PRACTICAL PERMEABLE PAVEMENT

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Pierce County Planning & Public Works

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Washington State Municipal Stormwater Conference
Introductions

Veronica Sisseck, P.E. of Pierce County
Pavement Testing

SPRINKER RECREATION CENTER: PARKING LOT

139 ST E: FLOODING CUL-DE-SAC

86 AV E/128 ST E: SIDEWALK

122 ST E: SIDEWALK

184 ST E: SIDEWALK

184 ST E: ARTERIAL

176 ST E: SIDEWALK

5/17/2017 Practical Permeable Pavement
Objectives of Permeable Pavement
Reduce Impact to Offsite Features

• Surface Water Pollution
• Intercept or Filter Contaminants
• Concentrate Impact
Physical Access – Traversable Terrain

- Support Weight
- Slope
- Friction
- Obstructions
Regulations

• Municipal Stormwater Permit
• Stormwater Management Manual for Eastern/Western Washington (SWMMEW)/(SWMMWW)
• ADA, FAA/FHWA, AASHTO, OSHA, L&I, USDA, DNR, ACE, DOH, DOE
• Local
Feasibility and Design
For Western Washington (SWMMWW):
• Full Dispersion is not an option (BMP T5.30)
  – 65%+ of site can remain forest
• Does not meet infeasibility criteria (BMP T5.15)
• Does not have competing needs (V-5.3.1)
  – FAA for airports (not airfields/airstrips/landing pads)
  – ADA (sidewalk ramps)
  – Local zoning & environmentally sensitive areas
  – Public health and safety standards
Infeasibility - Climate

• Routine/heavy applications of sand for snow

Other Concerns:
• Cold: Frost Weathering, Brittle Pavement, Shrinkage, Chains/Studs
• Hot: Binder Bleeding, Evaporation

Mediation:
• None stated
Infeasibility - Groundwater

• Threaten existing utility, groundwater within 1’ of gravel base, possible subgrade erosion

Other Concerns:
• Utility buoyancy (upward pressure on pavement)

Mediation:
• Underdrain
Unstable fill, over impervious object, infiltration rate too high for treatment, saturated conductivity <0.3 in/hr, replacing existing impervious (compacted)

Mediation:
• Layer of sand filter
• Underdrain
Infeasibility - Slope

- Reasonable concerns about erosion/slope failure/down gradient flooding, high runoff velocity, >5% sloped asphalt, >10% sloped concrete

Other Concerns:
- Subsurface pollutant transport

Mediation:
- Impervious check dams
Infeasibility - Contaminants

• Down slope of erosion prone areas (sediment), soil/ground water contamination, groundwater pollution migration, prohibited in cleanup plan, <100’ of landfill, <100’ of drinking well, <10’ of sewage disposal drainfield, <10’ underground storage tank

Mediation:
• None stated
Infeasibility - Pollution Generation

• High use site, industrial activity, concentrated pollutant spills likely

Other Concerns:
• Contamination from traffic collisions

Mediation:
• None stated
Infeasibility - Adjacent Features

• Ground water drains into an erosion/landslide hazard area, impervious pavement, basement, bulkhead

Other Concerns:
• Shadows promote moss buildup
• Transition from crown to flat

Mediation:
• None stated
Infeasibility - Traffic Loading

• Pavement can not support heavy load (weight), saturated soil cannot support load (weight), projected >400 Average Daily Traffic (ADT)

Mediation:
• None stated
Infeasibility - Friction

• none

Concerns:
• Rock shed
  – Acceleration from stop/dry steering (turning)
  – Chained/studded (abrasive) tires
• Low use promotes moss buildup
• Low debris tolerance (sidewalk ramp)

Note: See “Competing Needs” (SWMMWW V-5.3.1)
Infeasibility - Access

• none

Concerns:
• Physical
• Safety
• Legal
• Privacy

Note: Required to inspect all regulated facilities
See “Competing Needs” (SWMMWW V-5.3.1)
Materials

Up to the municipality to define standards
Subgrade?
Filter layer?
Base material?
Wearing layer
• Compressive strength:
  – crushed aggregate > rounded
“Roads should still be designed with adequate drainage conveyance facilities as if the road surface was impermeable” – BMP T5.15
Installation

• See BMP T5.15
• Weather:
  – Cool enough for concrete
  – Warm enough, and close enough to asphalt plant
• Scheduling:
  – Qualified labor availability
**Inspection**

- **Frequency:**
  - Owned/Operated system: similar to traditional
  - Regulated Facilities: annual

- **Methods:**
  - BMP T5.15 details simple infiltration testing methods
Maintenance
Maintain Porosity

• Frequency: BMP T5.15
  – Recommended routine cleaning 1-2 times/year
  – Required cleaning when infiltration rate <10 in/hr
• Note:
  – No protocol established for when corrective maintenance does not achieve 10 in/hr
Porosity Maintenance Methods

- BROOM
- PRESSURE WASH
- SUCTION
- MECHANICAL SWEEPER
- POWER SWEEPER
- REGENERATIVE AIR SWEEPER
- MUNICIPAL CLEANING VEHICLE
- CYCLONE CY5000
- BUNYAN BIRD

5/17/2017 Practical Permeable Pavement
## Porosity Maintenance Testing

<table>
<thead>
<tr>
<th>Method</th>
<th>Infiltration Improvement</th>
<th>Efficiency Of Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regenerative Air Sweeper</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Power Sweeper</td>
<td>lowest</td>
<td>medium</td>
</tr>
<tr>
<td>Mechanical Sweeper</td>
<td>low</td>
<td>high</td>
</tr>
<tr>
<td>Pressure Wash</td>
<td>low-negative</td>
<td>low</td>
</tr>
<tr>
<td>Bunyan BIRD</td>
<td>high</td>
<td>lowest</td>
</tr>
<tr>
<td>Cyclone CY5000</td>
<td>low</td>
<td>medium</td>
</tr>
<tr>
<td>Municipal Cleaning Vehicle</td>
<td>high</td>
<td>medium</td>
</tr>
</tbody>
</table>
Municipal Cleaning Vehicle
“Ice build up on permeable pavement is reduced and the surface becomes free and clear more rapidly compared to conventional pavement. ...deicing and sand application may be reduced or eliminated...”

– BMP T5.15

PC Experience: Snow remains longer (no maintenance)
Snow & Ice Experience

Conventional Concrete (1’ collar)
Pervious Concrete
Conventional Asphalt
Pennsylvania Department of Environmental Protection (PDEP) suggestions:
• Monitor the permeable pavement in the winter
• Do not apply sand, cinders, or other abrasives
• Salts will infiltrate: consider organic deicers
• Place snowplow blades slightly higher than for conventional pavements. (1”)
Spill Response

• Methods:
  – Conventional systems allow for containment
  – Permeable systems may require a dig out following subsurface flow to low point
• Research opportunity: coagulant in road base

• Note:
  – A definition/threshold to define spill could reduce ambiguity
• BMP T5.15:
  “Small utility cuts can be repaired with conventional asphalt or concrete if small batches of permeable material are not available or are too expensive”
  — Definition needed:
    • Small
    • Available
    • Too expensive
• Greenroads Manual v1.5 PT-2:
  — Over 50 sf must be patched in-kind
Pothole Repair

• SWMMWW Table V-4.5.2 (22):
  – Fill with patching mixes
  – Definition needed:
    • Patching mixes
Crack Repair

• SWMMWW Table V-4.5.2 (22):
  – Small cracks: patch w/ patching mixes
  – Large Cracks: Cut out and replace
  – Use appropriate precautions to protect surrounding pavement
  – Definition needed:
    • Threshold between small and large
    • Appropriate precautions

3 years
Preservation
Wearing Surface

• Frequency:
  – Conventional pavement life span: 12-15 years
  – Raveling noted at 1 year in residential cul-de-sac

• Methods:
  – Conventional seal coat/overlay would eliminate porosity
  – No known option for porous

• Costs:
  – Not comparable, as no porous method established
Pavement Marking

• Frequency:
  – Not established

• Methods:
  – Conventional options include paint, thermoplastic, Raised Pavement Markers (RPMs)
  – Applications untested

• Costs:
  – Not comparable, as no porous method established
Long Range Planning
Additional Design Costs

• Assess feasibility
  – Consider mapping infeasible regions to save time in design and review
• Availability of equipment and qualified labor
• Contingency plan for stormwater overflow
• Establishment of access easements for inspections
## Budgeting - Installation Costs

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Pervious</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asphalt</td>
<td>+10-20%</td>
<td>PDEP, 2006</td>
</tr>
<tr>
<td>Bedding</td>
<td>Deeper</td>
<td>PDEP, 2006</td>
</tr>
<tr>
<td>Stormwater</td>
<td>Conventional + Underdrain</td>
<td></td>
</tr>
<tr>
<td>Labor</td>
<td>More labor, more skill</td>
<td>PDEP, 2006</td>
</tr>
<tr>
<td>Equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>Up to 150%</td>
<td>W &amp; C, 2007</td>
</tr>
</tbody>
</table>
Additional M&O/Preservation Costs

• Traffic control and road closures for cleaning
  – MCV travels 0.15 mph and must stop to refresh water and waste reservoirs
• Cost & Access to:
  – Cleaning equipment
  – Snow & Ice treatments
  – Small batches of material
  – Qualified labor
    • Consider training staff for in-house repairs
• Unknown design life, repair methods, spill containment, or long term porosity
### Rough Road Maintenance Budget

<table>
<thead>
<tr>
<th>Task</th>
<th>Conventional</th>
<th>Pervious</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspect</td>
<td>$109</td>
<td>$109</td>
</tr>
<tr>
<td>Clean</td>
<td>$1,850</td>
<td>$6,753</td>
</tr>
<tr>
<td>Incidental (snow/ice, spill*)</td>
<td>$575</td>
<td>$995</td>
</tr>
<tr>
<td>Preserve Pavement*</td>
<td>$3,646</td>
<td>$120,601</td>
</tr>
<tr>
<td>Preserve Storm*</td>
<td>$300</td>
<td>$369</td>
</tr>
<tr>
<td>Total</td>
<td>$6,480</td>
<td>$128,825</td>
</tr>
</tbody>
</table>

All costs average/lane mile for PC using 2016 quantities

*Assumed dig out as repair method
Funding Considerations

• Dedicated funds spent appropriately (road/street funds, stormwater fees)
• Impacts to stormwater fee revenue, if presently assessed by impervious surface area
• Grants may be available
Risk Considerations

- Groundwater contamination
- Increased groundwater elevation
- Flooding
- Boondoggle if not sustainable
- Improper maintenance

Accusations after the fact

—Consider defining maintenance by action, not result
Consider Combining Forces

• Combine/stagger contract timeframes if shortage of qualified contractors
• Rent or share equipment
  – PC offering agreements to clean using MCV
• Share lessons learned to reduce duplicated effort and repeated mistakes
Questions?
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