Oldcastle Precast®

PERKFILTER™

Submittal Package

Stormwater

Table of Contents

Section 1

Features & Benefits

Oldcastle Precast®

PERKFILTER™

Cartridge Filtration Proven to Reduce Pollutant Loading in Runoff from Urban Developments

Flexible Configurations
Available in vaults, manholes and catch basins with variable inlet/outlet locations.

Superior Flow Rates
High-efficiency treatment in a compact footprint.

Field & Laboratory Tested
High Total Suspended Solids (TSS) and phosphorus removal rates.

Vault Style Configuration

Internal High-Flow Bypass
Integrated bypass system reduces construction costs by eliminating the need for a separate bypass structure.

Integral Pre-Treatment
Pre-treatment chamber prolongs media lifespan by removing gross pollutants.

Modular Cartridge Construction
Simple design provides for efficient media replacement and cartridge handling.

Washington State Department of Ecology
- TAPE/GULD for basic treatment (TSS) and phosphorus treatment

New Jersey Department of Environmental Protection
- NJCAT certified 80% TSS removal rate

Maryland Department of the Environment
- Approved structural practice for 80% TSS removal

Virginia Department of Environmental Quality
- BMP clearinghouse 50% credit for phosphorus reduction

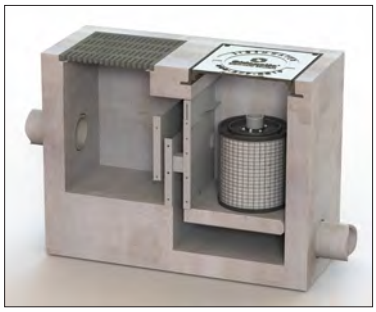
Impervious surfaces and other urban and suburban landscapes generate a variety of contaminants that can enter stormwater, polluting downstream receiving waters. The PerkFilter is a stormwater treatment device that utilizes a wide variety of proprietary media to treat specific pollutants of concern.

Call us today **(800) 579-8819** or visit our website for detailed product information, drawings and design tools at **www.oldcastlestormwater.com**

MEDIA FILTRATION

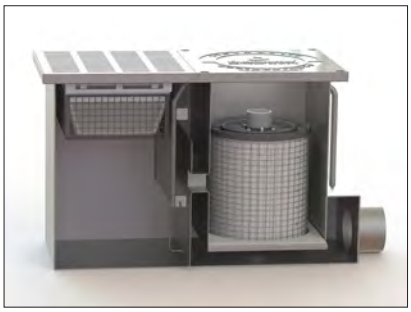
Oldcastle Precast®

Captures and Retains Suspended Solids, Phosphorous, Petroleum Hydrocarbons, Metals and Other Target Constituents Close to the Source, Reducing the Total Downstream Discharge Load



Concrete Catch Basin

Manhole Configuration

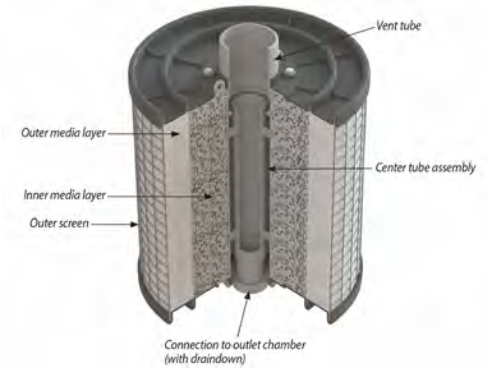


Steel Catch Basin

Standard Cartridge Capacities

Cartridge Height Inches	Treatment Capacity (gpm) at Media Surface Loading Rate of:	
	1.5 gpm/ft^2**	2.5 gpm/ft^2**
12	6.8	12
18	10.2	18
*24	13.6	24
*30	17	30

*Standard cartridge heights are 12 & 18 inches.
24 & 30 inch cartridges use modular stacks.
**Depending on regulatory sizing.



Applications

Typical installation locations include:

- Drop inlets or vaults in commercial or residential developments
- Industrial applications
- Pre- or post-treatment for retention/detention systems

Performance

Field-tested removal efficiencies of:

- Total Suspended Solids > 80%
- Total Phosphorus > 60%

Section 2

Product Specifications

Section 02722

STORMWATER FILTRATION SYSTEM

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PART 1 – GENERAL 1.1

Related Requirements

A. Section 01330 – Submittals: Shop Drawings, Product Data and Samples
B. Section 02330 – Earthwork: Excavation, Trenching, Backfill and Compaction
C. Section 02370 – Erosion and Sedimentation Control (including SWPPP)

1.2 Summary

A. This section includes radial cartridge stormwater media filters.

1.3 Reference Standards

A. American Association of State Highway and Transportation Officials (AASHTO)
   a. AASHTO M105 – Gray Iron Castings

B. American Society for Testing and Materials (ASTM)
   a. ASTM A48, CL.30B – Gray Iron Castings
   b. ASTM A82 – Steel Wire, Plain, for Concrete Reinforcement
   c. ASTM A185 – Steel Welded Wire Reinforcement, Plain for Concrete
   d. ASTM A496 – Steel Wire, Deformed, for Concrete Reinforcement
   e. ASTM A497 – Steel Welded Wire Reinforcement, Deformed for Concrete
   f. ASTM A615 – Deformed and Plain, Carbon-Steel Bars for Concrete Reinforcement
   g. ASTM B209 – Aluminum, Aluminum Alloy Sheet and Plate
   h. ASTM C32 – Sewer and Manhole Brick (Made from Clay or Shale)
   i. ASTM C139 – Concrete Masonry Units for Construction of Catch Basins and Manholes
   j. ASTM C150 – Portland Cement
   k. ASTM C478 – Precast Reinforced Concrete Manhole Sections
   l. ASTM C595 – Blended Hydraulic Cement
   m. ASTM C857 – Minimum Structural Design Loading for Underground Precast Concrete Utility Structures
   n. ASTM C858 – Underground Precast Concrete Utility Structures
   o. ASTM C891 – Installation of Underground Precast Utility Structures
   p. ASTM C990 – Joints for Concrete Pipe, Manholes and Precast Box Sections Using Preformed Flexible Joint Sealants
   q. ASTM C1107 – Packaged Dry, Hydraulic Cement Grout (Non-Shrink)
   r. ASTM D698 – Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort

1.4 Definitions

A. BMP: Best Management Practices
B. TSS: Total Suspended Solids

1.5 Submittals

The following shall be submitted by Contractor in accordance with Section 01330 Submittal Procedures:

A. Product Date for the following:
   a. Radial Cartridge Stormwater Media Filter
      1. Product specifications to include but not limited to specification sheets, brochures and performance claims.
      2. Installation procedures.
      3. Shop drawings shall be provided to include details for fabrication, construction, reinforcement, joints, assembly, and any accessory items. Shop drawings shall be annotated to indicate all materials to be used and applicable material standards, required tests of materials and all design assumptions for structural analysis.
      4. Operations & Maintenance Manual.

B. Independent third-party certification or test report demonstrating conformance to applicable local or regional BMP standards before the treatment system is installed for the following:
   1. Removal efficiency
   2. Targeted pollutants of concern
   3. Hydraulic capacity
   4. Certification of adherence to applicable standard

C. Products submitted as approved equal must be submitted at least two weeks prior to project bid opening and must be approved by project engineer. Submittal for approved equal product must contain

a signed letter from an executive officer of the manufacturer stating product is equivalent to all applicable requirements of this specification.

1.6 Delivery, Storage and Handling

A. All filtration system components shall be delivered to the site and unloaded with handling that conforms to the manufacturer's instructions for reasonable care. Concrete and internal components shall not be rolled or dragged over gravel or rock during handling. The Contractor shall take necessary precautions to ensure the method used in lifting or placing the filtration system does not induce stress fatigue in the concrete.

PART 2 – PRODUCTS

2.1 Radial Cartridge Stormwater Media Filter

2.1.1 Description

The Contractor, and/or a manufacturer selected by the Contractor and approved by the Engineer, shall furnish all labor, materials, equipment and incidentals required and install all precast concrete Stormwater Filtration Systems and appurtenances in accordance with the Drawings and these Specifictions. The Stormwater Filtration System shall consist of an underground precast concrete structure at houses rechargeable, passive, orifice controlled, radial-flow media-filled filter cartridges which trap particulates (TSS) and absorb pollutants such as dissolved metals, nutrients and hydrocarbons.

The Stormwater Filtration System shall be sized at a hydraulic loading rate of no more than 2.0 gpm/sf of media surface area. The water quality treatment flow rate shall be as determined and approved by the Engineer.

The Stormwater Filtration System shall contain a pre-treatment bay and be self-draining to increase the effective life of the filter media. The media cartridges shall be elevated to reduce the accumulation of material on the cartridge surface. Each radial-flow filter cartridge shall operate at a pre-determined flow rate through the use of an integrated flow control mechanism located within each filter cartridge.

The filtration system must include the capability to partition flows, causing all runoff to be diverted into the filtration chamber during low-flow conditions. This can be accomplished with either internal or external diversion. Flows exceeding the treatment capacity of the unit shall be diverted around the filtration chamber to prevent re-suspension and washout of previously trapped pollutants.

The Contractor shall furnish and install the Stormwater Filtration System complete and operable as shown and as specified herein in accordance with the requirements of the plans and contract documents.

2.1.2 Materials and Design

A. Concrete for precast Stormwater Filtration Systems shall conform to ASTM C478, C857 and C858 and meet the following additional requirements:

1. In all cases the wall thickness shall be no less than the minimum thickness necessary to sustain HS20-44 (MS18) loading requirements as determined by a Licensed Professional Engineer.
2. Sections shall have tongue and groove or ship-lap joints with a butyl mastic sealant conforming to ASTM C990.
3. Cement shall be Type I, II or III Portland cement conforming to ASTM C150.
4. All sections shall be cured by an approved method. Sections shall not be shipped until the concrete has attained a compressive strength of 4,000 psi (28 MPa) or other designate suitable handling strength.
5. Pipe openings shall be sized to accept pipes of the specified size(s) and material(s), and shall be sealed by the Contractor with hydraulic cement conforming to ASTM C595M or ASTM C1107.
6. Aggregates shall conform to ASTM C33, except that the requirement for gradation shall not apply.

7. Reinforcement shall consist of wire conforming to ASTM A82 or A496, of wire mesh conforming to ASTM A185 or A497, or Grade 40 steel bars conforming to ASTM A615.
8. Castings for manhole frames and covers shall be in accordance with ASTM A48, CL.30B and AASHTO M105. The access cover/s shall be designed for HS20-44 traffic loading and shall provide a minimum of 30-inch clear opening.
9. Brick or masonry used to build the manhole frame to grade shall conform to ASTM C32 or ASTM C139 and shall be installed in conformance with all local requirements.
10. Diversion weirs, separation chamber and oil baffle shall be made from concrete, marine grade fiberglass and/or stainless steel and shall conform to ASTM A240.
11. All mounting hardware for internal components shall be made of 304SS and shall con form to ASTM A240.

B. All internal components including stainless steel bypass manifold, pre-treatment filter, filter cartridge(s), filter media (as specified on the plans or by the Engineer), and shall be provided by the manufacturer.

1. The bypass manifold shall be fabricated of stainless steel, minimum Type 304, complying with the requirements of ASTM A240.
2. Filter cartridge bottom pan, inner ring, top and hood shall be constructed from high density polyethylene (HDPE). Filter cartridge screen shall consist of 1" x ½" welded wire fabric (16-gauge minimum) with a bonded PVC coating. An orifice mechanism plate shall be supplied with each cartridge to restrict flow rate to a maximum of 12 gpm (12-inch cartridge), 18 gpm (18-inch cartridge), 24 gpm (24-inch cartridge), 30 gpm (30-inch cartridge) at a system design head or as specified on drawings.
3. The filter media shall consist of one or more of the following, as specified on the Plans or by the Engineer:
    a. Perlite Media: Perlite media shall be made of natural siliceous volcanic rock free of any debris or foreign matter. The perlite media shall have a bulk density ranging from 6.5 to 8.5 lb/ft3 and particle sizes ranging from that passing through a 0.50-inch screen and retained on a U.S. Standard #8 sieve.
    b. Zeolite Media: Zeolite media shall be made of naturally occurring clinoptilolite, which has a geological structure of potassium-calcium-sodium aluminosilicate. The zeolite media shall have a bulk density ranging from 44 to 48 lb/ft3, particle sizes ranging from that passing through a U.S. Standard #4 sieve to that retained in a U.S. Standard #6 sieve, and a cation exchange capacity ranging from 1.0 to 2.2 meq/g.
    c. Granular Activated Carbon: Granular activated carbon (GAC) shall be made of lignite coal that has been steam activated. The GAC media shall have a bulk density ranging from 28 to 31 lb/ft3 and particle sizes ranging from that passing through a U.S. Standard #4 sieve to that retained on a U.S. Standard #8 sieve.
    d. Zeolite-Perlite-Carbon (ZPC): ZPC is a mixed media that shall be composed of a blend of Zeolite (see above), Perlite (see above) and Granular Activated Carbon (see above).
    e. Zeolite-Perlite (ZP): ZP is a mixed media that shall be composed of a blend of Zeolite (see above) and Perlite (see above).

2.1.3 Performance

A. Each specified flow based Stormwater Filtration System shall be capable of removing 80% of the net annual Total Suspended Solids (TSS) load based on a d50 particle size of 20 microns. Annual TSS removal efficiency models shall be based on laboratory and field performance data, site-specific hydraulics and hydrology, and local rainfall intensity distributions. Filtration units shall have the ability of being placed inline without re-suspending trapped sediments or re-entrain contaminants up to and including the Peak Flow Rate.

B. Each Stormwater Filtration System shall contain one or more media cartridges that maintain a uniform pressure profile across the face of the filter during operation. At the design flow rate, the maximum filter hydraulic loading rate is not to exceed 2.0 gpm/sf of filter surface area. Stormwater shall enter the filter cartridges through the sides and shall flow through the filter media radially from the outer perimeter inward and shall have an average media contact time of not less than 39 seconds.
C. The Stormwater Filtration System performance shall be third partied verified and shall be based on lab and field performance. The Stormwater Filtration System shall have Washington Department of Ecology General Use Level Designation (GULD).
D. The Stormwater Filtration System shall be supplied with either internal or external bypass with a minimum capacity not less than the peak design storm as determined by the Engineer.

2.1.4 Quality Assurance

The materials, process and finished Stormwater Filtration System shall be subject to inspection by the Engineer. Acceptance or rejection of the system shall be based on the Specifications contained in this section. Imperfections may be repaired but subject to the acceptance of the Engineer.

2.1.5 Manufacturer

Each Stormwater Filtration System shall be a PerkFilter as manufactured by Oldcastle Precast, 7100 Longe Street, Stockton, California, 95206.

PART 3 – EXECUTION

3.1 Earthwork

A. Excavation, trenching and backfilling shall be as specified in Division 2 Section “Earthwork”.

3.2 Identification

A. All Stormwater Filtration devices shall be identified at the surface level with markings indicating that they are treatment devices.

3.3 Inspection

3.3.1 General

A. Concrete, internals and accessories shall be inspected prior to installation and any defective or damaged product shall be replaced.

3.3.2 Manhole Sections

A. Any manhole section with chipped bells or spigots shall be rejected and replaced.
B. Any section with a fracture or crack greater than 0.10-inch in length or 0.01 in width shall be rejected and replaced.
C. Any manhole section that has not had at least seven (7) days cure time (including 12 hours steam cure, or 21 days without steam cure) or is out of round shall be rejected and replaced.
D. Any section with indications of imperfections in mixing and/or molding, honeycombed, or open textured surface, shall be rejected and replaced.
E. Any section with indications of patches or repairs shall be rejected and replaced.
F. Any section with exposed reinforcing steel shall be rejected and replaced.

3.4 Structure Installation

3.4.1 General

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm and drainage piping systems. Location and arrangement of Stormwater Filtration Systems is critical and design consideration should be taken into account. Install filtration system as indicated herein and as directed by the product manufacturer, to the maximum extent practical. Where specific installation procedure is not indicated, follow product manufacturer’s written instructions.

B. All products shall be inspected for defects and cracks before being lowered into the trench, piece by piece. Any defective, damaged or unsound structure or any product that has had its grade disturbed after laying, shall be taken up and replaced. Open ends shall be protected with a pipe plug to prevent earth or other material from entering the filtration system during construction. The interior of the filtration system shall be free from dirt, excess water and other foreign materials as the installation progresses and left clean at the completion of the installation.

3.4.2 Trench Excavation

3.4.2.1 Excavation

A. Excavate trenches to ensure that sides will be stable under all working conditions. Slope trench walls or provide supports in conformance with all local and national standards for safety. Open only as much trench as can be safely maintained by available equipment. Backfill all trenches as soon as practicable, but not later than the end of each working day.

B. Where trench walls are stable or supported, provide a width sufficient, but no greater than necessary, to ensure working room to properly and safely place and compact haunching and other embedment materials. The space between the filtration system and trench wall must be wider than compaction equipment used in the compaction zone.

C. When supports such as trench sheeting, trench jacks, trench shields or boxes are used, ensure that support of the filtration system and its embedment is maintained throughout installation. Ensure that sheeting is sufficiently tight to prevent washing out of the trench wall from behind the sheeting. Provide tight support of trench walls below viaducts, existing utilities, or other obstructions that restrict driving of sheeting.

3.4.2.2 Dewatering

A. Do not lay or embed any section of the Stormwater Filtration System in standing or running water. At all times prevent runoff and surface water from entering the trench.

B. When water is present in the work area, dewater to maintain stability of in-situ and imported materials. Maintain water level below pipe bedding and foundation to provide a stable trench bottom. Use, as appropriate, sump pumps, well points, deep wells, geofabrics, perforated underdrains, or stone blankets of sufficient thickness to remove and control water in the trench. When excavating while depressing ground water, ensure the ground water is below the bottom of cut at all times to prevent washout from behind sheeting or sloughing of exposed trench walls. Maintain control of water in the trench before, during and after pipe system installation and until embedment is installed and sufficient backfill has been placed to prevent flotation of the pipe, fitting or drainage structures. To preclude loss of soil support, employ dewatering methods that minimize removal of fines and the creation of voids in in-situ materials.

3.4.2.3 Removal of Rock

A. Rock in either ledge or boulder formation shall be replaced with suitable materials to provide a compacted earth cushion having a thickness between exposed rock and the manhole sections of at least 12 inches (0.3m). Rock excavation shall be as specified and defined under section 02300 “Earthwork”.

3.4.2.4 Removal of Unstable Material

A. Where wet or otherwise unstable soil incapable of properly supporting the manhole structure, as determined by the Engineer, is encountered in the bottom of a trench, such material shall be removed to at least 24 inches below bottom of the structure

and replaced to the proper grade with select granular material, compacted as directed by the Engineer. When removal of unstable material is due to the fault or neglect of the Contractor while performing shoring and sheeting, water removal, or other specified requirements, such removal and replacement shall be performed at no additional cost to the Owner.

3.4.3 Bedding

A. A stable and uniform bedding shall be provided for the manhole structure and any protruding features of its joint and/or fittings. The bedding shall be compacted to a minimum of 90% of maximum density per AASHTO T99, or as shown in the plans. Structure bedding shall be a minimum of 6" in thickness. The bedding surface for the structure shall provide a firm foundation of uniform density throughout the entire length of the pipe.

3.4.4 Setting Structures

A. Each structure section shall be thoroughly examined before being placed; defective or damaged sections shall not be used. Structures shall be placed to the elevations as indicated on the plans. Proper facilities shall be provided for lowering structure sections into trenches. Sections shall not be laid in water, and the sections shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches shall be provided as directed by the Engineer; see dewatering section.

3.4.5 Jointing

A. Joints shall be constructed as described herein and in accordance with manufacturer's installation instructions.
B. All bell-and-spigot manhole joints shall be thoroughly cleaned. The supplied gasket shall be installed on the spigot end with the angled surface facing toward the mating surface. Joint lubricant, supplied by the manufacturer, shall be liberally applied to the entire interior of bell and gasket on spigot prior to assembly. Sections shall be mated with sections level and plumb to prevent rolling the gasket.
C. All tongue-and-groove joints shall be thoroughly cleaned. Sections shall be mated and hydraulic cement grout (non-shrink) complying with ASTM C1107 shall be applied liberally to the exterior and exterior of the joint ensuring all voids are filled completely.

3.4.6 Backfilling

3.4.6.1 General

Backfill placement and compaction shall be constructed in accordance with specifications herein and the product manufacturer's published installation guides.

3.4.6.2 Backfilling Manhole Sections in Trenches

After the manhole sections and connecting pipes have been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along all sides of pipe in layer depths to ensure minimum compaction density is obtained evenly throughout the backfill material. The backfill shall be brought up evenly on all sides of the structure. Each layer shall be thoroughly compacted with mechanical tampers or rammers. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below.
Where it is necessary, in the opinion of the Engineer, that sheeting or portions of bracing used be left in place, the contract shall be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.

3.4.6.3 Movement of Construction Machinery

Movement of construction machinery over a manhole structure at any stage of construction shall be at the Contractor's risk. Any damaged structure shall be repaired or replaced.

Section 3

Design Guidelines

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Description

The PerkFilter is a media filtration system that uses physical and chemical treatment processes such as sedimentation, filtration and sorption to remove Total Suspended Solids (TSS), metals, nutrients, gross solids, trash and debris, and petroleum hydrocarbons to significantly reduce the total pollutant discharge load in stormwater runoff. The PerkFilter is a media-filled, cartridge filtration system where the number and size of cartridges is tailored to accommodate the water quality flow rate and to meet the specific needs of the site. To allow maximum design flexibility, the PerkFilter is available in multiple configurations, including catch basins, precast concrete vaults, manholes, and curb inlets, and larger custom-designed concrete structures.

The PerkFilter consists of an inlet chamber for high-flow bypass and removal of gross pollutants, a treatment chamber for filtration through media-filled cartridges, and an outlet chamber for flow collection and discharge. A variety of filter media is available to target specific pollutants of concern. Standard configurations allow for internal high-flow bypass, so the PerkFilter can be designed as an online or offline system. As with any stormwater treatment system, the PerkFilter requires periodic maintenance to prolong the life of the system. The frequency of maintenance depends on the conditions of the site and performance of the system.

Function

The PerkFilter is a water quality treatment system consisting of three chambers: an inlet chamber, a treatment chamber with filter cartridges, and an outlet chamber (Figure 1). Stormwater runoff enters the inlet chamber through an inlet pipe, curb opening, or grated inlet. Gross solids are settled out and floating trash and debris are trapped in the inlet chamber. Pre-treated flow is then directed to the treatment chamber through an opening in the baffle wall between the inlet chamber and treatment chamber.

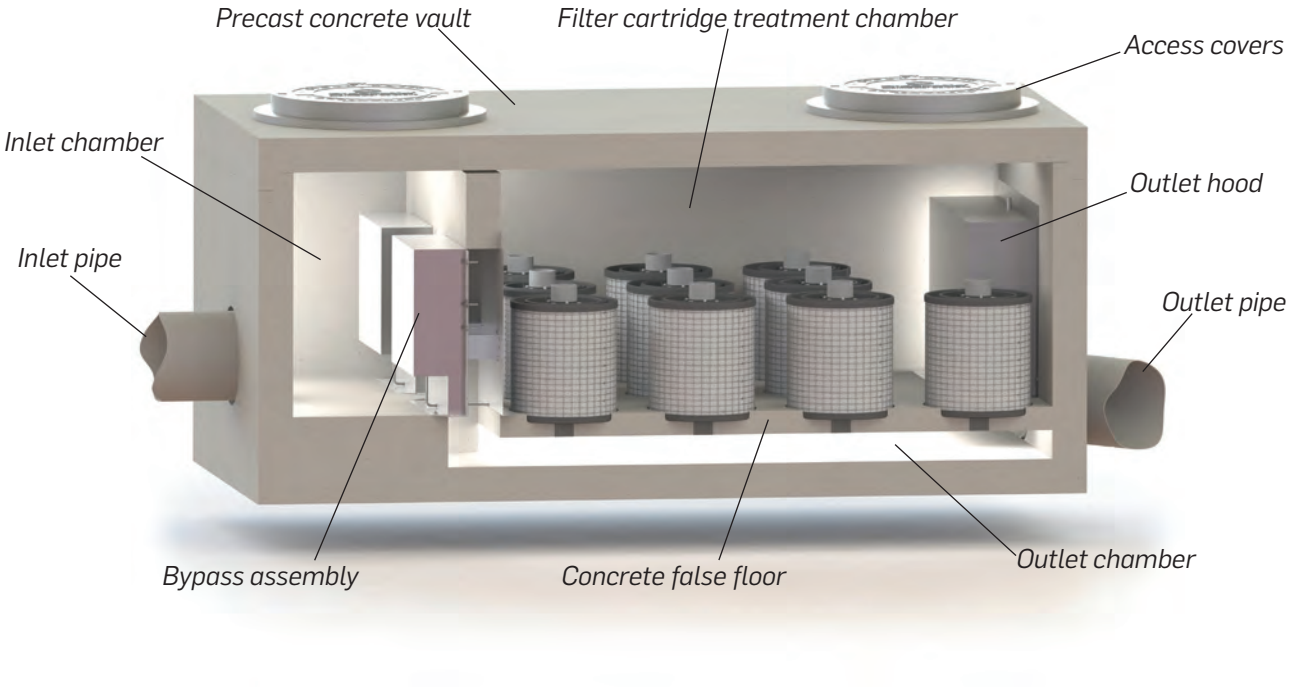
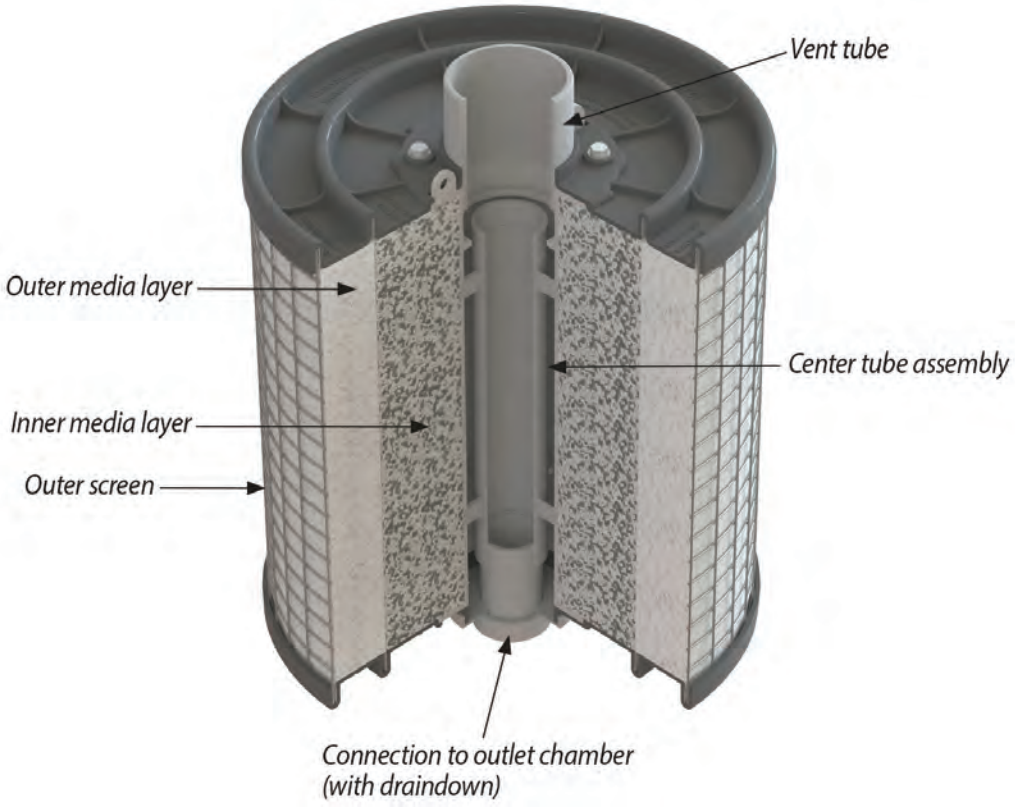


Figure 1. Schematic of the PerkFilter system

The treatment chamber contains media-filled filter cartridges that use physical and chemical processes to remove pollutants (Figure 2). The standard media consists of a perlite outer layer and a zeolite and carbon inner layer. During a storm event, runoff pools in the treatment chamber before passing radially through the cylindrical cartridges from the outside surface, through the media for treatment, and into the center of the cartridge. At the center of the cartridge is a center tube assembly designed to distribute the hydraulic load evenly across the surface of the filter cartridge and control the treatment flow rate through the cartridge. The center tube assembly discharges treated flow through the false floor and into the outlet chamber. A draindown feature built into each cartridge allows the treatment chamber to dewater between storm events.



All cartridges are 18 inches in diameter and are available in two heights: 12 inches and 18 inches. Cartridges may be used alone or may be stacked to provide a 24-inch combination (12" + 12") or a 30-inch combination (12" + 18") as shown in Figure 3. The capacity of each cartridge or cartridge combination is dictated by the allowable hydraulic loading rate of the media and the outer surface area of the cartridge. Thus, taller cartridges have greater treatment capacity than shorter cartridges but they require more hydraulic drop.

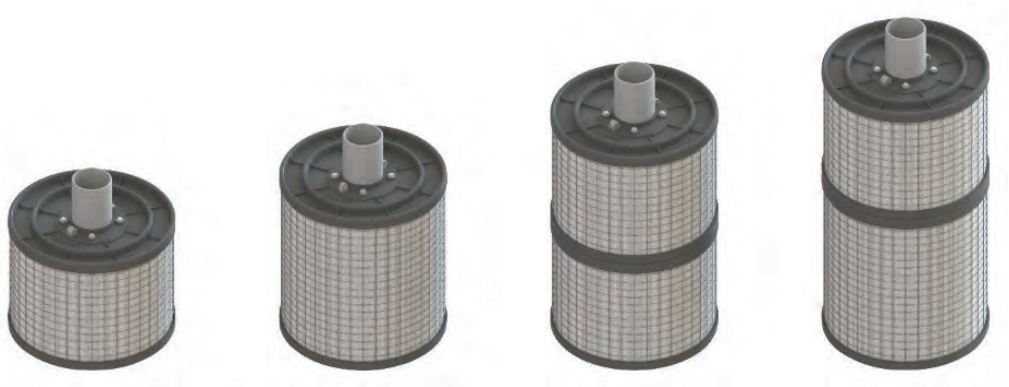


Figure 3. Cartridge Stack Configurations

Treatment Processes

The PerkFilter provides water quality treatment through physical and chemical unit processes. Treatment is achieved through separation, sedimentation, filtration and sorption.

Separation: A floatables baffle located in the chamber prevents the majority of floatable gross solids and oils from entering the treatment chamber or going to bypass. Water must pass under the baffle to move past the weir, which prevents floatable materials such as trash, litter, surfactants, oils and greases from exiting the inlet chamber. If the system is located downstream of a storage facility, the outlet control of the storage facility may provide the function of the inlet gallery without the use of the floatables baffle.

Sedimentation: The PerkFilter is designed to reduce flow velocities in the inlet chamber and in the treatment chamber, around the filter cartridges. This promotes gravity settling of entrained particles. Sedimentation of larger particles in the inlet chamber acts as a pre-treatment mechanism that improves system performance and extends the life of the filter cartridges. The amount of sedimentation attained is a function of particle size and density, water density, residence time and turbulence.

Filtration: Particulates are physically removed from suspension as they come into contact with the filter media. The filter retains those particles that are unable to follow the tortuous channels of connected void space within the filter. Pollutant removal rates achieved through filtration are a function of the stormwater composition and media properties including permeability, grain size and hydraulic conductivity.

Sorption: Unlike filtration, where physical processes control removal of sediment from suspension, sorption relies on opposing surface charges of media and dissolved species to remove pollutants from stormwater. The granular media contains material with a high surface area so that binding sites are numerous and not easily exhausted. In addition, the filter media has a high cation exchange capacity which promotes the removal of positively charged dissolved pollutants (including metal ions) from solution.

System Hydraulics

The PerkFilter can be designed to operate at hydraulic loading rates ranging from 1.5 gpm to 2.5 gpm per square foot of media surface area. The hydraulic loading rate is typically dictated by regulatory requirements and/or pollutant removal goals. The PerkFilter system is designed to meet regulatory and site-specific requirements to ensure full treatment of the water quality flow rate or water quality volume by the cartridges prior to bypass.

The PerkFilter requires hydraulic driving head to push water through the filter media and to account for other hydraulic losses across the system. The maximum head loss varies from 1.7 feet to 3.5 feet, depending on the cartridge stack configuration as shown in Table 1 below. If the drop across the system, as measured from the invert

of the inlet pipe to the invert of the outlet pipe, is greater than or equal to the maximum head loss shown in Table 1, the PerkFilter will not induce significant backwater in the collection system upstream. If the drop across the system is less than the head loss shown in Table 1, backwater may occur and the design team at Oldcastle Precast should be consulted for guidance. Given the physical constraints of the system, the drop across the system cannot be less than 9 inches.

The minimum installation depth as measured from rim to invert of the outlet will vary depending on the cartridge configuration. These specifications are comparable to other cartridge-based filter systems.

Cartridge Stack Configuration	Maximum Head Loss (ft)	Cartridge Flow Rate (gpm) at 1.5 gpm/ft^2	Cartridge Flow Rate (gpm) at 2.5 gpm/ft^2
12-inch	1.7	6.8	12
18-inch	2.3	10.2	18
12-inch + 12-inch	2.9	13.6	24
18-inch + 12-inch	3.5	17.0	30

Table 1. Cartridge Stack Configuration Details

System Sizing

The PerkFilter can be designed as either a flow-based or volume-based stormwater practice, depending upon the requirements established by the regulatory jurisdiction to meet their water quality standards.

Flow-Based Design Methodology: The flow-based design methodology is typically used in jurisdictions that specify a design storm event and are looking for treatment of a specific water quality flow rate. To design a PerkFilter as a flow-based system, a design storm event would first be used to calculate a water quality flow rate (WQf) off the site. The flow rate is usually calculated using the Rational Method, an SCS unit hydrograph, or a continuous simulation hydrology model. The treatment flow rate would then be divided by the design, per-cartridge operating flow rate (see Table 1) to determine the number of cartridges or cartridge stacks required. The PerkFilter structure would then be selected to accommodate the required number of cartridge stacks.

Volume-Based Design Methodology: The PerkFilter can also be designed as a volume-based system. This methodology is typically used in jurisdictions that specify a design rainfall and are looking for treatment of a specific water quality volume or when the PerkFilter is located downstream of detention.

Some jurisdictions specify a water quality volume (WQv) that must be captured and treated instead of a water quality flow rate. To ensure that the WQv is indeed captured and treated, the system must consist of two components: a storage component with outlet control followed by a filtration component. The WQv would first be calculated according to local regulatory guidance. The storage component would be sized to contain the WQv or some portion thereof (as specified by the jurisdiction) with an outlet control device, and the filtration component would be sized to ensure treatment of the pollutant mass load.

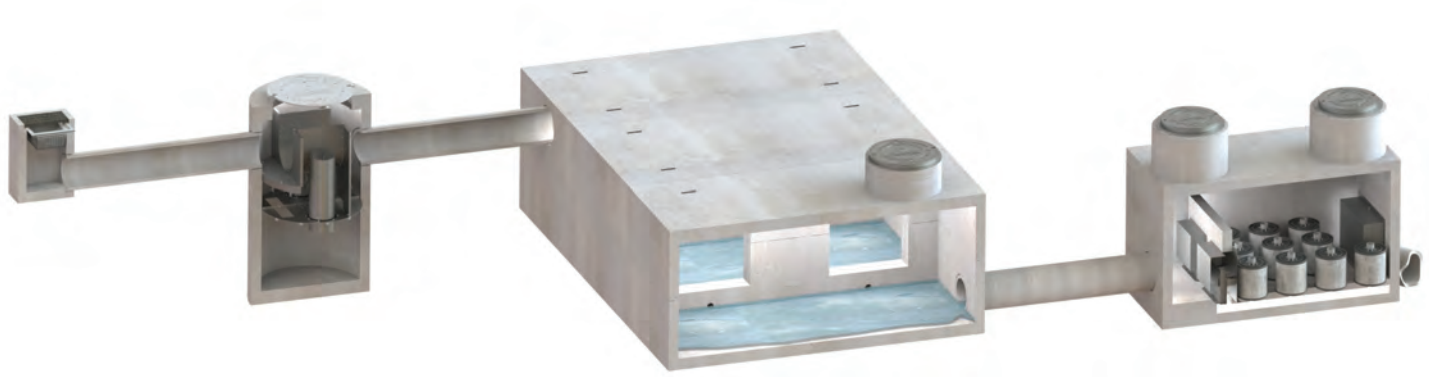
Other jurisdictions require the reduction of peak flows from new or redeveloped sites to meet pre-existing conditions or reduce hydromodification of downstream waterbodies. Detention facilities are designed to detain stormwater to an allowable release rate using an outlet control structure. Often, this allowable release rate is very low. The PerkFilter can be designed downstream of the detention system, however the flow-based method it not typically applicable in this case, as it does not account for the total volume of stormwater that passes through the PerkFilter during each storm and the associated pollutant loading.

To design a PerkFilter as a volume-based system, the number of cartridges is determined using a mass-loading calculation (or other calculation as specified by the jurisdiction) to account for the anticipated annual runoff volume and pollutant load. A mass-loading sizing typically targets a 1-year maintenance cycle and requires the calculation of an expected annual pollutant mass load off a developed site. This is typically calculated using a regional TSS

event mean concentration (EMC) multiplied by the annual volume of runoff (annual rainfall depth multiplied by the site area). Once the annual pollutant mass load is known, the number of cartridges required can then be calculated using the mass-load capability of each cartridge and the targeted mass-load reduction, which is typically 80%. If sedimentation is provided in the storage or detention component using a sump or dead storage, the mass load to the cartridges may be reduced.

If a volume-based treatment system is required, Oldcastle Stormwater can provide a StormCapture storage system that can be used in conjunction with the PerkFilter. The StormCapture is a modular, structural precast concrete storage system that may be used to capture the water quality volume or provide detention upstream of the PerkFilter. If pre-treatment is needed, Oldcastle can also provide a hydrodynamic device called the Dual-Vortex Separator to keep heavy solids and gross pollutants out of the storage system.

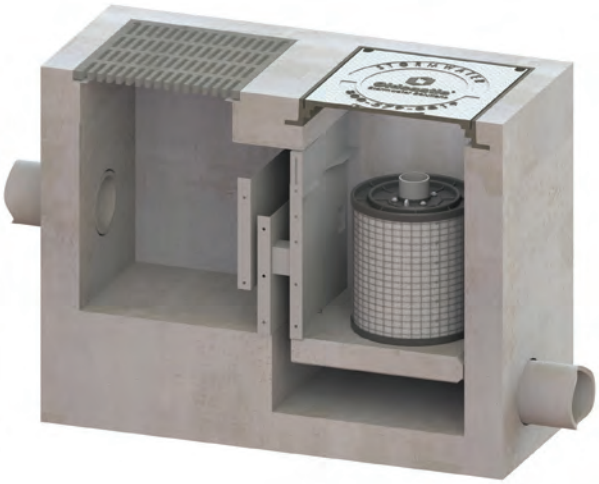
Oldcastle Stormwater's Engineers can assist in the calculations to determine the appropriate number of cartridges for either design methodology.

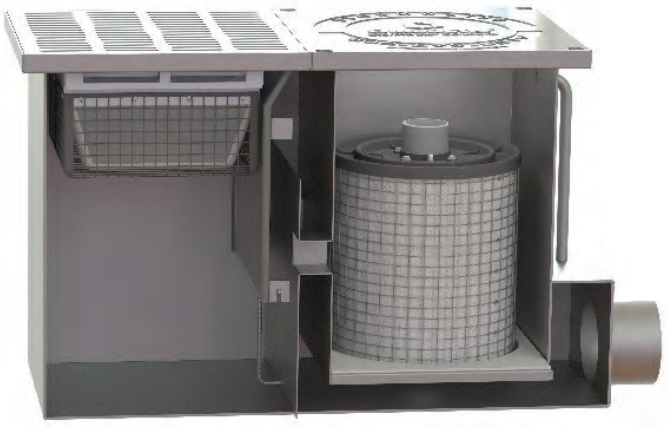


PerkFilter Configurations

There are many ways to configure the PerkFilter system. The structure types included below are the most common. Standard drawing details for each configuration are available and provide specific dimensions and depth constraints for each structure.

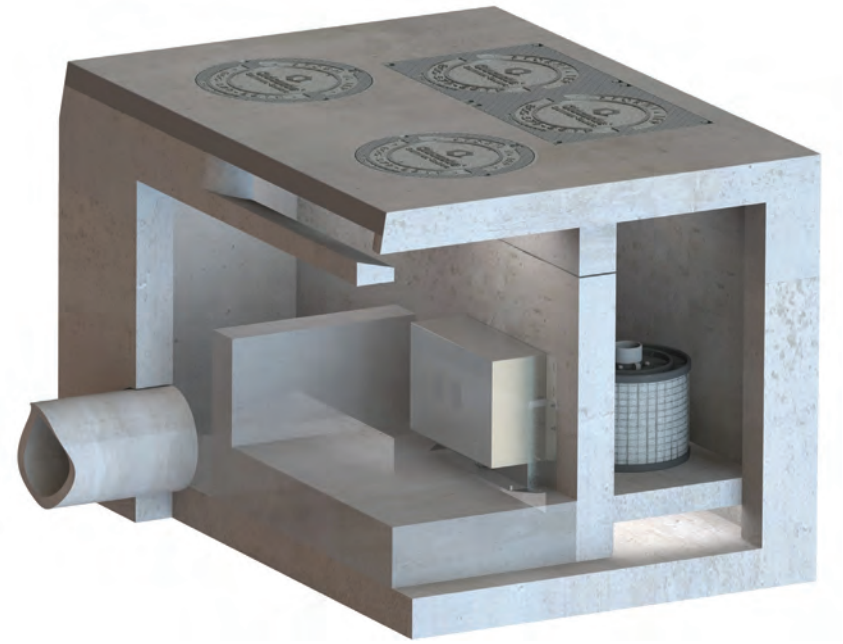
Catch Basin: The Catch Basin PerkFilter contains from one to four cartridge stacks and is housed in a precast concrete or powder-coated steel structure. The standard design includes a grated inlet to capture stormwater runoff from paved surfaces like roadway gutters and parking lots.





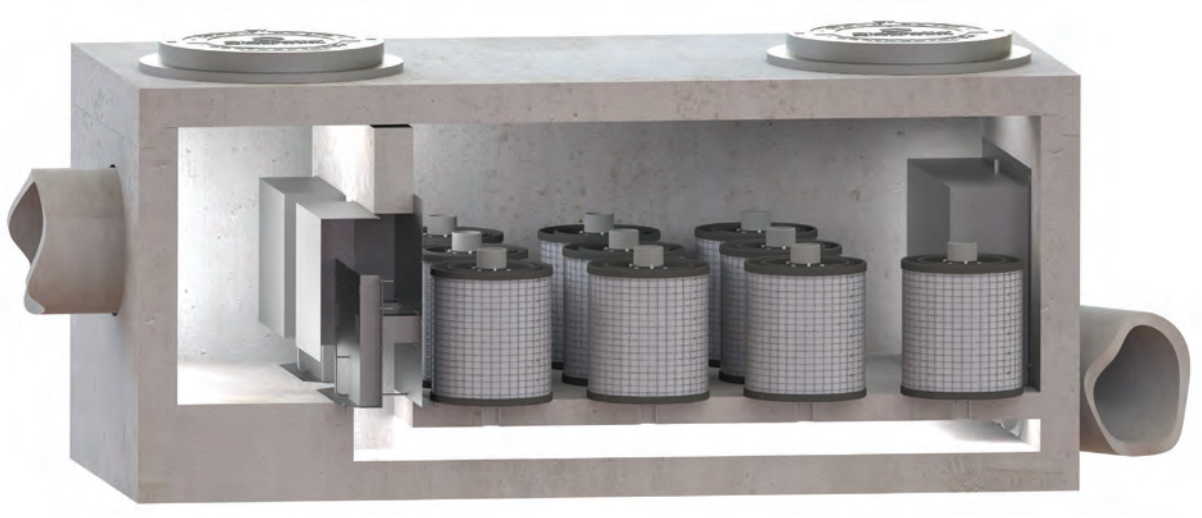
These systems have a maximum depth of 5 feet from the rim to the invert of the outlet pipe. The minimum depth is dictated by the cartridge stack height. The catch basin configuration can also accommodate an inlet pipe if needed, and includes a high-flow bypass that routes peak flows around the treatment chamber to discharge.

Curb Inlet: The Curb Inlet PerkFilter contains up to 24 cartridge stacks and is provided in a precast concrete vault ranging in size from 4' x 4' up to 8' x 16'. The standard design includes a 3.5', 4' or 7' curb inlet opening to capture stormwater runoff from roadways at the curb face. The Curb Inlet PerkFilter includes a high-flow bypass that routes peak flows around the treatment chamber to discharge.



Manhole: The Manhole PerkFilter contains from one to eleven cartridge stacks and is provided in a concrete manhole structure that can range from 48" to 96" in diameter. Stormwater is typically delivered to the Manhole PerkFilter through an inlet pipe connection. The Manhole PerkFilter includes a high-flow bypass that routes peak flows around the treatment chamber to discharge.

Vault: The standard Vault PerkFilter can contain up to 31 cartridge stacks and is provided in a precast concrete vault ranging in size from 4' x 4' up to 8' x 18'. Stormwater is typically delivered to the Vault PerkFilter through an inlet pipe connection. The Vault PerkFilter includes a high-flow bypass that routes peak flows around the treatment chamber to discharge.



Larger Systems, Shallow Applications and Custom Configurations: Custom structures can be constructed that can contain any number of cartridges for any required treatment flow rate. Panel vault and box culvert designs can be provided when more treatment capacity is necessary. The PerkFilter can also be designed with a full access hatch when site constraints do not allow standard minimum depths. In summary, a custom configuration may be provided to accommodate most site conditions. The Engineering team at Oldcastle Stormwater is prepared to work with you to develop the most cost-effective and functional configuration for your site.

Redmond Regional Water Treatment Facility, Redmond, WA

Inspection and Maintenance Requirements

As with any stormwater treatment system, the PerkFilter requires periodic maintenance to prolong the life of the system. The PerkFilter should be inspected once or twice per year and maintained as needed. Standard maintenance includes removal of gross pollutants from the inlet chamber and treatment chamber, and replacement of the filter cartridges. Frequency of maintenance depends on the conditions of the site and performance of the system. Owners can typically expect at least 12 months of service from a PerkFilter before maintenance is required but the maintenance frequency may extend up to five years in regions with limited rainfall or at sites with minimal pollutant loading.

More detail on inspection and maintenance procedures can be found in the PerkFilter Inspection and Maintenance Guide.

Verification and Approvals

The PerkFilter has been rigorously tested in the laboratory and in the field. After extensive field investigation, the PerkFilter received a General Use Level Designation (GULD) from the Washington Department of Ecology (Ecology) for both Basic (TSS) and Phosphorus Treatment in 2010. Systems receiving a GULD are approved for stand-alone treatment in the state of Washington. In addition, the Virginia Department of Environmental Quality has included the PerkFilter on the Virginia BMP Clearinghouse list as an approved filtration device with a total phosphorus removal efficiency credit of 50%.

Project Design Assistance

Oldcastle Stormwater offers design assistance for your project offering site specific details and written specifications. Please visit our website for detailed product information, drawings, design tools and local contacts.

www.oldcastlestormwater.com
(800) 579-8819

From the start of construction to the completion of any project, Oldcastle Stormwater offers a comprehensive approach to meet your stormwater management needs.

Section 4

Inspection & Maintenance

PerkFilter™ Media Filtration System

Description

The PerkFilter is a stormwater treatment device used to remove pollutants from urban runoff. Impervious surfaces and other urban and suburban landscapes generate a variety of contaminants that can enter stormwater and pollute downstream receiving waters. The PerkFilter is a media-filled cartridge filtration device designed to capture and retain sediment, gross solids, metals, nutrients, hydrocarbons, and trash and debris. As with any stormwater treatment system, the PerkFilter requires periodic maintenance to sustain optimum system performance.

Function

The PerkFilter is a water quality treatment system consisting of three chambers: an inlet chamber, a filter cartridge treatment chamber, and an outlet chamber (Figure 1). Stormwater runoff enters the inlet chamber through an inlet pipe, curb opening, or grated inlet. Gross solids are settled out and floating trash and debris are trapped in the inlet chamber. Pretreated flow is then directed to the treatment chamber through an opening in the baffle wall between the inlet chamber and treatment chamber. The treatment chamber contains media-filled filter cartridges (Figure 2) that use physical and chemical processes to remove pollutants. During a storm event, runoff pools in the treatment chamber before passing radially through the cylindrical cartridges from the outside surface, through the media for treatment, and into the center of the cartridge. At the center of the cartridge is a center tube assembly designed to distribute the hydraulic load evenly across the surface of the filter cartridge and control the treatment flow rate. The center tube assembly discharges treated flow through the false floor and into the outlet chamber. A draindown feature built into each cartridge allows the treatment chamber to dewater between storm events.

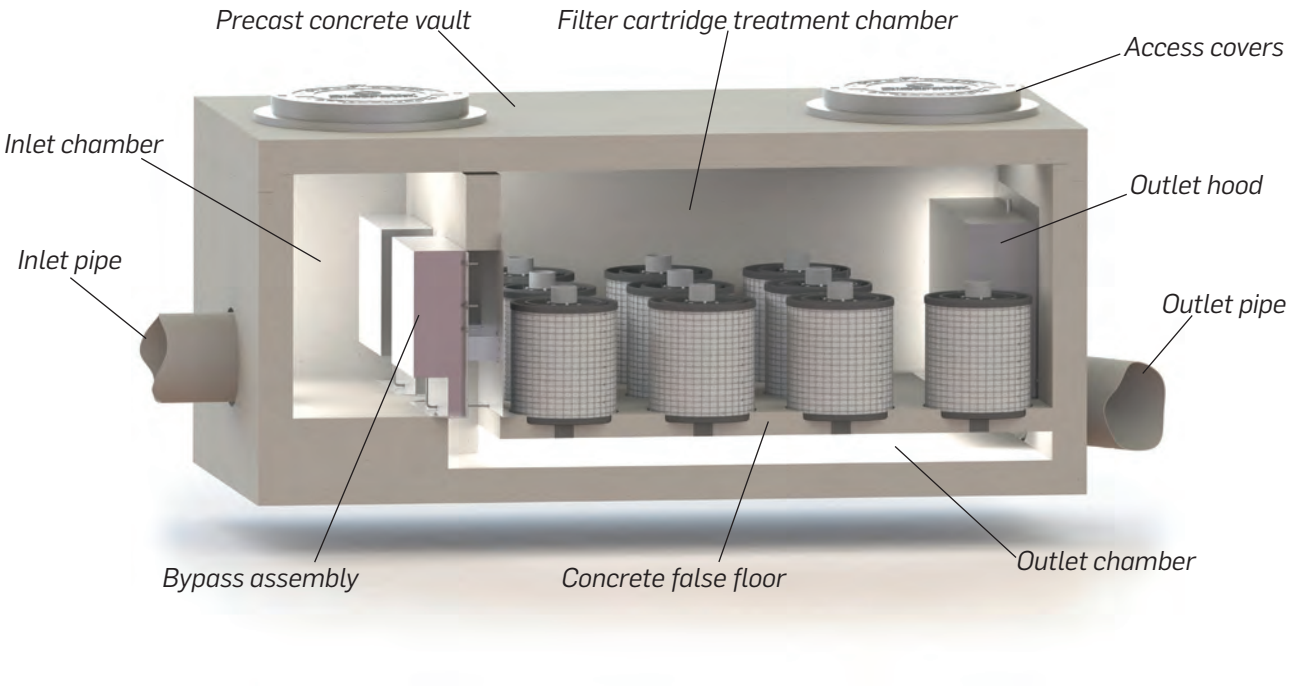
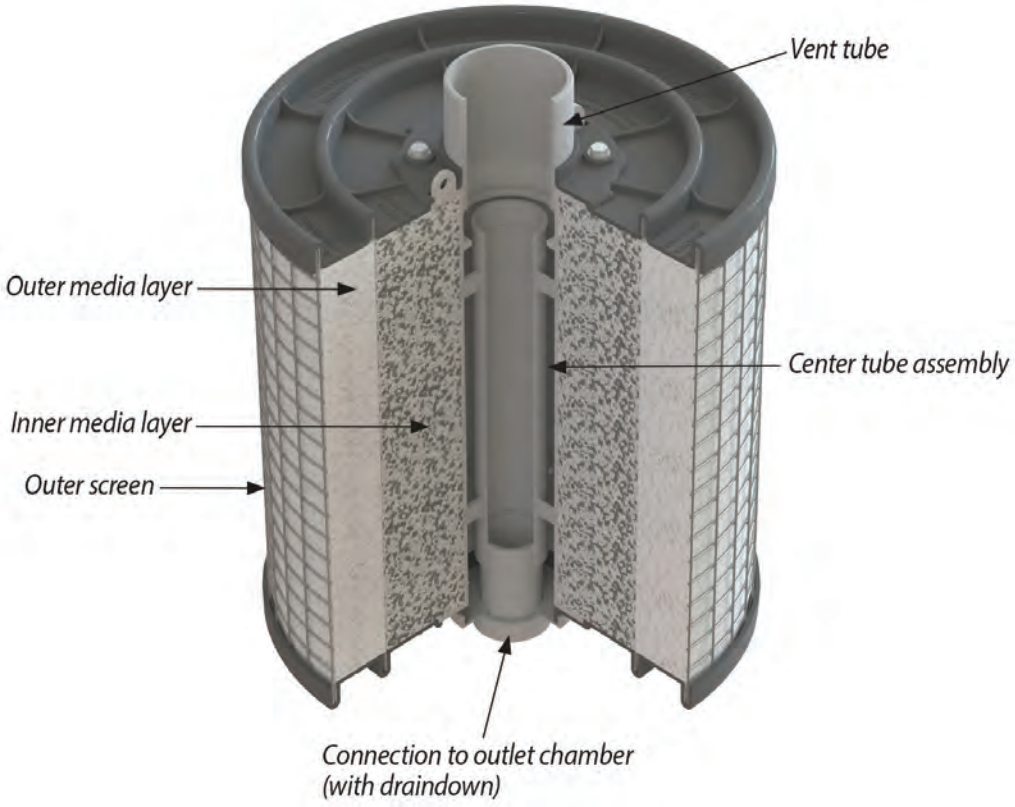


Figure 1. Schematic of the PerkFilter system.

All PerkFilter systems include a high flow bypass assembly to divert flow exceeding the treatment capacity of the filter cartridges around the treatment chamber. The bypass assembly routes peak flow from the inlet chamber directly to the outlet chamber, bypassing the treatment chamber to prevent sediment and other captured pollutants from being scoured and re-entrained by high flow. Treated flow and bypass flow merge in the outlet chamber for discharge by a single outlet pipe.



Configuration

The PerkFilter structure may consist of a vault, manhole, or catch basin configuration. Catch basin units may be fabricated from concrete or steel. Internal components including the PerkFilter cartridges are manufactured from durable plastic and stainless steel components and hardware. All cartridges are 18 inches in diameter and are available in two heights: 12-inch and 18-inch. Cartridges may be used alone or may be stacked (Figure 3) to provide 24-inch and 30-inch combinations. The capacity of each cartridge or cartridge combination is dictated by the allowable operating rate of the media and the outer surface area of the cartridge. Thus, taller cartridges have greater treatment capacity than shorter cartridges but they also require more hydraulic drop across the system. Cartridges may be filled with a wide variety of media but the standard mix is composed of zeolite, perlite and carbon (ZPC).

Access to an installed PerkFilter system is typically provided by ductile iron castings or hatch covers. The location and number of access appurtenances is dependent on the size and configuration of the system.

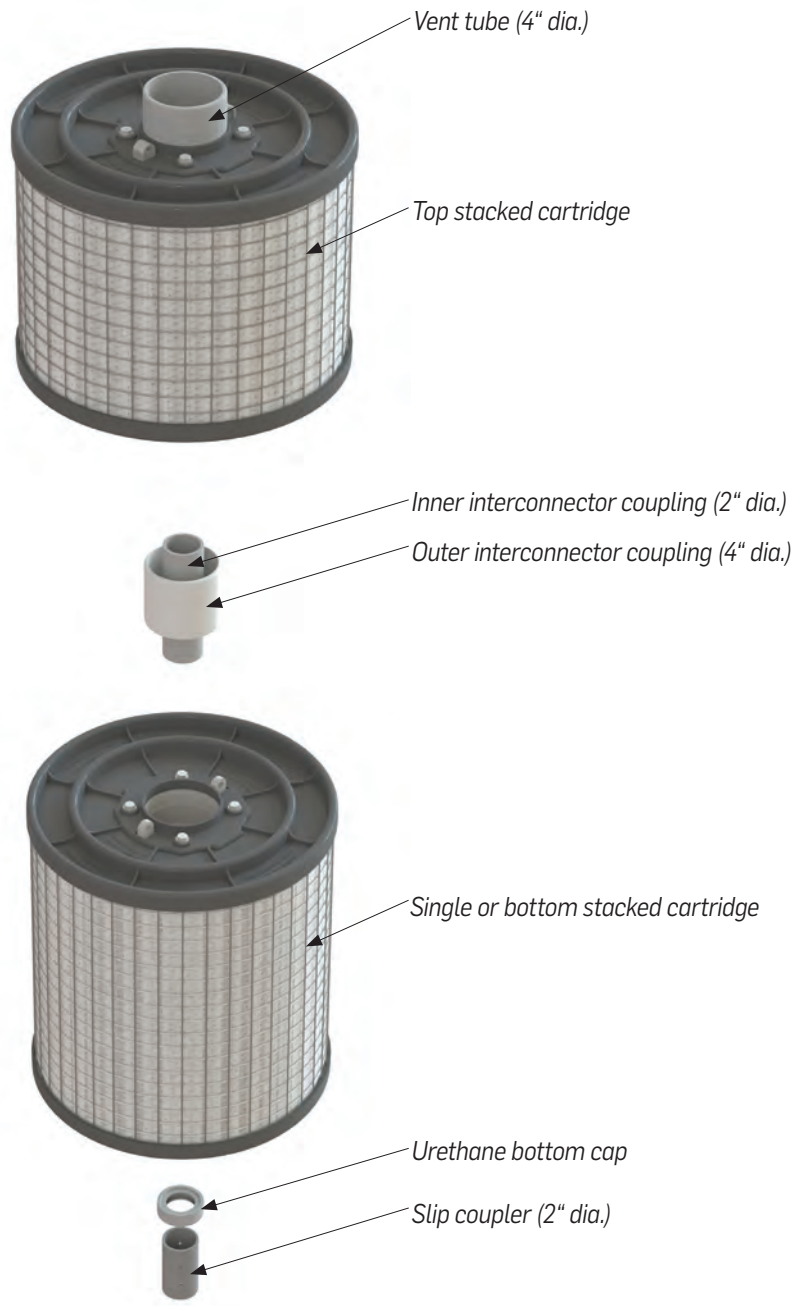


Figure 3. Schematic of stacked cartridges and connector components.

Maintenance Overview

State and local regulations require all stormwater management systems to be inspected on a periodic basis and maintained as necessary to ensure performance and protect downstream receiving waters. Maintenance prevents excessive pollutant buildup that can limit system performance by reducing the operating capacity and increasing the potential for scouring of pollutants during periods of high flow.

Inspection and Maintenance Frequency

The PerkFilter should be inspected on a periodic basis, typically twice per year, and maintained as required. Initially, inspections of a new system should be conducted more frequently to help establish an appropriate site-specific inspection frequency. The maintenance frequency will be driven by the amount of runoff and pollutant loading encountered by a given system. In most cases, the optimum maintenance interval will be one to three years. Inspection and maintenance activities should be performed only during dry weather periods.

Inspection Equipment

The following equipment is helpful when conducting PerkFilter inspections:

- Recording device (pen and paper form, voice recorder, iPad, etc.)
- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Socket and wrench for bolt-down access covers
- Manhole hook or pry bar
- Flashlight
- Tape measure
- Measuring stick or sludge sampler
- Long-handled net (optional)

Inspection Procedures

PerkFilter inspections are visual and may be conducted from the ground surface without entering the unit. To complete an inspection, safety measures including traffic control should be deployed before the access covers are removed. Once the covers have been removed, the following items should be checked and recorded (see form provided at the end of this document) to determine whether maintenance is required:

- Inspect the internal components and note whether there are any broken or missing parts. In the unlikely event that internal parts are broken or missing, contact Oldcastle Stormwater at (800) 579-8819 to determine appropriate corrective action.
- Note whether the inlet pipe is blocked or obstructed. The outlet pipe is covered by a removable outlet hood and cannot be observed without entering the unit.
- Observe, quantify and record the accumulation of floating trash and debris in the inlet chamber. The significance of accumulated floating trash and debris is a matter of judgment. A long-handled net may be used to retrieve the bulk of trash and debris at the time of inspection if full maintenance due to accumulation of floating oils or settled sediment is not yet warranted.

- Observe, quantify and record the accumulation of oils in the inlet chamber. The significance of accumulated floating oils is a matter of judgment. However, if there is evidence of an oil or fuel spill, immediate maintenance by appropriate certified personnel is warranted.
- Observe, quantify and record the average accumulation of sediment in the inlet chamber and treatment chamber. A calibrated dipstick, tape measure, or sludge sampler may be used to determine the amount of accumulated sediment in each chamber. The depth of sediment may be determined by calculating the difference between the measurement from the rim of the PerkFilter to the top of the accumulated sediment and the measurement from the rim of the PerkFilter to the bottom of the PerkFilter structure. Finding the top of the accumulated sediment below standing water takes some practice and a light touch, but increased resistance as the measuring device is lowered toward the bottom of the unit indicates the top of the accumulated sediment.
- Finally, observe, quantify and record the amount of standing water in the treatment chamber around the cartridges. If standing water is present, do not include the depth of sediment that may have settled out below the standing water in the measurement.

Maintenance Triggers

Maintenance should be scheduled if any of the following conditions are identified during the inspection:

- Internal components are broken or missing.
- Inlet piping is obstructed.
- The accumulation of floating trash and debris that cannot be retrieved with a net and/or oil in the inlet chamber is significant.
- There is more than 6” of accumulated sediment in the inlet chamber.
- There is more than 4” of accumulated sediment in the treatment chamber.
- There is more than 4” of standing water in the treatment chamber more than 24 hours after end of rain event.
- A hazardous material release (e.g. automotive fluids) is observed or reported.
- The system has not been maintained for 3 years (wet climates) to 5 years (dry climates).

Maintenance Equipment

The following equipment is helpful when conducting PerkFilter maintenance:

- Suitable clothing (appropriate footwear, gloves, hardhat, safety glasses, etc.)
- Traffic control equipment (cones, barricades, signage, flagging, etc.)
- Socket and wrench for bolt-down access covers
- Manhole hook or pry bar
- Confined space entry equipment, if needed
- Flashlight
- Tape measure
- 9/16” socket and wrench to remove hold-down struts and filter cartridge tops
- Replacement filter cartridges
- Vacuum truck with water supply and water jet

Contact Oldcastle Stormwater at (800) 579-8819 for replacement filter cartridges. A lead time of four weeks is recommended.

Maintenance Procedures

Maintenance should be conducted during dry weather when no flow is entering the system. Confined space entry is necessary to maintain vault and manhole PerkFilter configurations. Only personnel that are OSHA Confined Space Entry trained and certified may enter underground structures. Confined space entry is not required for catch basin PerkFilter configurations. Once safety measures such as traffic control are deployed, the access covers may be removed and the following activities may be conducted to complete maintenance:

- Remove floating trash, debris and oils from the water surface in the inlet chamber using the extension nozzle on the end of the boom hose of the vacuum truck. Continue using the vacuum truck to completely dewater the inlet chamber and evacuate all accumulated sediment from the inlet chamber. Some jetting may be required to fully remove sediment. The inlet chamber does not need to be refilled with water after maintenance is complete. The system will fill with water when the next storm event occurs.
- Remove the hold-down strut from each row of filter cartridges and then remove the top of each cartridge (the top is held on by four 9/16" bolts) and use the vacuum truck to evacuate the spent media. When empty, the spent cartridges may be easily lifted off their slip couplers and removed from the vault. The couplers may be left inserted into couplings cast into the false floor to prevent sediment and debris from being washed into the outlet chamber during washdown.
- Once all the spent cartridges have been removed from the structure, the vacuum truck may be used to evacuate all accumulated sediment from the treatment chamber. Some jetting may be required to fully remove sediment. Take care not to wash sediment and debris through the openings in the false floor and into the outlet chamber. All material removed from the PerkFilter during maintenance including the spent media must be disposed of in accordance with local, state, and/or federal regulations. In most cases, the material may be handled in the same manner as disposal of material removed from sumped catch basins or manholes.
- Place a fresh cartridge in each cartridge position using the existing slip couplers and urethane bottom caps. If the vault is equipped with stacked cartridges, the existing outer and inner interconnector couplers must be used between the stacked cartridges to provide hydraulic connection. Transfer the existing vent tubes from the spent cartridges to the fresh cartridges. Finally, refit the struts to hold the fresh cartridges in place.
- Securely replace access covers, as appropriate.
- Make arrangements to return the empty spent cartridges to Oldcastle Stormwater.

PerkFilter
Inspection and Maintenance Log

Location _____

Structure Configuration and Size:

Inspection Date _____

☐ Vault _____feet x _____feet
☐ Manhole _____feet diameter
☐ Catch Basin _____feet x _____feet

Number and Height of Cartridge Stacks:

Count_____each ☐12" ☐18" ☐24" ☐30"

Media Type:

☐ ZPC ☐ Perlite ☐ Other_____

Condition of Internal Components ☐ Good ☐ Damaged ☐ Missing	Notes:
Inlet or Outlet Blockage or Obstruction ☐ Yes ☐ No	Notes:
Floating Trash and Debris ☐ Significant ☐ Not Significant	Notes:
Floating Oils ☐ Significant ☐ Not Significant ☐ Spill	Notes:
Sediment Depth in Inlet Chamber ☐ Inches of Sediment:_____	Notes:
Sediment Depth in Treatment Chamber ☐ Inches of Sediment:_____	Notes:
Standing Water in Treatment Chamber ☐ Inches of Standing Water:_____	Notes:

Maintenance Required

☐ **Yes - Schedule Maintenance** ☐ **No - Inspect Again in _____ Months**

PERKFILTER™

OUR MARKETS

BUILDING STRUCTURES

COMMUNICATIONS

WATER

ENERGY

TRANSPORTATION