Porous Pavement as a Stormwater Management Tool on Urban Streets

Nick Hutchinson, P.E. - City of Ann Arbor, MI
Agenda

- Benefits
- Sylvan Avenue
- Willard Street
- Maintenance
- Analysis
- Alternatives
Benefits of Permeable Pavement

- Improve storm water management
- Reduced downstream impacts
- Improved storm water quality
- Winter Conditions
- Noise
Agenda

- Benefits
- Sylvan Avenue
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Sylvan Ave - Background

Sylvan Ave Issues...

- Flat road
- Narrow road
- Narrow ROW
- Ponding
Sylvan Ave - Design

- Initial soil borings
- Deeper soil borings
- To infiltrate or not to infiltrate?

<table>
<thead>
<tr>
<th>Sample No./Type</th>
<th>Recovery (in.)</th>
<th>Depth (ft.)</th>
<th>Description of Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>SS-1</td>
<td>18</td>
<td>0-2</td>
<td>SILTY FINE TO MEDIUM SAND FILL - trace clay and gravel - loose - moist - brown - (SM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3-5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6-7</td>
<td>Note 1: 2.0&quot; Bituminous Concrete Pavement</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Note 2: 6.0&quot; SILTY FINE TO COARSE SAND AND GRAVEL FILL - moist - brown - (SM-GM Fill)</td>
</tr>
</tbody>
</table>

Ground Surface Elevation = Note 1
Note 2
SYLVAN AVENUE CROSS SECTION

1. INfiltration
2. EXisting SUBgrade
3. UNDERdRAIN & SUMP CONNECTION

PERMEABLE PAVEMENT
STONE STABILIZATION AND RESERVOIR LAYER
CURB AND GUTTER
SIDEWALK

EXISTING SUBGRADE
GEOTEXTILE FABRIC
FILTER SAND

RAINFALL
Sylvan Ave - Design

1. Filter Layer
   - Free draining sand
   - 6” Underdrain
   - Impermeable liner

2. Reservoir
   - 100 yr design storm
   - 18-24” thickness (35-40% voids)
   - Open graded stone
Sylvan Ave - Design

3. Pavement section & details
   - Permeable HMA
     - 3” thick
     - 50 gyratory mix design
     - 75-85% density; 15-25% porosity
     - AC 5.0-6.5%
     - Polymer Binder
   - Standard curb & gutter vs. spill-out
3. Pavement section & details

- Permeable HMA
  - 3” thick
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  - 75-85% density; 15-25% porosity
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- Standard curb & gutter vs. spill-out
Sylvan Ave - Construction

- Subgrade prep
Sylvan Ave - Construction

- Membrane & underdrains
Sylvan Ave - Construction

- Aggregate
Sylvan Ave - Construction

- Curb & gutter and sidewalk
Sylvan Ave - Construction
Sylvan Ave - Construction
Sylvan Ave - Construction

- Permeability Test ("bucket test")
Agenda

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Willard St. - Background

1. Different Challenges
   - Soils
   - Cross Slope
   - Traffic Volumes

2. Different Opportunities
   - Full Infiltration
   - Spill-Out Curbs
1. Stone Reservoir
   - Used different aggregate
   - Minimum 30% voids
   - Grid, but no liner

2. HMA mix
   - 4” thickness
Willard St. - Construction

06/23/2012
Willard St. - Construction

06/23/2012
Agenda

- Benefits
- Sylvan Avenue
- Willard Street
- Maintenance
- Analysis
- Alternatives
Maintenance - General

**Vacuum Road** - twice per year (Fall and Spring)

**Clogged Areas** - Power wash (<200 psi) with detergent, and vacuumed.
Maintenance - General

**Exposed Ground** - Seed and mulch

**Stock Piling Materials** - Not permitted

**Surface Sealing or Resurfacing** - Not permitted

**Patching (< 50 square feet)** - Standard patch

**Patching (> 50 square feet)** - Permeable pavement
Maintenance - Winter

**Plowing** – Plow every 2”+ storm with a slightly raised blade

**Salt** – Minimal salt permitted

**Sand** – Not permitted
Agenda

- Background
- Design
- Construction
- Maintenance
- Analysis
- Alternatives
Performance Analysis

- Evaluating Permeability over time
  - Custom designed device

- Two years of data now in hand
## Performance Analysis

<table>
<thead>
<tr>
<th>Street</th>
<th>Infiltration 2013</th>
<th>Infiltration 2014 before sweeping</th>
<th>Infiltration 2014 after sweeping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sylvan (2010)</td>
<td>0.25</td>
<td>1.00</td>
<td>0.42</td>
</tr>
<tr>
<td>Wells Alley (2011)</td>
<td>7.27</td>
<td>0.87</td>
<td>0.88</td>
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<tr>
<td>Willard (2012)</td>
<td>6.13</td>
<td>0.27</td>
<td>0.30</td>
</tr>
<tr>
<td>Fuller Lot</td>
<td>24.40</td>
<td>22.41</td>
<td></td>
</tr>
</tbody>
</table>
Alternatives

- Infiltration without permeable pavement?
  - Conventional HMA surface
  - Open graded stone reservoir
  - Storm inlets to connect
- Forest & Fourth Ave in 2013
Alternatives

- Infiltration without permeable pavement?
- Conventional HMA surface
- Open graded stone reservoir
- Storm inlets to connect Forest & Fourth Ave in 2013
Questions?

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