

Attachment 1

Manufactured Treatment Device (MTD) Registration

1. Manufactured Treatment Device Name:

HydroFilter

2. Company Name: Hydroworks, LLC

Mailing Address: 257 Cox Street

City: Roselle

State: NJ Zip: 07203

3. Contact Name (to whom questions should be addressed):

Graham Bryant

Mailing Address: 257 Cox Street

City: Roselle

State: NJ

Zip: 07203

Phone number: 848-235-5950 ext.111

Fax number: 888-783-7271

E-mail address: gbryant@hydroworks.com

Web address: hydroworks.com

4. Technology

Specific size/capacity of MTD assessed (include units):

The HydroFilter is a filtration system that uses round cartridges filled with perlite to filter stormwater. The cartridges are installed in a precast concrete box or round manhole structure. Water filters through the cartridges radially from the outside into a hollow core. Water reaching the core is conveyed through piping to the outlet pipe of the structure. The cartridges are modular and stackable such that the footprint of the structure housing the cartridges can be minimized.

The HydroFilter is available in a variety of sizes and configurations. Structure size and number of filter cartridges are determined based on providing annual TSS removal that meets or exceeds the regulatory requirements for a project. The performance, and therefore sizing, of the HydroFilter is largely driven by the local hydrology of a site.

The model numbers referenced in the NJDEP certification letter (Appendix 1) refer to the size and type of structures (R=round or B=rectangular), number of filter stacks, and filters cartridges per stack. These model numbers are based on NJ precast availability, which varies in different regions (e.g. Virginia in this case). Therefore, to simplify the process, HydroFilter model numbers reference only the number of filter cartridges. Each model has the preface HF for

HydroFilter followed by the number of cartridges. For example, an HF 9 has nine (9) filter cartridges, which can be stacked in various configurations.

The HydroFilter was independently tested in Holden, MA by Alden Research Laboratory. Alden is the premier stormwater testing laboratory in the United States, having been involved in flow studies since the 1890s. The NJDEP certified maximum treatment flow rate (MTFR) of a single HydroFilter cartridge based on laboratory testing is 0.03 cfs. The NJDEP MTFR can be scaled up for any HydroFilter model by multiplying the single-cartridge MTFR by the number of cartridges contained in the unit. However, the filter media, and therefore filtration rate, are specific to the target of 80% TSS removal for the NJDEP particle size distribution (PSD). If a coarser design PSD is specified, fewer cartridges and/or a faster flowing filtration media can be used to achieve the same level of TSS removal.

In Virginia, test results are accepted from both TAPE and NJDEP. Accordingly, Hydroworks reserves the right to provide alternate equal designs to TAPE tested filters based on the TSS PSD data from the TAPE reports themselves.

Range of drainage areas served by MTD (acres):
Include sizing chart or describe sizing criteria:

Laboratory testing to the NJDEP filter protocol evaluates an MTD's TSS removal efficiency at a single, constant flow rate. The resulting removal efficiency therefore does not represent annual removal. To more accurately simulate annual TSS removal performance, Hydroworks uses local historical rainfall records to design and size its products. Using local rainfall allows Hydroworks to optimize a design to achieve the desired level of TSS removal and treatment volume with the minimum number of cartridges.

Laboratory testing showed that the HydroFilter's removal rate remained consistent, independent of TSS loading. For the 20 test runs performed, the starting and ending TSS removal rates were both 86.5% with no decreasing trend observed (see Figure 1). NJDEP testing is conducted with the NJDEP TSS PSD, which is plotted in Figure 2. As shown in the figure, 85% TSS removal correlates to removal down to 6 um. Based on this performance data, HydroFilter can be sized to provide the required removal efficiency and treatment flow rate for the volume of water from the upstream drainage area. Design parameters include the temporal distribution of rainfall (i.e., influent flow rate), the design PSD, and the number of filter cartridges (i.e., filtration rate). The NJDEP MTFR for the HydroFilter is calculated based on 80% removal of the NJDEP PSD at a constant flow rate. The MTFR for HydroFilter based on regulatory requirements outside New Jersey may differ.

Due to site-specific variations in hydrology, TSS, and optimal design, a generic sizing chart for the HydroFilter will not be used. Instead, sizing will be tailored to site-specific characteristics and requirements.

Intended application: on-line or offline:

The HydroFilter can be installed on-line or offline.

Media used (if applicable):

Treated perlite (proprietary process)

5. Warranty Information (describe, or provide web address):

Hydroworks provides a standard 1-year warranty for manufacturing defects on all of its products including HydroFilter. Fouling of the filter cartridges is not covered under the warranty.

6. Treatment Type

- Hydrodynamic Structure
- Filtering Structure
- Manufactured Bioretention System
- Provide Infiltration Rate (in/hr):
- Other (describe):

7. Water Quality Treatment Mechanisms (check all that apply)

- Sedimentation/settling
- Infiltration
- Filtration (specify filter media)
- Adsorption/cation exchange
- Chelating/precipitation
- Chemical treatment
- Biological uptake
- Other (describe):

8. Performance Testing and Certification (check all that apply):

Performance Claim (include removal efficiencies for treated pollutants, flow criteria, drainage area): 80% removal of total suspended solids (TSS)

The HydroFilter achieved a cumulative TSS removal efficiency of 85.3% with no performance drop-off for the duration of testing. For the 2-cartridge system, the calculated MTRF was 25 gpm (0.06 cfs), and the surface loading rate was 2.0 gpm/ft². The HydroFilter also removes nutrients and other pollutants from stormwater, although the removal efficiencies for these

constituents were not quantified due to a lack of standardized nutrient test protocols for laboratory testing.

Specific size/Capacity of MTD assessed:

Independent testing of the HydroFilter was performed by Alden Labs in Holden, MA. Twenty TSS removal tests were conducted on a HydroFilter unit consisting of two cartridges (one stacked on top of the other). The average TSS removal over the 20 tests was 85.3% as shown in Figure 1. There was no reduction in TSS removal efficiency over the span of tests (i.e. no observed trend and the result of 1st run [86.5% removal] equaled the result of 20th run). No maintenance was performed during any of the tests (i.e. TSS removal results represent cumulative loading of TSS on filter cartridges). The NJDEP certification letter and NJCAT verification report are provided in Appendices 1 and 2 respectively.

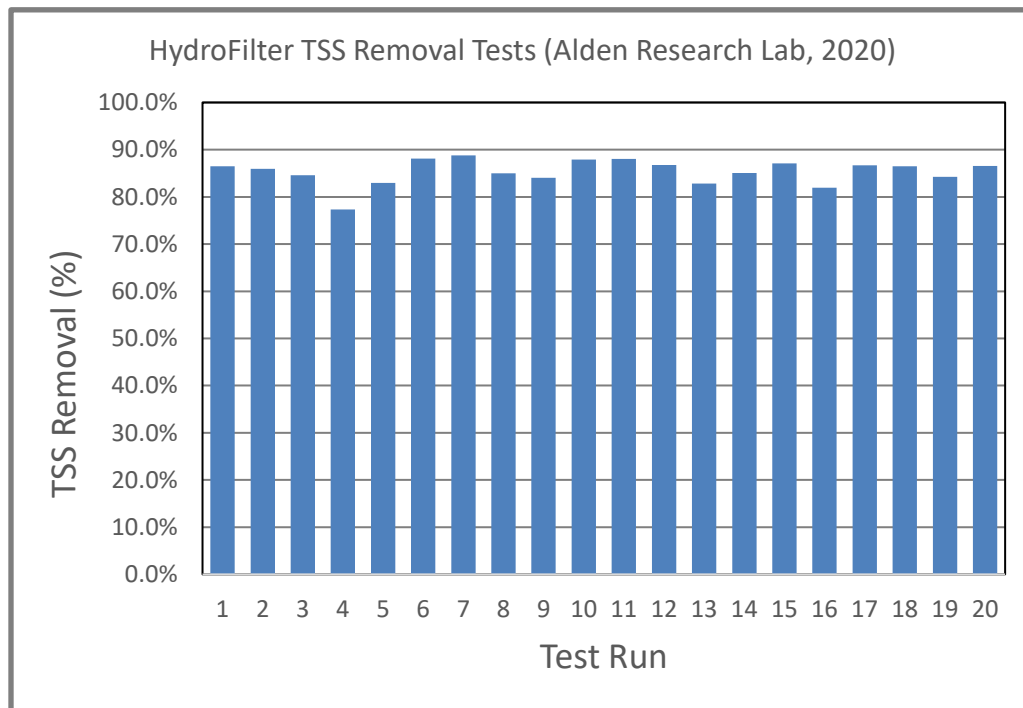


Figure 1. HydroFilter TSS Removal Results at 25 gpm for a 2-Cartridge System

Scour testing was performed at the end of the TSS removal results with the cumulative TSS load in place. Additional scour testing was performed by adding additional TSS onto the floor of the tank housing the filter. No Scour (average < 2 mg/l) was observed during the scour test, even with additional preloaded sediment. Accordingly, the HydroFilter is rated by NJDEP for online use.

All testing at Alden was supervised by Jim Mailloux, who is a senior engineer at Alden and is well recognized in the stormwater testing community. No personnel from Hydroworks were involved in any of the testing (data collection) or data analysis.

It should be noted that the Alden report references an HF3i. This nomenclature references the diameter of the test tank (3 ft) in which the HydroFilter cartridges (2 ft diameter) were tested. The "I" references an inlet orientation since the 2 cartridges were tested with water falling in from above through a grate. This testing configuration creates the maximum turbulence inside the test tank, which supports the use of the HydroFilter as either an inlet or for inline (horizontal pipes) applications.

Has the MTD been "approved" by an established granting agency, e.g. New Jersey Department of Environmental Protection (NJDEP) , Washington State Department of Ecology, etc.

No

Yes; For each approval, indicate (1) the granting agency, (2) use level if awarded (3) the protocol version under which performance testing occurred (if applicable), and (4) the date of award, and attach award letter.

HydroFilter has received laboratory certification from NJDEP for a TSS removal rate of 80%. The NJDEP certification letter dated December 17, 2020 is included in Appendix 1.

Was an established testing protocol followed?

No

Yes, (1) Provide name of testing protocol followed, (2) list any protocol deviations:

Independent laboratory testing was performed by Alden Research Laboratory, Inc (Alden) in accordance with the NJDEP "Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device" (January 2013a)(NJDEP Filter Protocol).

Provide the information below and provide a performance report (attach report):

For lab tests:

- i. Summarize the specific settings for each test run (flow rates, run times, loading rates) and performance for each run:

For sediment removal efficiency testing, a minimum of ten (10) 30-minute test runs were required to be conducted to meet the removal efficiency criterion. An additional ten (10) test runs were conducted to assess mass loading. The filter cartridges were initially clean and free of sediment, but captured sediment was not removed between test runs. Each test was conducted at a constant flow rate of 25 gpm (MFR for 2-cartridge system) with a target influent sediment concentration of 200 mg/L \pm 20 mg/L. All test runs met or exceeded the protocol criteria. Figure 1 shows the removal efficiency results for each run. The cumulative removal efficiency was 85.3%. The mass loading capacity was 31.8 lbs with a mass loading capture capacity of 27.1 lbs (2.1 lbs/ft² of filter area).

Scour testing was performed at the conclusion of the removal efficiency and mass loading testing to qualify the HydroFilter as an on-line system. The scour testing was conducted at 50

gpm (200% MTRF), and fifteen (15) effluent samples were collected over a period of 30 minutes (every 2 minutes). The system qualified for on-line installation since the average adjusted effluent concentration was ≤ 20 mg/L.

- ii. If a synthetic sediment product was used, include information about the particle size distribution of the test material:

The sediment particle size distribution (PSD) used for removal efficiency testing was comprised of 1-1000 micron silica particles as shown in Table 1 and Figure 2, which meets the NJDEP specifications for PSD. The d_{50} of 60 microns was less than the required 75 microns.

Table 1. PSD Analyses of Alden NJDEP 1-1000 micron Mix					
Particle Size (um)	NJDEP Specification	Sample 1	Sample 2	Sample 3	Average
1000	100%	100%	100%	100%	100%
500	95%	96%	96%	97%	96%
250	90%	91%	91%	93%	92%
150	75%	76%	76%	75%	76%
100	60%	60%	60%	61%	60%
75	50%	53%	53%	52%	53%
50	45%	48%	48%	46%	47%
20	35%	33%	34%	35%	34%
8	20%	18%	19%	19%	19%
5	10%	12%	13%	15%	13%
2	5%	4%	5%	4%	4%
75	d_{50}	56	59	65	60

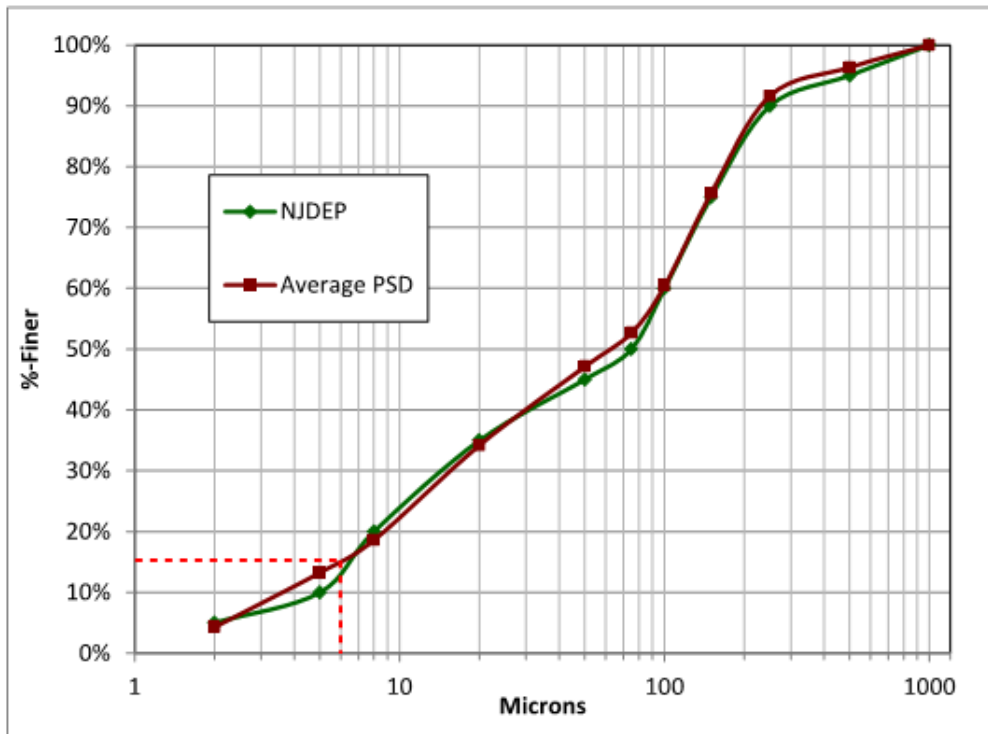


Figure 2. PSD Curves of 1-1000 micron Test Sediment and NJDEP Specifications

- iii. If less than full-scale setup was tested, describe the ratio of that tested to the full-scale MTD:

Laboratory testing used a full-scale HF 2 (two 12" high x 24" diameter stacked cartridges) in a 3-foot diameter tank.

For field tests:

- i. Provide the address, average annual rainfall and characterized rainfall pattern, and the average annual number of storms for the field-test location:
- ii. Provide the total contributing drainage area for the test site, percent of impervious area in the drainage area, and percentages of land uses within the drainage area (acres):
- iii. Describe pretreatment, bypass conditions, or other special circumstances at the test site:
- iv. Provide the number of storms monitored and describe the monitored storm events (amount of precipitation, duration, etc.):
- v. Describe whether or not monitoring examined seasonal variation in MTD performance:
- vi. If particle size distribution was determined for monitored runoff and/or sediment collected by the MTD, provide this information:
- vii.

9. MTD History:

How long has this specific model/design been on the market?

The HydroFilter received NJDEP certification in December 2020.

List no more than three locations where the assessed model size(s) has/have been installed in Virginia. If applicable, provide permitting authority. If known, provide latitude & longitude:

Currently there are no HydroFilters installed in Virginia.

List no more than three locations where the assessed model size(s) has/have been installed outside of Virginia. If applicable, provide permitting authority. If known, provide latitude & longitude:

Currently there are no 2-cartridge systems installed.

An HF 9 is installed in Ajax, Ontario.

10. Maintenance:

What is the generic inspection and maintenance plan/procedure? (attach necessary documents):

HydroFilter should be visually inspected at least twice during the first year of operation for normal stabilized sites. The initial inspections will indicate the required future frequency of inspection and maintenance. An inspection involves observing the water level inside the structure approximately 24 hours after rainfall. If the structure has not drained down to the outlet pipe within 24 hours, the HydroFilter requires maintenance. This indicates that the filter's treatment rate has decreased to the point where it can no longer provide the required annual pollutant removal.

It is anticipated that the filter cartridges will need to be replaced annually. However, this will depend on site-specific hydrology and pollutant loadings. An Operations and Maintenance Manual is provided in Appendix 3. The manual should be consulted for details regarding O&M.

Is there a maintenance track record/history that can be documented?

No, no track record.

Yes, track record exists; (provide maintenance track record, location, and sizing of three to five MTDs installed in Virginia [preferred] or elsewhere):

Recognizing that maintenance is an integral function of the MTD, provide the following: amount of runoff treated, the water quality of the runoff, and what is the expected maintenance frequency for this MTD in Virginia, per year?

Based on independent lab testing, it is anticipated that the filter cartridges will need to be replaced approximately once per year in Virginia. Actual maintenance frequency will be dependent on site-specific conditions. It is also noted that TSS removal efficiency did not decrease at the end of 20 sequential test runs indicating that the test filters did not require maintenance even after 31.8 lbs of sediment had been loaded onto the 2-cartridge system.

Total life expectancy of MTD when properly operated in Virginia and, if relevant, life expectancy of media:

The life expectancy of homopolymer and copolymer polypropylene and HDPE (internal components of HydroFilter) have not been defined since these products have only been available for the last 50 years or so. TEPPFA (The European Polypropylene and Polyethylene Fittings Association) gives a 100-year service life to these plastics (TEPPFA, 2014). The life expectancy of the precast manhole is 100 years. The filter media will be periodically cleaned or replaced.

For media or amendments functioning based on cation exchange or adsorption, how long will the media last before breakthrough (indicator capacity is nearly reached) occurs?

N/A

For media or amendments functioning based on cation exchange or adsorption, how has the longevity of the media or amendments been quantified prior to breakthrough (attach necessary performance data or documents)?

N/A

Is the maintenance procedure and/or are materials/components proprietary?

- Yes, proprietary
 No, not proprietary

The cartridges and filter media are proprietary, but inspection, removal, and cleaning of the HydroFilter cartridges can be performed by anyone appropriately licensed.

Maintenance complexity (check all that apply):

- Confined space training required for maintenance
 Liquid pumping and transportation

Specify method: [Vacuum truck](#)

- Solids removal and disposal

Specify method: [Landfill](#)

Other noteworthy maintenance parameter (describe):

11. Comments

Include any additional explanations or comments:

12. Certification

Signed by the company president or responsible officer of the organization:

“I certify that all information submitted is to the best of my knowledge and belief true, accurate, and complete.”

Signature: 

Name: Graham Bryant, P.Eng.

Title: President

Date: May 28, 2021

NOTE: All information submitted to the department will be made publically accessible to all interested parties. This MTD registration form will be posted on the Virginia Stormwater BMP Clearinghouse website.

Appendices

Appendix 1

NJDEP Certification Letter

Appendix 2

NJCAT Verification Report

Appendix 3

Operations and Maintenance Manual