

# Technical Guide 3-B

Permeable Interlocking Concrete Paver System for  
Effective Storm Water Management



## Best Management Practice with Concrete Permeable Paver Systems

County Materials produces cost-effective and environmentally-conscious permeable concrete pavers for residential, commercial and municipal storm water management. Permeable interlocking concrete paver systems are designed to allow storm water to effectively percolate into the ground. This reduces the risk and severity of flooding, eliminates surface puddling, and can even reduce the snow and ice removal by speeding up the melting process.

Permeable interlocking concrete pavements are widely recognized by federal and state stormwater and transportation agencies as a Best Management Practice (BMP) and Low Impact Development (LID) tool to reduce runoff and water pollution. They offer an effective solution for reducing total suspended solids (TSS) levels in storm water to help municipalities meet EPA-mandated standards. Often, permeable pavers are also the preferred best management practice where space is at a premium.

Many municipalities now offer tax incentives and utility fee reductions when permeable pavers are installed.

## SpecWizard for Permeable Concrete Paver Systems

Use County Materials' Unit Paver SpecWizard to automatically create a complete and accurate CSI 3-part formatted specification in just minutes for Permeable Interlocking Concrete Paver Systems.

<http://www.arcat.com/specwizard/clients/countyma.html>



## Advantages of Installing Permeable Interlocking Concrete Paver Systems

**Sustainability** - Permeable concrete pavers deserve special mention as a sustainable construction material. These concrete pavers are specially installed to filter storm water runoff through the paver joints to base and sub-grade layers that act as natural filters by capturing many harmful pollutants. This allows precipitation to seep into the ground naturally or be retained in an underground reservoir structure to be reused. Additionally, permeable pavers can help to reduce the heat island effect because they are manufactured in lighter colors, offer a higher solar reflective index (SRI), and help to cool the surrounding air. Some projects may also earn credits and qualify for LEED certification.

**Stormwater management** - Runoff from paved surfaces can cause serious environmental damage such as erosion and silt build-up in rivers, lakes and streams. Permeable paver systems

reduce impervious surfaces and allow rain and snowmelt to infiltrate on site, which helps to reduce the volume of runoff or eliminate runoff problems. Permeable paving eliminates surface puddles and local flooding, and is typically required in many waterfront applications to protect fragile shorelines and improve water quality.

**Groundwater recharge** - With permeable pavers, a higher percentage of rain and snowmelt percolates naturally down through layers of aggregates to replenish the water table. This helps maintain natural hydrologic conditions on site that existed before development was constructed.

**Pollution control** - The aggregate base and subbase system acts as a built-in filtration device. This allows permeable paver systems to trap up to 80% or greater of total suspended solids (TSS), including oil and other pollutants in runoff rather than allowing them to wash into the local watershed where they can harm fish and other wildlife. The U.S. Environmental Protection Agency (EPA) recognizes permeable paver systems as an effective solution and best management practice for storm water, and as a low impact development (LID) practice.

**Aesthetics** - Permeable pavers provide an appealing alternative to conventional storm water management systems. Typical detention and retention ponds are proving to be ineffective, they take up viable building space, disturb the ecosystem, create unsightly areas, and pose safety and health hazards because of standing water. As a low impact system, permeable pavers actually enhance and even support the urban landscape.

**Tax incentives** - Local governments may offer tax incentives, utility fee reductions, expedited permitting or approval for demonstration projects to encourage use of permeable pavers as a sustainable best management practice.

**Lower lifecycle costs** - Permeable pavers provide economic benefits to municipalities because they reduce peak flow (discharge to sewer systems is spread out over longer periods); additionally they reduce wastewater treatment costs and the need for costly retention and detention systems. Permeable paver systems require less de-icing materials than conventional pavement systems. Regular cleaning can easily be done with a vacuum to ensure effective surface infiltration rates.



# Meeting Industry Standards

County Materials provides general construction guidelines to design professionals and installers of interlocking concrete pavers and concrete slabs. For additional installation information, reference the Interlocking Concrete Pavement Institute’s (ICPI) Tech Spec Technical Bulletins.

All interlocking concrete pavers and slabs manufactured by County Materials are manufactured in general accordance with industry guidelines.

## Pavers

Characteristics	ASTM C936
Compressive strength	8000 psi at 28 days
Durability to freeze thaw cycles	Total mass loss after 50 cycles, no greater than 1%
Water absorption	Lower than 5%
Dimension tolerance	± 3 mm (1/8") Height ± 1.58 mm (1/16") Length and width

## Slabs

Characteristics	ASTM C1782 & C140
Flexural Strength	725 psi (min.)
Freeze-thaw durability with use of de-icing salt	Loss of 225g/m <sup>2</sup> max. at 28 cycles Loss of 500g/m <sup>2</sup> max. at 49 cycles
Water absorption	6% (max.)
Dimension tolerance	± 3 mm (1/8") Height ± 2 mm (5/64") Length and width
Warpage	± 3 mm (1/8")



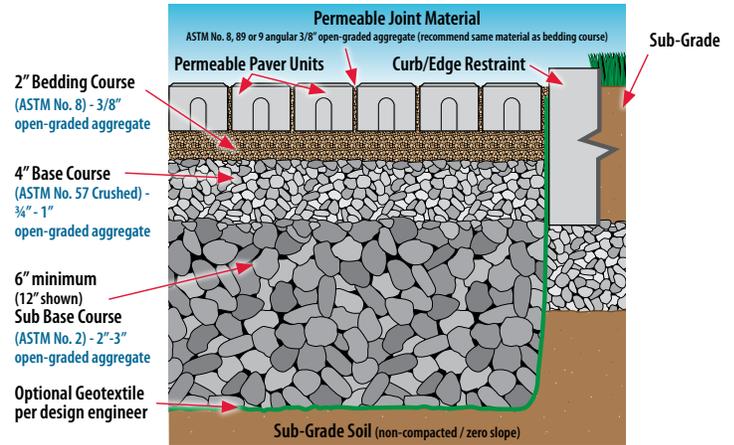
- Permeable Interlocking Concrete Paver Applications:**
- Driveways
  - Patios
  - Heavy vehicular travel areas
  - Residential streets
  - Parking lots
  - Sidewalks
  - Office plazas
  - Traffic calming features
  - Tree planting areas
  - Subdivision roads
  - Outdoor seating areas
  - Courtyards
  - Parking bays or lanes
  - Redevelopment sites
  - Public spaces
  - Parks
  - Commercial parking lots

# Installation Guidelines

## Full Exfiltration Cross Section

Allows storage and infiltration. This is a common cross-section installation over highly infiltratable soils such as clean sands and gravel mixtures. By design, all water seeps directly into the soil; a subbase drainage pipe system is not required.

Overflows are directed to swales, bioretention areas or storm sewer inlets.

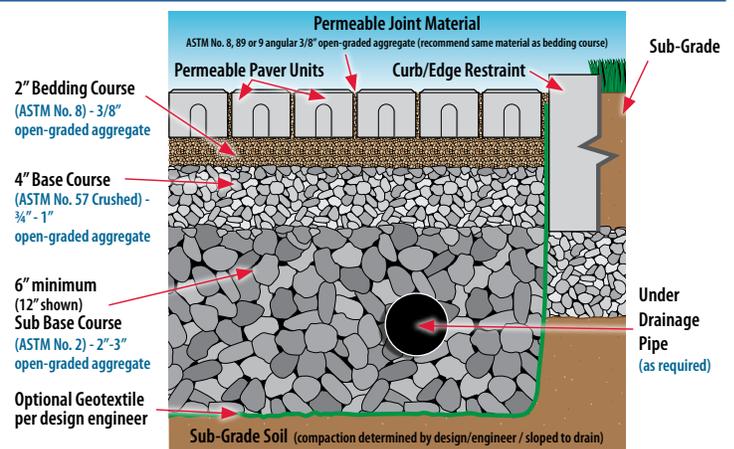


Full Exfiltration

## Partial Exfiltration Cross Section

Water does not infiltrate fully. A perforated pipe system in the subbase is required to allow the residual water to be evacuated to the storm water conveyance network.

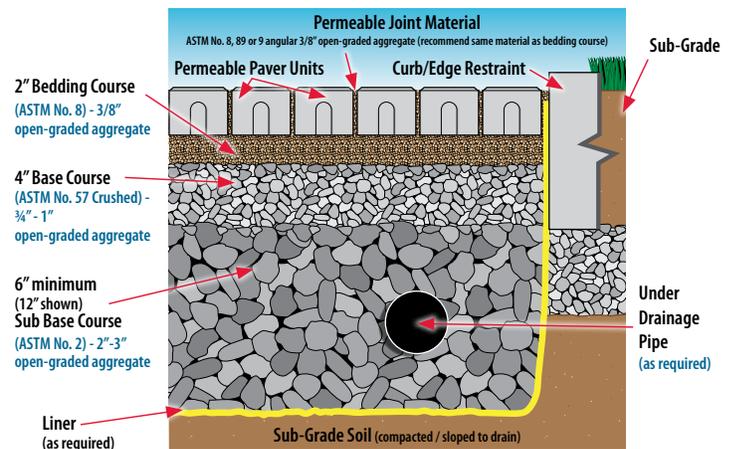
Sub-grade soil preparation, including compaction, is part of the design/engineer's decision and should be executed according to the project specifications. If it is specified not to compact the subgrade, the initial undisturbed soil infiltration should be carefully maintained during excavation and construction; this will enable the base to drain as designed.



Partial Exfiltration

## No Exfiltration Cross Section

Recommended when soil infiltration capacity is too low or the water table is too high. Water is discharged through a system of pipes and a flow restrictor to control the entry of water into the municipal network. The system essentially acts as an underground reservoir.



No Exfiltration

County Materials provides general construction guidelines to design professionals and installers of permeable interlocking concrete pavers systems. For additional installation information, reference the Interlocking Concrete Pavement Institute's (ICPI) Tech Spec Technical Bulletins: (<https://www.icpi.org/countymaterials>)

### Cross Section Notes:

Geotextile fabrics may be required in some applications. Consult a civil or geotechnical (soil) engineer for recommendations.

Special design considerations should be considered for each application before starting, including but not limited to, traffic, drainage issues, climate, environmental conditions and functionality. A qualified engineer must perform a final design because site conditions and specific design parameters may vary.

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# Installation Guidelines for Permeable Interlocking Concrete Pavers

## 1 Excavation

Excavate to the desired depth, based on the Engineer's analysis of the soil.

## 2 Curb

It is recommended to provide a concrete curb and/or a concrete curb and gutter for edge support around concrete permeable pavers.

## 3 Subbase and Base Materials

For the subbase, place the ASTM-33 #2 aggregate to a thickness not less than 6"; the thickness must be calculated by the engineer to allow storage of water based on the subsoil infiltration. State/Local regulations may have minimum requirements. Next, for the base place the ASTM-33 #57 aggregate to a 4" thickness and compact the aggregate.

## 4 Compaction

A buffer between the plate compactor and the paver surface is recommended to prevent scuffing. Refer to County Materials' Interlocking Concrete Paver or Slab Installation Guidelines, or contact County Materials for information. Vibrate in 4" lifts using a plate compactor or roller compactor for large areas to 98% Proctor Density.

## 5 Bedding Course

Once the subbase and base layers are compacted, the surface should be topped with a minimum 2" thick layer of ASTM-33 #8 aggregate for the bedding course that is screeded and leveled.

## 6 Paver Installation

The concrete pavers should be placed immediately after the ASTM-33 #8 stone bedding course is placed and screeded. Install the pavers manually or with mechanical installation equipment. With mechanical installation, an installer is able to set between 10,000 – 13,800 sq. ft. per day with 1 operator.

## 7 Deflectometer

Calculate stiffness-related parameters of an aggregate pavement structure

## 8 Filling Paver Joints

Once all pavers are installed, disperse ASTM-33 #8, 9 or 89 open graded aggregate over the surface. This aggregate can be the same material used in the bedding course (ASTM-33 #8).

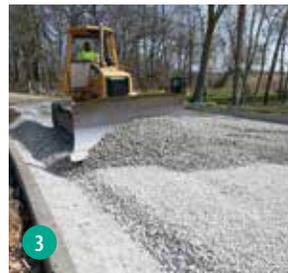
## 9 Clean Surface

Top up joints with joint material as needed and sweep the surface clean.

## 10 Final Compaction

After sweeping off excess stones from the surface, compact pavers into the bedding course with several passes of a plate compactor that has a buffer attached to prevent scuffing.

Additional stone may be placed in the joints as needed, and the surface swept clean.



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# Frequently Asked Questions

**Q: What infiltration rates can be achieved with permeable pavers?**

A: Several factors affect storm infiltration rates and water management, including the amount of water draining onto permeable pavers, the depth (and storage capacity) of the system, the base materials, the infiltration rate of the soil under an open-graded base, and the presence of drain pipes within an open-graded base.

The Interlocking Concrete Pavement Institute (ICPI) offers the following for determining infiltration rates. NRCS Curve Numbers (CN) and Rational Method runoff coefficients ('C' value) used depend on the soil infiltration rate, base storage and design storm. In every case, permeable pavers yield significantly lower CN and C values than impervious pavements.

Curve Number and Rational Method Runoff Coefficients			
Land Cover	Infiltration Rates in./hr (mm/hr)	Curve Number CN	Runoff Coefficient C
Permeable	Up to 50 in./hr (1270 mm/hr) w/maintenance 3-4 in./hr (75-100 mm/hr) w/no maintenance	45-80	0.00-0.30
Impervious Asphalt or Concrete Pavement	0 in./hr (0 mm/hr)	95-98	0.90-0.95

**Q: What intensity and duration of storms can be managed?**

A: According to research from the Interlocking Concrete Pavement Institute (ICPI), permeable pavers can reduce runoff as much as 100% from a 3 in. (75mm) rain event with sandy soil and a minimum of 12 in. (300mm) thick open-graded aggregate base. Given regional variations in annual rainstorms and base storage capacities, ICPI states that permeable pavers can reduce annual runoff between 30-80%. Conservative design rates of 3 in./hour can be used as the basis for surface infiltration rates with a 20 year life. This design infiltration rate will take in most storms.

Permeable pavers are intended to manage water quantities and pollutants from smaller, more frequent storms such as those with a return period of 10 years or less. These storms tend to be shorter in duration and often have the highest concentrations of pollutants. Permeable pavers are not intended to control flooding from larger, infrequent rainstorms. A well maintained permeable paver application can reduce runoff volumes from intense rain events typically between 70% and 90%.

**Q: What is the Solar Reflective Index for permeable pavers?**

A: Permeable Pavers can be manufactured in lighter colors with a Solar Reflective Index (SRI) of at least 29. This helps to reduce urban heat islands (thermal difference between urban and rural areas) by increasing albedo (a measure of the solar energy reflected from a surface). In addition, permeable pavers have substantially higher reflectivity than conventional asphalt pavement and can meet the requirement for less than 50% imperviousness.

**Q: Are permeable paver applications eligible for LEED® Credits?**

A: Permeable paver applications are eligible for LEED® credits under the U.S. Green Building Councils (USGBC) guidelines in the following categories:

**Sustainable Sites**

- Credit 6.1 & 6.2 Storm water runoff reduction
- Credit 7.1 Heat Island reduction

**Materials & Resources**

- Credit 5.1 & 5.2 Regional materials

**Q: Do permeable pavers meet sustainable design performance requirements?**

A: County Materials' permeable pavers comply with U.S. National Pollutant Discharge Elimination System (NPDES) regulations, and meets U.S. Environmental Protection Agency (EPA) storm water performance criteria as a structural best management practice (BMP) while providing parking, road and pedestrian surfaces. They are also designed to meet local, state and national storm water design criteria. Permeable pavers can also be designed to provide a water harvesting function which can contribute to the water efficiency credits related to water efficient landscaping and using non-potable water for irrigation.

**Q: What type of traffic are permeable pavers suitable for?**

A: With proper design and installation, permeable paver systems are suitable for areas with heavy vehicle traffic and low speed limits (≤40 mph). This includes driveways, parking lots, patios, walkways, parking lanes and residential streets.



## Frequently Asked Questions (continued)

**Q: Can County Materials' permeable pavers be installed on clay soils?**

A: County Materials' permeable pavers can be installed on most soil types, including slower-draining clay soils. Permeable pavers help to capture first flush runoff in rainfall events and reduce pollution. If soil infiltration is slow, perforated plastic pipe drains can be installed at the bottom of the base materials to remove excess water while still allowing some of the water to infiltrate into the soil. The drainage rate for the water contained in the base is typically no greater than 24 hours. Impervious liners can be used to isolate the system if subgrade conditions require a barrier such as the presence of expansive soils or high ground water table. Regardless of the rate of soil infiltration, the filtering action of the open-graded base can reduce water pollutants.

**Q: Can permeable pavers be installed in cold climates?**

A: Permeable pavers have been in service for years in freezing climates, including Canada and the northern U.S., and have performed effectively by accepting snowplows and salts without paver damage. To ensure high durability in freezing climates, H2O Pro Pavers® conform to the requirements of ASTM C 936 in the U.S.

With sunshine and above freezing temperatures, ice and snow can melt and immediately soak into the pavement surface. Water does not puddle on the surface and re-freeze. Sand should not be used for foot or tire traction to prevent clogging. Deicing salts should be used sparingly to reduce salt contamination in groundwater. Water that remains in the base typically drains within 24 hours. If the water does freeze before draining, there is adequate space for ice to expand within the open-graded base, thereby minimizing the risk of heaving. If soil heaving does occur, the pavement surface is flexible and should not be damaged from minor upward movement or from resettlement during a thaw.



**Q: Do permeable pavers meet design considerations for pedestrians and disabled persons?**

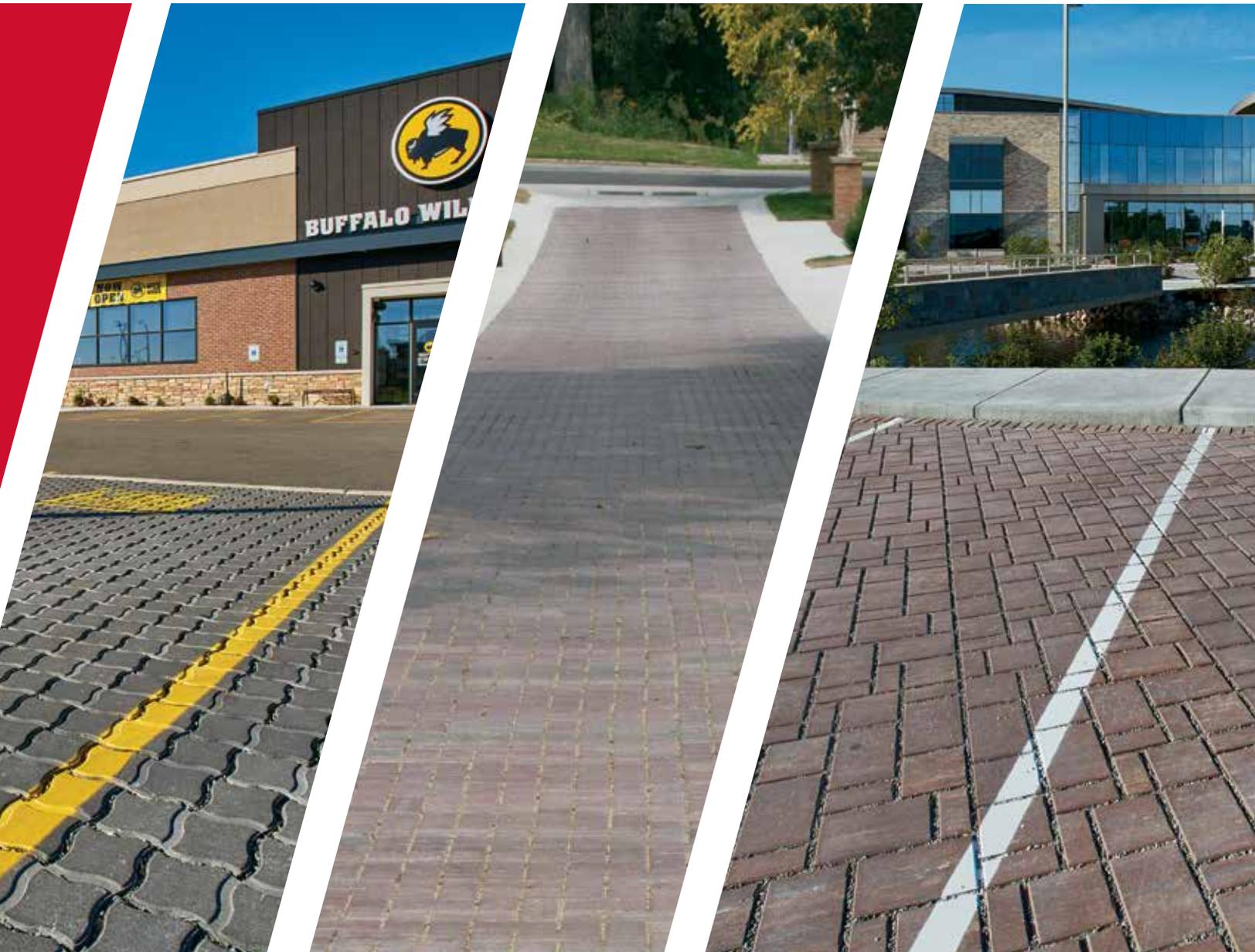
A: Permeable pavers can be utilized in installations with non-permeable pavers as part of a system specifically designated for pedestrian paths and spaces for disabled persons. These systems are designed to meet Americans with Disabilities Act (ADA) requirements. Before any paving project is constructed, vehicle lanes, parking spaces and walking routes for disabled people should be studied, defined and delineated with non-permeable concrete pavers. Non-permeable pavers offer more comfort and easier accessibility in pedestrian paths and spaces used by disabled people and the elderly. Concrete pavement could also be considered for ADA parking stalls and accessible routes, doubling as the concrete edge restraint for the permeable pavers.

**Q: Is it difficult to maintain permeable pavers?**

A: The joints between permeable pavers should be periodically inspected to look for detritus and sediment trapped by the small sized crushed stone. Dirt is typically removed by a vacuum-sweeping street cleaning machine. Cleaning is done when the pavement surface and detritus are dry and can be loosened by sweeping and vacuuming. The frequency of cleaning will vary with the use of the pavement and position of sediment, leaves, etc. from adjacent areas. Cleaning should be done at least once a year, and the surface monitored during the early life of the pavement so that a regular cleaning schedule can be established.



To learn more about County Materials' permeable pavers, including project case studies, additional technical information and availability in your area, please contact your local County Materials sales representative or visit us online at [www.countymaterials.com](http://www.countymaterials.com).



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