WISCONSIN ASPHALT PAVEMENT ASSOCIATION

TECHNICAL BULLETIN

Porous Asphalt Pavements

Introduction

Porous asphalt pavements with stone reservoirs are a multifunctional, low impact development technology that integrate ecological and environmental goals for a site with land development goals, reducing the net environmental impact for a project.

Not only do they provide a strong pavement surface for parking, walkways, trails, and roadways, they are designed to manage and treat stormwater runoff. With proper design and installation, porous asphalt pavements can provide a cost-effective solution for stormwater management in an environmentally friendly way.

As a result, they are recognized as a best practice by the U.S. Environmental Protection Agency (U.S. EPA) and many state agencies (New Jersey Department of Environmental Protection, 2009; Pennsylvania Department of Environmental Protection, 2006; U.S. EPA, n.d.).

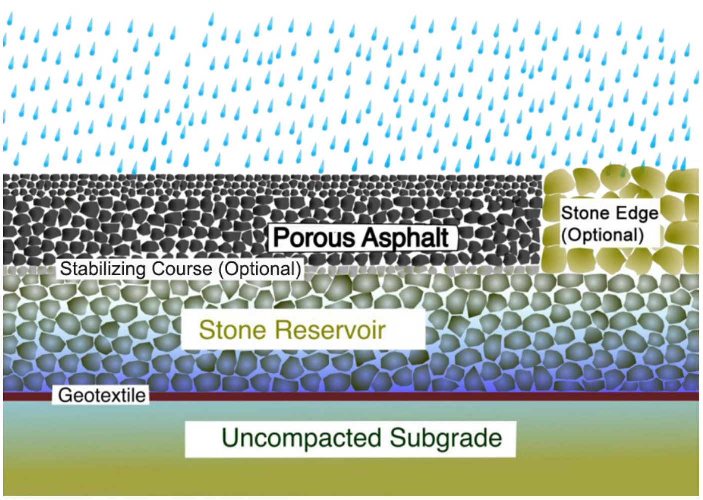

Figure 1. Cross section of typical porous asphalt pavement with stone reservoir (Image courtesy of FHWA)

Unlike conventional pavements, porous asphalt pavements (Figure 1) are typically built over an uncompacted subgrade to maximize infiltration through the soil. Above the uncompacted subgrade is a geotextile fabric, which prevents the migration of fines from the subgrade into the stone recharge bed while still allowing for water to pass through.

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The next layer is a stone reservoir consisting of uniformly graded, clean crushed stone with 40% voids serving as a structural layer and temporarily storing water as it infiltrates into the soil below.

To stabilize the surface for paving, a thin (about 1 inch thick) layer of clean, smaller, single-size crushed stones is often placed on top; this is called the stabilizing course or choker course.

The last layer consists of one or more layers of porous asphalt mixes with interconnected voids that allow water to flow through the pavement into the stone reservoir. These porous asphalt layers consist of asphalt binder, aggregates, sands, and recycled materials and are much like a dense-graded hot mix asphalt mixture. By limiting the amount of fines, the porous mixture allows for more air voids. (Typically between 16% and 22% is recommended.)

It should also be noted that in Figure 1, an optional stone edge is shown resting on the stone reservoir. This would allow rain to infiltrate into the stone reservoir if the porous asphalt surface becomes ineffective due to improper drainage (which could be caused by plugged air voids, for example).

Benefits and Advantages

One of the greatest benefits of porous asphalt pavements is its effectiveness for stormwater management, improving water runoff quality, reducing stormwater runoff, and restoring groundwater supplies.

Stormwater drains through the porous asphalt surface; is temporarily held in the voids of the stone reservoir, reducing stormwater runoff; and then slowly drains into the underlying, uncompacted subgrade to eventually restore groundwater supplies. As stormwater drains, contaminants are filtered and microbial activity decomposes pollutants, improving water quality.

Several studies have quantified high removal rates of total suspended solids, metals, oil, and grease, as well as moderate removal rates for phosphorus, from using porous asphalt pavements (Cahill, Adams, & Marm, 2005; Roseen, Ballestero, Houle, Briggs, & Houle, 2012).

During the winter, porous asphalt pavements have excellent performance since water drains quickly through the surface. They are a potential strategy for minimizing use of deicing chemicals. The University of New Hampshire Stormwater Center (UNHSC) reports a 75% or greater reduction of deicing salts. While the system does not remove chloride, the drastic reduction of deicing chemicals required is an effective method for reducing chloride pollution (Roseen, Ballestero, Houle, Heath, & Houle, 2014).

Following is a list of benefits and advantages of porous asphalt pavements with stone reservoirs:

- Faster melting of snow and ice, reducing the need for deicing salts (Lebens, 2012).
- Cools stormwater temperature during summertime before discharge and mitigates heat island effects (Lebens, 2012).
- Reduction in contamination in water runoff and sediment loading (Lebens, 2012; Houle, Roseen, Ballestero, Puls, & Sherrard, 2013).
- Recharging of groundwater supplies (UNHSC, 2012).
- Low-impact development and cost-effective technology for stormwater management by reducing need for drainage structures and rights of way (Houle, Roseen, Ballestero, Puls, & Sherrard, 2013; UNHSC, 2011; U.S. EPA, 2014).
- Improved wet-weather visibility, tire spray, and hydroplaning (Lebens, 2012).
- Absorption of noise from tires and engines (Lebens, 2012).
- Reduction in stormwater runoff volume (Lebens, 2012).
- Improved water and oxygen transfer to nearby plant roots (Minnesota Department of Transportation, 2012).
- Credits in green construction rating systems, such as Leadership in Energy and Environmental Design, Greenroads, and International Green Construction Code.

For roadways, other major benefits include reduced noise, increased wet-weather friction and visibility, and reduced stormwater temperatures before discharge (Lebens, 2012).

Recent research has identified permeable pavements as a cool pavement technology. Due to their high air void structure, porous asphalt can mitigate urban heat island effect by reducing stored pavement energy and allowing for rapid cooling via evaporation (Li, Harvey, Holland, & Kayhanian, 2013; Stempihar, Pourshams-Manzouri, Kaloush, & Rodezno, 2012; U.S. EPA, 2008).

Applications

Porous asphalt pavements are typically recommended for parking areas and low-volume roadways (Roseen, Ballestero, Houle, Briggs, & Houle, 2012). Additional applications of porous asphalt are for pedestrian walkways, pathways, sports complex applications, sidewalks, driveways, bike lanes, and shoulders (Hein, Strecker, Poresky, Roseen, & Venner, 2013). Porous asphalt pavements have also been used successfully for residential and urban streets as well as highways.

Porous asphalt pavements can be installed as whole or in part with traditional impervious asphalt pavements. When installed in combination with impervious pavements or adjacent to building roofs, porous asphalt can sufficiently contain and treat the additional runoff generated.

Design of Porous Asphalt Pavements

There are three considerations required when determining the thickness of the layers of porous pavements:

- **Site considerations** to ensure that the site is acceptable.
- **Hydrological design** to ensure the porous pavement meets the potential stormwater runoff demands.
- **Structural design** to ensure that the porous pavement withstands the anticipated traffic loading.

Most often, the thickness of the stone recharge bed will be controlled by soil infiltration rates (site considerations) and water quantity (hydrological design) rather than structural requirements, while the porous asphalt surface layer will be determined by the traffic loads (structural design).

Site Considerations

The location of porous pavements should be considered early during the design process.

Contrary to conventional construction pavement siting, porous pavements perform best on upland soils (Cahill, Adams, & Marm, 2005). Additional site considerations include soil types, depth of bedrock, pavement slope, and additional sources of runoff. General site guidelines include:

- Soil infiltration rates of 0.1 to 10 inches/hour (0.5 inches/hour is recommended by U.S. EPA). Do not place over known sinkholes.
- Minimum depth to bedrock or seasonal high groundwater should be greater than 2 feet, and frost depth should be taken into consideration.
- Conduct a site evaluation of sufficient detail to establish site-specific conditions, including soil type.
- The bottom of the infiltration bed should be flat. For roadways it may be necessary to construct berms under the pavement surface to retain water on slopes and install drains/overflows at low points (Roseen, Janeski, & Gunderson, 2011).
- For parking areas, the slope of the porous pavement surface should be less than 5%. For slopes greater than 5%, the parking areas should be terraced with berms in between.
- Seek opportunities to route runoff from nearby impervious areas to infiltration bed.
- Impervious to pervious areas should be less than a 5:1 ratio for most conditions or 3:1 for sinkhole-susceptible areas (karst formations).

For systems that will infiltrate water into the soil subgrade, evaluate the site in accordance with Wisconsin Department of Natural Resources (WDNR) Conservation Practice Standards 1002, "Site Evaluation for Stormwater Infiltration," and 1008, "Permeable Pavement" (WDNR, 2004; WDNR, 2014).

Hydrological Design

Hydrological design determines what layer thicknesses are required to sufficiently infiltrate, store, and release the expected inflow of water, which includes both rainfall and excess stormwater runoff from any adjacent impervious surfaces. This requires information regarding the layer thicknesses and subgrade permeability along with precipitation intensity levels.

The hydrologic design of porous pavements should be performed by a licensed engineer. The two most common methods for modeling stormwater runoff are the U.S. Department of Agriculture's Natural Resources Conservation Service (formerly Soil Conservation Service) Curve Number method and the Rational method. The Rational method is not recommended for evaluation of porous pavement systems. Specific details on hydrological design are beyond the scope of this report. If a hydraulic connection is possible, porous asphalt pavement systems shall be located per the requirements of WDNR Conservation Practice Standards 1002, "Site Evaluation for Stormwater Infiltration," and 1008, "Permeable Pavement" (WDNR, 2004; WDNR, 2014).

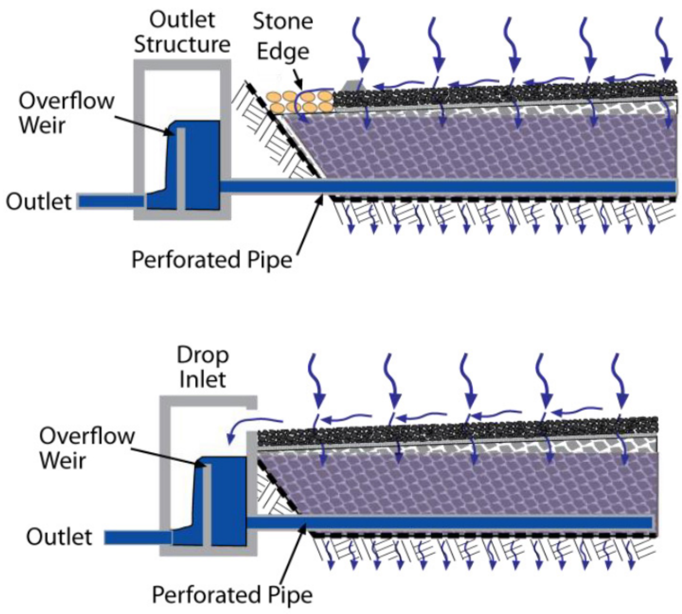

Figure 2. Stone edge (top) and drop inlet (bottom) designs (Image courtesy of FHWA)

Porous pavements are often not designed to store and infiltrate the maximum precipitation at the site. Therefore overflow should be included in the design to prevent stored stormwater from reaching the surface layers. This will typically involve perforated pipes in the stone reservoir that are connected to the discharge pipe, as shown in Figure 2. It is also recommended that an alternative path for stormwater to enter the stone reservoir be provided in case the surface should become plugged. Figure 2 shows examples of designs using a stone edge or drop inlet to manage overflows.

Structural Design

While limited structural information is available, some porous pavements have lasted for more than 20 years. For porous pavements carrying light automobile traffic only, the structural requirements are not significant, and the material thicknesses are determined by the hydrological design and minimum thicknesses required for porous asphalts. For porous asphalt pavements expected to carry truck loads, structural design should follow standard design procedures. Recommended layer coefficients for porous asphalt pavements are shown in Table 1 (Hansen, 2008). Recommended minimum thicknesses of the compacted porous asphalt layer for different truck loadings are shown in Figure 3.

Table 1. Recommended layer coefficients

Material Layer	Structural Coefficients
Porous Asphalt	0.40–0.42
Asphalt-Treated Permeable Base	0.30–0.35
Porous Aggregate Base (Stone Recharge Bed)	0.10–0.14

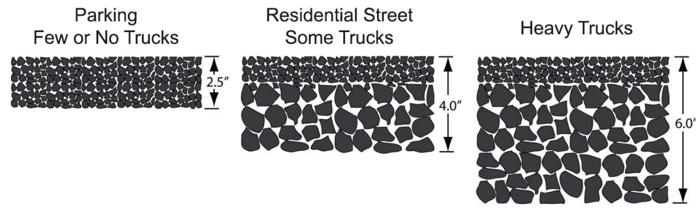

Figure 3. Recommended minimum compacted porous asphalt thicknesses (Image courtesy of FHWA)

WDNR states that a pavement surface infiltration design analysis shall be conducted using an accepted continuous simulation model (e.g., WinSLAMM) per the requirements of WDNR Conservation Practice Standards 1002, "Site Evaluation for Stormwater Infiltration," and 1008, "Permeable Pavement" (WDNR, 2004; WDNR, 2014). Those documents also provide prohibited source areas, impervious/pervious source areas with equations, and clogging potential ratios.

Aggregate Storage Reservoir

Aggregate storage reservoirs shall be designed to achieve site-specific pavement structural requirements and stormwater management goals. The aggregate specifications are as follows per WDNR Conservation Practice Standards 1002, "Site Evaluation for Stormwater Infiltration," and 1008, "Permeable Pavement" (WDNR, 2004; WDNR, 2014):

- Use open-graded base consisting of crushed stone or crushed gravel with no greater than 5% passing the No. 200 sieve.
- Provide a minimum porosity of 30% per ASTM C29, "Standard Test Method for Bulk Density (Unit Weight) and Voids in Aggregate."
- Comply with soundness, wear, and fracture requirements listed in Wisconsin Department of Transportation (WisDOT) Standard Specifications Section 301.2.4.5, "Aggregate Base Physical Properties."
- Comply with construction requirement in WisDOT Standard Specifications Section 301.3, "Construction," or administering authority.

Selection of smaller-size aggregate (e.g., ¾-inch No. 57 stone rather than 3-inch No. 2 stone) will reduce the rate of discharge along the subgrade slope and the rate of accumulation at the downgradient end of the system.

Table 2. WAPA porous asphalt mix design recommended specifications

Porous asphalt mixes designed in accordance with these specifications are compatible with WisDOT-approved warm mix asphalt technologies. Road authorities that adopt these specifications may provide for allowances based on a contractor's track record and experience with porous pavements.

MIX

Property	Value	Notes
Binder Content	5.5%	5.2–6.0% is recommended depending on Nmas gradation.
Binder Grade	28	Minimum high temperature of 64°C is recommended. PG 64-28 or PG 70-28 modified binders can be specified in an effort to provide improved mix stability and durability.
Percent Binder Replacement	25 max	
% Air Voids (V_a @ 50 gyrations)	16–22	
Dust to Effective Binder Ratio	1.0 max	
Tensile Strength Ratio (TSR @ 50 gyrations and design air voids) [ASTM D4867]	70% min	
Draindown at Production Temperature	0.3% max	Effective measures to reduce draindown include the use of manufactured sand in lieu of crusher screenings as well as the use of fibers or recycled asphalt shingles.

NOTE: It is also considered to be acceptable practice to follow ASTM D6752, "Standard Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Automatic Vacuum Sealing Method," as the method to determine the bulk specific gravity for the air voids determination.

AGGREGATE

Property		Value
LA Abrasion (% Loss) [AASHTO T96]	100 revolutions	13 max
	500 revolutions	45 max
Soundness (% Loss) Using Sodium Sulfate [AASHTO T104]		12 max
Freeze/Thaw Soundness (% Loss) [AASHTO T103]		18 max
Fractured Faces (% by Count) [ASTM D5821]	2 faces	90 min
	1 face	100 min
Flat and Elongated (% by Weight) [ASTM D7064M]		5% max; 5:1 ratio

BLENDED AGGREGATE GRADATION

Property		Value	
		12.5 mm NMAS	**9.5 mm NMAS**
Sieve (% Passing)	3/4"	100	n/a
	1/2"	85–100	100
	3/8"	55–75	90–100
	#4	10–25	15–40
	#8	3–15	5–20
	#200	1–4	2–6
Voids in Mineral Aggregate (%)		24 min	25 min

Porous Asphalt Mixtures

Porous asphalt mixtures are designed using the Superpave method (50 gyrations) with requirements for higher air voids and low draindown to assure permeability and performance. To reduce draindown and provide resistance to scuffing, mixes are typically designed with polymer-modified binders. Fibers are often added to the mix to reduce draindown. Mix design recommended specifications are presented in Table 2 (Hansen, 2008).

Mixture Test Methods

Because porous asphalt surfaces do not hold water, they have a very low risk of moisture-related damage. Despite this, it is still recommended to add an anti-stripping agent to the mix if it would be required for dense-graded mixtures using the same materials. If there is no history determining whether an anti-stripping agent would be required, then a moisture susceptibility test may be run on a dense-graded mix with the same aggregate and binder per ASTM D4867, "Standard Test Method for Effect of Moisture on Asphalt Concrete Paving Mixtures."

Construction

One of the most important concerns during the construction of porous asphalt pavements is the clogging of the surface or filling of the voids in the stone reservoir. As a result, protecting the pavement during construction from uncontrolled runoff in adjacent areas and the surrounding soil from compaction is critical. This includes having temporary stormwater controls in place until the site is stabilized and clear, specific guidance for construction procedures.

Typical guidelines for construction procedures for porous pavement include the following:

- Plan to construct the porous pavement as late as possible in the construction schedule.
- Protect site area from excessive heavy equipment running on the subgrade, compacting soil, and reducing permeability. If the subgrade soil is overcompacted during construction, consider refracturing or ripping the soil subgrade to a depth of 12 to 20 inches. Additional base/subbase aggregate may be needed, as well as additional compaction of these materials, to reduce the risk of surface settlement and to render a stable structure for supporting vehicular traffic.
- Excavate the subgrade soil using equipment with oversize tires or tracks to minimize compaction to soil.
- As soon as the bed has been excavated to the final grade, the fabric filter should be placed with an overlap of a minimum of 16 inches. Use the excess fabric (at least 4 feet) to fold over the stone bed to temporarily protect it from sediment.
- Install drainage pipes, if required per WDNR Conservation Practice Standards 1002, “Site Evaluation for Stormwater Infiltration,” and 1008, “Permeable Pavement” (WDNR, 2004; WDNR, 2014).
- Place the aggregate stone recharge bed carefully to avoid damaging the fabric. The aggregate should be dumped at the edge of the bed and placed in layers of 8 to 12 inches using tracked equipment and compacted with a single pass of a light roller or vibratory plate compactor.
- When using a stabilizer course, it is important that the aggregate be sized properly to interlock with the aggregate in the recharge bed. The stabilizer course should be placed at a thickness of about 1 inch. Some larger stones from the stone reservoir should be visible at the surface.
- The porous asphalt should be placed in 1- to 4-inch-thick lifts, and tracked pavers are recommended.
- The porous asphalt should be compacted with two to four passes of a 10-ton roller.
- Restrict traffic for at least 24 hours after final rolling.

Maintenance

In order to maintain long-term performance of porous asphalt pavements’ stormwater management capabilities, it is recommended that the surface infiltration rates be inspected annually during rain events to observe any changes in effectiveness of infiltrating stormwater.

To remove any solids and debris that could lead to more permanent clogging of the pavement, it is recommended that porous asphalt pavements be vacuumed two to four times a year or power-washed (UNHSC, 2012; Palmer, 2012). Best practice is to recommend conducting surface cleaning operations during spring and fall.

During winter months, there are no special requirements for plowing. Deicing chemicals may be used to melt ice and snow from the surface, but the amount of deicing chemicals will be significantly less than for impervious pavements. Do not use sand or cinders as they will clog up the air void spaces within the pavement structure.

The appendices to this publication include more detailed inspection and maintenance guidance for porous pavements. These appendices were adapted from materials published by UNHSC (UNHSC, 2011; UNHSC, n.d.; Hall, n.d.).

Caution

Porous asphalt pavements should never be seal coated or crack sealed. If patching is necessary, conventional mixes may be used if less than 15% of the pavement area is affected.

Porous asphalt may not be used in industrial storage and loading areas or vehicle fueling and maintenance areas. See WDNR Conservation Practice Standards 1002, “Site Evaluation for Stormwater Infiltration,” and 1008, “Permeable Pavement” (WDNR, 2004; WDNR, 2014).

Summary

Porous asphalt pavements have been successfully used for more than 35 years in a variety of climates around the United States. They provide a pavement surface that is also part of the stormwater management system, reducing stormwater runoff and pollutants and replenishing groundwater. A number of porous asphalt parking lots have lasted more than 20 years with no maintenance other than routine cleaning.

Acknowledgments

WAPA wishes to acknowledge the U.S. Federal Highway Administration and the University of New Hampshire Stormwater Center, whose guidance was drawn from extensively in the development of this guide (FHWA, 2015; Hall, n.d.; UNHSC, n.d.; UNHSC, 2011; UNHSC, 2012).

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POROUS ASPHALT FACT SHEET

Porous Asphalt Pavement for Stormwater Management	
Benefits and Uses	Porous asphalt can be used in place of traditional stormwater management measures given the proper conditions. Porous asphalt's primary advantages are: • Quantity and flood control. • Water quality treatment. • Recharges groundwater to underlying aquifers. • Allows for reduction of stormwater infrastructure (piping, catch basins, retention ponds, curbing, etc.). • Suitable for cold-climate applications; maintains recharge capacity when frozen. • Allows for reduced salt usage due to low/no black ice development. • Maintains traction while wet. • Reduced spray from traveling vehicles; reduced roadway noise. • Extended pavement life due to well-drained base and reduced freeze/thaw.
Disadvantages	• Requires routine vacuum sweeping/pressure washing. • Proper construction stabilization and erosion control are required to prevent clogging. • Seal coating or similar surface treatment will cause failure.
Cost and Maintenance	• Total project cost for porous asphalt with reduced stormwater infrastructure is comparable to standard pavement applications where typical stormwater infrastructure is required. • Materials cost is more than traditional asphalt but can be offset by deicing costs. • Long-term maintenance is required by routine vacuum sweeping. • Sweeping cost may be offset by reduced deicing costs. • Repairs can be made with standard asphalt, not to exceed 15% of surface area.
Design Criteria	• Recommended drainage time of 24–48 hours. • Sub-drains should be used to minimize frost damage where proper drainage may be an issue. • Most appropriate for use with low-volume roadways, pathways, and parking lots.
For More Information	See WAPA's *Porous Asphalt Pavements Design Guide.*

WISCONSIN ASPHALT PAVEMENT ASSOCIATION

POROUS ASPHALT MAINTENANCE GUIDE

Regular Inspection and Maintenance Guidance for Porous Pavements

Regular inspection and maintenance are critical to the effective operation of porous pavement. It is the responsibility of the owner to maintain the pavement in accordance with the minimum design standards. This page provides guidance on maintenance activities that are typically required for these systems along with the suggested frequency for each activity. Individual systems may have more or less frequent maintenance needs, depending on a variety of factors, including the occurrence of large storm events, seasonal changes, and traffic conditions.

Inspection Activities

Visual inspections are an integral part of system maintenance. This includes monitoring pavement to ensure water drainage, debris accumulation, and surface deterioration.

ACTIVITY	FREQUENCY
Check for standing water on the surface of the pavement after a precipitation event.	2–4 times per year; more frequently for high-use sites or sites with higher potential for run-on
Vacuum sweeper shall be used regularly to remove sediment and organic debris on the pavement surface. The sweeper may be fitted with water jets.	
Pavement vacuuming should occur during spring cleanup following the last snow event to remove accumulated debris, at a minimum.	
Pavement vacuuming should occur during fall cleanup to remove dead leaves, at a minimum.	
Power washing can be an effective tool for cleaning clogged areas.	
Check for debris accumulating on pavement, especially debris buildup in winter. For loose debris, a power/leaf blower or gutter broom can be used to remove leaves and trash.	
Check for damage to porous pavements from nondesign loads.	

Maintenance Activities

Routine preventative cleaning is more effective than corrective cleaning.

ACTIVITY	FREQUENCY
Controlling run-on and debris tracking is key to extending the life of porous surfaces. Erosion and sedimentation control of adjacent areas is crucial.	As needed
Repairs may be needed following utility repairs. Repairs can be made using standard (nonporous) asphalt for most damages. Repairs using standard asphalt should not exceed 15% of total area.	
Do not store materials such as sand/salt, mulch, soil, yard waste, and other stockpiles on porous surfaces.	
Stockpiled snow areas on porous pavements will require additional maintenance and vacuuming. Stockpiling snow on porous pavements is not recommended and will lead to premature clogging.	
Posting of signage is recommended indicating presence of porous pavement. Signage should display limitations of design loads (i.e., passenger vehicles only, light truck traffic, etc., as per pavement durability rating).	
Damage can occur to porous pavement from nondesign loads.	

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POROUS ASPHALT INSPECTION CHECKLIST

Inspection Checklist for Porous Pavements		
LOCATION	INSPECTOR	
DATE / TIME	SITE CONDITIONS	
DATE SINCE LAST RAIN EVENT		
Inspection Items	**Satisfactory (S) or Unsatisfactory (U)**	**Comments/ Corrective Action**
1. Salt/Deicing		
Use salt only for ice management	**S** or **U**	
Piles of accumulated salt removed in spring	**S** or **U**	
2. Debris Cleanup (2–4 times a year minimum, spring and fall)		
Clean porous pavement to remove sediment and organic debris on the pavement surface via vacuum street sweeper	**S** or **U**	
Adjacent nonporous pavement vacuumed	**S** or **U**	
Clean catch basins (if available)	**S** or **U**	
3. Controlling Run-On (2–4 times a year)		
Adjacent vegetated areas show no signs of erosion and run-on to porous pavement	**S** or **U**	
4. Outlet/Catch Basin Inspection (if available) (2 times a year and after large storm events)		
No evidence of blockage	**S** or **U**	
Good condition; no need for cleaning/repair	**S** or **U**	
5. Poorly Draining Pavement (2–4 times a year)		
Pavement has been pressure washed and vacuumed	**S** or **U**	
6. Pavement Condition (2–4 times a year minimum, spring and fall)		
No evidence of deterioration	**S** or **U**	
No evidence of improper design load applied	**S** or **U**	
7. Signage/Stockpiling (as needed)		
Proper signage posted indicating usage for traffic load	**S** or **U**	
No stockpiling and no seal coating	**S** or **U**	

Corrective Action Needed	Due Date
1.	
2.	
3.	
4.	
5.	

WAPA
WISCONSIN ASPHALT PAVEMENT ASSOCIATION

POROUS ASPHALT WINTER MAINTENANCE

Winter Maintenance Guidelines for Porous Pavements	
Maintenance Guidelines	• If possible, plow with a slightly raised blade; while not necessary, this will help prevent pavement scarring. • Up to approximately 75% salt reduction for porous asphalt can be achieved. Salt reduction amounts are site-specific and are affected by degree of shading. • Apply anti-icing treatments prior to storms if possible. Anti-icing has the potential to provide the benefit of increased traffic safety at the lowest cost and with less environmental impact. • Deicing is NOT required for black ice development. Meltwater readily drains through porous surfaces thereby preventing black ice. • Apply deicing treatments during and after storms as necessary to control compact snow and ice not removed by plowing. • Vacuum porous areas a minimum of 2–4 times per year, especially after winter and fall seasons when debris accumulation and deposition are greatest. • If ponding water is observed during precipitation, cleaning is recommended.
Winter Maintenance Challenges	• Mixed precipitation and compact snow or ice are problematic for all paved surfaces, but are particularly problematic for porous surfaces. This is corrected by application of additional deicing materials. • Deicing materials work by lowering the freezing point of water. Generally, the longer a deicing chemical has to react, the greater the amount of melting. Meltwater readily drains through porous surfaces thereby reducing chemical contact time. This is corrected by application of additional deicing materials. • Additional salt application in these instances is offset by the overall reduced salt during routine winter maintenance.
For More Information	See WAPA's *Porous Asphalt Pavements Design Guide.*