Perforated pipe systems can be thought of as long infiltration trenches or linear soakaways that are designed for both conveyance and infiltration of stormwater runoff. They are composed of perforated pipes installed in gravel beds or stone reservoirs that are lined with geotextile fabric. The purpose of the stone bed is to hold the gravel and prevent clogging.

**CONSTRUCTION CONSIDERATIONS**

Soil Disturbance and Compaction
Before site work begins, locations of facilities should be clearly marked. Only vehicular traffic used for construction of the infiltration facility should be allowed close to the facility location.

Crossed Sediment Control
Infiltration practices should never serve as a sediment control device during construction. Construction activity should be isolated away from the proposed facility location. After the site is vegetated, erosion and sediment control strategies can be removed.

**GENERAL DESCRIPTION**

Perforated pipe systems can be constructed on any soil type, but hydrologically sensitive soils A or B should be avoided for achieving water balance objectives. If feasible, facilities should be located in portions of the site with the highest native soil infiltration rates. Designs should allow for the native soil infiltration rate at the proposed location and depth to maintain infiltration rates under field saturated conditions.

**DESIGN GUIDANCE**

**SITE CONSIDERATIONS**

- **Site Topography**
  - Stormwater systems can be located on natural slopes greater than 15%.
  - The gravel bed should be designed with a slope of 0.5% to 1.5%.

- **Drainage Area**
  - Typically designed with an impervious drainage area to the treatment facility area ratio of between 5:1 to 10:1.

- **Soil**
  - Perforated pipe systems can be located over any soil type, but hydrologically sensitive soils A or B should be avoided for achieving water balance objectives. If feasible, facilities should be located in portions of the site with the highest native soil infiltration rates.

**Erosion and Sediment Control**
Infiltration practices should never serve as a sediment control device during construction.

**Perforated Pipe Systems**

- Perforated pipe systems can be thought of as long infiltration trenches or linear soakaways that are designed for both conveyance and infiltration of stormwater runoff. They are composed of perforated pipes installed in gravel beds or stone reservoirs that are lined with geotextile fabric. The purpose of the stone bed is to hold the gravel and prevent clogging.

**GENERAL SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Material</th>
<th>Specification</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perforated pipes</td>
<td>Pipe should be continuously perforated, smooth interior, with a minimum inside diameter of 200 millimetres.</td>
<td></td>
</tr>
<tr>
<td>Stone</td>
<td>The trench in which perforated pipes are installed should be filled with washed 50 mm clear stone with a 40% void ratio.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Should be woven monofilament or non-woven needle punched fabrics. Woven felt and non-woven heat bonded fabrics should not be used as they are prone to clogging.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Around the gravel filled trench (stone reservoir).</td>
<td></td>
</tr>
</tbody>
</table>

**CONVEYANCE AND OVERFLOW**
Collection and conveyance of runoff into the perforated pipe system can be accomplished through conventional catchbasins and non-perforated pipes leading from foundation drain and downspouts. Perforated pipes should be smooth-walled to reduce the potential for clogging and facilitate cleanout. The gravel filled trench should be 75 to 150 mm deep above the perforated pipe. On-fine gravel, stone or plastic trenched beds can be installed across the gravel filled trench to reduce flow along the system, thereby increasing the potential for infiltration. Overflows from the gravel filled trench should either back up into manholes that are also connected to conventional storm sewers or be conveyed to a storm sewer or receiving water body overland flow.

**PRE-TREATMENT**
It is important to prevent sediment and debris from entering infiltration facilities because they could contribute to clogging and failure of the system. The following pre-treatment devices are common.

- In-ground devices: Devices placed between a conveyance pipe and the facility (e.g., oil and grit separators, sediment chambers, grass traps) that can be designed to remove both large and fine particulate from runoff. A number of proprietary filters devices are also available.
- Vegetated filter strips or grass swales: Road and parking lot runoff can be pre-treated with vegetated filter strips or grass swales prior to entering the infiltration practice.

**CONVEYANCE AND OVERFLOW**
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**FILTER MEDIA**
- Gravel filled trench: Should be filled with uniformly graded, washed, 50 mm clear stone that provides 40% void space.
- Geotextile: A non-woven needle punched or woven monofilament geotextile fabric should be installed around the stone reservoir of perforated pipe systems with a minimum overlap at the top of 500 mm.

**COMMON CONCERNS**
Risk of Groundwater Contamination
Most pollutants in urban runoff are well retained by infiltration practices and soils, and therefore are a low risk of potential groundwater contamination. To minimize risk of groundwater contamination: the following management practices are recommended.

- Infiltration practices should not receive runoff from high traffic areas where large amounts of de-icing salts are applied (e.g., busy highways), nor from pollution hot spots; stand water and mosquito pockets.
- Avoid infiltration of runoff from source areas that are comparatively less contaminated such as roads, low traffic roads and parking areas, etc.
- Apply sedimentation management practices (e.g., oil and grit separators) before infiltration of road or parking area runoff.

- Standing Water and Mosquitoes
  - Complete dryout should occur within 72 hours after a storm event, before mosquitoes have an opportunity to breed.

- Foundations and Seepage
  - Should be setback at least four (4) metres from building foundations to prevent base- ment flooding and diffusion during freeze-thaw cycles.
  - Winter Operation
    - Perforated pipe systems will continue to function during winter months if the inlet pipe and top of the gravel bed is located below the local minimum freeze penetration depth.

- Maintenance
  - With proper location and adequate pretreatment, perforated pipe systems can continue to function effectively with very low levels of maintenance activities. Like conventional stormwater conveyance infrastructure (i.e., catchbasins and storm sewers), perforated pipe systems are typically located on public property (e.g., within road right-of-way). Any advantage to incorporating these systems in stormwater management systems is that legal agreements with property owners or managers, to ensure long term operation and maintenance, are not needed.

**ABILITY TO MEET SWM OBJECTIVES**

<table>
<thead>
<tr>
<th>BMP</th>
<th>Water Balance Benefit</th>
<th>Water Quality Improvement</th>
<th>Stream Channel Erosion Control Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perforated Pipes Systems</td>
<td>Yes</td>
<td>Yes</td>
<td>Partial, depends on soil infiltration rate</td>
</tr>
</tbody>
</table>

**OPERATION AND MAINTENANCE**
Maintenance typically consists of clearing out leaves, debris and accumulated sediment. Periodic inspection, especially after snow melt or rainfall, is essential. Maintenance should be performed to ensure the facility drains within the maximum allowable acceptance length of time (typically 72 hours) at least annually and following every major storm event (>25 mm). The time required to dry out sediment ranges between 72 hours, drain via pumping, and the convective drying out the perforated pipe by flushing. If slow drainage periods, the system may need removal of the granular medium and/or geotextile liner. Perforated pipe systems should be located below shoulders of roadways, previous boulevards or grass swales where they can be readily excavated for servicing.

**CATEGORIC IMPACT DEPENDENT PLANNING AND DESIGN GUIDE**

**FOR FURTHER DETAILS SEE SECTION 4.10 OF THE CVC/TRCA LID SWM GUIDE**