4 Stormwater Construction Standards

4.1 General

A. This Section specifies requirements for a stormwater management (aka drainage) systems, including conveyance and water quality structures.

B. Groundwater and stormwater runoff should be managed on-site to the extent possible. On-site retainage of stormwater and implementation of other stormwater management measures to control the rate, volume and characteristics of stormwater discharged to the City's storm drainage systems shall be required whenever feasible, with exceptions to be approved by the City. Storm drains, catch basins, manholes, retention/detention structures, water quality structures, permeable surfaces, and related best management practices (BMPs), shall be installed where necessary to provide adequate treatment and onsite infiltration or offsite disposal of surface water from all streets and adjacent land as shown on the proposed plans that require approval by the City prior to construction.

C. Groundwater shall not be managed by or discharged (such as by sump pumps) into the stormwater system. Lowest level floors and the bottom of stormwater BMPs should be at least 3 feet, but no less than 2 feet, above the seasonal high ground water table. The seasonal high ground water table should be field verified at the site.

D. No stormwater discharge shall cause or contribute to an exceedance of water quality standards. Additional stormwater quality controls may be required to reduce pollutant loading from drainage systems that ultimately discharge to a water body listed as an impaired water on the most recent Massachusetts Integrated Report of Waters.

E. Stormwater drainage systems shall incorporate Low Impact Development (LID) techniques, where feasible.

F. No stormwater discharge (point or sheet flow) shall cause flooding or erosion on adjacent properties. Driveways, aprons, and other entrances to the street shall be constructed to prevent roadway drainage from entering the private property.

G. Work under this section shall comply with federal, state, and local requirements. All private and public stormwater management systems shall comply with the most current National Pollutant Discharge Elimination System (NPDES) requirements.

H. The Developer shall process and record permanent easements for communal drainage structures or BMPs located on private property.

I. Calculations and designs shall demonstrate compliance with the DEP Stormwater Management Standards. The specified design storms shall be defined as a 24-hour storm using the rainfall distribution recommended by the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, as amended.

I. Submittals required for stormwater projects include:

1. Designs and calculations showing: post-construction runoff will be equal to or less than pre-construction conditions, recharge, and pollutant removal.
2. Erosion and sediment control plan
3. As-built Plans
4. Recorded easements

5. Long-term operation and maintenance plan for all permanent stormwater management measures. Such a plan shall include non-structural and structural measures to manage stormwater after construction of the new or expanded facility. An approved long-term operations and maintenance plan for that stormwater system shall be recorded with the deed at the Massachusetts Registry of Deeds.

4.2 Erosion Control

A. All construction shall comply with the City's By-Laws/Ordinances regarding clearing, erosion control, and stormwater management. In addition, construction shall comply with any applicable federal and state requirements, including but not limited to National Pollutant Discharge Elimination System (NPDES) Construction General Permit.

B. Silt fencing may be used as one of the primary erosion control measures. Silt fence shall consist of a sheet of synthetic fabric such as polypropylene, nylon, polyester, or polyethylene yarn. Silt fence shall be erected in a continuous fashion from a single roll of fabric. The bottom of the fabric fence shall be buried sufficiently below the ground surface to prevent gaps from forming, usually 4 to 6 inches below ground surface. The fabric shall be installed on the upstream side of the stakes. Stakes shall be strong enough and tall enough to securely anchor the fabric to the ground. Stake spacing shall be no more than 10 feet apart for extra-strength fabric and 6 feet apart for standard strength fabric. Maintenance of the fence is required during construction. Material shall be based on the synthetic fabric requirements as follows:

1. Filtering efficiency: 75% (minimum)
2. Tensile strength: Standard strength: 30 lb./linear inch (minimum), Extra strength: 50 lb./linear inch (minimum)
3. Elongation: 20% (maximum)
4. Ultraviolet radiation: 90% (minimum)
5. Slurry flow rate: 0.3 gal/ft2/min (minimum)

C. Fiber rolls or an approved equal may be used as another primary erosion control measures. Fiber rolls shall be trenched between 3 and 5 inches into the ground, depending on the size of the fiber roll. Fiber rolls shall be staked securely into the ground using wood stakes. A minimum of 3 inches of the stake shall stick out above the roll. Stakes shall be spaced 3 to 4 feet. Fiber rolls placed around drain inlets shall be placed a minimum of one (1) foot back from the inlet.

For slope stabilization, fiber rolls shall be placed perpendicular to the expected flow of stormwater runoff, with the following separation:

1:1 slopes = 10 feet apart
2:1 slopes = 20 feet apart
3:1 slopes = 30 feet apart
4:1 slopes = 40 feet apart

D. Gravel aprons shall be installed at the entrance of construction sites or where new roads under construction are being connected to the public way to prevent sediment from the construction site entering the roadway. Aprons shall be a minimum of 25 feet in length and the width of the proposed street or at least 15 feet in width and filled with 6 inches of 2-inch crushed stone. Regular maintenance to remove trapped dirt and to replace stone shall be provided to keep the public way clean.

E. Silt sacks (or equivalent) shall be placed in down gradient catch basins to prevent sediment from entering the drainage system. Silt sacks shall be periodically cleaned while in use and must be cleaned prior to and after precipitation events. Contractors are advised they may be required to

respond immediately for repair and maintenance at the request of the City within two hours of notification.

F. All soil stockpiles to be in place for more than 14 days shall have erosion controls (e.g., fiber rolls) installed on the down gradient side to prevent migration of soils.

G. All erosion and sediment controls shall remain in effective operating condition during construction activities. The contractor shall inspect all erosion and sediment controls regularly and make the necessary repairs or modifications to ensure effectiveness or as directed by the City Inspector.

H. The contractor shall initiate soil stabilization measures immediately whenever earth-disturbing activities have permanently or temporarily ceased on any portion of the site. The contractor shall complete soil stabilization measures as soon as practicable, but no later than 14 calendar days after the initiation of soil stabilization measures.

4.3 Private Connections to City Drainage System

A. In general, discharge of groundwater or stormwater runoff from sources on private property to the City's drainage system or right-of-way is prohibited. This includes sump pumps, foundation drains, roof downspouts, and runoff from driveways and yards. However, when suitable alternatives do not exist, private drainage systems may be connected to the City drainage system with approval from the DPW.

B. New private stormwater management systems that connect to the City's drainage system shall be approved by DPW and shall be constructed, installed, maintained, repaired, and operated to the satisfaction of the DPW

C. Private drains, including building storm drains for new or existing buildings, groundwater sump drains, cellar drains, and drains from irrigation systems, shall not be connected directly to the City's sanitary sewer system. Illicit connections to the sanitary sewer system shall be removed by the property owner at their expense.

D. For redevelopment projects, existing connections to the City's system that will remain connected shall be video inspected to verify pipe condition and ensure integrity prior to approval of redevelopment plans. The inspection should be witnessed by DPW staff.

E. Proposed private connections must discharge to the City's drainage system by gravity. If the private stormwater system is lower than the City's system, stormwater shall be lifted by approved means to a structure on the private property prior to connecting to the City's MS4.

F. The City assumes no responsibility for the installation and maintenance of private connections or for any damage that may result from their failure or from water backflow from the City's drainage system. The owner is required to submit a waiver to this effect, signed and dated by the owner.

G. Private connections shall include a backflow preventer, cleanout, and a shutoff device in such places that all fittings are accessible to the municipality.

4.4 Drainage Piping

4.4.1 Pipe Material

4.4.1.1 PVC

A. Polyvinyl chloride (PVC) pipe shall not be used in drainage systems within the City right-of-way or other roadways, except for underdrains.

B. The DPW prefers headwalls to pipe ends for most drainage conditions. Designs for pipe ends shall be submitted for approval by the DPW.

C. Minimum inside drainage pipe diameter – 12 inches

D. Outfall protection (e.g. headwalls, riprap) shall be constructed at the open ends of any drainage pipes.

4.4.1.2 High Density Polyethylene (HDPE) Pipe

A. The DPW prefers HDPE for drainage piping.

B. The pipe shall conform to MassDOT Section M5.03.10. Pipe shall be smooth interior wall and corrugated exterior wall, and be water-tight. Pipe shall be minimum 12-inch diameter. Ends shall be bell-and-spigot unless approved by the DPW for the specific application. Pipe shall comply with the requirements for test methods, dimensions and markings found in AASHTO Designations M252 and M294. Pipe shall support an HS-20 live load with a maximum deflection of 5% of the minimum pipe diameter. Pipe and fittings shall be made from virgin polyethylene compounds which conform to the applicable current edition of the AASHTO Material Specifications for cell classification as defined and described in ASTM D3350. Nominal sizes of 12- to 60-inch shall be either AASHTO Type 'S' or Type 'D.'

C. Flared end HDPE sections shall conform to MassDOT Section M5.03.10. They shall also meet AASHTO Designations M252 and M294 as well as cell specifications in ASTM D3350.

4.4.1.3 Reinforced Concrete Pipe (RCP)

A. Pipe and flared ends shall conform to the AASHTO M170 for Standard Strength Reinforced Concrete Culvert Pipe for class III Pipe, Wall B. or ASTM C76 for Reinforced Concrete Culvert and Storm Drain Pipe. All pipe 24 inches in diameter or smaller shall be of the bell and spigot type. Pipes larger than 24 inches in diameter shall be tongue and groove or bell and spigot. A preformed flexible plastic sealing compound of Butyl Mastic Rope Sealer ” 1" size, "EZ Stick" as manufactured by Concrete Products supply or an approved equal shall be used for sealing water-tight joints.

B. Flared end RCP sections shall be fabricated to conform to the requirements of AASHTO M170, Class III except the edge bearing tests shall not be required. The flare shall be of the same thickness and materials as the barrel and shall have steel reinforcement equaling or exceeding the requirements of AASHTO M170, Class III except that a double row of steel will not be required. The end sections shall meet MassDOT Standard Specifications Section 230 and MassDOT Construction and Traffic Standard Details Drawing 206.8.0.

4.4.2 Pipe Laying

A. Pipe, manholes, catch basins, and leaching basins shall be laid in any of the following materials, as specified hereafter or as approved by the inspector.

1. Pea stone (3/8 inch in size)
2. Angular crushed stone or rock, dense or open graded with little or no fines (¼ inch to 1 ½ inches in size).
3. AASHTO classifications A1 and A3: Clean, coarse grained materials, such as gravel, coarse sands and gravel/sand mixtures (1 ½ inches maximum in size).
4. AASHTO classifications A-2-4 and A-2-5: Coarse grained materials with fines including silty or clayey gravels or sands. Gravel or sand must comprise more than 50 percent of Class III materials (1 ½ inches maximum size).

5. Reuse of approved native material shall be sifted to remove rocks larger than 3 inches.

B. Pipe bedding material shall be carefully and lightly tamped under pipe to provide uniform support. Fill to a minimum depth of 12 inches above the top of the pipe. Material for backfilling the rest of the trench, except for sub base (top 15 inches) shall be suitable material, approved by the DPW Inspector. The compaction process shall be material placed in 12-inch lifts and thoroughly compacted by mechanical rammers, vibrators, or other methods to be approved by the Department (e.g., hydraulic plate compactors) to 90 percent Modified Proctor density in off-road or nonstructural areas and 95% in roadway or structural areas. Haunching large-diameter pipes (greater than 30 inches) shall be performed using maximum 8-inch lifts and compacted to 90 percent standard proctor density. Bucket compaction will not be accepted.

C. Minimum Drain Pipe Grades

1. Main lines and cross runs – grades 1% minimum
2. Building storm drainage stubs – 1% minimum
3. Subdrain – 0.5% minimum
4. All other – 0.5% minimum.
5. Any slope greater than 8% requires Department approval.

D. The bottom of the trench shall be excavated to a flat grade 6 inches below the pipe invert for trenches in suitable earth and 12 inches below pipe invert for trenches in rock. When rock or ledge is encountered it shall be removed to such widths as will give a clearance of at least 12 inches on each side of the pipe or other structure and a sand cushion used. The width of trenches shall be sufficient to allow thorough compacting of the refill adjacent to the lower quarters of the pipe

E. Water tight joints shall be used. Pipe shall be watertight according to the ASTM D3212. Joint design shall be bell-and-spigot with an elastomeric rubber gasket meeting ASTM F477 or equal approved by the DPW Inspector.

F. Trenches at pipe joints shall be excavated as necessary to give ample room for properly making and inspecting the pipe joints. RCP joints shall be cement mortared (as specified in MassDOT Section M4.02) carefully placed in the joints around its entire perimeter and mixed relatively dry, in the ratio of one part cement to two parts sand.

G. When laying pipe in groundwater, pipe material and method of installation shall be approved by the DPW Inspector. A qualified engineer shall be consulted to determine dewatering methods, if needed. Water must not be permitted to rise in the trench until all pipes have been securely bedded, jointed and observed by the City and until backfilling has progressed to an elevation at least one foot above the top of the pipe. Temporary plugs shall be installed in open ends of pipe to prevent silt from washing into pipe during construction; and open ends of the pipe shall be closed with suitable plugs upon suspension of the work for any reason.

H. The minimum cover over drainage pipes shall be 3 feet below the pavement slab or as specified by the type of pipe per manufacturer's specifications, whichever is greater. Where the clearance is less than 1 foot below the pavement, provide a design method to maintain the integrity of the pipe and right of way. For drainage pipe outside of the pavement, the minimum cover shall be 18 inches or as specified by the type of pipe, whichever is greater.

I. Pipe ends shall be accurately aligned on compacted gravel fill unless otherwise approved by the DPW. Rip Rap stone shall be placed to line and grade as shown on the plans on a prepared bed of embankment material or existing materials. Each stone shall be placed or embedded to prevent erosion and displacement. Stone size shall be determined by the design storm flow discharging from the pipe.

J. Drainage pipe shall be installed with minimum distance from water pipes as summarized below.

1. *Horizontal Separation:* Drainage mains shall be located at least 5 feet horizontally from sewer mains. The distance shall be measured from inside edge of pipe.
2. *Vertical Separation:* Drainage mains shall be laid to provide a separation of at least 18 inches from either water or sewer lines. The minimum vertical separation is measured from outside of water or sewer main to outside of the storm drain main.
3. At crossings, sewer should cross under drainage lines.
4. When it is impossible to obtain horizontal and/or vertical separation as stipulated above, DPW shall be given the opportunity to review and provide more stringent requirements.

4.5 Drainage Manholes

A. Drainage manholes shall have a minimum inside diameter of 4 feet minimum. Manholes over 12 feet in depth shall have minimum of 5 feet inside diameter.

B. A drainage manhole shall be located at any change in direction or slope of a drain pipe. A drainage manhole will be constructed at private connections to the City's drainage system, unless otherwise approved by DPW.

C. Manholes shall be constructed in series and shall have a distance of no more than 250 feet between manholes, unless otherwise approved by DPW.

D. Cross-drain inverts should, where possible, enter the structure a minimum of one foot (1') above the outgoing invert.

E. When drop manholes are used the drop shall not be more than 3 ½ feet.

F. Contractor shall excavate to a depth of 12 inches below the bottom of and all around the proposed manhole, compact and fine grade and install washed screened gravel as a sub-base material. Pipes shall extend no more than 3 inches inside the interior wall and all openings around pipe entrances and lift holes shall be thoroughly grouted with non-shrink grout prior to back filling. Compaction process shall be the same manner as compaction around pipe.

G. When ground water is higher than the elevation of the bottom of the manhole, ¾-inch to 1-inch washed stone shall be placed around structure to a distance of at least half-way up the barrel of the highest pipe. The manhole shall be tested for tightness prior to backfill and approval.

H. Precast Manholes shall be constructed of reinforced precast concrete monolithic base section, barrel section and dome section meeting the latest applicable requirements of ASTM C478 I and AASHTO M 199, or latest revision thereto. Special manholes shall also meet the requirements of MassDOT Standard Specifications, Section M4.02.14, Precast Units. After curing a minimum of 14 days, the outside surface of the tapered or cone section of precast cement concrete drainage structures shall be dried and cleaned. Pre-cast manholes shall not have steps installed.

I. Constructed in Place Manholes shall be built of precast sump, 6-inch concrete barrel blocks, and 4-inch (pie) plates with an inside diameter of 4 feet. Such manholes shall have a solid (impenetrable) sump. Cement concrete blocks shall conform to ASTM C139. As circular concrete block walls are laid, the horizontal joints and key ways shall be flush full with mortar. As rectangular blocks are laid, all horizontal and vertical joints shall be flushed full with mortar.

J. All joints between the frame, grade rings, dome, barrels and base shall be set in place with non-shrink mortar. Inside the manhole, all joints where the sealing material is not flush with the inside wall shall be grouted with nonshrink mortar and finished by hand / wet-brushed. Tongue and groove sections between barrel sections shall be mortared or use butyl rubber sealants.

K. Risers shall be brick, not concrete blocks. Risers shall be clay or shale brick, and shall conform to the requirements of AASHTO M 91, Grade MM or as specified in MassDOT M4.05.

L. Grade adjustments shall be made using either precast grade rings/risers or clay/shale bricks.

M. Live load design shall be H-20 loading.

N. Manhole frames and covers

1. Manhole frames and covers shall be minimum Class 25 conforming to ASTM “Standard Specification for Gray Iron Castings,” Designation: A48. Manhole frame shall have a clear opening of 26 inches and be a minimum of 6 inches in height.
2. The surface of the cover shall have a diamond pattern with the words "FRAMINGHAM DRAIN" if in the public right-of-way or “DRAIN” if on private property cast thereon for drainage manholes.
3. All manholes frames and covers shall be manufactured by East Jordan Iron Works (formerly LeBaron Foundry Co.) or an approved equal.
4. Manhole covers shall be watertight when placed in the 100-year flood plain, wetland areas, cross country easements, or as determined by DPW, and as specified in federal, state and local regulations. Manhole frames shall be set on a grout pad to make a watertight fit. Watertight manhole covers shall be secured with four (4) stainless steel bolts and have a watertight gasket. The frame and cover shall be watertight up to 15 psig external pressure.

N. The tops of frames and covers shall be set 1/8 inch below finish grade pavement in the street. Final grade locations for installations outside of the paved roadway shall be as approved by the DPW Inspector.

O. Frames shall be set upon a full bed of mortar, and mortar shall be brought up alongside of frame to provide a water-tight joint.

4.6 Catch Basins

A. Catch basins shall be installed on both sides of the roadway, at low points in the roadway, and near the upper point of curvature of the curb roundings of intersecting streets. Catch basins shall not be installed in the roadway within driveway entrances.

B. Catch basins shall be located so that the maximum distance which water will have to flow over the surface shall not be greater than 250 feet.

C. Catch basins shall be connected to manholes and not to other catch basins. Chain basins are prohibited.

D. All basins shall have a sump of at least 48 inches (4 feet) below the invert of the outlet pipe, or otherwise approved by the DPW, and an inside diameter of 4 feet minimum.

E. Contractor shall excavate to a depth of 12 inches below the bottom of and all around the proposed catch basin base, compact and fine grade and install washed screened gravel as a sub-base material. Pipes shall extend no more than 3 inches inside the interior wall and all openings around pipe entrances and lift holes shall be thoroughly grouted with non-shrink grout prior to back filling. Compaction process shall be the same manner as compaction around pipe.

F. When ground water is higher than the elevation of the bottom of catch basins, ¾-inch to 1-inch washed stone shall be placed 2 feet all around structure to a distance of the high ground water elevation. The stone shall be placed against and over the end of the pipe opening to prevent entrance of the finer filling material. The catch basin shall be tested for tightness prior to backfill and approval.

G. Precast Catch Basins shall conform to ASTM C478 and AASHTO M 199, or latest revision thereto. Live load design shall be H-20 loading. Catch basins which are limited by height shall be installed with a flat top slab, cast in place, designed for H-20 loading and cast iron frame cast in place.

H. Constructed in place catch basins shall be constructed of a precast sump, 6-inch cement block and 4-inch (pie) plates that conform to ASTM C139. Live load design shall be HS-25 loading.

I. Drop (aka Direct) inlet catch basins may be connected to standard catch basins. They shall not be connected to drainage manholes unless otherwise approved by DPW.

J. Circular concrete block walls are laid up the horizontal and key ways shall be flush full with mortar above the outlet invert. The dome or cone section shall be constructed in the same manner. The opening between the plates shall be filled with washed, screened gravel and left open. A 24-inch opening shall be left open at the top for a frame and grate.

K. Grade adjustments shall be made using either precast grade rings/risers or clay/shale bricks.

L. Catch basin grates shall be 24-inch square grate with an 8-inch heavy duty frame, East Jordan Iron Works (formerly LeBaron Foundry Co.), LF248-2-4F. Single or dual catch basin grate shall consist of a 24-inch square grate LeBaron Foundry Co. L24SG1-000 or approved equal with an 8-inch heavy duty frame (MassDOT Standard).

M. Grates shall have the following wording cast into the outside borders: "Dump No Waste" and "Drains to Waterway". Text shall be bold capital letters, at least 1 inch high. Placement may be as per manufacturer

N. All catch basins that do not have a flat top slab designed for H-20 loading and cast iron frame cast in place shall be installed using blocks to make a square hole that will accept a frame and grate, and there shall be at least two full courses of brick for frame adjustment.

O. The tops of frames and covers shall be set 1/8 inch below finish grade pavement in the street. Final grade locations for installations outside of the paved roadway shall be as approved by the DPW Inspector.

P. Frames shall be set upon a full bed of mortar, and mortar shall be brought up alongside of frame to provide a water-tight joint.

4.7 Granite Curb Inlets (Throat Stones)

A. Granite Curb Inlets shall be installed at all catch basins. Granite curb and inlets shall be constructed in conformance with MassDOT Standard Specification Section 501, except that cement concrete shall be placed beneath the center section of each curbstone and as backfill in front and behind the curb.

B. The back face for a distance of 3 inches down from the top shall have no projections greater than 1 inch. The front shall be straight split, free from drill holes, and shall have no projection greater than 1 inch or depression greater than 1/2 inch for a distance of 10 inches down from the top. For the remaining distance there shall be no depression or projection greater than 1 inch. The ends shall be squared with the top for the depth of the face finish. The granite curb inlet shall be 6 feet in length, plus or minus 1/2 inch from 17 to 19 inches in depth, 6 inches wide at the top and at least 6 inches wide at the bottom. The reveal shall be 10 inches.

C. Curb inlets set on a radius of 160 feet or less shall be cut to that radius. The gutter mouth at least 3 inches in depth and at least 2 feet in length shall be cut in the front face of the stone. If there is no other curbing, or as applicable, transitional curbing shall be required on both sides of the inlet. The transitional curbing shall be 6 feet in length, with a height equal to the inlet and tapering to grade at the end.

4.8 Drainage Swales

A. Drainage swales shall be stabilized with vegetation or rip rap to prevent erosion.

B. Drainage swales shall be designed to convey the 2-year and 10-year 24-hour storms.

C. The maximum depth of a swale shall be 24 inches. Side slopes shall be no steeper than 3:1 (horizontal: vertical) with a minimum grade of 0.5 percent and maximum grade of 5%. The minimum bottom width for a swale, whether earthen, gravel, or paved is 2 feet.

D. The bottom of the drainage swale shall be at least 3 feet above seasonal high water table or bedrock.

E. The use of swales draining across a sidewalk into the gutter is generally unacceptable. In those cases where necessary, DPW approval shall be required for the design.

4.9 Structural Stormwater BMPs

A. Post-construction structural Best Management Practices (BMPs) shall follow design practices outlined in Volume 2 of the Massachusetts Department of Environmental Protection (DEP) Stormwater Management Standards: "Structural BMP Specifications for the Massachusetts Stormwater Handbook". Stormwater BMPs shall be built in accordance with approved plans and manufacturer's specifications.

B. This document contains standards for some BMPs. The inclusion of these standards is not meant to be an exhaustive listing of approved BMPs. The *Massachusetts Stormwater Handbook* shall be considered as a guide for other BMPs.

C. In accordance with MS4 permit requirements, all stormwater management systems for new development must be designed to:

1. Retain the volume of runoff equivalent to, or greater than, one (1.0) inch multiplied by the total post-construction impervious surface area on the site OR

2. Remove 90% of the average annual load of Total Suspended Solids (TSS) generated from the total post-construction impervious area on the site AND 60% of the average annual load of Total Phosphorus (TP) generated from the total post-construction impervious surface area on the site. Pollutant removal shall be calculated consistent with EPA Region 1's BMP Accounting and Tracking Tool (2016) or other BMP performance evaluation tool provided by EPA Region 1, where available. If EPA Region 1 tools do not address the planned or installed BMP performance any federally or State approved BMP design guidance or performance standards (e.g. State stormwater handbooks and design guidance manuals) may be used to calculate BMP performance, OR

3. meeting a combination of retention and treatment that achieves the above standards.

D. In accordance with MS4 permit requirements, all stormwater management systems for redevelopment must be designed to:

1. Retain the volume of runoff equivalent to, or greater than, 0.8 inch multiplied by the total post-construction impervious surface area on the site OR

2. Remove 80% of the average annual load of Total Suspended Solids (TSS) generated from the total post-construction impervious area on the site AND 50% of the average annual load of Total Phosphorus (TP) generated from the total post-construction impervious surface area on the site. Pollutant removal shall be calculated consistent with EPA Region 1's BMP Accounting and Tracking Tool (2016) or other BMP performance evaluation tool provided by EPA Region 1, where available. If EPA Region 1 tools do not address the planned or installed

BMP performance any federally or State approved BMP design guidance or performance standards (e.g. State stormwater handbooks and design guidance manuals) may be used to calculate BMP performance.

a. Redevelopment activities that are exclusively limited to maintenance and improvement of existing roadways, (including widening less than a single lane, adding shoulders, correcting substandard intersections, improving existing drainage systems, and repaving projects) shall improve existing conditions where feasible and are exempt from part l above. Roadway widening or improvements that increase the amount of impervious area on the redevelopment site by greater than or equal to a single lane width shall meet these requirements.

E. Areas excavated for stormwater BMPs shall be backfilled with clean fill or aggregate.

F. An appropriate number of observation and access points shall be installed to enable inspections and maintenance.

4.9.1 Proprietary Separators

A. If constructed in the public right-of-way, the City has standardized on Stormceptor hydrodynamic separators or approved equal.

4.9.2 Infiltration BMPs

A. Infiltration BMPs are stormwater runoff impoundment constructed on or beneath the surface over permeable soils. Examples include: dry wells, infiltration pits, chambers, perforated pipes, and galleys. Infiltration systems shall be designed and constructed in accordance with The Massachusetts Stormwater Handbook and the EPA NPDES Small MS4 permit.

B. Pretreatment BMPs shall remove at least 25% TSS. In the following areas, at least 44% TSS shall be removed:

1. Areas with rapid infiltration (greater than 2.4 inches/hour);
2. Land use with a higher potential pollutant loads (LUHPPL);
3. Zone II or an Interim Wellhead Protection Area of a Public Drinking Water Source/Supply;
4. Discharge to or near a critical area (Outstanding Resource Waters or bathing beaches).

C. Infiltration systems shall be designed to treat the runoff volume generated by the 2-year and 10-year 24-hour storms.

D. The bottom of the infiltration system shall be at least 3 feet above seasonal high water table or bedrock.

E. Infiltration systems shall be placed only in soil where the permeability allows a percolation rate of at least 0.17 inch/hour. Percolation rates shall be field verified prior to completion of design, when feasible. Do not allow construction equipment to drive across the area intended to be used for infiltration.

F. The infiltration system shall be designed to drain within three days of filling under normal conditions, and completely dewater between storms.

G. Infiltration systems shall be placed at least 10 feet downslope or 100 feet upslope from any building foundations including slab foundations without basements. Systems shall be placed at least 10 feet from property lines.

H. Infiltration systems shall not be used in the following locations:

1. In industrial and commercial areas where petroleum products, herbicides, pesticides, or solvents may be loaded/unloaded, stored, or applied within the drainage area, especially locations with soluble heavy metals and toxic organics in the runoff;

2. In areas with documented soil contamination;
3. Where the soil around and below infiltration basin does not have the necessary permeability to infiltrate the entire Stormwater Quality Design Storm runoff volume; or
4. Where infiltration would create a significant risk for basement seepage or adversely impact a septic system's disposal field.

4.10 Testing of Drainage System

A. At the discretion of the Department, a mandrel test shall be conducted following completion of pipe laying.

B. Placement of curb, gutter, sidewalk, or asphalt concrete pavement shall not occur until the DPW Inspector has approved the mandrel test. The DPW Inspector shall be present through the duration of the mandrel testing.

C. The allowable deflection (reduction in vertical inside diameter) for all non-rigid pipe shall be 7.5 percent maximum. The deflection shall be tested by pulling a mandrel which is 92.5 percent of the inside pipe diameter through all installed pipe. The mandrel shall be the "go/no-go" type and shall be pulled without mechanical assistance. At each location in which the mandrel cannot pass, the cause shall be ascertained. Obstacles in the pipe shall be removed. If it is determined that the deflection exceeds 7.5 percent, that a gasket has been improperly installed or that the pipe has been damaged due to trenching for another utility, the respective section of pipe shall be re-bedded or removed, replaced and re-bedded using water tight repair couplings. A passing mandrel retest is required. At the contractor's discretion, any sections of non-rigid pipe not passing the mandrel test may be televised to ascertain the problem.

D. A CCTV inspection may be requested after installation, with the results being provided to the DPW.

4.11 Pipe/Structure Abandonment

A. Pipes left in place that are equal to or less than 6 inches in diameter may be left unfilled.

B. Pipes left in place that are greater than 6 inches in diameter shall be filled with LDCC.

C. Structures left in place shall be demolished down to five feet below ground surface, the bottom shall be cracked and compacted, and the remaining structure filled with CDF, LDCC, or clean gravel, as directed the City Inspector. Demolition debris shall be removed, and the area regraded and compacted over the filled structure.

4.12 Long-term Maintenance

A. Private stormwater management systems will be constructed, installed, maintained, repaired, and operated by their owners, at the owner's expense. Ongoing maintenance of stormwater management systems placed on private property, rather than within the City right-of-way limits, shall be responsibility of the property owner or homeowners' association.

B. The owner of any property on which a drainage system is located is responsible for the maintenance and upkeep of the system. The inspection and maintenance of the drainage systems shall be performed at minimum on an annual basis, and more frequently depending on the circumstances.

C. The owner shall provide documents that describe the long-term operation and maintenance of all permanent stormwater management measures. Such a plan shall include non-structural and structural measures to manage stormwater after construction of the new or expanded facility. An approved long-term operations and maintenance plan for that stormwater system shall be recorded with the deed at the Massachusetts Registry of Deeds.