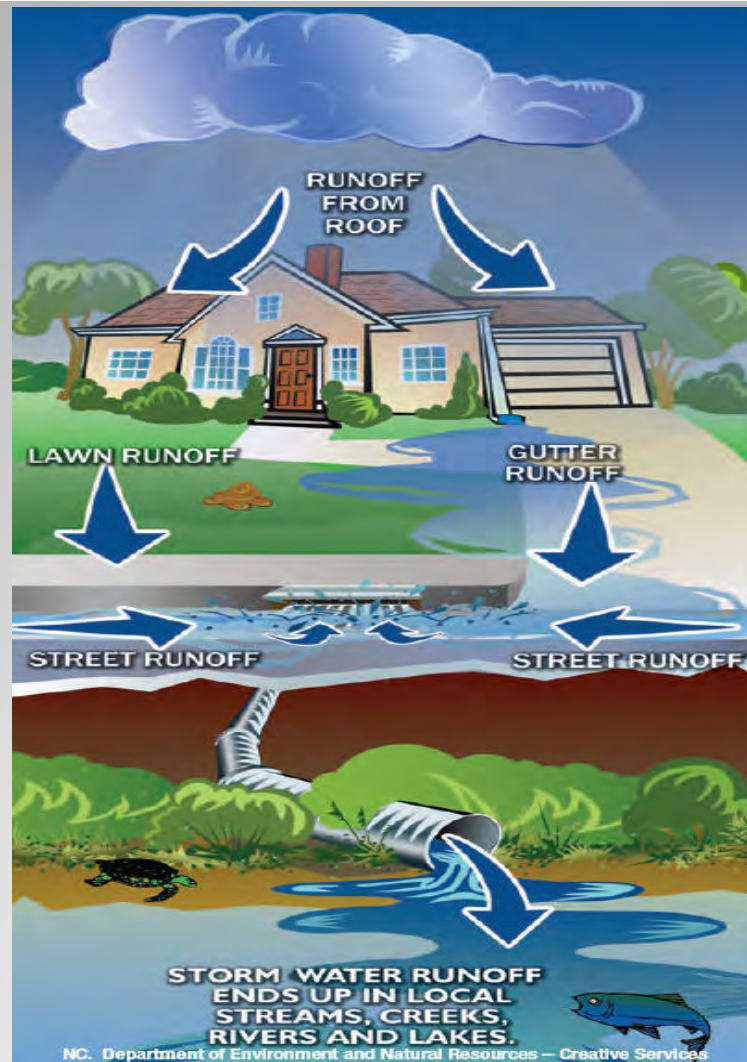


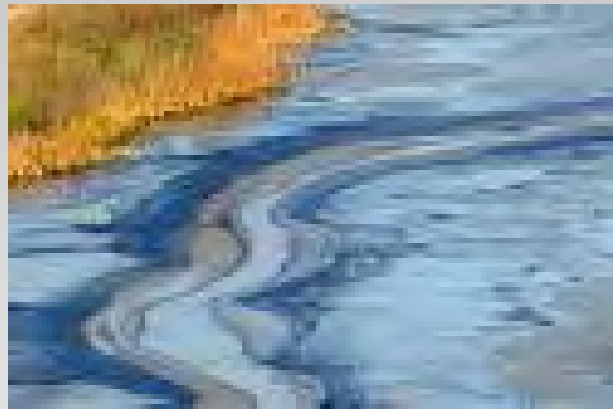
Pervious Pavements

Pervious Concrete / Porous Asphalt / Permeable Pavers
w/ a STRONG focus on Pervious Concrete

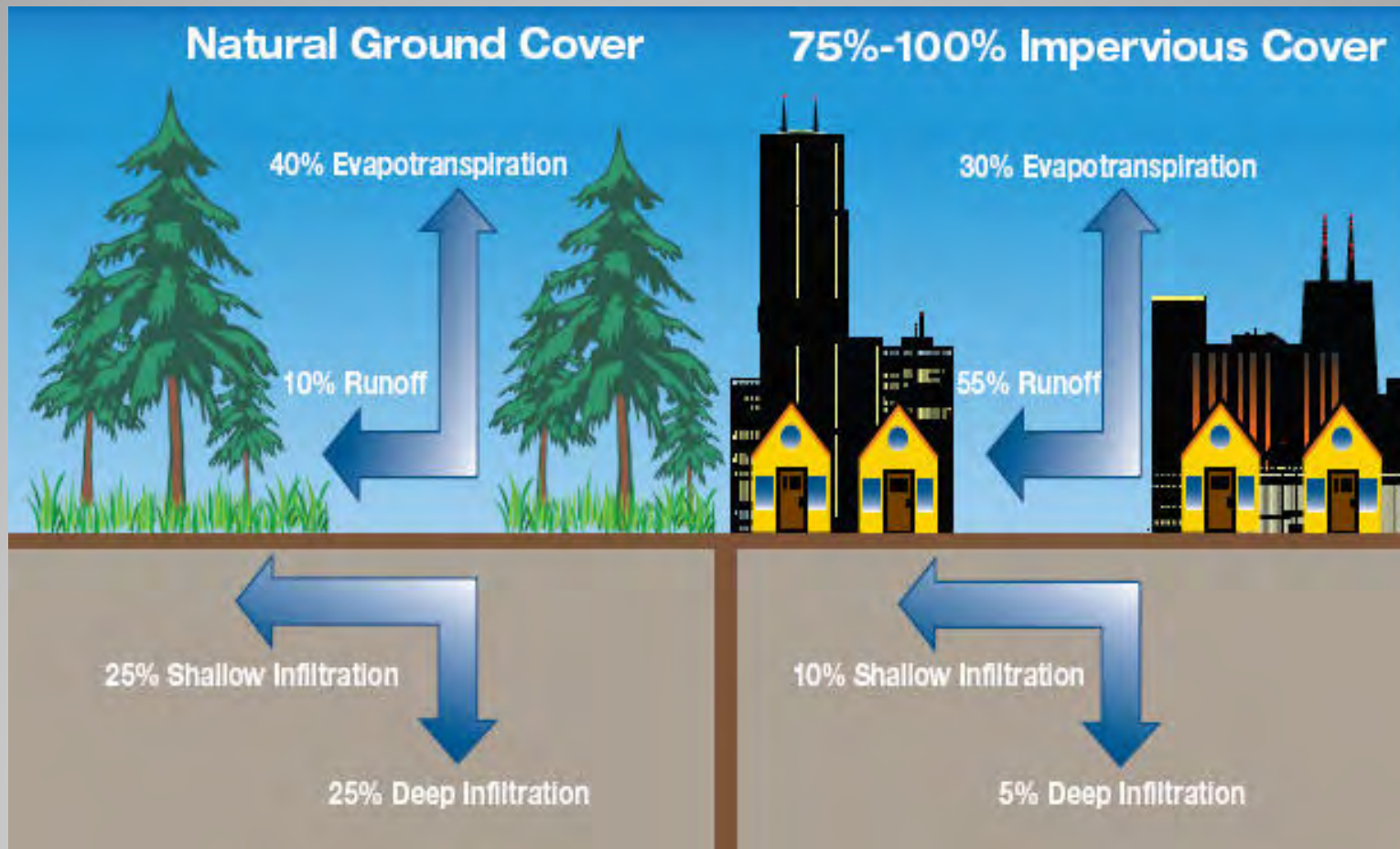
Ryan Marlinghaus
ryan@earthcareland.com
October 2011



Storm Water Runoff



Water Pollution



Infiltration

What we're going to cover:

- Benefits & overviews of pervious pavements
- Good overall pervious pavement design
- Proper pervious concrete design & installation
- Maintenance of pervious pavements
- Design possibilities of pervious concrete

Pervious Pavement Benefits:

- Meets US EPA BMP for stormwater control
- Mimics pre-development conditions
- Can reduce 'heat island effect'
- Can benefit trees & shrubs
- Filters pollutants
- Recharges groundwater

Pervious Pavement Design:

- Determine objectives
- Isolate run-off/'run-on'
- Design for slopes

Pervious Pavement Objectives:

- % water capture
- Sensitive habitat protection
- Satisfy stormwater requirements
- Save overall costs by maximizing developable land
- Groundwater recharge



Use coarse mulch only



Coarse mulch w/ french drain



Drain away from the pavement



Notch curbs for backup drainage



Isolate sediment runoff



Please avoid!



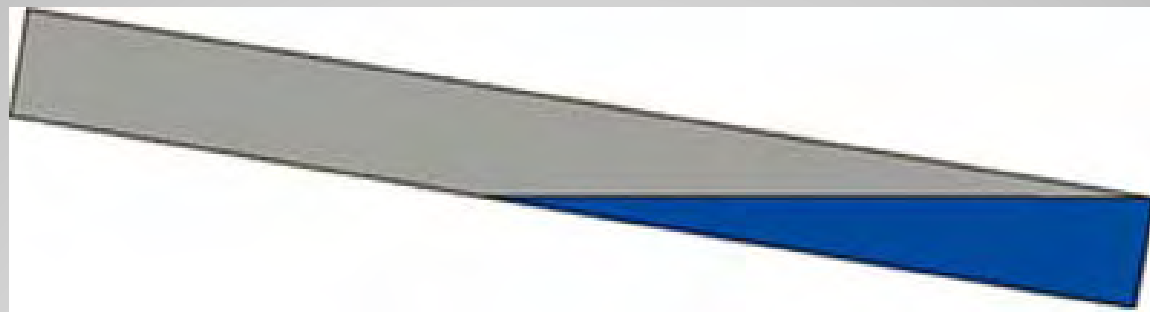
Please avoid!



Please avoid!



Please do!



Pavements slope

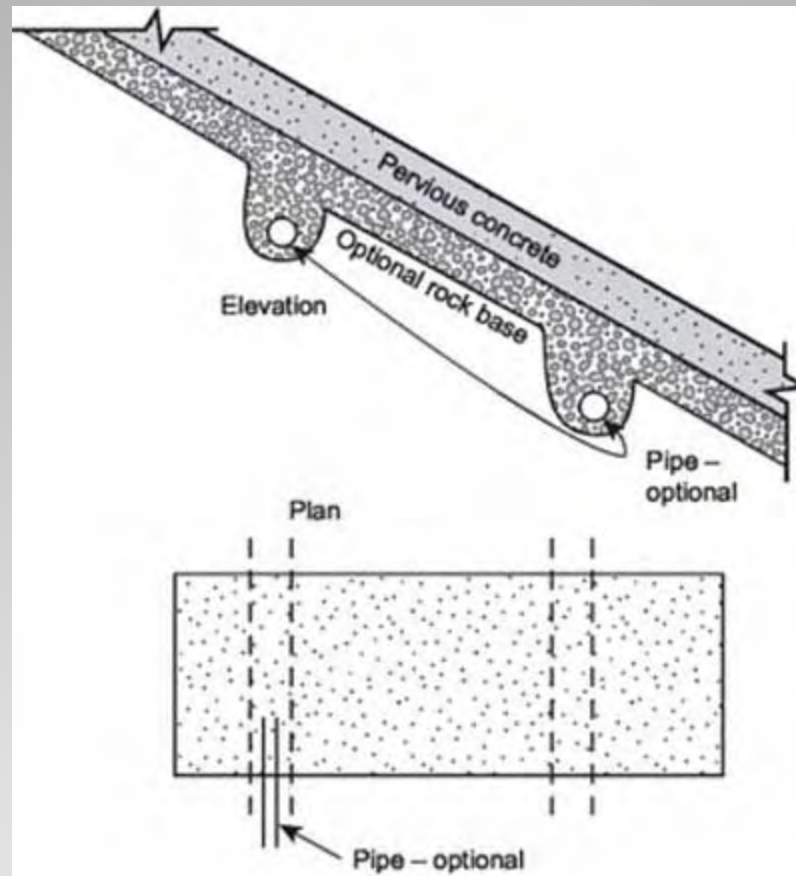


Figure 10. Elevation and plan view drawings of sloped installation.

Design for the slope

Some of the advantages & disadvantages of different types of pervious pavements...

Porous Asphalt Advantages:

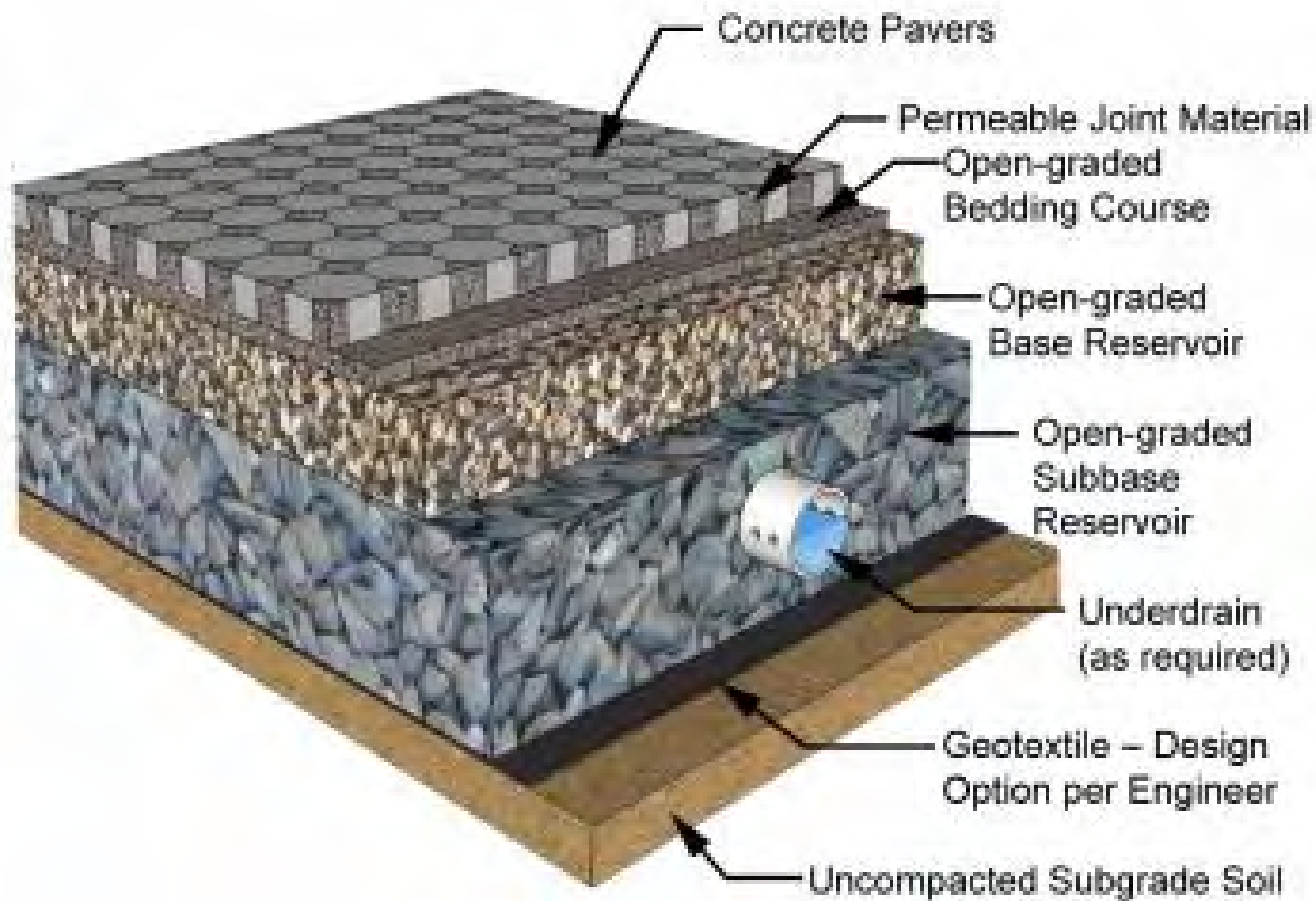
- Low cost

Permeable Pavers Advantages:

- Ease & success of installation
- Attractive, many design options

Permeable Pavers Disadvantages:

- High cost
- Maintenance issues



Permeable Paver specification

Pervious Concrete Advantages:

- Moderate cost
- Low maintenance
- Attractive & design potential

Pervious Concrete Disadvantages:

- Unsuccessful installers & suppliers

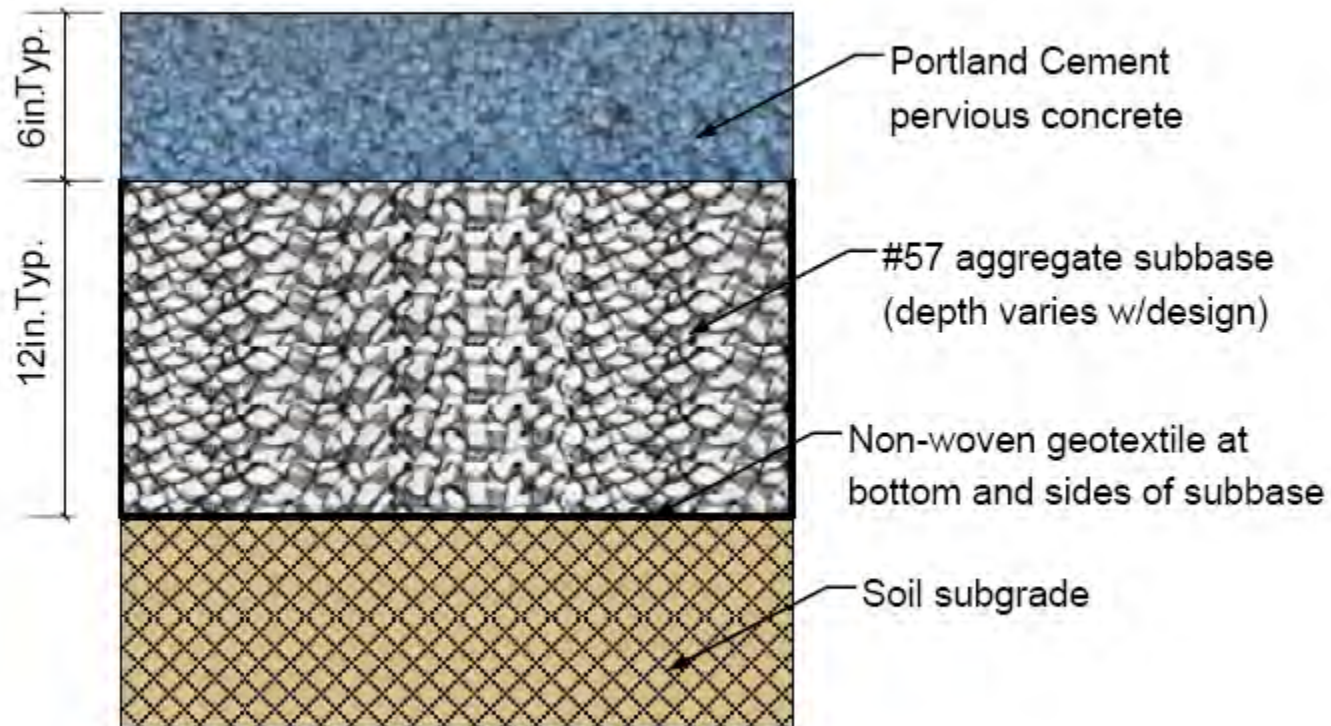


Concrete that water flows right through!

What is Pervious Concrete?

- Generally consists of rock (coarse aggregate), cement and water.
- Has about 20% voids so water flows right through it, up to about 600"/hr
- Poured on a bed of a gravel, often $\frac{3}{4}$ " crushed drain rock over a geotextile

Pervious Concrete Profile (Typ.)



Pervious Concrete Profile

Brief History of Pervious Concrete?

- First used in the 1850's.
- Used on the East Coast since the early 80's.
- First pervious concrete installed in CA in 2001
- Estimated 15 mil/sft per year will be installed in the US by 2013
- Chinese installed over 2 ½ million sft for 2008 Beijing Olympics

How Strong is Pervious Concrete?

- Typical compressive strengths range from 2000 to 3000 psi.
- Typical residential concrete compressive strengths range from 2500 to 4000 psi.
- 2500 psi turns out to be over 7-fold safety factor for firetrucks

* US Dept of Commerce NOAA grant

Where is Pervious Concrete Used?

- Sidewalks
- Parking lots
- Residential streets
- Driveways
- Fire truck lanes

Typical Pavement Sections:



4-5" Inches

Sidewalks
Bike Lanes



5-6" Inches

Car Parking
Driveways



8" Inches

Commercial
Local Streets

Pervious Concrete Benefits:

- Meets US EPA BMP for stormwater control
- Reduces 'heat island effect'
- Can benefit trees & shrubs
- Filters pollutants
- Recharges groundwater
- **Some Carbon Sequestration**

Design & Installation of Pervious Concrete...



All pervious concrete is not created equal



Are you wanting this?



Clearly specify or you might end up with this.

Proper mix design for pervious concrete:

- Starts with the aggregate
- Generally less cement & more water than has been suggested
- Know your admixes

Aggregate for pervious concrete:

- Should be clean, very little fines
- Know the void content
- Generally crushed rock is better than round

You cannot design a mix for pervious concrete without knowing the exact aggregate that is going into it!

Installing Pervious Concrete:

- Specify an installer w/experience
- And/or require the contractor to retain an experienced consultant for the duration of the project
- Require a test panel first



Pervious concrete being leveled & compacted w/ Bunyan Roller

Maintenance of Pervious Pavements:

- On average vacuum once or twice a year and pressure wash every 5 years
- Studies in 13 year + old pervious in Florida show even with no maintenance still acceptable percolation rates



Good idea to blow/sweep
regularly



Rotojet 5800 Turbo Nozzle

Design Possibilities of Pervious Concrete...



**Our first pervious job, standard
pervious concrete w/ integral
color installed 5/2005**



Up close of standard pervious
concrete

PrettyPervious... an improvement on standard pervious concrete

- More attractive
- Finer
- More color and design options
- More consistent



'PrettyPervious' Concrete

What is 'PrettyPervious'?

- Overlay for pervious concrete, applied 1/8" thick
- Very fine aggregate (like coarse sand), cement, admix, polymer, color and water.
- Pre-packaged dry in bag + jug of all necessary liquid & color
- Can be used to repair failed standard pervious concrete



PrettyPervious layer

Costs:

- Regular Concrete \$11.50/sft
- Regular Concrete w/color \$12.50/sft
- Standard Pervious Concrete \$12.00/sft
- Pervious Concrete w/color \$13.00/sft
- PrettyPervious Concrete \$14.00/sft
- 'Pervious' Pavers \$16to\$21/sft

* all costs include a minor amount of site prep



'PrettyPervious' many design options



'PrettyPervious' many design options



'PrettyPervious' many design options



'PrettyPervious' many design options



'PrettyPervious' many design options



'PrettyPervious' many design options



'PrettyPervious' in unique colors



'PrettyPervious' w/ solid concrete borders



Unlimited Color Options



Showing off the beautiful natural aggregate



Showing off the beautiful natural aggregate



PrettyPervious, from a child's art project to...



PrettyPervious, so many possibilities...

Evolution Paving Resources of Salem, Or...



Portland Street of Dreams



Splash Garden City of Salem



City of Beaverton Commuter Plaza



2 ½ acre school parking lot



City Street Longview, WA



Bike & pedestrian path Eugene, Or



Slipform paver

Cupertino, CA

Other Pervious Pavement...



Gold Fines washout & weeds



PrettyPervious between flagstone



Regular concrete that is pervious too!



China prepares for the Beijing Olympics

courtesy of Dave Mitchell of Bunyan Industries



**Over 2 1/2 million square feet of
beautiful pervious concrete**



Over 2 1/2 million square feet of
beautiful pervious concrete



Over 2 1/2 million square feet of
beautiful pervious concrete

Additional Resources

- www.ICPI.org for permeable pavers
- www.perviouspavement.org
- www.concretenetwork.com/pervious/
- 'Porous Pavements' Bruce K. Ferguson
- 'Sustainable Landscape Construction' Thompson & Sorvig