Agenda

• Introduction
• O & M General Overview
• SCM - Design
• SCM - Construction
• SCM - Maintenance
Introduction

• The Northeast Ohio Regional Sewer District supports the strategic implementation and long-term maintenance of green infrastructure that protects, preserves, enhances, and restores natural hydrologic function.

• The Green Infrastructure Grant (GIG) for the Combined Sewer Area Program (Program) focus is the funding of green infrastructure projects to remove stormwater runoff from the combined sewer collection system within the District’s combined sewer service area.
Introduction

• The District is now requiring, through our GIG Agreement, that all grantees attend an Operation & Maintenance (O&M) Workshop to ensure green infrastructure practices will continue to function properly and yield expected water quality and environmental benefits, while ensuring good stewardship of rate payer dollars.
# Green Infrastructure Grant Program

<table>
<thead>
<tr>
<th>Funding Round</th>
<th>Award Recommendations</th>
<th>Runoff Reduction gallons/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 GREEN INFRASTRUCTURE GRANTS PROGRAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$1,746,274</td>
<td>7,138,890</td>
</tr>
<tr>
<td>2016 GREEN INFRASTRUCTURE GRANTS PROGRAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$1,974,747</td>
<td>9,658,777</td>
</tr>
<tr>
<td>2018 GREEN INFRASTRUCTURE GRANTS PROGRAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$799,130</td>
<td>1,730,688</td>
</tr>
<tr>
<td>2019 GREEN INFRASTRUCTURE GRANTS PROGRAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$1,908,361</td>
<td>4,906,083</td>
</tr>
<tr>
<td>2020 GREEN INFRASTRUCTURE GRANTS PROGRAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>$1,935,944</td>
<td>2,913,808</td>
</tr>
<tr>
<td>GRAND TOTAL</td>
<td>$8,364,456</td>
<td>26,348,246</td>
</tr>
</tbody>
</table>
Stormwater Control Measures

• Bioretention Practices
• Cistern
• Green Wall
• Permeable Pavement
• Underground Infiltration/Detention Systems
Operation & Maintenance

GENERAL OVERVIEW
General Overview - Design
General Overview - Construction
General Overview – Day 1
General Overview – Day 1
General Overview – the first few months
General Overview – the awkward years
General Overview – Maturity
General Overview - Construction

HARTMAN MAKES THEM MAINTAIN!

Northeast Ohio Regional Sewer District

@neorsd
General Overview - Design Considerations
General Overview - Design

• Begin with the end in mind
• Setup project for success
  – Construction
  – Long-term maintenance
General Overview - Design

• Refer to an accepted standard
General Overview - Design

• Ensure accessibility by needed equipment
General Overview - Design

• Schedule

Construction Issues

1. **Timing of Construction** - Construction of bioretention practices shall take place after land grading is complete and the contributing drainage area has been stabilized. Construction may take place if the entire contributing area can be effectively diverted until construction is complete and fully-vegetated cover protects all soil areas. Construction shall not occur during periods of precipitation since clogging of soils, bedding, filter or planting media may occur.
General Overview - Design

• Consider ways to simplify inspections (e.g., observation wells)
General Overview - Design

- Flood Routing
  - What happens if the practice clogs/fails?
General Overview - Design
General Overview - Design

• Material Specifications

4. Planting Soil – The planting soil filters the treatment volume, detains runoff in the available void space and provides a media for plant growth and a biological community. Much of the pollutant removal occurs in this zone due to filtering, microbial activity, ion exchange, adsorption and plant uptake. The planting soil (an engineered soil media) shall be at least two feet deep and up to four feet in depth (settled) depending upon the planned vegetation. Greater depth is necessary to accommodate the root ball of trees planted in bioretention facilities. Soils and soil mixes must be certified by a qualified laboratory (1 test per 100 yd³ of soil) and have the following attributes:

- Texture class: loamy sand. Having no less than 80% sand and no greater than 10% clay considering only the mineral fraction of the soil.
- pH range: 5.2 - 8.0
- Soluble Salts: 500 ppm maximum.
- Decomposed organic matter: 3-5% by weight [Note: this translates to 8-20% organic matter by volume. See note on “Creating a Suitable Soil Media” below.]
- Phosphorus: phosphorus of the planting media should fall between 15 and 60 mg/kg (ppm) as determined by the Mehlich III test. For sites in watersheds with a phosphorus TMDL or sites with high phosphorus loads, the phosphorus content of the planting media should fall between 10 and 30 mg/kg as determined by the Mehlich III test.
- Sand added shall be clean and meet AASHTO M-6 or ASTM C-33 with a grain size of 0.02-0.04” inches.
General Overview - Design

• Applicable Notes & Details

SECTION A-A
BIORETENTION BASIN

PERMEABLE PAVERS
GABION BASKETS

REFER TO LANDSCAPE PLANS FOR MATERIALS

4" UNDERDRAIN

686.67 INV.

3.5'

ADS STORMTECH SC740 UNDERGROUND DETENTION PER DETAILS ON SHEETS 5-6
General Overview - Construction Considerations
General Overview - Construction

• Milestone Inspections
General Overview - Construction

• Milestone Inspections
General Overview - Construction

- Milestone Inspections
General Overview - Construction

- Milestone Inspections
General Overview - Construction

• Milestone Inspections
General Overview - Construction

- Milestone Inspections
General Overview - Construction

• Milestone Inspections
General Overview - Construction

- Milestone Inspections
General Overview - Construction

• Milestone Inspections
General Overview - Construction

• Milestone Inspections
General Overview - Construction

• Do not ruin your SCM!!!
General Overview - Construction

• Follow the construction schedule
General Overview - Construction

• Scarify underlying subsoil of infiltrating practices
General Overview - Construction

• Keep sediment out!!
General Overview - Construction

• Refer to applicable notes

**Utility Notes:**

1. Prior to construction, the contractor shall locate existing slants #21 and #28 for re-use. Contractor shall expose slant and it shall be inspected by water pollution control for reuse. If connection is viable, contractor shall notify engineer of location and elevation. If water pollution control determines the slant is no longer viable, the contractor shall install a new 6" VCP slant per WPC standards. Contractor to coordinate with water pollution control. Sewer within the R/W, from test tee to the main shall be 6" VCP @ a minimum slope of 1.0%.

2. Proposed gas meter, location and size and connection to be coordinated with utility companies prior to construction.

3. Relocated water spigot, contractor to coordinate final location with owner prior to construction. If existing shut off valve is within construction limits, contractor shall also relocate valve with water spigot.

4. Proposed electric meter and transformer, contractor shall coordinate with MEP plans and utility companies prior to construction.

5. Proposed 4" fire line and 2" domestic line. Meter and backflow shall be located inside building.


7. 6" perforated underdrain at 0.3% slope where pavers meet building. See detail sheet C6.02.

8. Solid pipe for connection between perforated pipe and collector pipe.
General Overview - Construction

• Complete as-built drawings
General Overview - Construction

- Update O&M plan as applicable when design changes are made during construction
General Overview - Construction

- Construct infiltrating practices during dry weather only
General Overview - Construction

• Ensure non-contaminated construction materials are used
General Overview – Maintenance Considerations
General Overview – Maintenance

What do the following have in common?
General Overview – Maintenance

A man-made feature that requires no maintenance

A perfect system of government
THEY DON’T EXIST!!!
General Overview – Maintenance

• First year need vs long-term need
General Overview – Maintenance

Maintaining Stormwater Control Measures

Over the next few pages we will discuss common SCMs approved for use in Ohio. A good understanding of SCM design and operation will enable property owners and operators of SCMs to plan and implement required maintenance activities on schedule.

If your SCM is not listed in this manual, please contact your local stormwater manager.

- Bioretention Area (page 7)
- Dry Pond or Dry Extended Detention Basin (page 9)
- Wet Pond or Wet Extended Detention Basin (page 15)
- Vegetated Infiltration Swale (page 23)
- Permeable Pavement (page 25)
- Green Roof (page 35)
- Non-Structural SCMs: Riparian & Wetland Setbacks and Conservation Areas (page 20)
- Rain Barrels & Cisterns (page 22)
- Rain Gardens (page 23)
- Sand Filter System (page 25)
- Underground Detention (page 27)
- Oil Water Separator (page 29)


Northeast Ohio Regional Sewer District

@neorsd
General Overview – Maintenance

MAINTAINING STORMWATER CONTROL MEASURES
Guidance for Private Owners & Operators

STORMWATER CONTROL MEASURES

Bioretention Area

Bioretention areas are depressed areas that allow shallow ponding of stormwater runoff that utilize specified soil media, mulch and vegetation to capture and treat stormwater runoff from impervious surfaces such as parking lots and rooftops. The soil media, mulch and vegetation filter pollutants to improve water quality within urban environments. The specified soil media, composed of sand, is placed over layers of sand, pea gravel and gravel within the depression which enables ponded stormwater runoff to be treated and filtered and before either soaking into the underlying soils or leaving through an underdrain pipe. Underdrains may be installed to drain the bioretention area to local sewers or appropriate outlet. Bioretention areas are planted with specific types of plant material that can withstand both wet and dry weather conditions. Recommended plant material information for Bioretention Areas can be found in Appendix 5.

MAINTAINING STORMWATER CONTROL MEASURES
Guidance for Private Owners & Operators

STORMWATER CONTROL MEASURES

Floored bioretention area with sidewalk curb cut in foreground. Stormwater runoff is conveyed through gravel to shallow depression of bioretention area. Credit: Northeast Ohio Regional Sewer District

Wells and unlined plantings prevent stormwater runoff from entering the bioretention area from the curb cut. Credit: Northeast Ohio Regional Sewer District

Stormwater flow will be blocked by the dead vegetation on the outer catch basin grate. Credit: Chagrin River Watershed Partners

Erosion of side slopes and subsequent sediment accumulation within bioretention area and contribute to clogging issues. Credit: Summit Soil & Water Conservation District

MAINTENANCE REQUIRED WHEN:
- Standing water is visible 48 hours after a rain event.
- Erosion is visible within the bioretention area, or on the slopes and inlets leading into the bioretention area.
- Vegetation, sediment or debris is blocking inlets or outlets.
- Vegetation is wilting, discolored, or dying.
- Foul odors present.
- Sediment has accumulated over the mulch or soil media.
General Overview – Maintenance

MAINTAINING STORMWATER CONTROL MEASURES
Guidance for Private Owners & Operators

ROUTINE AND NON-ROUTINE MAINTENANCE

Recommendations for Routine and Non-Routine Maintenance

The following section lists general recommendations for routine and non-routine maintenance items. Some routine maintenance items are completed on a seasonal basis, others require greater frequency. Non-routine maintenance items often require professional expertise and assistance before appropriate corrective measures can be determined. Resources for professional assistance are listed in Appendix 3.

Bioretention Area

Routine Maintenance:

• Sediment and Debris: Remove gross accumulated sediment and debris from the mulch or grass surface area of the bioretention area.

• Outlet Structure: Keep outlets of bioretention area free from blockage by sediment, debris, trash, mulch or plant material.

• Erosion and Scour: Repair soil erosion or scouring within the bioretention area, side slopes or inlets leading into the bioretention area.

• Mulch: Maintain a 2 to 3 inch depth of hardwood bark mulch layer within the planted area of the bioretention area. If an excessive depth of mulch exists, remove mulch until the mulch layer is 2 to 3 inches in depth.

• Curb Cuts: Keep curb cuts to bioretention area free from blockage by sediment, debris and trash.

• Weeds: Remove weeds and invasive plants from bioretention area.

• Vegetation Management: Inspect plant health seasonally to ensure vigorous growth. Prune plants, particularly shrubs and trees, during the dormant season (fall to early spring).

• Snow Removal: Do not pile or store snow within the bioretention area as this will compact the specialized soils and add sediments that may lead to clogging.

Non-Routine Maintenance:

• Plant Replacement: Replace diseased or dying plants.

• Water Ponding Period: When ponding continues beyond a 48 hour period or the designed ponding duration, there may be construction, or design issues that need to...
Operation & Maintenance

BIORETENTION
Bioretention

• Small-scale, vegetated depressions
• Small contributing areas (e.g. roads and roof tops)
• Stormwater runoff percolates through soil and plant roots
• Physical, chemical and biological processes
• Clean water infiltrates or is discharged
Bioretention - Design
Bioretention - Design

• General
  – Use accepted standards
  – Ensure accessibility
  – Prepare logical schedule
  – Keep inspection & maintenance in mind
  – Include applicable notes & details
  – Provide for flood routing
  – Provide material specifications
Bioretention - Design

• Design assumptions made:
  – Appropriate drainage area vs. filter bed area (5% of watershed’s IA)
  – Adequate outlet
  – Groundwater considerations
  – Setbacks met
Bioretention - Design

- Assumptions:
  - Appropriate drainage area vs. filter bed area (5% of watershed’s IA)
Bioretention - Design

- Pre-treatment options:
  - Forebay
  - Grass filter
  - Gravel Verge
  - Proprietary devices
Bioretention - Design

- Curb cuts: Sumps (easy) vs. Slopes (hard)
Bioretention - Design

• Curb cuts: Use the right size stone

Nice! = Naughty

Northeast Ohio Regional Sewer District

@neorsd
Bioretention - Design

- Upturned elbows:

![Bioretention diagram](image)

**Note:**
1. Water tight seals must be provided pre-cast riser sections necessary to bioretention cell outlet structure to that would otherwise allow CMs to pass what is designated for.
2. All pipe penetrations shall be water...
Bioretention - Design

• Infiltration testing:

  - Double-ring infiltrometer
  - Infiltration test pit
Bioretention - Design

• Plant Selection:
  – Aesthetics
  – Line of site
  – Moisture variability
  – Salt tolerance
  – Sunlight needs
Bioretention - Construction
Bioretention - Construction

• General
  – Adhere to construction schedule
  – Keep sediment away!
  – Refer to applicable notes/details
  – Construct during good weather
  – Scarify subsoil (infiltrating practices)
  – Use non-contaminated materials
  – Plan revisions = O&M Plan revisions
  – As-built drawings
  – Milestone inspections
Bioretention - Construction

- Avoid compaction
Bioretention - Construction

- Account for settling of layers (additional 5% volume)
Bioretention - Construction

• Keep sediment out!!!
Bioretention - Construction

• Pre-treatment grass filter strips...sod in place of seed & mulch
Bioretention - Construction

- Properly stake taller plants
Bioretention - Maintenance

• General
  – All SCMs will require maintenance
  – First year need vs. long-term need
# Bioretention - Maintenance

## Bioretention Area Inspection and Maintenance Checklist

<table>
<thead>
<tr>
<th>Inspection Item</th>
<th>Comment</th>
<th>Action Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sediment</td>
<td>✔️ Yes</td>
<td>✔️ Yes</td>
</tr>
<tr>
<td>Trash and debris</td>
<td>✔️ Yes</td>
<td>✔️ Yes</td>
</tr>
<tr>
<td>Standing water</td>
<td>☐ No</td>
<td>☐ No</td>
</tr>
<tr>
<td>Erosion</td>
<td>✔️ Yes</td>
<td>✔️ Yes</td>
</tr>
<tr>
<td>Vegetation</td>
<td>✔️ Yes</td>
<td>✔️ Yes</td>
</tr>
<tr>
<td>Mulch</td>
<td>✔️ Yes</td>
<td>✔️ Yes</td>
</tr>
<tr>
<td>Subgrade or bank erosion</td>
<td>✔️ Yes</td>
<td>✔️ Yes</td>
</tr>
<tr>
<td>Site slopes and embankments</td>
<td>✔️ Yes</td>
<td>✔️ Yes</td>
</tr>
</tbody>
</table>

Additional Notes:

- Site Sketch:
- Wet weather inspection needed: Yes / No
Bioretention - Maintenance

• Pre-treatment
  – Remove accumulated sediments

• De-watering
  – Ensure it drains
Bioretention - Maintenance

- **Inlets**
  - Are they stabilized?

- **Vegetative health**
  - Watering & weeding
  - Trimming/pruning
  - Thinning
  - Winterizing
Bioretention - Maintenance

• Infiltration bed
Bioretention - Maintenance

• Outlet & Overflow
CISTERN (RAINWATER HARVESTING)

Operation & Maintenance
Cistern
Cistern

• Water distribution
  – Can be used for on-site irrigation or domestic use
  – Controlled through automation or passively
  – Must have an overflow for large storms
Cistern - Design
Cistern - Design

- General
  - Accepted standards
  - Accessibility
  - Schedule
  - Simplify inspections
  - Applicable notes & details
  - Flood routing
  - Material specifications
Cistern - Design

- Design assumptions made:
  - Catchment area – dictates type of pre-treatment needed
  - Drainage area – sized according to drainage area and volume needed
  - Proper base is provided
  - Outlet (overflow) is appropriate
  - Setbacks are adhered to (property line and building)
Cistern - Design

• Design assumptions cont’d:
  – Quality – life expectancy and durability (local seasonal conditions were considered)
  – Adhere to applicable plumbing codes
  – Sunlight exposure minimized (above ground)
  – System is flushable
  – Tank is accessible
Cistern - Design

• Pre-treatment

Function of a First-Flush System

The first flush of contaminated water is diverted into chamber

Water flow from roof

Ball seals off chamber

To tank

Once the chamber is full, fresh water flows to tank

Inflow from Roof

Outflow to Cistern

Courtesy Innovative Water Solutions LLC (2)
Cistern - Design

• General treatment of water

Filter

Ultraviolet Light

HOW DOES UV WORK?
The ULTRAVIOLET WATER PURIFICATION PROCESS

1. Water enters UV system
2. Water is exposed to UV light which kills the DNA of bacteria so it can no longer reproduce
3. Purified water enters your home

Ultraviolet (UV) Water Purification is a proven technology that uses UV light to kill harmful microorganisms in water. It is a safe and effective method of water treatment. UV systems are used around the world in millions of homes and businesses. For more information, visit https://www.uwewaterproducts.com/forms/uw/
Cistern - Design

• Design features

- Drain pipes
- Water level indicator
- Alarms
Cistern - Construction
Cistern - Construction

• General
  – Adhere to construction schedule
  – Keep sediment away!
  – Refer to applicable notes/details
  – Plan revisions = O&M Plan revisions
  – As-built drawings
  – Milestone inspections
Cistern - Construction

- Testing water tightness, mechanical components and alarms
Cistern - Maintenance
Cistern - Maintenance

• General
  – All SCMs will require maintenance
  – First year need vs. long-term need
# Cistern - Maintenance

## Rain Barrel/Cistern Inspection and Maintenance Checklist

<table>
<thead>
<tr>
<th>Inspection Item</th>
<th>Comment</th>
<th>Action Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Treatment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment and debris have accumulated in pipe</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>The screens or trap is clogged or not attached</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Foundation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basin foundation is stable</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Inlet/Diapers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gutter and downspouts pipes are disconnected and in leaks are present</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Newspapers are disconnected from basin and/or leaks are present</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Stormwater drain and/or leaks are present</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Spigot</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Valve leaks are present and connections are not tight</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Valve and handle do not turn</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Rain Barrel/Cistern</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment accumulated at bottom of barrel</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Odor of mildew present or algae is visible inside the barrel</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Cracks or leaks are visible in barrel</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Mosquito larvae is visible in barrel</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Overflow Structure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overflow is directed away from the structure or disconnected from downspout</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
<tr>
<td>Other</td>
<td>□ Yes □ No □ N/A</td>
<td>□ Yes □ No</td>
</tr>
</tbody>
</table>

*Special Notes: An untreated individual should never drink water from a cistern. Always follow the manufacturer’s manual and recommended maintenance schedule.

Yet weather inspection needed: □ Yes □ No
Cistern - Maintenance

- Tank stability
- Check for leaks (pipes, hoses, valves)

Northeast Ohio Regional Sewer District
@neorsd
Cistern - Maintenance

- Test mechanicals
- Water sampling
Cistern - Maintenance

- Flush & sanitize entire system (confined space entry)

- Winterization
Operation & Maintenance
GREEN WALL
Green Wall - Design

• Vertical structures that have different types of plants or other greenery attached to them.
• Growth medium consisting of soil, stone, or water
• Built-in irrigation systems.
Green Wall - Design
Green Wall - Design

• General
  – Use accepted standards
  – Ensure accessibility
  – Prepare logical schedule
  – Keep inspection & maintenance in mind
  – Include applicable notes & details
  – Provide for flood routing
  – Provide material specifications
  – Refer to Cistern slides – ensure proper conveyance for irrigation
Green Wall - Construction
Green Wall - Construction

• General
  – Adhere to construction schedule
  – Refer to applicable notes/details
  – Construct during good weather
  – Use non-contaminated materials
  – Plan revisions = O&M Plan revisions
  – As-built drawings
  – Milestone inspections
  – Refer to Cistern slides – ensure proper conveyance for irrigation
Green Wall - Maintenance
Green Wall - Maintenance

• General
  – All SCMs will require maintenance
  – First year need $ vs. long-term need $
Green Wall - Maintenance

• Refer to Cistern Maintenance
• Accessibility with specialized equipment
Green Wall - Maintenance

• Long-term structural stability
Green Wall - Maintenance

- Plant health
- Winterization (irrigation system & plants)
PERMEABLE PAVEMENT

Operation & Maintenance
Permeable Pavement

• Provide structural support for vehicle, bicycle, and pedestrian traffic
• Allows water to permeate through the pavement surface, aggregate base, and to infiltrate into the subgrade soils
• Receive runoff from adjacent rooftops and/or traditional paved areas
Permeable Pavement - Design

• General
  – Use accepted standards
  – Ensure accessibility
  – Prepare logical schedule
  – Keep inspection & maintenance in mind
  – Include applicable notes & details
  – Provide for flood routing
  – Provide material specifications
Permeable Pavement - Design

• Design assumptions made:
  – Traffic loading patterns
  – Contributing drainage area’s land use impacts (i.e., sediments)
  – Foundation offsets
  – Groundwater issues addressed
  – Flat subgrade provided
Permeable Pavement - Design

- Drainage area ratios (max. 2:1, traditional pavement-to-permeable pavement)

Paver field = 5,000 sq.ft
Pavement drainage area = 7,500 sq.ft
Ratio of 1.5:1
Permeable Pavement - Design

- Underdrains & elbows
Permeable Pavement - Design

• Observation wells

• Edge restraints (curbing)
Permeable Pavement - Design

- Infiltration testing*: based on finished compaction

*Northeast Ohio Regional Sewer District*
Permeable Pavement - Design

- Erosion & sediment control plan
Permeable Pavement - Construction
Permeable Pavement - Construction

- General
  - Adhere to construction schedule
  - Keep sediment away!
  - Refer to applicable notes/details
  - Construct during good weather
  - Scarify subsoil (infiltrating practices)
  - Use non-contaminated materials
  - Plan revisions = O&M Plan revisions
  - As-built drawings
  - Milestone inspections
Permeable Pavement - Construction

- Do not work on the subgrade when it is raining
- Remove unintended sediments before backfilling
Permeable Pavement - Maintenance
Permeable Pavement - Maintenance

- General
  - All SCMs will require maintenance
  - First year need vs. long-term need
# Permeable Pavement - Maintenance

## Permeable Pavement Inspection and Maintenance Checklist

<table>
<thead>
<tr>
<th>Inspection Item</th>
<th>Comment</th>
<th>Action Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PRETREATMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment has accumulated</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trench and debris have accumulated</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Non-permeable transition area or pavement edges is not flush/unleveling</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>2. RETREATING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standing water visible on the surface after a rain</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>3. REHARDENING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sediment has accumulated on pavement surface or around curbing</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pavement has deteriorated, cracked, scaled, or broken</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Sediment has accumulated in the joints of PCC</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Vegetation is growing in the joints of PCC</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Gravel is insufficient in the joints of PCC</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Additional Notes</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Wet weather inspection needed: Yes | No
Permeable Pavement - Maintenance

- Remove landscaping debris regularly
- Stockpile snow piles downslope
Permeable Pavement - Maintenance

- Do not apply any sealants
Permeable Pavement - Maintenance

- Vacuum/sweep 2x-4x per year

Regenerative air sweeper

Debris disposal

DIY – old school

Northeast Ohio Regional Sewer District

@neorsd
UNDERGROUND INFILTRATION/DETENTION SYSTEMS

Operation & Maintenance
Underground Systems

• Saves valuable space - area above remains available for traditional uses (parking, roads, active recreation, etc.)
• Allows water to infiltrate into the subgrade soils
• Receive runoff from adjacent rooftops and/or traditional paved areas
Underground Systems - Design
Underground Systems - Design

- General
  - Use accepted standards
  - Ensure accessibility
  - Prepare logical schedule
  - Keep inspection & maintenance in mind
  - Include applicable notes & details
  - Provide for flood routing
  - Provide material specifications
Underground Systems - Design

- Design assumptions made:
  - Traffic loading patterns
  - Foundation offsets
  - Groundwater issues addressed
  - Flat subgrade provided
Underground Systems - Design

- Pre-treatment options (80% TSS removal)
Underground Systems - Design

- Observation & accessibility ports
Underground Systems - Construction
Underground Systems - Construction

- General
  - Adhere to construction schedule
  - Keep sediment away!
  - Refer to applicable notes/details
  - Construct during good weather
  - Scarify subsoil (infiltrating practices)
  - Use non-contaminated materials
  - Plan revisions = O&M Plan revisions
  - As-built drawings
  - Milestone inspections
Underground Systems - Construction

• Do not work on the subgrade when it is raining

• Remove unintended sediments before backfilling
Underground Systems - Maintenance
Underground Systems - Maintenance

• General
  – All SCMs will require maintenance
  – First year need $ vs. long-term need $
## Underground Detention System Inspection and Maintenance Checklist

<table>
<thead>
<tr>
<th>Section</th>
<th>Description</th>
<th>Comment</th>
<th>Action Needed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. PRE-TREATMENT</td>
<td>Sediment has accumulated</td>
<td>☐Yes ☐No ☐NA</td>
<td>☐Yes ☐No</td>
</tr>
<tr>
<td></td>
<td>Debris or debris have accumulated</td>
<td>☐Yes ☐No ☐NA</td>
<td>☐Yes ☐No</td>
</tr>
<tr>
<td>2. INLETS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. OUTLETS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. OTHER SYSTEM COMPONENTS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. CHAMBERS</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Site Specific Notes</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note: Inspectors should follow the procedures outlined in the maintenance manual provided by the manufacturer. *

---

**Important Notes:**

- Inspectors should wear proper safety gear, including hard hats, safety glasses, and gloves.
- Ensure that all equipment is in proper working condition.
- Report any issues or concerns to the appropriate authority immediately.
- Keep a record of all inspections for future reference.

---

*This checklist is subject to change without notice.*
Underground Systems - Maintenance

- Specialized equipment to remove accumulated sediments

Culvert cleaning nozzle

Vac truck

Debris disposal
Conclusion

• Maintenance Considerations
  - Design Phase
  - Construction Phase
  - Long-Term
Conclusion

• Additional Resources
  – Cistern Video:
    • https://youtube/ORzczMLq5to
  – Underground Infiltration/Detention Video:
    • https://www.youtube.com/watch?v=Upn5aPEESGA
Thank You

**Administrative Inquiries**
Crystal Davis | 216.881.6600 x6447 | davisc@neorsd.org

**Technical Inquiries**
Chris Hartman | 216.881.6600 x6656 | hartmanc@neorsd.org

https://www.neorsd.org/stormwater-2/