



PERKFILTER®

Technical Note

Nutrients Removal - Kjeldahl Nitrogen

Nutrients Removal with the PerkFilter®

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 Testing 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 summarizes 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.

Nitrogen Removal

In addition to the parameter sampling required for the GULD application, total Kjeldahl nitrogen (TKN) was also sampled. TKN is a measurement of the organic and ammonia forms of nitrogen, and is one component of the total nitrogen commonly found in stormwater. Total nitrogen refers to the combination of both organic and inorganic nitrogen, and is commonly approximated by adding TKN and nitrite plus nitrate nitrogen concentrations. The relative amounts of the different forms of nitrogen in stormwater runoff depend on many factors, and vary based on land use.

Using similar criteria for event qualification as for the TP analysis (10 events), the PerkFilter had an average TKN removal efficiency of 53% for an influent concentration between 0.5 mg/L and 3.6 mg/L, and demonstrated an aggregate TKN load reduction of 60%. The performance of the PerkFilter relative to both TP and TKN removal demonstrates that the PerkFilter is capable of significant removal of nutrients.

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.

PERKFILTER®

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