How New Methods of Nitrogen Treatment for Stormwater are Designed to Help Cape Cod and Other Coastal Communities Meet Nitrogen TMDLs

Ray Cody, EPA
Matt Lundsted, CEI

Background: the Clean Water Act, Cape Cod and Green Infrastructure

- Permits – next-generation Small MS4 General Permits for MA and NH
  - incl. structural and non-structural BMPs to achieve water quality objectives for nutrients
- Policy – recent Jan 2016 GI Policy
  - promoting SRF financing of GI Projects nationally
- Cape Cod §208 Water Quality Plan Update
  - Developed by Cape Cod Commission (CCC). Approved Sept 2015.
  - "Watershed-based approach to restore embayment water quality on Cape Cod . . . recommends strategies, regulatory reforms and a process for communities to reduce or eliminate excess nitrogen, the primary cause of degraded conditions." (CCC website)
- Southern New England Program (SNEP)
  - new EPA geographic program with line-item appropriation.
  - Goal: restore the ecological health of southeastern New England's estuaries, watersheds, and coastal waters and ensure access now and in the future to resilient, self sustaining ecosystems of clean water, healthy diverse habitats, and associated populations of fish, shellfish, and other aquatic dependent organisms.

Background: the Clean Water Act, Cape Cod and Green Infrastructure

- Green Infrastructure – a different way of thinking about stormwater control?

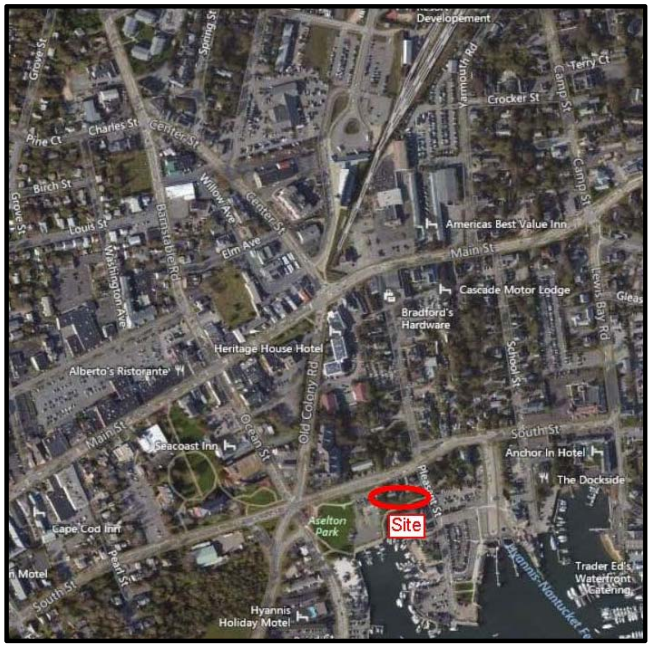
- EPA's interest in Green Infrastructure:
  - demonstrating innovative technologies
  - technology Transfer
  - building practitioner understanding and acceptance

- CWA Technical Assistance Projects for promoting GI Interests

Cape Cod N BMP Retrofits: Technical Assistance Project Solicitation & Selection

- State, CCC and Muni's request EPA to provide stormwater project for nitrogen → Best Management Practice (BMP) Retrofits for N (N BMP Retrofits)
- June 2014: EPA invites interested muni's to submit SNEP project proposals
- Project selection criteria (among others):
  - ability and interest → partnership (MOU, outreach, coordination, O&M)
  - transferability of technology
  - ease of permitting
  - site ideally situated to promote public outreach/awareness of nutrient pollution in stormwater
  - site ideally situated near an impaired waterbody with a high nitrogen reduction target (NRT)
  - Other:
    - Potential tie-in / ease of tie-in to MS4
    - Materials management,
    - Location of utilities,
    - Site traffic (e.g., Cape Cod summer season),
    - Etc.

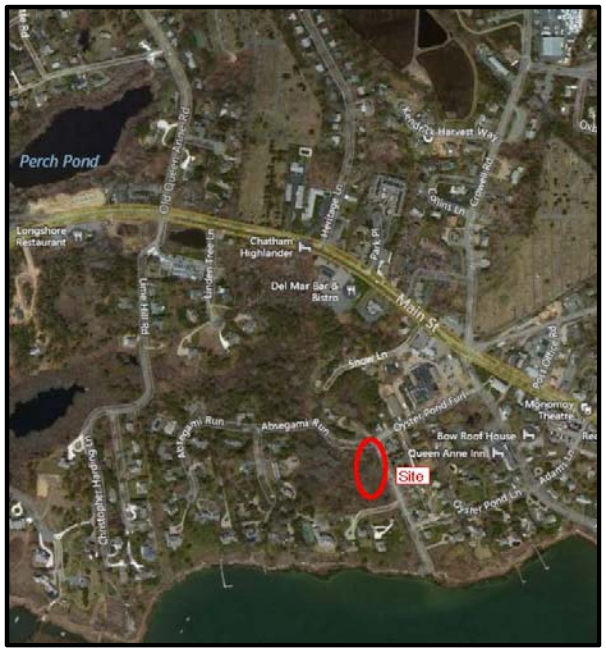
Selected Site: Barnstable



- **Hyannis Inner Harbor, Barnstable, MA**
  - parcel: 0.35 acres
  - drainage area: 6.9 acres
  - IC: 3.5 acres (~ 51% IC)
  - MS4 trunk line runs through the site
  - drains to Hyannis Inner Harbor
    impaired for TN and fecal coliform
  - Total attenuated watershed N load: 41.5%
  - subwatershed N load reduction
    target (NRT): 19.6-52.8%
  - percent NRT due to stormwater / IC: 21%

Selected Site: Chatham

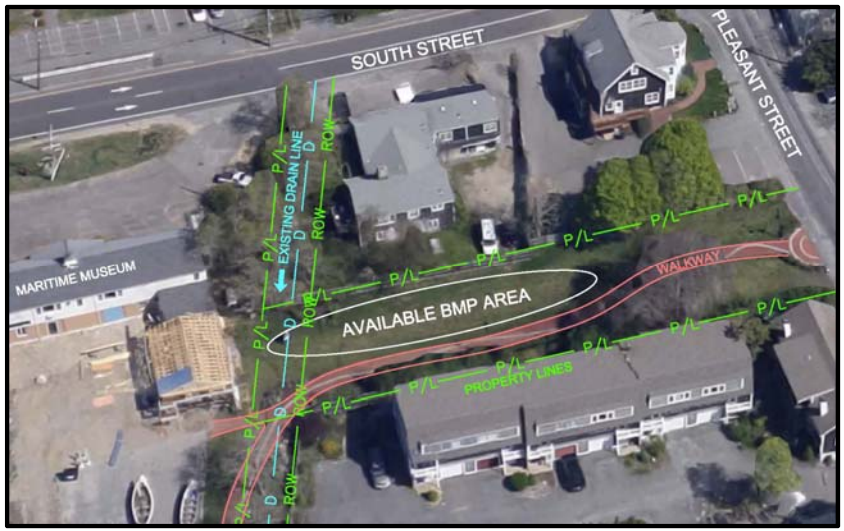
- **Undeveloped Town parcel near Oyster Pond, Chatham, MA**
  - parcel: 3.19 acres
  - drainage area: 16.9 acres
  - IC: 5.7 acres (34% IC)
  - MS4 trunk line runs by the site
  - drains to Oyster Pond, impaired for TN and fecal coliform
  - watershed/subwatershed N load reduction target (NRT): 74-88.2%
  - percent NRT due to stormwater: 15%



Site Constraints

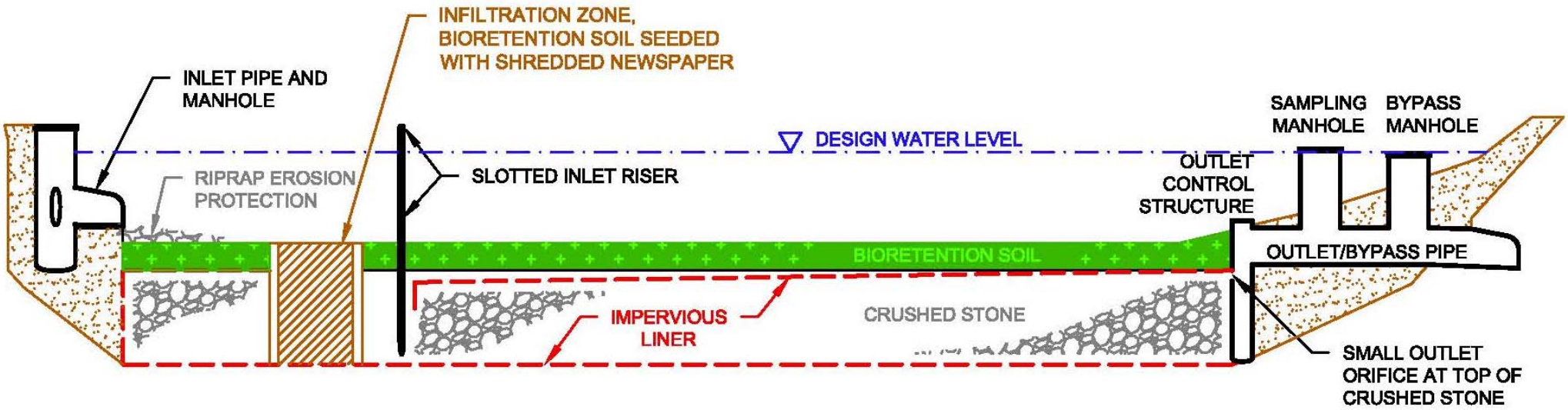
- **Hyannis Inner Harbor, Barnstable, MA**
  - parcel: 0.35-ac, 0.19-ac available (54%)
  - park site, high traffic area
  - very shallow groundwater

- **Oyster Pond, Chatham, MA**
  - parcel: 3.19-ac, 0.33-ac available (10%)
  - wetland complex
  - shallow groundwater
  - deep drain line

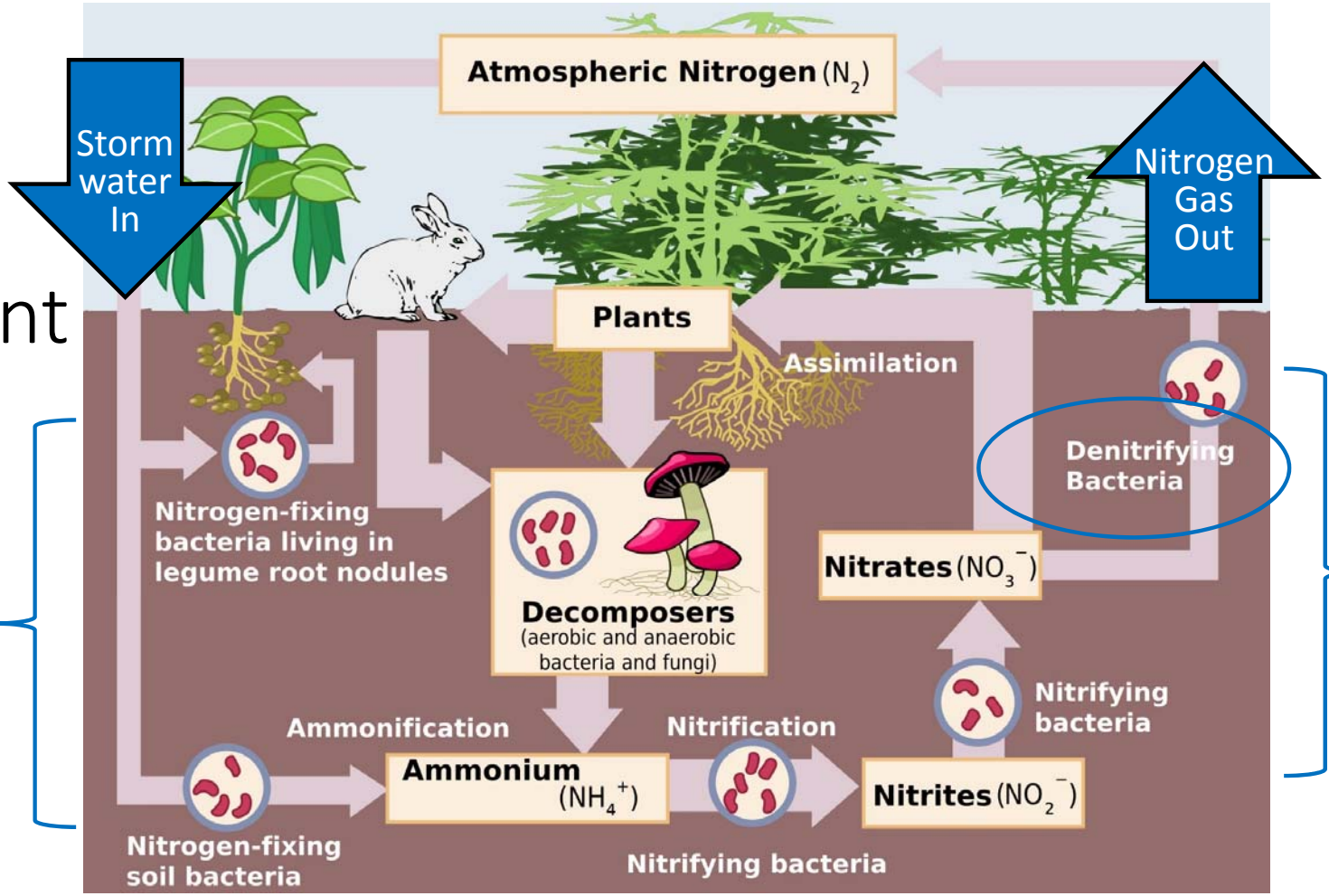


Selected BMP: Hybrid Bioretention and Gravel Wetland System

- **Bioretention aesthetics - surface aerobic storage**
- **Gravel wetland functionality - subsurface anaerobic storage**



Treatment Science



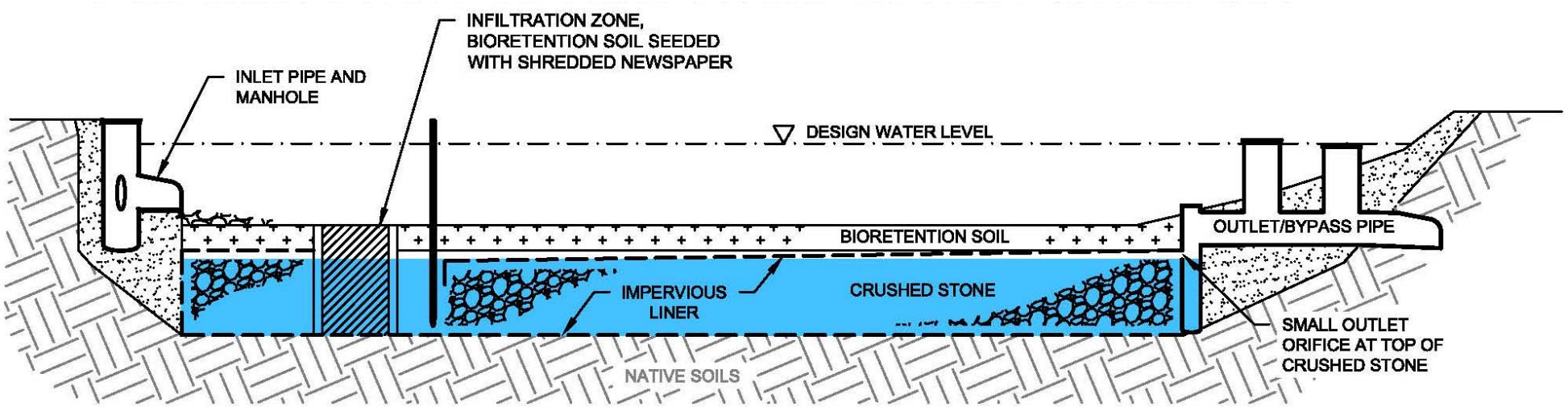
Aerobic Conditions

Anaerobic Conditions

Image Credit: US EPA, http://www3.epa.gov/caddis/ssr_amm_nitrogen_cycle_popup.html

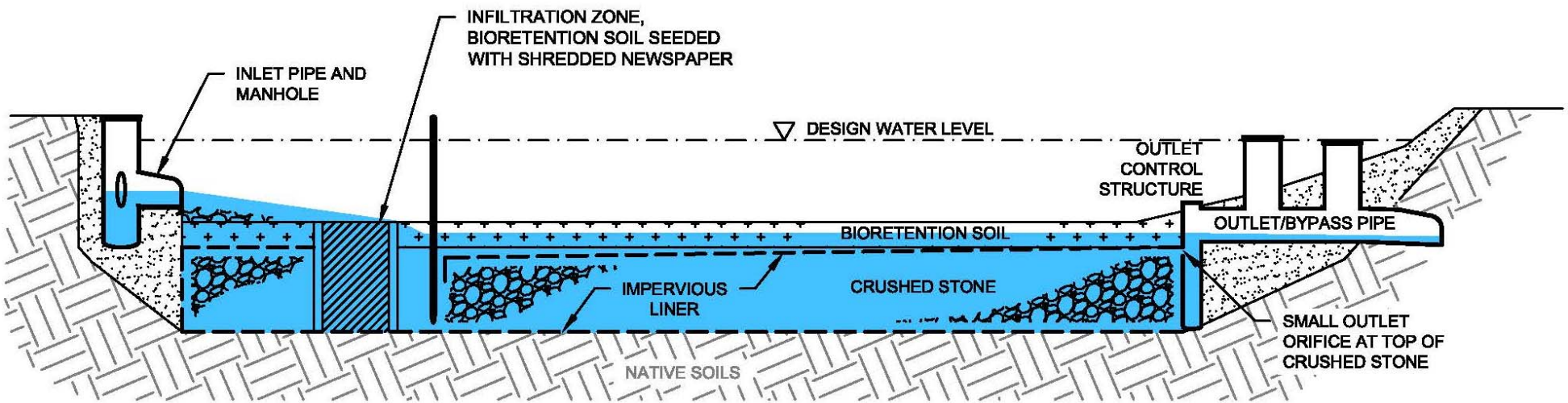
BMP, Pre-Storm

- Gravel cell full of water
- Water level regulated by low-flow orifice



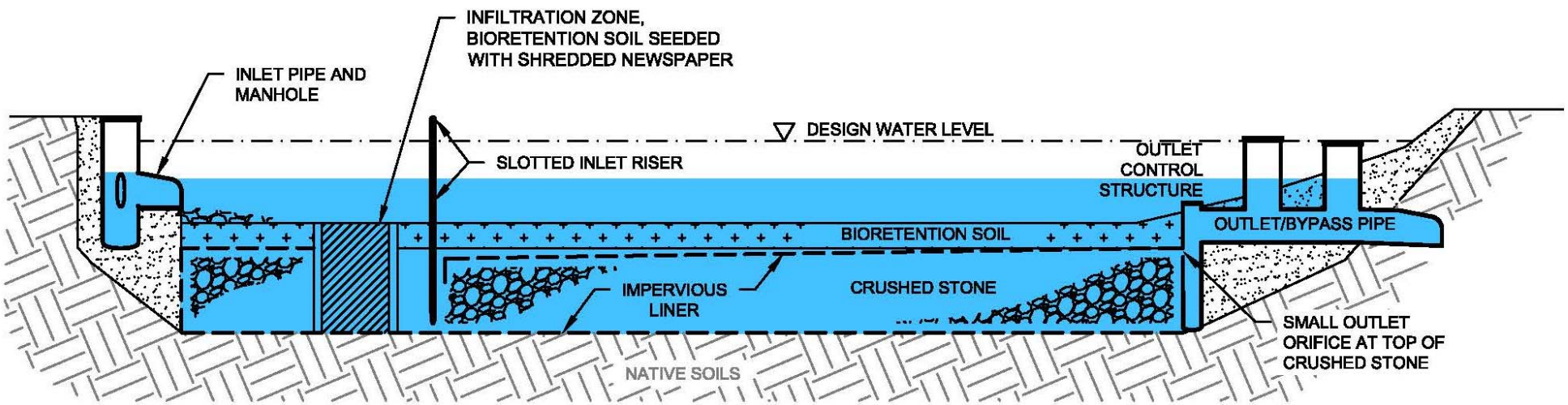
BMP, Start of Storm

- Water flows in through inlet pipe/manhole
- Stormwater infiltrates through infiltration zone
- BMP begins to outlet through outlet control structure



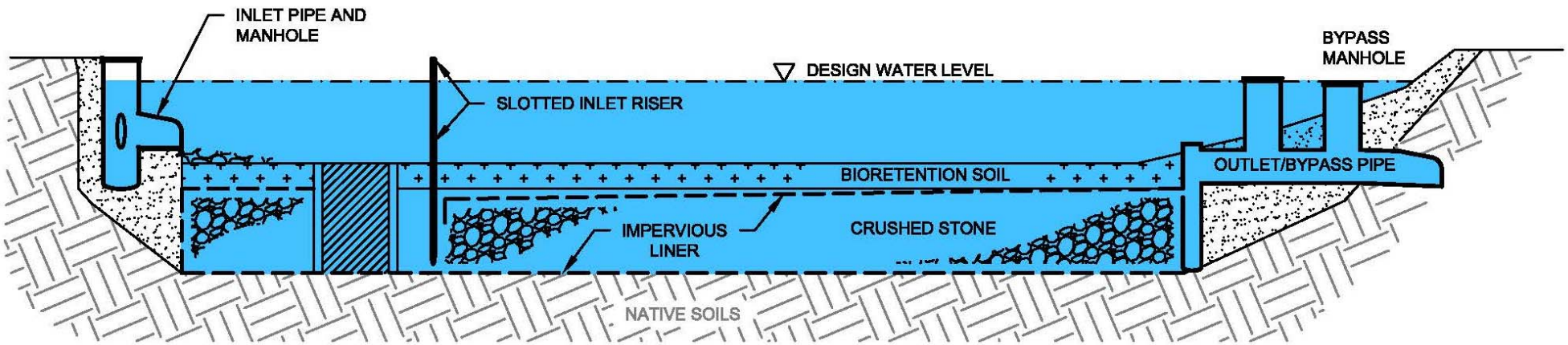
BMP, Mid-Storm

- Water continues to flow in through inlet pipe/manhole
- Stormwater infiltrates through infiltration zone and slotted inlet riser
- BMP outlets through outlet structure orifice



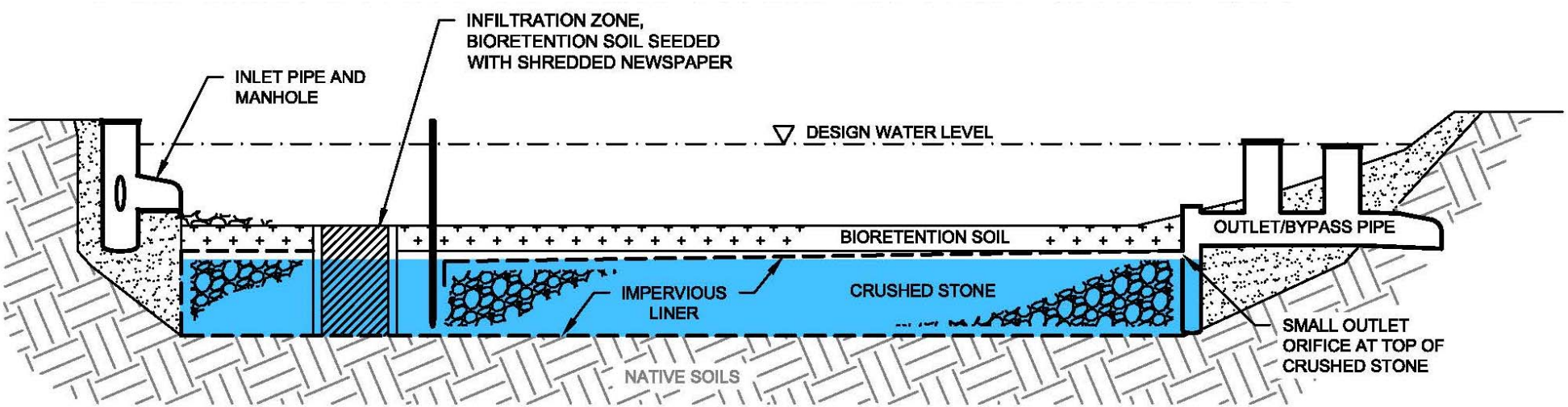
BMP, Large Storm

- Inlet pipe and manhole surcharge
- Stormwater infiltrates through infiltration zone and slotted inlet riser
- BMP outlets through outlet structure orifice and bypass manhole



BMP, Post-Storm

- Surface water slowly infiltrates into gravel cell
- Drains out over 24 hours, water level regulated by low-flow orifice
- Gravel cell remains full of water



Construction- Barnstable

Construction- Barnstable

Finished Barnstable Site

Construction- Chatham

Construction- Chatham

Finished Chatham Site

Performance Assessment

- To Be Determined . . .
- Approach: allow BMP anerobe populations to establish over ~1-year, then install monitoring equipment:
  - sample inlet to BMP, outlet from BMP, existing drainage system bypass.
  - sample each for flow and nutrients with auto-samplers and volunteers
- Monitoring Plan and Quality Assurance Project Plan (QAPP) currently under development
- Schedule:
  - start 2017
  - ~ 20 storm events per year
  - 3+ years of performance monitoring

Questions?

Ray Cody, EPA
Matt Lundsted, CEI