# Large-Scale Green Infrastructure & Non-GI Stormwater BMPs

Engineering Standards, Sizing Mechanisms, and Compliance with N.J.A.C. 7:8

# The NJDEP Regulatory Hierarchy: Selecting the Right BMP

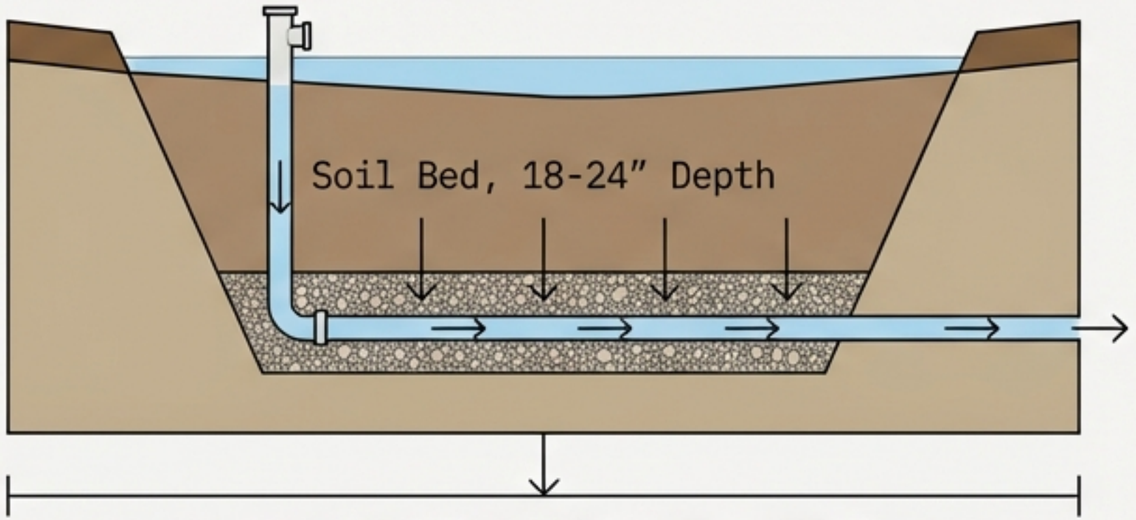
| GREEN INFRASTRUCTURE (Table 5-1) | GI WITH WAIVER (Table 5-2) | NON-GI / WAIVER REQUIRED (Table 5-3) |
|---|---|---|
| Cisterns | Bioretention Systems (> 2.5 acres) | Blue Roofs |
| Small-Scale Bioretention Basin | Infiltration Basins | Extended Detention Basins |
| Small-Scale Infiltration Basin | Standard Constructed Wetlands | Manufactured Treatment Devices (Non-GI) |
| Small-Scale Sand Filter | Wet Ponds | |
| Pervious Paving System | | |

## Design Constraints

- Dry Well: Max 1 acre drainage
- MTDs: Max 2.5 acres drainage
- Small-Scale GI: Max 2.5 acres drainage

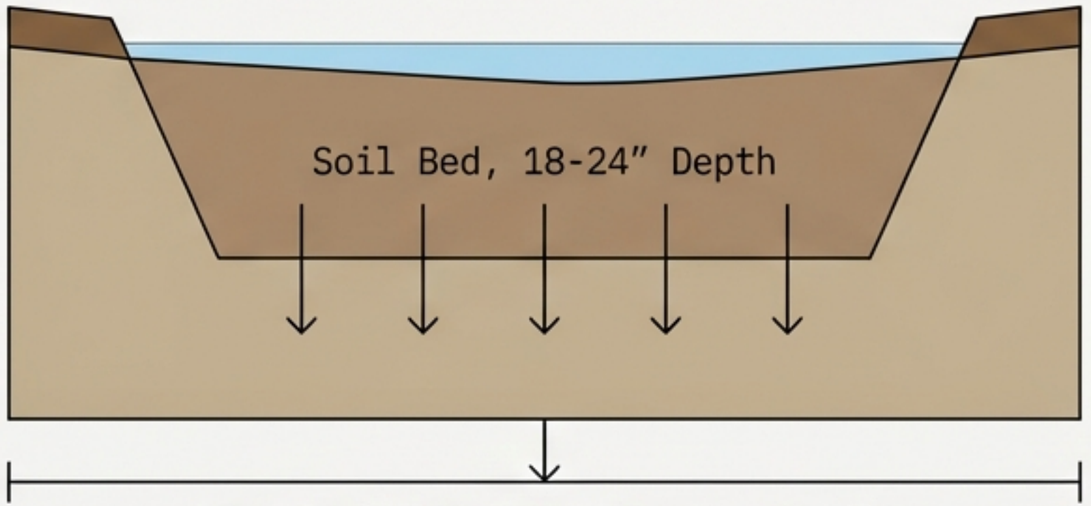
# Bioretention Anatomy: Infiltration vs. Underdrain

## System with Underdrain




Use when subsoil permeability is poor or water table is high. Treats and releases.

## System with Infiltration




Use when soils are permeable. Maximizes groundwater recharge.

# Engineering Design: Sizing a Bioretention Basin

### 1. Input

Drainage Area (1.2 ac) × Runoff Coeff (1.0) × Rainfall (1.25 in)

### 2. Runoff Volume (V)

5,450 cubic ft

### 3. Basin Area (A)

Volume ÷ Max Depth (0.5 ft) = 10,900 sq ft (0.25 acres)

### Safety Check: Ponding Time calculation (Darcy's Law)

**Formula:** T = Max Depth / (Permeability / Safety Factor)

**Calculation**: 6 inches / (4 inches/hr / 2) = 3 Hours

**Result**: 3 Hours < 72 Hours Max Limit (ACCEPTABLE)

# Case Study: Rutgers Campus Implementation

## Bioretention Basin, Chemistry Building

Concrete Outlet Control Structure (Hard Infrastructure).

Vegetative Uptake System (Soft Infrastructure).

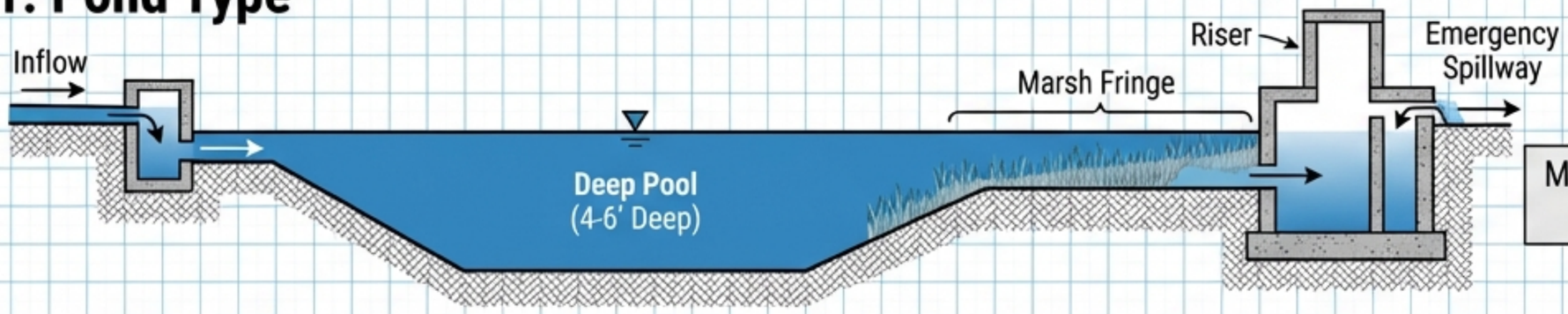
FEBRUARY 2018: Construction Complete.

OCTOBER 2018: Established Vegetation.

Properly designed bioretention integrates hydraulic control with biological treatment.

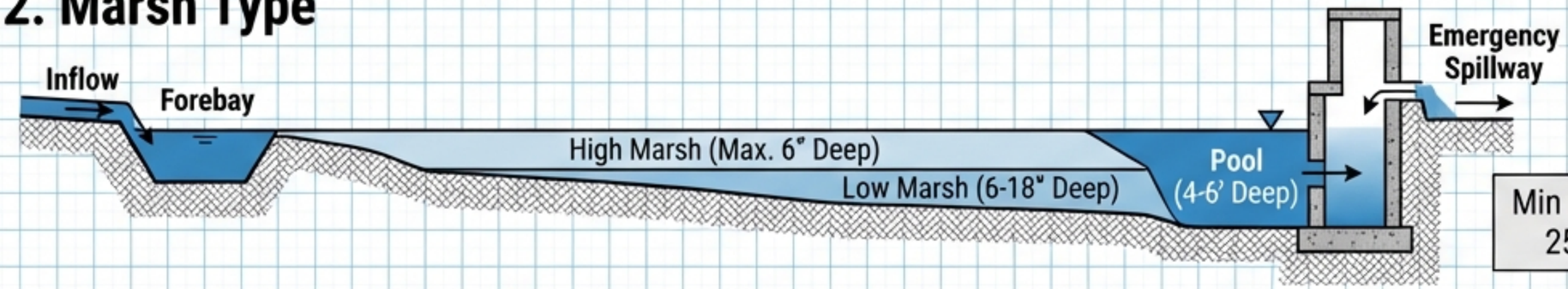
# Large-Scale GI: Constructed Wetlands

## 1. Pond Type



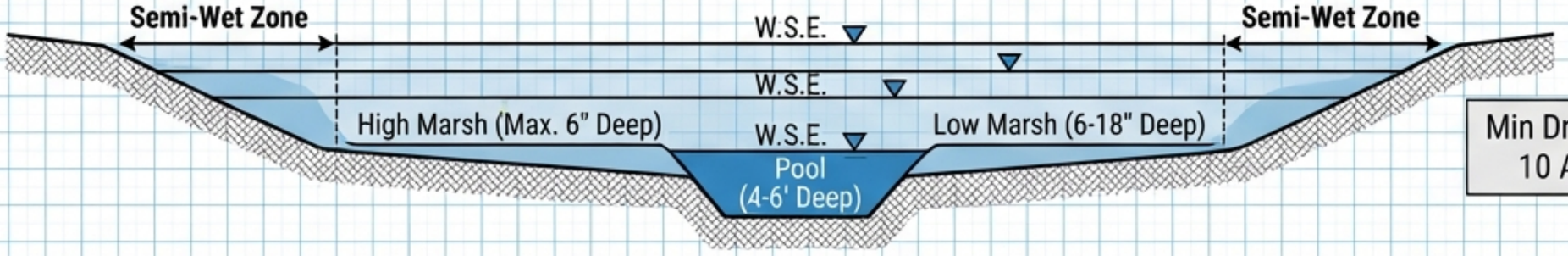

Min Drainage: 25 Acres

## 2. Marsh Type




Min Drainage: 25 Acres

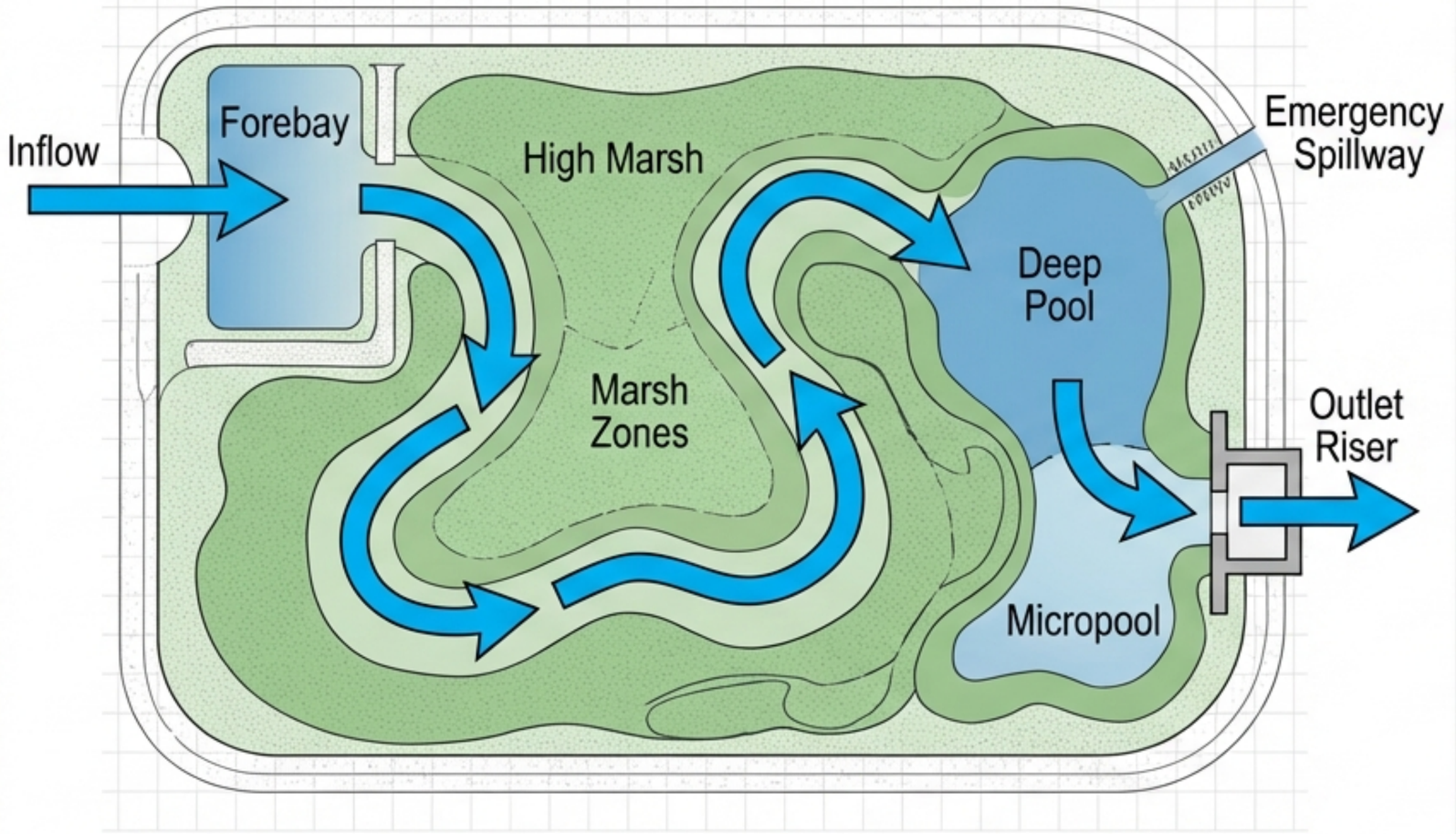
## 3. Extended Detention Type




Min Drainage: 10 Acres

| Key |
| --- |
| Deep Pool: 4-6 ft |
| Low Marsh: 6-18 in |
| High Marsh: Max 6 in |

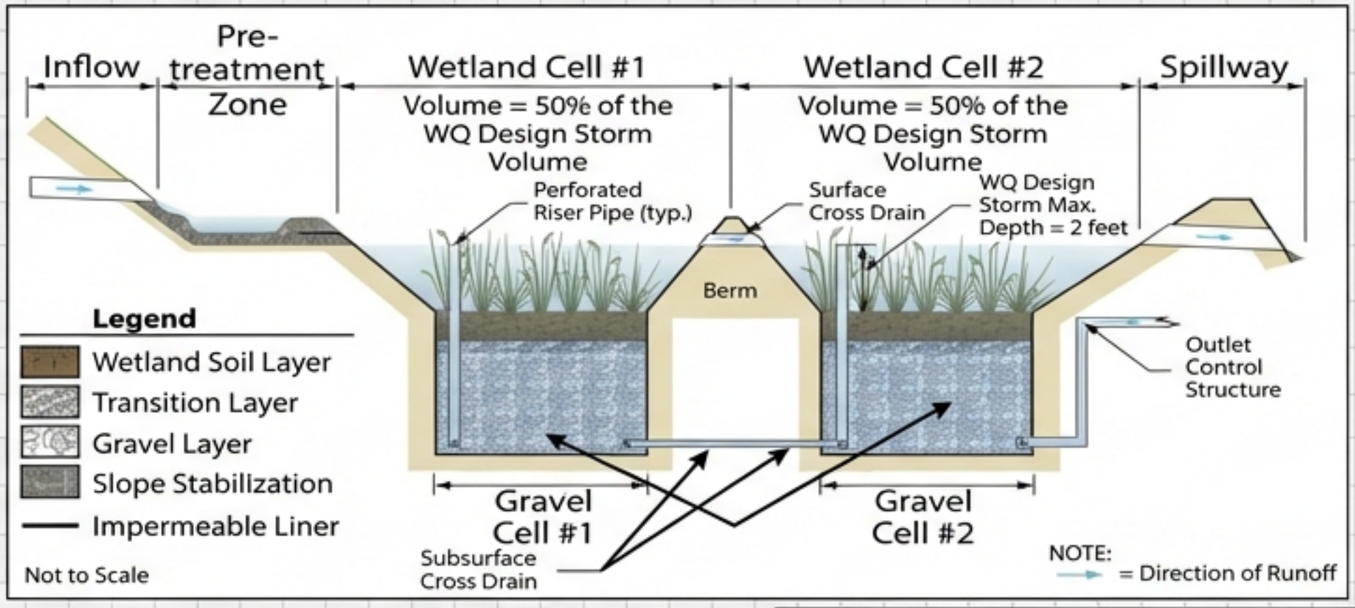
# Wetland Design Criteria & Configuration

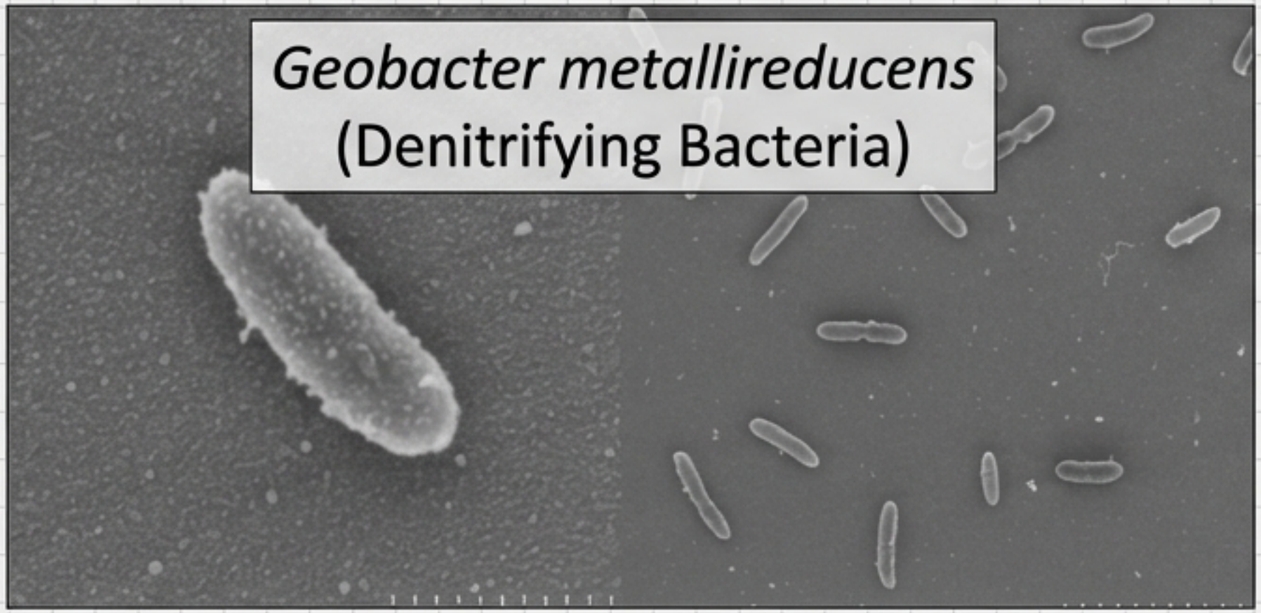


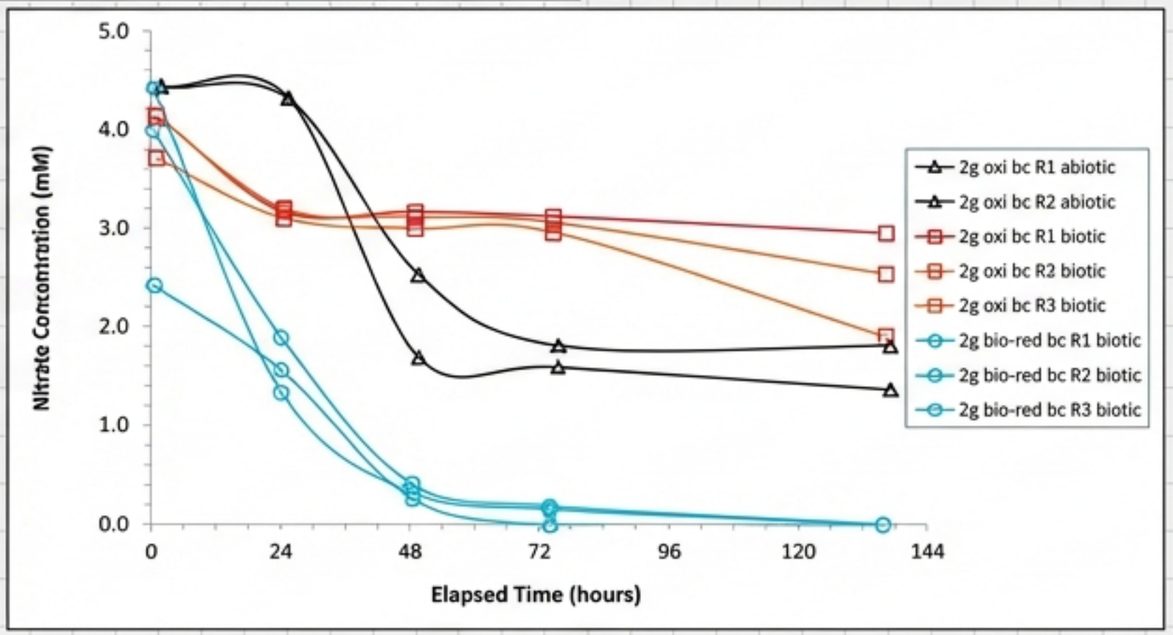

Plan view: Marsh Constructed Wetland

| Configuration Rules |
| --- |
| • Length-to-Width Ratio: 1:1 Minimum |
| • Pretreatment: Forebay Required |
| • High Marsh Depth: Max 6 inches |
| • Low Marsh Depth: 6 - 18 inches |
| • Deep Pool Depth: 4 - 6 feet |

# Innovation: Subsurface Gravel Wetlands & Nitrogen Removal



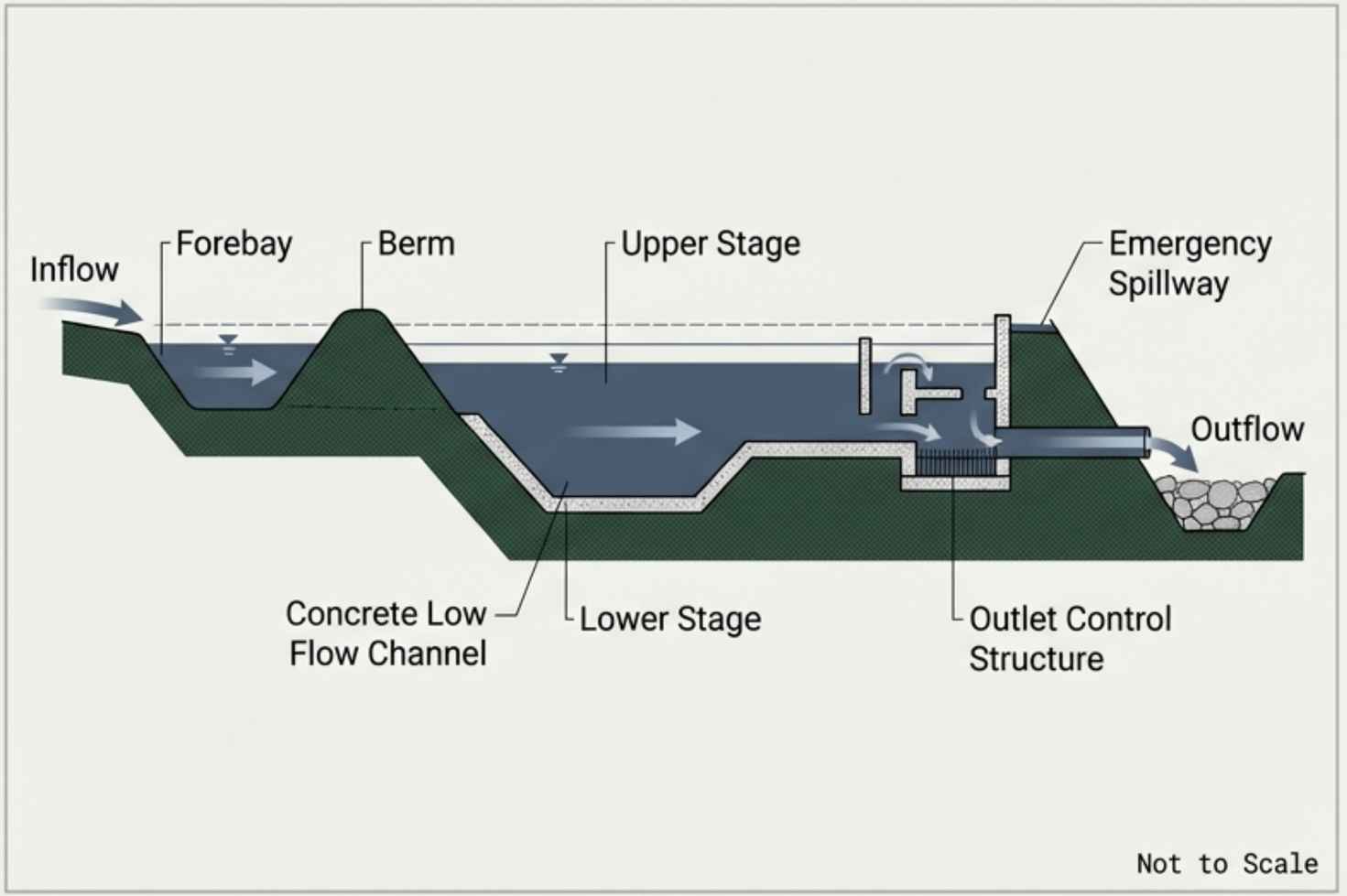



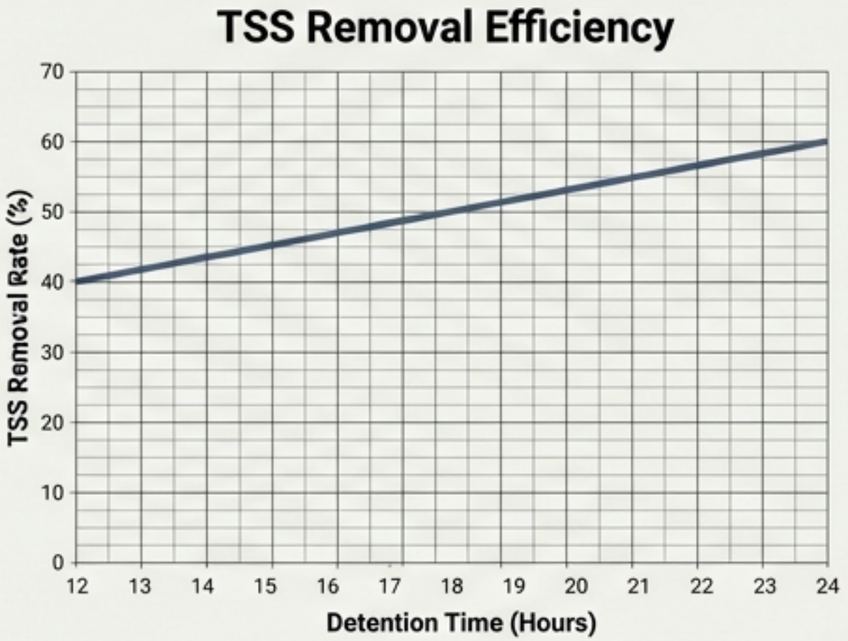




Nitrate reduction over 48 hours with Biochar

# The ‘Gray’ Standard: Extended Detention Basins

Regulatory Status: Non-GI (Table 5-3). Waiver Required.



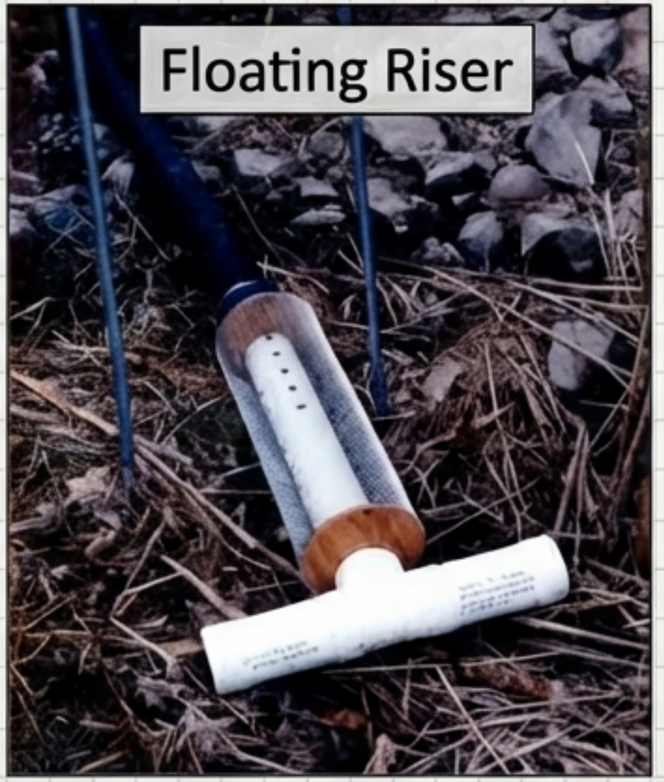



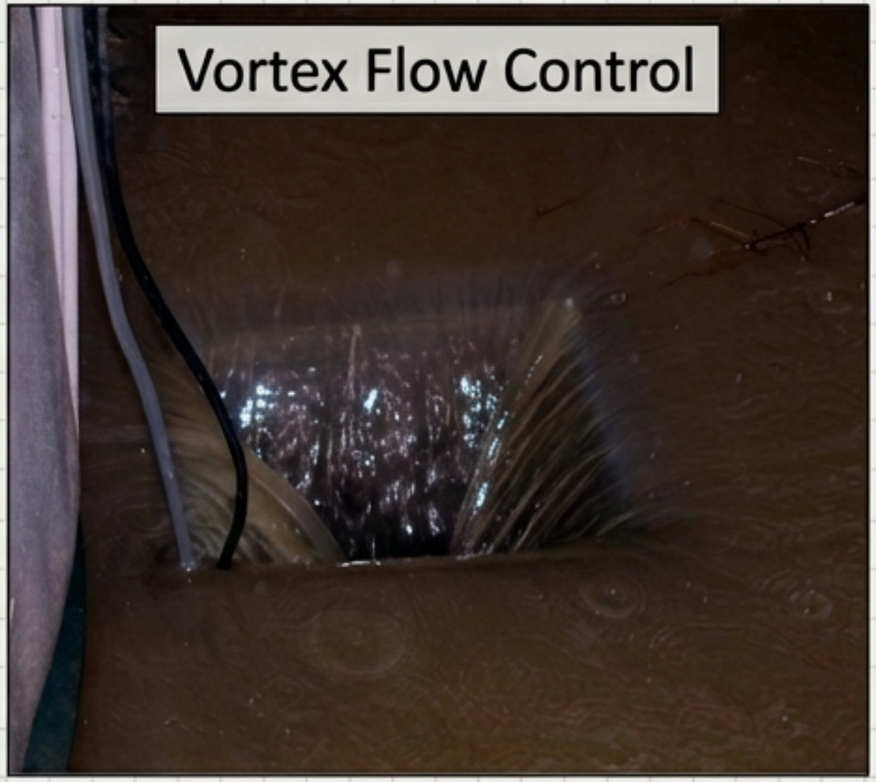

Performance is variable (40-60%) compared to Bioretention (80-90%). Efficiency relies entirely on settling time.

Not to Scale

# Retrofitting Legacy Infrastructure

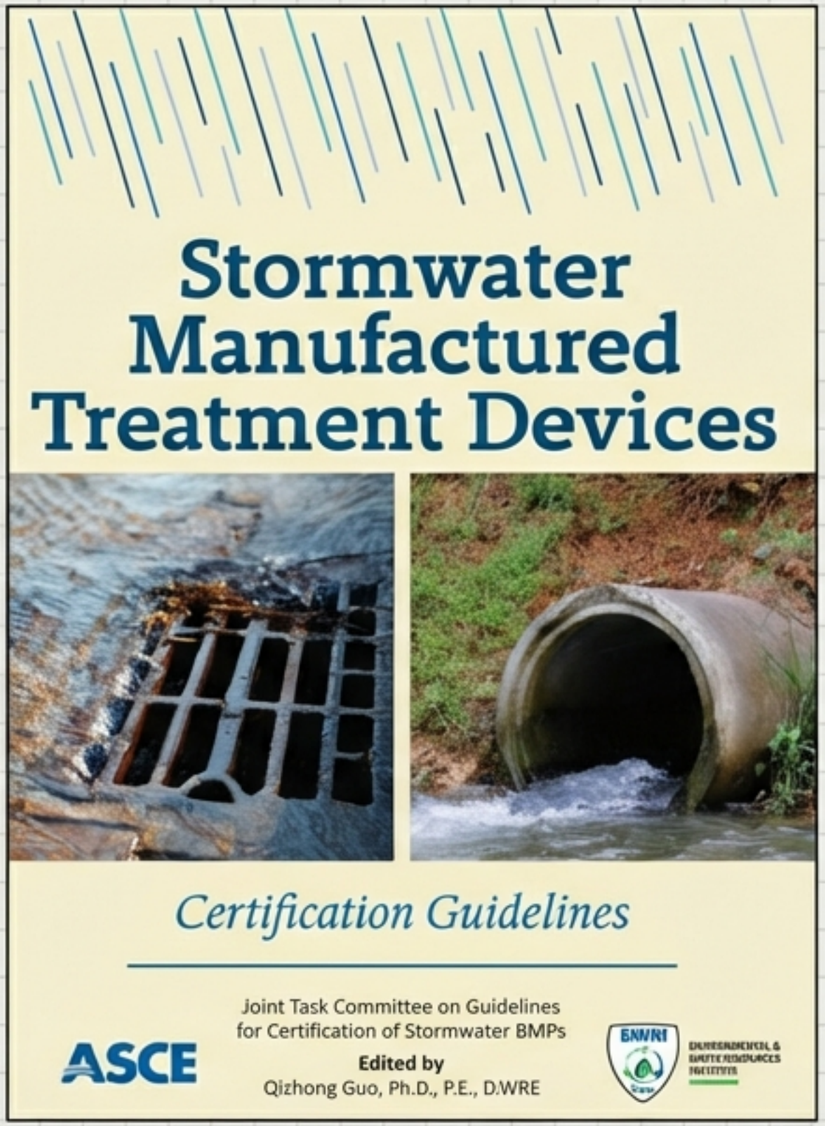
## Upgrading Dry Detention Basins for Water Quality


**Technique:** Constricting the outlet to increase **residence time** and **settling** without full reconstruction.

# Manufactured Treatment Devices (MTDs): Solutions for Constraints




**Use Case:**

High-density urban redevelopment and highway expansion where space is limited.

**Certification Process:**

1. NJCAT Verification (Laboratory Testing)
2. NJDEP Certification (Regulatory Approval)

**Critical Constraint:**

- Maximum Drainage Area: **2.5 Acres per device.**

# Classifying MTDs: Green vs. Non-Green

## GREEN INFRASTRUCTURE (GI) MTDs

Must infiltrate into subsoil OR treat runoff via bio-filtration with vegetation.

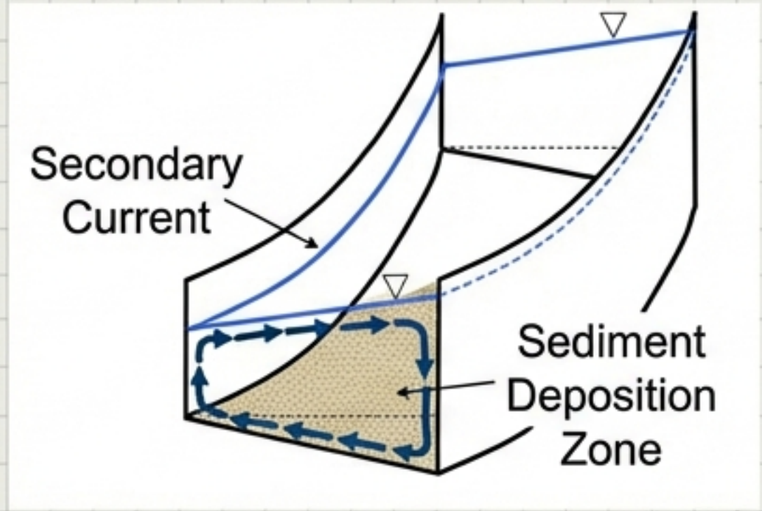
- Filterra Bioretention System
- BioPod with StormMix
- StormGarden Bio-Filter
- Modular Wetlands 360

## NON-GI MTDs

Hydrodynamic separators or media filters without biological processes.

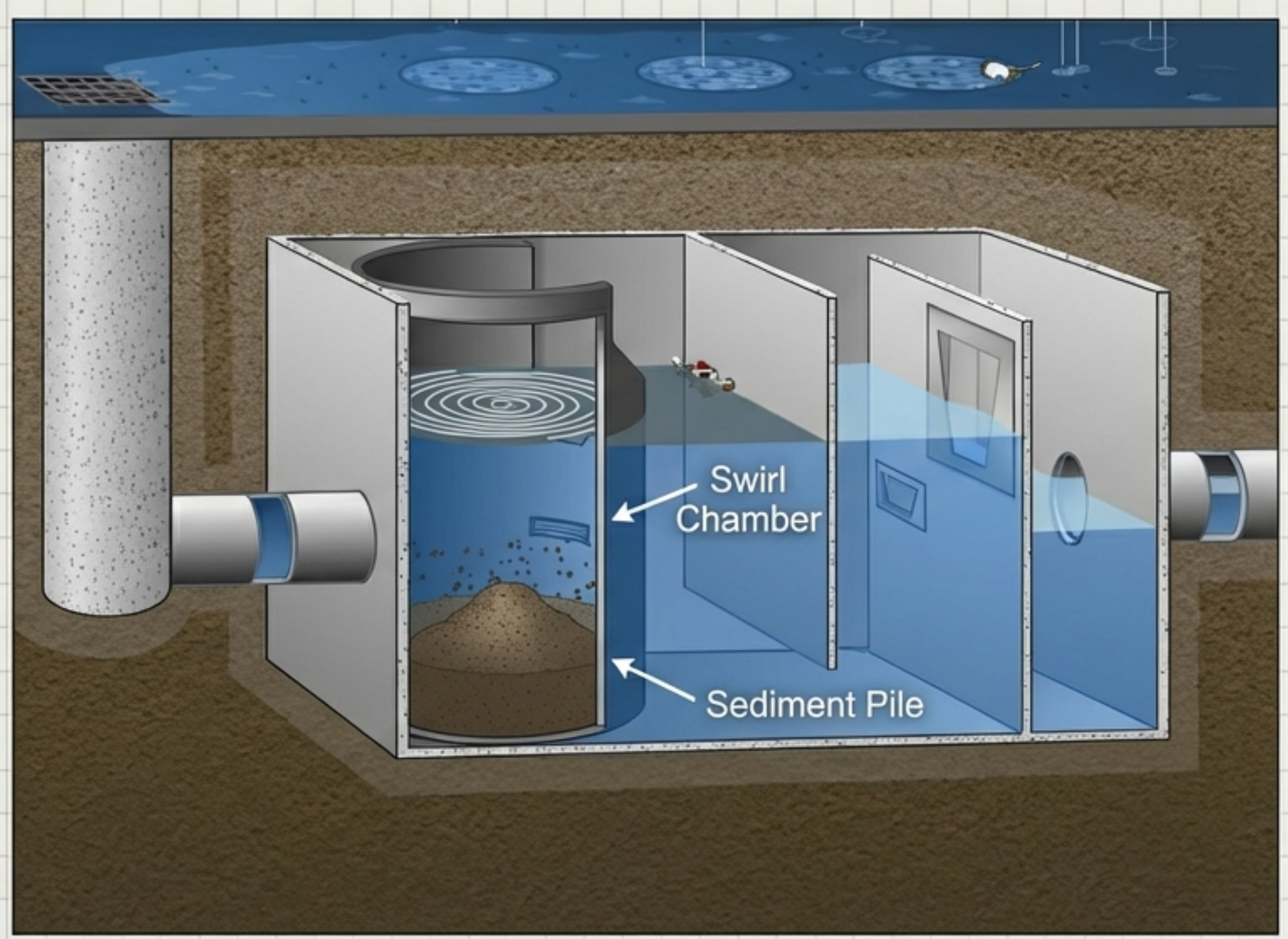
- Vortechs
- StormFilter
- Aqua-Filter
- Kraken Filter
- StormTrap

# Mechanisms of Action: Hydrodynamic Separation





Historical Precedent: River separation physics used for >2000 years.



# Operational Reality: Maintenance is Mandatory

Performance depends on regular cleaning

**IF YOU DON'T CLEAN IT, IT FAILS.**

Requirement: All BMPs require a Maintenance Plan filed with the municipality. MTDs typically require vacuuming when sediment depth reaches manufacturer specifications.

# Strategic Summary: The Design Hierarchy