



# Stormwater Training Part II

Basic Design, Installation & Common Problems Associated with  
Commercial Stormwater Control Measures

Presenter:  
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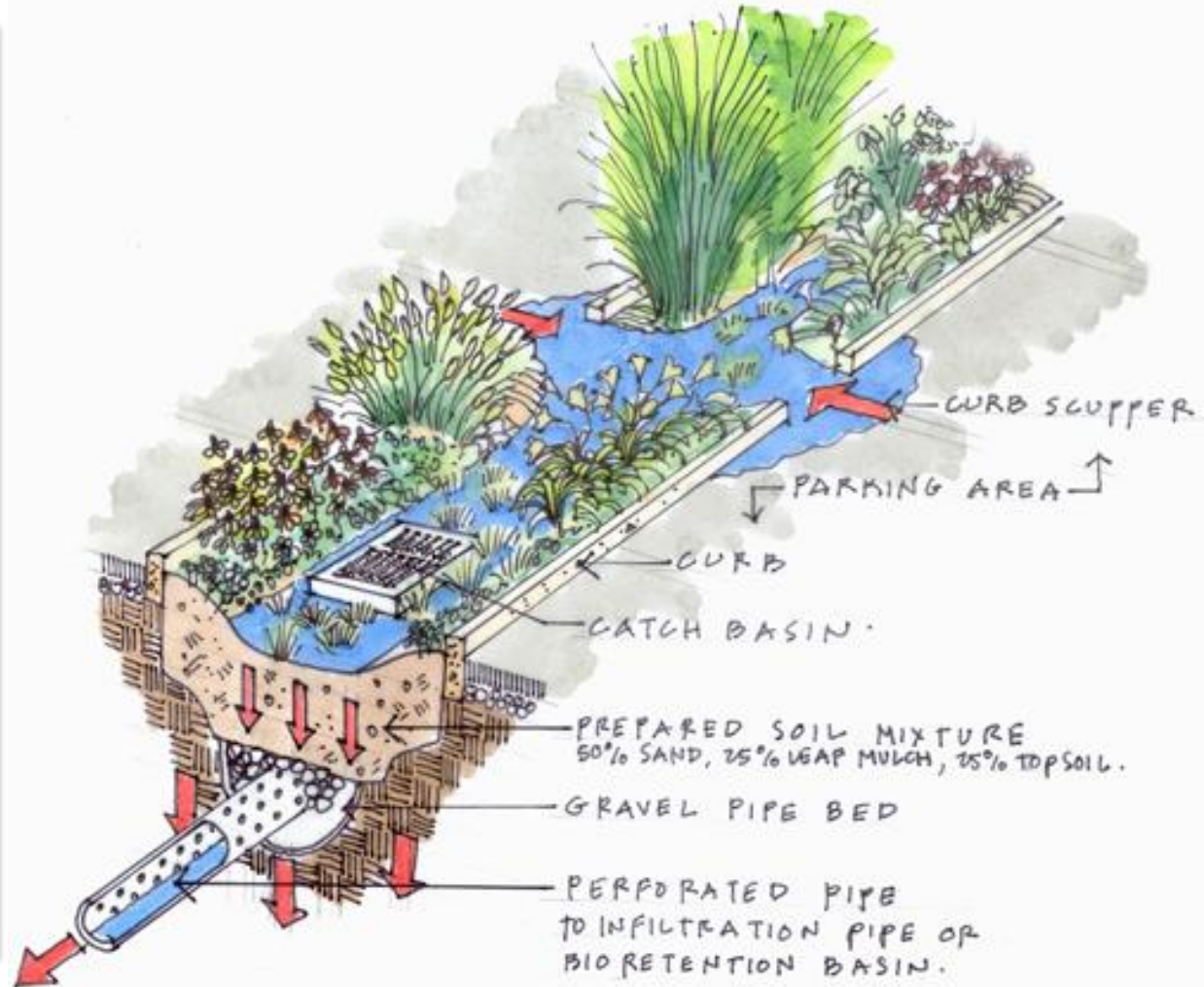
# Bioinfiltration Cells

**Bioswales**  
**Rain Gardens**  
**Flow-through Planter Boxes**  
**Vegetated Swales**





# Bioretention Cells





# Bioretention Cells



West Creek  
Reservation



Windemere Community Learning  
Center



# Rain Gardens



***Rain Gardens can reduce peak flows by more than 80%***

University of New Hampshire Stormwater Center, USEPA

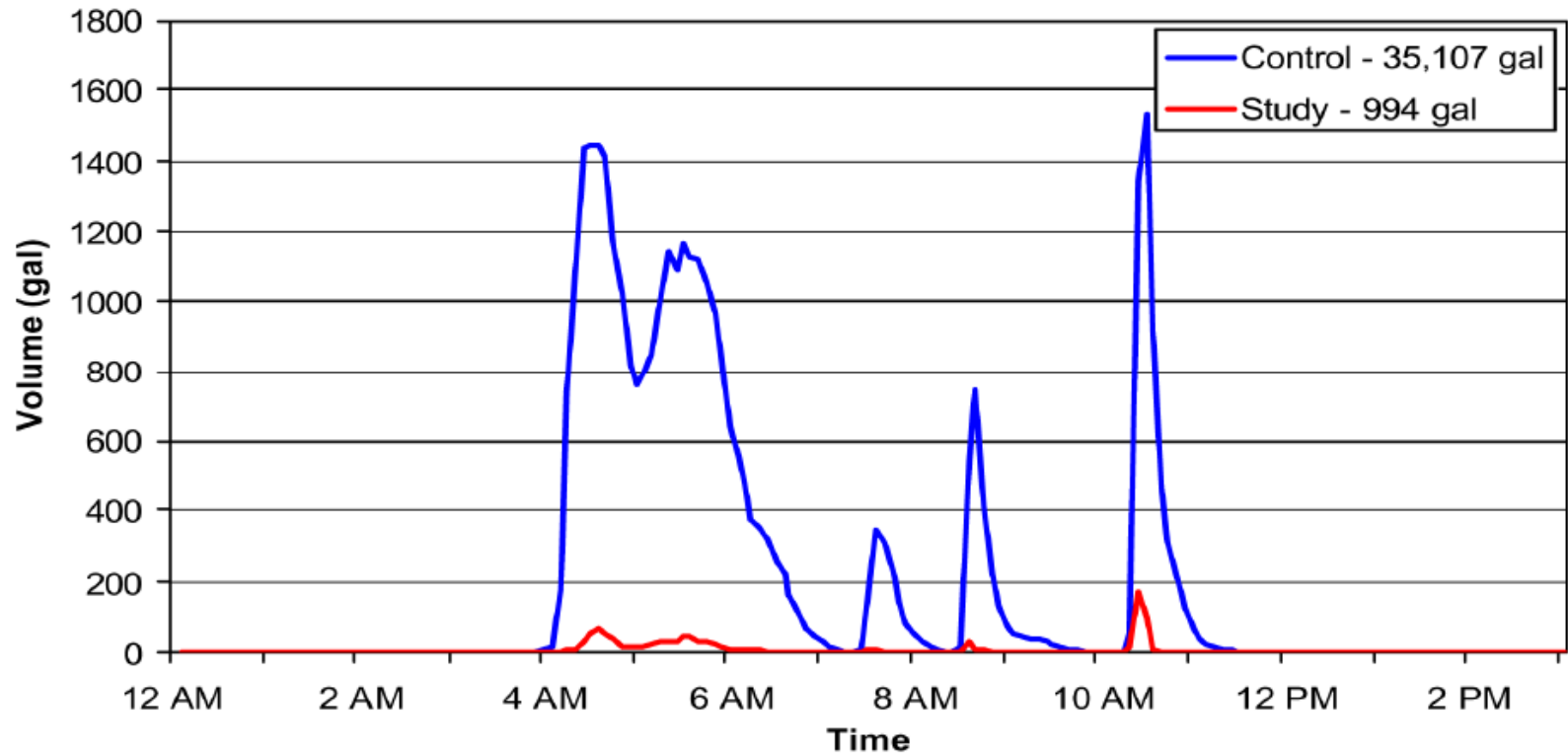


# Flow-through/Filter Boxes



# Bioinfiltration Cells

**Post-Construction Runoff Data**  
**May 29, 2004**  
**0.71" Rainfall**





# Permeable Pavements

**Porous Asphalt**

**Porous Concrete**

**Permeable Pavers**

**Recycled Glass Pavement**

**Grass Pavement**



# Porous Asphalt



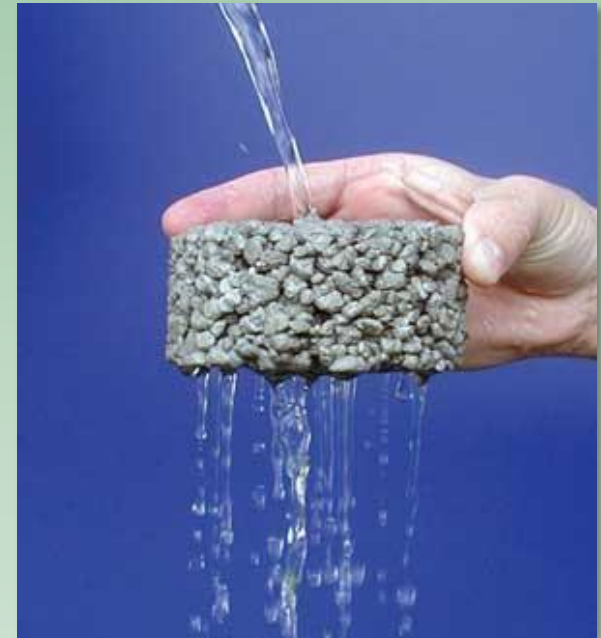
Tallmadge Meadows  
Metro Parks, Serving Summit County



# Porous Concrete

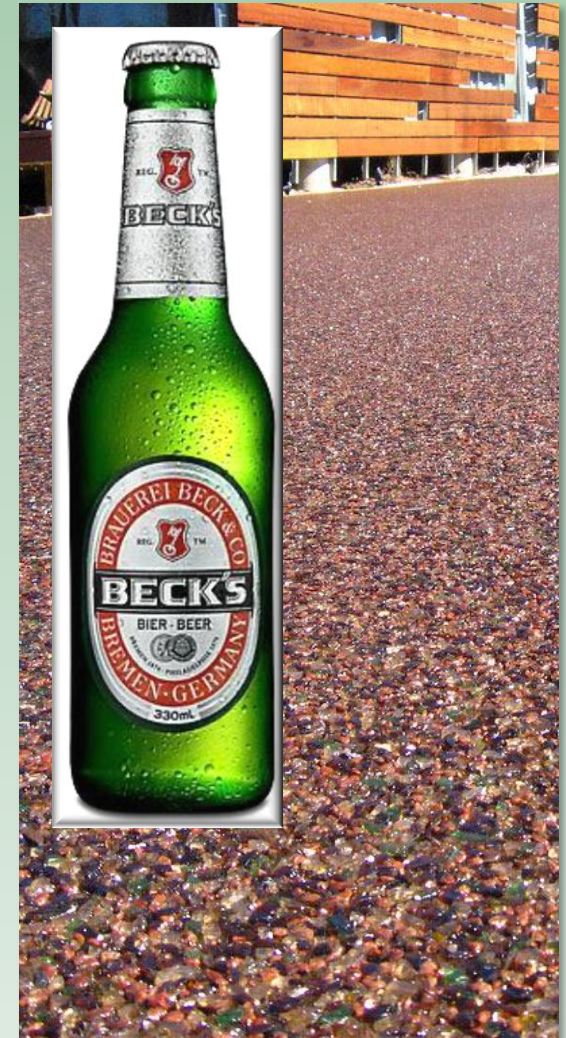


West Creek Reservation  
Cleveland Metroparks





# Recycled Glass Porous Pavement





# Permeable Pavers



Windemere Community Learning Center Akron,  
Ohio





# Constructed Stormwater Wetlands





# Constructed Stormwater Wetlands



Bridgestone  
Technical Center



New Franklin City Hall Green  
Infrastructure Demonstration Project



Akron General Health  
& Wellness Center, Stow, Ohio



West Creek Reservation  
Cleveland Metro Parks



# Observations (“Lessons Learned”)



**Bioretention**  
**Porous Concrete**  
**Porous Asphalt**  
**Grass Pavers**  
**Constructed Wetlands**



# Observations

“Lessons Learned”

## Bioretention



Fiber Rolls



Bridgestone Technical Center



# Observations

## "Lessons Learned"

### Bioretention



West Creek Reservation

# Observations

“Lessons Learned”

## Bioretention



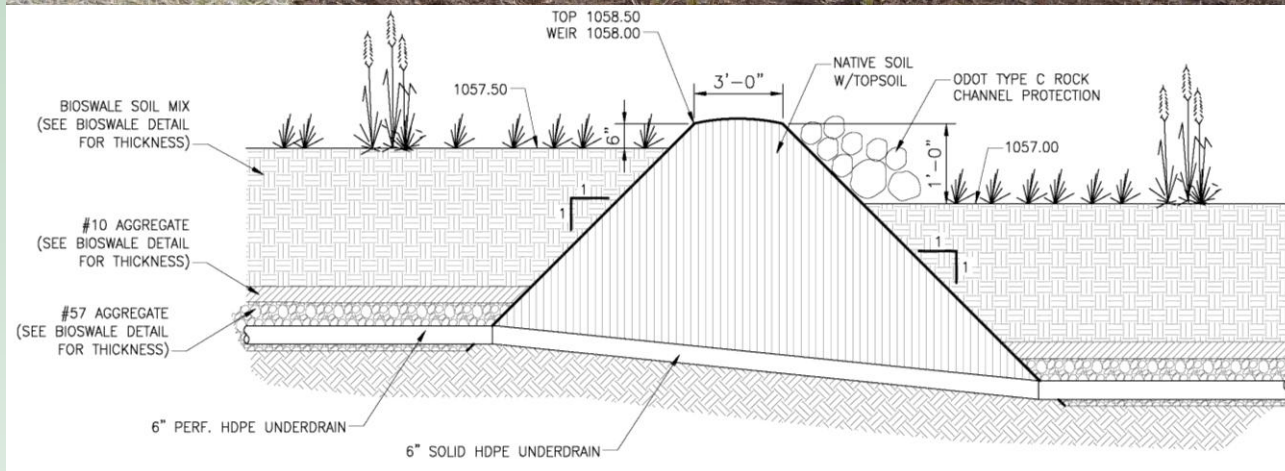
New Franklin Stormwater Demonstration Project



# Observations

## "Lessons Learned"

### Bioretention



# Observations

## "Lessons Learned"

### Porous Concrete



Hydraulically  
Actuated Pipe Roller



Rolling Groover



Improper Porous  
Concrete Installation

#### Ohio Ready Mixed Concrete Association Specifications and Guidelines:

- ❑ Quality Assurance - Must be installed by NRMCA certified Pervious Concrete Craftsman, Installers, and Technicians.
- ❑ Requires special equipment for compaction and jointing.
- ❑ Mixture proportions and proper installation are critical.
- ❑ High water content results in paste sealing of the void structure and a poor bond strength.
- ❑ Improper compacting could result in closing of the void structure in the pavement.
- ❑ Improper use of rolling groover could cause de-consolidation along either side of the joint which could result in raveling under traffic.
- ❑ Placing, finishing, jointing and curing procedures must begin no later than 10 minutes from the time the pervious concrete is discharged from the truck.



# Observations

“Lessons Learned”

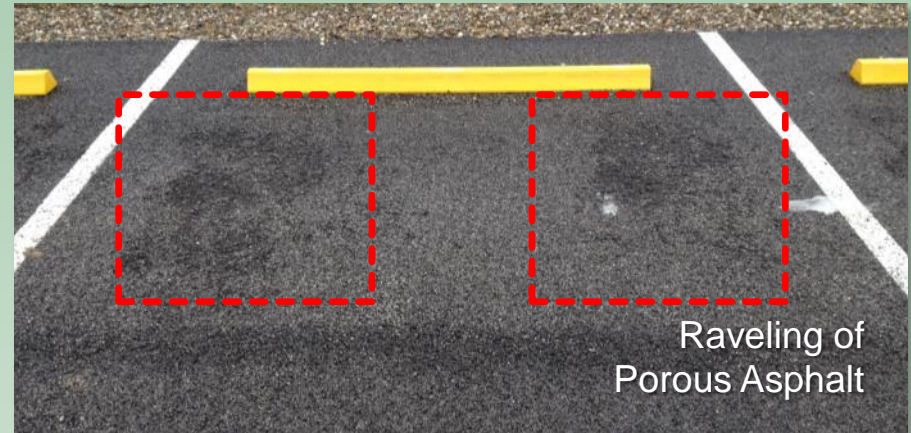
## Porous Concrete



# Observations

## "Lessons Learned"

### Porous Asphalt



- *Porous asphalt* was developed around 1970.
- Some early installations failed because the asphalt binder that holds the aggregate together never hardened and migrated down due to gravity and created a clogging layer.
- Today, polymers are added to the asphalt binder to prevent migration, and polymer-reinforcing fibers further hold it together.
- The most widespread use of porous asphalt today; all interstate highways in Georgia and Oregon are repaved with porous asphalt.



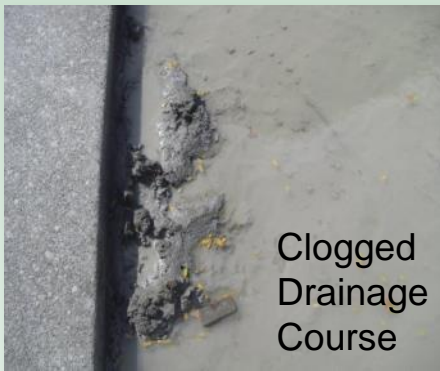
# Observations

"Lessons Learned"

## Grass Pavers



Bridgestone  
Technical Center



Clogged  
Drainage  
Course



Improper Base Course

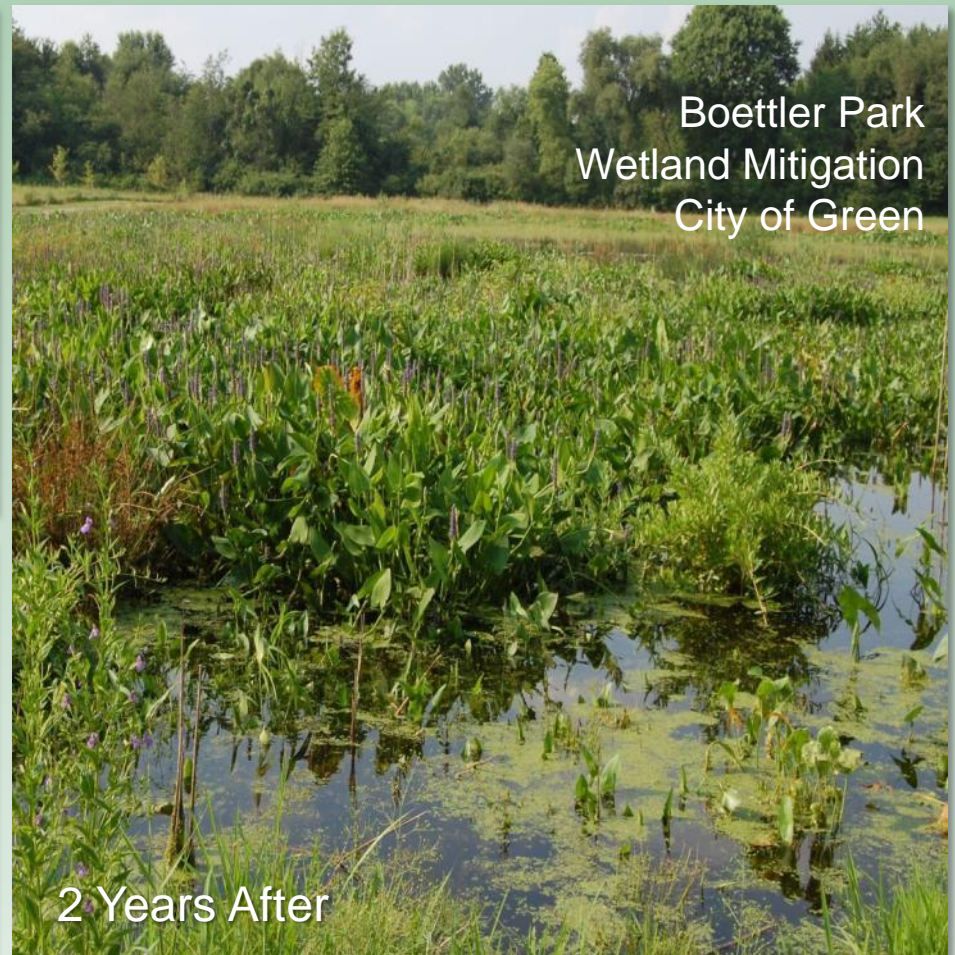




# Observations

"Lessons Learned"

## Maintenance – Constructed Wetlands





# Observations

## "Lessons Learned"

### Maintenance – Constructed Wetlands



- Wetlands typically take at least 3 years to become established once planted.
- Herbicide application vs. hand pulling

# Observations

“Lessons Learned”

## Maintenance – Constructed Wetlands



Boettler Park Mitigation Wetland, City of Green

**Geese!!!!!!!!!!!!!!!**



# Observations

“Lessons Learned”

## Managing Expectations - Aesthetics





