Protocol for Manufactured Hydrodynamic Sedimentation Devices for Total Suspended Solids Based on Laboratory Analysis
Dated August 5, 2009, Revised December 15, 2009

The New Jersey Stormwater Management Rules at N.J.A.C. 7:8-5.5 require "major development" projects to remove 80% of the total suspended solids (TSS) from the projects' runoff on an annual basis. To help achieve this requirement, Table 2 at N.J.A.C. 7:8-5.5(c) provides a list of approved annual TSS removal rates for constructed stormwater best management practices (BMPs). However, the Rules presently specify at N.J.A.C. 7:8-5.7(d) that approved TSS removal rates for manufactured treatment devices (MTDs) must be verified by the New Jersey Corporation for Advanced Technology (NJCAT) and then certified by the New Jersey Department of Environmental Protection (NJDEP).

Final certification or acknowledgement of such MTDs is to be based upon the results of field testing performed in accordance with the Technology Acceptance Reciprocity Partnership (TARP) Protocol for Stormwater Best Management Practice Demonstrations and any associated NJDEP amendments.

However, prior to the completion of field testing, manufacturers may be eligible for interim certification or acknowledgement of their MTD's TSS removal rate from the NJDEP. For MTDs that rely upon hydrodynamic separation and sedimentation to remove TSS, an interim certification or acknowledgement shall be based upon the results of a series of laboratory tests of the MTD performed in accordance with the requirements of this protocol and the following signed statements:

> A signed statement from the verification entity listing the protocol requirements and indicating that all of the requirements of the protocol were met or exceeded. Such statement must detail how any deviations to the protocol exceeds the requirements and that no mathematical adjustments were done to account for the deviations unless prior written agreement from the NJDEP was obtained. The submission from the verification entity for NJDEP acknowledgement or certification shall only be accepted for review if the package includes all of the required signed statements indicating that all of the protocol requirements were met or exceeded.
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> A written and electronic report from the verification entity that includes verified TSS removal rates, recommended TSS removal rates, and all items required for submission outlined in **H. Submission Requirements for MTD Verification and Certification or Acknowledgement** for the subject MTD.
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> A signed statement from the manufacturer listing the protocol requirements and indicating that all of the requirements were met or exceeded.
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> A signed statement from the testing entity, if different from the manufacturer, listing the protocol requirements and indicating that all of the requirements for testing were met or exceeded.

In reviewing the requirements, it is important to note that the New Jersey Stormwater Management Rules at N.J.A.C. 7:8-5 specifically require the removal of TSS from stormwater runoff. This requirement was mandated through NJPDES Municipal Stormwater Phase rules in compliance with the requirements by the USEPA Stormwater Phase II Final Rule. In addition, the removal rates for constructed BMPs contained in Table 2 at N.J.A.C. 7:8-5.5(c) are specifically for TSS. Therefore, in compliance with the requirements of the New Jersey Rules and for consistency with the removal rates for constructed BMPs published in the New Jersey Rules as well as the New Jersey Stormwater Best Management Practices Manual, the interim certification or acknowledgement requirements for Hydrodynamic Sedimentation Devices presented below specifically require the measurement of TSS during laboratory testing.

A. Overview of Laboratory Testing Procedures

A summary of the required laboratory testing procedures for hydrodynamic MTDs is presented below. Details of each procedure are presented in the indicated sections of this document. It should be noted that the procedures summarized below are not presented in strict sequential order.

1. Meet laboratory testing criteria, including laboratory and observer qualifications and testing water temperature, background TSS levels, and device availability requirements. See Section C below for details.
2. Determine the MTD's Maximum Conveyance Flow Rate (MCFR), Maximum Treatment Flow Rate (MTFR), Effective Treatment Area, and Maximum Sediment Storage Depth and Volume. See Section B below for details.
3. Conduct Maximum Treatment Flow Rate Scour Testing. See Section D below for details.
4. Conduct Annual Total Suspended Solids Removal Rate testing and compute Annual Removal Rate. See Section E below for details.
5. Conduct Optional Online Location Testing. See Section F below for details.
6. Compute Required Sediment Removal Interval. See Section G below for details.
7. Prepare pre- and post-laboratory testing submittals for MTD verification and certification. See Section H below for details.

B. Manufactured Treatment Device Characteristics

Maximum Conveyance Flow Rate

The maximum conveyance flow rate (MCFR) of a MTD is the highest flow rate that can be conveyed through all of the MTD's treatment components without overflow, bypass, or surcharging.

Maximum Treatment Flow Rate

The maximum treatment flow rate (MTFR) of a hydrodynamic MTD is the highest flow rate that can be conveyed through all of the MTD's treatment components without excessive scouring of accumulated sediment and that achieve the TSS removal rate and sediment and other maintenance intervals claimed by the manufacturer. As such, an MTD's MTFR will be equal to or less than the MTD's MCFR. Details of the scour testing procedures used to help determine an MTD's MTFR are presented in the section below titled **Maximum Treatment Flow Rate Scour Testing**.

Following its verification and certification or acknowledgement, an MTD can then be used to treat the runoff from a major development at its approved TSS removal rate provided that the MTD's MTFR is equal to or greater than the peak runoff rate to the MTD from the New Jersey Water Quality Design Storm as defined at N.J.A.C. 7:8-5.5.

Due to differences in MTDs, such as in cases where there is no internal bypass or overflow, the water level and/or other internal flow characteristics used to determine the tested MTD's MCFR and MTFR must be approved by the verification entity prior to conducting any lab testing. Once such levels and/or characteristics are approved, the MCFR and MTFR for the tested MTD shall be determined in the laboratory by measuring the flow rate that is conveyed through the MTD at these approved MCFR and MTFR characteristics. The final MCFR and MTFR determined in this manner shall be the arithmetic average of three laboratory flow tests using clear water.

Upon completion of these flow tests, the MCFR and MTFR (if different) and their associated characteristics for the tested MTD shall then be utilized to derive flow equations that can be used to develop the MCFRs and MTFRs for larger or smaller versions of the tested MTD. The MCFR and MTFR flow equations shall be based upon pertinent MTD dimensions, water levels, and an appropriate equation or equations for orifice, weir, pipe, and/or open channel flow. The flow equations shall be developed by solving for the value of the coefficient(s) in the selected flow equation(s) based upon the pertinent MTD dimensions, water levels, and MCFR and MTFR determined in the lab. Such coefficient(s) shall then be used in similar equation(s) to estimate the MCFR and MTFR of similar MTDs of different sizes.

Effective Treatment Area

The effective treatment area of a hydrodynamic MTD is the area where runoff treatment within the MTD occurs. In hydrodynamic MTDs, this area is typically the water surface area of the MTD's sedimentation chamber. The effective treatment area of a MTD is necessary to determine the MTD's sediment removal interval and to scale different size MTDs based on the MTD tested in the lab. Due to differences in MTDs, the effective treatment area and characteristics of the tested MTD must be approved by the verification entity prior to conducting lab testing. The use of the effective treatment area and the MTFR in the scaling of similar type MTDs of different sizes is discussed in the section below titled **Scaling of MTDs with Different Maximum Treatment Flow Rates**.

Maximum Sediment Storage Depth and Volume

The maximum sediment storage depth and volume of a hydrodynamic MTD represent the maximum amount of sediment that can accumulate in the MTD. As such, they are used as indicators of required maintenance frequency. They are also used to determine the amount and/or depth of sedimentation chamber preload used for both Maximum Treatment Flow Rate and Online Placement testing. Due to differences in MTDs, the maximum sediment storage depth and volume of the tested MTD and their associated characteristics must be approved by the verification entity prior to conducting lab testing.

C. Laboratory Testing Criteria

Laboratory Qualifications

The stormwater sampling for TSS analysis shall be conducted by an independent laboratory, or shall be overseen by an independent party if conducted at the manufacturer's own laboratory.

If the manufacturer is using its own lab and an independent observer, the observer shall meet the following requirements:

i) The observer shall have no personal conflict of interest regarding the test results.
ii) The observer shall have experience in a hydraulics, sampling and sedimentation lab, be familiar with the test and lab methods specified in this standard and have professional expertise in an appropriate discipline.
iii) The observer shall approve the experimental set-up and lab testing protocol and observe the test during its full duration.
iv) The qualifications of the observer are subject to approval by the verification entity.

All samples for TSS analysis shall be analyzed by an independent laboratory that either has New Jersey Environmental Laboratory Certification using the standards published at N.J.A.C. 7:18, "Regulations Governing the Certification of Laboratories and Environmental Measurements" or New Jersey National Environmental Laboratory Accreditation using the 2003 NELAC Standard and incorporated by reference at N.J.A.C. 7:18-1.5(d).

Temperature

The temperature of the water for all MCFR and MTFR test runs and TSS sample testing shall be between 60 and 80 degrees Fahrenheit.

Background TSS levels

Background levels of TSS shall be no more than 10% of the specified influent in all tests. Any background level with a higher concentration must adjust the sediment feed to ensure an influent concentration and PSD to be within 10% of the required concentration and PSD. The use of flocculants is not an acceptable means to reduce background TSS levels.

MTD Size and Availability

A full scale, commercially available MTD must be tested in the laboratory in the same configuration and with the same components as typically used in actual installations. Where the testing of a full scale, commercially available MTD as described above cannot be performed due to limitations outside of the control of the manufacturer, the manufacturer can request approval for a scaled configuration from the verification agency which, in consultation with the NJDEP, may allow such a configuration in very limited circumstances. Performance of testing without such written prior approval will result in the disqualification of the tested data.

D. Maximum Treatment Flow Rate Scour Testing

Purpose

Maximum Treatment Flow Rate (MTFR) scour testing is conducted to ascertain that excessive scouring of accumulated sediment in the MTD will not occur at the MTFR selected for the MTD by the manufacturer.

Procedure

First, the sedimentation chamber of the MTD shall be preloaded to 50% of the manufacturer's recommended maximum sediment storage volume with material consistent with the particle size distribution for particles 50 microns and greater in the New Jersey Particle Size Distribution (NJPSD) described in Table 1. In doing so, a false bottom may first be placed in the sedimentation chamber at a level below the 50% maximum sediment storage volume level and then covered with sufficient material as specified above to achieve 50% of the maximum sediment storage volume. In doing so, however, the level of the false bottom must be at least 12 inches below the 50% maximum sediment storage volume level or at the 40% maximum sediment storage level, whichever level is lower. The MTD shall also be filled with clean water to its normal, dry weather operating depth prior to conducting the test.

Next, a constant flow of clear water shall be run through the MTD at a constant rate of 125% of the MTD's selected MTFR for either 15 minutes or until a volume of water equal to five times the MTD's maximum storage volume has passed through the MTD, whichever is greater, after the influent and effluent flow rates have equalized. As noted below in the section titled **TSS Removal Efficiency Test Runs**, running this portion of the test may require the installation of an external influent bypass system for those MTDs that have a MCFR that is less than 125% of its MTFR.

Upon completion of this portion of the scour test and prior to proceeding to the next portion, the volume of pre-loaded sediment remaining in the chamber shall be determined. If the volume of preloaded sediment has been reduced by more than 10% (i.e., the remaining sediment volume is less than 90% of the preloaded sediment volume), the selected MTFR is too high and must be lowered and the MTD retested. To do so, additional material identical to the preloaded material described above shall be placed in the MTD's sedimentation chamber to return the total amount of material to 50% of the manufacturer's recommended maximum sediment storage volume. The testing described above at 125% of the MTD's selected MTFR shall then be repeated with a lower MTFR until the pre-loaded sediment in the chamber is reduced by no more than 10%. It should be noted that no additional material needs to be placed in the MTD's sedimentation chamber before proceeding with the next portion of the scour test if the volume of preloaded sediment remaining has been reduced by less than 10% (i.e., the remaining sediment volume is more than 90% of the preloaded sediment volume).

Following the successful completion of the testing described above, a constant flow of clear water shall once again be run through the MTD at a rate equal to 125% of the MTD's selected MTFR for either 30 minutes or until a volume of water equal to ten times the MTD's maximum storage volume has passed through the MTD, whichever is greater, after the influent and effluent flow rates have equalized. During this time period, a minimum of six samples of the effluent from the MTD shall be taken at equal time increments. All samples shall only be taken of the effluent from the MTD and shall not include any bypassing flow. All samples shall be tested for TSS in accordance with Standard Method APHA 2540D. If the average TSS concentration of all effluent samples is no more than 10 mg/l higher than the background TSS concentration of the clear water influent, then the selected MTFR is acceptable and the selected or lower MTFR can be utilized for remainder of the MTD characterization and testing described in this document. However, if the average TSS concentration of all effluent samples is more than 10 mg/l higher than the background TSS concentration of the clear water influent, the selected MTFR is too high and the testing described must be repeated with a lower MTFR until the above testing requirements are met. Once the testing requirements are met, the selected or lower MTFR can be utilized for the remainder of the MTD characterization and testing described in this document.

It should be noted that all TSS effluent and background sample data and analytic results must be provided as part of the submittal for interim certification.

E. Annual Total Suspended Solids (TSS) Removal Rate

TSS Removal Efficiency Test Runs

A minimum of three pairs of influent and effluent samples each shall be collected at constant flow rates of 25%, 50%, 75%, 100%, and 125% of the MTD's MTFR at TSS influent concentrations of 50 and 100 mg/l with the particle size distribution for particles 1 micron and greater in the New Jersey Particle Size Distribution (NJPSD) described in Table 1 below. This will result in a minimum of 30 pairs of influent and effluent sample pairs. During all test runs, the allowable variation in any of the five constant flow rates described above shall be $\pm$20% for the 25% and 50% flow rates and $\pm$10% for the 75%, 100%, and 125% flow rates provided that the actual flow rate remains constant during the collection of all three sample pairs for that rate. In addition, the allowable variation in the influent concentrations described above shall be $\pm$10 mg/l. All test runs shall also be conducted with a false bottom installed in the MTD at a level equal to 50% of the MTD's maximum sediment storage volume as defined above. It will also be necessary to install an external influent bypass system for those MTD's that have a MCFR that is less than 125% of its MTFR. This bypass system should replicate the hydraulic performance of a real external bypass system constructed in the field as closely as practical. As noted below, this bypass system must reconnect with the effluent from the MTD's treatment area in order to obtain representative effluent samples.

Sampling shall be performed either by grab samples or automatic samplers. Sampling methodologies must be consistent in all effluent and all influent samples.

The influent and effluent sample pairs described above for each flow rate must not be taken until the inflow and outflow rates in the MTD have equalized. Following this initial time period, collection of the influent and effluent samples in a sample pair must be separated by one residence time through the MTD. In addition, the collection of sample pairs must be separated by either a 10 minute interval or 10 times the residence time of the MTD at the selected flow rate, whichever is greater.

All samples must be taken from the entire influent and effluent flow. Therefore, where influent bypass may occur for the flows greater than the MTD's MTFR, the effluent sample must be taken downstream of the point where the waters bypassing the MTD's treatment area recombines with the water passing through the treatment area. Similarly, the influent samples must be taken upstream of the point where the bypassing begins. As noted above, such bypassing will require the installation of an influent bypass system that reconnects the bypassed flow with the treatment area effluent flow.

Table 1: New Jersey Particle Size Distribution[1]

Particle Size (Microns)	Percent by Mass of All Particles[2]	Percent by Mass of Particles $\geq$ 50 Microns[3]
500 – 1000	5%	10%

250 – 500	5%	10%
100 – 250	30%	55%
50 – 100	15%	25%
8-50	25%	0%
2 – 8	15%	0%
1 – 2	5%	0%

1. The material shall be hard, firm, and inorganic with a specific gravity of 2.65(+5%). The various particle sizes shall be uniformly distributed throughout the material prior to use.
2. This distribution is to be used in a MTD's influent flow for TSS Removal Efficiency Test Runs as described above. A variation of ±10% in each individual percentage is permissible provided that the individual percentage of the particles from 1 to 50 microns are not decreased and the net variation over all ranges shown in Table 1 above is 0%.
3. This distribution is to be used to preload the a MTD's sedimentation chamber for Maximum Treatment Flow Rate Scour Testing and Online Location Scour Testing as described above. A variation of ±10% in each individual percentage is permissible provided that the net variation over all ranges shown in Table 1 above is 0%.

The particle size distribution of the actual test material shall be determined through one or an appropriate combination of the following methods/devices:

1. Sieve Analysis
2. Coulter Counter
3. Hydrometer
4. Laser Diffraction

The particle size distribution of the actual test material shall meet the requirements presented in Table 1 above.

TSS Removal Rate

During each of the test runs described above, samples of the influent to and effluent from the MTD shall be taken and analyzed for TSS in accordance with Standard Method APHA 2540D. All sample data and analytic results must be provided as part of the submittal for interim certification or acknowledgement. In addition, influent and effluent particle size distributions must be developed from the combined influent and effluent samples taken for each combination of flow rate and influent concentration described above in **TSS Removal Efficiency Test Runs**. This will result in a total of ten paired particle size distributions. The particle size distributions shall be determined through one or an appropriate combination of the same methods/devices shown above in **TSS Removal Efficiency Test Runs**. As noted below, the methods/devices used to determine the particle size distributions and the results of such determinations are to be included in the submittal.

The TSS test results described above shall then be utilized to obtain the average influent and effluent TSS concentrations of all the influent and effluent samples taken (minimum of three as described above) for each combination of flow rate and particulate concentration. These average influent and effluent TSS concentrations shall then be multiplied by the associated flow rate to obtain average influent and effluent TSS load rates for each combination of flow rate and particulate concentration.

In addition to TSS, influent and effluent samples may also be collected and analyzed for Suspended Solids Concentration (SSC) in accordance with ASTM Method D3977-97. If collected, such data should then be utilized to also obtain average influent and effluent SSC concentrations and load rates in the same manner described above for TSS. If developed, such sample data, analytic results, and computations should also be provided as part of the submittal for interim certification or acknowledgement. This information will provide a more robust database comparing TSS and SSC removal rates that may inform future changes by the NJDEP to these lab testing requirements.

The resulting average removal efficiency for each combination of flow rate and particulate concentration shall then be determined through the following equations:

$$\textbf{Average TSS Removal Efficiency} = \frac{\text{(Average TSS Influent Load Rate - Average TSS Effluent Load Rate)}}{\text{Average TSS Influent Load Rate}}$$

$$\textbf{Average SSC Removal Efficiency} = \frac{\text{(Average SSC Influent Load Rate - Average SSC Effluent Load Rate)}}{\text{Average SSC Influent Load Rate}}$$

The representative influent and effluent TSS and SSC samples described above must not be taken until the inflow and outflow rates from the MTD have equalized. All influent and effluent TSS and SSC sample pairs must be taken one residence time apart. In addition, influent and effluent TSS and SSC samples must be taken from the entire influent and effluent flow. Therefore, where influent bypass may occur for the flows greater than the MTD's MCFR, the effluent sample must be taken downstream of the point where the waters bypassing the MTD's treatment area recombines with the water passing through the treatment area. Similarly, the influent samples must be taken upstream of the point where the bypassing begins. As noted above, such bypassing will require the installation of an influent bypass system that reconnects the bypassed flow with the treatment area effluent flow.

Annual TSS Removal Rate

The rainfall weighting factors in Table 2 are based on the total volume of annual runoff on an average year in New Jersey. The annual TSS removal rate shall be computed by multiplying the average TSS removal efficiency for each flow rate for each of the two particulate concentrations by the weighting factors in Table 2.

The removal efficiency for the MTD must be performed in the following manner:

1. For each influent concentration (i.e., 50 and 100 mgl), calculate the average removal efficiency for each tested flow rate as described in the **TSS Removal Rate** section above.
2. Multiply the average removal efficiency for each tested flow rate by the Annual Weighting Factor for that flow rate in Table 2.
3. Sum the values to achieve annual TSS rates for each concentration.
4. Average the TSS removal rates for the two particulate concentrations to obtain an annual TSS removal rate for the MTD.

(Note: The computation of the efficiency of a BMP cannot be based on the achievable efficiency. The achievable efficiency is defined in the "Urban Stormwater BMP Performance Monitoring: A Guidance Manual for Meeting the National BMP Database Requirements," April 2002 by EPA and ASCE.)

Table 2	
Tested Flow Rate as a Percentage of Maximum Treatment Flow	**Annual Weighting Factor**
25%	0.25
50%	0.30
75%	0.20
100%	0.15
125%	0.10

Scaling of MTDs with Different Maximum Treatment Flow Rates

The TSS removal rate determined for the tested MTD may be applied to similar MTDs with different MTFRs provided that

1. The ratio of the Maximum Treatment Flow Rate to Effective Settling Area for the similar MTD is the same or less than the tested MTD and
2. The relationship of the MTCR and MTFR of for the similar MTDs is the same as the tested MTD.

Vendors have the option to demonstrate alternative scaling methods associated with their particular design by thorough testing of a minimum of three MTDs to support the scaling equation.

The MTFR for the similar MTD is to be determined either through the MTFR laboratory procedures as described above and by using the MTFR flow equation and applicable MTD dimensions, water levels, and coefficients developed for the tested MTD.

Maintenance during Lab Testing

The lab report must include documentation of any maintenance that occurs on the MTD during the laboratory testing process, including frequency, reason for maintenance, and amount of sediment removed, if applicable.

F. Optional Testing for On-Line Installation

Purpose

Currently, all approved MTD's approved by NJDEP must be located offline from a storm sewer or other conveyance system so that the MTD cannot receive runoff rates in excess of the NJDEP's Stormwater Quality Design (NJWQD) storm as defined at N.J.A.C. 7:8-5.5. However, testing may be conducted at the manufacturer's option to determine whether the MTD may be located online in a storm sewer or other conveyance system that conveys runoff rates greater than the peak runoff rate from the

NJWQD storm. To qualify for such testing, however, the MTD must also be able to internally convey flow rates equal to or greater than the capacity of the upstream storm sewer or other conveyance system in which the MTD is located without overflow, bypassing, or surcharging or the use of an external influent bypass system.

Procedure

First, the sedimentation chamber of the MTD shall be preloaded to 50% of the manufacturer's recommended maximum sediment storage volume with material consistent with the particle distribution for particles 50 microns and greater in the New Jersey Particle Size Distribution (NJPSD) described in Table 1. In doing so, a false bottom may first be placed in the sedimentation chamber at a level below the 50% maximum sediment storage volume level and then covered with sufficient material as specified above to achieve 50% of the maximum sediment storage volume. In doing so, however, the level of the false bottom must be at least 12 inches below the 50% maximum sediment storage volume level or at the 40% maximum sediment storage level, whichever level is lower. The MTD shall also be filled with clean water to its normal, dry weather operating depth prior to conducting the test.

Next, a constant flow of clear water shall be run through the MTD at a rate equal to 200 percent of the MTD's selected MTFR for either 15 minutes or until a volume of water equal to five times the MTD's maximum storage volume has passed through the MTD, whichever is greater, after the influent and effluent flow rates have equalized. As noted above, the MTD must be able to internally convey this flow rate without upstream overflow, bypass, or surcharging or the use of an external influent bypass system.
Upon completion of this portion of the scour test and prior to proceeding to the next portion, the volume of sediment remaining in the chamber shall be determined. If the volume of preloaded sediment has been reduced by more than 10% (i.e., the remaining sediment volume is less than 90% of the preloaded sediment storage volume),then the applicant has the option to lower the MTFR and rerun the test from the beginning or to limit the applicability of the verification, certification and/or acknowledgement to off-line installations only. It should be noted that no additional material needs to be placed in the MTD's sedimentation chamber before proceeding with the next portion of the scour test if the volume of preloaded sediment remaining after the first portion of the test has been reduced by less than 10% (i.e., the remaining sediment volume is more than 90% of the preloaded sediment storage volume).

Following the successful completion of the testing described above, a constant flow of clear water shall once again be run through the MTD at a rate equal to 200 percent of the MTD's selected MTFR for either 30 minutes or until a volume of water equal to ten times the MTD's maximum storage volume has passed through the MTD, whichever is greater, after the influent and effluent flow rates have equalized. During this time period, a minimum of six samples of the effluent from the MTD shall be taken at equal time increments. All samples shall be tested for TSS in accordance with Standard Method APHA 2540D. If the average TSS concentration of all effluent samples is no more than 10 mg/l higher than the background TSS concentration of the clear water influent, then the MTD may be located online.

It should be noted that all TSS effluent and background sample data and analytic results must be provided as part of the submittal for interim certification.

G. Maintenance

Required Sediment Removal Interval

Following determination of the MTD's annual TSS removal rate (as described above), the MTD's required sediment removal interval must be computed using the equation shown below. This equation estimates the time required to accumulate a sediment volume equal to 50% of the MTD's maximum sediment storage volume (as described above) utilizing the MTD's annual TSS removal rate, annual average New Jersey rainfall, an estimated runoff coefficient, sediment loading rate, and wet sediment density, and an appropriate safety factor. See **Appendix A - Basis of Sediment Removal Interval Equation** for further details about the equation..

An interim certification or acknowledgement as described above shall only be obtained for the MTD if the computed required sediment removal interval is at least six months.

The required sediment removal interval of the tested MTD shall be computed by the following equation:

Required Sediment Removal Interval (Months) =

$$\frac{(50\%\text{ of MTD's Maximum Sediment Storage Volume})(3.57)}{(\text{MTFR})(\text{TSS Removal Efficiency})}$$

Documentation of any maintenance that occurs on the MTD during the laboratory testing process, including frequency, reason for maintenance, and amount of sediment removed must be submitted as part of the verification review.

H. Submission Requirements for MTD Verification and Certification or Acknowledgement

1. **Pre-Laboratory Testing Submittal**
   a. Basis of Maximum Conveyance and Maximum Treatment Flow Rates
   b. Basis of Maximum Sediment Storage Depth and Volume
   c. Basis of Effective Treatment Area
   d. Maximum Conveyance and Treatment Flow Rate Determinations and Equations

2. **Post-Laboratory Testing Submittal**
   a. Schematic drawings and photographs of lab testing setup.
   b. Detailed drawings of the MTD tested in the lab, indicating constants or variables in different sizes of the same MTD
   c. Comparison of Requirements Vs. Actual Values for the following:
      - Flow Rates
      - Concentrations
      - Water Temperatures
      - Specific Gravity
      - Particle Size Distribution including plot of both required and actual values.

d. Comparison of times that influent and effluent samples were taken for each flow rate and influent concentration starting from the time of initiation of flow into the MTD.
e. All raw measurements and data from lab testing.
f. Methods/devices used to determine particle size distributions and the results of such determinations.
g. All pertinent computations, including average influent and effluent concentrations, load rates, average removal efficiencies for each flow and concentration, weighted removal efficiency for each concentration, final MTD annual TSS removal rate, and sediment removal interval.

3. Verification Report Requirements

In addition to the documentation listed above, verification reports must also include the following information:

Description of Technology

Describe how the MTD works, including its physical, chemical, and/or biological treatment functions. The description must include the main treatment processes in the MTD and any ancillary processes required for the unit to function in accordance with the performance claim with respect to the pollutants of concern. The report should also indicate what other types of BMPs, based on their treatment processes, can or cannot be used in series with the MTD to provide enhanced removal rates.

A comparison to the design of the standard BMP as shown in the New Jersey Stormwater Best Management Practiced Manual should be provided where applicable,. (For example, a wet pond's pollutant treatment is mainly based on the residence time of the permanent pool, the volume, and the drawdown time of the water quality design storm above the permanent pool. A pool/drawdown MTD should at a minimum provide these comparisons.)

Indicate how the lab test relates to field placement. Provide a detailed discussion of the differences between the lab test and a field installation, and how the lab test mimicked or provide a more or less conservative performance than would occur in actual applications.

Design Criteria

Provide design criteria, including but not limited to, required soil characteristics, slope, and limitations on tailwater, and depth to seasonal high water table that are important to ensure the performance of the MTD.

Maintenance Plans

Maintenance plans must contain specific preventative and corrective maintenance information. All maintenance documents must be written in non-technical language. In order to ensure incorporation of appropriate maintenance, a detailed maintenance plan for each MTD must be provided that incorporates the following:

- Minimum required maintenance frequency for each component in order to achieve the annual TSS removal rate, including the required sediment removal interval and associated sediment depths in **G. Maintenance** above.
- Description of what conditions trigger the need for maintenance and how neglect of specified maintenance activities (e.g., sediment removal, filter media replacement, oil removal) causes BMP underperformance;

- Location of Access Points and type of inspection needed – whether above ground or underground;
- Training needed to Perform Maintenance. This may include training videos to be made available to maintenance staff.
- Equipment needed for maintenance and discussion of obtaining replacement parts. This must indicate what portions of the MTD are only available through the vendor.

The format of the design and maintenance sections of the report shall be similar to the non-proprietary BMPs currently in the New Jersey Stormwater Best Management Practices Manual.

Units

All dimensions must be consistent with standard units utilized in stormwater management design: **Length/Distance**: inches, feet; **Area**: square feet, acres; **Volume**: cubic feet; **Velocity**: feet per second; and **Flow Rate**: cubic feet per second.

I. References

Comments from the Public Received in Response to Draft Protocols.

EPA and ASCE, "Urban Stormwater BMP Performance Monitoring: A Guidance Manual for Meeting the National BMP Database Requirements," April 2002.

State of Washington Department of Technology, "Guidance for Evaluating Emerging Stormwater Treatment Technologies Technology Assessment Protocol – Ecology (TAPE)," January 2008.

Wisconsin Department of Commerce, Wisconsin Department of Natural Resources, "Method for Predicting the Efficiency of Proprietary Storm Water Sedimentation Devices (1006)," May 2008.

Appendix A:
Basis of Sediment Removal Interval Equation

Constants

62.4	LBS/CF Density of Water
2.65	Specific Gravity of Dry Sediment
2	Wet Sediment Bulking Factor
50%	Maximum Available Sediment Storage Volume
400	LBS/Acre Sediment Loading Rate
3.2	Inches per Hour Maximum Stormwater Quality Storm Rainfall Intensity for 10 Minutes
0.90	MTD Drainage Area Runoff Coefficient
10	Minute MTD Drainage Area Time of Concentration

Volume of Sediment per Acre per Year:

Density of Dry Sediment	= (62.4 LBS/CF)(2.65)	= 165 LBS/CF
Density of Wet Sediment	= (165 LBS/CF)/2 Bulking Factor	= 82.5 LBS/CF
Annual Sediment Volume per Acre	= (400 LBS/Acre)/(82.5 LBS/CF)	= 4.85 CF/Acre
Apply Safety Factor	= (4.85 CF/Acre)(2 Safety Factor)	= 9.70 CF/Acre
MTD Drainage Area in Acres	= MTFR/((3.2 Inches/Hour)(0.9))	= (0.347)(MTFR)

Annual Sediment Volume Captured = (9.70 CF/Acre)(0.347)(MTFR)(TSS Removal Efficiency)

= (3.366)(MTFR)(TSS Removal Efficiency)

Required Sediment Removal Interval (Years) =

$$= \frac{\text{(50\% of MTD's Maximum Sediment Storage Volume)}}{\text{(3.366)(MTFR)(TSS Removal Efficiency)}}$$

Required Sediment Removal Interval (Months)

$$= \frac{\text{(50\% of MTD's Maximum Sediment Storage Volume)(12)}}{\text{(3.366)(MTFR)(TSS Removal Efficiency)}}$$

Required Sediment Removal Interval (Months)

$$= \frac{\text{(50\% of MTD's Maximum Sediment Storage Volume)(3.57)}}{\text{(MTFR)(TSS Removal Efficiency)}}$$