Porous Pavement Where?
A Green Infrastructure Success Story in an Unlikely Place

NEWEA SPRING MEETING 2017
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June 5, 2017

Building better communities with you
Project Location

Vermont
New Hampshire
Massachusetts
Connecticut
Rhode Island

Boston
Hingham
Rockland
Project Location

- Project Site
- Accord Pond
- Ben Mann Brook
- Hannigan (Rockland) Reservoir
- Wetlands
- Hingham
- Rockland
- Norwell
- Hanover
Why Green Infrastructure

Environmentally-Responsible Approach
- Forward thinking owner/developer
- Wetland and water supply protection
- Suitable site conditions (Great Soils!)

Regulatory Drivers
- Challenging stormwater requirements
- GI/LID consistent with new (draft) MS4 permit requirements
- GreenDOT initiative supports remediating highway runoff

Project Benefits
- Both towns assumed to support Green Infrastructure implementation → Benefits to project schedule
- Cost savings
Original Project Site Plan
Project Permitting Requirements

Massachusetts Executive Office of Energy and Environmental Affairs

Conservation Commission
Planning Board
Zoning Board of Appeals

Order of Conditions
Site Plan Review
Special Permit (Parking)

Conservation Commission
Planning Board
Zoning Board of Appeals

Order of Conditions
Site Plan Review
Design Review
Special Permit (Property Use)
Variance

Direct Access Permit
Indirect Access Permit
Hingham Review and Approval Process
Planning, Zoning, Conservation

• Requested additional offset from wetland line – 50 foot undisturbed Buffer

• Confirmed design met MassDEP Stormwater Management Standards and contacted UNH to confirm design assumptions

Town requested the following:

• Increased porous pavement filter course thickness from 8” to 12”

• Clarification on soil testing and infiltration rates

• Back-up distribution pipe in case of porous asphalt clogging
**Rockland Review and Approval Process**

*Planning and Zoning*

- General design clarifications on stormwater management system
  - No major design changes required or concerns with Green Infrastructure

- Confirmed design met MassDEP Stormwater Management Standards and Town of Rockland Stormwater Requirements

**Town requested the following:**

- Confirmation that flow to wetland will meet Rockland volume requirement

- Retrofits of existing developed area to increase treatment

- Increased cover over subsurface infiltration systems
Rockland Review and Approval Process

Conservation

Engineering Peer Review focused on the following:

- Wetland impacts and required replication
- Wetland buffer preservation and tree protection
- **Porous asphalt suitability for the project site**
Addressing Uncertainty with Porous Asphalt

The stormwater management system for the project retrofits the existing system on 1050 Hingham Street with a bio-retention basin to treat the reconfigured common access drive and uses a combination of conventional and LiD (porous asphalt) infiltration systems to treat and control the impervious surfaces on the 1040 Hingham Street site. Porous asphalt has a mixed history of performance that has hampered its widespread adoption of usage. Recent advances in design, installation, maintenance commitment, and production quality control have addressed these concerns and its usage is highly advocated by the University of New Hampshire Stormwater Center (UNHSC), a recognized authority on stormwater BMP performance. Questions whether its usage is appropriate for the proposed development that has components considered Land Uses with Higher Potential Pollutant Loads (LUHPPLs).
Project Changes Due to Permitting

- Redesign site layout
- Increase retaining wall height
- Convert to standard asphalt within the buffer zone
- Build underground stormwater infiltration system
- Additional cost of apx. $75,000
Project Changes Due to Permitting
Porous Asphalt Construction – Construction Documents
Porous Asphalt Construction - Specifications

UNHSC Design Specifications for Porous Asphalt Pavement and Infiltration Beds

February 2014
Revision September 2016

University of New Hampshire Stormwater Center (UNHSC)
Gregg Hall • 35 Colonus Road • Durham, New Hampshire 03824-3348 • http://uhc.edu/unhsc/
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Figure 1: Typical Cross-Section for Pervious Pavement System
- Pervious pavement: 4-6' (10 - 15 cm) of porous asphalt
- Choker Course: 4'-8" (10 - 20 cm) minimum
- Filter Course: 8" - 12" (20 - 30 cm) minimum thickness of subbase (aka. bank run gravel, manufactured sand or modified 304.1)
- Filter Blanket: Intermediate settling bed: 1" (8 cm) thickness of 1/2" (1 cm) pea gravel
- Reservoir Course: 4" (10 cm) minimum thickness of 1/2" (2 cm) crushed stone for frost protection, 4-6" (10-15 cm) diameter perforated subdrains with 2" cover
- Optional-inlet for land uses where infiltration is undesirable (e.g., hazardous materials handling, soil-source aquifer protection)
- Perforated or slotted pipe

Table 2: Gradations of choker, filter, and reservoir course materials.

<table>
<thead>
<tr>
<th>US Standard Sieve Size</th>
<th>Per Cent Passing (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches/mm</td>
<td>Choker Course</td>
</tr>
<tr>
<td>6/150</td>
<td>-</td>
</tr>
<tr>
<td>2 1/2/63</td>
<td>-</td>
</tr>
<tr>
<td>2 5/8</td>
<td>-</td>
</tr>
<tr>
<td>1 1/2/37.5</td>
<td>100</td>
</tr>
<tr>
<td>1/2</td>
<td>95 - 100</td>
</tr>
<tr>
<td>1/4</td>
<td>-</td>
</tr>
<tr>
<td>1/8</td>
<td>25 - 60</td>
</tr>
<tr>
<td>3/8</td>
<td>0 - 10</td>
</tr>
<tr>
<td>#4</td>
<td>0 - 5</td>
</tr>
<tr>
<td>#8</td>
<td>0 - 5</td>
</tr>
<tr>
<td>#200</td>
<td>0 - 6***</td>
</tr>
</tbody>
</table>

* Alternate gradations (e.g. AASHTO No. 67) may be accepted upon Engineer’s approval.
** Alternate gradations (e.g. AASHTO No. 5) may be accepted upon Engineer’s approval.
*** Preferably less than 4% fines
Porous Asphalt Construction – Subgrade Preparation
Porous Asphalt Construction – Reservoir Course & Check Dams
Porous Asphalt Construction – Filter Blanket
Porous Asphalt Construction – Filter, Choker, & Pavement
Porous Asphalt Construction – Finishing Touches
Site Operation – Pavement Transition
Site Operation Procedures for Porous Pavement

Winter Protocols

• Minimize Salt
• Do Not Sand
• Plow with Rubber Blades

Site Management

• Maintain Landscaped Areas to Minimize Erosion
Commitment to Operation and Maintenance

Gallery Automotive Stormwater Management System
Inspection and Maintenance Program

2015 Inspection and Maintenance Schedule (1/2)

<table>
<thead>
<tr>
<th>January</th>
<th>April</th>
</tr>
</thead>
<tbody>
<tr>
<td>Porous Asphalt - Quarterly Inspection</td>
<td>Porous Asphalt - Quarterly Inspection and Semi-Annual Cleaning*</td>
</tr>
<tr>
<td>Catch Basin - Quarterly Inspection and Cleaning*</td>
<td>Street Sweeping</td>
</tr>
<tr>
<td>Area Drain - Monthly Inspection and Cleaning* of Debris</td>
<td>Catch Basin - Quarterly Inspection and Cleaning*</td>
</tr>
<tr>
<td>Oil/Water Separator - Monthly Inspection</td>
<td>Area Drain - Monthly Inspection and Cleaning* of Debris</td>
</tr>
<tr>
<td>Bioretention Area - Monthly Inspection and Maintenance</td>
<td>Subsurface Infiltration System - Semi Annual Inspection</td>
</tr>
<tr>
<td>Level Spreader - Monthly Inspection</td>
<td>Oil/Water Separator - Monthly Inspection</td>
</tr>
<tr>
<td>Sewer Oil/Gas Separator - Monthly Inspection</td>
<td>Bioretention Area - Monthly Inspection and Maintenance</td>
</tr>
<tr>
<td>Car Wash reclaim Tank - Monthly Inspection</td>
<td>Level Spreader - Monthly Inspection</td>
</tr>
<tr>
<td>Grasspave2 - Monthly Inspection and Maintenance</td>
<td>Sewer Oil/Gas Separator - Monthly Inspection</td>
</tr>
</tbody>
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<table>
<thead>
<tr>
<th>February</th>
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<tbody>
<tr>
<td>Area Drain - Monthly Inspection and Cleaning* of Debris</td>
<td></td>
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<tr>
<td>Oil/Water Separator - Monthly Inspection</td>
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Note: Additional inspection and maintenance may be needed following storm events and fuel/oil/chemical spills and in the case of heavy debris accumulation.

* All cleaning to take place if needed - Refer to O&M Plan for specific requirements for each BMP.
Commitment to Operation and Maintenance

Porous Pavement Inspection and Maintenance

- Monitor Regularly
- Vacuum Surface 2X Annually
- Check Infiltrative Capacity

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Porous Asphalt Checklist (Lot 1)

<table>
<thead>
<tr>
<th>Name of Inspector:</th>
<th>PURPOSE OF INSPECTION/MAINTENANCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection Date:</td>
<td>Quarterly visual inspection</td>
</tr>
<tr>
<td></td>
<td>Annual infiltrative capacity check</td>
</tr>
<tr>
<td></td>
<td>Cleaning following winter season (April)</td>
</tr>
<tr>
<td></td>
<td>Cleaning following foliage season (November) Date: _______</td>
</tr>
<tr>
<td></td>
<td>Inspection following storm event. Depth of storm: _______</td>
</tr>
</tbody>
</table>

**INSPECTION**

- Check asphalt for damage and deterioration.
  
Indicate locations and extent:

- Ensure proper drainage after storm events.
  
Indicate locations and extent:

**MAINTENANCE**

- Repair damaged porous asphalt (rutting, etc.) by heating and rerevling the asphalt.
  
Indicate locations and extent:

- Clean the surface of each porous asphalt area using vacuum sweeping as required to keep the pavement functioning as designed.
  
Indicate locations and extent:

- If infiltrative capacity of porous asphalt is reduced to less than the design rate, replace by milling to the choker course.
  
Indicate locations and extent:

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Material disposed of in accordance with applicable local, state and federal guidelines and regulations.
Porous Pavement in Action!

https://www.youtube.com/watch?v=V4IJagzSYTk
Q+A on Green Infrastructure

• What can other Cities and Towns do to encourage the use of Green Infrastructure?

• What are municipalities’ roles in educating their Town staff, boards and public on the benefits of Green Infrastructure?

• Small MS4s will be required to include LID strategies/Green Infrastructure into Town regulations

• What are the operations and site maintenance considerations for Green Infrastructure?

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