A21.5
 - 3.6. Couplings shall be shielded with stainless steel shear rings to prevent pipe dislocation. Fernco Strong Back 1000 or approved equal.
4. Storm Sewer Pipe (12" & greater)
 - 4.1. Preferred Material - High Performance Polypropylene Pipe (HPP) having a smooth interior and an annular corrugated exterior.
 - i Where up to 30 inches in diameter HPP pipe shall meet or exceed ASTM F2736.
 - ii Where 36 to 60 inches diameter HPP pipe shall meet or exceed ASTM F2881.

- iii AASHTO loading requirements shall be met.
 - iv Minimum gage of piping shall be per manufacturers recommendations.
- 4.2. Reinforced Concrete Pipe (RCP) conforming to ASTM C76 or AASHTO M170, Class 3 minimum, and asbestos-free.
- i Joints shall be flexible rubber gasket conforming to ASTM C443 or ASTM C361.
- 4.3. **MS&T only:** High Density Polyethylene Pipe (HDPE) up to 48" in diameter, can be used in all areas, except easements and roadways, conforming to AASHTO M294 and ASTM F2306, HDPE pipe to be ADS N-12 WT IB, smooth interior, dual wall or approved equal is another option.
5. Fittings and Connections
- 5.1. All connections and fittings shall be compatible and approved for use with piping system being installed.
 - 5.2. Tee connections into HPP Storm Sewer Pipe shall be Inserta-Tee lateral connection manufactured by ADS Pipe or MU engineer approved equivalent.
6. Inlets and Junction Boxes
- 6.1. May be cast-in-place or precast conforming to ASTM C478.
 - 6.2. Storm manholes (junction boxes) shall use a Deeter 1247, Neenah R-1642, or exact equal frame and lid. The lid shall be lettered with the words 'Storm Sewer' or 'Storm Drain'.
 - 6.3. Structures over 3-feet from lid to lowest flow line shall include steps. Steps shall be Neenah 1980-J, Deeter 1606, M.A. Industries PS2-PF, or equal.
 - 6.4. Manholes shall have eccentric top sections.
7. Trace Wire & Test Stations
- 7.1. MU: Tracer Wire shall be #14 AWG solid, steel core soft drawn high strength tracer wire, 250# average tensile break load, 30 mil High Molecular Weight (HMWPE) or High Density (HDPE) polyethylene jacket complying with ASTM-D-1248, 30 volt rating. Jacket color shall be green. No THHN insulated wire shall be allowed. Tracer wire shall be Copperhead Industries HS-CCS or approved equal. The tracer wire shall be taped to the pipe at the three o'clock position every 5 feet. The tracer wire ends will terminate in manhole near lid, or a tracer wire test station.
 - 7.2. MU: Tracer wire shall have moisture resistant splices for direct bury applications. Splices shall be Copperhead Industries Snakebite or 3M DBR or approved equal.

- 7.3. MU: Tracer Wire test stations shall be installed in locations where a manhole is not available to terminate a run. These test stations shall be designed to be easily detected by magnetic and electronic locators. A magnet shall be securely attached at the top of the upper tube of the box for locating purposes. Lid shall be green and have a brass terminal for attaching locating equipment and a brass 5 sided nut for removing cap. Tracer wire test station shall be Copperhead Industries Snake Pit or approved equal.
- 7.4. MS&T, UMSL and UMKC: Tracer wire shall be #12 THHN attached to top of pipe at 5' intervals. Tracer wire ends to terminate in manhole near the lid with 5' coil of wire.

8. Warning Tape

- 8.1. Install warning tape at least 12" above the top of pipe. Warning tape shall be 100% plastic.

INSTALLATION REQUIREMENTS:

1. Installation Requirements

- 1.1 Piping and fittings shall be installed per manufacturer's instructions and ASTM D2321-20.
- 1.2 Inserta-Tee penetrations into HPP Storm Sewer Pipe shall be made with correctly sized Inserta-Tee core saw.
- 1.3 Installation details shall be same as local municipality details where storm sewer is being installed.