Underground Infiltration System

Stormwater BMP Type

Pretreatment BMP	□
Infiltration BMP	■
Filtering BMP	□
Stormwater Pond BMP	□
Stormwater Wetland BMP	□
Water Quality Conveyance BMP	□
Stormwater Reuse BMP	□
Proprietary BMP	□
Other BMPs and Accessories	□

Stormwater Management Suitability

Retention	■
Treatment	■
Pretreatment	□
Peak Runoff Attenuation*	■

*Soils with high infiltration rates or when designed with additional storage

Pollutant Removal

Sediment*	**High**
Phosphorus	**High**
Nitrogen	**Low**
Bacteria	**High**

*Includes sediment-bound pollutants and floatables (with pretreatment)

Implementation

Capital Cost	**High**
Maintenance Burden	**Medium**
Land Requirement	**Medium**

Description

An underground infiltration system consists of open-bottomed storage chambers in a crushed stone reservoir. The chamber and crushed stone reservoir provide temporary storage for stormwater before it infiltrates into the underlying soil. A number of underground infiltration chamber products, including pipes, vaults, and modular structures, have been developed as alternatives to infiltration trenches and basins for space-limited sites and stormwater retrofit applications. Similar to traditional infiltration trenches and basins, these systems are designed to capture, temporarily store, and infiltrate stormwater runoff. Underground infiltration systems are typically designed as off-line systems for retention/runoff reduction, treatment, and groundwater recharge. These systems can provide stormwater quantity control for larger storms when used in soils with high infiltration rates or when designed with additional below-ground storage. The design and layout of these systems varies by manufacturer and system design.

While underground infiltration systems are more costly than other Infiltration BMPs that are located at the surface, they can be an effective approach to manage stormwater where there is little or no space on the surface.

Advantages

- Allows stormwater to be recharged on sites where there is little space available at the ground surface. Can be located under pavement.

- Suitable in both urban and rural settings.
- Suitable for piped drainage systems.
- Can be used to enhance storage and recharge capability of other BMPs.
- High solids, phosphorus, and bacteria removal efficiency.
- Can provide stormwater retention, runoff volume reduction, and groundwater recharge.
- Can also provide stormwater quantity control for larger storms when used in soils with high infiltration rates or when designed with additional below-ground storage.

Limitations

- Infiltration surfaces are buried, often under paved surfaces. Failed systems require excavating and replacing the system as well as repairing at-grade improvements built over the system. As a result, pretreatment is more critical for underground systems.
- Routine maintenance can be overlooked because the practice is not readily visible.
- Buried utilities can also be a substantial conflict to constructing these systems. While these systems can be constructed in a road right-of-way, utility conflicts can be a challenge in those spaces.
- Typically requires a piped drainage system to divert runoff into the buried chambers.
- Lower removal of dissolved pollutants especially in coarse soils.
- Should not be used with underdrain systems.

Siting Considerations

- **Potential Locations:** Best located where there is inadequate surface area for more cost-effective approaches to infiltrate stormwater. Suitable under parking lots, roads, sidewalks, and other at-grade, built features. Can also be placed under landscaped areas. Surfaces above the system may need to be excavated in the future in the case of a failed system, and thereby need to be replaceable. Therefore, infiltration chambers should not be used under structures.[81]
- **Drainage Area:** The maximum contributing drainage area for underground infiltration systems is 5 acres.

[81] Note: Infiltration systems below CT DOT roads are not permitted. Infiltration systems adjacent to CTDOT roads shall be directed exfiltration away from pavements base, subbase and subgrade. An impermeable barrier may be required.

- **Maintenance Considerations:** Ensure adequate vehicle access to pretreatment elements for the system as well as to inspection ports and manholes. Any at-grade improvements constructed above the systems should be replaceable in case of the need to replace the system if it fails.

- **General:** Meet the soils, water table, bedrock, and horizontal setback requirements specified in Chapter 10 - General Design Guidance for Stormwater Infiltration Systems. Infiltration chambers can be designed as on-line or off-line practices.

Soil Evaluation

- Conduct an evaluation of the soil characteristics and subsurface conditions at the location of the proposed system including soil type, depth to the seasonal high groundwater table, depth to bedrock, and soil infiltration rate. Refer to Chapter 10 for soil evaluation guidance.

Design Recommendations

Pretreatment

- Incorporate pretreatment measures at locations where runoff enters the infiltration system in accordance with the Pretreatment BMPs section of this Manual.

- Acceptable pretreatment measures are those that are suitable for piped drainage systems and include deep sump hooded catch basins,[82] oil grit separators, and proprietary pretreatment devices.

- Pretreatment measure(s) should treat at least the Water Quality Flow (WQF).

Sizing and Dimensions

- Infiltration systems should be designed by either the Static or Dynamic Methods as described in Chapter 10, including design guidance of the product manufacturer.

- Water Surface
    - Water surface elevations in the system should be designed to avoid flooding the subbase of the overlying paved surfaces.

- Bottom Slope
    - Bottom slope of the system should be level.

Inlet

- Design the inlet in accordance with the Inlet and Outlet Controls section of this Manual.

[82] Only recommended for space constrained sites where no other Pretreatment BMPs are feasible.

- Runoff is typically introduced into the system through a piped drainage system.
- Design in an off-line configuration, to the extent feasible, to bypass flows in excess of the water quality storm or larger storms if designed to provide stormwater quantity control.

Outlet & Overflow

- Design the outlet in accordance with the Inlet and Outlet Controls section of this Manual.
- Off-line systems should be designed with a bypass or overflow for flows in excess of the water quality storm and typically do not require an outlet. Once the system has reached its capacity (i.e., once the system is full), additional flow will bypass the system via a flow diversion structure.
- Underground infiltration systems designed in an on-line configuration should have a primary outlet sized to convey the 10-year, 24-hour storm event, at a minimum, to the storm drainage system.
- Outlets are typically a closed conduit/pipe that discharges to a storm drainage system.

Materials

- Underground Infiltration Chambers
  - As available from the manufacturer. Appurtenant structures (e.g., end caps, cross connectors, observation wells, etc.) should be from or approved for use by the chamber manufacturer.
  - Designer should comply with manufacturer's written specifications, details, installation instructions, and other guidance documents.
- Crushed Stone
  - The chambers should be underlain and backfilled with clean (washed and free from dirt and debris), crushed, angular aggregate with a diameter of 1.5" to 3" (porosity of 40 percent), or as specified by the manufacturer.
  - The top and sides of the stone reservoir surrounding the chambers should be lined with a non-woven geotextile (filter fabric). The non-woven geotextile should be compatible with the soil textures and application.
- Inspection Ports or Manholes
  - Inspection ports or inspection manholes should be provided along the infiltration chambers to monitor the water drainage in the system and to allow for sediment removal. The number and locations of observation ports or manholes should be in accordance with the manufacturer's recommendations.
- Filter Fabric

- Wrap around the exterior sides and top of the crushed stone only. Do not provide filter fabric on the bottom of the crushed stone unless recommended by the manufacturer of the underground infiltration system.
- Install fabric (including overlap) as specified by the manufacturer.
- Use non-woven filter fabric that complies with State of Connecticut Department of Transportation Standard Specifications, Section M.08.01.19 (Drainage – Geotextiles).

Construction Recommendations

- The designing qualified professional should develop a detailed, site-specific construction sequence.

- The designing qualified professional r should inspect the installation during the following stages of construction, at a minimum:
  - After excavation and scarification of bottom and sidewalls of excavation
  - After placement and leveling of stone below the chambers, placement of the chambers and inspection ports/manholes, and placement of stone above the chambers
  - After installation of bypass, outlet/overflow, and inlet controls
  - After infiltration system has been backfilled

- The designing qualified professional should provide an as-built plan of the completed infiltration system along with a certification that the system was designed in accordance with the guidance contained in this Manual and other local or state requirements and that the system was installed in accordance with the approved plans and manufacturer's guidelines.

- The entire contributing drainage area should be completely stabilized prior to directing any flow to the system. Adequate vegetative cover must be established over any pervious area adjacent or contributing to the system before runoff can be accepted.

- Erosion and sediment controls should be in place during construction in accordance with the Connecticut Guidelines for Soil Erosion and Sediment Control and the Soil Erosion and Sediment Control (SESC) Plan developed for the project.

- During clearing and grading of the site, measures should be taken to avoid soil compaction at the location of the proposed system.

- The system should be fenced off during the construction period to prevent disturbance of the soils.

- The infiltration system should be excavated to the dimensions, side slopes, and elevations shown on the plans. The method of excavation should avoid compaction of the bottom of the system. A hydraulic excavator or backhoe loader, operating outside the limits of the

infiltration system, should be used to excavate the system. Excavation equipment should not be allowed within the limits of the system.

- The stone storage media should be placed in the excavation by a hydraulic excavator or backhoe loader located outside the limits of the infiltration system and then hand-raked to the desired elevation.

Maintenance Needs

- Underground infiltration systems should be designed with easy access to all components of the system for maintenance purposes. Refer to Chapter 7 for general design considerations to reduce and facilitate system maintenance.
- Detailed inspection and maintenance requirements, inspection and maintenance schedules, and those parties responsible for maintenance should be identified on the plans and in the Stormwater Management Plan.
- Maintenance should be detailed in a legally binding maintenance agreement.
- Maintain infiltration chambers in accordance with the manufacturer's guidelines.
- Typical maintenance includes removal of accumulated oil and grease, floatables, and sediment from the pretreatment structure using a vacuum truck and removal of accumulated sediment from the infiltration chambers using a high-pressure water nozzle (i.e., JetVac process) and vacuum truck.

Recommended Maintenance Activities

- Inspect after major storms (1 inch or more of precipitation) in the first few months following construction.
- Inspect the pretreatment structure and isolator row (if one is used) twice a year.
- Inspect the remainder of the infiltration system annually.
- Refer to Appendix B for maintenance inspection checklists, including items to focus on during inspections.
- Remove sediment from the pretreatment structure when it accumulates to more than 50% of the design depth.
- Remove sediment from the infiltration chambers when the sediment accumulation exceeds 2 inches throughout the length of the chamber or when drawdown time exceeds 48 hours after the end of a storm event, indicating that the system is clogged.