Bioinfiltration

Application

- Principal/Primary Arterial
- Secondary Arterial
- Collector Street
- Minor Collector/Local Street

Advantages

- Provides high pollutant removal and volume reduction
- Can be integrated into landscape areas
- Relatively low maintenance

Limitations

- Not recommended for steep slopes
- Requires adequate soils for infiltration
- Adequate depth to groundwater required for infiltration

DESCRIPTION

Bioinfiltration areas are vegetated and mulched (i.e., landscaped) shallow depressions that temporarily capture and detain stormwater runoff. These facilities typically consist of a ponding area, mulch layer, planting soils and plantings. They can be easily integrated into the roadway right-of-way as either a bioinfiltration cell or rain gardens. When properly incorporated into a road shoulder or median, bioinfiltration systems can reduce the connectivity of impervious cover, accent the natural landscape, and provide aesthetic benefits. Bioinfiltration facilities function as soil and plant-based filtration devices that remove pollutants through various physical and biochemical treatment processes while detaining the runoff. As stormwater passes down through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants.

CONDITIONS WHERE PRACTICE APPLIES

Application

Bioinfiltration areas have a wide range of applications and can be easily incorporated into existing development areas. Bioinfiltration cells typically serve as an above-ground detention facility with a relatively flat depressed surface, rain gardens are a small version of this. Bioinfiltration cells can also provide below-ground detention through the voids of treated soil media or if a gravel drainage layer is used. Bioinfiltration systems can be used in both the urban and rural environment and anywhere along roadways with adequate open space available along roadways or as traffic controls – i.e., bumpouts within the roadway. Runoff from the impervious areas is typically conveyed into the facilities via shallow engineered open conveyances, shallow pipes, curb cuts, or other innovative drainage structures.

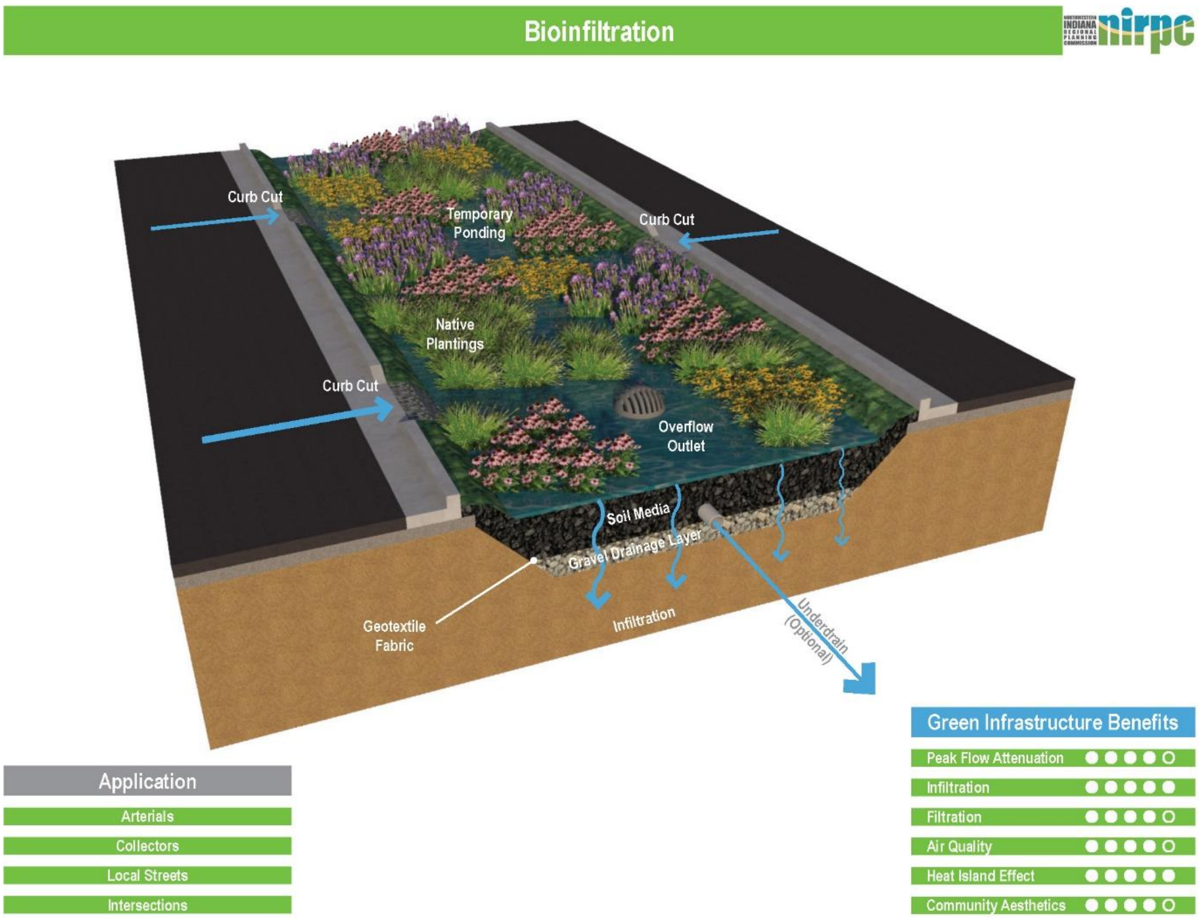
Before (picture on the left) and after (picture on the right) comparison of bioinfiltration being installed as traffic control, reducing a four-lane road down to a two-lane road – Principal and Minor Arterial Roads.

Examples of bioinfiltration facilities installed along roadways(Collector and Local Roads) as either a larger stormwater management feature (picture on the left) or a smaller, distributed stormwater management features (picture on the right).

Site Constraints

For areas where native soils have low permeability or steep slopes, bioinfiltration areas can be designed with amended soils and an underdrain system to route treated runoff to storm drain networks. Perforated pipe underdrains are recommended for bioinfiltration BMPs due to the limited infiltration capacity of the underlying soils. Underdrains can improve vegetation health, prevent the bottom of bioinfiltration areas from becoming soggy, and mitigate concerns related to the formation of stagnant pools of water in poorly drained soils. However, water draining to quickly can also compromise plant and consideration should be given to optimize release rates.

Additional volume can be realized if the perforated pipe is placed above the bottom of the gravel drainage layer creating a sump storage area.



Site Suitability Considerations for Bioinfiltration Areas

Tributary Area	< 5 acres [1]
BMP Area Typically Required as Percentage of Tributary Area (%)	5 to 15 percent
Hydrologic Soil Group	Any [2]

1) Tributary area is the area of the site draining to the bioinfiltration area. Tributary areas provided here should be used as a general guideline only. Tributary areas can be larger or smaller in some instances and dependent on the tributaries land cover..

2) Underdrains may not be required in areas where the infiltration capacity of the underlying soils is not limited (hydrologic soil groups "A" or "B"). If the bioinfiltration area is located within 10 feet from a building or has a longitudinal slope less than 1.5%, underdrains should be incorporated. If underdrains are provided, the site must have

adequate relief between land surface and the stormwater conveyance system to permit vertical percolation through the gravel drainage layer (open-graded base/sub-base) and underdrain to the stormwater conveyance system.

VARIATIONS AND ENHANCEMENTS

Enhancements that maximize contact time, aid in trapping and removing pollutants, or assist with volume reduction are the main categories of enhancements for bioinfiltration. Structural and operational enhancements that can increase performance in bioinfiltration area facilities are presented below.

- Check dams or drop structures are encouraged where slopes exceed 6%. Shallower slopes enhance sediment removal by causing stormwater to pond, allowing coarse sediment to settle out.
- Amended soils provide sorption sites for removing dissolved and suspended pollutants, can be used to increase or decrease infiltration, and provide additional support for plant growth. Soil amendments can increase evapotranspiration and infiltration losses by increasing retention storage and hydraulic conductivity.
- In areas where the infiltration capacity of the underlying soils is not limited (hydrologic soil groups "A" or "B"), underdrains may not be required. Additional volume removal can be provided by omitting an underdrain and promoting percolation into the underlying native soils.
- Placing the underdrain at 2 feet above the bottom of the gravel sump area is recommended to provide additional storage and volume removal

SIZING AND DESIGN CONSIDERATIONS

The following are recommended sizing and design considerations. Final bioinfiltration designs should be based on site-specific considerations and limitations.

- The bioinfiltration area should be sized based on the target percent capture and the tributary area percent impervious.
- Drawdown time of soil media should be less than a few hours.
- The recommended maximum ponding depth is 12 inches.
- The typical soil media depth is about 2 feet, with 3 feet ideal.
- The typical minimum gravel sump storage area depth is 2 feet.
- Provide energy dissipation and a flow spreader at each concentrated inlet point to the bioinfiltration area. Sheet flow inputs into the bioinfiltration area do not require energy dissipation.
- Overflow devices should be installed where ponded water could adversely impact adjacent properties or cause ponding on roadways.
- See Plant Lists for recommendations of vegetation for Northwest Indiana.

INSPECTION AND MAINTENANCE

Inspection frequencies, specific routine maintenance activities, and major maintenance activities should be considered as part of the design of bioinfiltration facilities. Permeable pavement mainly requires vacuuming and the management of adjacent areas to limit soils migration and prevent clogging by fine sediment particles.

Routine Maintenance

Routine maintenance activities in bioinfiltration areas should include:

- Maintenance of vegetation as needed to preserve aesthetics in urban areas;
- Removal of trash and debris and visible floatables such as oil and grease;
- Removal of minor sediment accumulations near inlet/outlet structures;
- Stabilization and repair of eroded areas;
- Performing minor structural repairs to inlet/outlet structures; and
- Eliminate vectors and conditions that promote vectors.

Major Maintenance

Major maintenance activities in bioinfiltration areas should include:

- Re-grading of bioinfiltration area to restore design longitudinal bottom slope and
- Aeration of compacted areas to restore infiltration capacity.