THE ENVIRONMENTAL TECHNOLOGY VERIFICATION PROGRAM

U.S. Environmental Protection Agency

NSF International

ETV Joint Verification Statement

TECHNOLOGY TYPE:	**STORMWATER TREATMENT TECHNOLOGY**	
APPLICATION:	**SUSPENDED SOLIDS AND ROADWAY POLLUTANT TREATMENT**	
TECHNOLOGY NAME:	**THE STORMWATER MANAGEMENT STORMFILTER® USING PERLITE FILTER MEDIA**	
TEST LOCATION:	**GRIFFIN, GEORGIA**	
COMPANY:	**STORMWATER MANAGEMENT, INC.**	
ADDRESS:	**12021-B NE Airport Way** **Portland, Oregon 97220**	PHONE: **(800) 548-4667** FAX: **(503) 240-9553**
WEB SITE:	**http://www.stormwaterinc.com**	
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NSF International (NSF), in cooperation with the U.S. Environmental Protection Agency (EPA), operates the Water Quality Protection Center (WQPC), one of six centers under the Environmental Technology Verification (ETV) Program. The WQPC recently evaluated the performance of the Stormwater Management StormFilter® (StormFilter), with perlite filter media, manufactured by Stormwater Management, Inc. (SMI). The StormFilter was installed in a city-owned right-of-way near downtown Griffin, Georgia. Paragon Consulting Group (PCG) performed the testing.

EPA created the ETV Program to facilitate the deployment of innovative or improved environmental technologies through performance verification and dissemination of information. The goal of the ETV program is to further environmental protection by accelerating the acceptance and use of improved and more cost-effective technologies. ETV seeks to achieve this goal by providing high quality, peer-reviewed data on technology performance to those involved in the design, distribution, permitting, purchase, and use of environmental technologies.

ETV works in partnership with recognized standards and testing organizations; stakeholder groups, which consist of buyers, vendor organizations, and permitters; and with the full participation of individual technology developers. The program evaluates the performance of innovative technologies by developing test plans that are responsive to the needs of stakeholders, conducting field or laboratory tests (as appropriate), collecting and analyzing data, and preparing peer-reviewed reports. All evaluations are conducted in accordance with rigorous quality assurance protocols to ensure that data of known and adequate quality are generated and that the results are defensible.

TECHNOLOGY DESCRIPTION

The following description of the StormFilter was provided by the vendor and does not represent verified information.

The StormFilter consists of an inlet bay, flow spreader, cartridge bay, overflow baffle, and outlet bay, housed in an 18-ft long by 8-ft wide pre-cast concrete vault. The inlet bay serves as a grit chamber and provides for flow transition into the cartridge bay. The flow spreader traps floatables, oil, and surface scum. This StormFilter was designed to treat stormwater at a maximum flow rate of 495 gpm (1.1 cfs). Flows greater than the maximum flow rate would overflow a baffle between the cartridge bay and the outlet bay, bypassing the filter media.

The StormFilter contains filter cartridges that contain media designed to remove specific pollutants. In this test, the cartridges were filled with perlite filter media, which traps particulates and adsorbs materials such as petroleum hydrocarbons, suspended solids, and pollutants such as nutrients and metals that commonly bind to sediment particles. Water in the cartridge bay infiltrates the filter media to a tube in the center of the filter cartridge. When the center tube fills, a float valve opens and a check valve on top of the filter cartridge closes, creating a siphon that draws water through the filter media. The filtered water drains into a manifold under the filter cartridges and to the outlet bay, where it exits the system through the discharge pipe. The system resets when the cartridge bay is drained and the siphon is broken. Air pulled into the filters when the siphon breaks helps to scrub solids from the filter, cleaning the filters and preventing the filter cartridges from clogging.

The vendor claims that the treatment system can remove 50% to 90% of the suspended solids in stormwater, as well as 25% to 60% of total phosphorus, depending on site characteristics, pollutant loading, and sediment particle size. The vendor's claims are outlined in greater detail in the verification report.

VERIFICATION TESTING DESCRIPTION

Methods and Procedures

The test methods and procedures used during the study are described in the *Environmental Technology Verification Test Plan For The Stormwater Management StormFilter, TEA-21 Project Area, City of Griffin, Spalding County, Georgia,* (June 2003). The City of Griffin requires that all storm drain systems be designed to pass peak flows from a 25-yr event without causing surface flooding. For the StormFilter drainage basin, a 25-yr storm event would have a 1.47-min time of concentration and would generate a peak runoff of 4.93 cfs. The rational method was used to calculate the peak flows to the system.

Verification testing consisted of collecting data during a minimum of 15 qualified events that met the following criteria:

- The total rainfall depth for the event, measured at the site, was 0.2 in. (5 mm) or greater;
- Flow through the treatment device was successfully measured and recorded over the duration of the runoff period;
- A flow-proportional composite sample was successfully collected for both the influent and effluent over the duration of the runoff event;
- Each composite sample was comprised of a minimum of five aliquots, including at least two aliquots on the rising limb of the runoff hydrograph, at least one aliquot near the peak, and at least two aliquots on the falling limb of the runoff hydrograph; and
- There was a minimum of six hours between qualified sampling events.

Automated sample monitoring and collection devices were installed and programmed to collect composite samples from the influent and effluent during qualified flow events. In addition to the flow and analytical data, operation and maintenance (O&M) data were recorded. Samples were analyzed for the following parameters:

Sediments
- total suspended solids (TSS)
- suspended sediment concentration (SSC)
- particle size distribution

Metals
- total and dissolved cadmium, lead, copper and zinc

Nutrients
- total and dissolved phosphorus
- total Kjeldahl nitrogen (TKN)
- total nitrate
- total nitrite

The test plan included total petroleum hydrocarbon (TPH) and polynuclear aromatic hydrocarbon (PAH) analyses in the suite of analytical parameters. Samples were initially analyzed for TPH and PAH along with the sediment, metals, and nutrient parameters. TPH and PAH concentrations were below detection limits for every event. In December 2003, SMI, NSF, PCG, and EPA agreed to eliminate the hydrocarbon analyses from the sampling plan since these analyses were always below detection limits.

VERIFICATION OF PERFORMANCE

The following is a summary of the verified data gathered during the course of verification testing. Verification testing of the StormFilter lasted approximately 11 months. A significant number of storm events that met the qualification criteria were not sampled due to issues with the automated sampling equipment and power supply, including blown fuses, power surges and interruptions, or sample tube clogging. A total of 15 storm events were successfully sampled.

Test Results

The precipitation data for the rain events are summarized in Table 1. The peak flow rates exceeded the StormFilter's rated flow capacity during several events, indicating the likelihood that some bypass occurred during storm events with peak flows exceeding the StormFilter's rated flow capacity.

Table 1. Rainfall Data Summary

Event number	Start date	Start time	Rainfall amount (in.)	Rainfall duration (hr:min)	Peak Discharge Rate (gal)[1]	Runoff volume (gpm)[1]
1	7/21/03	18:30	0.49	0:40	362	7,730
2	7/22/03	15:00	0.22	0:55	398	7,090
3	7/23/03	17:40	0.33	1:05	572	8,650
4	8/1/03	16:25	1.73	4:15	1,040	38,200
5	8/6/03	14:40	0.76	1:30	881	18,400
6	1/17/04	21:15	0.44	4:40	175	10,700
7	2/2/04	10:35	0.33	8:10	21.7	2,910
8	4/12/04	19:30	0.31	0:35	778	10,000
9	4/30/04	18:05	0.74	6:40	296	14,100
10	5/12/04	17:10	0.52	2:00	431	10,400
11	5/18/04	15:10	1.24	0:50	879	25,600
12	6/14/04	11:35	0.43	0:35	838	9,180
13	6/25/04	13:10	0.46	6:20	282	6,270
14	6/27/04	18:25	0.82	2:45	959	22,600
15	6/28/04	22:40	0.59	1:35	975	16,900

1. Runoff volume and peak discharge rate measured at the outlet of the StormFilter. See the verification report for further details.

The monitoring results were evaluated using event mean concentration (EMC), or efficiency ratio comparison, and sum of loads (SOL) comparisons. The EMC evaluates treatment efficiency on a percentage basis by dividing the effluent concentration by the influent concentration and multiplying the quotient by 100. The EMC was calculated for each analytical parameter and each individual storm event. The SOL comparison evaluates the treatment efficiency on a percentage basis by comparing the sum of the influent and effluent loads (the parameter concentration multiplied by the precipitation volume) for all storm events. The calculation is made by subtracting from one the quotient of the total effluent load divided by the total influent load, and multiplying by 100. SOL results can be summarized on an overall basis since the loading calculation takes into account both the concentration and volume of runoff from each event. The analytical data ranges, EMC range, and SOL reduction values are shown in Table 2.

Table 2. Analytical Data, EMC Range, and SOL Reduction Results

Parameter	Units	Inlet Range	Outlet Range	EMC Range (%)	SOL Reduction (%)
TSS	mg/L	90 – 410	12 – 110	24 – 69	50
SSC	mg/L	120 – 430	55 – 200	20 – 61	50
Total phosphorus	mg/L as P	0.13 – 0.38	0.05 – 0.19	11 – 68	50
Dissolved phosphorus	mg/L as P	<0.02 – 0.23	<0.02 – 0.07	0 – 96	42
TKN	mg/L as N	<0.4 – 2.5	<0.4 – 1.3	0 – 67	24
Total nitrate	mg/L as N	0.37 – 1.1	0.27 – 1.9	-170 – 30	-13
Total nitrite	mg/L as N	<0.01 – 0.04	<0.01 – 0.03	0 – 75	36
Total cadmium	mg/L	<0.0005 – 0.001	<0.0005 – <0.0005	50 – 75	70
Total copper	mg/L	<0.004 – 0.02	<0.004 – 0.02	0 – 65	34
Total lead	mg/L	0.02 – 0.07	0.009 – 0.04	0 – 67	37
Total zinc	mg/L	0.07 –0.23	0.04 –0.10	30 – 67	52
Dissolved cadmium	mg/L	<0.0005 – <0.0005	<0.0005 – <0.0005	ND	ND
Dissolved copper	mg/L	<0.004 – 0.008	<0.004 – 0.006	0 – 67	-44
Dissolved lead	mg/L	<0.005 – 0.02	<0.005 – 0.02	-50 – 75	-3.5
Dissolved zinc	mg/L	0.02 –0.14	0.01 –0.10	-67 – 75	21

ND: Not determined.

Based on the SOL evaluation method, TSS, SSC and total phosphorus reductions met the vendor's performance claim. The StormFilter was also able to remove some nutrients, total metals, and dissolved zinc.

A particle size distribution procedure known as "sand-silt split" was conducted on samples as part of the SSC analysis. The sand-silt split procedure quantifies the percentage (by weight) of particles greater than 62.5 µm (defined as sand) and less than 62.5 µm (defined as silt). The percentage of silt in the inlet ranged from 73% to 99%, while the percentage of silt in the outlet ranged from 97% to 99%. This data was incorporated into the SOL calculation, revealing the reduction in the SSC sand fraction was 95% and the reduction in the SSC silt fraction was 42%.

System Operation

The StormFilter was installed by a subcontractor, under the supervision of PCG. No issues were noted during the installation.

The StormFilter was cleaned in February 2003, and inspected in August 2003, January 2004, May 2004, and December 2004. During the December 2004 inspection, the filter chamber contained sediment at depths ranging from one to four inches. The filters were covered in sediment and organic detritus, but appeared not to be clogged. A composite sample of the sediment was collected and analyzed for Toxicity Characteristic Leachate Procedure metals, and the sediment was found to be non-hazardous.

Quality Assurance/Quality Control

NSF personnel completed a technical systems audit during testing to ensure that the testing was in compliance with the test plan. NSF also completed a data quality audit of at least 10% of the test data to ensure that the reported data represented the data generated during testing. In addition to QA/QC audits performed by NSF, EPA personnel conducted an audit of NSF's QA Management Program.

Original signed by:	*Original signed by:*
Sally Gutierrez *10/3/05*	*Robert Ferguson* *10/5/05*
Sally Gutierrez Date	Robert Ferguson Date
Director	Vice President
National Risk Management Research Laboratory	Water Systems
Office of Research and Development	NSF International
United States Environmental Protection Agency	

Availability of Supporting Documents

Copies of the *ETV Verification Protocol, Stormwater Source Area Treatment Technologies Draft 4.1, March 2002,* the verification statement, and the verification report (NSF Report Number 05/23/WQPC-WWF) are available from:

ETV Water Quality Protection Center Program Manager (hard copy)
NSF International
P.O. Box 130140
Ann Arbor, Michigan 48113-0140

NSF website: http://www.nsf.org/etv (electronic copy)
EPA website: http://www.epa.gov/etv (electronic copy)
Appendices are not included in the verification report, but are available from NSF upon request.