# Permeable Interlocking Concrete Pavement (PICP) Performance in a Cold Climate

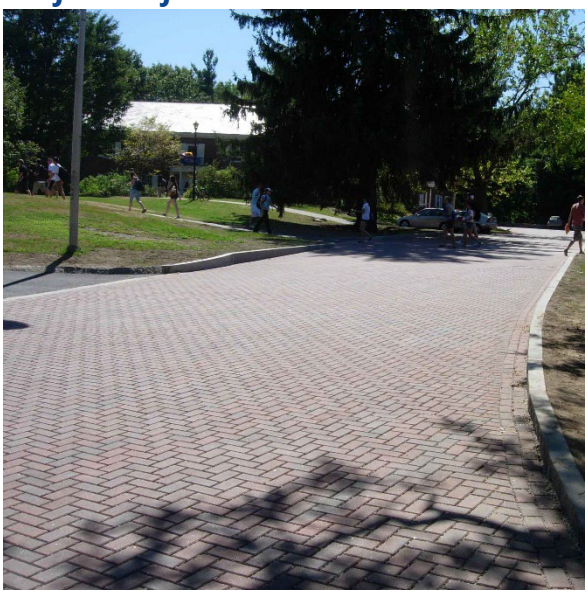
**Recipient: University of New Hampshire Stormwater Center (UNHSC)**
**Grant: $110,704*  PI: Robert Roseen, PhD, P.E.**
**Completion: 2013**
**Project Summary: 3**

icpi
Foundation for Education and Research

## Background and Need

The purpose of this study was to evaluate cold climate functionality of PICP in an institutional setting. This was in response to resistance from stormwater agencies and engineers using PICP in such climates due to risks of heaving, freeze-thaw damage, slowed or blocked surface infiltration, plus perceived maintenance and snow removal difficulties. The research project also provided a demonstration site for educational sessions hosted by the UNHSC. These were attended by local stormwater agency personnel and designers.

## Project Objectives



UNHSC completed a two-year field verification study of PICP located in on its campus in Durham, NH. The 13,500 sf area called Hood House Drive and adjoining small parking lot at one end were converted from an asphalt pavement to PICP in the summer of 2010. The pre-existing condition included no stormwater control measures and directed surface runoff into the municipal storm sewer. The PICP was designed by Appledore Engineering, Inc. with assistance from UNHSC and ICPI. An ICPI recommended PICP profile was used for the study site for the drive and a modified section with reservoir was used in the parking area. The PICP receives rainfall plus run-on from three pedestrian walkways and Memorial Union Building Drive. The PICP and the surrounding grassed landscaping are separated by granite curbing. Rainfall is designed to enter the PICP system, be stored and infiltrate into the soil subgrade. Excess stormwater drains through underdrains which discharge into the municipal storm sewer system. Pollutant loading for the pre-existing asphalt pavement was estimated by monitoring runoff from an adjacent parking lot at Thompson Hall, similar in size, use, and location.

Project objectives included:

1) Water Quantity and Water Quality Monitoring
2) Surface Infiltration Testing
3) Thermal Performance and Comparisons
4) Educational Outreach

Assessment of eleven water quality parameters comparing the PICP lot and the adjacent reference asphalt lot was used to evaluate performance. All analyses and procedures comply with the Technology Acceptance and Reciprocity Partnership (TARP), and the Technology Acceptance

Protocol – Ecology (TAPE), protocols used to evaluate performance of stormwater management practices.

## Outcomes

Monitoring included 26 storms and 18 water sampling events. Due to high infiltration subgrade soils, volume reduction and pollutant load reductions were exceptional. Local infiltration measurements were consistent with rates of an HSG-B sandy loam soil at 3 in./hr. Volume reduction and subsequently pollutant mass removal exceeded 95% for all pollutants including sediment (total suspended solids and suspended sediment concentrations), metals (total zinc), petroleum hydrocarbons, and nutrients (total phosphorous, ortho-phosphorous, total nitrogen, total Kjeldahl nitrogen plus nitrate, nitrite and ammonia nitrogen forms). Reductions in effluent concentrations were not observed for these same pollutants. This was presumably due to exceptional volume reduction. Effluent volumes in any single event never exceeded 5 gallons and peak flows were all less than 1 gallon per minute (with one exception).

Surface infiltration testing showed a substantial decline in areas subjected to run-on. Infiltration rates declined 69% over 21 months yet still retained greater than 1,000 inches per hour capacity. Minimal maintenance was performed during the monitoring period. Impacts from run-on underscore the importance of designs minimizing it. The PICP was cleaned regularly with a regenerative air vacuum truck. Three thermal analyses were conducted comparing four pavement surface types. The PICP surface temperatures were lower than porous asphalt, pervious concrete, and standard asphalt. The research demonstrated PICP volume and pollutant reductions as well as durability in a cold climate. The final report is found here.

Education sessions were conducted during 2011 and 2012 as three permeable pavement design workshops. A full-day ICPI training was performed in collaboration with ICPI technical staff. Training included a field visit to the PICP site, as well as pervious concrete and porous asphalt sites on campus and nearby. Participants learned key design principles necessary to successfully design, evaluate, specify, and install permeable pavements for stormwater management.

As a footnote, the parking lot end of Hood House Drive was demolished in 2016 to make space available for expansion of an adjacent administrative building called Hamilton Hall. Being segmental, the PICP area was reduced and reinstated in 2017 to accommodate the building expansion.

*Donations included ICPI member-donated paving materials (~$14,000) and construction funds ($31,245). UNH committed about $80,000 to demolish the existing asphalt pavement, excavate, install underdrains plus supply and install open-graded aggregate subbase and base, as well as provide new granite curbs.