District of Columbia Water and Sewer Authority
George S. Hawkins, General Manager

Briefing on:

Greening Grey Infrastructure: A Lightweight Alternative to Upgrade the District's Water Supply Facilities

Briefing for:

Excellence in Environmental Engineering and Science Conference

April 23, 2015

DCWATER.COM

Overview

- Background
- Project Goals, Locations, and GI Practices
- Green Roof Design and Construction
- Pre- and Post-Construction Monitoring
- Maintenance
- Green Jobs
- Education and Outreach
- DC Clean Rivers Project Green Infrastructure Next Steps

DC WATER AND DC CLEAN RIVERS PROJECT


Green Roof at Fort Reno Reservoir

Background: What is DC Water?

- Independent Authority formed in 1996
- Formerly Water and Sewer Utility Administration (WASUA) under Dept. of Public Utilities
- Services Provided
  - Water Distribution
  - Wastewater Collection and Treatment
  - Stormwater Collection and Conveyance
- Largest advanced wastewater treatment plant in the world – 370 mgd capacity
- Serves 2 million people
  - District of Columbia
  - Parts of Maryland & Virginia

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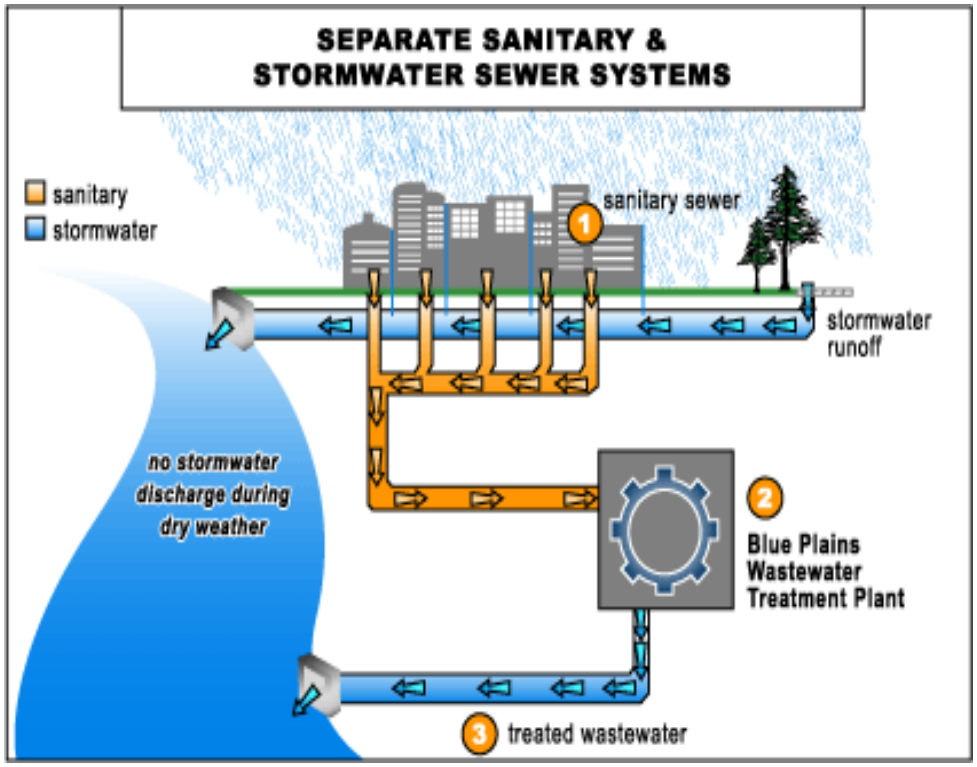
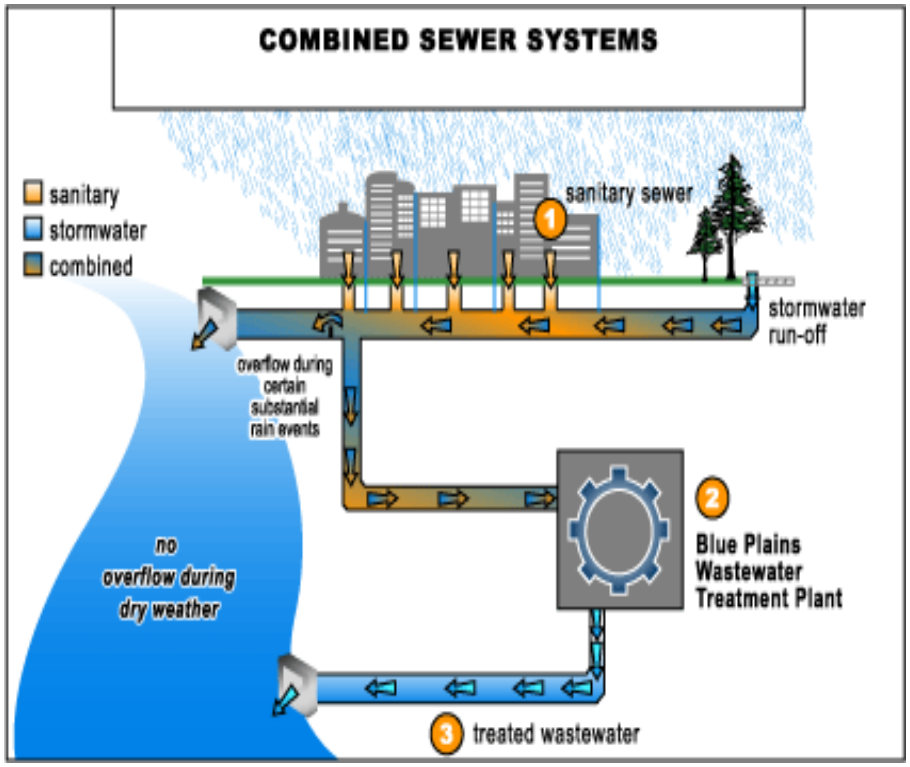
Background:
Separate and Combined Sewer Systems





100% of suburbs

67% of D.C.

0% of suburbs

33% of D.C.

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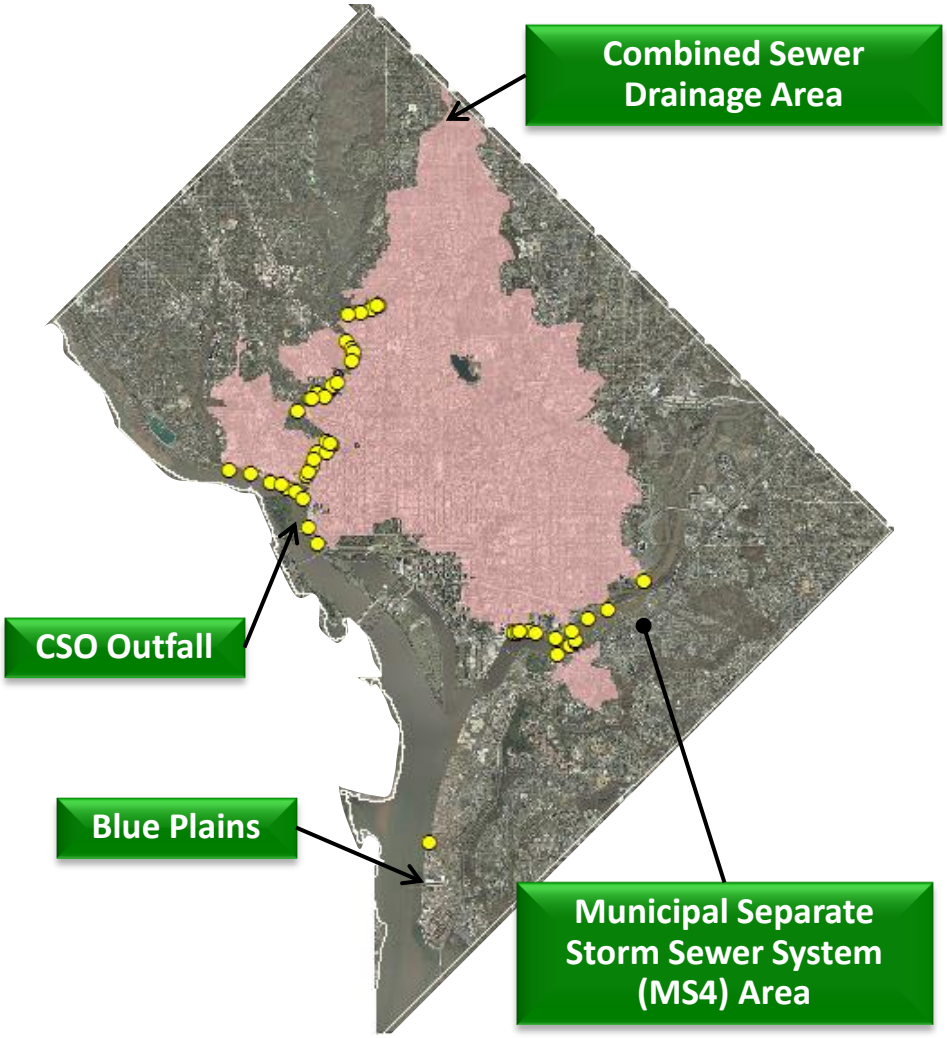
Background:
Where are Combined Sewers Located?



- 1/3 area is combined (12,478 acres)
- 53 CSO outfalls
  - 15 to Anacostia
  - 10 to Potomac
  - 28 to Rock Creek
- Three receiving waters
  - Anacostia River
  - Potomac River
  - Rock Creek

Background:
DC Clean Rivers Project Development

1998 - LTCP Started

2002 – Final LTCP

2003 – LTCP Meets WQS (EPA/DC)

2005 – Consent Decree Signed

2007 - New Nitrogen limits require changing LTCP

2011 - DC Water begins evaluating GI for Potomac and Rock Creek

2014 - DC Water proposes changing LTCP to include Green Infrastructure

Public Participation

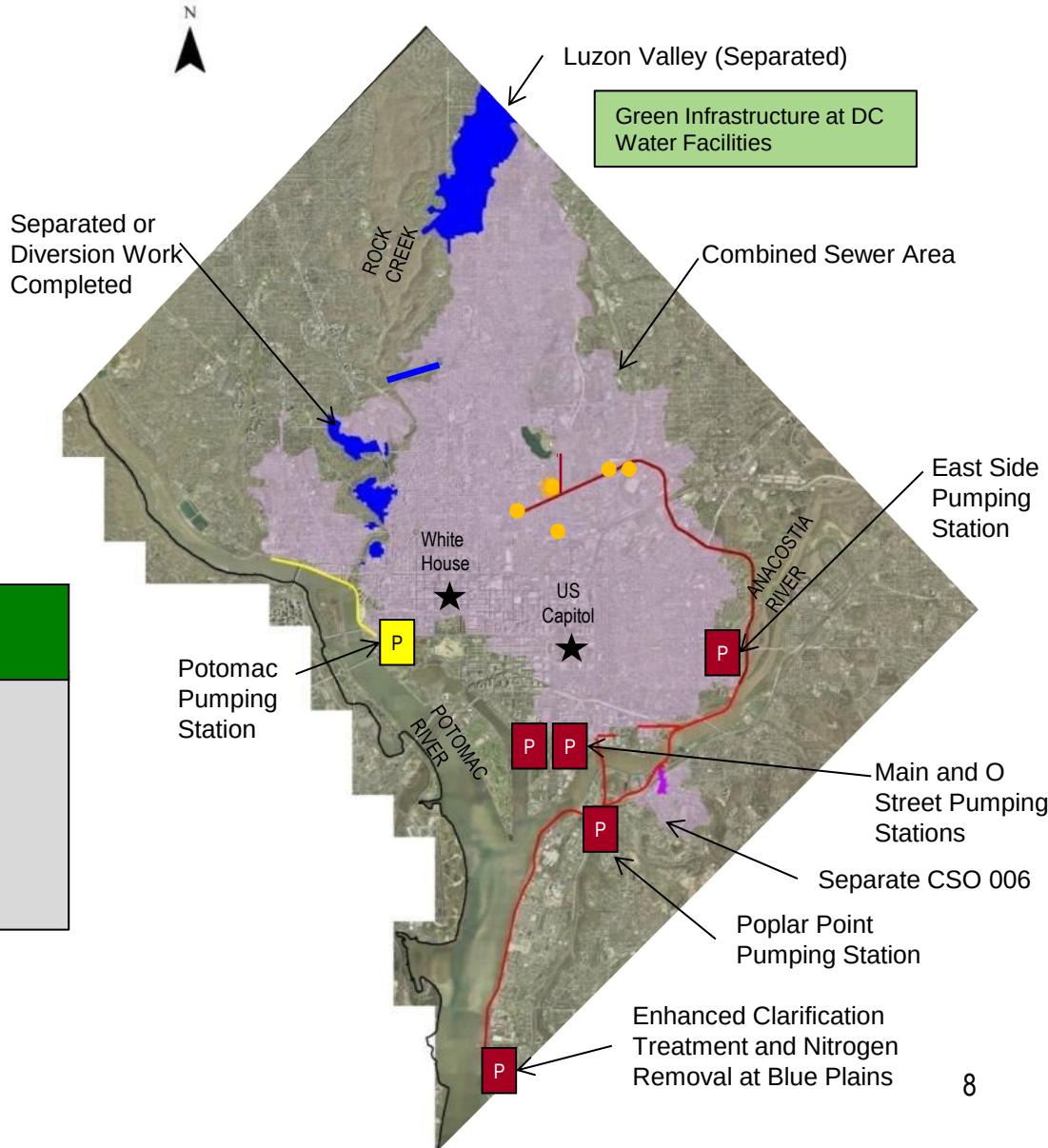
Total Nitrogen implementation

LTCP implementation

Background:
DC Clean Rivers Project Scope and Timeline

LEGEND

- Anacostia River Tunnel System
- Potomac River Tunnel
- Piney Branch Tunnel
- P — Pumping Station Rehabilitation
- Known Flood Area



DC CLEAN RIVERS PROJECT AND NITROGEN REMOVAL PROGRAMS

- DC Clean Rivers Project: $2.6 Billion
- Nitrogen Removal: $950 Million
- Total > $ 3.5 Billion
- 20 yr implementation (2005 – 2025)
- 96% reduction in CSOs & flood relief in Northeast Boundary
- Approx 1 million lbs/yr nitrogen reduction predicted

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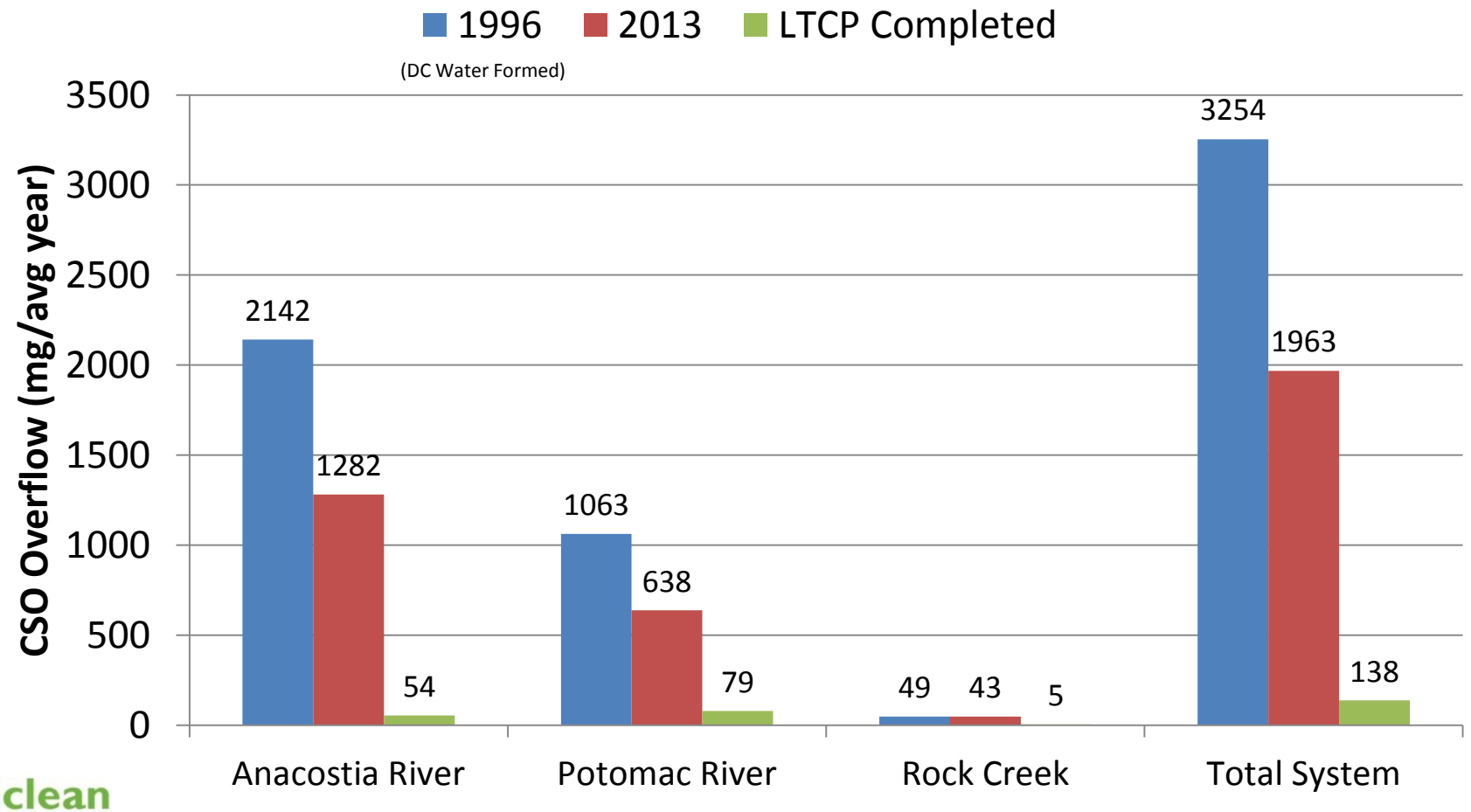
Background:
Progress to Date Controlling CSOs



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FORT RENO RESERVOIR GREEN ROOF


Green Roof at Fort Reno Reservoir

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‘Low Impact Development Retrofit at DC Water Facilities’ Project

- Project required by Consent Decree
- Low Impact Development (LID)/Green Infrastructure (GI) at three DC Water Sites
  - Multiple GI practices designed to manage 1.2”
    - Green Roofs
    - Pervious Pavement
    - Bioretention

BIORETENTION

Captures surface runoff in a shallow, vegetated depression underlain with a permeable soil medium.

GREEN ROOF

Intercepts rainfall via a growing medium and vegetation on a roof.

PERVIOUS PAVEMENT

Permits percolation of surface runoff through a permeable media (concrete, asphalt, or pavers) into a gravel subgrade.

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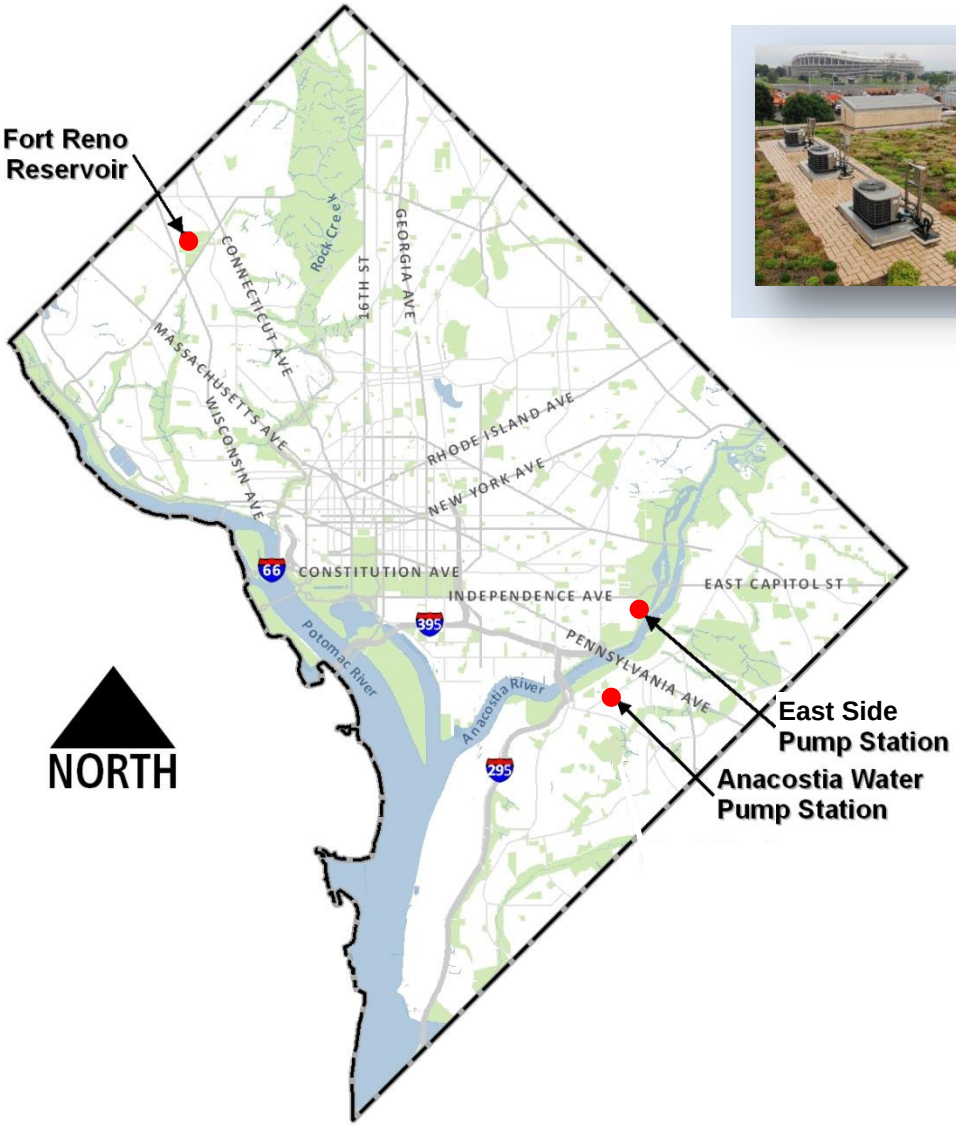
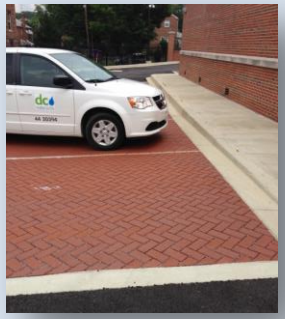
Project Sites

- **Fort Reno Reservoir**
  - 8,400 sf Pervious Pavement
  - 42,400 sf Green Roof



- **East Side Pumping Station**
  - 6,570 sf Green Roof



- **Anacostia Water Pumping Station**
  - 1,000 sf Pervious Pavement
  - 1,500 sf Bioretention

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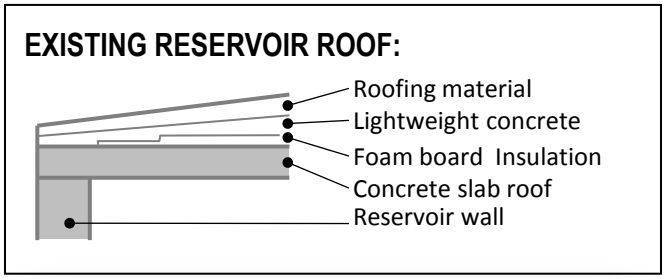
Fort Reno Reservoir Site
Existing Conditions

View of Parking Area, Office, and Trailer Office

West End of Reservoir from Northwest Corner

Fort Reno Reservoir Existing Conditions

- Built: 1926-28
- 5.8 million gallon covered drinking water reservoir serves District of Columbia
- Access hatches throughout
- Historic ventilation houses at each end
- Roof:
  - Approximately 1-acre
  - Repairs and upgrades to reservoir and roof in 1997
  - Internal and external inspection in 2010
  - 8-inch thick concrete slab with 2-way reinforcing
  - Built-up roof




Existing Reservoir Roof


Existing Reservoir Roof

Fort Reno Reservoir Green Roof Structural Assessment

- Structural analysis indicated no structural deficiencies
- Existing roofing material loading = 30 psf
- Concrete and Rebar Sampling Program:
  - Three 6-inch concrete cores
  - Reinforcing steel from wall sample

Item	Assumed	Actual
Compressive Strength of Concrete	2,500 psi	6,120 – 7,360 psi
Yield Strength of Steel (billet or axle)	33 ksi	72 ksi

- Available loading of 50 psf for the complete green roof system was determined (used assumed values)
- Additional snow load of 30 psf
- Staging of materials prohibited on roof


Structural Assessment


Concrete Roof Slab Sample

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Fort Reno Reservoir Green Roof Design Considerations

Design Consideration	Concern	Solution
Structural Loading	• Integrity of the existing concrete slab (potential for leakage) • Compressive strength of concrete roof slab • Tensile strength of the structural steel reinforcing in the roof slab	• Structural integrity assessed • Concrete and steel testing performed to ensure structural roof capacity
Safety of Drinking Water Supply	• Protection of the potable water stored within the reservoir • Perception of constructing a green roof over a potable water reservoir • Presence of contaminants in the concrete and built-up roofing system	• Green roof designed with three waterproofing layers • Leak detection system designed as part of green roof system • Environmental sampling performed on existing roof material • Reservoir removed from service during construction

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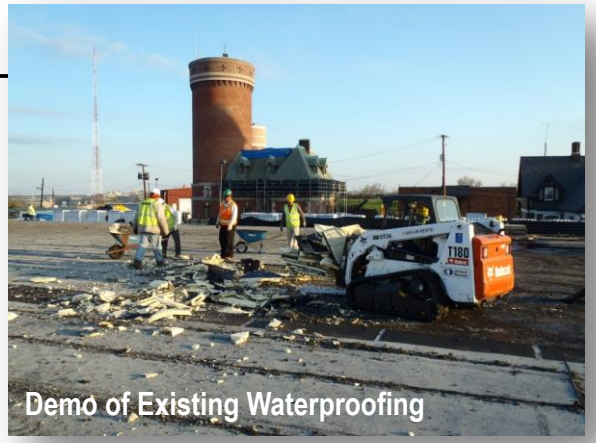
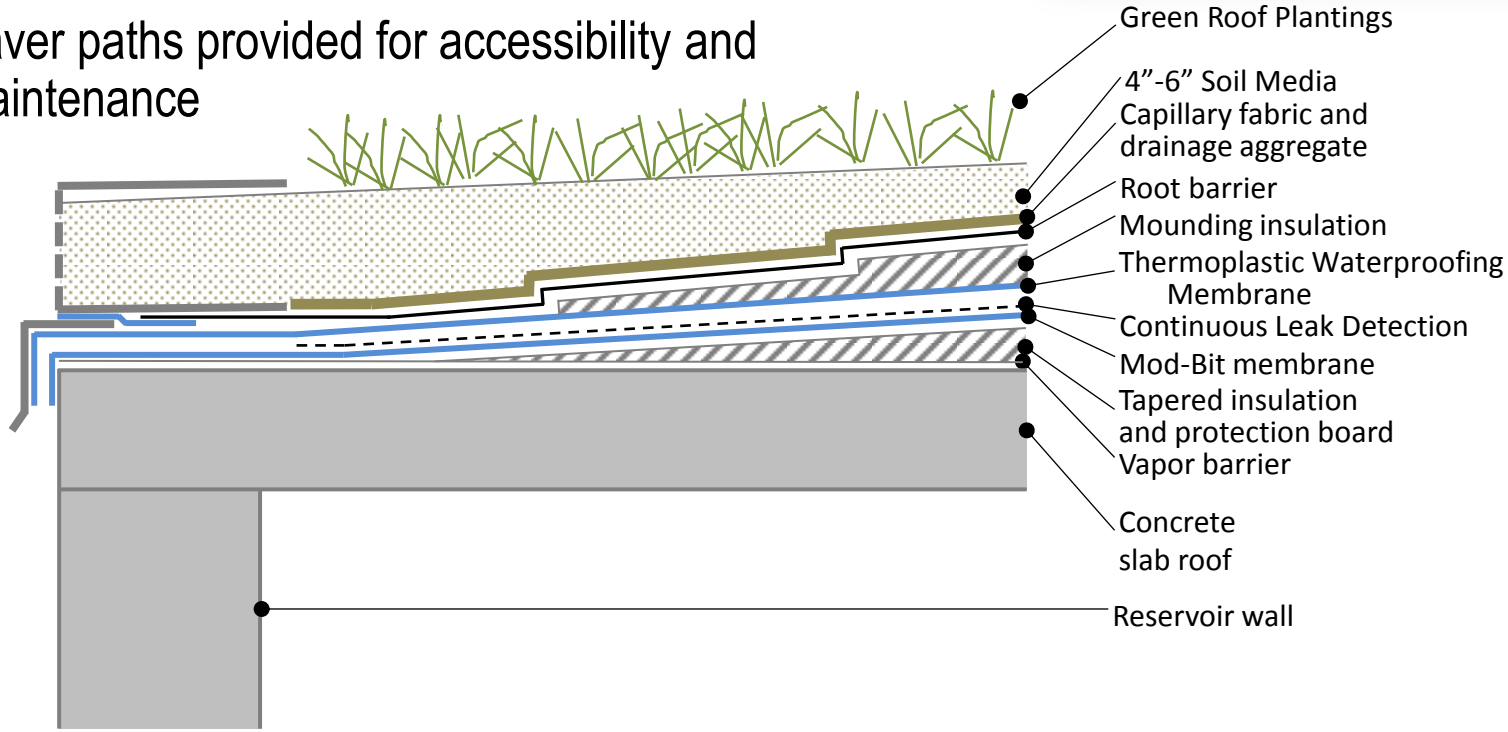
Fort Reno Reservoir Green Roof Design and Construction

- 42,500 square feet
- Extensive: 4 to 6-inch depth
- “Mounding” design
- Planted with sedums, succulents, grasses and perennials
- Access hatches and ventilation houses not impacted
- Paver paths provided for accessibility and maintenance


Demo of Existing Waterproofing



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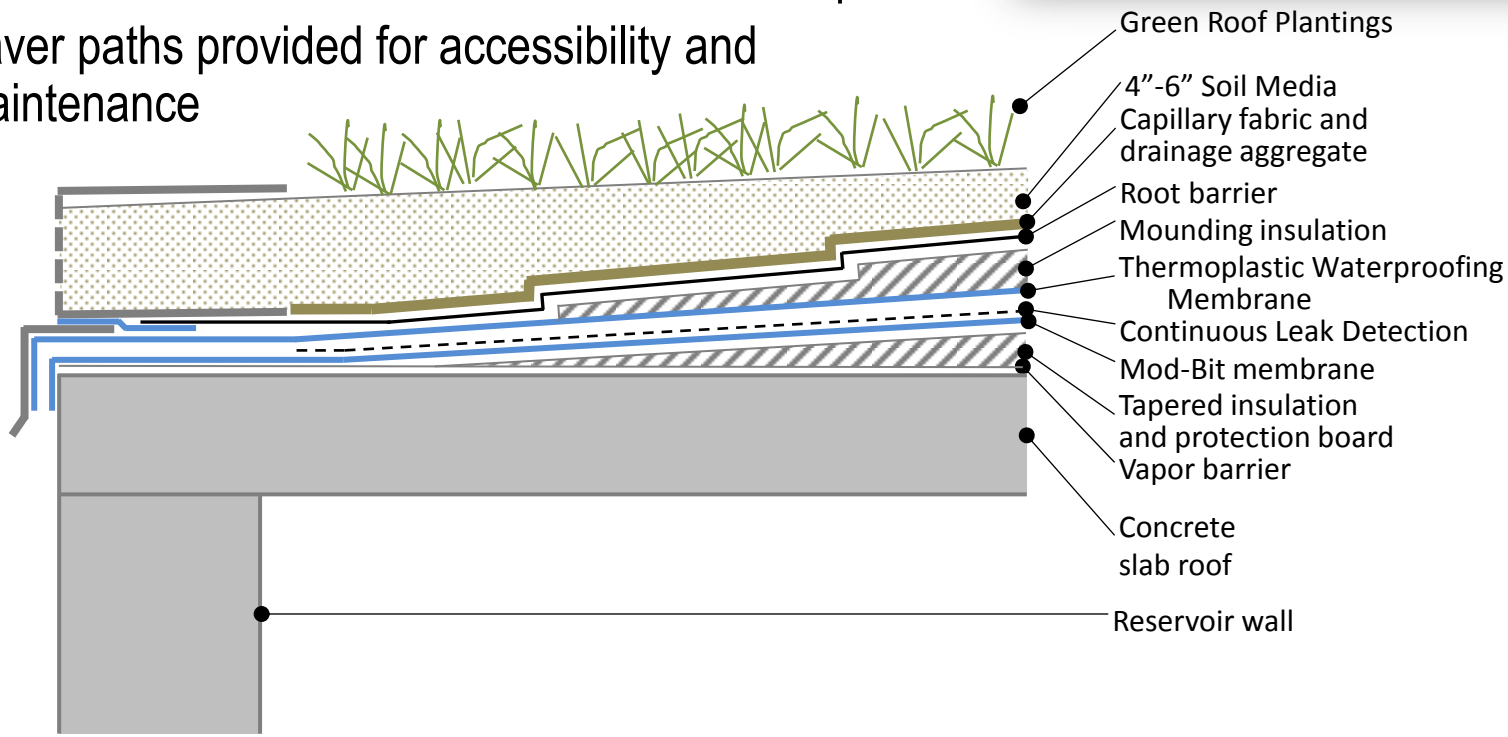
Installation of Mod-Bit Membrane



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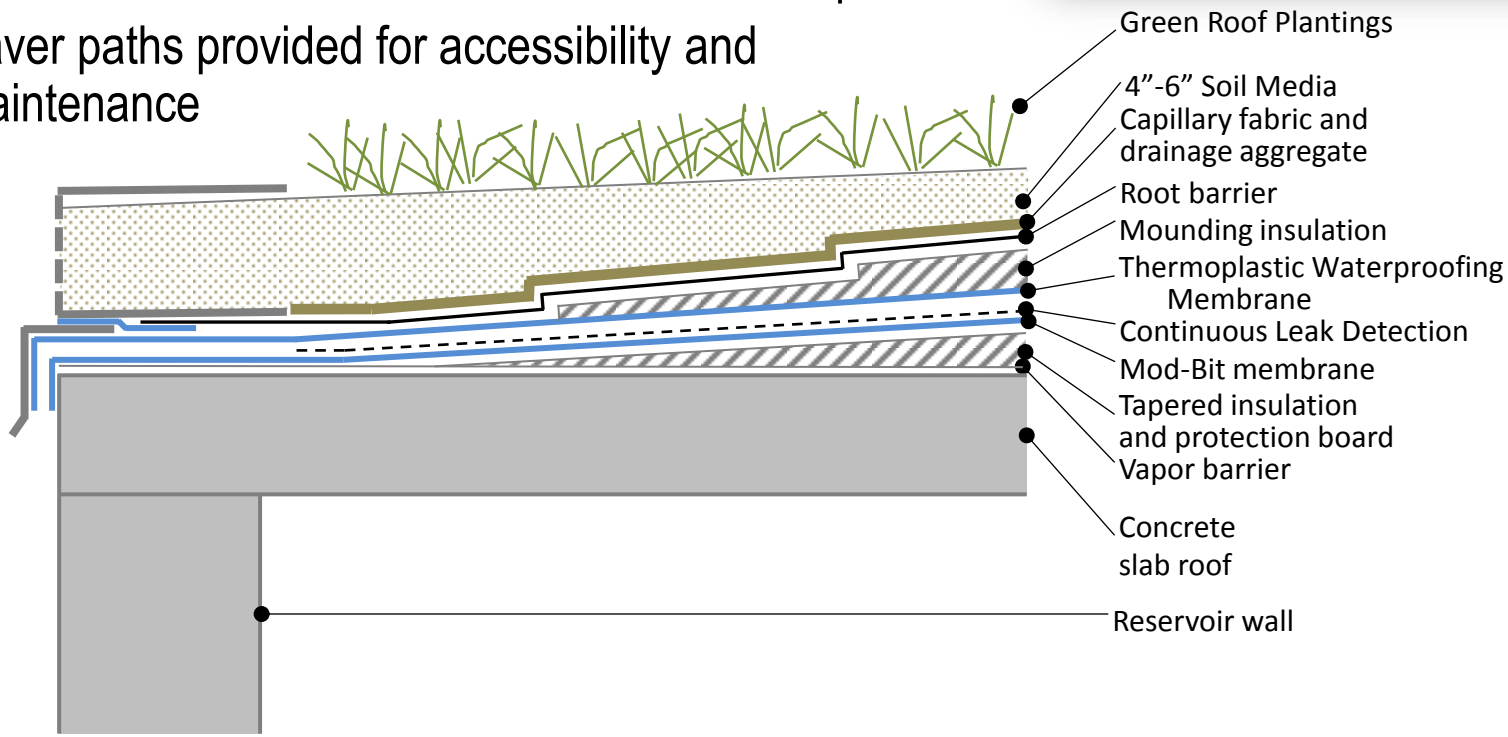

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Fort Reno Reservoir Green Roof Design and Construction

Planting Plan by Zones Based on Mounding Insulation Heights

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Pre- and Post-Construction Monitoring

- Pre-Construction Monitoring
  - Rain gages and flow meters installed to document pre-construction runoff
- Post-Construction Monitoring (underway)
  - Rain gages and flow meters in place to document post-construction runoff
  - Monitoring to date indicates 90% reduction in runoff volume compared to pre-construction

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Post-Construction Maintenance

- Contractor performing post-construction maintenance for five years at all facilities
- Green roof maintenance includes:
  - Weeding
  - Annual soil media tests (with fertilization as required)
  - Supplemental plantings (as required)
    - 90% coverage required by end of third growing season
  - Inspecting roof drains, pavers, other roof components, etc.
  - Pest management (as required)
  - Irrigation (temporary during plant establishment)


Weeding


Pest Management

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Green Jobs

- 2014 Green Roof Maintenance Pilot Program
  - Green Roof Focus
  - Program began in summer 2014
  - Recruited 10 underemployed candidates from soft skills training programs (Sasha Bruce Youthwork, Jubilee Jobs, and AFL-CIO)
  - 4 in-class technical sessions led by DCG and UDC
  - 4 in-field sessions: DC Water Fort Reno Reservoir green roof and in-field "job shadowing" with Furbish and Capital Greenroofs
  - Online trainee database accessible to local green roof installation and maintenance companies at training completion (forthcoming)

For additional Information visit:
http://www.dcwater.com/giatdcwater
and http://dcgreenworks.org/programs/green-job-training/

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Outreach and Education

- Advance STEM outreach and education opportunities with schools:
  - Alice Deal Middle School Collaboration
  - Earth Echo Hangout
  - Site tours with students

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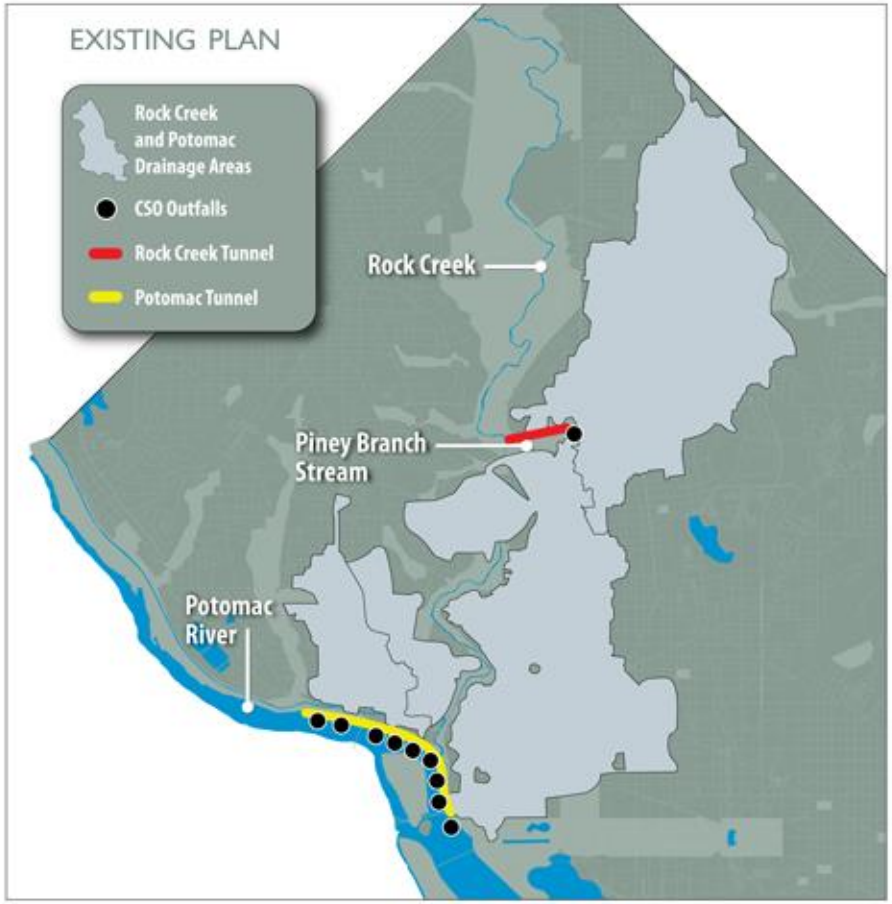
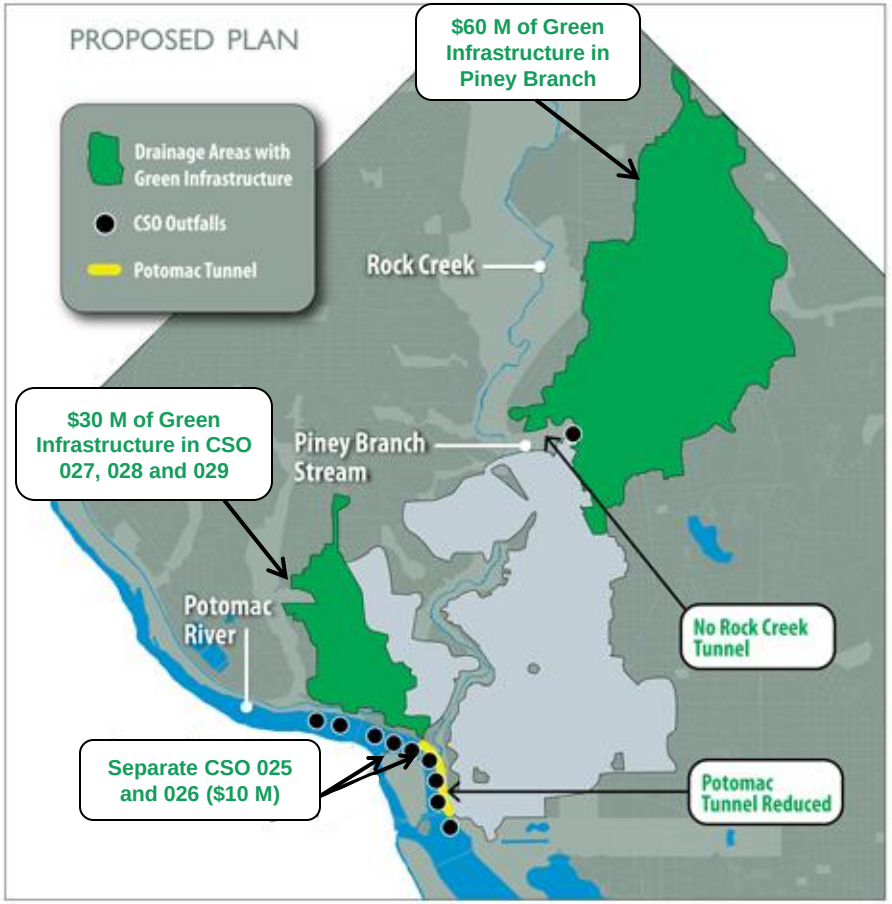
DC Clean Rivers Project:
Green Infrastructure Next Steps





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Questions?

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Fort Reno Green Roof
Ribbon Cutting Ceremony