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

Upper Watershed – 34% Impervious

Lower Watershed – 60% Impervious

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
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
Edgewood Avenue
Before
After
Polo Lake

Before

After
Lessons Learned

Diversion Structure & Rock Swale

Elevation Issues

Structure Removed – Spillway Renovated

Sidewalk Removed

Sidewalk Returns

Bench, Picture Post & Sign

Scenic Overlook Added
Lessons Learned

Clogged Inlet Causes Flooding

Clogged Inlet Swale

Overtopped berm

Box culvert cleaning
Temple / Boat Ramp - Before
Lessons Learned

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
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
<table>
<thead>
<tr>
<th>Element/Benefit</th>
<th>Perception/Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoreline Plantings</td>
<td>Shoreline Plantings</td>
</tr>
<tr>
<td>Discourages Geese</td>
<td>Aggravates Fisherman</td>
</tr>
<tr>
<td>Selective Mowing on Hillsides</td>
<td>Selective Mowing on Hillsides</td>
</tr>
<tr>
<td>Filters Water &amp; Prevents Erosion</td>
<td>Not Doing Our Job - Unkempt</td>
</tr>
<tr>
<td>Rain Gardens</td>
<td>Rain Gardens</td>
</tr>
<tr>
<td>Water Filtration</td>
<td>Love the Flowers – but Tics and Rodents</td>
</tr>
<tr>
<td>Aerating Fountains</td>
<td>Aerating Fountains</td>
</tr>
<tr>
<td>Water Movement &amp; Oxygen</td>
<td>Activates Park (Lit at Night)</td>
</tr>
<tr>
<td>Pavement Removal</td>
<td>Pavement Removal</td>
</tr>
<tr>
<td>Decreases Impermeable Area</td>
<td>Less Parking Spots</td>
</tr>
</tbody>
</table>
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
Roger Williams Park - Providence, RI
Site 12 – Terraced Bioretention
Operation and Maintenance Checklist

Date: 
Time: 
Inspector:

<table>
<thead>
<tr>
<th>Maintenance Item</th>
<th>Description</th>
<th>Maintenance Required? (Y/N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drainage Structures:</td>
<td>Includes: Manholes/Diversion Structures/Water Quality Units and Outlets</td>
<td>Inspect annually and after major storm events (2” rain or greater)</td>
</tr>
<tr>
<td>Debris</td>
<td>Remove all trash, leaf litter and debris.</td>
<td></td>
</tr>
<tr>
<td>Manholes/Diversion Structures/Outlets</td>
<td>Check for sediment accumulation that impacts inflow. If sediment accumulation, Schedule cleaning. Check for leaf litter and inlet clogging and clear.</td>
<td></td>
</tr>
<tr>
<td>ADS Water Quality Unit</td>
<td>Per manufacturer recommendations. See Appendix D of OBM manual.</td>
<td></td>
</tr>
<tr>
<td>Drainage Network</td>
<td>Check contributing and associated catch basins, manholes and pipes for sediment or clogging.</td>
<td></td>
</tr>
<tr>
<td>Bioretention Inlet</td>
<td>Inspect annually and after major storm events (2” rain or greater)</td>
<td></td>
</tr>
<tr>
<td>Debris</td>
<td>Remove all trash and debris from the swale and headwall.</td>
<td></td>
</tr>
<tr>
<td>Sediment/Organic Debris Removal</td>
<td>Check for sediment accumulation. Remove sediment as necessary.</td>
<td></td>
</tr>
<tr>
<td>Vegetation Maintenance</td>
<td>Check to ensure vegetation is not blocking the inlet. Prune within vegetation as necessary. Remove undesirable woody vegetation and weeds.</td>
<td></td>
</tr>
<tr>
<td>Bioretention System</td>
<td>Inspect at least annually and after major storm events the first year; then annually and after major storm events (2” of rain or greater)</td>
<td></td>
</tr>
<tr>
<td>Debris</td>
<td>Remove all trash and debris from the surface of the bioretention system.</td>
<td></td>
</tr>
<tr>
<td>Side Slopes</td>
<td>Check for signs of erosion gullies, animal burrowing, or slumping. Repair as necessary.</td>
<td></td>
</tr>
<tr>
<td>Sediment</td>
<td>Check for sediment accumulation that impacts infiltration. Remove any sediment accumulation and properly dispose.</td>
<td></td>
</tr>
</tbody>
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<tr>
<td>Vegetation Maintenance / Replacement</td>
<td>Check for erosion and signs of scouring. Replace and remove 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.</td>
<td></td>
</tr>
<tr>
<td>Overflow Structure</td>
<td>Check for sediment accumulation that impacts inflow. If sediment accumulation, Schedule cleaning. Check for leaf litter and inlet clogging.</td>
<td></td>
</tr>
<tr>
<td>Water Draining property</td>
<td>48 hours after a storm event: If standing water is observed in the bioretention area. See plans Aerate; Rodel the bottom 6 inches to breakup any hard-packed sediment, and replant with mulch.</td>
<td></td>
</tr>
<tr>
<td>Boulder Walls</td>
<td>Inspect annually and after major storm events (2” rain or greater)</td>
<td></td>
</tr>
<tr>
<td>Boulder Walls</td>
<td>Check for wall settlement, areas of erosion or water seepage. Repair as necessary.</td>
<td></td>
</tr>
<tr>
<td>Emergency Spillways</td>
<td>Inspect annually and after major storm events (2” rain or greater)</td>
<td></td>
</tr>
<tr>
<td>Emergency Spillways</td>
<td>Check for settling gullies, erosion damage or settling. Repair as necessary and return to design grades.</td>
<td></td>
</tr>
<tr>
<td>Overflow</td>
<td>Look for areas of erosion in the overflow swale between bioretention areas. Repair as necessary.</td>
<td></td>
</tr>
<tr>
<td>Routine Grounds Maintenance</td>
<td>Inspect annually or as needed.</td>
<td></td>
</tr>
<tr>
<td>Debris</td>
<td>Remove trash from perimeter areas.</td>
<td></td>
</tr>
<tr>
<td>Pavement Sweeping</td>
<td>Sweep roads minimum once a year after spring thaw.</td>
<td></td>
</tr>
<tr>
<td>Contributing drainage area</td>
<td>Check for erosion/sediment sources from the surrounding area.</td>
<td></td>
</tr>
</tbody>
</table>

Action to be Taken:

[Signature] [Date]
Plants to be removed:

**Trees/shrubs**

**Cottonwood**
*Populus sp.*

**Pussy willow**
*Salix discolor*

**Willow**
*Salix sp.*

**Maple**
*Acer sp.*

**Staghorn**
*Rhus typhina*

**Tulip Tree**
*Liriodendron tulipifera*
Maintenance Documentation – Asset Essentials
Nature is at work here!
We’re creating a healthy community! This site uses nature to clean dirty stormwater and reduce flooding.

What’s happening here?

Clean
Uses plants and soil to 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.
Awareness

Willow Lake
Stormwater Treatment

ROGER WILLIAMS PARK

PONDS RESTORATION GOALS;

1. Improve water quality, habitat and biodiversity within the ponds.
2. Improve the overall quality and user experience of the Park.
3. Identify health risk associated with fish consumption; increase public awareness on same.
4. Foster watershed stewardship and environmental stewardship among Park users and surrounding residents through a public outreach campaign.

1. INLET DRAINAGE
2. STONE LINE SWALE
3. SEDIMENT FOREBAY
4. BIORETENTION
5. PIPE INTO EXISTING CATCH BASIN

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
Storms runoff from parking area to prevent flooding.

Eastern half of the parking lot drainage area 1.4 acres, 38% impervious is to create a bioretention in the open grasses area between Carousel Village parking lot and Cladristis Avenue. The overflow runoff outlet exit into closed drainage system. Stormwater feature design estimate 30% total Phosphorus removal.
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.
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 contaminant 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 contaminant 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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