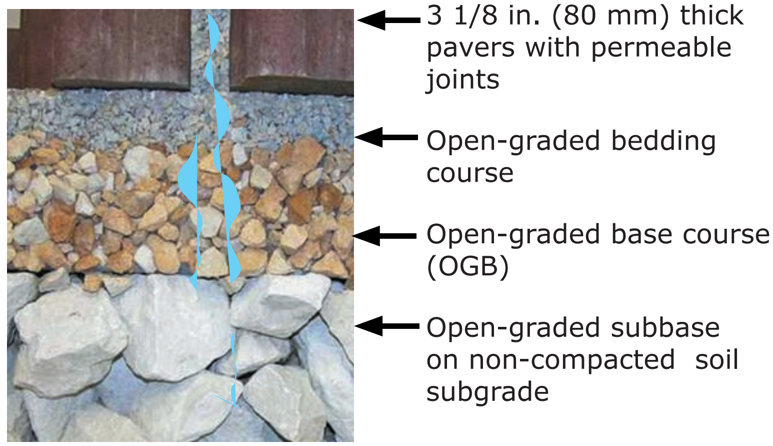
SCHOOLS AND UNIVERSITIES FACT SHEET

Stormwater Benefits

- Helps meet local, state, provincial stormwater drainage design criteria and provides compliance with the U.S. National Pollutant Discharge Elimination System (NPDES) regulations
- Outdoor demonstration lab for classes focussed on environment and energy
- Pilot projects offer research opportunities for faculty and students.
- LEED® point eligible for Sustainable Sites, Water Efficiency, Materials & Resources and/or Innovative Design; Earns Green Globe points
- Meets U.S. Environmental Protection Agency stormwater performance criteria as a structural best management practice (BMP) while providing parking, road and pedestrian surfaces
- No curing is required. The paver surface may be used when installed and may be designed to display an array of patterns.
- PICP typically reduces or eliminates the need for conventional stormwater management ponds.
- Snow plowed with typical removal equipment; reduced winter ice hazards, de-icing salt use and snow removal costs
- Reduces runoff temperatures thereby preserving aquatic habitats
- Infiltrates, filters and treats stormwater runoff from conventional impervious pavements and roofs



Permeable interlocking concrete pavement (PICP) with base and subbase for infiltration and storage

Meets sustainablity goals for campus master plans

Students can use an infiltrometer (shown above) to measure surface infiltration as class work.

PICP parking lot at University of Victoria, Vancouver, BC treats stormwater and visually unifies the building entryway.

Design Software Available

New software for permeable pavement incorporates research from a range of university studies available.

Contact ICPI for further information.

APPLICATION OPPORTUNITIES:

New construction parking spaces, low-speed roads, plazas , sidewalks, walkways, bikepaths, courtyards and parking lot retrofits

ICPI INTERLOCKING CONCRETE PAVEMENT INSTITUTE®

Attractive ***Educational*** ***Sustainable***

Application examples

School Campus

Driveway treats stormwater and reduces runoff at Brentwood School, Plainfield, IN.

Permeable Interlocking Concrete Pavement Meets Low Impact Development Goals

- Conserves on-site space: roads, parking, stormwater infiltration and detention/ retention all combined into the same space creates more green space or building opportunities
- Preserves wooded areas that would otherwise be cleared for stormwater detention or retention ponds
- Increases site infiltration that helps maintain pre-development runoff volumes, peak flows and times of concentration
- Promotes tree survival and growth
- Reduces urban heat island through evaporation and reflective, light colored pavers
- Highly visible, exemplary demonstration for public and property owners on a cornerstone LID technique

Permeable joint material consisting of small aggregates allows infiltration of stormwater.

Permeable Interlocking Concrete Pavement: A Low Impact Development Tool

PICP supports LID Principles

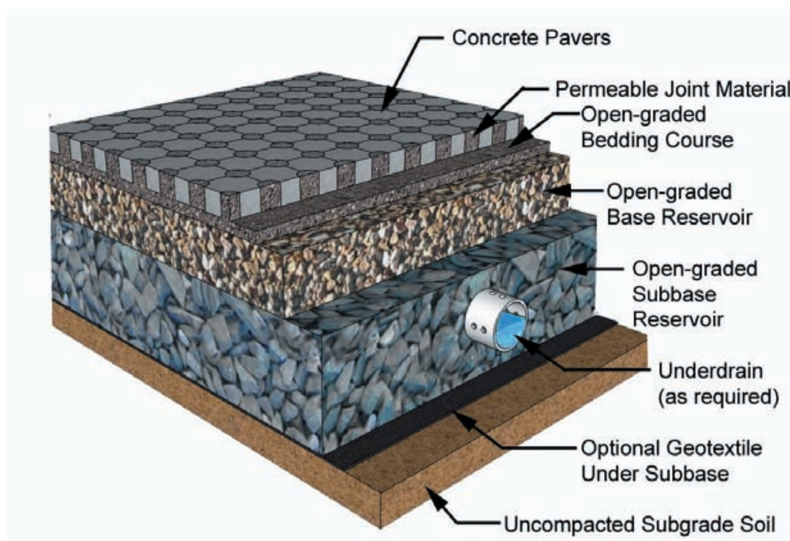
1. Conserve vital ecological and natural resources: trees, streams, wetlands and drainage courses

2. Minimize hydrologic impacts by reducing imperviousness, conserving natural drainage courses, reducing clearing, grading and pipes

3. Maintain pre-development time of concentration for runoff by routing flows to maintain travel times and discharge control

4. Provide runoff storage and infiltration uniformly throughout the landscape with small, on-site decentralized infiltration, detention and retention practices such as permeable pavement, bioretention, rain gardens, open swales and roof gardens

5. Educate the public and property owners on runoff and pollution prevention measures and benefits



Typical PICP cross section

PICP lot eliminates need for detention basin at Dominican University, Chicago.

University Campus - an instructional opportunity

Integrate Permeable Pavement into the Curriculum!

PICP makes a useful instructional tool for engineering, architecture, landscape architecture and construction students. The outdoor classroom provides a demonstration site to monitor performance and maintenance aspects and can have a lasting impact on students as they move into their careers.

PICP under bleachers at the U.S. Naval Academy in Annapolis, MD provides structural support and on-site infiltration.

Base construction uses locally available materials.

Pavers are delivered ready to place, joints filled, compacted and ready for traffic.

Mechanical installation equipment accelerates construction; typical 5,000 sf (500 m^2)/ machine/day.

After placement, joints and/or openings filled with small aggregate and pavers are compacted.

Multiple permeable pavement materials monitored by university students in Kinston, NC.

PICP functions as a retention pond and parking lot at the Elmhurst College, LEED® project in Elmhurst, IL, part of an LID sustainable site.

ICPI Civil Engineering University Curriculum Available (www.icpi.org/university/)

Instructional Modules include:

* Module 1: Introduction
* Module 2: Materials and Standards
* Module 3: Road Design
* Module 4: Construction Methods
* Module 5: Maintenance and Management
* Module 6: Life-Cycle Cost Analysis
* Module 7: Airport Pavement Design
* Module 8: Port and Industrial Pavement
* **Module 9: Permeable Pavement Design**

Performance

Peak Flow Reduction

- Permeable pavers can reduce the peak flow by as much as 100%, bringing runoff volumes nearer to pre-development levels. (Bean, Eban Z., William F. Hunt, David A. Bidelspach, "Evaluation of Four Permeable Pavement Sites in Eastern North Carolina for Runoff Reduction and Water Quality Impacts, *Journal of Irrigation and Drainage Engineering* 133 no. 6 (2007): 583-592).

- Reduced peak flows can relieve campus storm sewers and distressed streams. Increased flows (volume per time) of stormwater runoff, as a result of impermeable surfaces, cause stream channel erosion and loss of aquatic habitat.

Volume Reduction

- PICP reduces runoff for ALL rainstorms.

- May be designed to store **and slowly release** runoff from larger storms thereby reducing flooding potential.

Additional Benefits

- Cooler than conventional pavements

- ADA compliant

- Concrete pavers available in various shapes and colors from local ICPI members; colored pavers mark lanes and parking spaces.

- Simplified surface and subsurface repairs by reinstating the same paving units; no ugly patches or weakened pavement from utility cuts

Hydrologic Characteristic	Asphalt	PICP	Bioretention Swale
Total Flow Volume (m^3)	*37.0*	*33.5*	*16.7*
Avg. Peak Flow (L/s)	*2.2*	*0.05*	*0.40*
Avg. Flow Duration (hrs)	*2.0*	*73.50*	*0.04*
Avg. Rainfall-runoff Lag (hrs)	*Negligible*	*5.5*	*2.5*

Hydrologic performance for 12 rainfall events in 2006: Asphalt compared to LID tools PICP and a bioswale adjacent to an asphalt lot at Seneca College, Ontario by the Toronto & Region Conservation Authority (www.trca.on.ca)

FAQs

Can PICP be used on clay soils? *Yes. Even in clay soils, PICP reduces runoff and helps to capture"first flush" runoff and reduce pollution.*

Can PICP be combined with other LID tools? *Yes. University studies have demonstrated a treatment train that starts with PICP in the parking lot and continues with the outlet from the PICP feeding an adjacent bioretention cell or grassy swale.*

Is Maintaining PICP difficult? *No. PICP can be maintained through street sweeping and vacuuming based on periodic inspections. Fewer deicing salts are needed in the winter and small aggregate is used to enhance traction rather than sand.*

References

Collins, K.A., Hunt, W.F., Hathaway, J.M. *Hydrologic and Water Quality Comparison of Four Different Types of Permeable Pavement and Standard Asphalt in Eastern North Carolina.* ICPI.*2007*.

Ferguson, B. K. *Porous Pavements*. Boca Raton, FL:CRC Press,2005.

Smith, David R. *Permeable Interlocking Concrete Pavements*: *Selection • Design • Construction • Maintenance*. Washington,DC:ICPI 3rd ed., 2006. www.icpi.org.

For more information pertaining to permeable interlocking concrete pavement, please visit the Interlocking Concrete Pavement Institute (**icpi.org**) or the Low Impact Development Center. (**lowimpactdevelopment.org**)

13291 Park Center Road
Suite 270
Herndon, VA 20171
Tel: 703-657-6900
Fax:703-657-6901
Email: icpi@icpi.org
Web: www.icpi.org

561 Brant Street
P.O. Box 85040
Burlington, Ontario, Canada
L7R 4K2