



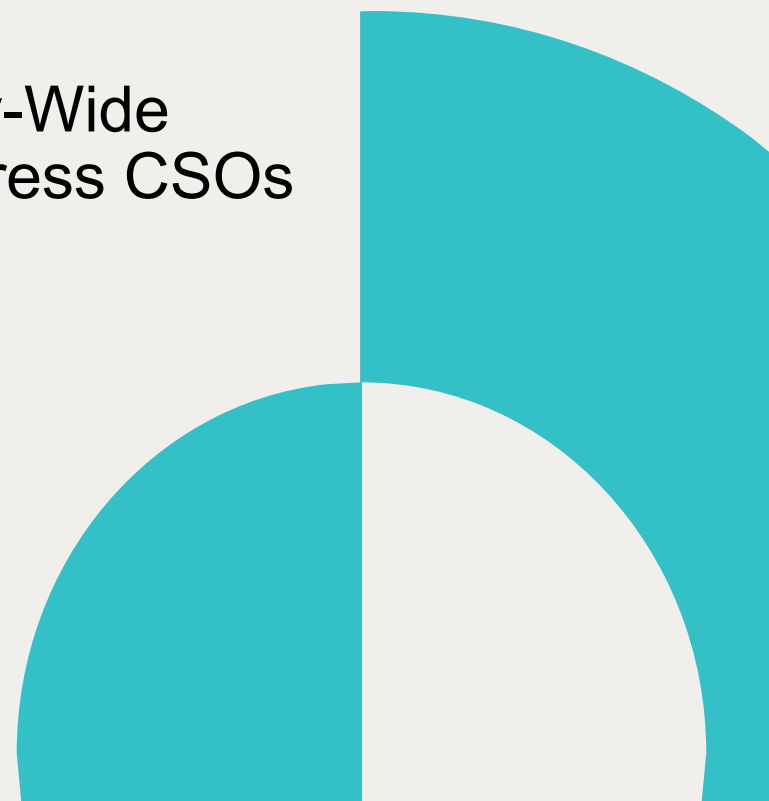
Analysis of the Implementation of City-Wide Green Infrastructure Solutions to Address CSOs

Case Studies:
New York City, Philadelphia, Cleveland

NJEW Annual Conference

Atlantic City, NJ

May 7, 2018





Presentation Outline

- Background on Regulations
- Overview of GI Programs and Long Term Control Plans (LTCPs)
 - New York City
 - Philadelphia
 - Cleveland (NEORSD)
- Examples of Common GI Technologies
- Status Updates on LTCPs
- Lessons Learned
- Questions



Regulations

Background on city regulations



Consent Decree Requirements by City

Regulations by City

City		Time Frame	Goal	Methods Utilized
New York City	New York	20 Years	Reduce CSO discharge through green and grey infrastructure	Green and grey infrastructure
Philadelphia	Pennsylvania	25 Years	Reduce stormwater pollution entering the waterways by 85%	Mostly green infrastructure
Northeast Ohio Regional Sewer District	Ohio	25 Years	Limit overflows from 80 per year to 4 per year resulting in 98% capture	Mostly grey infrastructure

GI Programs and Long Term Control Plans

New York City, Philadelphia and Cleveland





New York City

Regulated Agency: NYC
Department of
Environmental Protection

Population: > 8 million
citizens

Infrastructure: 14
wastewater treatment plants

Collection System: 60%
Combined, 40% Separated

GI Program and LTCPs:
City-wide GI Program and 11
LTCPs utilizing green and
grey infrastructure

NYC Green Infrastructure Program

2010

NYC Green Infrastructure Plan was published. Consent Order began in 2012 and extends through 2030

\$410 Million

Total investment of GI between 2010 and March 2017

1.67

BG/yr

Target CSO volume reduction per based on Performance Metric Report

78,749

Acres

Total Impervious Area Citywide

\$1

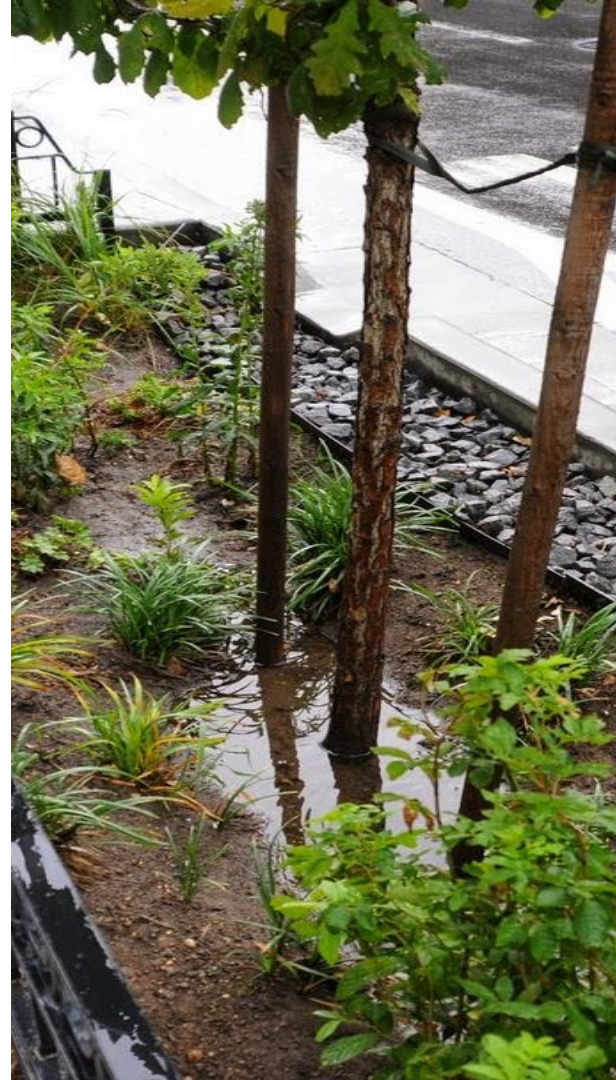
Billion

Budgeted between 2017-2027

4,000

Constructed

Total number of assets that have ben constructed since the start of the program



NYC's Long Term Control Plans – Grey Infrastructure Improvements

Tunnels

1

Bronx River

\$185M grey – sewer modifications

Hydraulic Relief

2

Hutchinson River

\$167M grey – disinfection, floatables and outfall

Disinfection

3

Alley Creek

\$12M grey - disinfection

4

Flushing Creek

\$18M grey – disinfection

5

Flushing Bay

\$1,616M 25 MG CSO storage tunnel

6

Newtown Creek

\$1,422M 39 MG CSO storage tunnel and PS expansion

7

Gowanus Canal

\$932M 2 CSO storage tanks

Tanks

8

Coney Island

\$197M already implemented in grey infrastructure

9

Westchester Creek

\$124M already implemented in grey infrastructure

10

Jamaica Bay

LTCP not yet approved

11

East River/ Open Waters

LTCP not yet approved



Philadelphia

Regulated Agency: Philadelphia Water Department

Population: > 1.5 million citizens

Infrastructure: 3 wastewater treatment plants

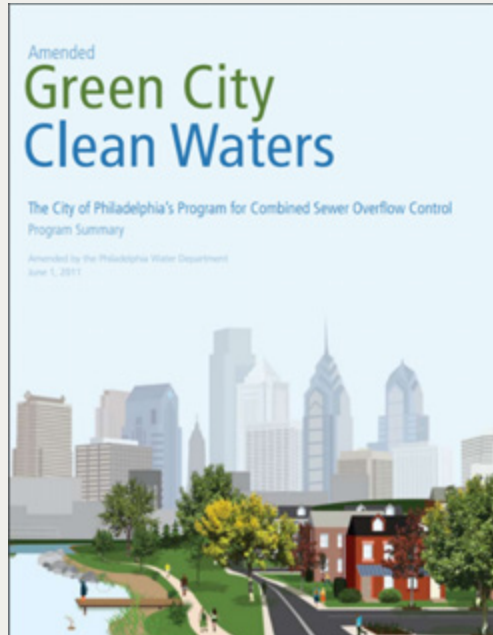
Collection System: 60% Combined , 40% Separated

Long Term Control Plan:

- Green stormwater infrastructure
- Stream corridor restoration and preservation
- Wet weather treatment plant upgrades

PHILADELPHIA, PENNSYLVANIA

GREEN INFRASTRUCTURE PLAN



2011

“eliminate the pollutants that otherwise would be removed by the capture of 85% by volume of the combined sewage collected in the Combined Sewer System during precipitation events”

Philadelphia Green City Clean Waters Program

25

Year plan

\$2.4

Billion

Total investment
after 25-year period

85%

Of CSS

Eliminate the pollutants that otherwise would be removed by the capture of 85% by volume of the combined sewage collected in the Combined Sewer System during precipitation events

\$1.67

Billion

Dedicated to Green
Stormwater
Infrastructure

\$345

Million

Wet weather
treatment plant
upgrades

\$420

Million

Adaptive
management which
can be directed
towards either
green or gray
infrastructure



Stream Corridor Restoration and Preservation

Restoring Living Resources and...

Tookany/Tacony-Frankford Watershed

\$3.12M Commitment
Public Education and Volunteer Programs
Municipal Measures
Sewer Evaluation, cleaning, relining and rehab
Monitor and Reporting

Cobbs Creek Watershed

\$2.92M Commitment
Public Education and Volunteer Programs
Municipal Measures
Sewer Evaluation, cleaning, relining and rehab
Monitor and Reporting

Delaware Direct Watershed

\$33.65M Commitment
Public Education and Volunteer Programs
Municipal Measures
Sewer Evaluation, cleaning, relining and rehab
Monitor and Reporting

Tidal Schuylkill

\$33.65M Commitment
Public Education and Volunteer Programs
Municipal Measures
Sewer Evaluation, cleaning, relining and rehab
Monitor and Reporting

Wet Weather Upgrades to WWTPs

Northeast, Southeast and Southwest WWPTs

Northeast



- Vortex Swirl Concentrator
- Conventional Clarifiers
- Chemically Enhanced Primary Treatment with Conventional Clarifiers
- Ballasted Flocculation

Southeast



- Vortex Swirl Concentrator
- Conventional Clarifiers
- Chemically Enhanced Primary Treatment with Conventional Clarifiers
- CEPT with Plate Settlers
- Ballasted Flocculation

Southwest



- Vortex Swirl Concentrator
- Conventional Clarifiers
- Chemically Enhanced Primary Treatment with Conventional Clarifiers
- Ballasted Flocculation



Cleveland

Regulated Agency:
Northeast Ohio Regional
Sewer District

Population: > 1.4 million
citizens in Cleveland and 61
suburban communities

Infrastructure: 3
wastewater treatment plants

Collection System: 23%
Combined , 77% Separated

Long Term Control Plan:
Grey infrastructure utilized
and only minimum required
green infrastructure
implemented

NEORSD – Project Clean Lake

25

Year plan

Reduce total volume of raw sewage discharges from 4.5 billion gallons to 494 million gallons annually

98%

Capture of CSO

Wet weather flows will be captured and treated

3

WWTPs

Increasing capacity at all three wastewater treatment plants

7

Storage Tunnels

Construction of 7 tunnels ranging from 2-5 miles in length up to 300 feet underground

\$42

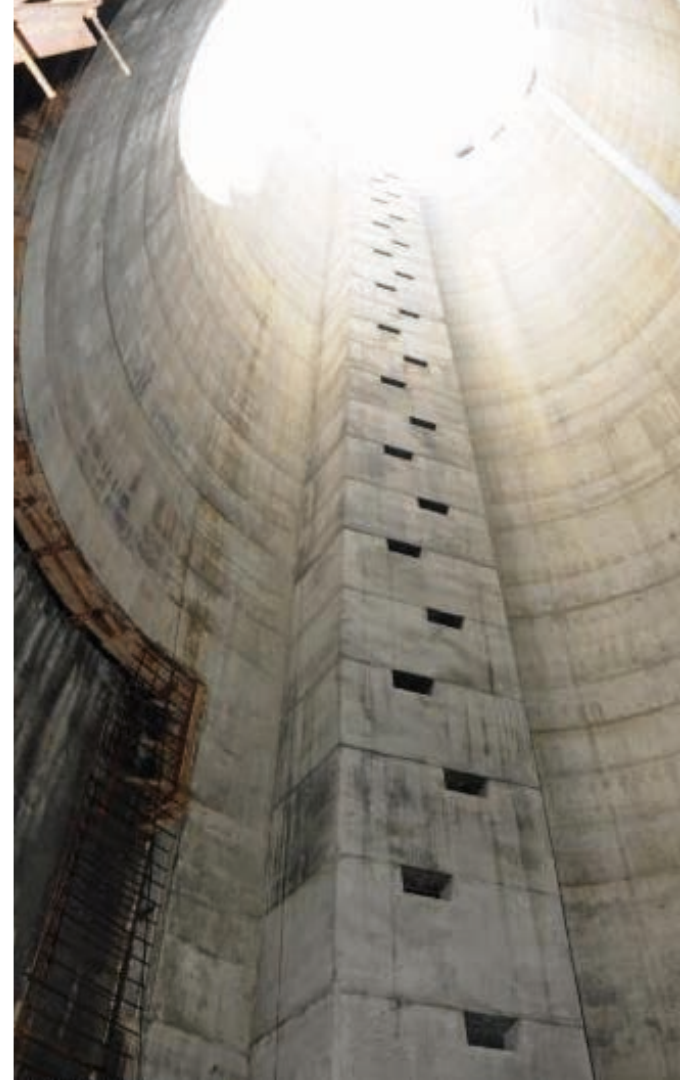
Million

Six program areas to implement green infrastructure technologies

\$3

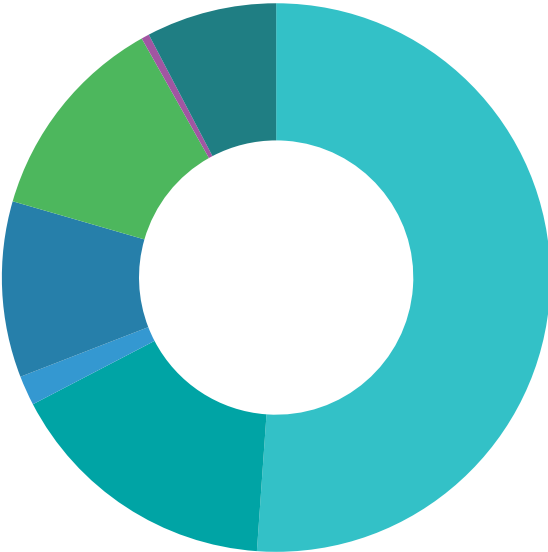
Billion

Total 25-year investment for green and gray improvements



Cleveland Consent Decree: \$3B

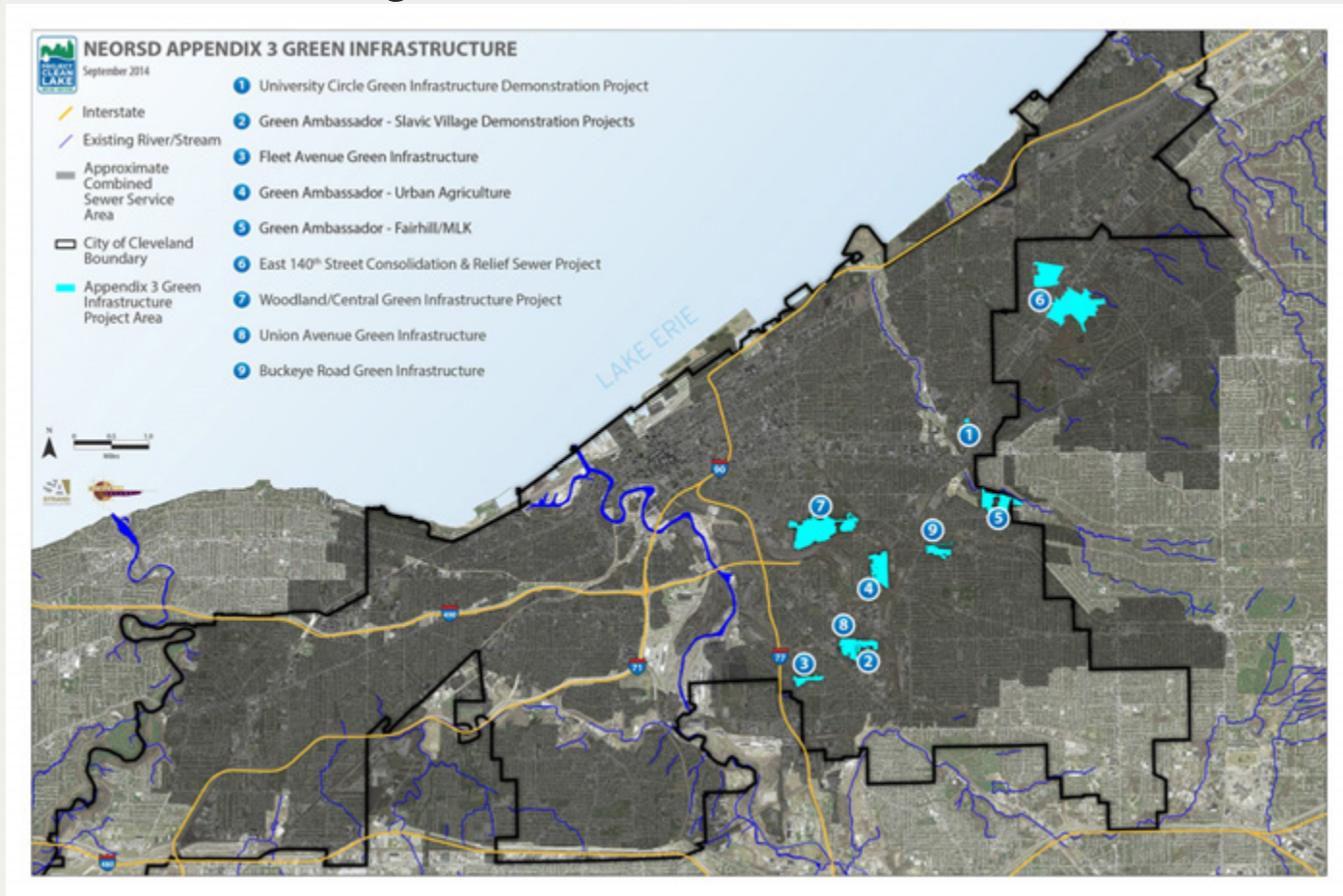
CSO – 25 Year Capital Improvement Plan



- Tunnels
- Sewer Improvements
- Green Infrastructure
- WWTP Improvements
- Pump Stations
- Storage Tanks
- Other



Green Infrastructure Programs



GI Technologies Used

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Common Types

GI Technologies Philadelphia



STORMWATER WETLAND



GREEN ROOFS

Common Types

GI Technologies Philadelphia/NYC



**RIGHT-OF-WAY
BIOSWALES / RAIN
GARDENS**

**POROUS /
PERMEABLE
PAVEMENT**



**STORMWATER GREEN
STREETS / BUMPOUTS**



RAIN BARRELS / CISTERNS (Philadelphia Only)



Common Types

GI Technologies Cleveland



INFILTRATION BASINS



PERMEABLE PAVERS



DETENTION BASINS

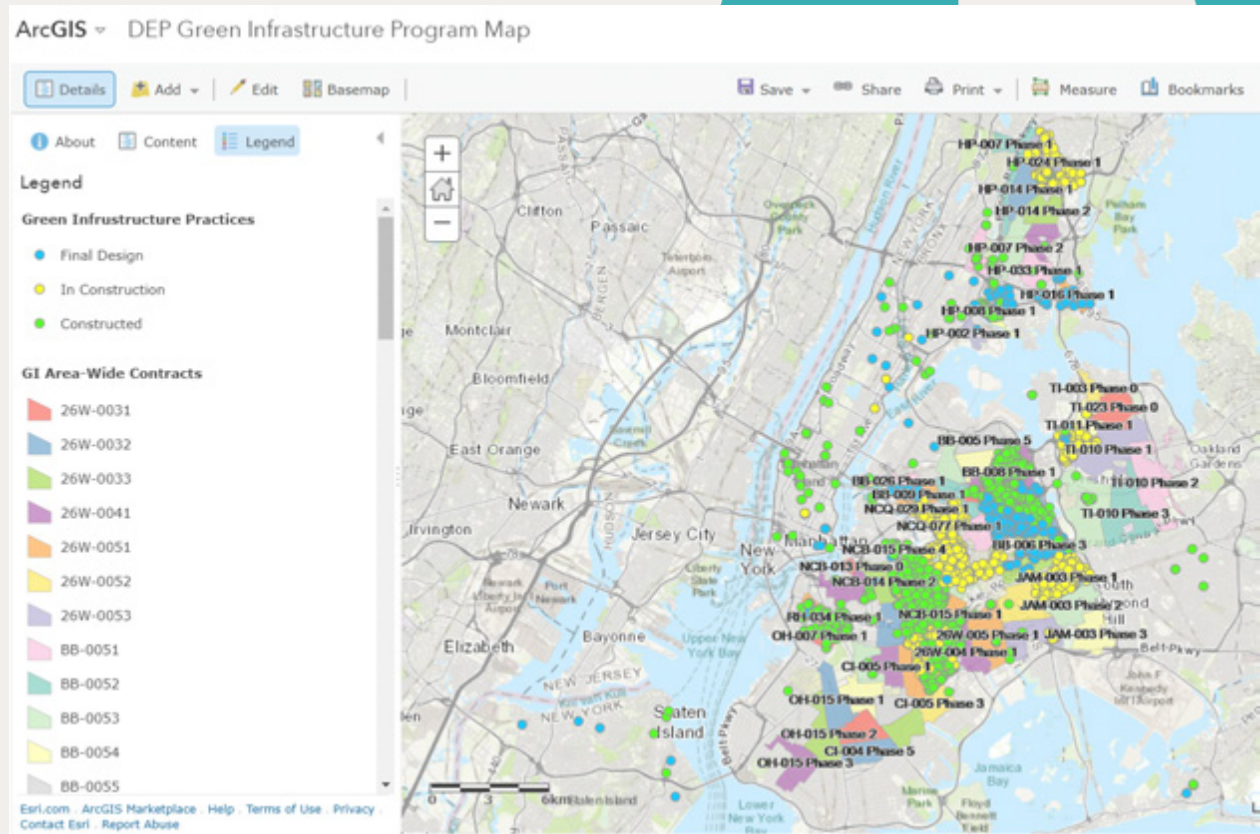


Status Update

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Status Update

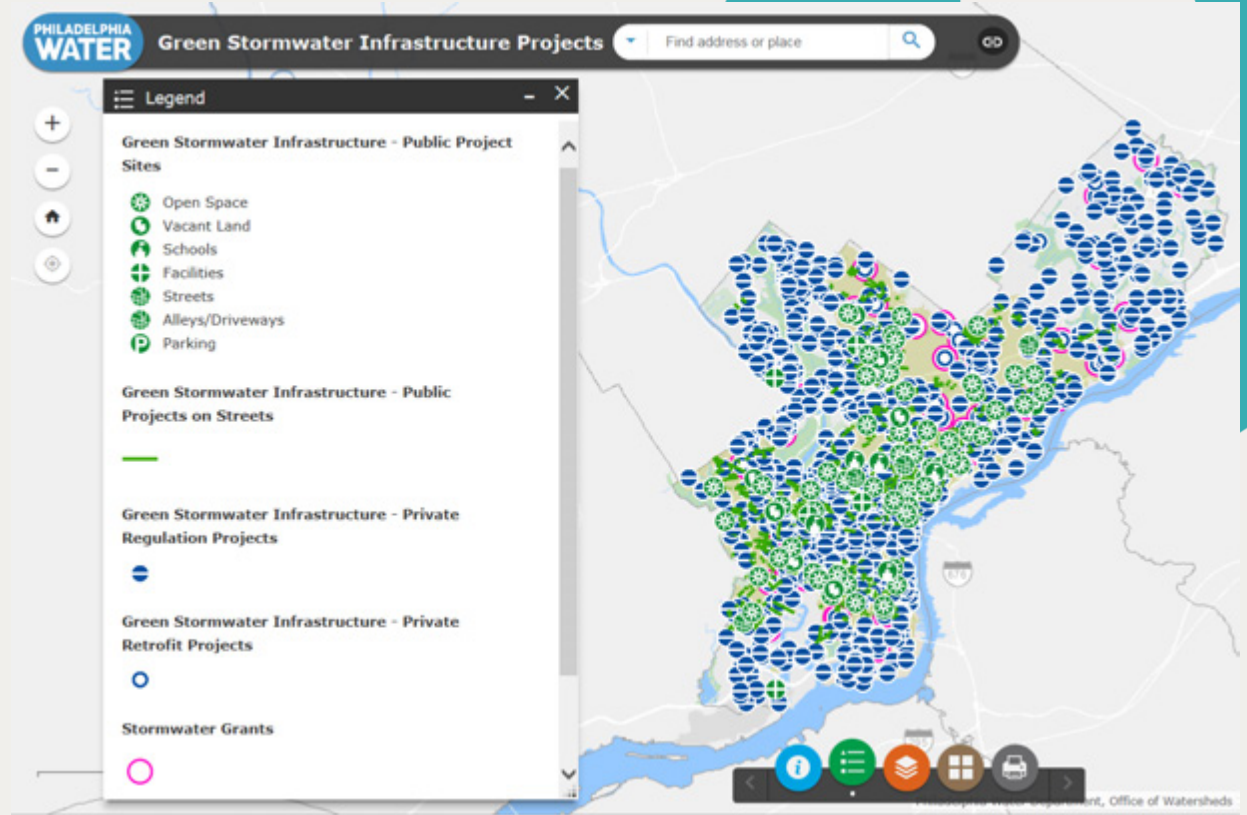
- 3,841 GI systems constructed or in construction between 2010 and 2016, thousands more in planning and design
- Based on 1.5% GI implementation rate, 507 MG/yr of CSO volume reduction
- Planned \$1 billion investment over the next 10 years

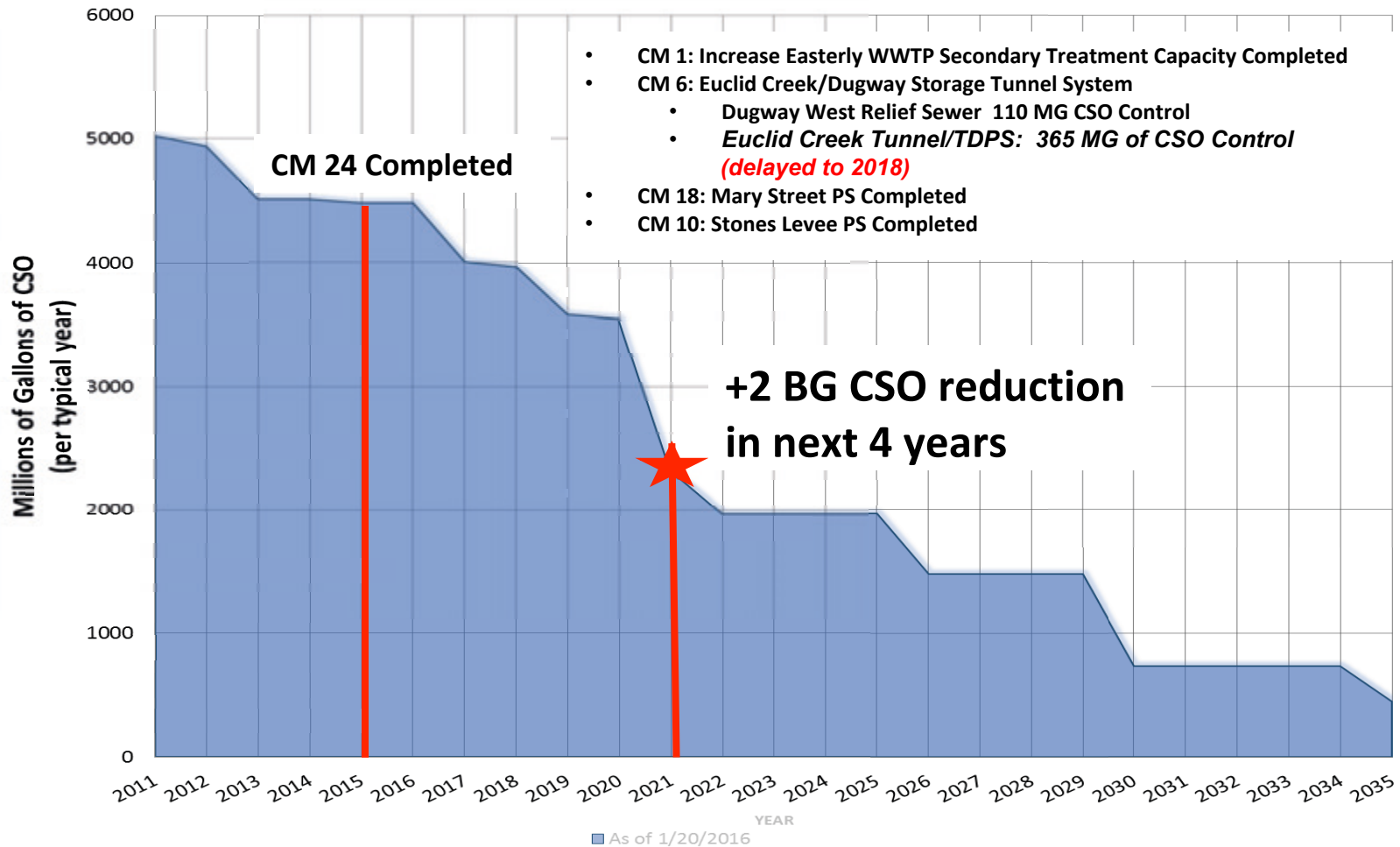


Philadelphia, Pennsylvania

Status Update 2016

- Installed 837.7 “greened acres”
- Reduction of over 1.5 billion gallons of CSOs
- 441 green infrastructure sites





Lessons Learned

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Lessons Learned

1

There is a need for BOTH green and grey technologies

2

Some cities find green infrastructure to be more cost effective while others find grey to be more cost effective

3

Grey infrastructure allows for the management more stormwater during **larger** wet-weather events; green infrastructure good for **small** and **long duration** storms

4

Green infrastructure allows for increased public awareness between agencies and rate payers and other environmental benefits

Green Infrastructure is trending



Chicago



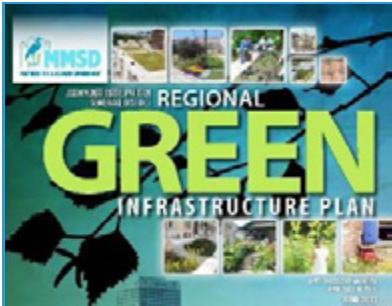
St. Louis



Seattle



Atlanta



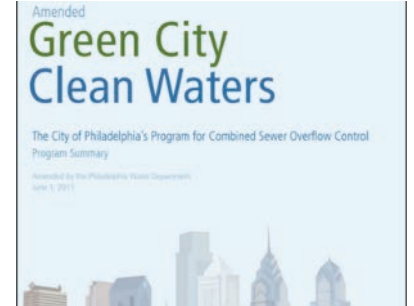
Milwaukee



Los Angeles



New York City



Philadelphia

Green Infrastructure Lessons Learned

- Use of vegetation & natural features to assure water supplies and manage stormwater
- 85% of storms <1-inch in rainfall volume
- 80% of pollutant mass is transported in the first quarter inch of runoff
- GI is less effective during flash flood events compared to long duration storms
- Dispersed management approach
- Most effective higher in watershed
- Community benefits & visibility
- Long term maintenance plan required
- Public Relations



Success: Combination of Green and gray

- GI technologies are good for smaller rain events <1 inch in depth
- GI technologies will have minimal effects on large scale flood events
- Gray infrastructure will be more cost effective in storing large volumes of stormwater





Thank you!

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