Structural BMP Criteria

# BMP #: Infiltration Basin


An Infiltration Basin is a shallow impoundment that stores and infiltrates runoff over a level, subtle, uncompacted, (preferably undisturbed area) with permeable soils.

## Key Design Elements

- Uncompacted sub-base
- Infiltration Guidelines and Soil Testing Protocols apply
- Preserve existing vegetation, if possible
- Design to hold/infiltrate difference in 2-yr storm

## Potential Applications

| | |
|---|---|
| **Residential Subdivision:** | **YES** |
| **Commercial:** | **YES** |
| **Ultra Urban:** | **LIMITED** |
| **Industrial:** | **YES*** |
| **Retrofit:** | **YES** |
| **Highway/Road:** | **LIMITED** |

**Applicable with specific considerations to design*

## Stormwater Functions

| | |
|---|---|
| **Volume Reduction:** | **High** |
| **Recharge:** | **High** |
| **Peak Rate Control:** | **High** |
| **Water Quality:** | **Med./High** |

## Pollutant Removal

| | |
|---|---|
| **Total Suspended Solids:** | **x** |
| **Nutrients:** | **x** |
| **Metals:** | **x** |
| **Pathogens:** | **x** |

## Description

Infiltration Basins are shallow, impounded areas designed to temporarily store or infiltrate stormwater runoff. The size and shape can vary from one large basin to multiple, smaller basins throughout a site. Ideally, the basin may avoid existing vegetation, from meadow to wooded areas. If disturbance is unavoidable, re-planting and landscaping may be necessary and should integrate the existing landscape as subtly as possible and compaction of the soil must be prevented (see Infiltration Guidelines). Infiltration Basins use the existing soil mantle to reduce the volume of stormwater runoff by infiltration and evapotranspiration. The quality of the runoff is also improved by the natural cleansing processes of the existing soil mantle and also by the vegetation planted in the basins. The key to promoting infiltration is to provide enough surface area for the volume of runoff to be absorbed within a given time (48 hours or less). An overflow must be provided for the larger storms.

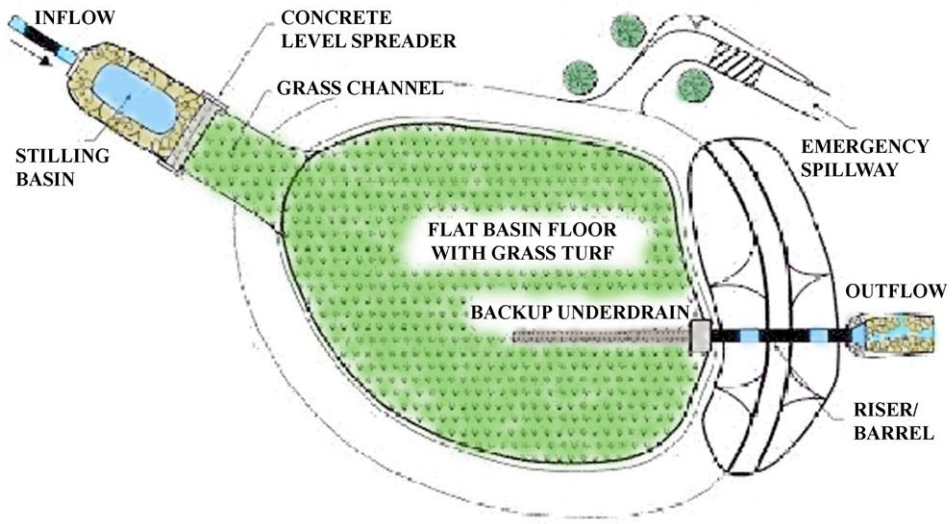


*Figure 1. Schematic design of infiltration basin with concrete level spreader*

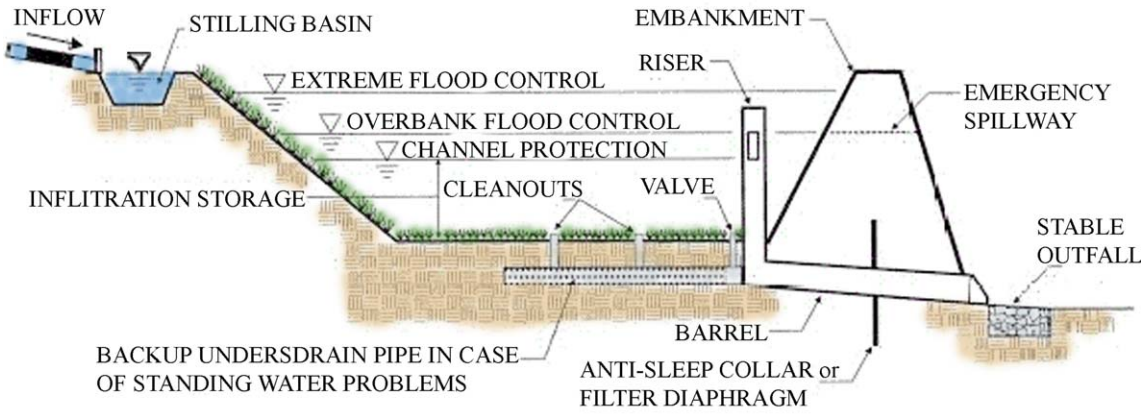


*Figure 2. Cross section schematic of infiltration basin*

## Variations

- **Re-Vegetation**
  For existing unvegetated areas or for infiltration basins that require excavation, vegetation may be added. Planting in the infiltration area will improve water quality, encourage infiltration, and promote evapotranspiration. This vegetation may range from a meadow mix to more substantial woodland species. The planting plan should be sensitive to hydrologic variability anticipated in the basin, as well as to larger issues of native plants and habitat, aesthetics, and other planting objectives.

- **Usable Surface**
  A grassed Infiltration Basin can be used for recreation (usually informal) in dry periods. Heavy machinery and/or vehicular traffic of any type should be avoided so as not to compact the infiltration area.

- **Soils with Poor Infiltration Rates**
  A layer of sand (6") or gravel can be placed on the bottom of the Infiltration Basin, or the soil can be amended to increase the permeability of the basin. (See Soil Amendment BMP for details.)

## Applications

- **New Development**
  Infiltration Basins can be incorporated into new development. Ideally, existing vegetation can be preserved and utilized as the infiltration area. Runoff from adjacent buildings and impervious surfaces can be directed into this area, which will "feed" the vegetation, thereby increasing evapotranspiration in addition to encouraging infiltration.

- **Retrofitting existing "lawns," "open space"**
  Existing grassed areas can be converted to an infiltration basin. If the soil and infiltration capacity is determined to be sufficient, the area can be enclosed through creation of a berm and runoff can be directed to it without excavation. Otherwise, excavation can be performed as described below.

- **Other Applications**
  Other applications of Infiltration Basins may be determined by the Design Professional as appropriate.

### Design Considerations

1. Soil Investigation and Percolation Testing is required (see Section x/x) Appropriate soil for infiltration is important; site selection for this BMP should take soil and infiltration capacity into consideration.

2. Guidelines for Infiltration Systems must be met (i.e., depth to water table, setbacks, Loading Rates, etc. See Section x/x) Infiltration capacity is crucial for this BMP, as infiltration is the main mechanism used for volume control and the condition of the basin bottom will dictate this effectiveness.

3. As with these Infiltration Systems, Infiltration Basins should be designed so that runoff volumes from contributing areas are not increased for up to the 2-year storm, pre- to post-development.

4. The slope of the Infiltration Basin bottom should be level or with a slope no greater than 1%. A level bottom assures even water distribution and infiltration.

5. Although Infiltration Basins in the ideal do not remove existing vegetation or disturb existing soil, these basins may be constructed where impermeable soils on the surface are removed and where more permeable underlying soils then are used for the base of the bed; extreme cases must be taken in the excavation process to make sure that soil compaction does not occur.

6. The discharge or overflow from the Infiltration Basin must be properly designed for anticipated flows. Invert of outlet control structures should be placed so that the volume beneath the inverts is based on the difference in the 2-year storm. Large infiltration basins may require multiple outlet control devices to effectively overflow water during the larger storms. Emergency spillways can be constructed to direct large storm overflows.

7. The berms surrounding the basin should be compacted earth with a slope of 3:1, and a top width of at least 2 feet.

8. There should be at least 2 feet of freeboard between the invert out and the top of the berms, or maintaining one foot of freeboard above the 100-year storm elevation.

9. Infiltration basins can be planted with natural grasses, meadow mix, or other “woody” mixes. These plants have longer roots than traditional grass and will likely reach the moisture in the infiltration basin, improving the growth of these plantings and increasing evapotranspiration. Native plants should be used.

10. Use of fertilizer should be avoided.

11. The surface should be compacted as little as possible to allow for surface percolation through the soil layer.

12. Roof leaders and other impervious surfaces should be directed into the Infiltration Basin as much as the capacity of the basin allows for.

13. The inlets into the basin should have erosion protection. (See the Level Spreader BMP for design guidelines.)

14. Contributing inlets (up gradient) should have a sediment trap or proprietary water quality insert to prevent large particles from clogging the system.

15. Note: the presence of soluble contaminants should be avoided as much as possible, as this will risk groundwater contamination.

16. Use of a back-up underdrain or low-flow orifice should be considered in the event that the water in the basin does not drain in 48 hours.

## Detailed Stormwater Functions

**1. Infiltration Area:**

The Infiltration Area is the bottom area of the bed.

This is the area to be considered when evaluating the Loading Rate to the Infiltration basin.

**2. Volume:**

The storage volume of the Infiltration basin is defined as the volume beneath the discharge invert. This is equal to:

Area x Depth below invert = Storage Volume

All Infiltration basins should be designed to infiltrate or empty within 48 hours.

**3. Peak Rate Mitigation Calculations:** See Section z/z in Section 8 for Peak Rate Mitigation methodology which addresses link between volume reduction and peak rate control.

**4. Water Quality Improvement:** See Section a/a in Section 8 for Water Quality Improvement methodology, which addresses pollutant removal effectiveness of this BMP.

## Construction Sequence

1. Protect Infiltration basin area from compaction prior to installation.

2. If possible, install Infiltration basin during later phases of site construction to prevent sedimentation and/or damage from construction activity. After installation, protect sediment-laden water from entering inlets and pipes.

3. Install and maintain proper Erosion and Sediment Control Measures during construction.

4. If necessary, excavate Infiltration basin bottom to a uniform, level uncompacted subgrade free from rocks and debris. Do NOT compact subgrade.

5. Install Outlet Control Structures.

6. Seed and stabilize topsoil. (Vegetate if appropriate with native plantings.)

7. Do not remove Inlet Protection or other Erosion and Sediment Control measures until site is fully stabilized.

8. Any sediment that enters inlets during construction is to be removed within 24 hours.

## Maintenance and Inspection Issues

- Catch Basins and Inlets (upgradient of infiltration basin) should be inspected and cleaned on an annual basis.
- The vegetation along the surface of the Infiltration basin should be maintained in good condition, and any bare spots immediately revegetated.
- Vehicles should not be parked or driven on an Infiltration Basin, and care should be taken to avoid excessive compaction by mowers.
- Inspect the completed basin and make sure that runoff drains down within 48 hours. If a problem occurs, contact your engineer.
- Also inspect for accumulation of sediment, damage to outlet control structures, erosion control measures, signs of water contamination/spills, and slope stability in the berms.
- Mosquito's should not be a problem if the water drains in 48 hours. Mosquitoes require a considerably long breeding period with relatively static water levels.
- Mow only as appropriate for vegetative cover species.
- Remove sediment from basin accumulations. Restore original cross section and infiltration rate. Properly dispose of sediment.

## Cost Issues

The construction cost of Infiltration Basins can vary greatly depending on the configuration, location, site-specific conditions, etc.

Excavation (if necessary) - varies
Plantings - to Meadow mix $2500 - $3500 / acre
Pipe Configuration – varies with stormwater configuration, may need to redirect pipes into the infiltration basin.

## Specifications:

The following specifications are provided for information purposes only. These specifications include information on acceptable materials for typical applications, but are by no means exclusive or limiting. The designer is responsible for developing detailed specifications for individual design projects in accordance with the project conditions.

**1. Topsoil** amend with compost if necessary or desired. (See soil restoration BMP)

**2. Vegetation** See Native Plant List in appendix.

## References and Sources

Michigan Department of Environmental Quality. *Index of Individual BMPs*. 2004. State of Michigan. < http://www.michigan.gov/deq/1,1607,7-135-3313_3682_3714-13186—,00.html>

FHWA

California Stormwater Quality Association. *California Stormwater Best Management Practices Handbook: New Development and Redevelopment*. 2003.

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New Jersey Department of Environmental Protection. *New Jersey Stormwater Best Management Practices Manual*. 2004.