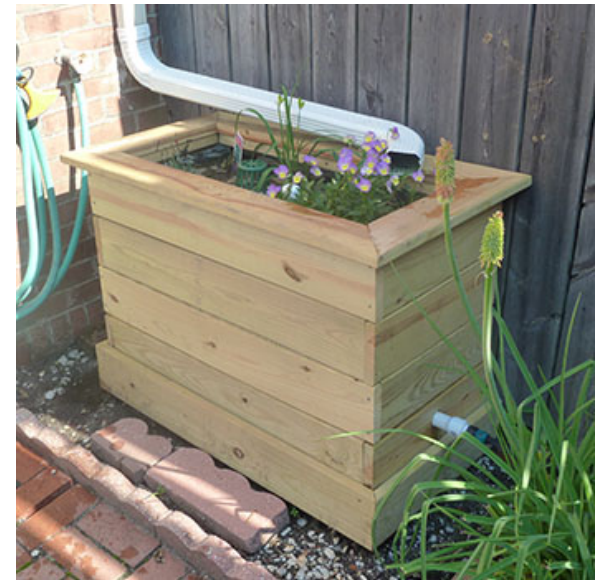




# Will Your Green Infrastructure Program Help You Comply with Your Consent Order?

# Presentation Agenda

- General Requirements under EPA's Consent Order
- Green City, Clean Waters
- Role of Green Stormwater Infrastructure (GSI)
- Case Study – PWD SMP Management Program
  - Need for Inspection and Assessment of SMP
  - Inspection and Hydraulic Assessment Elements
  - Inspection Findings and Take-away



## • Discussion

# Regulatory Framework for Combined Sewer Overflows

- **Clean Water Act Section 301(a) -**

*Prohibits discharge of pollutants from point source into waters of United States, except in Compliance with a permit issued pursuant to National Pollutant Discharge Elimination System (NPDES) program.*

- **EPA's 1994 CSO Control Policy –**

*Most CSO communities are required to develop and implement a Long-Term Control Plan (LTCP) to restore and protect water quality.*



Mill Creek Tunnel Construction, late-1800's West Philade

# Green City, Clean Waters

## - City of Philadelphia, PA DEP & EPA Partnership

- Timeframe - 25-year implementation of Long-Term Control Plan (LTCP)
- Commitment - \$1.2B net present value (represents \$2.4B capital construction plus operating and maintenance costs, in terms of actual future expenditures)
- Goal - Capture of 85% by volume of the combined sewage collected in the CSS

How? – Greened Acres

**Greened Acre represents 1 acre of impervious cover within the combined sewer service area that has at least the first inch of**

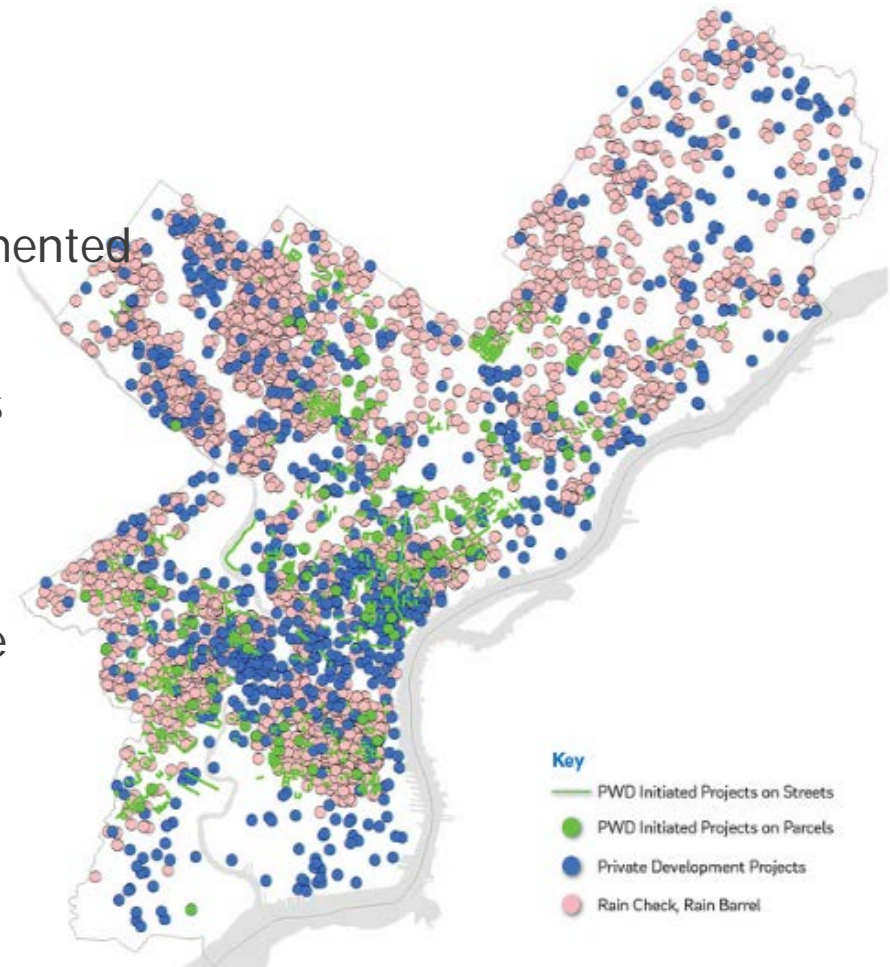
**runoff managed by stormwater infrastructure.**

Will Your Green Infrastructure Program Help You Comply with Your Consent Order? | June 29, 2017



# Green City, Clean Waters – “5 Down”

- 1.5B Gallons Treated
- 440 GSI Sites Constructed
- 1600 Stormwater Tools Implemented
- 430 New Jobs – 14% Growth
- \$51M – Private & Public Grants
- 308,759 Citizens Engaged
- 2958 Rain Check Projects
- 10.3% Property Value Increase
- 6,000 Tons of Trash Removed



GCCW Progress, PWD (Courtesy City of Philadelphia)

# Achieving Greened Acres

- Planning & Design Priorities:
  - Reduce impervious cover
  - Disconnection of impervious cover
  - Use of existing topography
- Design Approach:
  - First Flush Storm
  - Reuse, Recycle and Recharge
  - Long Term Maintenance
- Collaboration:
  - Community Engagement
  - Education/Programs
  - Agency Partnerships



# Achieving Greened Acres

- **Green stormwater infrastructure (GSI) -**

Soil-water-plant systems that intercept stormwater, infiltrate a portion of it into the ground, evaporate a portion of it into the air, and in some cases release a portion of it slowly back into the sewer system (PWD).



- **Stormwater Management Practice (SMP) –**

Any man-made or natural structure, system, landscape feature, channel, or improvement designed, constructed, installed, and/or used to detain, infiltrate, or otherwise control stormwater runoff quality, rate, or quantity (PWD).





**SMP Post  
Construction  
Inspection  
and  
Assessment –  
Philadelphia  
Water**



# SMP Inspection & Assessment Program

## Scope of Work

- Verify SMP is constructed per approved plans
- Performance evaluation of existing SMP
- Repairs and maintenance recommendation and follow-up

## Program Basics

- Inspection of privately owned/operated sites
- Located predominantly in CSS areas
- Two 4-year contracts
- Two inspection “batches” per year
- 20-25 sites per batch



Philadelphia Art Museum  
Green Roof



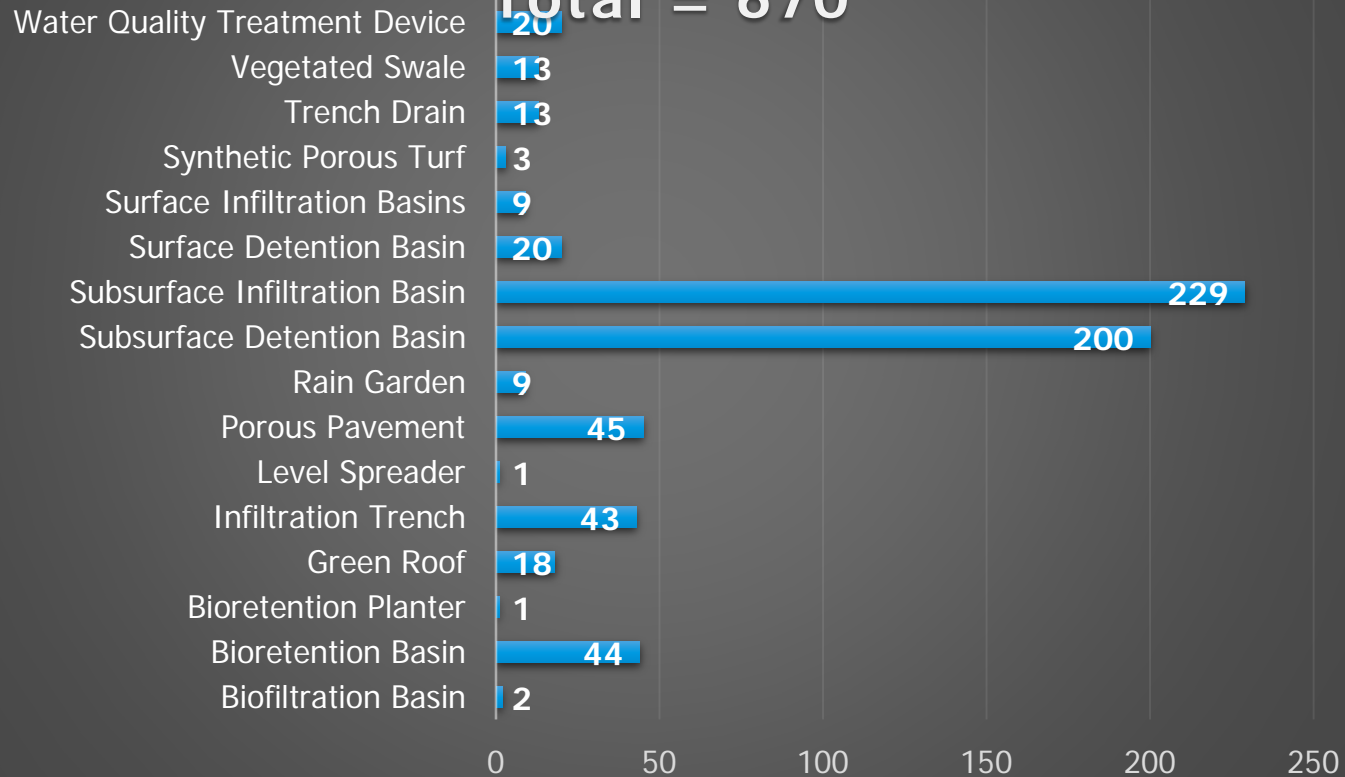
Philadelphia Zoo – Sidewalk on Zoological St.  
Porous Asphalt

# Inspection and Assessment



## SMPs Inspected Under Existing PWD Contract

Total = 670

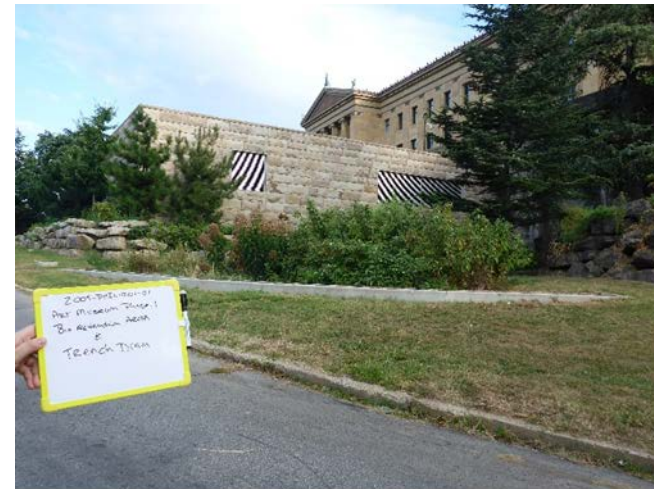


# Project Objectives and Goals

- As-built verification
  - Survey of SMP geometry and elevations
  - Drainage area verification
- Performance Evaluation
  - Visual Inspection
  - Field Inspection
  - Wet-weather inspection
- Performance Recommendations
  - Site/SMP Grading



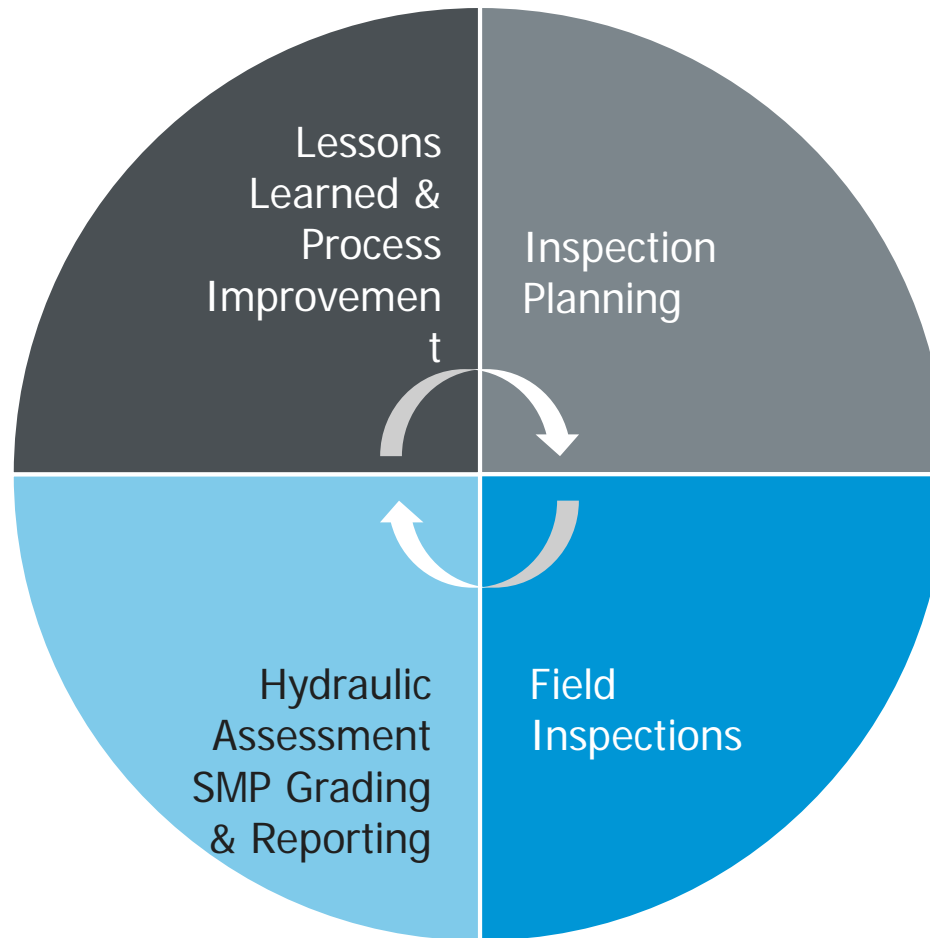
Philadelphia Stock Exchange  
Surface Detention Basin



Philadelphia Art Museum  
Bioretention Basin & Trench Drain

# Adaptive Management Delivers Continuous Improvement

- Opportunities for enhancing operational efficiency and cost effectiveness
- Protocol enhancement for future phases
- As-built plans
- SMP Assessment Report



- Protocol and Checklists
- Plan & Schedule
- Resource Allocation
- Site Owner Coordination
- Wet and Dry Weather
- CCTV, Camera
- SUE (GPR, EM)
- Photo log and video documentation

# SMP Types Dictate Inspection Techniques

- Surface SMP (SWM Planters, Bioretention, Bioswales, Green Roofs)
  - Topographical Survey
  - Visual Inspection
  - Confined Space Inspections (OS only)
- Subsurface SMP (Subsurface Infiltration systems, Proprietary Systems)
  - Topographical Survey
  - Visual Inspection
  - Confined Space Inspections

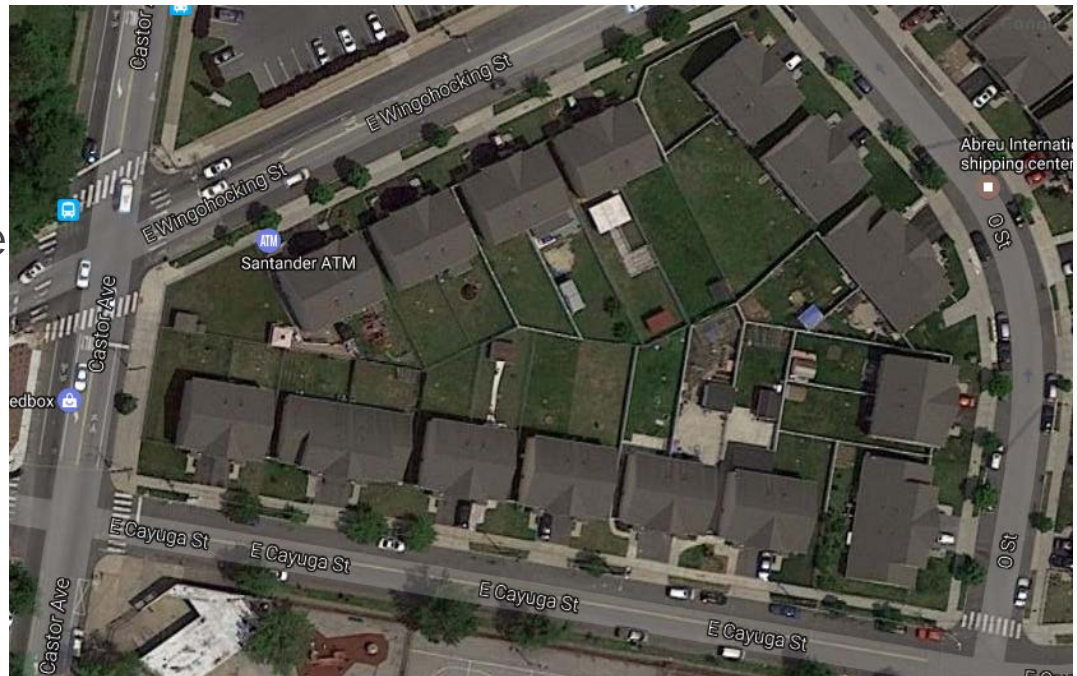


- Video/CCTV Inspection

# Drainage Area Inspection & Verification

## Inspection Elements: Visual Inspection

- Drainage boundary to SMP
- Areas by-passing SMPs
- Source of trash, debris, sediment
- Signs of erosion or lack of vegetation
- Source of pollutants
- Change in ground cover - **Important**



# Drainage Area Inspection



# Drainage Area Inspection





# Conveyance System Inspection



# Conveyance System Inspection



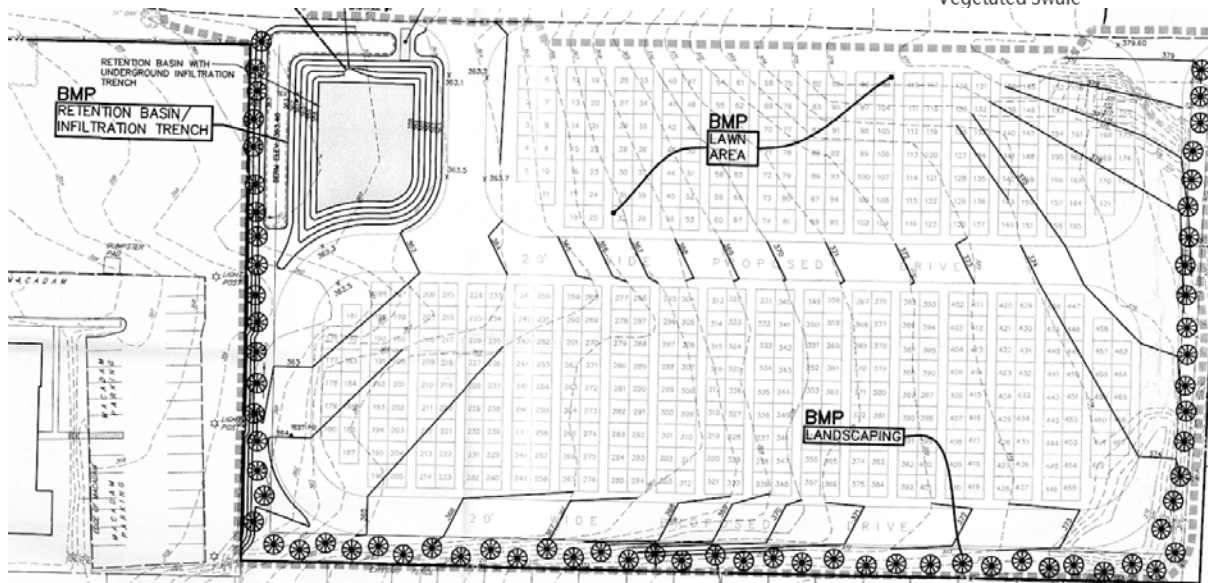
# Bioretention/Bioswale Inspections

## What are we looking for?

- Bioretention bed dimensions
- Soil media depth
- Vegetation type and condition
- Sediment & trash accumulation
- Outlet structure condition



Please Touch Museum  
Vegetated Swale



# Bioretention/Bioswale Inspection

What we would like to see:



# Bioretention/Bioswale Inspection

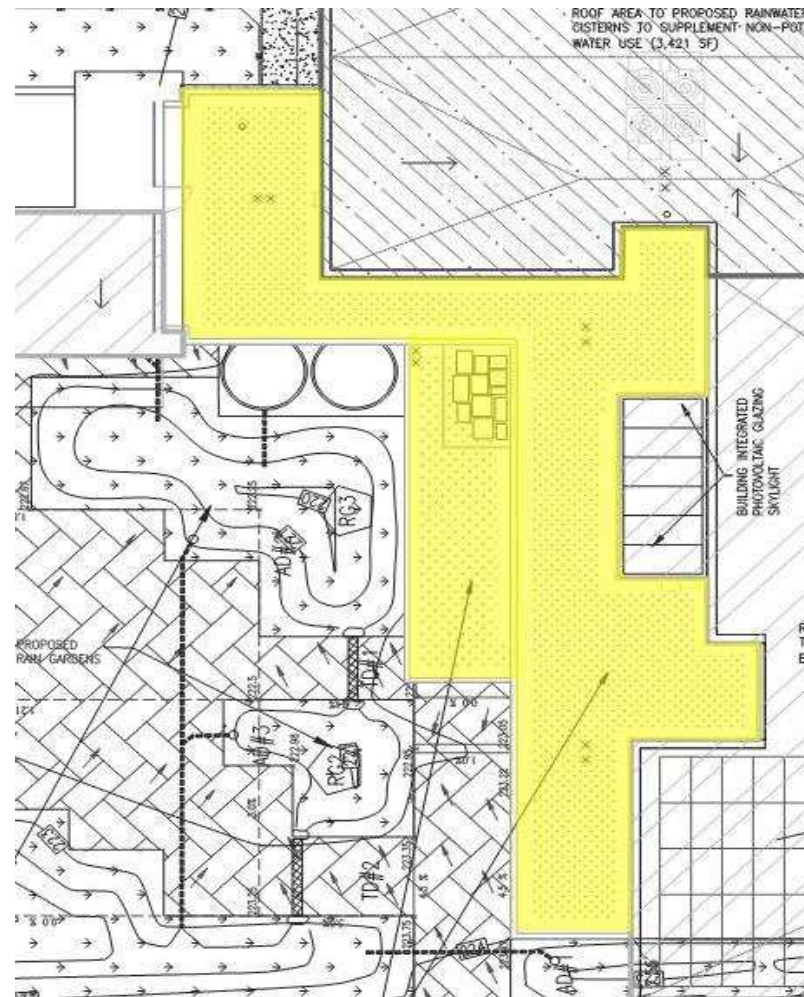
What we may see:



# Green Roof Inspection

## What are we looking for?

- Vegetation cover area
- Soil media depth
- Vegetation type and condition
- Growth delays
- Ponding



# Green Roof Inspection

What we would like to see:



# Green Roof Inspection

What we may see:

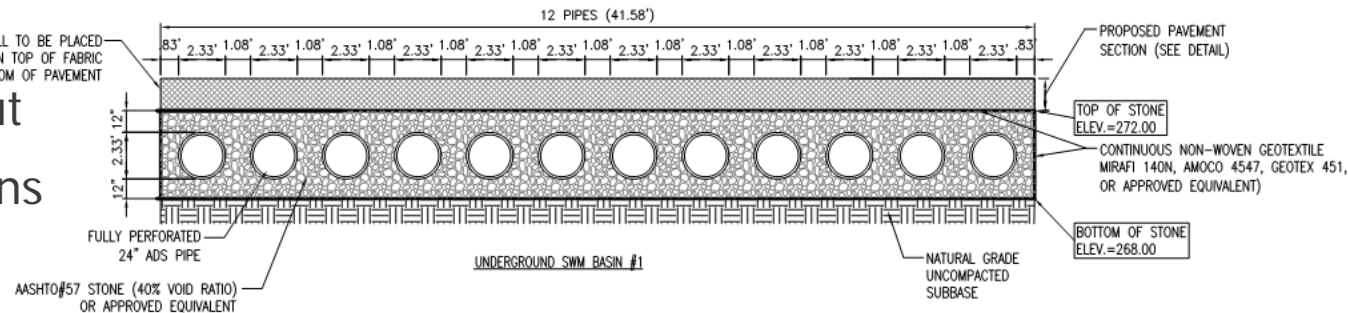
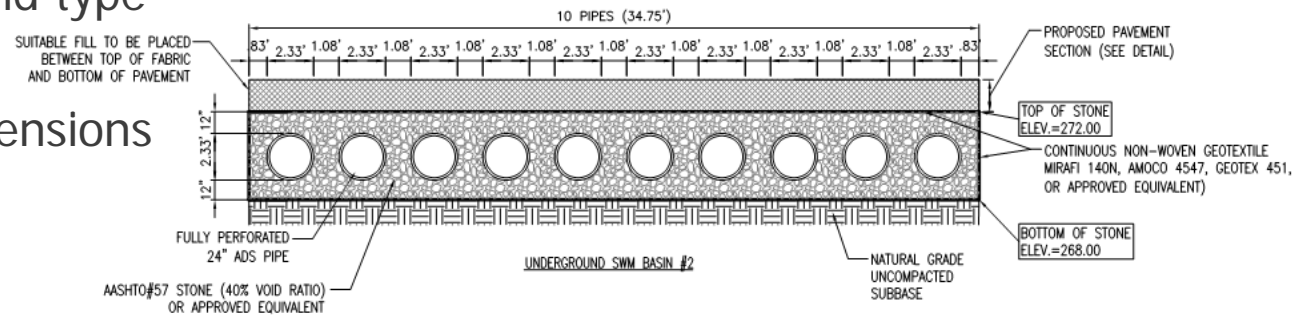




# Subsurface Infiltration System Inspection

## What are we looking for?

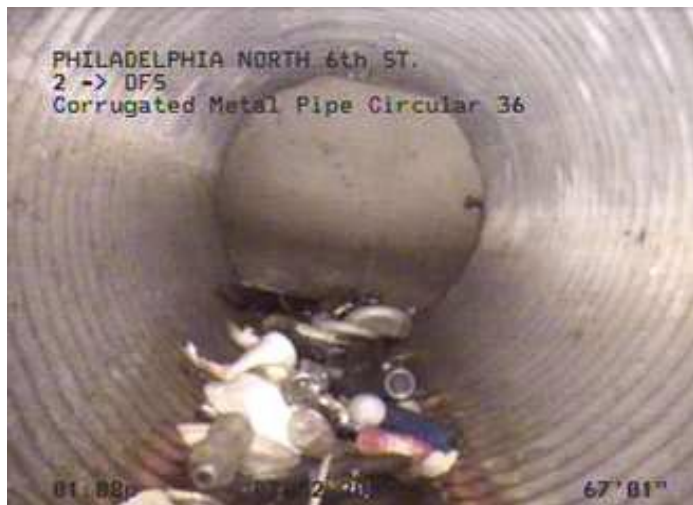
- Verify –
  - No. of rows of pipe
  - Pipe size, and type
  - Perforations
  - System dimensions
- Clogging
- Source of pollutants
- High water marks
- Outlet structure layout
- Structural deformations



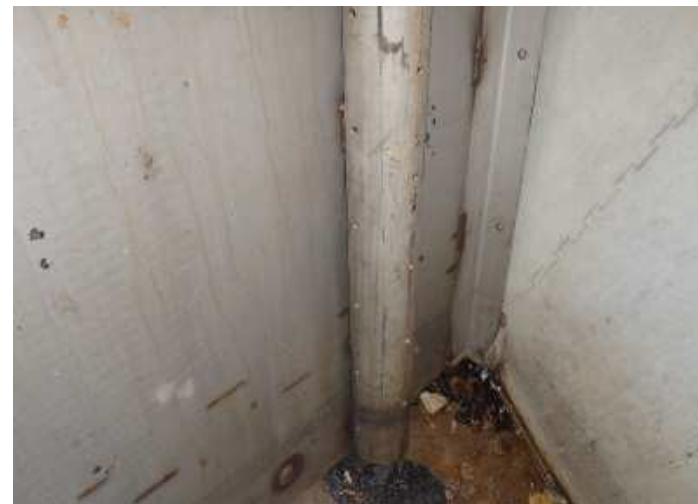


# Infiltration System Inspection

What we may see:



# Outlet Structure Inspection



# Outlet Structure Inspection



# Porous Pavement Inspections

## What are we looking for?

- Pavement coverage
- Drainage area condition and size
- Estimate percentage of clogged pavement
- Identify sources of sediment & trash
- Causes of failures
- Ineffective operations



# Porous/Permeable Pavement Inspection

What we would like to see:



# Porous/Permeable Pavement Inspection

What we may see:





# Compliance Reporting & As-Built Plans

## Compliance Report Elements:

- Site and SMP Description
- Field Observations
- Photo/Video Log
- Inspection Checklists
- Hydraulic Assessment of SMPs
- SMP Grading
  - A - System functioning as designed. Regular maintenance required.
  - B - System functioning with minor issues - Regular maintenance required.
  - C - System functioning with major issues - Immediate remediation/maintenance required
  - D - System non-functional -

Immediate  
remediation/maintenance  
required

CHESTNUT HILL VILLAGE  
(2007-CHES-594-01)



June, 2017

**SMP INSPECTION AND ASSESSMENT  
REPORT**

Prepared For:



Prepared By:



# Lessons Learned

- As-built verification is key
  - Inspection planning is necessary
  - No. 1 Inspection Issue – Site access / Owner Permission
  - “High-water mark” = good indicator of the health of SMP
  - Snouts/traps reduce debris significantly = Pre-treatment
  - Site use determines the performance of porous pavement systems
  - Subsurface Infiltration – GPR
- Key Factors for Performance -
    - Construction Inspection
    - Long-term maintenance
    - Pre-treatment
    - Outlet structure design



South 61<sup>st</sup> St.  
Surface Detention Basin



**Discussion**