

# **NJCAT TECHNOLOGY VERIFICATION**

## **FocalPoint High Performance Modular Biofiltration System**

### **Convergent Water Technologies**

**November 2021**

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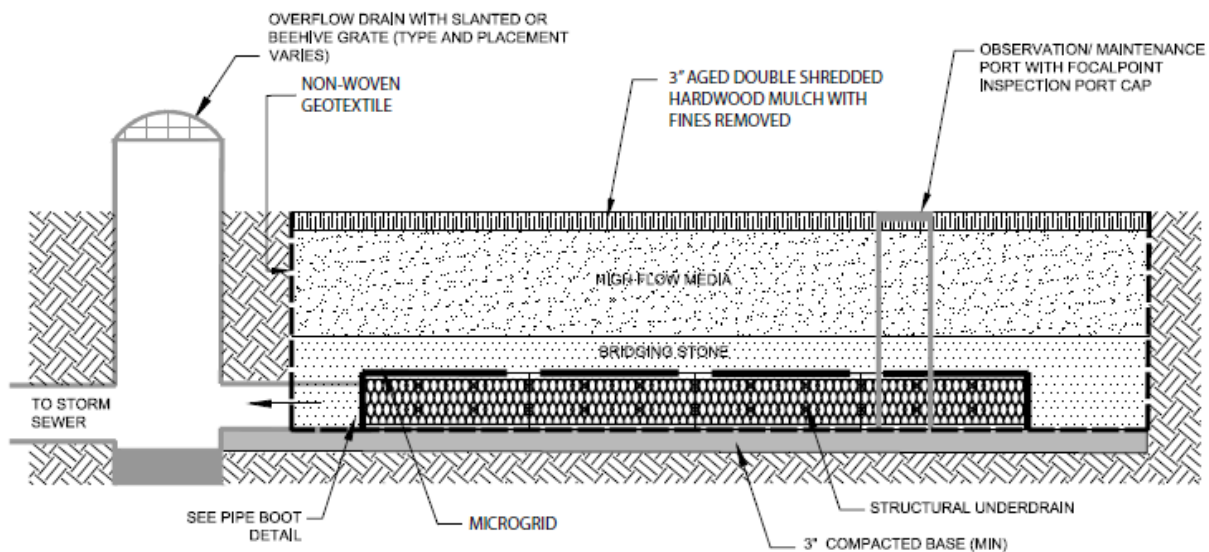
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## 1. Description of Technology

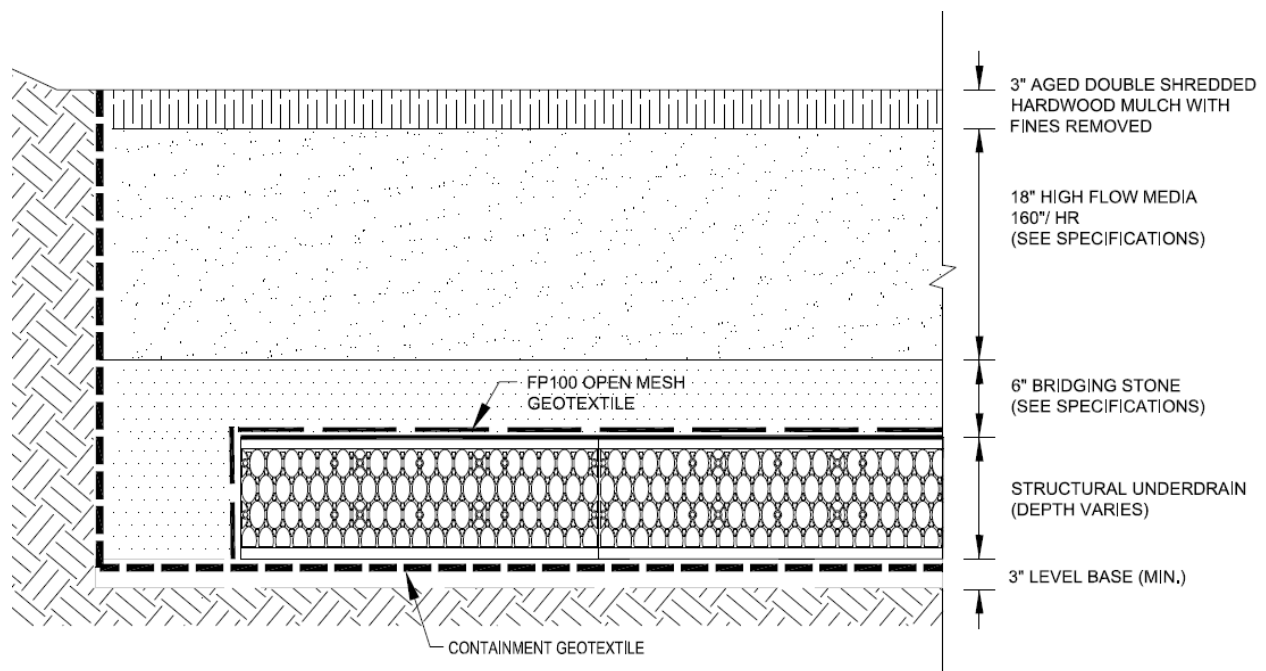
The FocalPoint® High Performance Modular Biofiltration System (FocalPoint HPMBS) is a manufactured treatment device (MTD) that utilizes a high flow biofiltration soil media. The FocalPoint HPMBS is a scalable biofiltration system which combines the efficiency of high flow rate soil media with the durability and modularity of a high void space underdrain system. The FocalPoint HPMBS is a complete, integrated system that is typically deployed in a soft-shell configuration near the edge of pavement and within a landscaped area, esplanade strip, traffic island or curb bump out area. Where there needs to be a vertical edge, the system can be surrounded by an open top precast structure, planter box, etc.

The FocalPoint HPMBS provides the same level of treatment as traditional bioretention systems and because of its high flow rate, allows significant reduction in footprint, therefore, offering a solution for highly urbanized developments where footprint at the surface is limited.

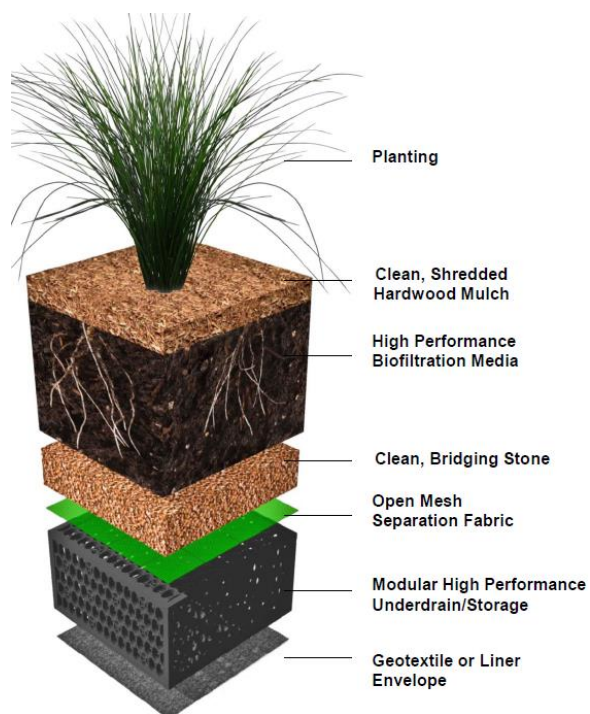
Stormwater enters the FocalPoint HPMBS the same way water would enter a bioretention or bio-swale practice – typically as sheet or pipe flow and runs through an inlet control that may include a curb cut and rock apron, forebay, or other pretreatment structure and conveyed via gravity through the mulch layer (3”), engineered soil media (18”), bridging stone (6”), structural underdrain (9.45”) and outlet pipe. The maximum driving head is set by an overflow drain, typically installed downstream of the filter area, and set a minimum of 12” above the mulch layer. An elevation of 12” was used for the verification testing. Where feasible, the modular underdrain component can be configured to infiltrate runoff into native soils; thereby offering a space efficient treatment and volume management solution. Diagrams of the system geometry are shown on **Figures 1 through 4**.



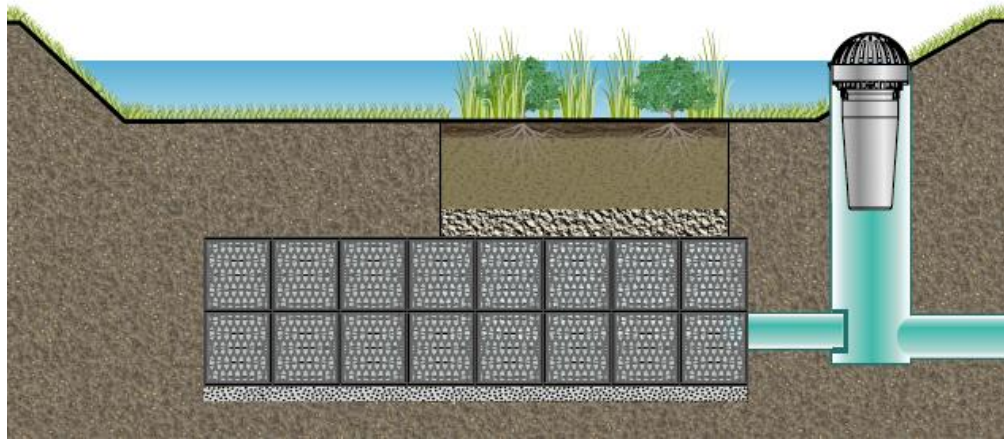
**Figure 1 Typical FocalPoint HPMBS Cross Section**



**Figure 2 Elevation View Showing Typical Component Dimensions**



**Figure 3 FocalPoint HPMBS Components**



**Figure 4 Typical FocalPoint HPMBS Cross Section with Expanded Infiltration/Storage**

The FocalPoint HPMBS has a unique cap and seal protection method to ensure a viable system regardless of construction sequencing by sealing off the media bed until the contributing drainage area is stabilized.

## **2. Laboratory Testing**

The test program was conducted at the Alden Research Laboratory, Inc. (Alden), Holden, Massachusetts, under the direct supervision of Alden's senior stormwater engineer, James Mailloux. Alden has performed verification testing on Hydrodynamic Separator and Filtration Manufactured Treatment Devices (MTDs) for manufacturers under various state and federal testing protocols. Particle size distribution (PSD) analysis was conducted by GeoTesting Express, Inc., Acton, Massachusetts. GeoTesting is an ISO/IEC 17025 accredited independent laboratory. Water quality samples collected during the testing process were analyzed in Alden's Stormwater Testing Laboratory.

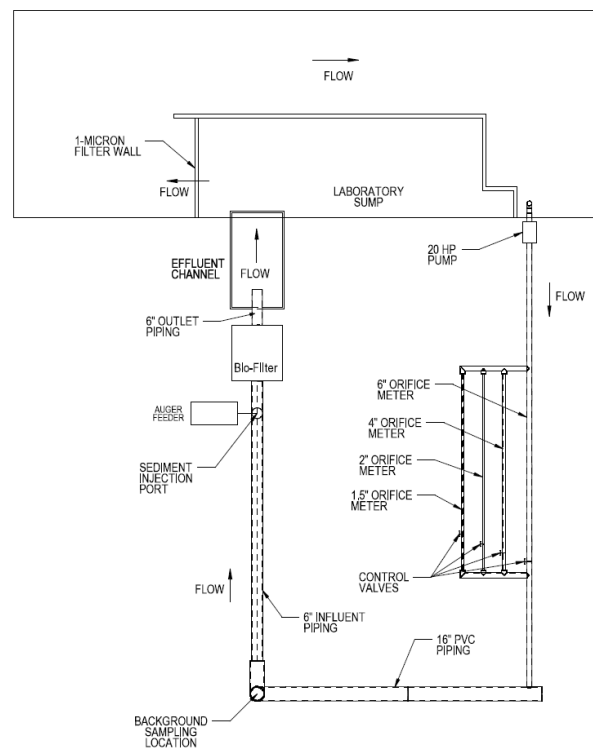
Laboratory testing was done in accordance with the New Jersey Department of Environmental Protection "Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device" (January 2013a) (NJDEP Filter Protocol). Prior to starting the performance testing program, a quality assurance project plan (QAPP) was submitted to, and approved by, the New Jersey Corporation for Advanced Technology (NJCAT) as per the NJDEP certification process.

### **2.1 Test Setup**

The tested filtration system was assembled in a 4.04 ft wide X 5 ft long X 4.25 ft deep tank, with a resulting filtration area of 20.21 square feet. The filtration system was installed according to the vertical dimensions of each component as shown in **Figure 2**. The modular underdrain was 9.45" high and installed on a single layer of 8 oz non-woven geotextile that laid directly on top of the floor. The modular underdrain consisted of 3 modules wide by 2 modules long, which equates to a modular underdrain area to filter bed area ratio of at least 0.9. The underdrain modules were covered with an open mesh geotextile, pushed up against the outlet wall to ensure

a tight connection with the outlet opening and the annular space around the edges of the tank were filled with bridging stone. The modular underdrain for larger filtration systems would be scaled to maintain the 0.9 ratio, with or without infiltration, to achieve the reported performance included herein. The total height of the filtration system was 3.04 ft as measured from the bottom of the underdrain to the top of mulch.

The assembled FocalPoint HPMBS was installed in a test loop at Alden Research Laboratory's Stormwater Testing Facility, shown on **Figure 5**, which is designed as a recirculating system. Flow was supplied to the unit with a 20hp laboratory pump drawing water from a 50,000-gallon supply sump. The flow was set and measured using a control valve and 1.5-inch calibrated orifice plate flow meter, constructed to ASME guidelines. A differential pressure (DP) cell and computer Data Acquisition (DA) program was used to record the test flow. Flow measurement accuracy was within  $\pm 1\%$ . Approximately 25 ft of 6-inch PVC influent pipe conveyed the metered flow to the test tank. The influent pipe was set with a 1% slope and the invert was approximately 6 inches above the mulch layer. A 6-inch tee was located 30 inches (5 pipe-diameters) upstream of the tank for injecting the test sediment into the crown of the influent pipe. A 6-inch diameter by 12-inch long acrylic pipe was attached to the test tank to free-discharge the effluent flow from the underdrain system into an effluent channel and returned the flow back to the sump. A calibrated V-notch weir was located at the end of the effluent channel to measure the drawdown flow at the end of each test run. Background samples were collected from the vertical pipe, located upstream of the influent piping, with the use of a calibrated isokinetic sampler. All effluent samples were collected at the free-discharge of the outlet pipe. Filtration of the supply sump was performed with an in-situ filter wall containing 1-micron bag filters.



**Figure 5 Alden's Stormwater Filter Test Loop**



Photographs of the test setup are shown on **Figures 6 through 9.**



**Figure 6 FocalPoint HPMBs Test Setup**



**Figure 7 FocalPoint HPMBs Inlet Geometry**



**Figure 8 FocalPoint HPMBS Outlet Piping**



**Figure 9 Effluent Channel Drawdown Flow V-notch Weir**

## 2.2 Removal Efficiency Testing

Sediment testing was conducted to determine sediment removal efficiency, as well as sediment mass loading capacity. The sediment testing was conducted on an initially clean system at the 100% MTFR of 32 gpm (1.6 gpm/sq-ft selected by Convergent Water Technologies (Convergent)). A minimum of ten (10) 30-minute test runs were required to be conducted to meet the removal efficiency criterion. Additional runs were conducted to determine the maximum mass loading. The captured sediment was not removed from the system between test runs. The total mass injected into the system was quantified for each run by subtracting the mass remaining in the feeder from the starting mass. This value was used in calculating the influent mass/volume concentration.

The test sediment was prepared by Alden to meet the PSD gradation of 1-1000 microns in accordance with the distribution shown in column 2 of **Table 1**. The sediment was silica based, with a specific gravity of 2.65. Three random PSD samples of the test sediment were analyzed by GeoTesting Express, an independent certified analytical laboratory using ASTM D6913/D6913M-17 (2017), “Standard Test Methods for Particle-Size Distribution (Gradation) of Soils Using Sieve Analysis” and ASTM D7928-21e1 (2021), “Standard Test Method for Particle-Size Distribution (Gradation) of Fine-Grained Soils Using the Sedimentation (Hydrometer) Analysis”. The average of the three samples was used for compliance with the protocol. Additional discussion of the sediment is presented in **Section 4.1**.

**Table 1 Test Sediment Particle Size Distribution**

<b>Table 1: Test Sediment Particle Size Distribution<sup>1</sup></b>	
<b>Particle Size (Microns)</b>	<b>Target Minimum % Less Than<sup>2</sup></b>
1,000	100
500	95
250	90
150	75
100	60
75	50
50	45
20	35
8	20
5	10
2	5
<p>1. The material shall be hard, firm, and inorganic with a specific gravity of 2.65. The various particle sizes shall be uniformly distributed throughout the material prior to use.</p> <p>2. A measured value may be lower than a target minimum % less than value by up to two percentage points. A measured value may be lower than a target minimum % less than value by up to two percentage points (e.g., at least 3% of the particles must be less than 2 microns in size [target is 5%]), provided the measured d50 value does not exceed 75 microns..</p>	

The target influent sediment concentration was 200 mg/L (+/-20 mg/L) for all tests. The

concentration was verified by collecting a minimum of three timed dry samples at the injector and correlating the data with the measured average flow to verify the influent concentration values for each test. The allowed Coefficient of Variance (COV) for the measured samples was 0.10. The mass/volume concentration was used to calculate the removal efficiency for each test run.

The protocol required the temperature of the supply water to be below 80 degrees F.

A minimum of 5 time-stamped effluent samples were collected from the end of the outlet pipe during each run. A minimum of three detention times were allowed to pass before collecting a sample after the start of sediment feed and again when the feed was interrupted for injection measurements. Three (3) background samples of the supply water were collected during each run. The samples were collected with each odd-numbered effluent sample (1, 3, 5, etc.). Collected samples were analyzed for Suspended Solids Concentration (SSC) using ASTM D3977-97 (2019). Note: Per the protocol, SSC represents TSS.

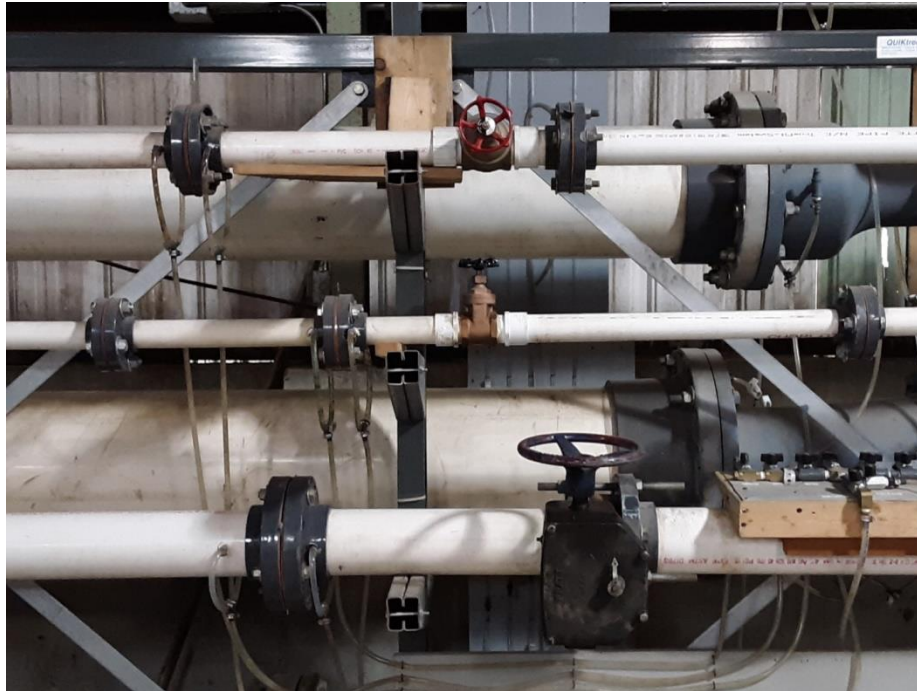
At the conclusion of a run, the injection feed was stopped and time-stamped. The flow was stopped after a duration of 10-seconds had passed. Two (2) volume-based evenly-spaced effluent samples were collected from the pipe during drawdown.

## **2.3 Instrumentation and Measuring Techniques**

### *Flow*

The inflow to the test unit was measured using a 1.5” calibrated orifice plate differential-pressure flow meter. The meter was fabricated per ASME guidelines and calibrated in Alden’s Calibration Department prior to the start of testing. The high and low pressure lines from the meter were connected to manifolds containing isolation valves. Flows were set with a control valve and the differential head from the meter was measured using a Rosemount® 0 to 250-inch Differential Pressure cell, also calibrated at Alden prior to testing. All pressure lines and cells were purged of air (bled) prior to the start of each test. The test flow was averaged and recorded every 5 seconds throughout the duration of each test run using an in-house computerized data acquisition program. The accuracy of the flow measurement is  $\pm 1\%$ . A photograph of the flow meters is shown on **Figure 10** and the laboratory pumps on **Figure 11**.





**Figure 10 Photograph of Laboratory Flow Meters**



**Figure 11 Photograph of Laboratory Pumps**

### *Temperature*

Water temperature measurements within the supply sump were obtained using a calibrated Omega® DP25 temperature probe and readout device. The calibration was performed at the Alden laboratory prior to testing. The temperature measurement was documented at the start and end of each test, to ensure an acceptable testing temperature of  $\leq 80$  degrees F.

### *Water Levels*

The ponding water level above the mulch layer was recorded to the nearest 1/16" at the end of each test run with the use of a staff gauge mounted to the inside of the test tank.

### *Drawdown Flow*

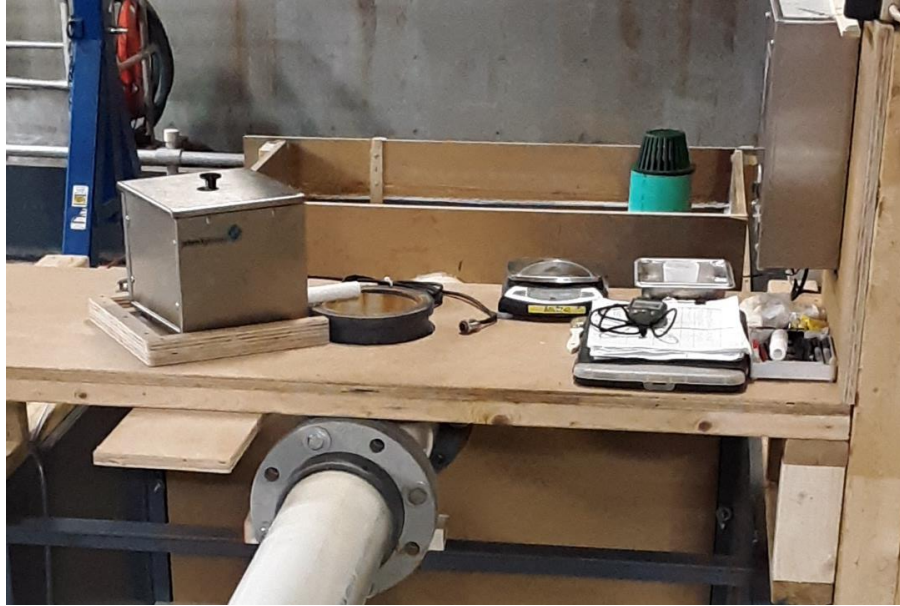
The drawdown flow was measured at the conclusion of each test run with the use of the calibrated V-notch weir. The water level at the weir was recorded every 5 seconds using a piezometer tap, Omegadyne PX419, 0 - 2.5 psi pressure transducer (PT), and computer DA program. The PT and weir were calibrated as a system prior to testing. Accuracy of the readings is  $\pm 0.001$  ft. A photograph of the pressure instrumentation is shown on **Figure 12**.



**Figure 12 V-notch Weir Pressure Measurement Instrumentation**

### *Sediment Injection*

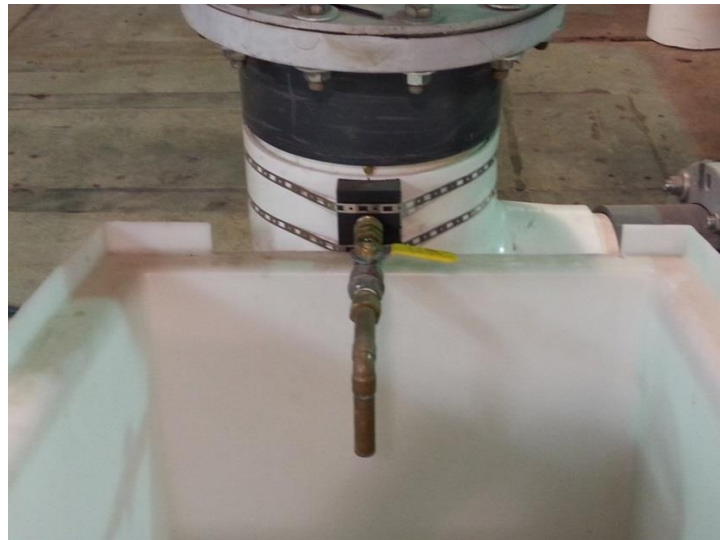
The test sediment was injected into the crown of the influent pipe using a Schenk® volumetric screw feeder, model 106, shown on **Figure 13**. The auger feed screw, driven with a variable-speed drive, was calibrated with the test sediment prior to testing. The calibration, as well as test verification of the sediment feed was accomplished by collecting timed dry samples of 0.1-liter, up to a maximum of 1-minute, and weighing them on an Ohaus® 4000g x 0.1g, model SCD-010 digital scale. The allowable Coefficient of Variance (COV) for the injection was  $\leq 0.10$ .



**Figure 13 Photograph of Variable-Speed Sediment Feeder**

#### *Sample Collection*

Effluent samples were collected in 2-liter containers from the free-discharge at the end of the 6-inch effluent pipe. Background concentration samples were collected from the center of the vertical pipe upstream of the test unit with the use of a calibrated isokinetic sampler, shown on **Figure 14**.



**Figure 14 Photograph of the Background Isokinetic Sampler**

### *Sample Concentration Analysis*

Effluent and background concentration samples were analyzed by Alden in accordance with Method B, as described in ASTM Designation: D 3977-97 (2019), “Standard Test Methods for Determining Sediment Concentration in Water Samples”. The required silica sand used in the sediment testing did not result in any dissolved solids in the samples and therefore, simplified the ASTM testing methods for determining sediment concentration.

### *Spiked Sample Analyses*

The ASTM D3977 analysis method is not currently included as part of Alden’s 17025 accreditation. Analytical accuracy was verified by preparing four blind control samples (2 at ~25 mg/L and 2 at ~60 mg/L), using the test sediment, and processed using the ASTM method. The final calculated values were within 5% of the theoretical sample concentrations, as shown in **Table 2**. The lower processed sample concentrations were within expected values, as the %-finer value of the 1.5 micron size (filter porosity) ranged from 3% to 5%. Deviations in the Delta % values are due to rounding.

**Table 2 Results of Processed Spiked Concentration Samples**

Sample	Prepared Concentration mg/L	Processed Concentration mg/L	Delta %
2	26.6	25.8	-3.0
3	24.6	23.2	-5.5
<b>Avg</b>	<b>25.6</b>	<b>24.5</b>	<b>-4.2</b>
1	58.6	55.8	-4.8
4	61.4	58.4	-4.8
<b>Avg</b>	<b>60.0</b>	<b>57.1</b>	<b>-4.8</b>

## **2.4 Data Management and Acquisition**

A designated Laboratory Records Book was used to document the conditions and pertinent data entries for each test conducted. All entries were initialed and dated.

A personal computer running an Alden in-house Labview<sup>®</sup> Data Acquisition program was used to record all data related to instrument calibration and testing. A 16-bit National Instruments<sup>®</sup> NI6212 Analog to Digital board was used to convert the signal from the pressure cells. Alden’s in-house data collection software, by default, collects one second averages of data collected at a raw rate of 250 Hz. The system allows very long contiguous data collection by continuously



writing the collected 1-second averages and their RMS values to disk. The data output from the program is in tab delimited text format with a user-defined number of significant figures.

Test flow and pressure data were continuously collected at a frequency of 250 Hz. The flow data was averaged and recorded to file every 5 seconds. The recorded data files were imported into a spreadsheet for further analysis and plotting.

Excel based data sheets were used to record all data used for quantifying injection rate, effluent, and background sample concentrations. The data were input to the designated spreadsheet for final processing.

### **3. Performance Claims**

Per the NJDEP verification procedure and based on the laboratory testing conducted for the FocalPoint High Performance Modular Biofiltration System (FocalPoint HPMBS), the following are the performance claims made by Convergent.

#### *Total Suspended Solids (TSS) Removal Efficiency*

Based on the laboratory testing conducted, the tested FocalPoint HPMBS system achieved a 95.0% cumulative TSS removal efficiency rounded down to 80% per the NJDEP Protocol.

#### *Maximum Treatment Flow Rate (MTFR)*

The tested system has an MTFR of 32.3 gpm (0.072 cfs) and an effective filtration treatment area (EFTA) of 20.21 ft<sup>2</sup> (loading rate = 1.6 gpm/ft<sup>2</sup>).

#### *Effective Filtration Treatment Area*

The Effective Filtration Treatment Area (EFTA) for the test system is 20.21 ft<sup>2</sup>.

#### *Sediment Load Capacity/Mass Load Capture Capacity*

Based on laboratory testing results, the test system has a mass loading capacity of 75.87 lbs and a mass loading capture capacity of 72.02 lbs (3.56 lbs/ft<sup>2</sup> of filter area).

#### *Maximum Allowable Inflow Drainage Area*

Per the NJDEP Filter Protocol, to calculate the maximum inflow drainage area, the total sediment load captured mass observed during the test (72.02 lbs) is divided by 600 lbs/acre. Thus, the maximum inflow drainage area for the tested system is 0.12 acres.

### **4. Supporting Documentation**

The NJDEP Procedure (NJDEP, 2013b) for obtaining verification of a stormwater manufactured treatment device (MTD) from the New Jersey Corporation for Advanced Technology (NJCAT)

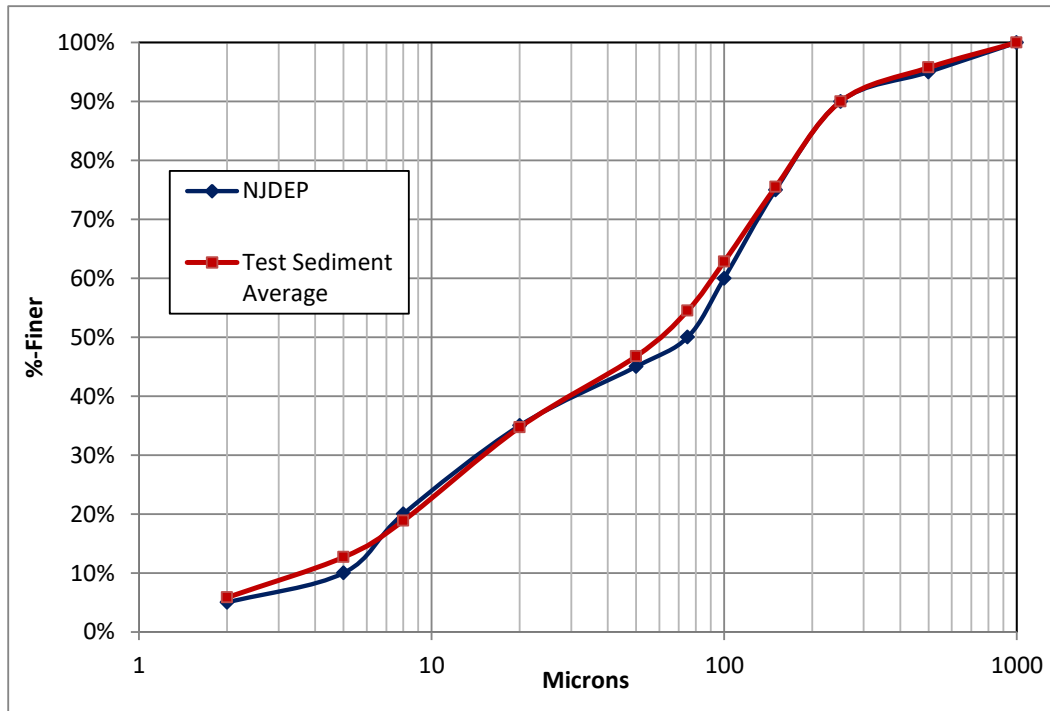
requires that “copies of the laboratory test reports, including all collected and measured data; all data from performance evaluation test runs; spreadsheets containing original data from all performance test runs; all pertinent calculations; etc.” be included in this section. This was discussed with NJDEP, and it was agreed that as long as such documentation could be made available by NJCAT upon request that it would not be prudent or necessary to include all this information in this verification report. This information was provided to NJCAT.

#### 4.1 Test Sediment PSD Analysis

The sediment particle size distribution (PSD) used for removal efficiency testing was comprised of 1-1000 micron silica particles, as shown in **Table 1**. The Specific Gravity (SG) of the sediment mixes was 2.65. Commercially-available silica products were provided by AGSCO Corp., a QAS International ISO-9001 certified company, and blended by Alden as required. Test batches were prepared in individual 5-gallon buckets, which were arbitrarily selected for the removal testing. A well-mixed sample was collected from three random test batches and analyzed for PSD in accordance with ASTM D6913 (2017) and ASTM D7928 (2021), by GeoTesting Express, an ISO/IEC 17025 accredited independent laboratory. The average of the samples was used for compliance to the protocol specifications listed in Column 2 of **Table 1**. The median  $D_{50}$  of the samples was 58 microns. The PSD data of the samples are shown in **Table 3** and the corresponding curves are shown on **Figure 15**.

**Table 3 PSD Analyses of Alden NJDEP 1-1000 Mix**

Particle size ( $\mu\text{m}$ )	NJDEP %-Finer	Bucket 8	Bucket 9	Bucket 10	Average	QA/QC Compliant
1000	100%	100%	100%	100%	100%	Y
500	95%	96%	96%	96%	96%	Y
250	90%	90%	90%	90%	90%	Y
150	75%	76%	75%	76%	76%	Y
100	60%	64%	63%	64%	63%	Y
75	50%	56%	56%	56%	55%	Y
50	45%	47%	47%	48%	47%	Y
20	35%	34%	34%	35%	35%	Y
8	20%	19%	18%	19%	19%	Y
5	10%	13%	15%	13%	13%	Y
2	5%	6%	7%	6%	6%	Y
$D_{50}$	$\leq 75$	58	58	57	58	Y



**Figure 15 PSD Curves of 1-1000 micron Test Sediment**

## 4.2 Removal Efficiency and Mass Loading Testing

### *Testing Summary*

Twelve (12) removal efficiency tests (runs 1-12) and 13 mass loading tests (runs 13-25) were conducted at a 100% MTFR target flow of 32.3 gpm (1.6 gpm/ft<sup>2</sup>). Runs number 1 and 4 were omitted from the cumulative removal efficiency, as the mass/volume influent concentration exceeded the 10% allowable tolerance. The injected mass was however, per the NJCAT protocol interpretation, included in the overall mass loading value. The duration of runs 1-12 was 33.5 minutes, meeting the 30-minute criterion of the protocol. The duration of the mass loading runs ranged from 35.5 to 198.5 minutes. All test runs were conducted at the target influent sediment concentration of 200 mg/L. The removal efficiencies were calculated using the influent concentration based on the quantified injected mass and water volume.

The removal efficiencies were calculated using the mass/volume influent concentrations shown in **Table 4** and **Table 7**, and the adjusted effluent and drawdown sediment concentrations and influent, effluent and drawdown volumes shown in **Table 6** and **Table 9** using **Equation 1**. The sediment was dried prior to conducting each test run, so no adjustment for moisture content was conducted in the removal efficiency calculations.

The injected and captured mass are shown in **Table 5** and **Table 8**. The removal efficiency vs mass loading is shown on **Figure 16**. The recorded driving head at the end of each run vs mass loading is shown on **Figure 17**.

$$\text{Removal Efficiency (\%)} = \frac{\left( \frac{\text{Average Influent TSS Concentration} \times \text{Total Volume of Test Water}}{\text{Average Influent TSS Concentration} \times \text{Total Volume of Test Water}} \right) - \left( \frac{\text{Adjusted Effluent TSS Concentration} \times \text{Total Volume of Effluent Water}}{\text{Average Influent TSS Concentration} \times \text{Total Volume of Test Water}} \right) - \left( \frac{\text{Average Drawdown Flow TSS Concentration} \times \text{Total Volume of Drawdown Water}}{\text{Average Influent TSS Concentration} \times \text{Total Volume of Test Water}} \right)}{\text{Average Influent TSS Concentration} \times \text{Total Volume of Test Water}} \times 100$$

### Equation 1 Equation for Calculating Removal Efficiency

#### Removal Efficiency Testing

The measured flow ranged from 32.2 gpm to 33.0 gpm, with an average flow of 32.4 gpm. The calculated COV ranged from 0.002 to 0.013. The maximum recorded temperatures ranged from 68.3 to 74.7 degrees F. The measured injected influent concentration averages ranged from 186.8 to 211.9 mg/L for the 10 compliant runs. The injection COV ranged from 0.018 to 0.093. The calculated mass/volume influent concentration for the 10 compliant runs ranged from 183.8 to 209.6 mg/L. The average adjusted effluent concentrations ranged from 8.5 to 17.3 mg/L and the average drawdown concentrations ranged from 7.4 to 11.6 mg/L. The calculated removal efficiencies ranged from 92.6% to 96.0%, with a cumulative average removal of 94.6%. The cumulative injected mass for runs 1-12 was 21.97 lbs. The maximum end-of-run ponding elevation was 0.51 ft above the surface of the mulch layer. Recorded and calculated test data are shown in **Tables 4 through 6**.

**Table 4 Measured Removal Efficiency Test Parameters**

Test Run #	Measured Flow		Maximum Water Temperature	End of Run Water El. Above Mulch	Influent Concentration (mg/L)					QA/QC Compliant
	gpm	COV	Deg. F	ft	Minimum	Maximum	Average	COV	Mass/Volume	
1	32.2	0.002	70.7	0.021	201.0	218.4	212.1	0.046	221.3	N
2	32.3	0.002	71.5	0.021	179.9	215.5	195.6	0.093	183.8	Y
3	32.3	0.002	70.5	0.000	201.7	217.8	208.7	0.040	199.5	Y
4	32.3	0.002	69.2	0.000	206.9	215.6	211.9	0.021	231.4	N
5	32.3	0.002	68.6	0.000	187.9	198.5	193.8	0.028	190.8	Y
6	32.3	0.002	68.7	0.156	194.6	212.1	203.9	0.043	200.5	Y
7	32.3	0.002	68.9	0.167	192.8	208.1	198.4	0.042	197.5	Y
8	32.3	0.002	68.3	0.083	199.1	213.5	203.9	0.041	202.4	Y
9	32.4	0.002	68.3	0.281	204.9	212.2	208.4	0.018	203.1	Y
10	33.0	0.013	74.5	0.250	176.2	193.7	186.8	0.050	190.8	Y
11	32.3	0.002	73.3	0.511	210.7	212.4	211.6	0.004	209.6	Y
12	32.3	0.002	74.7	0.157	192.7	204.2	198.2	0.029	198.7	Y

**Table 5 Removal Efficiency Injected and Captured Mass**

Run #	Test Duration	Injected Mass	Total Mass Injected	Mass Captured	Total Mass Captured
	minutes	lbs	lbs	lbs	lbs
1	33.5	1.99	1.99	1.84	1.84
2	33.5	1.66	3.65	1.56	3.40
3	33.5	1.80	5.46	1.70	5.10
4	33.5	2.09	7.55	1.97	7.07
5	33.5	1.72	9.27	1.64	8.71
6	33.5	1.81	11.08	1.70	10.41
7	33.5	1.78	12.86	1.70	12.10
8	33.5	1.83	14.69	1.72	13.83
9	33.5	1.84	16.53	1.73	15.55
10	33.5	1.76	18.29	1.68	17.23
11	33.5	1.89	20.18	1.82	19.05
12	33.5	1.79	21.97	1.69	20.74

**Table 6 Removal Efficiency Testing Results**

Run #	Mass/Volume Influent Concentration	Average Adjusted Effluent Concentration	Average Adjusted Drawdown Concentration	Influent Volume	Effluent Volume	Drawdown Volume	Removal Efficiency	Cumulative Average
	mg/L	mg/L	mg/L	L	L	L	%	%
1	221	17.3	11.6	4082	3460	622	<b>92.6</b>	-*
2	184	11.8	9.7	4097	3584	513	<b>93.7</b>	<b>93.7</b>
3	200	12.1	8.1	4100	3610	490	<b>94.2</b>	<b>94.0</b>
4	231	13.3	10.9	4100	3640	459	<b>94.4</b>	-*
5	191	9.8	8.1	4099	3640	459	<b>94.9</b>	<b>94.3</b>
6	200	12.8	10.8	4097	3537	561	<b>93.7</b>	<b>94.1</b>
7	197	9.7	8.5	4096	3516	580	<b>95.2</b>	<b>94.4</b>
8	202	12.1	8.7	4097	3577	519	<b>94.2</b>	<b>94.3</b>
9	203	12.3	9.8	4101	3481	620	<b>94.1</b>	<b>94.3</b>
10	191	8.5	8.9	4176	3513	663	<b>95.5</b>	<b>94.5</b>
11	210	8.6	7.4	4097	3272	825	<b>96.0</b>	<b>94.6</b>
12	199	11.4	9.2	4097	3523	575	<b>94.4</b>	<b>94.6</b>

\*Test omitted from cumulative average calculation due to out-of-tolerance influent concentration

### *Mass Loading Testing*

The measured flow ranged from 32.1 to 32.3 gpm, with an average flow of 32.3 gpm. The calculated COV ranged from 0.002 to 0.006. The maximum recorded temperatures ranged from 68.6 to 74.7 degrees F. The average injected influent concentrations ranged from 191.2 to 206.2 mg/L. The injection COVs ranged from 0.006 to 0.076. The calculated mass/volume influent concentration ranged from 185.7 to 203.9 mg/L. The average adjusted effluent concentrations ranged from 6.3 to 11.9 mg/L and the average drawdown concentrations ranged from 5.9 to 11.0 mg/L. The calculated removal efficiencies ranged from 94.5% to 96.8%, with a cumulative average removal of 95.0% for all 25 runs. The maximum recorded driving head was 0.912 ft. It was decided by Convergent to terminate testing after Run #25. The total injected mass for runs 1-25 was 75.87 lbs, with a calculated captured mass of 72.02 lbs. The recorded and calculated test data are shown in **Tables 7 through 9**. While the FocalPoint efficiency did not drop below 80% and the driving head had not reached a failure point as defined by the protocol, all other applicable requirements of the protocol were met, and the mass loading rate had reached a point (3.56 lbs/ft<sup>2</sup> of filter bed area) at which it was concluded that there was little value in running additional test runs.

**Table 7 Measured Mass Loading Test Parameters**

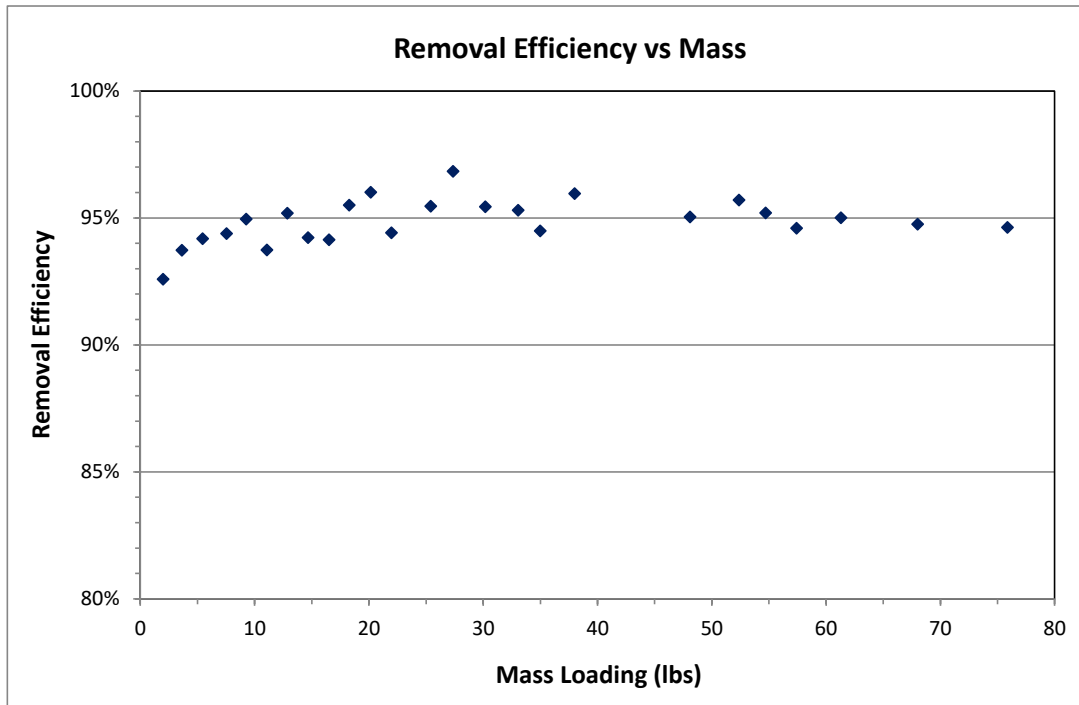
Test Run #	Measured Flow		Maximum Water Temperature	End of Run Water El. Above Mulch	Influent Concentration (mg/L)					QA/QC Compliant
	gpm	COV	Deg. F	ft	Minimum	Maximum	Average	COV	Mass/Volume	
13	32.3	0.002	74.2	0.750	190.7	193.2	192.4	0.008	189.5	Y
14	32.1	0.006	70.7	0.875	197.3	201.1	199.0	0.010	195.1	Y
15	32.3	0.002	69.1	0.760	193.7	200.8	196.3	0.020	188.8	Y
16	32.3	0.003	70.2	0.823	196.2	201.9	198.3	0.016	192.4	Y
17	32.3	0.002	71.5	0.865	205.2	207.5	206.2	0.006	200.0	Y
18	32.3	0.002	74.6	0.907	200.8	207.0	203.6	0.015	185.7	Y
19	32.3	0.002	74.7	0.912	189.5	216.5	197.2	0.057	188.6	Y
20	32.3	0.002	71.4	0.875	184.9	203.3	191.2	0.044	186.2	Y
21	32.3	0.004	68.6	0.854	196.4	205.8	201.3	0.023	202.9	Y
22	32.3	0.002	71.0	0.854	194.0	206.7	200.6	0.032	203.9	Y
23	32.3	0.002	72.4	0.844	181.4	216.3	200.9	0.076	203.4	Y
24	32.3	0.002	71.2	0.792	192.1	208.8	201.0	0.035	202.9	Y
25	32.3	0.002	72.3	0.771	196.8	212.3	204.2	0.031	203.1	Y

**Table 8 Mass Loading Injected and Captured Mass**

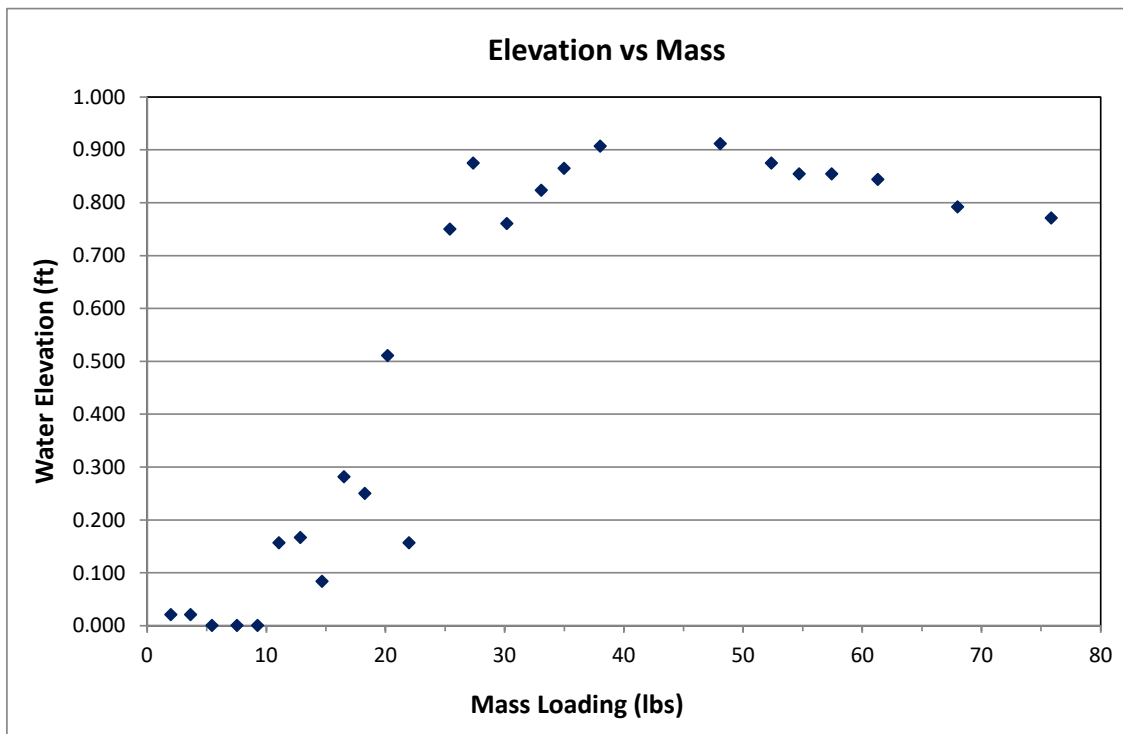
Run #	Test Duration	Injected Mass	Total Mass Injected	Mass Captured	Total Mass Captured
	minutes	lbs	lbs	lbs	lbs
13	67.5	3.44	25.42	3.29	24.03
14	37.5	1.96	27.38	1.90	25.93
15	55.5	2.82	30.20	2.69	28.62
16	55.5	2.88	33.08	2.74	31.37
17	35.5	1.91	34.99	1.81	33.17
18	60.5	3.02	38.02	2.90	36.07
19	198.5	10.09	48.10	9.59	45.66
20	85.5	4.29	52.40	4.11	49.77
21	42.5	2.33	54.72	2.21	51.98
22	49.5	2.72	57.44	2.57	54.56
23	70.5	3.87	61.31	3.67	58.23
24	122.5	6.71	68.01	6.35	64.58
25	143.5	7.86	75.87	7.44	72.02

**Table 9 Mass Loading Removal Efficiency Results**

Run #	Mass/Volume Influent Concentration	Average Adjusted Effluent Concentration	Average Adjusted Drawdown Concentration	Influent Volume	Effluent Volume	Drawdown Volume	Removal Efficiency	Cumulative Average
	mg/L	mg/L	mg/L	L	L	L	%	%
13	189	8.7	7.6	8241	7352	889	<b>95.5</b>	<b>94.7</b>
14	195	6.3	5.9	4561	3494	1067	<b>96.8</b>	<b>94.9</b>
15	189	8.4	9.7	6780	5880	900	<b>95.4</b>	<b>94.9</b>
16	192	9.3	7.7	6785	5881	904	<b>95.3</b>	<b>94.9</b>
17	200	11.9	7.6	4343	3433	910	<b>94.5</b>	<b>94.9</b>
18	186	7.7	6.2	7384	6435	949	<b>96.0</b>	<b>95.0</b>
19	189	9.4	9.2	24257	23211	1046	<b>95.0</b>	<b>95.0</b>
20	186	8.1	7.1	10456	9522	935	<b>95.7</b>	<b>95.0</b>
21	203	9.9	9.1	5199	4255	944	<b>95.2</b>	<b>95.0</b>
22	204	11.7	7.7	6050	5081	970	<b>94.6</b>	<b>95.0</b>
23	203	10.4	8.2	8619	7653	966	<b>95.0</b>	<b>95.0</b>
24	203	10.6	11.0	14987	14062	925	<b>94.7</b>	<b>95.0</b>
25	203	10.9	10.9	17553	16641	912	<b>94.6</b>	<b>95.0</b>



**Figure 16 FocalPoint HPMBS Removal Efficiency vs Mass Loading**



**Figure 17 FocalPoint HPMBS Recorded Driving Head Elevations**



Note: Drops in driving head were observed after the system was not tested for multiple days due to weekend and vacation shutdown. These fluctuations will be observed in the field as well. The maximum driving head reached during testing was 10.92 inches.

## **5. Design Limitations**

Convergent and its network of value-added resellers typically work with the civil site designers, engineers, landscape architects and land planners to ensure all potential constraints are addressed during the specification process and that the system will function as intended. Each installation will have unique limitations or requirements and the following limitations should be considered general and not all inclusive.

### *Required Soil Characteristics*

The functionality of the FocalPoint HPMBS is not affected by existing soil conditions and can be designed to accommodate almost any site-specific soil type, condition or characteristic. For example, FocalPoint HPMBS can be installed directly into an excavated basin, providing infiltration when native soils allow. If subsoils do not allow infiltration, the modular box underdrain would be connected to an outlet pipe to convey water away from the system.

### *Infiltration Regulatory Requirements*

The state of New Jersey requires that any green infrastructure (GI) device must treat the Water Quality Design Storm (WQDS) through soil and/or vegetation, infiltration, or storage for reuse. Any configuration that uses a biofiltration media and can be configured "at grade" and incorporated into a soft shell, planter box, or vegetated area would meet the GI definition. MTDs with biofiltration media that would be placed "below ground" as a vault without vegetation can be considered GI only if the device infiltrates the entire water quality design storm into the subsoil. A below ground device (vault) would need to meet the NJDEP Stormwater BMP Manual conditions of having the soil below the MTD meet the minimum tested infiltration rate of one inch per hour, have at least two feet of separation from the seasonal high-water table, and infiltrate into the subsoil.

### *Slope*

Typically, a FocalPoint HPMBS is installed flat and since it is a relatively small footprint because of its hydraulic loading rate (1.6 gpm/ft<sup>2</sup>), it is rare that slope becomes an issue for installation. If it does, there are simple and effective grading practices that include terraced walls, retaining walls or water ladders/steps that can create an aesthetically pleasing, safe and stable method to allowing a flat installation. We would recommend a designer contact Convergent to discuss the design prior to specifying the system.

### *Maximum Flow Rate*

The hydraulic loading rate of the FocalPoint HPMBS is 1.6 gpm/ft<sup>2</sup> of effective filtration treatment area, equivalent to 160 inches/hour. Based on this information, the maximum flow rate of a FocalPoint HPMBS is equal to the filter bed area multiplied by the hydraulic loading rate.

### *Maintenance Requirements*

FocalPoint HPMBS includes a 1-year maintenance and inspection plan with each unit purchased which includes mulch replacement, debris removal, weeding and inspection of the overflow and underdrain during the first year after activation. At a minimum it is recommended inspection and maintenance be conducted at intervals of no more than six months. Observations made during site inspection and maintenance activities over the long-term can be used to develop site-specific maintenance frequency and trends.

### *Driving Head*

A bypass/overflow riser structure is placed a minimum of 12 inches above the mulch surface. This is the recommended head required to maintain the MTFR and annual sediment load and would be the minimum value used by a designer to set the appropriate top of pavement, bottom of curb, and bypass/overflow elevations. The actual height of the bypass may vary based on the climate of the design location if there is a rainy season or the rainfall events are long duration in nature since the antecedent moisture content of biofilter media affects the filtration rate, and therefore the head required to maintain the filtration rate.

### *Installation Limitations*

Prior to installation, Convergent provides an installation guide to the Contractor and offers on-site support during installation. The system is specified with a cap and seal method to protect it during construction. This cap and seal should not be removed until site construction is complete, and the area is permanently stabilized. Note that plants should be installed at the time of activation or when site landscaping activities commence, provided the runoff area is completely stabilized.

### *Configurations*

The FocalPoint HPMBS is typically located in a recessed bowl (same as a rain garden or bioretention practice) and accepts sheet, curb and gutter flow, open channel flow or piped flow if site grading allows (e.g., roof downspouts or area drains). The FocalPoint HPMBS is primarily configured in a box-less or soft-shell system for better aesthetics and simplifies the connection between the filtration layer and the infiltration zone (native soils) because it requires less infrastructure to do so. It can be surrounded with a precast or cast-in-place curb wall or planter box if the designer chooses. Because FocalPoint HPMBS is typically a box-less system, it is not restricted to a width or length dimension which gives the designer tremendous versatility when laying the system out on a site. The minimum constructable filter bed area is 20 ft<sup>2</sup>, and the recommended minimum width is 3 ft. A bypass/overflow riser structure placed at the appropriate elevation acts as a bypass and inspection port.

There are two options of installation available for the FocalPoint HPMBS that include the following. Option one is an “underdrain” connected to a discharge pipe, where the system is installed directly in a prepared excavation with a geotextile or impermeable liner separating the native soils from the system. An unperforated overflow riser structure placed at the appropriate elevation acts as a bypass and inspection port and connects to the discharge pipe. Option two is where surrounding subsoils allow for infiltration, and the modular box underdrain system can be

expanded to provide temporary storage while infiltration occurs through native soils. This arrangement would be designed per the NJDEP Stormwater BMP Manual condition of having the most hydraulically restrictive soil layer below the MTD meet the minimum tested infiltration rate of one inch per hour, have at least 2 ft of separation from the seasonal high-water table measured from the lowest point of the system, and infiltrate into the subsoil.

#### *Structural Load Limitations*

FocalPoint HPMBS units are typically placed in landscaped or green space areas (traffic islands, behind curbing, etc.) and are not expected to receive vehicular loading, similar to a rain garden or bioretention practice. The modular box underdrain modules can be designed to support HS-20, HS-25 or greater loads should they extend out beyond the filter bed area and placed under a vehicular or motorized traffic surface. As always, designers can contact Convergent for technical assistance when trying to meet site-specific requirements.

#### *Pre-treatment Requirements*

There are no pre-treatment requirements for the FocalPoint HPMBS system based on the configuration that was tested; however, pretreatment will extend the functional life, increase the pollutant removal capability, facilitate ease of maintenance and is highly recommended for reducing incoming velocities and capturing coarser sediments.

#### *Limitations in Tailwater*

Tailwater conditions should be evaluated for each application. Generally, it is best to design under free discharge conditions, however given the system has a 95 percent void space modular underdrain system, it is possible to design for a permanent or intermittent tailwater condition so long as the media is not permanently wet. As always, designers can contact Convergent for technical assistance when trying to meet site-specific requirements.

#### *Depth to Seasonal High Water Table*

Seasonal high groundwater has the potential to impact driving head and when necessary, the FocalPoint HPMBS can be designed with an impermeable liner and watertight outlet so there is no impact. Depth of seasonal high-water table is typically not an issue when it comes to buoyancy as the weight of the section (mulch, media, bridging stone and modular box underdrain) will weigh more than the water it displaces. As always, designers can contact Convergent for technical assistance when trying to meet site-specific requirements.

## **6. Maintenance**

Routine maintenance is included by Convergent or its value-added resellers (VAR) in the first year after activation at no additional cost to the owner. Typically, two (2) visits per year are recommended to remove sediment/debris, replace the mulch, weed, prune the vegetation, etc. These visits should be conducted in spring and fall, with spring visits targeting cleanup from winter pollutant loads and the fall visit targeting leaf litter and pine spills in addition to sediment pollutant loads. More information can be found in Convergent's operation and maintenance guide: <https://convergewater.wpengine.com/wp-content/uploads/2021/06/focalpoint-operations->

[maintenance-guide.pdf](#)

### *Maintenance Visit Procedure*

Each maintenance visit consists of the following tasks.

- *Inspect FocalPoint HPMBs and Surrounding Area* – Document with photographs and record on maintenance report (example document provided).
- *Remove Silt/Sediment/Clay* – Dig out silt (if any) and mulch and remove trash and foreign items. After removal of mulch and debris, measure distance from the top of the FocalPoint HPMBs engineered media soil to the flow line elevation of the adjacent overflow conveyance. If this is greater than that specified on the plans add FocalPoint HPMBs media (not top soil or other) to recharge to the distance specified.
- *Mulch Replacement* – Bags of clean, double shredded hardwood mulch are typically used for smaller biofiltration beds; however, larger systems may require truckloads of mulch.
- *Plant Health Evaluation and Pruning or Replacement as Necessary* – Examine the plants' health and replace if dying. Prune as necessary to encourage growth in the correct directions.
- *Clean Surrounding Area* – Clean area around the unit and remove all refuse to be disposed of appropriately.
- *Complete Paperwork* – Including date stamped photos of the tasks listed above. Submit maintenance reports to local jurisdictions in accordance with approvals.

### **7. Statements**

The following signed statements from the manufacturer (Convergent), independent testing laboratory (Alden Research Laboratory) and NJCAT are required to complete the NJCAT verification process.

In addition, it should be noted that this report has been subjected to public review (e.g., stormwater industry) and all comments and concerns have been satisfactorily addressed.



**13810 Hollister Rd, Suite 100  
Houston, TX 77086**

September 8, 2021

Dr. Richard Magee, Sc.D., P.E., BCEE  
Executive Director – NJCAT c/o Center for Environmental Systems  
Stevens Institute of Technology  
One Castle Point on Hudson  
Hoboken, NJ 07030

**RE: Statement of Compliance  
FocalPoint High Performance Modular Biofiltration System**

Dear Dr. Magee,

Convergent Water Technologies (Convergent) has completed its verification testing for the FocalPoint high performance modular biofiltration system, a green infrastructure manufactured treatment device, in accordance with the *"Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology"* dated January 25, 2013. As required, manufacturers shall submit a signed statement confirming that all the procedures and requirements identified in the aforementioned process document and the *"New Jersey Department of Environmental Protection (NJDEP) Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device"* dated January 25, 2013, have been met. This letter serves as Convergent's statement that testing executed by Alden in the summer of 2021, under the direct supervision of Mr. James Mailloux - Principal Engineer, was conducted in full compliance with all applicable protocol and process documents.

Please feel free to contact me with additional questions or comments.

Kindest Regards,

Sincerely,

A handwritten signature in black ink, appearing to read "W. Scott Gorneau", followed by a long horizontal flourish.

W. Scott Gorneau, P.E.  
Vice President



Solving flow problems since 1894

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September 13, 2021

Dr. Richard Magee, P.E., BCEE  
Executive Director  
New Jersey Corporation for Advanced Technology  
Center for Environmental Systems  
Stevens Institute of Technology  
One Castle Point  
Hoboken, NJ 07030

Conflict of Interest Statement

Alden Research Laboratory (ALDEN) is a non-biased independent testing entity which receives compensation for testing services rendered. ALDEN does not have any vested interest in the products it tests or their affiliated companies. There is no financial, personal or professional conflict of interest between ALDEN and Convergent Water Technologies, Inc.

Protocol Compliance Statement

Alden performed the verification testing on the Convergent Water Technologies FocalPoint High Performance Modular Biofiltration System. The Technical Report and all required supporting data documentation has been submitted to NJCAT as required by the protocol.

Testing performed by ALDEN on the CWT FocalPoint HPMBS met or exceeded the requirements as stated in the "New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device", (January 25, 2013). Two tests were outside the specified concentration tolerance and were identified in the technical report.

James T. Mailloux

A handwritten signature in blue ink that reads 'James T. Mailloux'.

Principal Engineer  
Alden Research Laboratory  
[jmailloux@aldenlab.com](mailto:jmailloux@aldenlab.com)  
(508) 829-6000 x6446



**Center for Environmental Systems  
Stevens Institute of Technology  
One Castle Point  
Hoboken, NJ 07030-0000**

September 13, 2021

Gabriel Mahon, Chief  
NJDEP  
Bureau of Non-Point Pollution Control  
Division of Water Quality  
401 E. State Street  
Mail Code 401-02B, PO Box 420  
Trenton, NJ 08625-0420

Dear Mr. Mahon,

Based on my review, evaluation and assessment of the testing conducted on the Convergent Water Technologies FocalPoint High Performance Modular Biofiltration System (FocalPoint HPMBs) at the Alden Research Laboratory, Inc. (Alden), Holden, Massachusetts, under the direct supervision of Alden's senior stormwater engineer, James Mailloux, the test protocol requirements contained in the "*New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device (January 25, 2013)*" (NJDEP Filtration Protocol) were met or exceeded. Specifically

*Test Sediment Feed*

The sediment particle size distribution (PSD) used for removal efficiency testing was comprised of 1-1000 micron silica particles. The Specific Gravity (SG) of the sediment mixes was 2.65. Commercially-available silica products were provided by AGSCO Corp., a QAS International ISO-9001 certified company, and blended by Alden as required. Test batches were prepared in individual 5-gallon buckets, which were arbitrarily selected for the removal testing. A well-mixed sample was collected from three random test batches and analyzed for PSD in accordance with ASTM D6913 (2017) and ASTM D7928 (2021), by GeoTesting Express, an ISO/IEC 17025 accredited independent laboratory. The average of the samples was used for compliance to the protocol specifications. The average D<sub>50</sub> of the samples was 58 microns, well below the less than 75 micron protocol requirement.

### *Removal Efficiency Testing*

Twenty-five (25) removal efficiency testing runs were completed in accordance with the NJDEP filter protocol. Twelve (12) of the 25 test runs were conducted during removal efficiency testing and 13 during mass loading capacity testing. The target flow rate and influent sediment concentration were 32 gpm and 200 mg/L. The FocalPoint HPMBS demonstrated an average sediment removal efficiency on a cumulative mass basis of 94.6% over the course of the 12-removal efficiency test runs and 95.0% for the 25 test runs.

### *Sediment Mass Loading Capacity*

Mass loading capacity testing was conducted as a continuation of removal efficiency testing. Mass loading test runs were conducted using identical testing procedures and targets as those used in the removal efficiency runs. The FocalPoint HPMBS demonstrated a mass loading capture capacity of 72.02 lbs (3.56 lbs/ft<sup>2</sup> of filter area).

Since no scour testing was conducted, the FocalPoint HPMBS is only qualified for off-line installation.

Sincerely,



Richard S. Magee, Sc.D., P.E., BCEE  
Executive Director



## 8. References

ASME (1971), *“Fluid Meters Their Theory and Application- Sixth Edition”*.

ASTM (2007), *“Standard Test Method for Particle Size Analysis of Soils”*, Annual Book of ASTM Standards, D422-63, Vol. 04.08.

ASTM (2016), *“Standard Test Methods for Determination of Water (Moisture) Content of Soil by Direct Heating”*, Annual Book of ASTM Standards, D4959-07, Vol. 04.08.

ASTM (2019), *“Standard Test Methods for Determining Sediment Concentration in Water Samples”*, Annual Book of ASTM Standards, D3977-97, Vol. 11.02.

NJDEP 2013a. *New Jersey Department of Environmental Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Filtration Manufactured Treatment Device*. Trenton, NJ. January 25, 2013.

NJDEP 2013b. *New Jersey Department of Environmental Protection Procedure for Obtaining Verification of a Stormwater Manufactured Treatment Device from New Jersey Corporation for Advanced Technology*. Trenton, NJ. January 25, 2013.

## **VERIFICATION APPENDIX**

### ***Introduction***

- Manufacturer – Convergent Water Technologies, 13810 Hollister Rd, Suite 100, Houston, TX 77086. [www.convergentwater.com](http://www.convergentwater.com) (800)-711-5428.
- Convergent Water Technologies FocalPoint HPMBS verified models are shown in **Table A-1**.
- TSS Removal Rate – 80%
- Off-line installation

### ***Detailed Specification***

- FocalPoint HPMBS models, MTFR, and maximum drainage area per NJDEP sizing requirements are attached (**Table A-1**).
- Maximum inflow drainage area
  - The maximum inflow drainage area is governed by the maximum treatment flow rate or sediment loading on the filter for each filter arrangement as presented in **Table A-1**.
- The FocalPoint HPMBS O&M manual can be accessed at:  
<https://convergewater.wpengine.com/wp-content/uploads/2021/06/focalpoint-operations-maintenance-guide.pdf>
- This device cannot be used in series with another MTD or a media filter (such as a sand filter) to achieve an enhanced removal rate for total suspended solids (TSS) removal under N.J.A.C. 7:8-5.5.

**Table A-1 FocalPoint HPMBS Design Specifications**

<b>FOCALPOINT HPMBS MODEL<sup>1</sup></b>	<b>Filter Bed Area (ft<sup>2</sup>)</b>	<b>MTFR<sup>2</sup> (gpm)</b>	<b>MTFR (cfs)</b>	<b>Maximum Allowable Drainage Area (acre)<sup>3</sup></b>	<b>EFTA (ft<sup>2</sup>)</b>	<b>MTFR/ EFTA (gpm/ft<sup>2</sup>)</b>	<b>ESTA (ft<sup>2</sup>)</b>	<b>ESTA/ EFTA</b>	<b>Acre/EFTA</b>
FP-20	20	32	0.071	0.12	20.0	1.6	20.0	1.0	0.006
FP-30	30	48	0.107	0.18	30.0	1.6	30.0	1.0	0.006
FP-42	42	67.2	0.150	0.25	42.0	1.6	42.0	1.0	0.006
FP-50	50	80	0.178	0.30	50.0	1.6	50.0	1.0	0.006
FP-55	55	88	0.196	0.33	55.0	1.6	55.0	1.0	0.006
FP-70	70	112	0.249	0.42	70.0	1.6	70.0	1.0	0.006
FP-80	80	128	0.285	0.47	80.0	1.6	80.0	1.0	0.006
FP-83	83	133	0.297	0.49	83.3	1.6	83.3	1.0	0.006
FP-90	90	144	0.321	0.53	90.0	1.6	90.0	1.0	0.006
FP-100	100	160	0.356	0.59	100.0	1.6	100.0	1.0	0.006
FP-120	120	192	0.428	0.71	120.0	1.6	120.0	1.0	0.006
FP-140	140	224	0.499	0.83	140.0	1.6	140.0	1.0	0.006
FP-160	160	256	0.570	0.95	160.0	1.6	160.0	1.0	0.006
FP-166	166	265.6	0.592	0.98	166.0	1.6	166.0	1.0	0.006
FP-220	220	352	0.784	1.31	220.0	1.6	220.0	1.0	0.006

Notes:

1. FocalPoint HPMBS model sizes are not fixed to a width or length dimension and expressed as a filter bed area that can be dimensioned based on site specific conditions, minimum width being 3 ft. See manufacturer's details and design guidelines for dimensional layout of systems. The modular underdrain area to filter bed area ratio will be at least 0.9, with or without infiltration, to achieve the reported performance.
2. MTFR is based on 1.6 gpm/ft<sup>2</sup> (0.0036 cfs/ft<sup>2</sup>) of effective filtration treatment area.
3. Maximum Allowable Inflow Drainage Area is based on 3.56 lbs/ft<sup>2</sup> mass loading rate and the equation in the NJDEP Filtration Protocol Appendix, where drainage area is calculated on 600-lbs of mass contributed per acre of drainage area annually.