

[ORGANIZATION NAME]
OPERATIONS & MAINTENANCE PLAN
FOR
[PROJECT NAME (GREEN ALLEY OR PERMEABLE PAVER PROJECT)]

OWNER INFORMATION

[Organization Name][Address]

[Address]

CONTACT: _____ Phone: _____

Permeable Pavement Systems O&M Overview

Maintenance is necessary for any type of permeable pavement system, much like any impervious pavement with catch basins and underground infrastructure. Over the lifetime of the permeable pavement system there will be a need to clean any sediment, soil, dirt and debris from the permeable pavement in order to maintain a sufficient infiltration rate. The following maintenance plan is intended to prevent clogging of the voids within the pervious portions of the permeable pavement system. The maintenance plan shall be monitored and revised as necessary, through an amendment to the IGA. Permeable Pavements Systems include green alleys, permeable pavers, pervious concrete, and pervious asphalt.

The O&M plan is included as an exhibit to the Intergovernmental Agreement and is legally binding. Upon completion of project construction, the following Operations & Maintenance (O&M) procedures shall take effect and be conducted perpetually from the date that construction was completed.

General Requirements

1. This Operations & Maintenance (O&M) plan shall take effect upon completion of the construction.
2. O&M plan procedures and practices must be reviewed and assessed annually by the Owner. If upon review, the O&M plan is changed, these changes must be approved by MWRD.
3. Permeable pavement systems shall be inspected by the Owner a minimum of three (3) times a year. The Regular Maintenance Schedule shall be followed and corrective actions shall be required to repair or remediate problems identified in inspections.
4. Landscaped areas adjacent to permeable pavement systems shall be well maintained and shall not allow soil or other debris to be transported onto the permeable pavement system.
5. The Owner shall budget for sweeping permeable pavement three (3) times per year, as described in the Regular Maintenance Schedule below.
6. The following activities shall be prohibited from occurring on the permeable pavement surface:
 - a. Temporary or permanent stockpiling of soil or other material that can potentially cause or contribute to clogging.
 - b. Application of pavement seal-coating.
 - c. Application of excessive load, so as to cause cracking and deformation.
 - d. Application of sand for improving traction.
 - e. Application of salt [prohibited on permeable concrete only.]

Examples of Common Maintenance Issues

Below are several warning signs and visual clues of common maintenance issues which must be prevented and addressed or remediated to ensure continued surface infiltration. These common problems can often be easily remedied by appropriate vacuuming and maintaining the proper joint aggregate level.

1. Slow Draining/Surface Runoff:
 - a. Verify with simple infiltration testing or observe after rain storms. (refer to Inspection of the Permeable Pavement System, 2.b)
 - b. Surface should drain immediately.
2. Ponding:
 - a. Look for signs of ponding during regular inspections and during rainfall events.
 - b. Rule of thumb: if more than a nickel deep one minute after a rainfall event, maintenance is necessary.
 - c. Verify correct materials were installed.
 - d. Exception: Ponding may be present at bottom of slopes.
3. Surface Crusting (debris and dirt caked on the infiltration surface):
 - a. Identify if there is a problem such as run-on sediments.
 - b. Increase cleaning frequency in troubled areas.
 - c. Remove debris immediately.
4. Weed Control:
 - a. Weed edges of permeable pavement systems near mown lawn areas.
 - b. Do not blow or discharge grass clippings onto the permeable pavement.
 - c. Remove weeds immediately. If weeds begins to grow in the openings, it should be easy to hand remove provided that the sprouts are pulled early.
 - d. Because weeding will be difficult where roots have been allowed to grow, inspecting and pulling grass sprouts from the permeable pavement shall be incorporated into the weekly lawn mowing routine surrounding the pavement system.
 - e. Weeds will not germinate unless there is a collection of soil or moisture.
 - f. Clean sediment from joint material [permeable pavers only].
5. Covered Joint Material [permeable pavers only]:
 - a. Identify problem and correct.
 - b. Remove immediately.

Inspection of the Permeable Pavement System

Inspection of the permeable pavement system shall be conducted three (3) times a year (or in conjunction with regularly scheduled maintenance events) and after significant rainfall events exceeding 1.5 inches to evaluate the following:

1. Pavement Condition
 - a. Inspect permeable pavement surfaces for settlement, deformation or cracking.
 - b. Inspect void areas to determine needs for replenishing joint material.
 - c. Note vegetation growth for removal.

2. Surface Infiltration
 - a. Inspect permeable pavement surfaces for sedimentation (any collection of debris, dirt, topsoil, mulch, leaves, etc.) or evidence of ponding.
 - b. Use a garden hose connected to water tank or external house faucet with running water to verify surface infiltration rate. If more than 20% of the permeable pavement surface area does not allow water to infiltrate readily (resulting in ponding or runoff), a restorative maintenance service shall be scheduled immediately.
3. Drainage of the Storage Layer
 - a. Inspect observation wells 72 hours after a rain event of 1.5 inches or greater to verify that the aggregate storage reservoir is drawing down effectively.
4. Drainage structures
 - a. Inspect inlet structures, flow restrictors, and outfall locations for obstructions and evidence of erosion. Confined space safety procedures must be followed for manhole entry.
5. Run-on Areas – Inspect run-on areas for adequate cover and stability.

Operations and Maintenance Reporting Requirements

1. Maintain and update an electronic log book documenting the inspection activities and results, as well as, the performance of the required O&M activities in perpetuity. The logbook shall include:
 - a. Dates of inspection and maintenance/repair;
 - b. Facility components inspected and their conditions (refer to the previous section);
 - c. Details of all inspections and reasons that maintenance/corrective action is needed.
 - d. Details of all maintenance activities, both routine and emergency.

Examples of the Maintenance Checklist and Inspection Log are provided on pages 6 and 7.

2. Log book must be produced upon request of MWRD.
3. If the permeable pavement system is privately owned, the private owner shall keep an updated log book documenting the performance of the required O&M activities which must be produced upon request of the City or MWRD.

Maintenance Types and Equipment Requirements

There are two service types – preventative and restorative – for maintaining the integrity of a permeable pavement system.

1. **Preventative Maintenance Service**– removes most debris before being trapped in the joint aggregate material causing clogging. If the equipment settings are correct, this usually does not require removal of any joint material to restore infiltration.

Either high-efficiency vacuum sweepers or broom sweepers may be used. High-efficiency vacuum sweepers are more effective at capturing and removing fine sediment. However, mechanical sweeper equipment is able to dislodge surface encrusted sediment that typically clogs permeable pavement systems. When mechanical sweepers are used, permeable paving surface shall be dry-swept (water

shall be turned off) in dry weather to remove encrusted sediment that appears as small and curled in the joints between pavers. When vacuum equipment is used, vacuum settings shall be adjusted to prevent uptake of aggregate from the porous unit paving openings and joints. Maintenance equipment requirements will vary according to project size, age, and product type. For larger vehicular areas such as roads, parking lots, alleys or similar that can support vehicles, the following equipment shall be implemented:

- a. Regenerative Air Sweeper (preferred)
 - Utilize stream of air blowing horizontally across surface and vacuuming.
 - No rotating brushes.
 - b. Walk-Behind Vacuum (preferred)
 - Push-type gasoline-powered vacuum.
 - Applicable for smaller projects that cannot support vehicular weight (sidewalks and patios, etc.)
 - c. Rotary Brush (not preferred)
 - Poly bristles only.
 - Flip debris from joint.
 - Will require slight refilling of the joint aggregate material.
 - d. Broom Sweeper (not preferred)
 - Typical “street sweeper” type.
 - Rotating curb brushes with center pickup.
 - Poly bristles only.
 - Do not utilize high-pressure power wash to clean the surface. These cause sediments to wash into the joint aggregate and the underlying storage layer, and cause clogging over time.
2. **Restorative Maintenance Service**– requires some removal or complete removal of the joint material to renew infiltration. This occurs after debris has been captured and lodged in the joint aggregate. Equipment required:
- a. Vacuum Sweeper
 - Vacall Dynamic Multi-Purpose Vacuum Street Sweeper or Elgin Whirlwind Street Sweeper or equivalent equipment.
 - Minimum suction of 14,000 cubic feet per minute.
 - Complete evacuation of joint aggregate material [permeable pavers only].
 - Require replenishing removed joint aggregate material to “lip” of paver [permeable pavers only].

Regular Maintenance Schedule

The following maintenance schedule establishes a best practices maintenance program that helps to ensure longevity of the system before restorative action is required. The schedule shall be reviewed, assessed, and updated/revised annually to reflect experience gained in maintaining the permeable pavement system and changing site conditions.

1. Early Spring (after the snow melt) – March 1 through April 15

- a. Sweep the entire pavement surface using a regenerative air sweeper or broom/rotary brush followed by walk-behind vacuum or air sweeper.
 - b. Clean debris from paver surface with special focus at snow stockpile areas.
 - c. Replenish joint aggregate material after cleaning as necessary [permeable pavers only].
 - d. Inspect and remove sediment and floatables in drainage structures and flow restrictors, if any, within the project area. Confined space safety procedures must be followed for manhole entry. Repair chamber, structure, or equipment if needed.
 - e. Every other year or if more than 20% of the permeable pavement surface area does not allow water to infiltrate readily (resulting in ponding or runoff), whichever is more frequent, a restorative maintenance service shall be performed using a vacuum sweeper to restore the infiltration rate. If applicable, joint aggregate material shall be replenished after cleaning [permeable pavers only].
2. Mid-Summer - June 15 through August 15
 - a. Sweep the entire pavement surface using a regenerative air sweeper or broom/rotary brush followed by walk-behind vacuum
 - b. Replenish joint aggregate material after cleaning as necessary [permeable pavers only].
3. Late Fall – October 15 through November 30
 - a. Sweep the entire pavement surface using a regenerative air sweeper or broom/rotary brush followed by walk-behind vacuum
 - b. Replenish joint aggregate material as necessary [permeable pavers only].
 - c. Clean out drainage structures and flow restrictors, if any, within the project area. Confined space safety procedures must be followed for manhole entry.

Corrective Actions

The following corrective actions, if identified in inspections by the Owner or MWRD, shall be carried out in addition to the regularly scheduled maintenance events:

1. Repair any settlement, deformations or cracking that are significant enough to adversely impact the function of the overall permeable pavement system.
2. If water ponding persists on the pavement surface after a storm event, clean the pavement surface to mitigate clogging.
3. Remove any vegetation growing on the pavement.
4. Repair blocked, restricted or eroding underdrain outfalls.
5. Repair and/or replant eroding run-on areas.
6. If the pavement surface infiltration rate is questionable at any time during the effective life of the pavement, MWRD may require infiltration rate testing to verify that the surface infiltration rate is no less than 20 in/hr. If the surface infiltration rate is lower than 20 in/hr, restorative maintenance shall be taken to restore the infiltration rate to an acceptable level based on the remaining effective life of the pavement.
7. If verification of in-place pavement surface infiltration rates is necessary, conduct pavement surface infiltration rate testing per ASTM C1781 Standard Test Method for Surface Infiltration Rate of Permeable Unit Pavement Systems or other methods approved by MWRD.

Winter Maintenance and De-Icing

When clearing snow from permeable pavement systems, the Owner must ensure that plows have protective edges on the snowplow equipment.

When using commercial snow removal companies, confirm in writing that they have protective edges. To reduce damage to the pavement surface, only use a polymer or rubber cutting edge on the plow.

Due to the very short flow distance from the permeable paving surface to the point of infiltration, the opportunity for ice formation is greatly reduced. For this reason, regular deicing may not be necessary and is not recommended for water quality reasons. If abrasives are used to provide traction, stone chips shall be used rather than sand. De-icing substances will speed up the surface wear on some styles of pavers. Many of the exposed aggregate products and tumbled products are unaffected by virtue of their style.

[This section on salt application is only applicable to permeable pavers and permeable asphalt. Do not use any salt on permeable concrete.]

Sparingly, the following de-icing salts can be used:

1. **Sodium chloride** (common rock salt) is the most popular de-icing salt. It is widely available and it will melt snow and ice at temperatures down to approximately 16° F. Below 16° F, rock salt stops melting snow and ice. Sodium chloride can damage adjacent grass, plants and metal. Apply with caution and use as sparingly as possible.
2. **Calcium chloride** is another de-icing salt. It generally looks like small, white, round, pellets. It will melt snow down to about 0° F. It can irritate skin. Studies indicate that depending on the concentration, calcium chloride is less damaging to grass than sodium chloride is. Heavy concentrations of calcium chloride can chemically attack concrete. It is recommended that if chosen, this salt be used after the first year.
3. **Beet juice** also works as a de-icing compound, and can be diluted to the appropriate strength. It can cause some changes in color, but has significant environmental benefits and is very safe for permeable pavements.

The following material shall **not** be used on permeable pavement:

1. **Sand** for anti-skid as it will clog the paver system.
2. **Magnesium chloride, calcium magnesium acetate, potassium acetate**, and fertilizers that contain ammonium nitrate and ammonium sulfate. They can attack the integrity of concrete in permeable pavers and permeable concrete.
3. **Potassium chloride** is a de-icing salt available in some markets. It will not hurt skin or damage plants. However, it melts ice only when the air temperature is above 15° F. Manufacturers of permeable pavers recommend against using potassium chloride on their pavers, as they have seen some evidence of resulting early decay.

Maintenance Checklist for Permeable Pavements

- Refer to the “[Organization Name] Operations & Maintenance Plan” for detailed requirements.
- Maintenance of the permeable pavement system is required, at a minimum, three (3) times a year: Early Spring (3/1 to 4/15); Mid-Summer (6/15 to 8/15); Late Fall (10/15 to 11/30)

Crew foreman:	Maintenance Type:
Date:	<input type="checkbox"/> Regular (scheduled)
Time:	<input type="checkbox"/> Emergency/Corrective Action

List of Alleys Serviced:

Maintenance Items	Completed? (Y/N)	Comments*
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Salt/Deicing (Early Spring only)

Remove piles of accumulated salt		
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Preventive Pavement Cleaning (three times per year at a minimum)

Sweep the entire pavement area (including both permeable and impermeable sections)		
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Use walk-behind vacuum to remove sediment and organic debris on the permeable pavement surface		
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Drainage Structure Cleanup (Early Spring/Late Fall)

Remove debris and sediment from drainage structures		
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Joint Aggregate Refill (as needed)

Replenish joint aggregate material to “lip” of pavers as needed		
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Restorative Pavement Cleaning (Every 2 years or more often, as determined by inspection)

Run a vacuum sweeper over permeable pavement to restore infiltration rate.		
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Additional Comments & Corrective Actions Taken:

* Include explanation if maintenance is not performed or if further correction action is needed.

Inspection Log for Permeable Pavements		
<ul style="list-style-type: none"> Refer to the "[Organization]'s Operations & Maintenance Plan for [Project Name]" for detailed requirements. Inspection of the permeable pavement system is required, at a minimum, three (3) times a year and after significant rainfall events exceeding 1.5 inches Fill out one form for each permeable pavement area inspected. 		
Inspector: Date: _____ Time: _____ Time Passed Since Last Rain Event: _____		Inspection/Maintenance Type: <input type="checkbox"/> Regular (scheduled) <input type="checkbox"/> Emergency/Corrective Action <input type="checkbox"/> Following rainstorm > 1.5 in.
Permeable/Porous Pavement Area: General Site Conditions:		
Inspection Items	Satisfactory (S) or Unsatisfactory (U)	Comments/Corrective Action, Issue Location
Surface Infiltration		
No sedimentation or signs of sedimentation on permeable pavement and between pavers in joint aggregate material		
No water ponding or evidence of ponding on permeable pavement		
Verify surface infiltration via garden hose test at areas where sedimentation and/or ponding are suspected		
Pavement Condition		
No evidence of deterioration		
No cuts from utilities visible		
No evidence of improper load applied (deformation, settlement or cracking)		
No stockpiling of materials and no seal coating		
No vegetation growth between paver joints (if applicable)		
Joint material filled to "lip" of pavers (if applicable)		
Depth between top of joint material and top edge of paver = _____		
Controlling Run-On		
Adjacent vegetated areas show no signs of erosion and run-on to permeable pavement		
Salt/Deicing (Early Spring only)		
No evidence for the use of traction sand		
Piles of accumulated salt removed in spring		
Drainage Structure Inspection (Early Spring/Late Fall/After >1.5 inches of rainfall)		
No evidence of blockage		
Good condition, no need for cleaning/repair		
Observation wells show water has drained within 72 hours		
Signage		
Signage for appropriate traffic load, no stockpiling, no seal coating and other required District signage.		
Additional Comments, Recommendations:		