On- & Off-site Benefits of Permeable Interlocking Concrete Pavements

Recipient: Applied Research Associates, Inc.
Grant: $85,955
Completion: 2019
Project Summary: 20

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Foundation for Education and Research

Background and Need

Permeable interlocking concrete pavements (PICP) provide a dual function: stormwater management (reduction of pollutants and volumes) and pavement structure to support traffic. This dual role results in higher costs than conventional impervious pavements. However, there are significant benefits accompanying PICP use that can justify higher initial and lifetime costs.

Objectives

This project answered the question on what site aspects position PICP benefits to where they overcome costs, especially when analyzed using life cycle costs analysis tools. The project monetized PICP on- and off-site benefits and placed them in an Excel tool for calculating LCCAs. The following tables list the on- and off-site aspects, PICP benefits, and the extent to which they were quantified for this study. Those with medium or high feasibility on quantifying costs (initial and maintenance) were included in the Excel LCCA tool.

On/Off-site Aspects	Benefits	Quantifiable	Feasibility Ranking
Freshwater & Estuary Ecosystems	• Pollutant reductions can protect/repair • Maintain fishing & recreation opportunities	Difficult	Low
Reduce or eliminated detention ponds	• Land costs & area consumed by ponds	Yes	High
Flooding/Property Damage	• Reducing damage, cost, insurance, inconvenience	Difficult	Medium
Stormwater Management Costs (Regulatory compliance)	• Reduce compliance costs	Difficult	Medium
Erosion Control	• Prevent drainage system damage from soil erosion	Difficult	Low
Multiuse System	• Dual use of land: parking lot & runoff storage/infiltration	Yes	High
Rainwater Harvesting	• Reduced cost of tap water for municipal, commercial, or domestic irrigation • Gray water building use	Yes	Medium
Impervious Cover Fees	• Reduce stormwater fees where credits are offered	Yes	Medium
Pollutant Removal	• Assign treatment costs for pollutant reduction/ removal of TSS, total phosphorus, total nitrogen, metals, and/or oils.	Yes	High
Combined Sewer Overflows	• Reduced cost of waste treatment plant processing	Yes	High

On/Off-site Aspects	Benefits	Quantifiable	Feasibility Ranking
Urban Tree/Forest Canopy	• Reduce watering costs • Potentially longer tree life • Improved air quality, urban micro-climate, property values, & urban character	Yes Difficult Difficult	Low
Drinking Water Quantity/Quality	• Quantity: Aquifer recharge • Quality: Prevent pollution	Yes	Low to High
Winter Maintenance	• Reduce de-icer use; reduce injury	Yes	High
Utility Cut Restoration	• Reduce costs • Increase service life	Yes	High
Roadway Paint Marking	• No repainting costs	Yes	High
Traffic Calming	• Reduce costs • Increase driver and/or pedestrian safety	Yes	High
Urban Climate & Heat Island	• Reduce micro-climate temps via high reflectance & evaporative cooling	Difficult	Low

Outcomes

The first step was developing an LCCA Excel tool that compares beneficial costs of PICP to interlocking concrete, asphalt, and concrete pavements. The study provided pro forma costs for all PICP benefits noted above and placed them into a 50-year LCCA analysis period to characterize maintenance intervals and costs. Among all of the above benefits and related costs, the most influential factors justifying PICPs use on the basis of lower initial and life cycle costs compared to conventional pavements are (1) land not used for detention facilities and (2) reduced of combined sewer overflows and related expenses to process combined stormwater and sanitary sewage at waste treatment plants. These two factors provided the highest benefits compared to all other benefits and related costs.

These conclusions validate and rationalized PICP use that reduces or eliminate detention facilities, especially when land costs are high, as well as reducing costs by mitigating and treating combined sewer overflows. The study report is accompanied by an Excel LCCA program which can be accessed here. This can be downloaded and modified by users to specific PICP project conditions when PICP benefits (see above table) and related costs are weighed against those from conventional pavements and drainage systems. Besides these deliverables, a webinar was provided on the report and Excel tool with an example LCCA case study demonstrating PICP benefits compared to conventional impervious pavements. The one-hour webinar is available on the CMHA learning management system.

The final report on the PICP Life-Cycle Cost Analysis Tools is available online.