



PERKFILTER[®]

Submittal Package

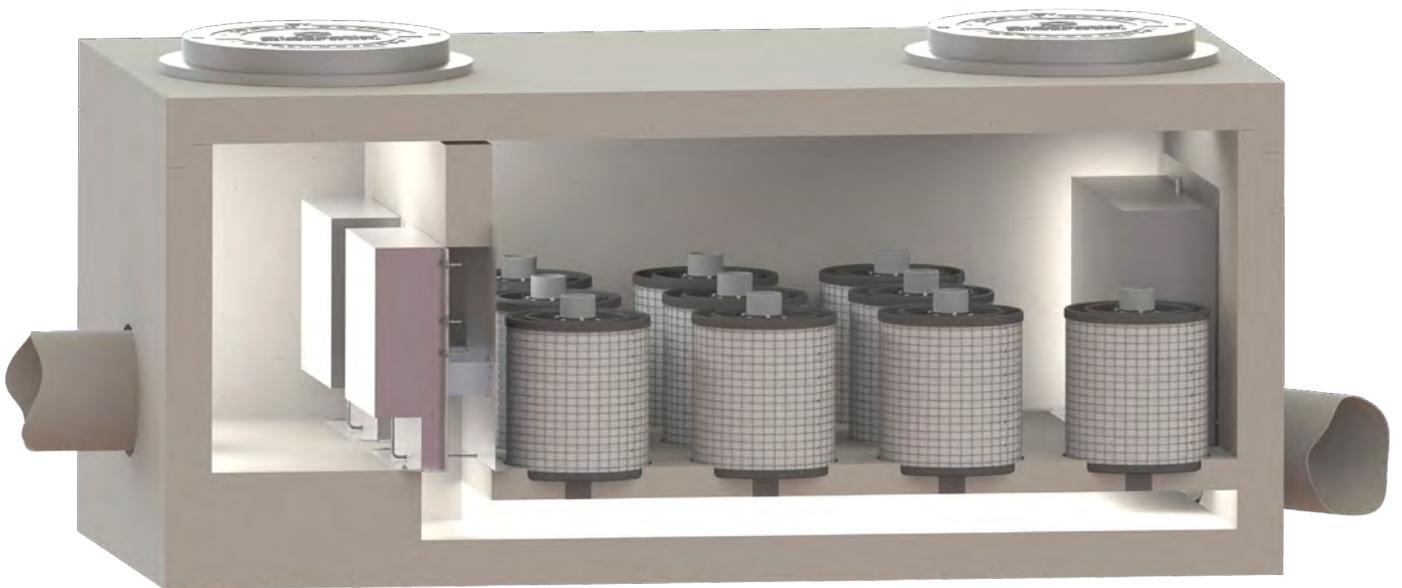


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SECTION 1

Submittal Drawing

SECTION 2

Features & Benefits



STORM WATER

MEDIA Filtration



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

Removal of Total Suspended Solids (TSS) and phosphorus.

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.

Captures and Retains Target Pollutants, Reducing the Total Downstream Discharge Load



Concrete Catch Basin



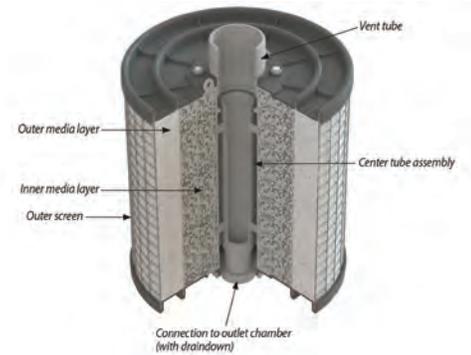
Manhole Configuration



Steel Catch Basin



Vault Configuration



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 cartridge 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%



(800) 579-8819

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SECTION 3

Product Specifications

PART 1 — GENERAL

1.1 Section Includes

- A. PerkFilter® Media Filtration System – cartridge filtration for stormwater treatment provided in a concrete vault, manhole, catch basin, or large panel vault.

1.2 Related Sections

- A. Section 01 33 00 – Submittals: Shop Drawings, Product Data, and Samples
- B. Section 02 30 00 – Earthwork: Excavation, Trenching, Backfill, and Compaction.
- C. Section 31 25 00 – Erosion and Sedimentation Controls

1.3 References

- A. American Association of State Highway and Transportation Officials (AASHTO)
 - 1. AASHTO M105 – Standard Specification for Gray Iron Castings
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A48, CL.30B – Standard Specification for Gray Iron Castings
 - 2. ASTM A82 – Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - 3. ASTM A185 – Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
 - 4. ASTM A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 - 5. ASTM A496 – Standard Specification for Deformed Steel Wire for Concrete Reinforcement
 - 6. ASTM A497 – Standard Specification for Steel Welded Wire Reinforcement, Deformed, for Concrete
 - 7. ASTM A615 – Standard Specification for Deformed and Plain, Carbon-Steel Bars for Concrete Reinforcement
 - 8. ASTM B209 – Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - 9. ASTM C33 – Standard Specification for Concrete Aggregates
 - 10. ASTM C139 – Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes
 - 11. ASTM C150 – Standard Specification for Portland Cement
 - 12. ASTM C478 – Standard Specification for Circular Precast Reinforced

Concrete Manhole Sections

13. ASTM C595 – Standard Specification for Blended Hydraulic Cements
14. ASTM C890 – Standard Practice for Minimum Structural Design Loading for Monolithic or Sectional Precast Concrete Water and Wastewater Structures
15. ASTM C891 – Standard Practice for Installation of Underground Precast Concrete Utility Structures
16. ASTM C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
17. ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants
18. ASTM C1107 – Standard Specification for Packaged Dry, Hydraulic Cement Grout (Non-Shrink)
19. ASTM C1227 – Standard Specification for Precast Concrete Septic Tanks
20. ASTM C1244 – Standard Test Method for Concrete Sewer Manholes by the Negative Air Pressure (Vacuum) Test Prior to Backfill
21. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
22. ASTM D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe
23. ASTM D2466 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

C. Definitions:

1. BMP: Best Management Practices
2. TSS: Total Suspended Solids

1.4 Submittals

The following shall be submitted by contractor in accordance with Section 01 33 00 Submittal Procedures:

A. Product Data for the Media Filter:

1. Product specifications to include but not limited to specification sheets, brochures, and performance claims.
2. Inspection and maintenance guidelines.
3. Submittal drawings shall be provided and annotated to indicate all

materials to be used and applicable material standards, required tests of materials, and all design assumptions for structural analysis. Details of steel reinforcing size and placement shall be submitted if professional engineering stamp and calculations are required by the customer. It is the responsibility of the project's engineer-of-record to verify that the design assumptions are suitable for the proposed application.

- 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, upon request:
 - 1. Targeted Pollutants of Concern
 - 2. Removal Efficiency
 - 3. Hydraulic Capacity
 - 4. Certification of adherence to applicable standard
- C. Products submitted as approved equal must be submitted at least 2 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.

1.5 Quality Assurance

The precast concrete producer shall demonstrate adherence to the standards set forth in the plant Quality Control Manual.

- A. Qualifications, Quality Control and Inspection
 - 1. The precast producer shall maintain a permanent quality control department.
 - 2. The precast concrete producer shall have a quality control program which is audited for compliance annually by persons outside that plant's employee structure.
 - 3. Upon request, the precast concrete producer shall supply a copy of their quality control manual.
- B. Quality Control
 - 1. The precast concrete producer shall perform standard concrete testing and inspection.
 - i. Replacement Check
 - 1. All non-machine-cast products shall be inspected for accuracy prior to placing concrete. Checks shall include, but not be limited to, form condition and cleanliness, form dimensions, joints, release agent, blockouts, inserts and locations, lifting devices, reinforcing steel size, spacing, clearances and proper placement. Machine cast products shall have a minimum 5% of the production checked at random.

2. Preplacement checks shall be documented and initialed by the inspector. A drawing with verifications of the above criteria can be used as documentation.

ii. Postplacement Check

1. All non-machine-cast products shall be inspected for accuracy after the concrete forms have been removed. Checks shall include, but not be limited to, dimensional checks, finishing, insert locations, squareness, honeycombing, cracking, marking, coatings, racking, hole size and location. Postplacement checks may require a corrective action report. Machine cast products shall have a minimum of 5% of production checked at random.
2. Postplacement checks shall be documented and initialed by the inspector. A drawing with verifications of the above criteria can be used as documentation.

2. Copies of the test results and inspections above shall be available upon request.

1.6 Delivery, Storage, and Handling

- A. All treatment 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 treatment system does not induce stress fatigue in the concrete.

PART 2 — PRODUCTS

2.1 Description

The inline stormwater filter treatment system shall consist of an underground precast concrete structure that houses rechargeable, passive, orifice controlled, radial-flow, media-filled filter cartridges. The concrete structure may be a vault, manhole, catch basin, or large panel vault. The treatment system shall remove sediment, metals, nutrients, gross solids, trash and debris as well as petroleum hydrocarbons.

The stormwater filter treatment system shall be sized at a hydraulic loading rate of no more than 2.5 gpm/sf of media surface area. The water quality treatment flow rate shall be as determined and approved by the Engineer.

The stormwater filter treatment system shall include an inlet chamber as well as a treatment chamber for the filter cartridges. The inlet chamber shall be self-draining, unless otherwise specified, to increase the effective life of the filter media. Filtration shall begin once the treatment chamber fills to the top of the cartridges, in order to promote distribution of sediment and other captured pollutants over the entire cartridge surface.

The treatment system must include the capability to partition flows, directing treatment flows into the filtration chamber. Flows exceeding the treatment capacity of the unit

shall be diverted around the filtration chamber to prevent resuspension and washout of previously trapped pollutants. This can be accomplished with either internal or external bypass.

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.

2.2 Materials and Design

- A. Concrete for precast stormwater treatment systems shall conform to ASTM A478 or ASTM C890 and C913 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 structure or manhole frame to grade shall conform to ASTM C32 or ASTM C139 and shall be installed in conformance with all local requirements.
 10. All mounting hardware for internal components shall be made of 304SS and shall conform to ASTM A240.
- B. Internal components including stainless steel bypass manifold (if required), filter cartridge(s), and filter media (as specified on the plans or by the Engineer) must be included as part of the filtration system and shall be provided by 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 1/2" welded wire fabric (16-gauge minimum) with a bonded PVC coating.
3. The filter media shall consist of one or more of the following, as specified on the Plans or by the Engineer:
 - i. 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.
 - ii. 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 on a U.S. Standard #6 sieve, and a cation exchange capacity ranging from 1.0 to 2.2 meq/g.
 - iii. 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.
 - iv. 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).

2.3 Performance

Each specified stormwater treatment system shall have a General Use Level Designation (GULD) for Basic and Phosphorus Treatment from the Washington Department of Ecology and shall be approved for use with integrated high flow bypass capability. Based on the GULD, each system shall be designed for an operating rate of 1.5 gpm/ft² and shall be capable of:

- Greater than 80% removal of TSS and
- Greater than 50% removal of total phosphorus.

Each specified stormwater treatment system shall also have a New Jersey Corporation for Advanced Technology (NJCAT) verification and New Jersey Department of Environmental Protection (NJDEP) certification and shall be approved for use as a filtration treatment system. Based on the certification, each system shall be designed for an operating rate of 2.5 gpm/ft² and shall be capable of greater than 80% removal of TSS.

2.4 Manufacturer

Each stormwater filtration system shall be a PerkFilter as manufactured by Oldcastle Infrastructure, 7000 Central Parkway, Suite 800, Atlanta, GA 30328. Phone: (800) 579-8819.

PART 3 — EXECUTION

3.1 Survey

- A. The installation area shall be surveyed using the work print and a checklist to identify the work to be done and to determine that the plans are correct.
- B. All underground facilities and structures such as gas, water, sewer, power, telephone cable, and so forth shall be located and identified. Location markings shall be placed by the affected utilities before construction.
- C. The survey shall identify obstacles such as overhead wires, building structures that will interfere with crane operations, work progress, or create a safety hazard.
- D. The survey shall give consideration to the soil structure so that proper shoring, sloping, or both may be planned in advance of the excavation work.

3.2 Planning

- A. Permits required to do work in accordance with the detail plans shall be secured before starting the job. All permits or a record of the permits shall be retained on the job for immediate reference.
- B. All utilities and owners of surface and subsurface facilities and structures in the area shall be given advance notification of proposed excavation. Every effort shall be made to avoid damage to the facilities of others. If any damage occurs, the owner of the damaged facility shall be notified immediately.
- C. Planning shall include the coordination of all responsible parties to ensure that arrangements for removal of excess and damaged material have been made.
- D. Should it appear that a structure location will interfere with traffic, review the situation with the engineer and notify appropriate authorities.
- E. Provide for access to call boxes, fire hydrants, etc.

3.3 Safety Requirements

- A. Safety requirements for construction shall be in accordance with all federal, state, and local regulations.

3.4 Excavating

- A. If unforeseen facilities or obstructions are encountered, stop excavation operations immediately. Expose the obstruction with wood handled digging tools and investigate them with caution. If there is any doubt as to the type of obstruction exposed, request positive identification from those suspected of owning the facility and then proceed as circumstances dictate.
- B. Inspect excavations after every rainstorm or other hazard-increasing occurrence, and increase the protection against slides and cave-ins, if necessary.
- C. In dewatering excavations, make certain that the discharge is carried to a suitable

runoff point.

- D. Excavation size shall be large enough to allow access around the structure after it is installed.

3.5 Shoring

- A. Shoring for construction shall be in accordance with all federal, state, and local regulations

3.6 Installation

- A. Site Access – The general contractor shall be responsible for providing adequate access to the site to facilitate hauling, storage, and proper handling of the precast concrete units.
- B. Vault Installation – Precast concrete units shall be installed: to the lines and grades shown on the contract documents or otherwise specified; be lifted by suitable lifting devices at points provided by the precast concrete producer; in accordance with applicable industry standards. Upon request, the precast concrete producer shall provide installation instructions. Field modifications to the product shall relieve the precast producer of liability and warranty regardless if such modifications result in the failure of the precast concrete unit.
- C. Plumbing – Inlet and outlet piping, as required, shall be installed and connected in accordance with applicable piping specification. All connections shall be watertight.
- D. Leak Resistance – Where leak resistance is a necessary performance characteristic of the precast concrete unit's end use, joint sealant, pipe-entry connectors and other penetrations shall be sealed according to manufacturer's requirements to ensure the integrity of the system.

3.7 Backfilling and Restoration

- A. Complete backfilling as soon as possible after the structure has been placed.
- B. Backfill material shall be granular and free from large stones, rocks, and pavement. Expansive soil material shall not be used as backfill around the structure.
- C. Backfilling shall be achieved by lifts (layers) to the required compaction.
- D. Follow up inspections for settlements are required. Should settlement occur, the contractor shall be responsible for all necessary repairs.

3.8 Field Quality Control

- A. Job Site Tests – When leak resistance testing is required for a precast concrete structure, one of the following methods may be followed:

- 1. Vacuum Testing

- i. Prior to backfill, vacuum test system according to ASTM C1244 for manholes and ASTM C1227 for septic tanks.

2. Hydrostatic Testing

- i. First Backfill the structure, then fill to the normal water level, let stand for 24 hours. Refill to the original water line and measure the water level change over a 24-hour period. Leak shall not exceed 5% of volume.

B. Inspection

1. Final field elevations and compaction properties shall be verified and documented.

3.9 Internal Component Installation

- A. Internal components may include bypass assembly(s), outlet hood, filter cartridge(s), and cartridge hold-down bar(s).
- B. If the filtration system is delivered without fully pre-installed internal components, the contractor shall install internal components, as required. All internal parts shall be pre-cut, and/or preassembled by the manufacturer for installation by the contractor. Upon request, the manufacturer will provide technical assistance for installation of internal components.

3.10 Activation

- A. The treatment system shall be protected from construction runoff and construction sediment using appropriate erosion control practices and pipe plugs, as necessary.
- B. The treatment system shall not be activated until all sediment is swept from gutters and stormwater collection system piping is flushed and cleaned, as appropriate. No sediment shall be allowed to enter the treatment system during flushing or as a result of the flushing process.
- C. If the inlet piping has been plugged to protect the treatment system from sediment during construction, remove the plug(s) from the inlet pipe(s) to activate the treatment unit.

END OF SECTION

SECTION 4

Design Guidelines



PERKFILTER®

Design Guide

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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. Filtered water then flows through the outlet chamber and is discharged through an outlet pipe.

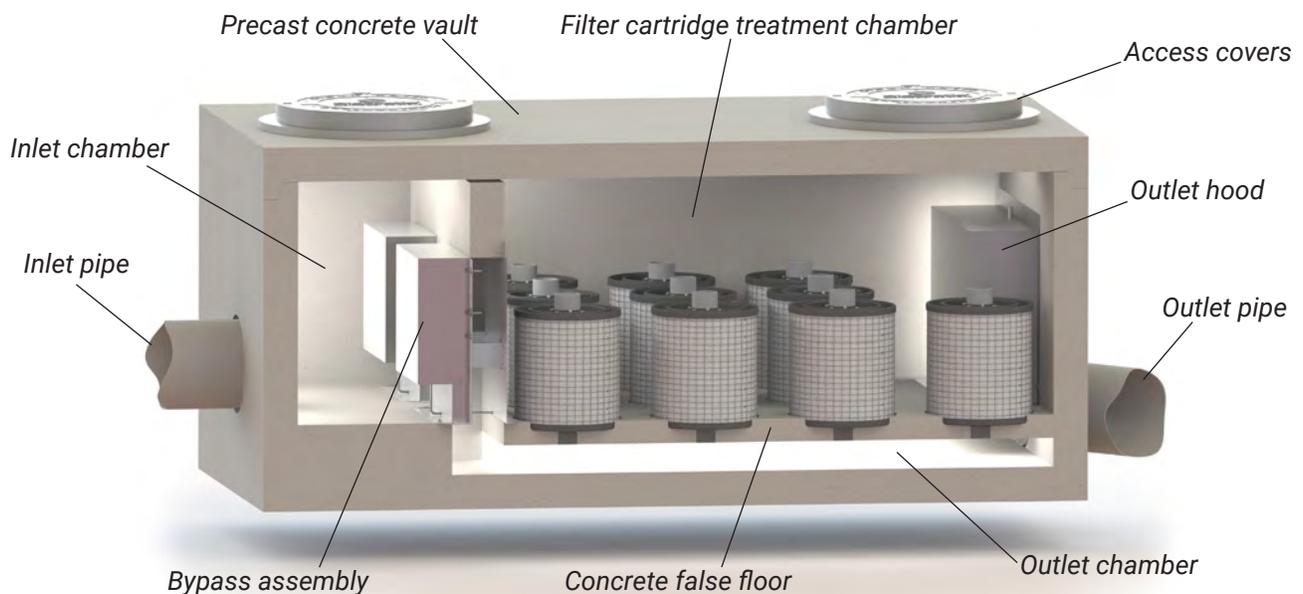
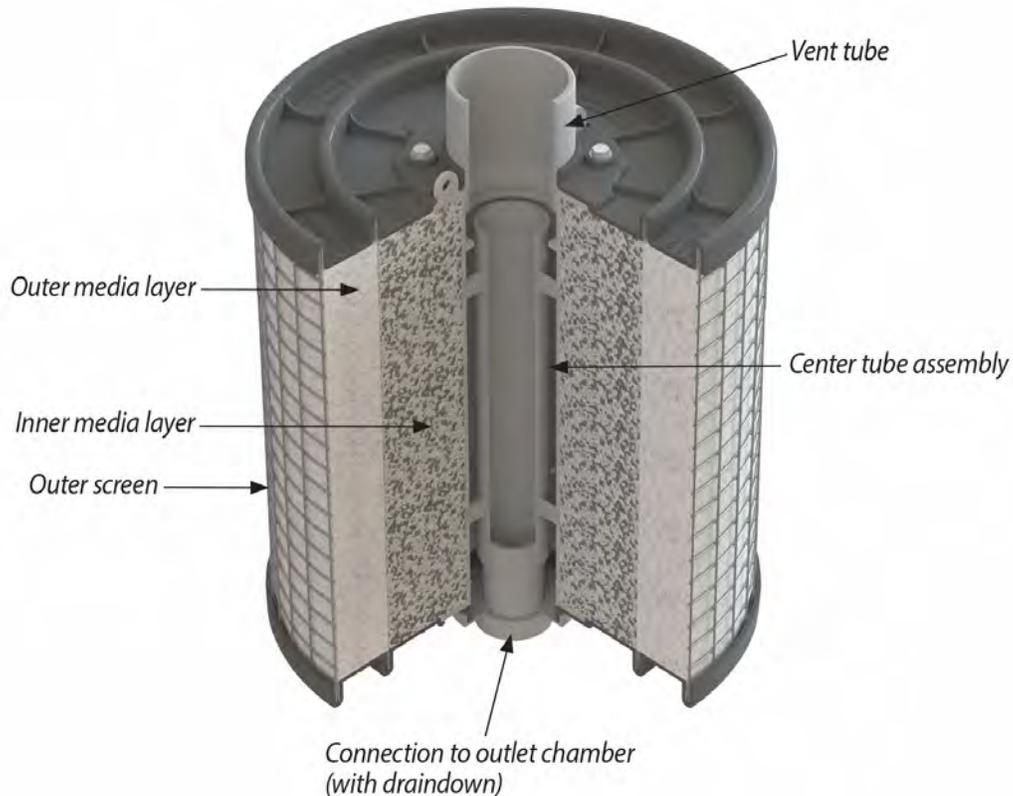


Figure 1. Schematic of the PerkFilter System

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

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 Infrastructure 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

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 Infrastructure 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

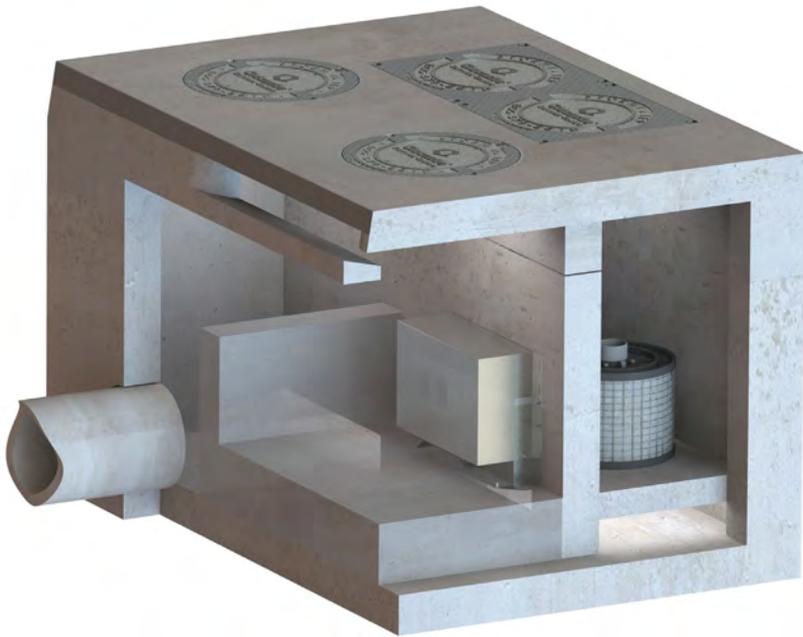
There are many ways to configure the PerkFilter system. The structure types included below are the most common. Standard drawing details for each configuration are available and provide specific dimensions and depth constraints for each structure.

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 Infrastructure 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 Infrastructure 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.oldcastleinfrastructure.com

(800) 579-8819

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

SECTION 5

Performance Data



PERKFILTER®

Field Monitoring Performance Summary

PerkFilter® Field Monitoring Performance Summary

Technology Description

The PerkFilter Media Filtration Device (PerkFilter) is a stormwater filtration device that uses physical and chemical treatment processes such as separation, sedimentation, filtration and sorption to remove sediment, metals, nutrients and hydrocarbons close to their sources. The PerkFilter is a media-filled, cartridge filtration device where the number and height of cartridges is tailored to the specific needs of the site. The PerkFilter is available in various configurations, including single- or multiple-cartridge catch basins, multiple sizes of precast concrete vaults and manholes, and larger custom-designed modular concrete structures, allowing maximum design flexibility.

The PerkFilter typically consists of an inlet chamber for removal of gross pollutants and diversion of bypass flows, 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. The PerkFilter can be designed as a flow-based or volume-based system, and may be used with or without a separate high-flow bypass structure since standard configurations allow for a certain amount of internal high-flow bypass. As with any stormwater treatment system, the PerkFilter requires periodic maintenance to prolong the life of the system. Typical maintenance includes removal of accumulated sediment and debris as well as replacement of spent cartridge media. Frequency of maintenance depends on the conditions of the site and performance of the system.

PerkFilter Approvals

After an 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. In addition, the PerkFilter has received approval from the Virginia Department of Environmental Quality (DEQ) with a total phosphorus removal efficiency credit of 50%, and has been placed on the Virginia BMP Clearinghouse as an approved filtration device. The PerkFilter has also been found to meet the general performance criteria of the Maryland Stormwater Design Manual, and thus may be used as a structural practice for water quality treatment according to the Maryland Department of the Environment. Most recently, a full-scale laboratory investigation of the PerkFilter was completed according to the Filtration Protocol of the New Jersey Department of Environmental Protection (NJDEP). Based on the results of the study, the NJDEP certified the use of the PerkFilter, credited at a TSS removal rate of 80% as an on-line system when designed according to the conditions of its verification from the New Jersey Corporation for Advanced Technology.

PerkFilter Field Monitoring and Certification

A PerkFilter installed at the Washington State Ferries Bainbridge Island Terminal was monitored from February 2009 through February 2010 by Herrera Environmental Consultants (Herrera) to obtain performance data in support of the GULD application. Monitoring was performed in accordance with procedures described in *Guidance for Evaluating Emerging Stormwater Treatment Technologies; Technology Assessment Protocol – Ecology (TAPE) (Ecology, 2008)*. *The Technical Evaluation Report (TER) – PerkFilter Stormwater Treatment System Performance Monitoring* was prepared by Herrera to demonstrate performance of the PerkFilter in meeting the goals specified by Ecology for both basic and phosphorus treatment.

Flow data was collected from eighty-two storm events, from May 2009 through February 2010. Twenty-two of these storm events were expected to meet the required storm event characteristics and were sampled for the water quality investigation and technical evaluation. Annual precipitation at the site during the test period was 36.75 inches, which is within the normal range of rainfall for this location based on the 61-year rainfall record. The twenty-two storm events sampled met the TAPE guidelines for minimum precipitation depth (except one), minimum antecedent dry period, minimum storm duration, and minimum storm intensity.

TSS and Phosphorus Removal

The following key Findings of Fact were issued by Ecology as part of the GULD, and summarize the performance of the PerkFilter for both Total Suspended Solids (TSS) and Total Phosphorus (TP) (Ecology, 2010):

- Based on field testing at a flow rate of 0.57 gpm/inch of cartridge height (1.5 gpm per sq ft filter surface area), the PerkFilter containing ZPC media had an average TSS removal efficiency of 82.4% for an influent concentration between 20 mg/L and 200 mg/L. The PerkFilter containing ZPC media had an average removal efficiency of 85.2% for an influent concentration between 100 mg/L and 200 mg/L.
- Based on field testing at a flow rate of 0.57 gpm/inch of cartridge height (1.5 gpm per sq ft filter surface area), the PerkFilter containing ZPC media had an average TP removal efficiency of 62.4% for an influent concentration between 0.1 mg/L and 0.5 mg/L.

Metals Removal

The field monitoring also included sampling for metals removal, including zinc, copper and aluminum. Using the same criteria for event qualification as for the TSS analysis (16 qualified events), the PerkFilter had the following removal efficiencies:

- For total zinc: an average removal efficiency of 62% for influent concentrations ranging from 0.04 mg/L to 0.25 mg/L,
- For total copper: an average removal efficiency of 50% for influent concentrations ranging from 0.005 mg/L to 0.035 mg/L, and
- For aluminum: an average removal efficiency of 76% for influent concentrations ranging from 0.34 mg/L to 9.3 mg/L.

Performance Summary

Table 1 summarizes the PerkFilter field monitoring performance, including the range of influent and effluent concentrations as well as average removal efficiency, by parameter. This performance summary demonstrates that the PerkFilter is capable of achieving high removal efficiencies for key stormwater pollutants.

Table 1. PerkFilter Performance Summary

Parameter	Influent Concentration Range	Effluent Concentration Range	Average Removal Efficiency
TSS	20 - 200 mg/L	3 - 36 mg/L	82%
TSS	100 - 200 mg/L	8 - 36 mg/L	85%
Total Phosphorus	0.1 - 0.5 mg/L	0.02 - 0.2 mg/L	62%
Total Zinc	0.04 - 0.25 mg/L	0.009 - 0.098 mg/L	62%
Total Copper	0.005 - 0.035 mg/L	0.002 - 0.015 mg/L	50%
Aluminum	0.34 - 9.3 mg/L	0.07 - 1.7 mg/L	76%

References

Herrera Environmental Consultants. 2010. Technical Evaluation Report (TER) - PerkFilter Stormwater Treatment System Performance Monitoring Volume 1.

Washington State Department of Ecology (Ecology). 2008. Guidance for Evaluating Emerging Stormwater Treatment Technologies: Technology Assessment Protocol - Ecology (TAPE). Publication No. 02-10-037, Washington State Department of Ecology, Olympia, Washington.

Washington State Department of Ecology (Ecology). 2010. PerkFilter Using ZPC Filter Media General Use Level Designation for Basic and Phosphorus Treatment.

SECTION 6

Inspection & Maintenance



PERKFILTER®

Inspection and Maintenance Guide



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.

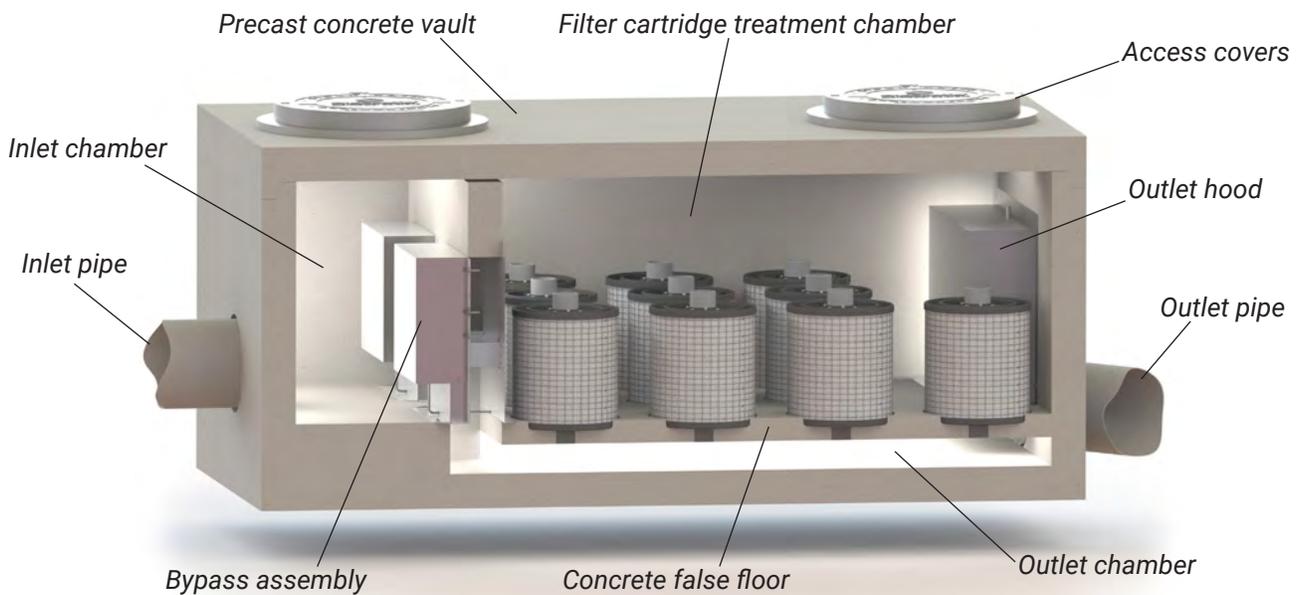
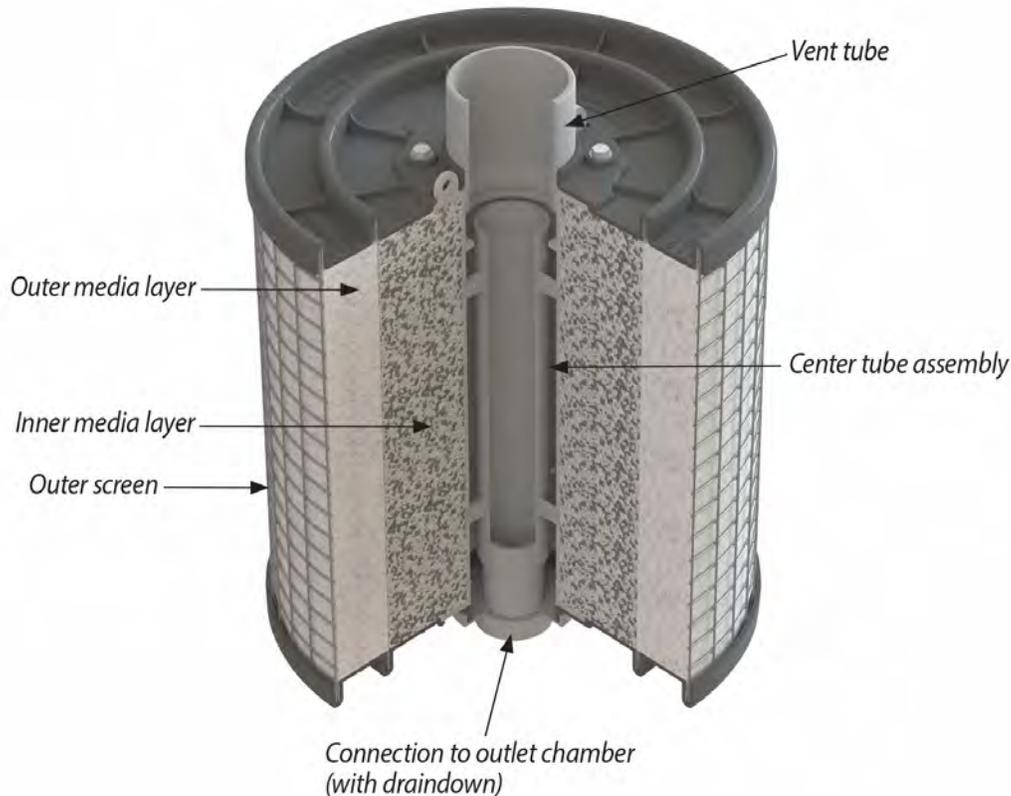


Figure 1. Schematic of the PerkFilter System.

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 Infrastructure 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 Infrastructure 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 Infrastructure.
-

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:

Media Type:

Count____each 12" 18" 24" 30"

ZPC Perlite Other _____

Condition of Internal Components

Notes:

- Good
- Damaged
- Missing

Inlet or Outlet Blockage or Obstruction

Notes:

- Yes
- No

Floating Trash and Debris

Notes:

- Significant
- Not Significant

Floating Oils

Notes:

- Significant
- Not Significant
- Spill

Sediment Depth in Inlet Chamber

Notes:

Inches of Sediment: _____

Sediment Depth in Treatment Chamber

Notes:

Inches of Sediment: _____

Standing Water in Treatment Chamber

Notes:

Inches of Standing Water: _____

Maintenance Required

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

PERKFILTER®

OUR MARKETS



**BUILDING
STRUCTURES**



COMMUNICATIONS



WATER



ENERGY



TRANSPORTATION