Providence Stormwater Innovation Center

Audubon Society of Rhode Island

PROVIDENCE PARKS + RECREATION
play · relax · explore

SC
UNIVERSITY OF NEW HAMPSHIRE STORMWATER CENTER

GROUNDWORK Rhode Island
CHANGING PLACES CHANGING LIVES

SAVE THE BAY
NARRAGANSETT BAY

The Nature Conservancy
Rhode Island

UNIVERSITY OF RHODE ISLAND
HOPE
1892

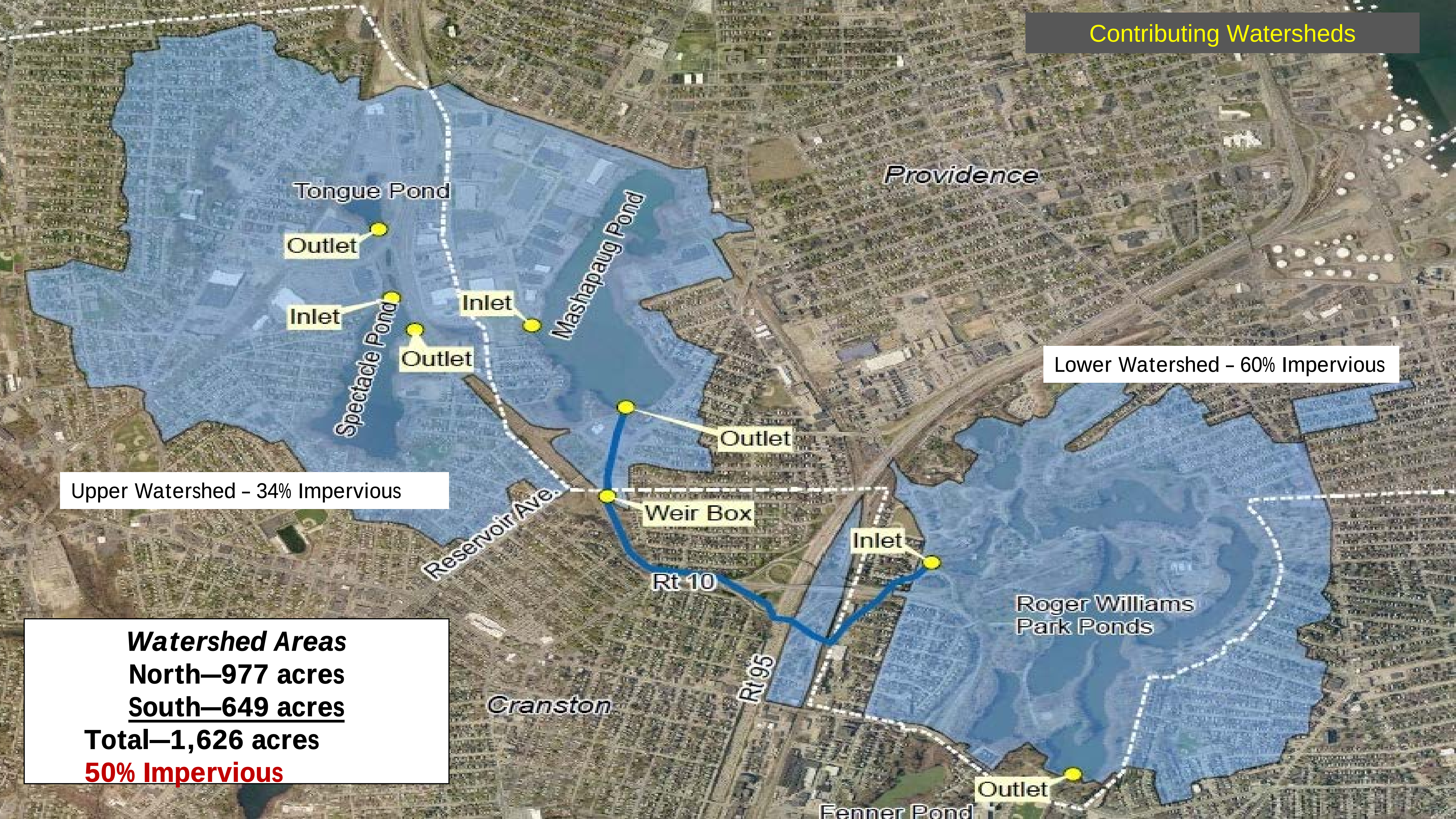
RHODE ISLAND GREEN INFRASTRUCTURE COALITION

RIDEM

RI DOT

ROGER WILLIAMS PARK

- **Designed by Horace Cleveland (1874)**
- **Historic Green and Open Space in an Urban Surrounding**
- **Over 1 Million Visitors per Year**
- **435 Acres**
- **100+ Acres of Water**
- **Attractions Including the Botanical Center, Zoo, Carousel Village, Museum of Natural History, Temple to Music, Athletic Fields, Equestrian Area (Mounted Command),Swan Boat and Train Rides, Boat Ramp, Tennis Center and Many Event Centers and Areas Throughout the Park**


Contributing Watersheds
Providence
Tongue Pond
Outlet
Inlet
Spectacle Pond
Outlet
Inlet
Mashapaug Pond
Outlet
Lower Watershed – 60% Impervious
Upper Watershed – 34% Impervious
Weir Box
Reservoir Ave.
Inlet
Rt 10
Roger Williams
Park Ponds
Rt 95
Cranston
Outlet
Fenner Pond
Watershed Areas
North—977 acres
South—649 acres
Total—1,626 acres
50% Impervious

Poor Water Quality - Cyanobacteria

So Why Should Roger Williams Park be a Stormwater Innovation Center?

- **Petri Dish for Stormwater Development**
- **435 Acres with 100+ Acres of Ponds (Impaired)**
- **TMDL (Total Maximum Daily Load) for Phosphorus**
- **Urban Environment – Surrounded by City**
- **The ponds are 2-3 feet in depth (shallow and warm)**
- **Wooded Areas with Trails, Athletic Fields, Roadways, Combined Sewer Overflow (CSO), Storm Drainage System, Many City Streets Feeding into the Park (Sediment & Salt), Canadian Geese and Several Historic Buildings**
- **Pipe Discharge from Another Impaired Waterway**
- **Historically Allowing Deferred Maintenance and BMP's (Bad Management Practices)**
- **Lastly, a Consent Agreement with a Water Quality Control Plan**

Restoring the Ponds in Roger Williams Park:
Executive Summary

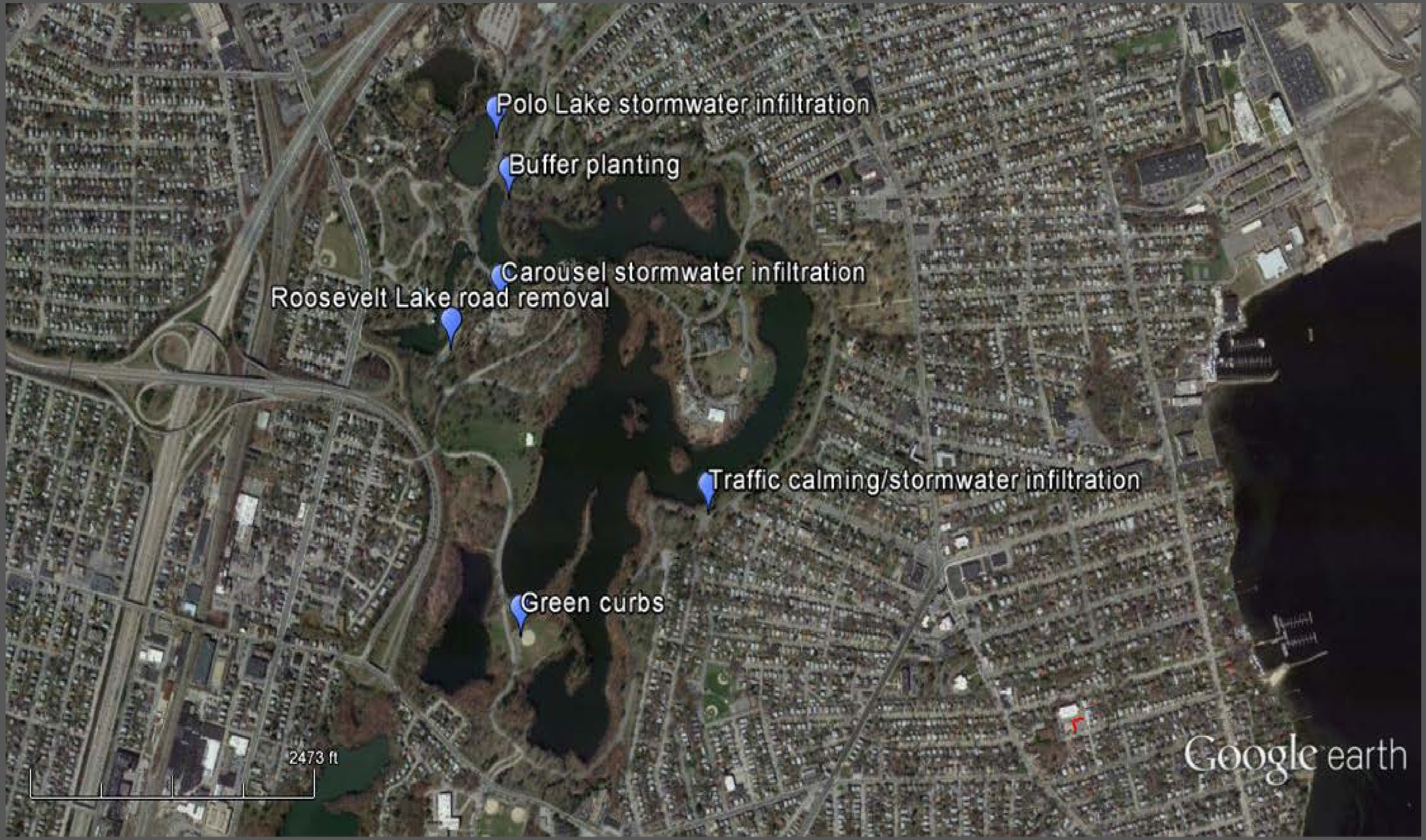
October 2013

Horsley Witten Group
Land & Coastal Services
Loon Environmental
Narragansett Bay Estuary Program
Providence Parks & Recreation

When was the Providence Stormwater Innovation Center (PSIC) Created?

- **The PSIC is a Collaboration of Many Different Stakeholders – Each one Playing a Critical Role in the Timeline for Stormwater Development, Research and Awareness**

- Landowners
- Municipalities
- Landscape Designers
- Environmental Engineers
- Contractors
- Maintenance Personnel
- Manufacturers
- Researchers
- Regulatory Agencies
- Environmental Organizations
- Educators



Stages of Stormwater Development and the Associated Stakeholders

- Identifying That There is a Problem and a Push to Action
    - Landowner (Municipality) and Regulatory Agency or Environmental Watch Group
- Conceptual Design and Procurement of Engineering Services
    - Environmental Engineers and Landscape Designers
- Stakeholders and Affected Community Notification
    - Community Meetings or Mailings to Adjacent Landowners – Historic Groups (If Applicable)
- Design Development and Procurement
    - Engineers, Landscape Designers, Manufacturers and Consultants (EPA Modeling)
- Site Construction
    - Project Managers, Contractors and Distributors - Volunteers
- Maintenance of New BMP’s
    - Landowner with Maintenance Staff or Third-Party Vendor
- System Performance
    - Researchers and Environmental Watch Groups (Often Overlooked)
    - Compliance with Regulations – Regulatory Agencies
- Outreach and Awareness
    - Educators and Environmental Groups

Stakeholders from each stage have unique experiences and challenges

The Providence Stormwater Innovation Center (PSIC) Brings These Stakeholders Together

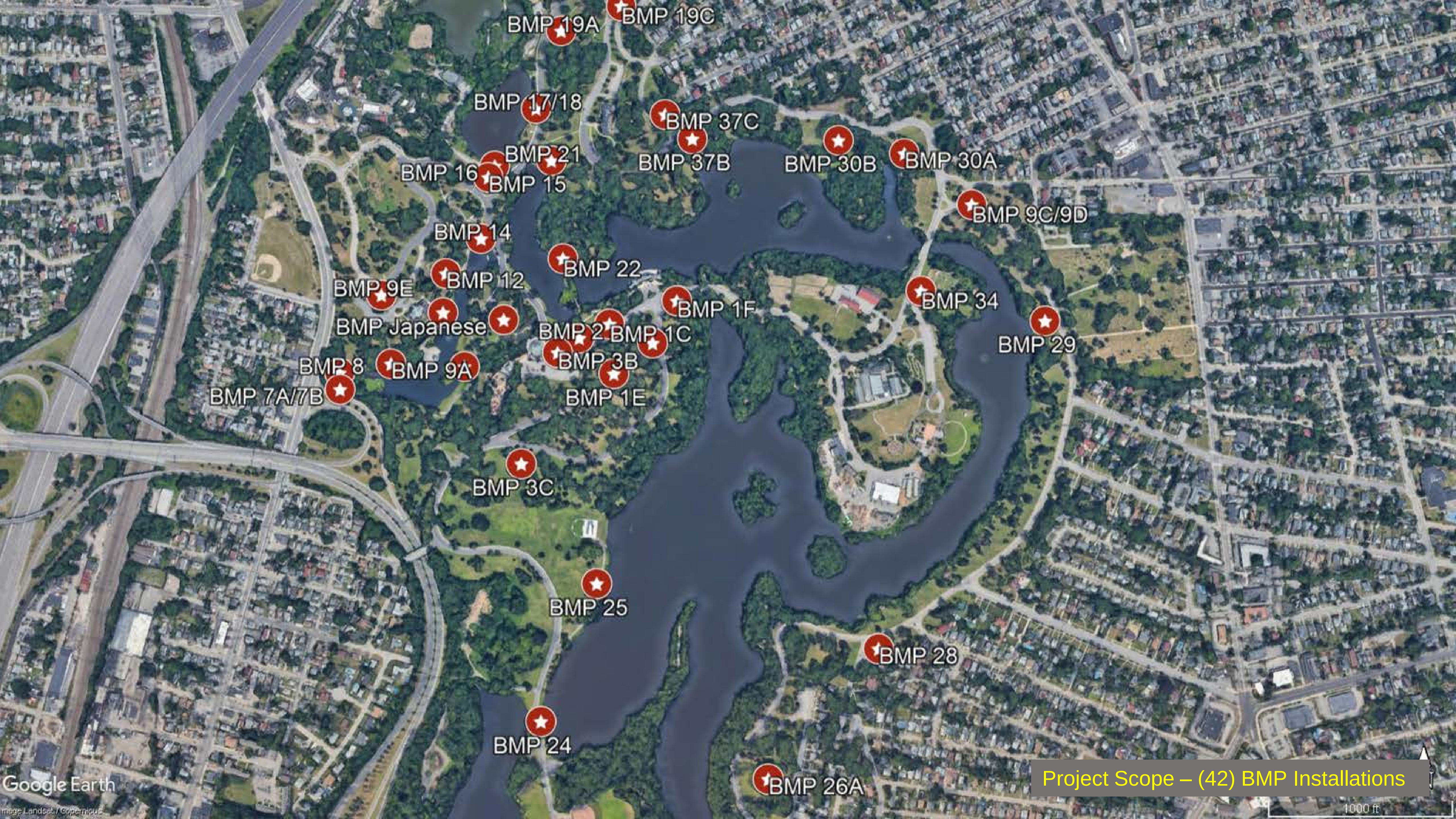
- The PSIC Provides an Opportunity for All Stakeholders to Share Challenges, Issues and Struggles Brought on by the Action of Other Stakeholders
    - Bad Construction Design = Difficult Construction & Maintenance
    - Bad Construction = Poor Performance
    - Poor Performance = Poor Water Quality

- Working Together Can Only Lead to Better Ways to Manage Stormwater
- Founding Members
    - Meg Kerr - The Audubon Society of RI
    - Sheila Dormody – The Nature Conservancy
    - Wenley Ferguson – Save The Bay
    - Ryan Kopp - PSIC
    - Will Helt – The Nature Conservancy
- Parks Superintendent Wendy Nilsson

City of Providence and RIDEM Execute Consent Agreement

Providence Forced to Invest in Stormwater System
March 09, 2017/ Jo Detz **By ecoRI News staff**
PROVIDENCE — *Mayor Jorge Elorza recently signed an agreement with the Rhode Island Department of Environmental Management (DEM) to bring the city's stormwater management system into compliance with its Municipal Separate Storm Sewer System permit.*

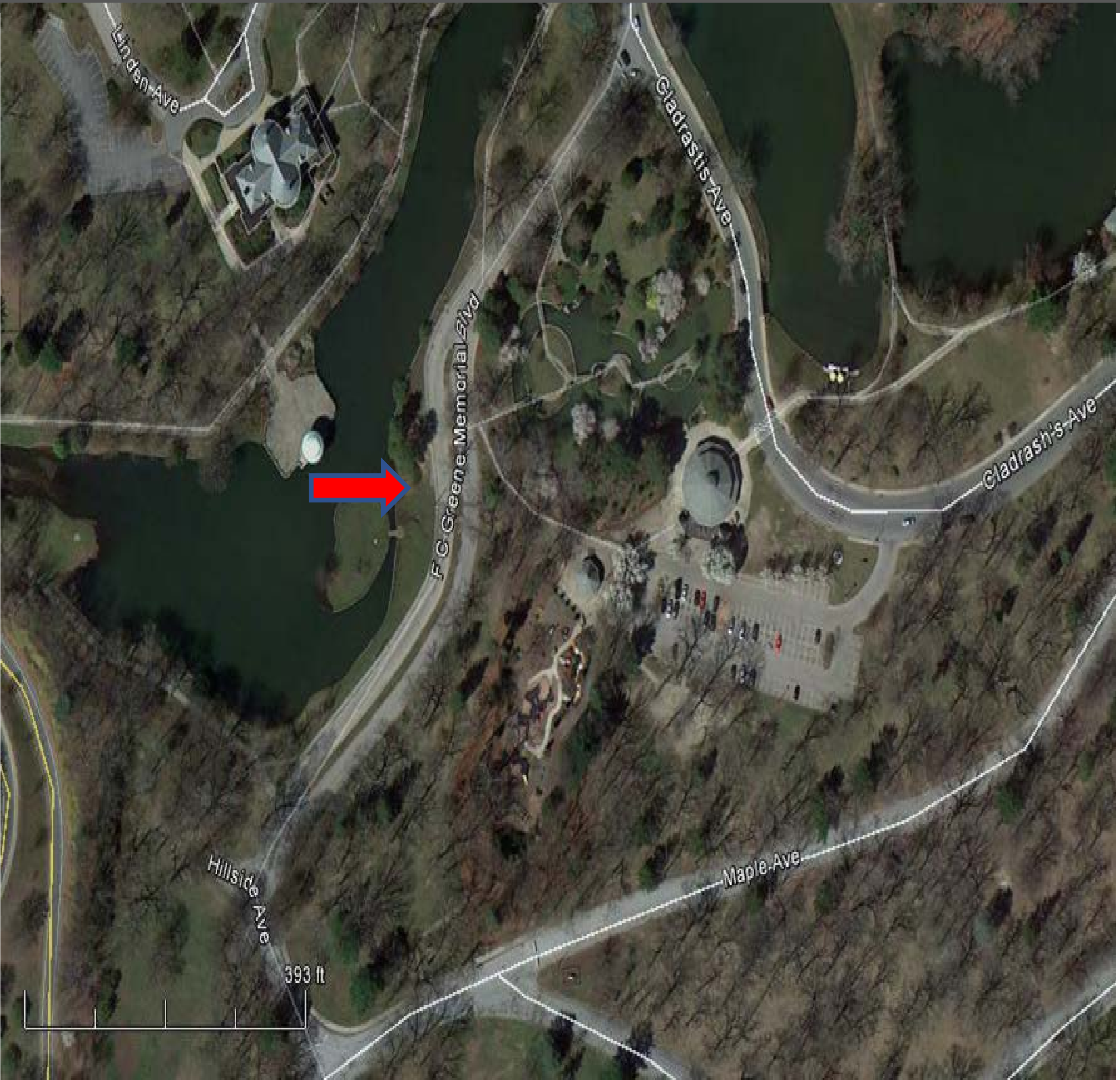
- Signed following a Notice of Violation issued by RIDEM with penalties of $25,000 per day
- City has seven (7) years to come into compliance with the EPAs Clean Water Act
- Items included in the agreement
  - Mapping of all 12,000 catch basins and piping
  - Increased Efforts related to Stormwater Management
  - Increased Public Engagement Around Stormwater Prevention
  - Implementation of Green Infrastructure Projects in Roger Williams Park



Project Scope – (42) BMP Installations

Roosevelt Path

Before



After

Roosevelt Path – Construction of Rain Gardens

Edgewood Avenue

Before

After

Edgewood Avenue – Sand Filter

Carousel Village

Before

After


Carousel Village – Bioretention

Carousel Village – After / After

Polo Lake

Before

After


River Rock Swale


Boulder Weir


Deep Pool in Swale


Secondary Weir


Vernal Pool Construction


Excavation

Volunteers – Planting Natives

Lessons Learned

Lessons Learned

Clogged Inlet Causes Flooding

Clogged Inlet swale

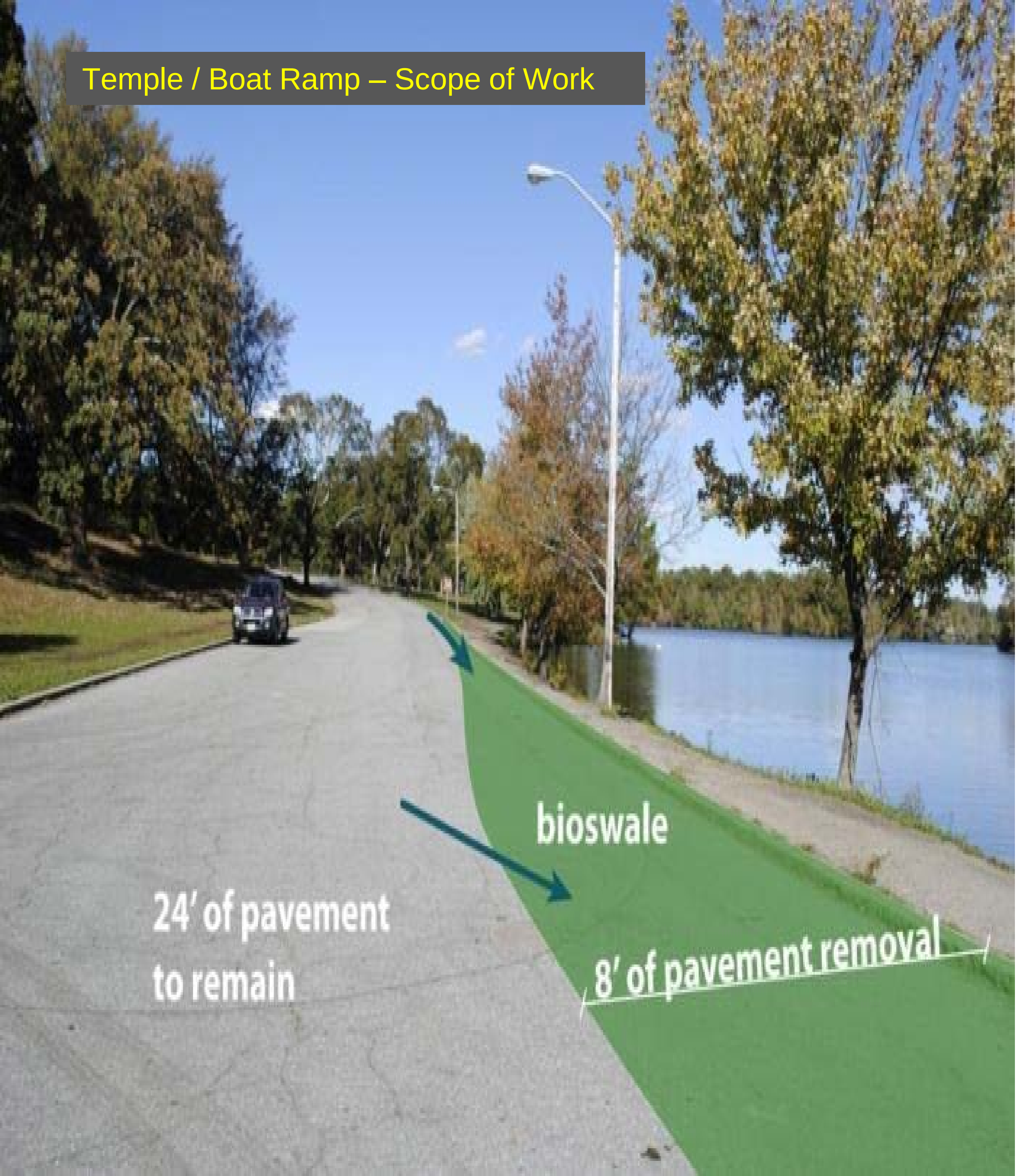
Overtopped berm

Box culvert cleaning

Polo Lake - After

Temple / Boat Ramp - Before

Temple / Boat Ramp – Scope of Work



Temple / Boat Ramp - After

Lessons Learned

Temple / Boat Ramp - After

Compaction Changes Berm Elevation

Clogged Inlet Causes Flooding

Clogged Inlet Increases Velocity of Water

Water Overtops Containment Berm

Lover's Retreat – 1 of 2

Before

After

Lover's Retreat – 2 of 2

Before

After

Lessons Learned - Breach in System Boulder Wall

Construction Practice

- Boulder Walls Need to be Set Higher in Terraced Areas – Overflow Pipe
- Mortar or Fill Voids in Boulder Walls
- Confirm Overflow is Lower Than Boulder Wall
- Train Maintenance Personnel in Proper Mowing & Invasive Plant Material Removals (Selective)
- Location Played a Role in Selection of Treatment Type – Ornamental in High Profile Areas - Turf

Japanese Garden – Wetland Filter






Design Challenges at Roger Williams Park -Visitors

Creating Places People Can Enjoy and Still Make Room for Green Infrastructure

- Lessons Learned – Temple to Music
  - Impact of Installation on Events
  - Difficult to Control Behavior
  - Result – Element not Functioning
  - Victims of Our Own Success
    - Increased Activity Day and Night

Design Options - Economics

Re-Purposing Materials

- Element of Value Engineering
  - Creating Weir Structures
    - Used Granite or Pre-Cast Curbing
  - Base Materials
    - Recycled asphalt
  - Firewood (Forestry Operations)
    - Water Bars
    - Retaining Structures
  - Used Brick and Cobblestones
    - Swales
  - What is the Next Great Idea?
    - Tires, Trash or Mattresses

Perception and Impact on Activities

Element/Benefit	Perception/Impact
Shoreline Plantings	**Shoreline Plantings**
Discourages Geese	Aggravates Fisherman
Selective Mowing on Hillsides	**Selective Mowing on Hillsides**
Filters Water & Prevents Erosion	Not Doing Our Job - Unkempt
Rain Gardens	**Rain Gardens**
Water Filtration	Love the Flowers – but Tics and Rodents
Aerating Fountains	**Aerating Fountains**
Water Movement & Oxygen	Activates Park (Lit at Night)
Pavement Removal	**Pavement Removal**
Decreases Impermeable Area	Less Parking Spots

Maintenance Challenges

- **Funding**
    - Staffing to Maintain (42) Stormwater Sites with Budgets Cuts Etc.
    - Huge Task for the Parks Department
    - Outsourcing Needs Commitment – Funding
- **Lack of Trained Personnel / Vendors**
- **Industry-wide Problem**
- **Education**
    - Schools
    - Adult Education Classes
    - Adult Job Training

Maintenance Issues - Accessibility

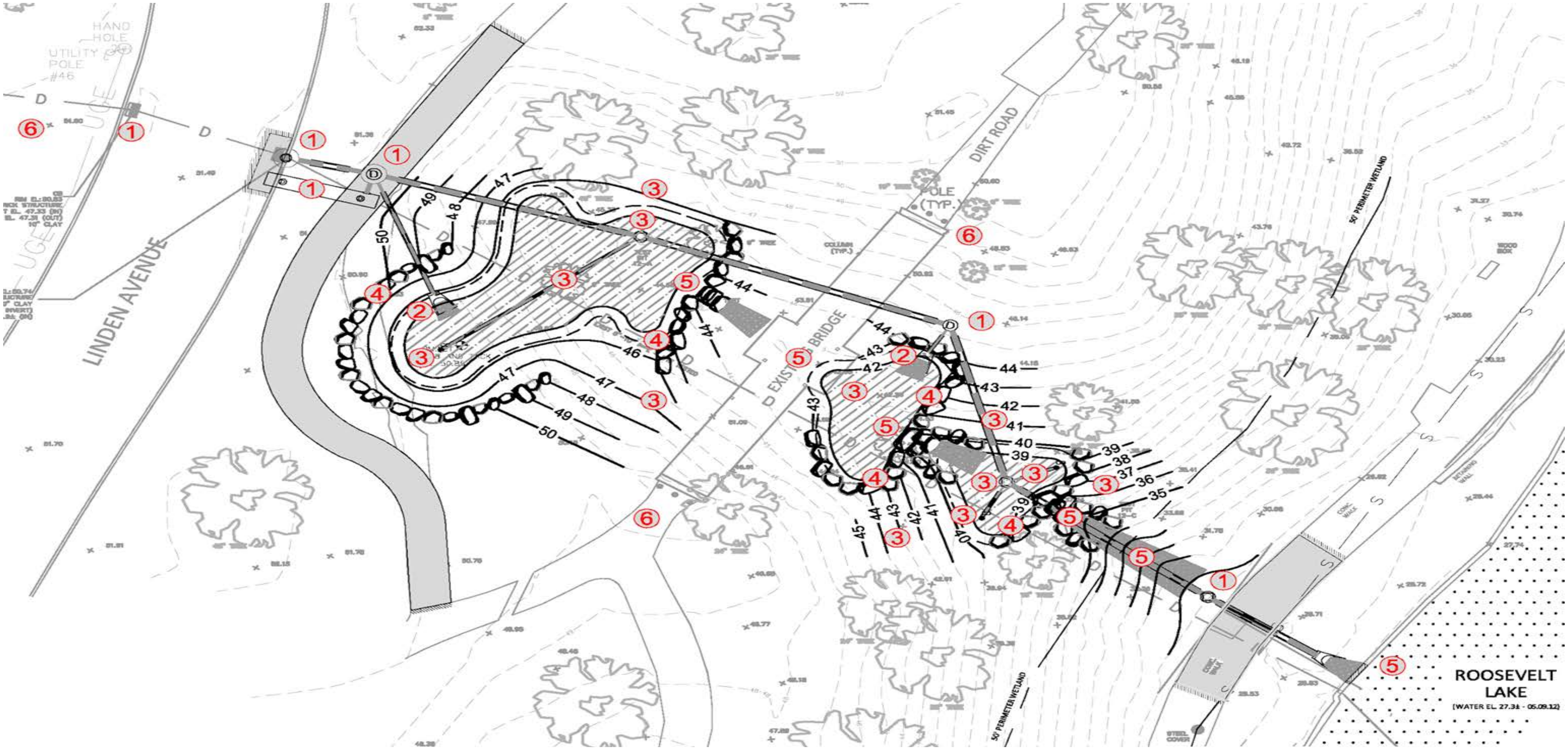
- Proximity to Roadway
  - Sediment Removal
    - Large Basin
  - Slopes
  - Access To All Areas
  - ‘In Water’ Access
  - Equipment Capabilities
  - Design for Staff and Machinery

Design with Maintenance in mind

Maintenance Issues - Training

- Experience of Crews
  - Equipment Operation
  - Training
  - Plant Identification
- Experience of Management
  - Landscape Architect
  - Botanical Center Manager
  - Training
- Willingness to Adapt

Maintenance – Training - Plans



Roger Williams Park - Providence, RI

Site 12 – Terraced Bioretention
Operation and Maintenance Checklist

Date:
Time:
Inspector:

Maintenance Item	Description	Maintenance Required? (Y/N)
1. Drainage Structures: **Includes: Manholes/Diversion Structures/Water Quality Units and Outlets** **Inspect annually and after major storm events (2" of rain or greater)**		
Debris	Remove all trash, leaf litter and debris.	
Manholes/Diversion Structures/Outlets	Check for sediment accumulation that impacts inflow. If sediment accumulation. Schedule cleaning. Check for leaf litter and inlet clogging and clear.	
ADS Water Quality Unit	Per manufacturers recommendations. See Appendix D of O&M manual.	
Drainage Network	Check contributing and asscocaited catch basins, manholes and pipes for sedimentation/clogging	
2. Bioretention Inlet **Inspect annually and after major storm events (2" of rain or greater)**		
Debris	Remove all trash and debris from the swale and forebay.	
Sediment/Organic Debris Removal	Check for sediment accumulation. Remove sediment as necessary	
Vegetation Maintenance	Check to ensure vegetation is not blocking the inlet. Prune/thin vegetation as necessary. Remove undesirable woody vegetation and weeds.	
3. Bioretention System **Inspect at least bi-annually and after major storm events the first year; then annually and after major storm events (2" of rain or greater)**		
Debris	Remove all trash and debris from the surface of the bioretention system.	
Side Slopes	Check for signs of erosion gullies, animal burrowing, or slumping. Repair as necessary.	
Sediment	Check for sediment accumulation that impacts infiltration. Remove any sediment accumulation and properly dispose.	

Maintenance Item	Description	Maintenance Required? (Y/N)
Vegetation Maintenance / Replacement	Check for erosion and signs of scouring. Remove and replace Ill-established, dead or severely diseased plants annually. Remove undesirable woody vegetation and weeds. See Sheet LA-1 of Construction Plans for appropriate species. Grasses should be cut back annually in the spring.	
Overflow Structure	Check for sediment accumulation that impacts inflow. If sediment accumulation. Schedule cleaning. Check for leaf litter and inlet clogging.	
Water Draining properly	If standing water is observed in the bioretention area 48 hours after a storm event: Check cleanouts for underdrain clogging. See plans Aerate/Rototill the bottom 6 inches to breakup any hard-packed sediment, and replenished with mulch	
4. Boulder Walls **Inspect annually and after major storm events (2" rain or greater)**		
Boulder Walls	Check for wall settlement, areas of erosion or water seepage. Repair as necessary.	
5. Emergency Spillways **Inspect annually and after major storm events (2" rain or greater)**		
Emergency Spillways	Check for settling gullying, erosion damage or settling. Repair as necessary and return to design grades.	
Overflow	Look for areas of erosion in the overflow swale between bioretention areas. Repair as necessary.	
6. Routine Grounds Maintenance **Inspect annually or as needed.**		
Debris	Remove trash from perimeter areas.	
Pavement Sweeping	Sweep roads minimum once a year after spring thaw.	
Contributing drainage area	Check for erosion/sediment sources from the surrounding area	

*Sediment shall be disposed of offsite in a pre-approved location.

Comments:

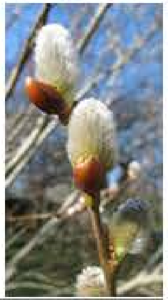
Action to be Taken:

Trees/shrubs

Cottonwood
Populus sp.


Pussy willow
Salix discolor





Willow
Salix sp.


Tulip Tree
Liriodendron tulipifera


Maple
Acer sp.


Staghorn Sumac
Rhus typhina



Maintenance Documentation – Asset Essentials

Education

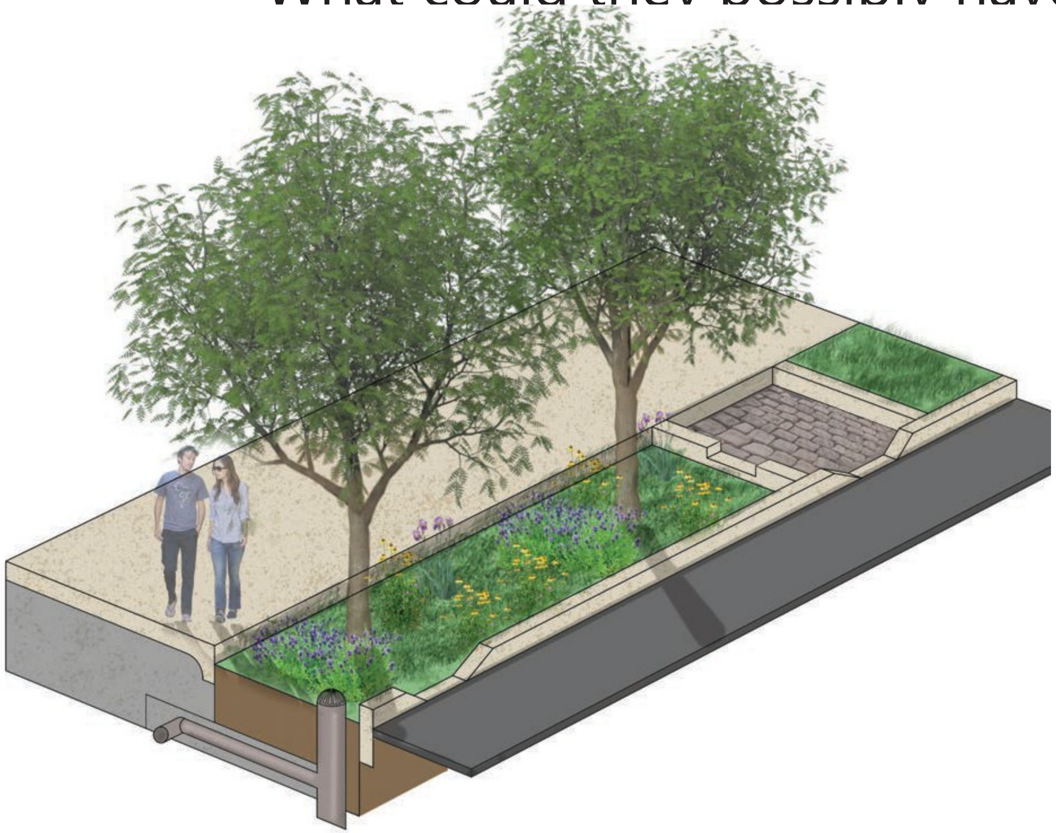

Nature at Work
8
Nature is at work here!
We're creating a healthy community! This site uses nature to clean dirty stormwater and reduce flooding.
www.greeninfrastructureri.org
What's happening here?
Clean
Uses plants and soilsto filter out pollution.
Protect
Absorbs rain and reduces flooding.
Economy
Reduces utility bills and creates local jobs.
Cool
Replaces hard surfaces that hold heat.
Wellness
Cleans our air and creates welcoming spaces.
Habitat
Attracts animals like butterflies, turtles and frogs.
William D'Abate Elementary Rain Garden
5th Graders here helped plant this rain garden to hold and clean rain water coming off of the school roof. Plants native to RI beautify the school while making food for butterflies. This garden will also help reduce flooding in the Woonasquatucket River at Riverside Park.
National Fish and Wildlife Foundation
United States Environmental Protection Agency
urban wildlife refuge
riverzedge arts
TREMCO
GROUNDWORK Rhode Island
H

Awareness

ROGER WILLIAMS PARK
Willow Lake
Stormwater Treatment
PONDS RESTORATION GOALS;
Improve water quality, habitat and biodiversity within the ponds.
Improve the overall quality and user experiance of the Park.
Identify health risk associated with fish consumption; increase public awareness as warranted.
Foster watershed awareness and environmental stewardship among Park user and surrounding residents through a public out reach campaign.
1 INLET DRAINAGE
2 STONE LINE SWALE
3 SEDIMENT FOREBAY
4 BIORENTENTION
5 PIPE INTO EXISTING CATCH BASIN
Willow Lake
Cladrastis Ave
Carousel
OVERFLOW SPILLWAY
OUTLET STRUCTURE
UNDERDRAIN AND CLEANOUT
WEIR
FIRE LANE
PARKING
Clean
Uses plants and bio-engineered soil to filter out pollution before entering Willow Lake.
Habitat
Attracts beneficial insects to help improve floral diversity.
Protect
Stores runoff from parking area to prevent flooding
Eastern half of the parking lot drainage areas 1.4 acres, 38% impervious is to create a biorentention in the open grasses area between Carousel Village parking lot and Cladrastis Avenue. The overflow runoff outlet exit into closed drainage system. Stromwater feature design estimate 30% total Phosphorus removal.
P
PROVIDENCE PARKS & RECREATION

Mr. Potato Head & The Tree Trench

What could they possibly have in common?



Note: Mr. Potato Head is a trademark of Hasbro Toy Company. Hasbro has not been consulted and is by no means endorsing the use of tree trenches.

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Horsley Witten Group
Sustainable Environmental Solutions

SNEP
Southeast New England Program

Providence Stormwater Innovation Center

How can I build my potato?

Components

1 **COLLECT**
Stormwater runoff enters the treatment system, typically through an inlet.

2 **CAPTURE**
The collected runoff is directed to a sediment forebay, that will slow the water down with a check dam, allowing debris and sediment to settle out.

3 **MOVE**
The runoff then overflows into the main filter area.

4 **FILTER**
The runoff is filtered through a manufactured soil to remove pollutants.

5 **OVERFLOW**
The filtered stormwater exits the system through subsurface infiltration providing groundwater recharge or via the overflow structure.

Collect / Inlet –Lessons Learned

- Allow Low Flow Water Only - High Flow Water Will Pass Inlet - by Design
  - Inlet must be constructed to gauge water flow (inch)
  - Extreme storms will not damage element
  - Berms and containments will not be breached
  - Can be achieved with a Diversion Structure
- Allow All Water to Enter Element – Low and High Flows
  - Height of inlet needs to be much lower than roadway etc.
  - Can be a scupper or structure
  - Needs to be clear of debris – avoid backup
  - Harder to keep off-line for grow-in period

Capture / Sediment Forebay – Lessons Learned

- Removes sediment prior to treatment area
  - Slows down water and makes volatile to remove sediment
  - Has to be 'maintainable' – need to know when clogged
  - Location is key to proper maintenance

- River Rock (Rip Rap) vs. Pavers
  - Rock swales fill 12-18" before needing maintenance
  - Pavers – personnel can see first ½"
  - Proximity to roadway – allows for 'drive bye'
  - Clean up is simple = element always functioning

Move / Weir – Lessons Learned

- Holds back sediment allows water into treatment
  - Options to re-purpose – roadway curbing
  - Allows for installation of art
  - Many different types used on sites

- Must be sustainable and maintainable
  - Materials will have constant flow of water
  - Wood weir used early on (value engineering)
  - Installation needs to be per plan to avoid settling
  - Gabion baskets being monitored – hard to clear debris in center of basket

Filter / Treatment Area – Lessons Learned

- Cannot allow sediment to clog up area
  - Sediment removal will affect performance
  - Elevations are very important Very difficult to re-establish
- Plants (Mulch)
  - Generally, plants will be better at contaminate removal than turf (much debate)
  - Invasive removals can be labor intensive
  - Mulch not recommended in basin floor (floatable)
  - Varieties need to change with new weather patterns
  - Size is Important – Seed, Plugs, Bare Root or Container
- Turf
  - Can provide adequate contaminate removal combined with a sand filter - Very easy to maintain

Overflow – Lessons Learned

- Allows high flow waters to exit or not enter practice

- Street as Overflow
  - Water will find its own way to go (damage)
  - May go into another drain directly into waterway unfiltered

- Overflow Pipe in Treatment Area
  - Will have some sediment removal / treatment before entering waterway
  - Will go where you direct

PSIC – Collaboration for Better Stormwater Management

Bringing Stormwater Stakeholders Together

- Landowners
- Municipalities
- Landscape Designers
- Engineers
- Contractors
- Maintenance Personnel
- Manufacturers
- Researchers
- Regulatory Agencies
- Environmental Organizations
- Educators

Seal House – Stormwater Kiosk & Research Location

How can the Stormwater Innovation Center support your work?

www.stormwaterinnovation.org

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