NJCAT TECHNOLOGY VERIFICATION

SiteSaver® Stormwater Treatment Device

Fresh Creek Technologies Inc.

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(Revised Table A-1 January 2017)

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1. Description of Technology

A SiteSaver® SS8 stormwater treatment device manufactured by Fresh Creek Technologies, Inc. (Fresh Creek) was tested at the Alden Research Laboratory, Inc. (Alden), Holden, Massachusetts, an independent third-party testing laboratory to assess removal efficiency and scour of total suspended solids performance in accordance with the New Jersey Department of Environmental Protection "Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device", 2013. **Figure 1** shows a graphic of a SiteSaver® unit.

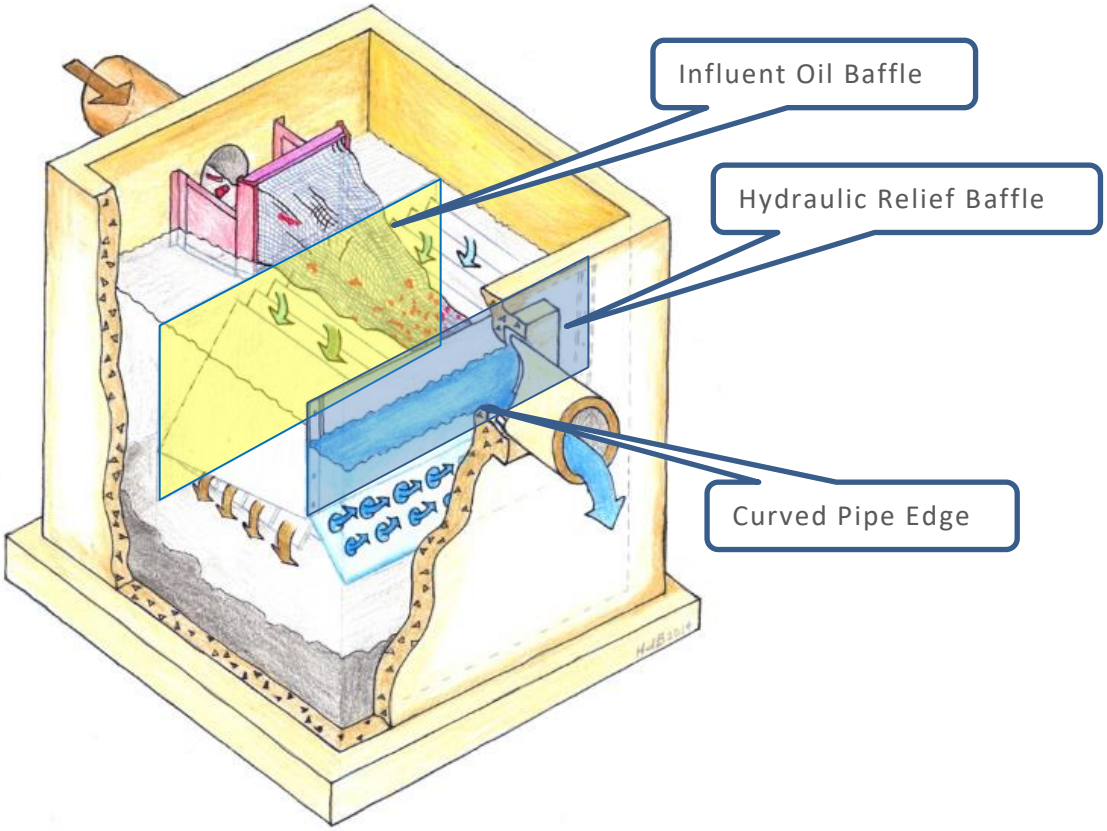

Figure 1 Graphic of Typical Inline SiteSaver® Unit

The SiteSaver® stormwater treatment device is a hydrodynamic stormwater treatment device containing a Netting-Trash-Trap®, an influent oil baffle, a hydraulic relief baffle, and inclined settling cells. The cells operate in parallel and self-clean to a collection chamber below the inclined cells. The cells support the netting bag, which collects floatables from the top region of the water column. The SiteSaver® is designed to capture and retain sediment as well as floating trash, debris, and oils that can enter stormwater and pollute downstream receiving waters. The concentration of

metals and other constituents associated with the sediment or floating pollutants may also be reduced.

The SiteSaver® internal components are typically housed in a precast concrete structure. A base, riser and lid are assembled in an excavation pit and connected to influent and effluent pipes by a site contractor. The internal components are fabricated from stainless steel and fiberglass with appurtenances such as rubber seals and nylon nets attached to plastic or wooden frames. Access hatches or frames and covers are made from aluminum and cast iron respectively. Loading rates are typically HS-20.

2. Laboratory Testing

The SS8 test unit is a rectangular concrete device measuring 3 feet wide by 8 feet long. The inflow and outflow lines are 12-inch diameter PVC pipe, with the inverts located 56 inches above the floor. Both pipe centerlines are positioned 8.44 inches to the left of center (looking downstream) and have a 1% slope. The entrance to the outlet pipe has a 3-inch rounding to reduce the exit loss. The internal geometry is made from ribbed fiberglass panels and is divided into an upstream pre-chamber, for settling of coarse particles, and a primary treatment area containing 8 inclined plates (48" x 27" at 55º to the horizontal) for settling of finer particles. The total projected horizontal settling area of the plates is 40 ft^2 (5.0 ft^2 of effective treatment area/plate) and the area of the collection sump is 24 ft^2. A trash collection net is positioned over the inclined plates. An overflow weir is located at the downstream end of the inclined plates. The flow is conveyed downward and out to an effluent chamber, where it passes through an effluent orifice baffle and is conveyed out of the unit through the outlet pipe. Horizontal louver panels are located below the inclined plates. The panels provide protection of the sediment bed from scour. A drawing of the SS8 test unit is shown in **Figure 2**.

2.1 Test Setup

The SS8 test unit was installed in the Alden test loop, shown in **Figure 3,** which is set up as a recirculation system. The loop is designed to provide metered flow up to approximately 17 cfs. Flow was supplied to the unit with one of two selected laboratory pumps (20HP, 50HP), drawing water from a 50,000-gallon supply sump. The test flow was set and measured using one of five differential-pressure meters (2", 4", 6", 8" or 12") and corresponding control valves. A Differential Pressure cell and computer Data Acquisition program was used to record the test flow. Thirty (30) feet of straight 12-inch pipe conveyed the metered flow to the unit. The influent and effluent pipes were set at 1% slopes. A 12-inch tee was located 4 pipe-diameters upstream of the test unit for injecting sediment into the crown of the influent pipe using a variable-speed auger feeder.

Filtration of the supply sump, to reduce background concentration, was performed with an in-situ filter wall containing 1-micron filter bags. A photograph showing the unit installed in the test loop is shown in **Figure 4.**

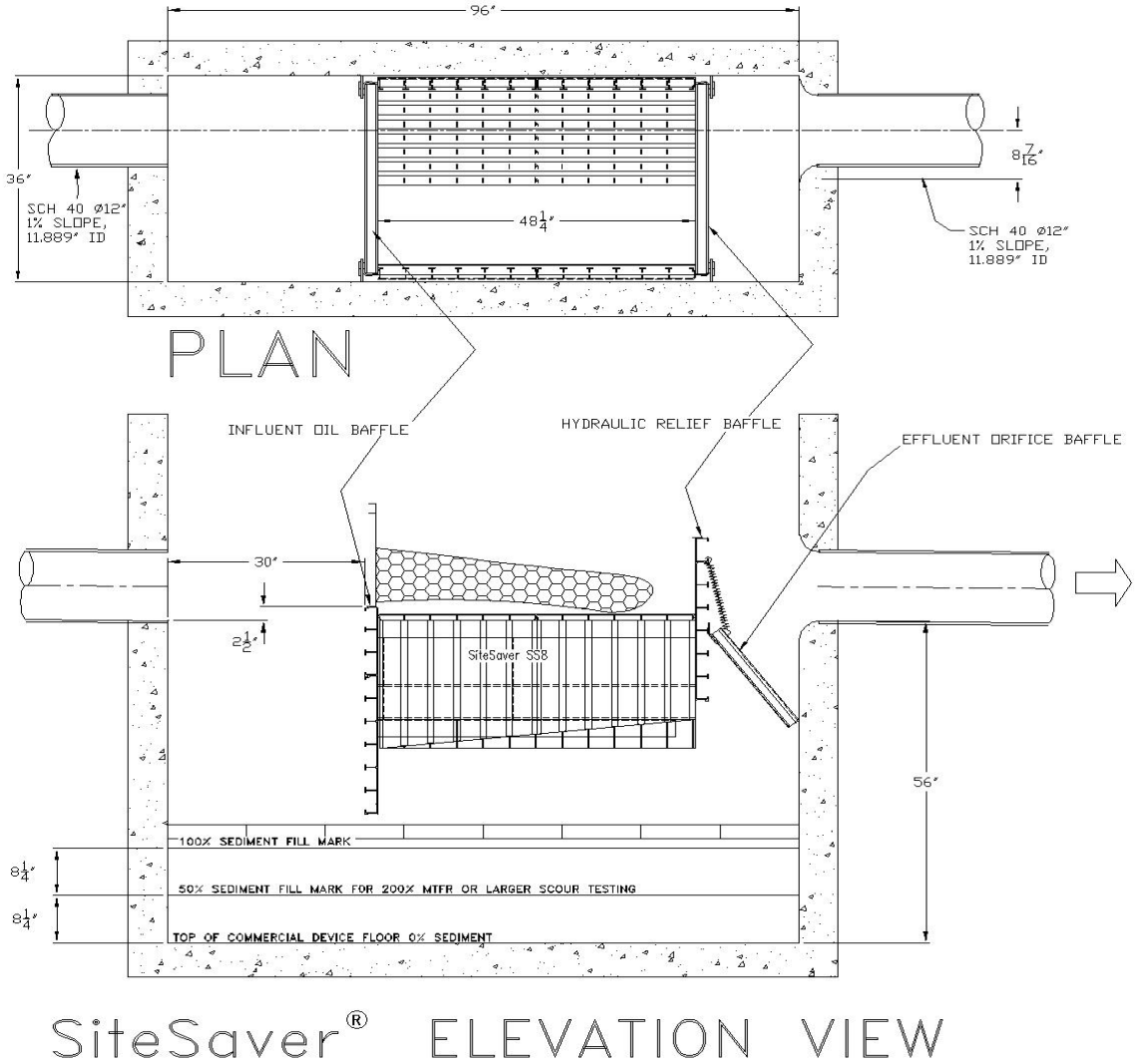

Figure 2 Drawing of the SS8 Test Unit

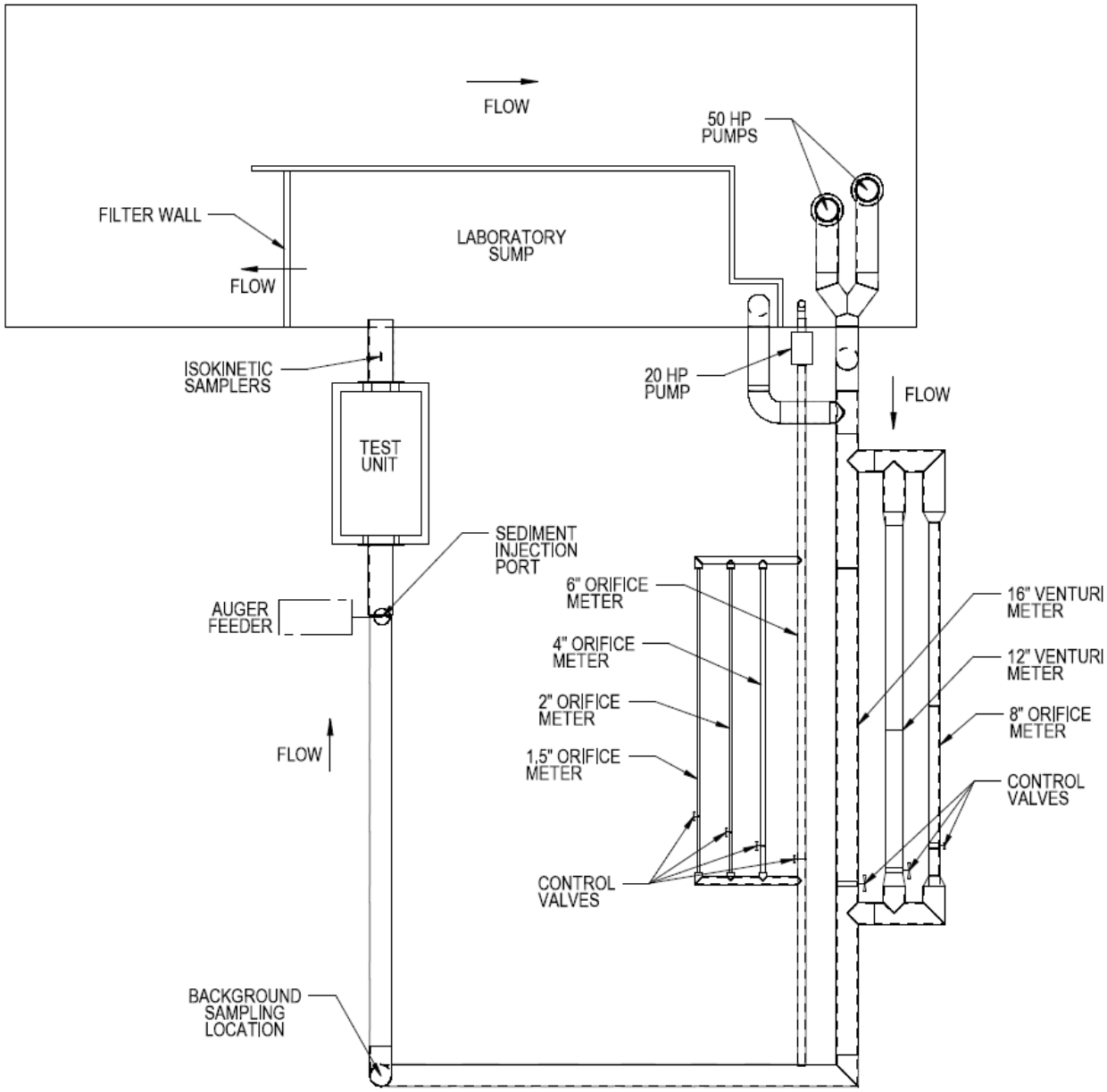

Figure 3 Plan View of Alden Flow Loop

Figure 4 SS8 Test Unit Installed in the Alden Flow Loop

2.2 Hydraulic Testing

The SS8 unit was tested with clean water to determine its hydraulic characteristic curves, including loss coefficients (Cd's) and/or K factors, as well as the maximum flow prior to bypass. Flow and water level measurements were recorded during steady-state flow conditions using a computerized Data-Acquisition system, which included a data collection program, 0-250" Rosemount Differential Pressure cell (flow), and Druck 0-2 psi Single-ended Pressure cell (water elevations). Flows were set and measured using calibrated differential-pressure flow meters and control valves. Each test flow was set and operated at steady state for approximately 10 minutes, after which time a minimum of 30 seconds of flow and pressure data were averaged and recorded for each pressure tap location. Water elevations were measured within the treatment unit upstream of the inclined plates, under the inclined plates and upstream of the outlet. Measurements within the influent and effluent pipes were taken one pipe-diameter upstream and downstream of the unit.

2.3 Removal Efficiency Testing

Removal testing was conducted on a clean unit utilizing the mass balance methodology. A false floor was installed at the 50% collection sump sediment storage depth of 8.25" (as stated by Fresh

Creek). All tests were run with clean water containing a sediment Suspended Solids Concentration (SSC) of less than 20 mg/L.

Preliminary sediment removal efficiency tests were conducted at flows that allowed for the generation of the SS8 characteristic removal curve, corresponding curve equation, and final selection of the NJDEP protocol test flows. The allowable variation of the target test flows is +/- 10% and the allowed Coefficient of Variance (COV) is 0.03.

The test sediment was prepared by AGSCO Corp. and adjusted by Alden to meet the PSD gradation of 1-1000 microns in accordance with the distribution shown in column 2 **Table 1**. The sediment is silica based, with a specific gravity of 2.65.

The target influent sediment concentration was 200 mg/L (+/-20 mg/L) for all tests. The concentration was verified by collecting a minimum of six evenly spaced timed dry samples at the injector and correlating the data with the measured average flow rate to produce the resulting influent concentration values for each test. The allowed Coefficient of Variance (COV) for the measured samples is 0.10.

Table 1 Test Sediment Particle Size Distribution

	TSS Removal Test PSD	Scour Test Pre-load PSD
Particle Size (Microns)	**Target Minimum % Less Than[2]**	**Target Minimum % Less Than[3]**
1,000	100	100
500	95	90
250	90	55
150	75	40
100	60	25
75	50	10
50	45	0
20	35	0
8	20	0
5	10	0
2	5	0

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.
2. A measured value may be lower than a target minimum % less than value by up to two percentage points, provided the measured d_{50} value does not exceed 75 microns.
3. This distribution is to be used to pre-load the MTD's sedimentation chamber for off-line and on-line scour testing.

A minimum of 25 lbs of test sediment was introduced into the influent pipe for each test. In addition, the criterion of the supply water temperature being below 80 degrees F was met for all tests conducted. The moisture content of the test sediment was determined using ASTM D4959-07 for each test conducted and was utilized in the final removal calculation.

A minimum of 6 background samples of the supply water were collected at evenly-spaced intervals throughout each test. Collected samples were analyzed for Suspended Solids Concentration (SSC) using the ASTM D3977-97 (2013).

After completion of a selected test, the unit was decanted over a period not exceeding 30 hours. The remaining water and sediment was collected from the collection sump and dried in designated pre-weighed nonferrous trays in compliance with ASTM D4959-07. All collection equipment was thoroughly rinsed with distilled water into 1-micron filter bags, which were rinsed, dried and weighed prior to use.

2.4 Sediment Scour Testing

A sediment scour test was conducted on the test unit to evaluate the ability to retain captured material during high flows. The collection sump of the test unit was pre-loaded to the 50% storage capacity level with the required 50-1000 micron sediment. The test sediment was prepared by AGSCO Corp. to meet the PSD gradation of 50-1000 microns in accordance with the distribution shown in column 3 **Table 1**. The sediment is silica based, with a specific gravity of 2.65.

A false floor was installed in the sump to reduce the quantity of material required for the test. However, a minimum sediment depth of 4 inches was preloaded as per the protocol specification. All test sediment was evenly distributed and levelled prior to testing.

The unit was filled with clean water (< 20 mg/L background) to the invert of the outlet pipe prior to testing. Testing was conducted at a water temperature not exceeding 80 degrees F. The test was conducted within 96 hours of filling the unit.

Testing consisted of conveying the selected target flow through the unit and collecting a minimum of 15 time-stamped effluent samples (every 2 minutes) for SSC analysis. Background samples were collected with each odd-numbered effluent sample. The target flow was reached within 5 minutes of commencement of the test. Flow data were continuously recorded every 6 seconds throughout the test and correlated with the samples.

Effluent samples for sediment concentration were collected with the use of isokinetic samplers located in the outlet pipe. The three samplers were evenly spaced in the water column and calibrated at the target flow prior to preloading the test sediment.

2.5 Instrumentation and Measuring Techniques

Flow

The inflow to the test unit was measured using one of five (5) calibrated differential-pressure flow meters (2”, 4”, 6”, 8” or 12”). Each meter is fabricated per ASME guidelines and calibrated in Alden’s Calibration Department prior to the start of testing. The high and low pressure lines from each meter were connected to manifolds containing isolation valves. Flows were set with a butterfly 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 bled prior to the start of each test. The test flow was averaged and recorded every 5-30 seconds (test dependent) throughout the duration of the test using an in-house computerized Data

Acquisition program. The accuracy of the flow measurement is ±2%. A photograph of the flow meters is shown on **Figure 5** and the pumps on **Figure 6.**

Figure 5 Photograph Showing Laboratory Flow Meters

Figure 6 Photograph Showing 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 laboratory prior to testing. The temperature reading was documented at the start and end of each test, to assure an acceptable testing temperature of less than 80 degrees F.

Pressure Head

Pressure head measurements were recorded at multiple locations using piezometer taps and a Druck®, model PTX510, 0 - 2.0 psi cell. The pressure cell was calibrated at Alden prior to testing. Accuracy of the readings is ± 0.001 ft. The cell was installed at a known datum above the unit floor, allowing for elevation readings through the full range of flows. A minimum of 30 seconds of pressure data were averaged and recorded for each pressure tap, under steady-state flow conditions, using the computerized Data-Acquisition program. A photograph of the pressure instrumentation is shown on **Figure 7.**

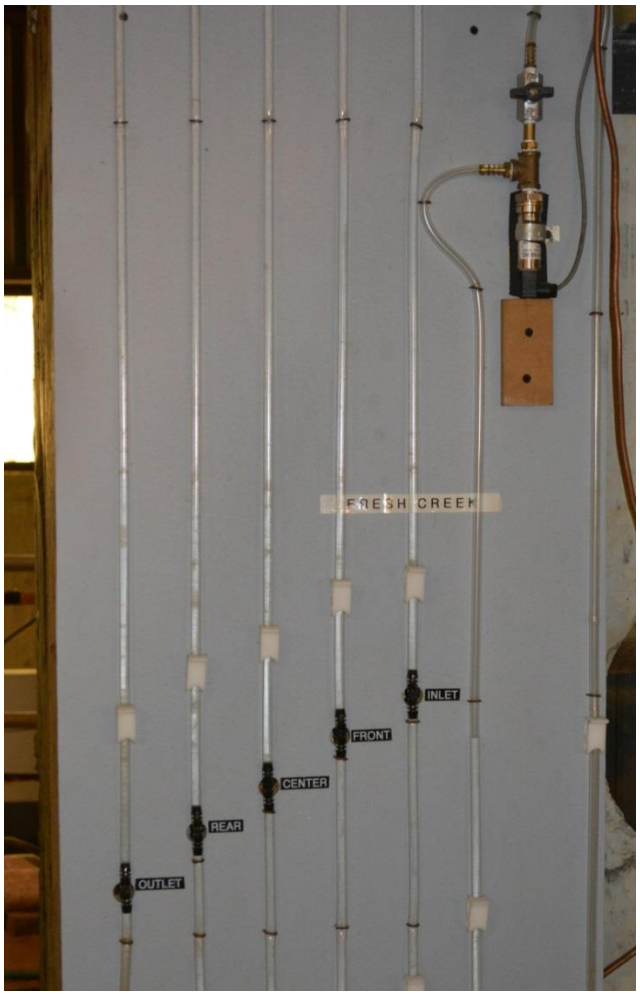

Figure 7 Pressure Measurement Instrumentation

Sediment Injection

The test sediment was injected into the crown of the influent pipe using an Auger® volumetric screw feeder, model VF-1, shown on **Figure 8**. The feed screws used in testing ranged in size from 0.5-inch to 1-inch, depending on the test flow. Each auger screw, driven with a variable-speed drive, was calibrated with the test sediment prior to testing, to establish a relationship between the auger speed (0-100%) and feed rate in grams/minute. 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 feeder has a hopper at the upper end of the auger to provide a constant supply of test sediment. The allowable Coefficient of Variance (COV) for the injection is 0.10.

Figure 8 Photograph Showing Variable-Speed Auger Feeder

Sample Collection

Three isokinetic sampling tubes were installed within the effluent piping to collect the required effluent sediment concentration samples during scour testing. The tube array was adjusted and calibrated prior to testing to match the effluent flow velocity. Background concentration samples were collected from the center of the vertical pipe upstream of the SS8 test unit also with the use of an 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 (Re-approved 2013), "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. Associated instrumentation included:

- 2-Liter collection beakers
- Ohaus® 4000g x 0.1g digital scale, model SCD-010
- Oakton® StableTemp gravity convection oven, model 05015-59
- Sanplatec Dry Keeper® desiccator, model H42056-0001
- AND® 0.0001-gram analytical balance, model ER-182A
- Advantec 3-way filtration manifold
- Whatman® 934-AH, 47-mm, 1.5-micron, glass microfiber filter paper

Samples were collected in graduated 2-Liter beakers which were cleaned, dried and weighed to the nearest 0.1-gram, using an Ohaus® 4000g x 0.1g digital scale, model SCD-010, prior to sampling. Collected samples were also weighed to the nearest 0.1-gram using the Ohaus® digital scale. Each collected sample was filtered through a pre-rinsed Whatman® 934-AH, 47-mm, 1.5-micron, glass microfiber filter paper, using a laboratory vacuum-filtering system. Prior to processing, each filter was rinsed with distilled water and placed in a designated dish and dried in an Oakton® StableTemp gravity convection oven, model 05015-59, at 225 degrees F for a minimum of 2.5 hours. Each dried filter was placed in a Sanplatec Dry Keeper® desiccator, model H42056-0001, to cool and then weighed to the nearest 0.0001-gram to determine the tare weight, using an AND® analytical balance, model ER-182A. Once filtered, each sample and dish was dried at a temperature between 175 and 210 degrees F (below boiling) for 20 to 30 minutes until visually dry. The oven temperature was increased to 225 degrees F and the samples were dried for an additional 2.5 hours. The dry samples and dishes were then cooled in the desiccator and weighed to the nearest 0.0001-gram, using the AND® balance. Net sediment weight (mg) was determined by subtracting the dried filter weight (tare) from the dried sample weight and multiplying the result by 1,000. The net sample volume, in liters, was determined by subtracting the beaker and net sediment weight from the overall sample weight and dividing by 1,000. Each sample sediment concentration, in mg/liter, was determined by dividing the net sediment weight by the net sample volume.

Mass Balance Analysis

A modified mass balance method, in which the influent and captured sediment is accounted for, was used to determine the sediment removal efficiency at each designated test flow. The mass of injected sediment was determined by weighing the prepared sediment batch on an Ohaus® 30kg x 0.001kg digital scale; model RD-30LS, before testing. All captured material was collected in designated pre-weighed (tared) non-ferrous trays and dried in a Modern Laboratory Equipment® oven; model 155-SS, in accordance with ASTM Method D 4959-07, "Standard Test Method for Determination of Water (Moisture) Content of Soil By Direct Heating". Depending on collected mass, each tray was weighed on either an Ohaus® 4000g x 0.1g; model SCD-010, or Ohaus® 30kg digital scale. A list of associated instrumentation includes:

- Ohaus® 4000g x 0.1g digital scale, model SCD-010
- Ohaus® 30kg x 0.001kg digital scale, model RD-30LS
- Oakton® StableTemp gravity convection oven, model 05015-59

- Modern Laboratory Equipment® oven, model 155-SS
- Sanplatec Dry Keeper® desiccator, model H42056-0001

2.6 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 are initialed and dated.

A personal computer running an Alden in-house Labview® Data Acquisition program was used to record all data related to instrument calibration and testing. A 16-bit National Instruments® 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 were averaged and recorded to file every 5 to 30 seconds, depending on the duration of the test. Steady-state pressure data were averaged and recorded over a duration of 30 seconds for each point. The recorded data files were imported into Excel for further analysis and plotting.

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

2.7 Laboratory Analysis

The following Test Methods were used to analyze the dry and aqueous sediment samples:

- Sediment Concentration
  ASTM Designation: D 3977-97 (Re-approved 2013), "Standard Test Methods for Determining Sediment Concentration in Water Samples"

- Sediment Moisture Content
  ASTM Designation: D4959-07, "Standard Test Method for Determination of Water (Moisture) Content of Soil by Direct Heating"

- Dry Sediment Particle Size Distribution
  ASTM D422-63 (2007), "Standard Test Method for Particle Size Analysis of Soils"

2.8 Quality Assurance and Control

A Quality Assurance Project Plan (QAPP) was submitted and approved outlining the testing methodologies and procedures used for conducting the verification tests. The QAPP was followed throughout the testing. All instruments were calibrated prior to testing and periodically checked throughout the test program.

Flow

The flow meters and pressure cells were calibrated in Alden's Calibration Laboratory, which is ISO 17025 accredited. All pressure lines were bled prior to initiating each test. A standard water manometer board and Engineers Rule were used to measure the differential pressure from the meter and verify the computer measurement of each flow meter.

Sediment Injection

The sediment feed in g/min was verified with the use of a digital stop watch and 4000g calibrated digital scale. The tare weight of the sample container was recorded prior to collection of each sample. The samples were a minimum of 0.1 liters in size, with a maximum collection time of 1-minute.

Sediment Concentration Analysis

All sediment concentration samples were processed in accordance with the ASTM D3977-97 (2013) analytical method. Gross sample weights were measured using a 4000g x 0.1g calibrated digital scale. The dried sample weights were measured with a calibrated 0.0001g analytical balance. Any change in filter weight due to processing was accounted for by including three control filters with each test set. The average of the three values, which was typically +/- 0.1mg, was used in the final concentration calculations.

Analytical accuracy was verified by preparing two blind control samples and processing using the ASTM method. The final calculated values were within 0.26% and 0.87% of the theoretical sample concentrations, with an average of 0.57% accuracy.

Testing Repeatability

The repeatability of the mass balance testing methodology was determined by conducting three tests at the same target flow and concentration. The influent concentrations of the tests ranged from 203 to 207 mg/L and the measured flows were within 0.3% of each other. The resulting maximum and minimum removal efficiencies were within 2.2% in value, with the largest deviation from the average being 1.4%.

3. Performance Claims

Per the NJDEP verification document, Fresh Creek Technologies Inc. makes the following performance claims for the SiteSaver® stormwater treatment device (all claims are supported by third-party testing at Alden research Laboratory, as reported in this verification report).

Verified TSS Removal Rates

Based on the laboratory testing conducted and reported by Alden the SiteSaver® achieved greater than 50% Total Suspended Solids (TSS) removal.

Maximum Treatment Flow Rate (MTFR)

The hydraulic loading rate used to calculate the MTFR for all commercially available SiteSaver® models is 18.75 gallons per minute per square foot of effective treatment area (gpm/sf).

Maximum Sediment Storage Depth and Volume

The maximum sediment storage depth is 16.5" for all SiteSaver® models. The total volume of sediment storage varies depending on the interior width and length of a particular model. The model tested, a SS8, has 33 cubic feet of available storage volume.

Effective Treatment Area

The effective treatment area is dependent on the size of the SiteSaver® model selected and is proportional to the interior width and length of a particular model. The pre-loaded area in the SS8 model tested (3'x8') is 24 ft^2.

Detention Time and Volume

Detention time is determined by dividing the effective treatment volume by the maximum treatment flow rate. The effective treatment volume does not include the volume dedicated to sediment storage. The detention time for the SS8 is 111 seconds at the verified MTFR (1.0 cfs).

Effective Sedimentation Area

The effective sedimentation area is the same as the effective treatment area for all SiteSaver® models.

Online or Offline Installation

Based on the results of the scour test, the SiteSaver® stormwater treatment system qualifies for online installation.

4. Supporting Documentation

The NJDEP Procedure (NJDEP, 2013a) 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.

4.1 Test Sediment PSD Analysis – Removal Efficiency Testing

The commercially-available AGSCO NJDEP 1-1000 sediment mix was procured for the sediment removal testing. Samples were collected from twelve (12) random bags and analyzed in accordance with ASTM D422-63 (2007), by GeoTesting Express, an ISO/IEC 17025 accredited independent laboratory. The average %-finer values between 8-75 microns were found to be below the NJDEP acceptance criteria of 2%. The test material was adjusted with the addition of commercially-available US-Silica Min-U-Sil 10, with a PSD of approximately 1-25 microns. Four random batches were selected and analyzed by GeoTesting prior to testing. The calculated average of the four samples was used for compliance to the specifications listed in column 2 of **Table 1**. The D_{50} of the 4 samples ranged from 58 to 75 microns, with an average of 65 microns. The PSD data of the samples are shown in **Table 2** and the corresponding curves are shown on **Figure 9**.

Table 2 PSD Analysis of Alden Sediment Mix

Particle size (µm)	NJDEP	Sample 1		Sample 2		Sample 3		Sample 4		**Average % Finer**
	% Finer	Retained	% Finer	Retained	% Finer	Retained	% Finer	Retained	% Finer	
1000	100	0%	100	0%	100	0%	100	0%	100	**100**
500	95	4%	96	3%	97	5%	95	5%	95	**96**
250	90	3%	93	3%	94	5%	91	4%	92	**92**
150	75	17%	76	12%	82	13%	78	12%	80	**79**
110	60*	14%	62	15%	67	13%	65	13%	67	**65**
75	50	12%	50	11%	56	11%	54	11%	56	**54**
53	45	6%	44	8%	47	8%	45	7%	48	**46**
20	35	10%	34	15%	33	13%	33	17%	31	**33**
8	20	15%	19	14%	18	14%	18	12%	19	**19**
5	10	8%	11	6%	12	6%	12	6%	14	**12**
2	5	8%	3	7%	5	9%	4	8%	6	**5**
<2		3%	0	5%	0	4%	0	6%	0	
D50	*100 µm	100%	D50	100%	D50	100%	D50	100%	D50	**D50**
75			75		60		66		58	**65**

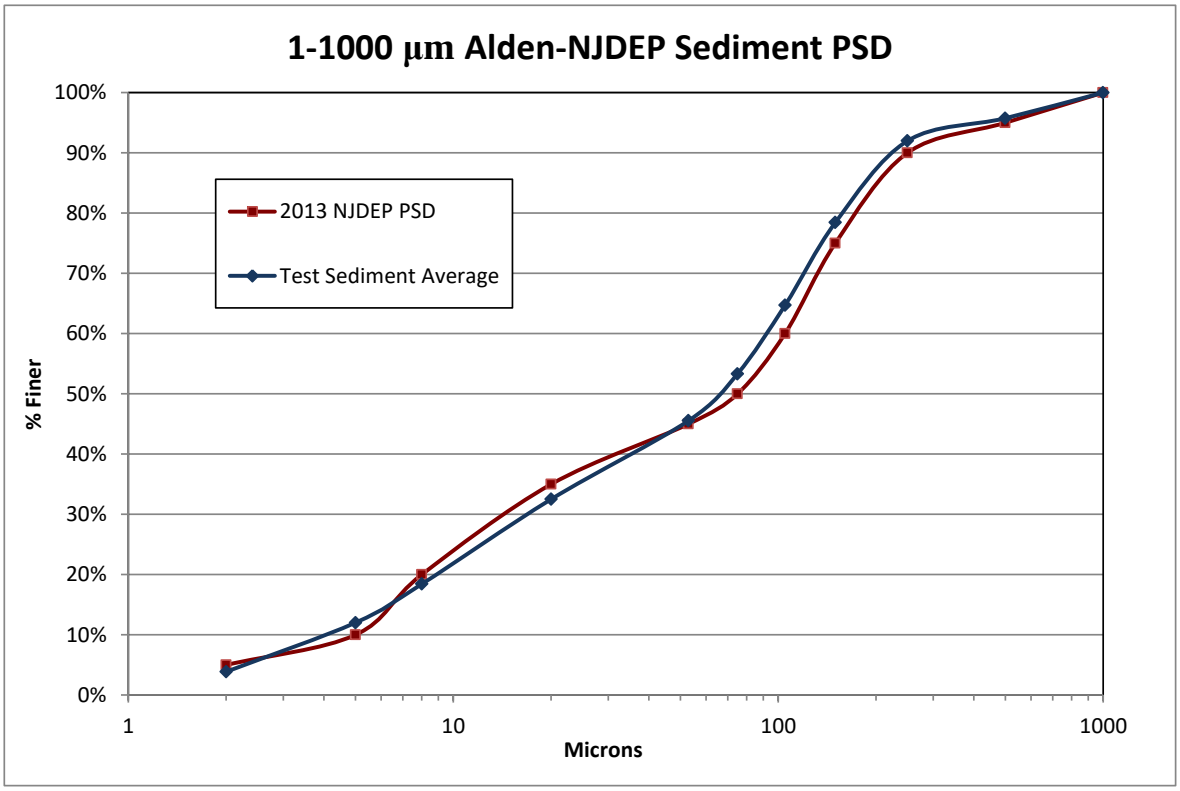

Figure 9 PSD of Removal Efficiency Test Sediment vs NJDEP Sediment Specification

4.2 Removal Efficiency Testing

Preliminary testing was conducted in accordance with the testing protocol to establish a 3rd-order removal characteristic curve and corresponding equation. The characteristic curve equation was used to calculate the weighted removal efficiencies and select the 100% MTFR of 450 gpm, and four subsequent test flows for final testing. The preliminary test data is shown in **Table 3**.

Table 3 Characteristic Curve Removal Efficiency Test Data Summary

Flow	Target Concentration	Measured Concentration	Mass Balance Removal
gpm	mg/L	mg/L	
180.4	200	201	58.3%
374.3	200	203	44.7%
536.3	200	201	36.4%
698.9	200	203	35.1%
1073.9	200	196	27.0%

The final NJDEP removal efficiency tests were conducted in accordance with the testing protocol at five flows ranging from 113 gpm to 536 gpm. The target 125% MTFR flow was 562.5 gpm. However, the 536 gpm test was data was used, as it was within 5% of the target and receives the lowest weight value. The target influent sediment concentration was 200 mg/l. The measured removal efficiencies ranged from 64.5% to 36.4% for the five flows tested. The measured 25%, 50%, 75% 100% and 125% MTFR test data and calculated weighted values are shown in **Table 4**. A removal curve and corresponding curve equation, incorporating all test points (preliminary and final), are shown on **Figure 10**. Additional offset curves showing +/-2% in value are included. The largest deviation from the curve was -1.7%, which occurred at 536 gpm.

Table 4 SS8 Final Testing Data Summary

Flow	Target Concentration	Measured Concentration	Mass Balance Removal	Weight Factor	Weighted Removal
gpm	mg/L	mg/L			
112.0	200	203	64.5%	0.25	**16.1%**
224.5	200	200	53.9%	0.30	**16.2%**
335.1	200	205	47.9%	0.20	**9.6%**
449.9	200	200	41.1%	0.15	**6.2%**
536.3	200	201	36.4%	0.10	**3.6%**
				1.00	**51.7%**

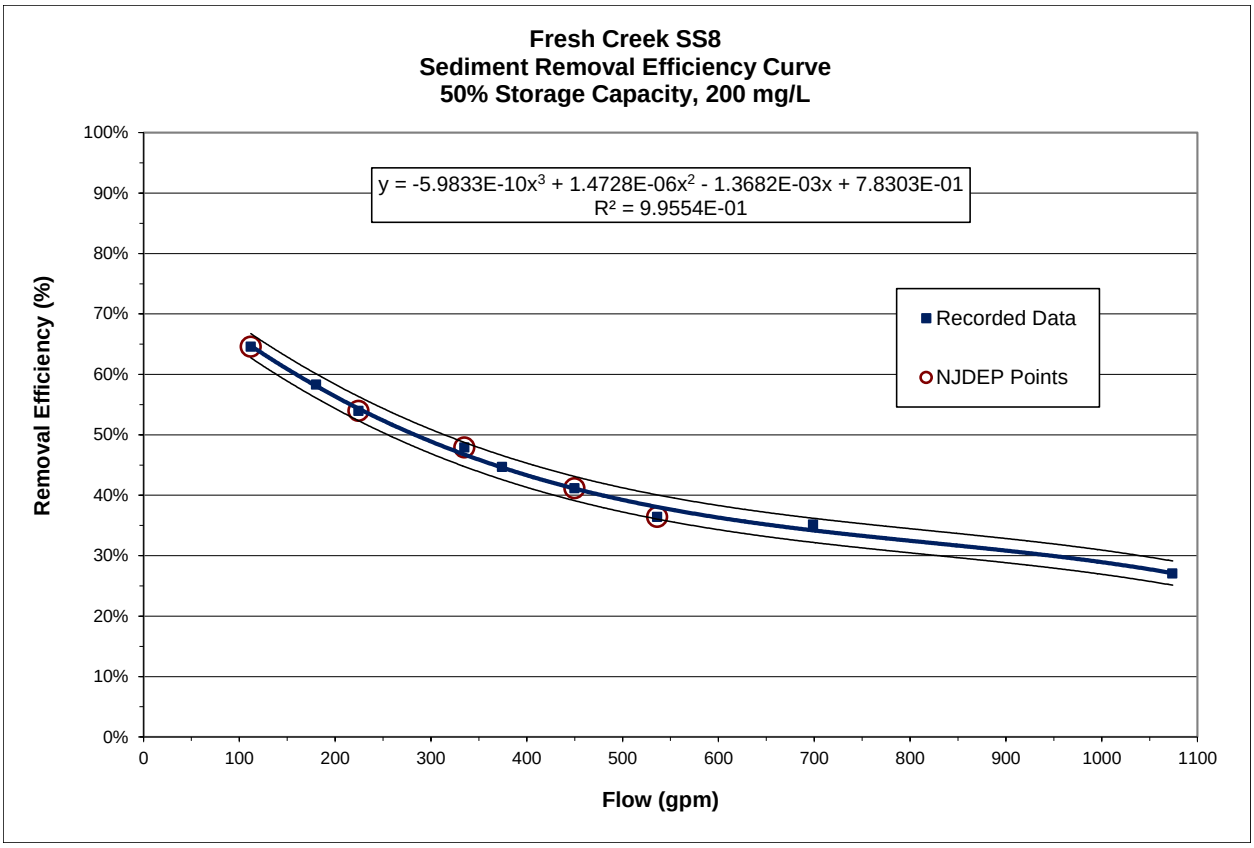

Figure 10 SS8 Removal Efficiency Curve

Detailed results of the five NJDEP protocol tests are presented in the following sections.

Target Flow (25% MTFR): 112.5 gpm (0.25 cfs)

The test was conducted over a period of approximately 2.5 hours to meet the minimum 25 Lb. sediment feed requirement. The test flow was averaged and recorded every 30 seconds throughout the test. The average recorded test flow was 112.0 gpm (99.6% of target flow rate), with a standard deviation (SD) of 0.12 and coefficient of variance (COV) of 0.001. The recorded temperature for the full test ranged from 68.6 to 68.7 degrees F.

The target injection feed rate of 85.2 g/min was verified by collecting six evenly-spaced timed weight samples from the injector. The measured influent injection concentrations for the test ranged from 201 mg/L to 205 mg/L, with a mean of 203 mg/L, SD of 1.2 and COV of 0.01. The total mass injected into the unit was 27.74 Lbs. The measured influent concentration data for the complete test is shown on **Figure 11**.

The total mass collected from the unit was 17.90 Lbs, resulting in a removal efficiency of 64.5%.

Six evenly-spaced background concentrations samples were collected throughout the test and ranged from 0.1 to 3.8 mg/L. The background curve is shown on **Figure 12**.

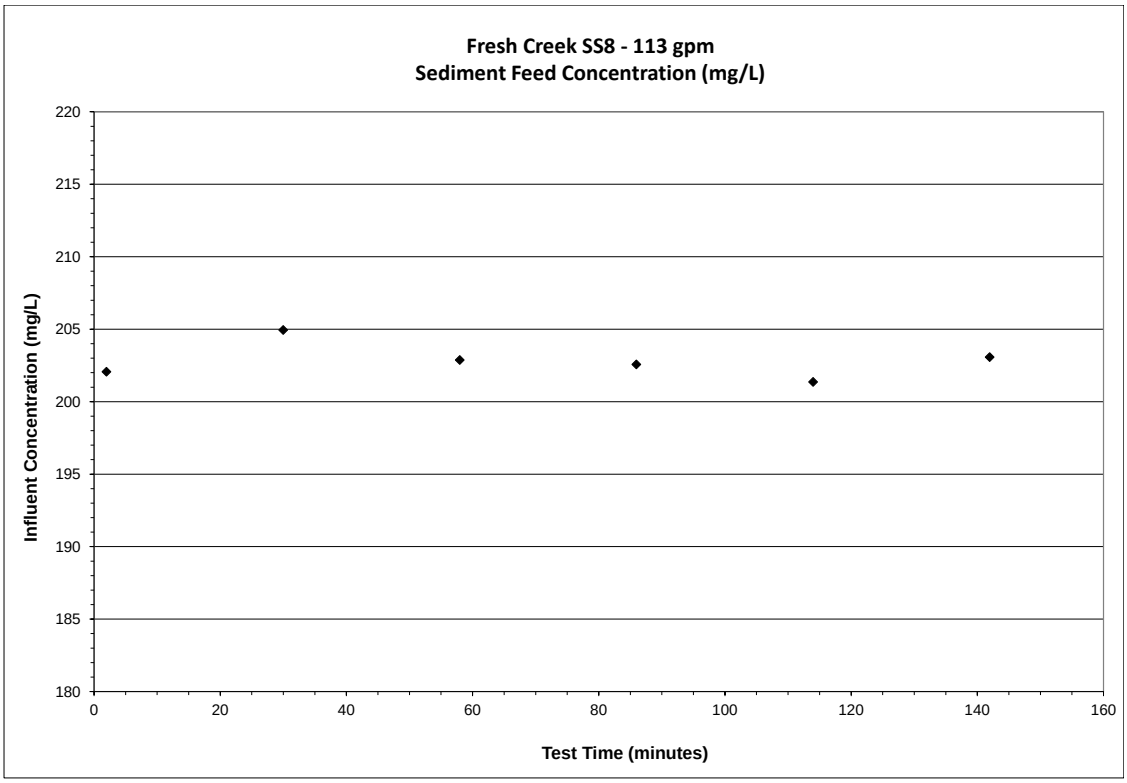

Figure 11 25% MTFR Measured Influent Concentrations

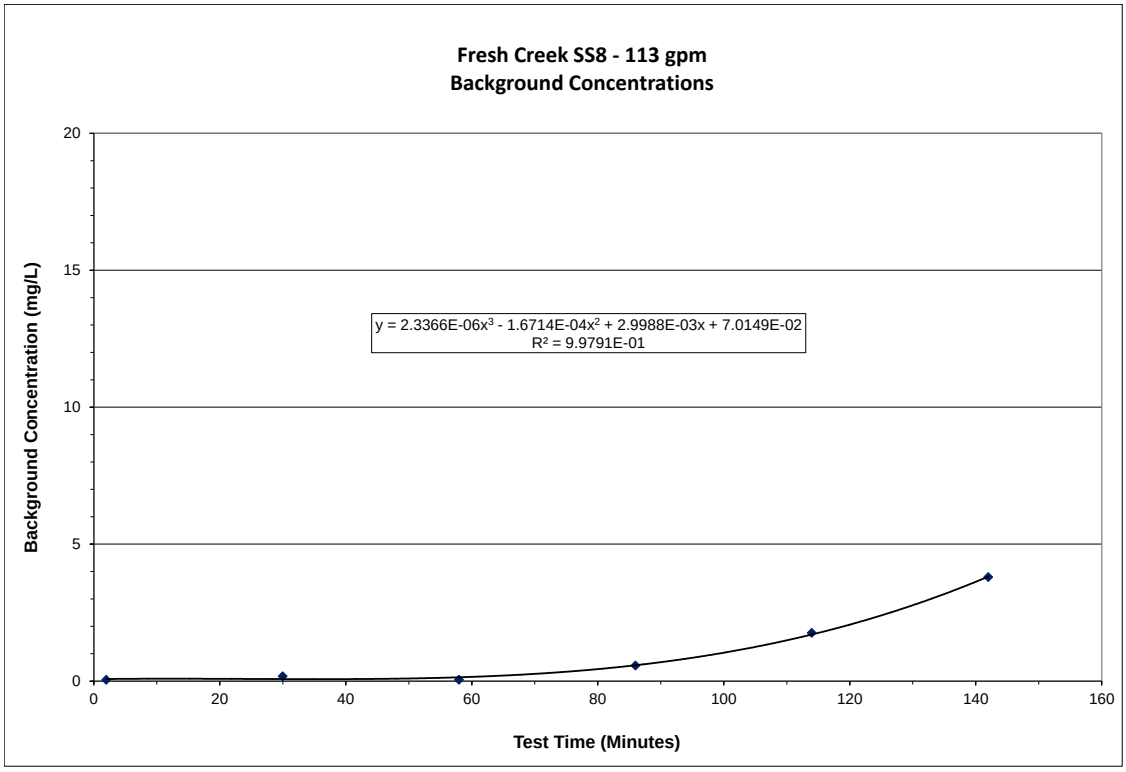

Figure 12 25% MTFR Measured Background Concentrations

Target Flow (50% MTFR): 225 gpm (0.50 cfs)

The test was conducted over a period of approximately 1.3 hours to meet the minimum 25 Lb. sediment feed requirement. The test flow was averaged and recorded every 10 seconds throughout the test. The average recorded test flow was 224.5 gpm (99.8% of target flow rate), with a SD of 0.46 and COV of 0.002. The recorded temperature was 66.0 degrees F for the full test.

The target injection feed rate of 170.3 g/min was verified by collecting six evenly-spaced timed weight samples from the injector. The measured influent injection concentration for the entire test was 200 mg/L, with a SD of 0.1 and COV of 0.00. The total mass injected into the unit was 27.96 Lbs. The measured influent concentration data for the complete test is shown on **Figure 13**.

The total mass collected from the unit was 15.08 Lbs, resulting in a removal efficiency of 53.9%.

Six evenly-spaced background concentrations samples were collected throughout the test and ranged from 0.5 to 2.2 mg/L. The background curve is shown on **Figure 14**.

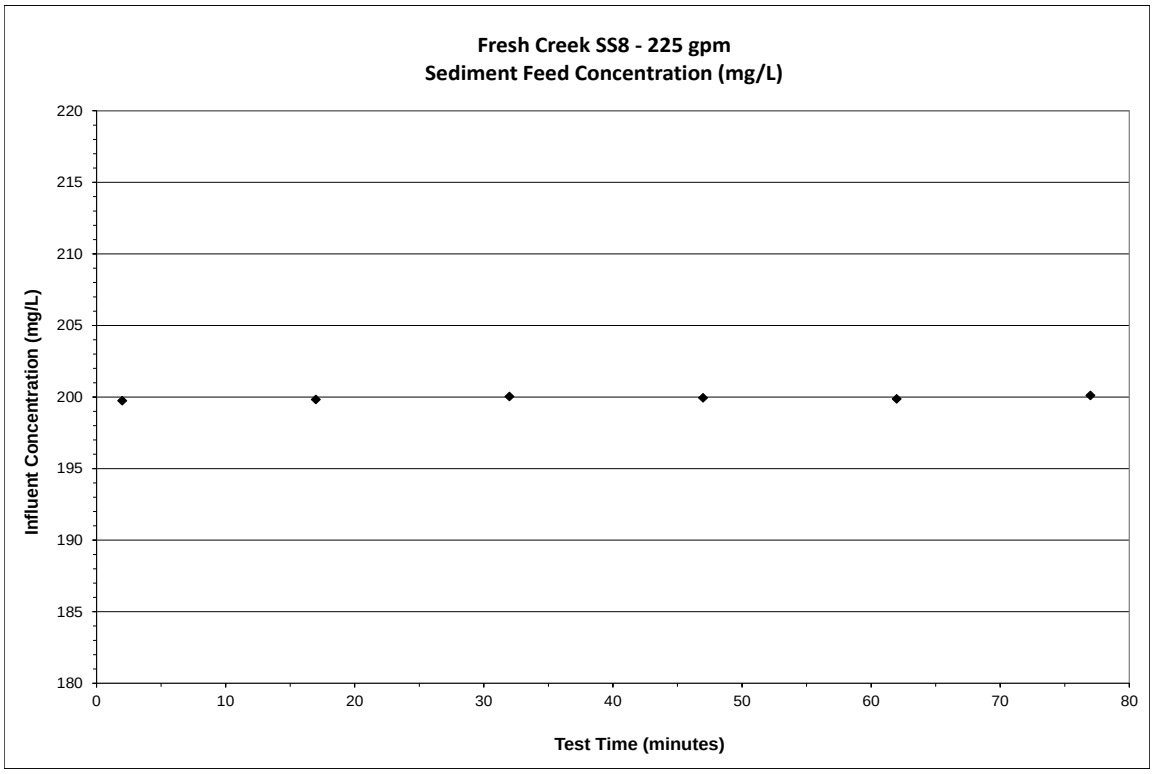

Figure 13 50% MTFR Measured Influent Concentrations

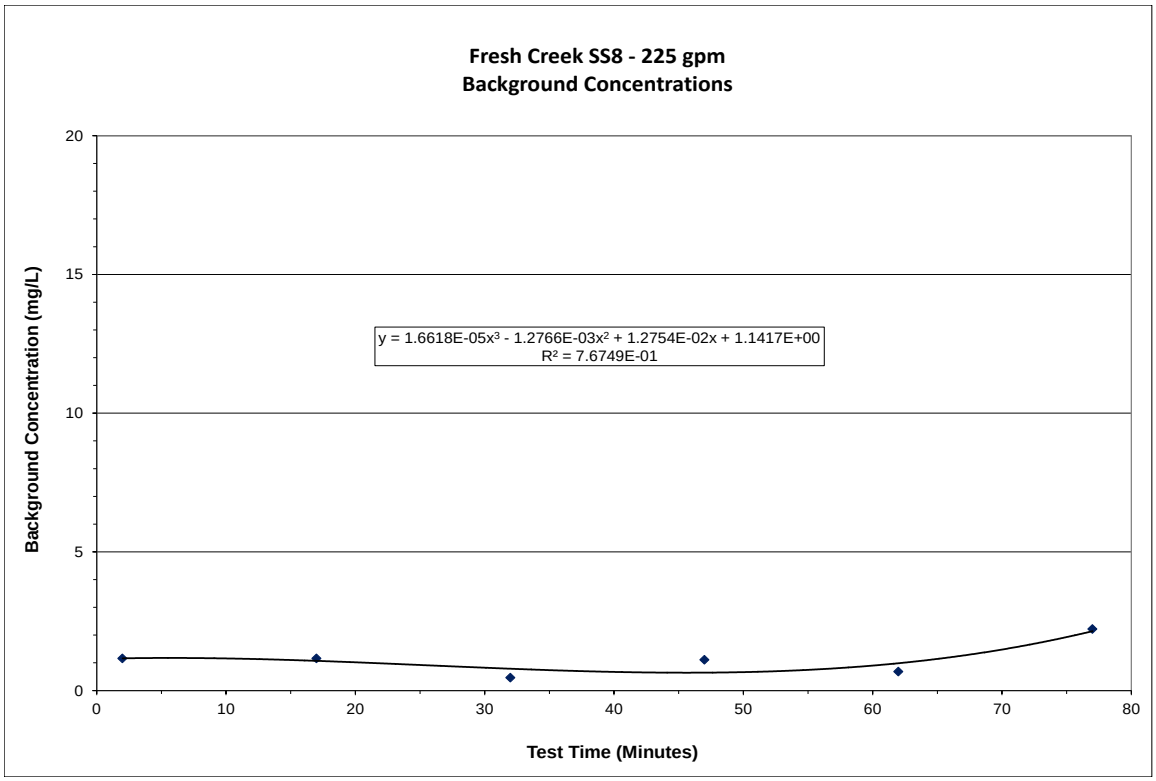

Figure 14 50% MTFR Measured Background Concentrations

Target Flow (75% MTFR): 337.5 gpm (0.75 cfs)

The test was conducted over a period of approximately 50 minutes to meet the minimum 25 Lb. sediment feed requirement. The test flow was averaged and recorded every 10 seconds throughout the test. The average recorded test flow was 335.1 gpm (99.3% of target flow rate), with a SD of 0.69 and COV of 0.002. The recorded temperature for the full test ranged from 65.3 to 65.5 degrees F.

The target injection feed rate of 255.5 g/min was verified by collecting six evenly-spaced timed weight samples from the injector. The measured influent injection concentration for the entire test was 205 mg/L, with a SD of 0.12 and COV of 0.00. The total mass injected into the unit was 27.91 Lbs. The measured influent concentration data for the complete test is shown on **Figure 15**.

The total mass collected from the unit was 13.36 Lbs, resulting in a removal efficiency of 47.9%.

Six evenly-spaced background concentrations samples were collected throughout the test and ranged from 0.5 to 6.9 mg/L. The background curve is shown on **Figure 16**.

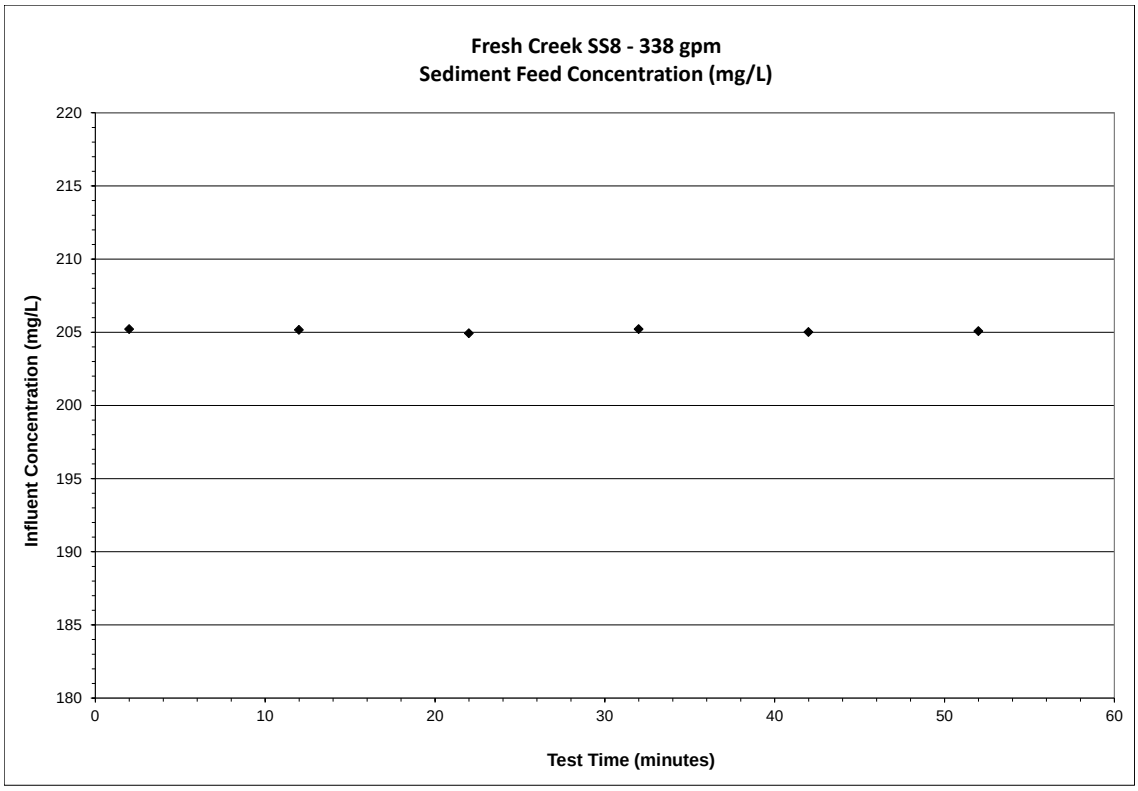

Figure 15 75% MTFR Measured Influent Concentrations

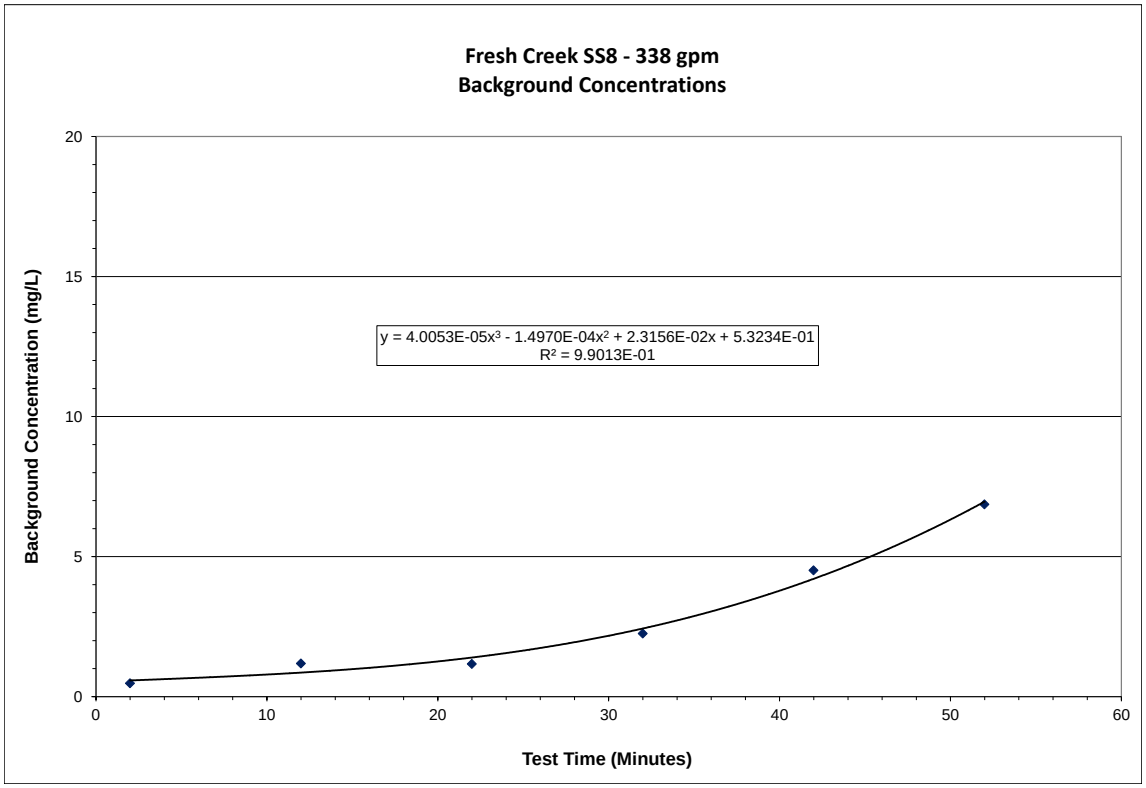

Figure 16 75% MTFR Measured Background Concentrations

Target Flow (100% MTFR): 450 gpm (1.0 cfs)

The test was conducted over a period of approximately 40 minutes to meet the minimum 25 Lb. sediment feed requirement. The test flow was averaged and recorded every 10 seconds throughout the test. The average recorded test flow was 449.9 gpm (100.0% of target flow rate), with a SD of 0.78 and COV of 0.002. The recorded temperature for the full test ranged from 61.9 to 62.0 degrees F.

The target injection feed rate of 340.7 g/min was verified by collecting six evenly-spaced timed weight samples from the injector. The measured influent injection concentration ranged from 200 mg/L to 201 mg/L, with a mean of 200 mg/L, SD of 0.34 and COV of 0.00. The total mass injected into the unit was 26.94 Lbs. The measured influent concentration data for the complete test is shown on **Figure 17**.

The total mass collected from the unit was 11.08 Lbs, resulting in a removal efficiency of 41.1%.

Six evenly-spaced background concentrations samples were collected throughout the test and ranged from 0.2 to 0.9 mg/L. The background curve is shown on **Figure 18**.

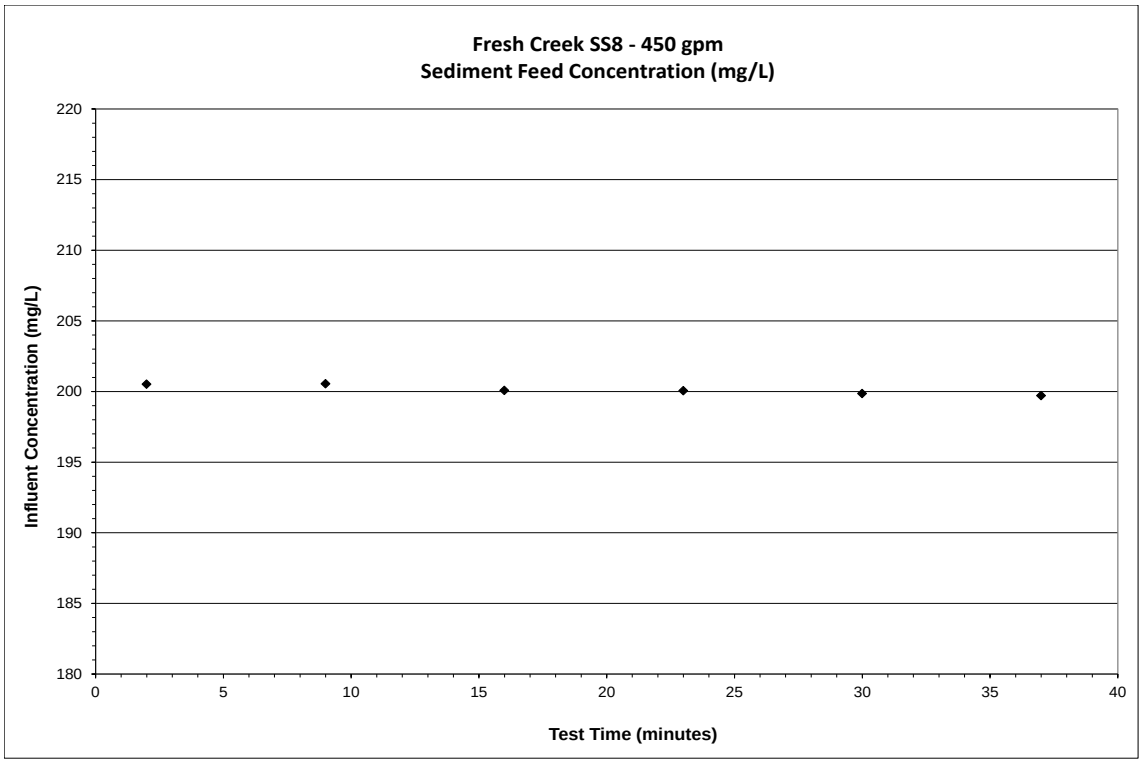

Figure 17 100% MTFR Measured Influent Concentrations

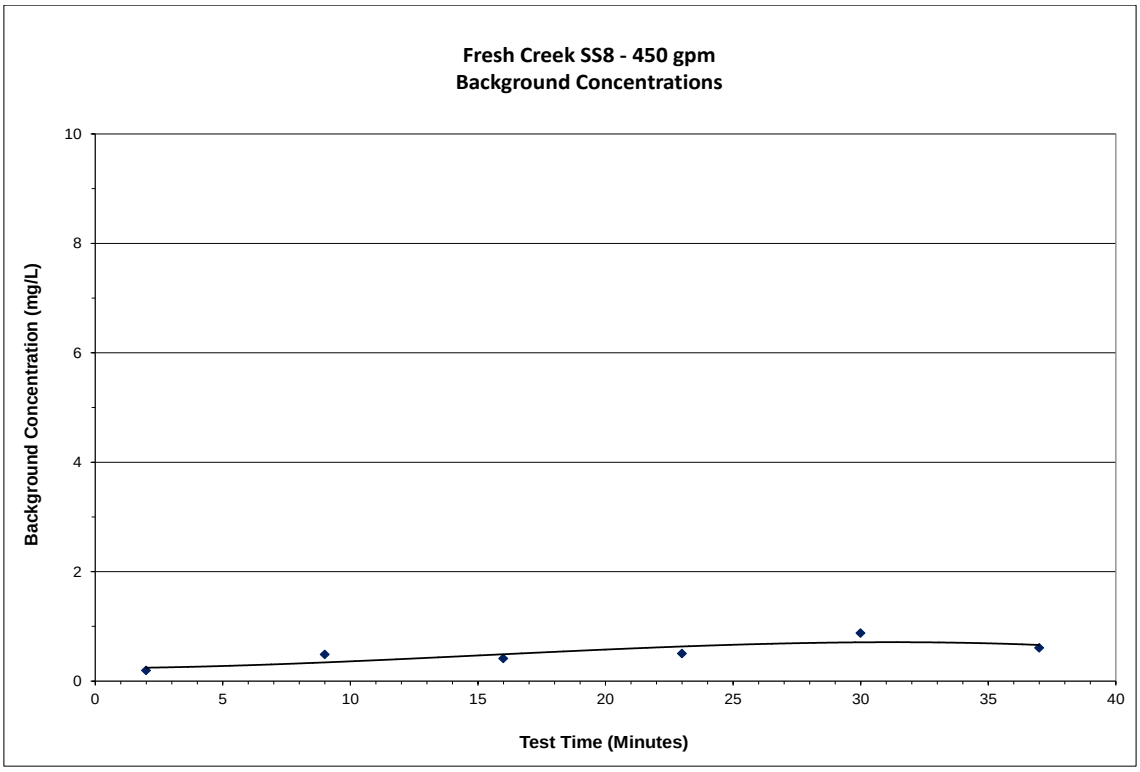

Figure 18 100% MTFR Measured Background Concentrations

Target Flow (125% MTFR): 562.5 gpm (1.25 cfs)

The test was conducted over a period of approximately 40 minutes to meet the minimum 25 Lb. sediment feed requirement. The test flow was averaged and recorded every 5 seconds throughout the test. The average recorded test flow was 536.3 gpm (95.4% of target flow rate), with a SD of 0.82 and COV of 0.002. The recorded temperature for the full test ranged from 63.4 to 63.8 degrees F.

The target injection feed rate of 405.8 g/min was verified by collecting eleven evenly-spaced timed weight samples from the injector. The first measured influent injection concentration for the test was deemed low, with a value of 174 mg/L. The feed rate was immediately increased, resulting in the third sample reaching the allowable maximum value of 220 mg/L. The overall mean influent concentration was 201 mg/L, with a SD of 16.3 and COV of 0.08, which meets the requirement of the protocol. The total mass injected into the unit was 26.71 Lbs. The measured influent concentration data for the complete test is shown on **Figure 19**.

The total mass collected from the unit was 9.72 Lbs, resulting in a removal efficiency of 36.4%.

Six evenly-spaced background concentrations samples were collected throughout the test and ranged from 0.0 to 3.0 mg/L. The background curve is shown on **Figure 20**.

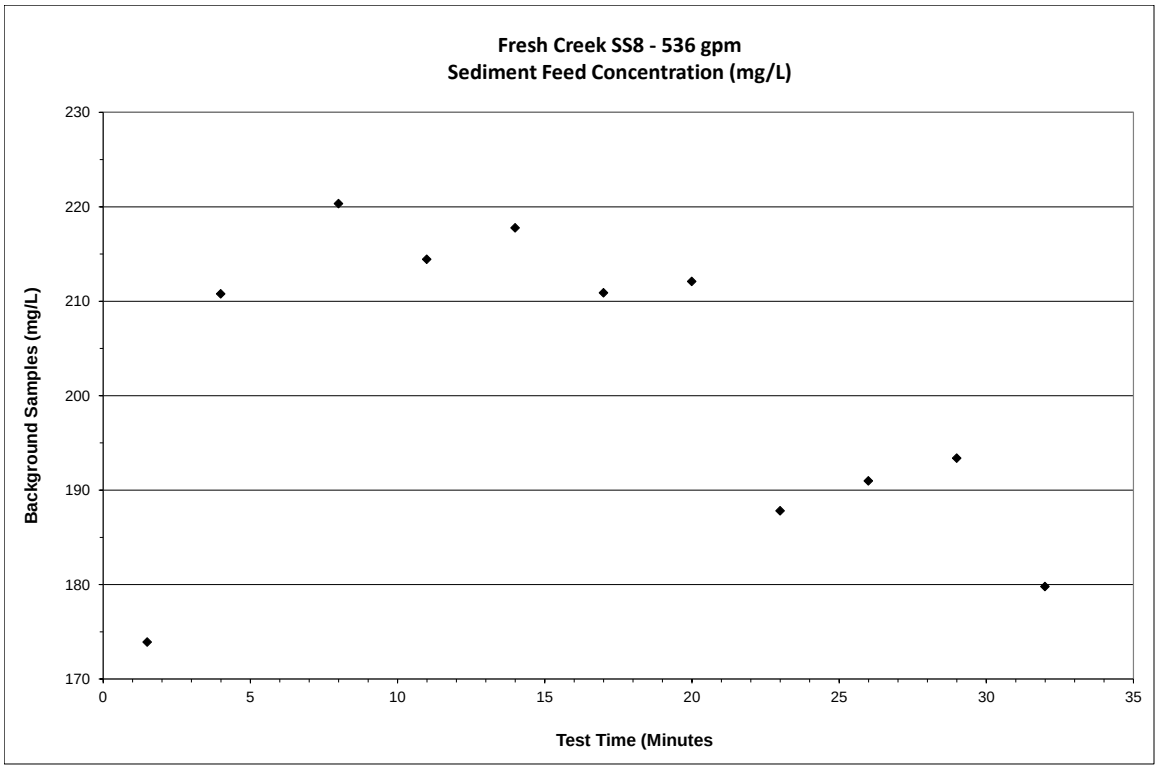

Figure 19 125% MTFR Measured Influent Concentrations

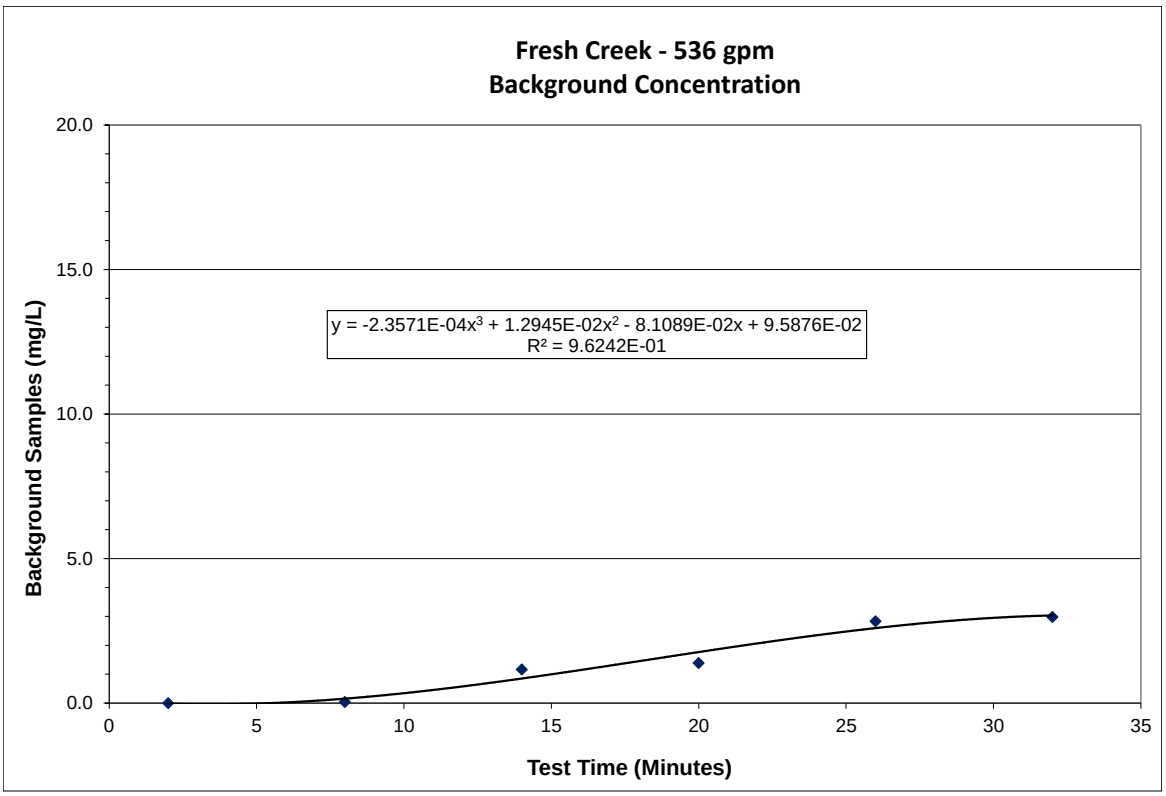

Figure 20 125% MTFR Measured Background Concentrations

4.3 Test Sediment PSD Analysis – Scour Testing

The commercially-available AGSCO NJDEP50-1000 sediment mix was utilized for the scour test. Three random samples of the batch mix were analyzed in accordance with ASTM D422-63 (2007), by CTLGroup, an ISO/IEC 17025 accredited independent laboratory, prior to testing. The specified less-than (%-finer) values of the sample average were within the specifications listed in column 3 of **Table 1**, as defined by the protocol. The D_{50} of the 3-sample average was 202 microns. The PSD data of the samples are shown in **Table 5** and the corresponding curves, including the initial AGSCO in-house analysis, are shown on **Figure 21**.

Table 5 PSD Analyses of AGSCO 50-1000 µm Sediment Batch Mix

Microns	ALLOWABLE MINIMUM VALUE % Finer	AGSCO NJDEP 50-1000 Mix, CTLGroup Analysis				
		Sample 1 Retained	**Sample 2** Retained	**Sample 3** Retained	**Average** Retained	**% Finer**
1000	100	0%	0%	0%	0%	**100**
500	90	5%	5%	5%	5%	**95**
250	55	37%	36%	37%	37%	**58**
150	40	17%	17%	17%	17%	**41**
105	25	16%	17%	16%	16%	**25**
75	10	14%	15%	15%	15%	**10**
53	0	9%	9%	9%	9%	**1**

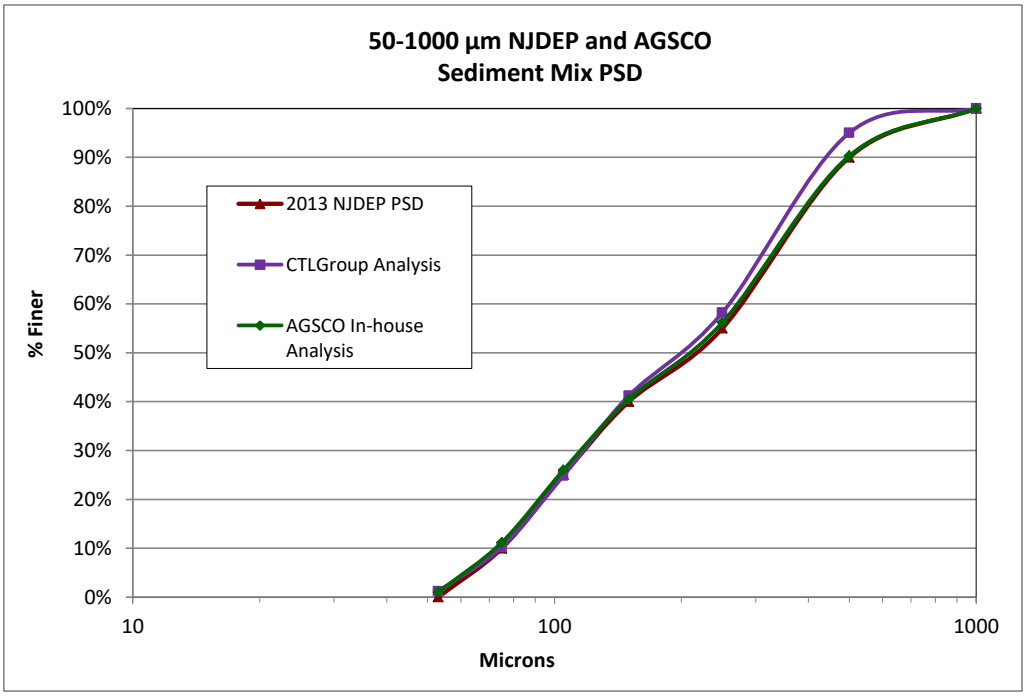

Figure 21 PSD of Scour Test Sediment vs NJDEP Sediment Specifications

4.4 Scour Testing for Online Installation

The collection sump of the test unit was preloaded to a depth of 4 inches with the 50-1000 micron sediment shown in **Table 5**. A false floor was installed in the collection sump to reduce the quantity of sediment required for the test and the sediment bed was preloaded to the 50% capacity level (stated by Fresh Creek), as specified in the test protocol. The test was conducted as described in Section 2.4, at the target flow of 2144 gpm (>400% final MTFR).

The flow data was recorded every 6 seconds throughout the test and is shown on **Figure 22.** The target flow was reached within 5 minutes of initiating the test. The average recorded steady-state flow was 2140 gpm, with a SD of 10.2 and COV of 0.005. Nine background samples were collected throughout the duration of the test, with the first sample being collected upon reaching steady-state flow (T = 5 minutes). The concentrations ranged from 1.6 to 2.8 mg/L, as shown on **Figure 23**. The recorded water temperature was 68.5 degrees F.

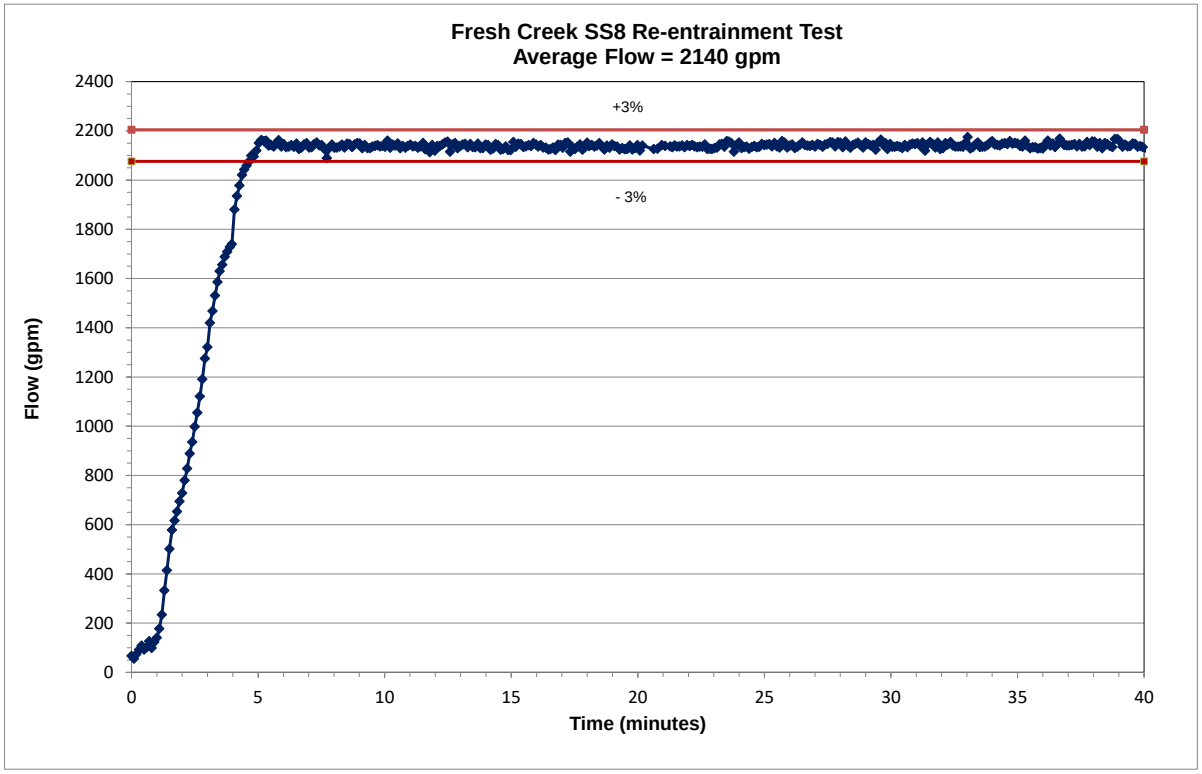

Figure 22 Scour Test Recorded Flow Data

The first effluent sample was collected at the moment steady-state flow was reached. When sampling began, it was immediately realized that the samplers had not been fully flushed prior to sampling, resulting in an effluent concentration of 29.2 mg/L. This concentration was discarded. An additional 17 effluent samples were collected every 2 minutes thereafter throughout the test. The concentrations for these samples ranged from 1.2 to 3.5 mg/L. Adjusting for background resulted in the majority of the samples being below 0 mg/L. The effluent concentration data is shown on **Figure 24**.

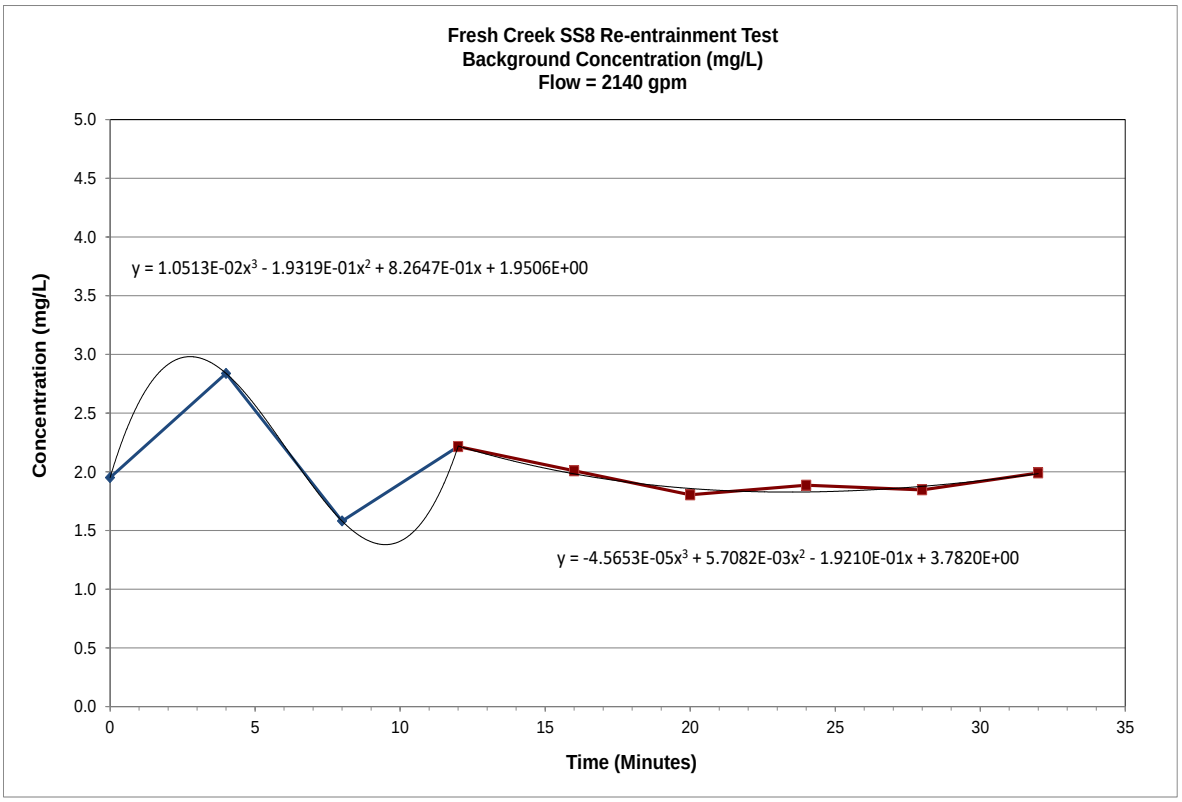

Figure 23 Measured Background Concentrations during Scour Testing

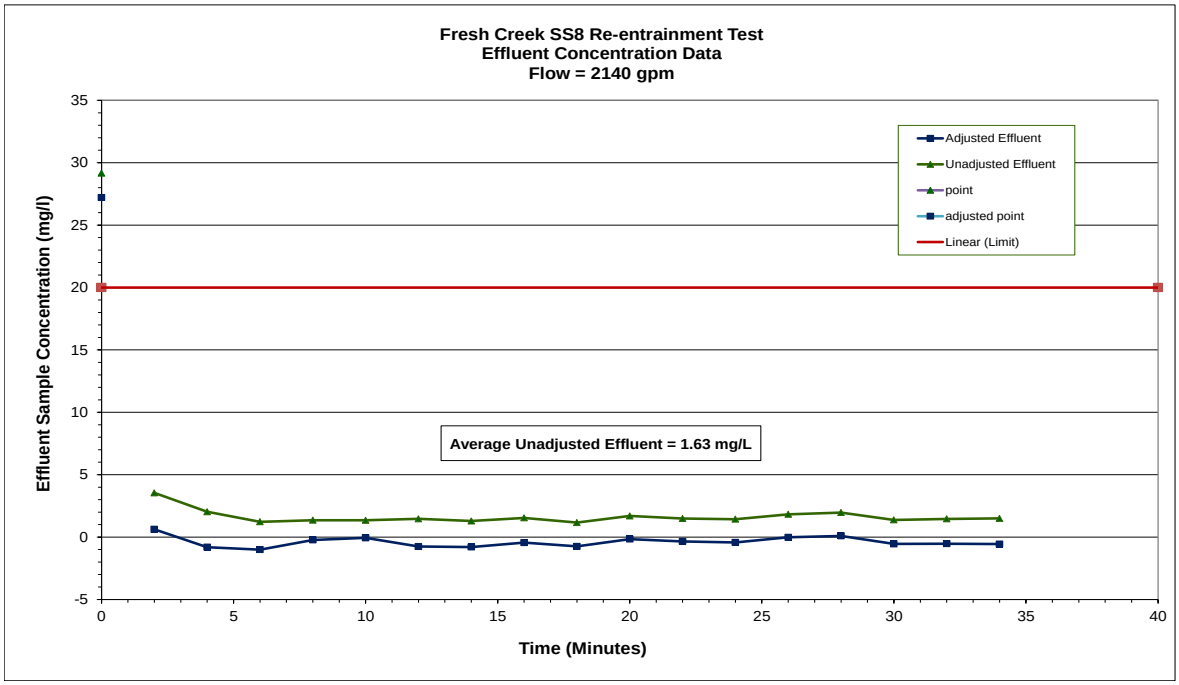

Figure 24 Scour Testing Effluent Concentrations

4.5 Hydraulic Characteristics

Piezometer taps were installed in the unit as described in Section 2.2. Flow (gpm) and water level (feet) within the unit were measured for 15 flows ranging from 0 to 3,000 gpm. The influent pipe was estimated to be flowing full at approximately 1,073 gpm. The entrance to the effluent pipe was submerged at approximately 1,500 gpm. The flow reached bypass at the downstream weir at 1,073 gpm. The recorded data is shown in **Table 6** and the Elevation Curves for each pressure tap location are shown on **Figure 25**.

Table 6 Recorded Flow and Elevation Data

Flow		Measured Water Elevations (adjusted to unit bottom)							
		Inlet Pipe	Area	Front Chamber	Inclined Plates	Effluent Chamber	Outlet Pipe	Inlet El. (A')	Outlet El. (E')
gpm	cfs	ft [A]	sq-ft	ft [B]	ft [C]	ft [D]	ft [E]	Corrected for Energy ft	Corrected for Energy ft
50.0	0.11	4.842	0.090	4.846	4.853	4.843	4.763	**4.866**	**4.895**
100.2	0.22	4.900	0.137	4.923	4.928	4.919	4.814	**4.941**	**4.967**
203.6	0.45	5.034	0.260	5.046	5.046	5.036	4.895	**5.081**	**5.073**
303.6	0.68	5.138	0.363	5.147	5.149	5.125	4.956	**5.192**	**5.159**
401.5	0.89	5.234	0.460	5.241	5.256	5.203	5.012	**5.292**	**5.230**
604.2	1.35	5.429	0.644	5.428	5.435	5.345	5.125	**5.497**	**5.357**
803.3	1.79	5.609	0.769	5.609	5.605	5.462	5.226	**5.693**	**5.474**
1072.6	**2.39**	**5.871**	**0.785**	**5.870**	**5.867**	**5.616**	**5.349**	**6.014**	**5.626**
1200.7	2.68	5.981	0.785	5.976	5.974	5.705	5.415	**6.161**	**5.700**
1503.5	3.35	6.128	0.785	6.123	6.114	5.878	5.572	**6.410**	**5.891**
1813.7	4.04	6.223	0.785	6.216	6.216	5.994	5.524	**6.634**	**5.935**
2101.9	4.68	6.321	0.785	6.304	6.306	6.112	5.443	**6.872**	**5.994**
2406.3	5.36	6.488	0.785	6.466	6.467	6.356	5.371	**7.212**	**6.095**
2851.4	6.35	6.929	0.785	6.899	6.913	6.812	5.371	**7.946**	**6.388**
3004.5	6.69	7.105	0.785	7.078	7.069	6.981	5.455	**8.233**	**6.583**

As seen on **Figure 26**, the calculated system energy loss (influent to effluent) ranged from 0 to approximately 0.39 ft. at the initial point of bypass. The system loss was 0.46 ft. at 1,200 gpm, which corresponded to the maximum loss across the bypass weir. The loss decreased slightly as expected due to bypass flow and started increasing once the water elevation reached the top of the outlet pipe at 1,500 gpm. The loss coefficient (Cd) for the inclined plates was calculated for flows up to bypass and was based on the total area of the plate bundle inlet. The inclined plates Cd values ranged from 0.01 to 0.07. The calculated losses are shown in **Table 7**.

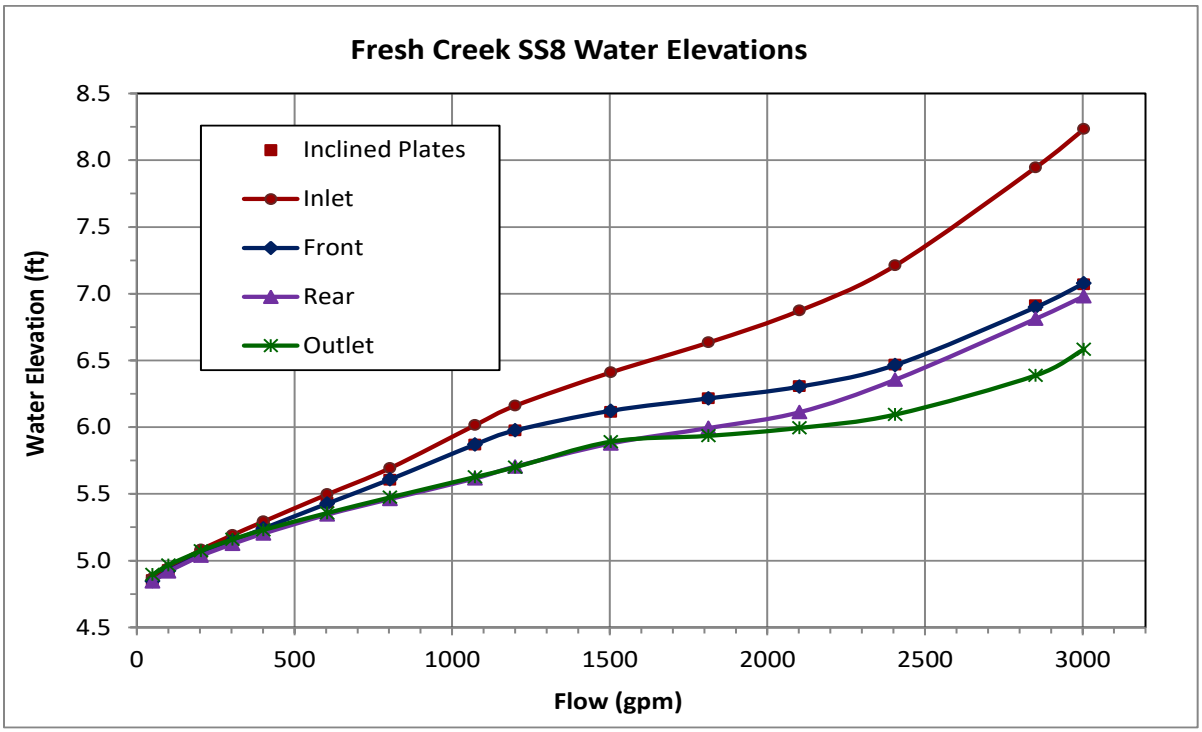

Figure 25 Measured Flow vs Water Elevations

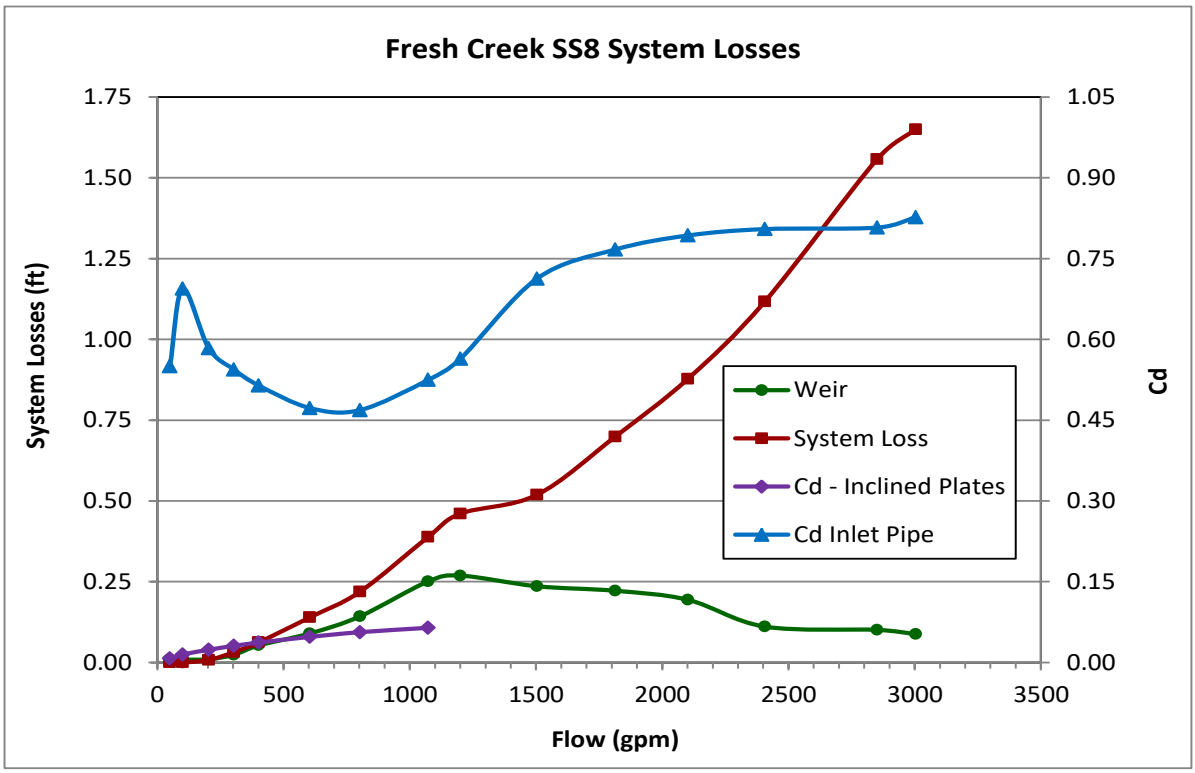

Figure 26 Calculated Losses and Inlet Cd

Table 7 Recorded Flows and Headloss Data

Flow		Losses						Loss Coefficients	
		Inlet With Energy		Inclined Plates & Effluent Baffle	Outlet With Energy		System Energy Loss	Inclined Plates	Inlet Pipe
gpm	cfs	A'-B	B-C	C-D	D-E'	A-E	**A'-E'**	Cd	Cd
50.0	**0.11**	0.020	-0.007	0.010	-0.053	0.079	**0.000**	0.008	0.550
100.2	**0.22**	0.018	-0.005	0.009	-0.048	0.086	**0.000**	0.015	0.694
203.6	**0.45**	0.035	0.000	0.010	-0.038	0.139	**0.008**	0.024	0.584
303.6	**0.68**	0.045	-0.002	0.024	-0.034	0.182	**0.032**	0.031	0.544
401.5	**0.89**	0.052	-0.015	0.053	-0.027	0.222	**0.062**	0.037	0.515
604.2	**1.35**	0.069	-0.007	0.090	-0.012	0.304	**0.140**	0.048	0.472
803.3	**1.79**	0.084	0.004	0.143	-0.012	0.383	**0.219**	0.056	0.469
1072.6	**2.39**	**0.145**	**0.003**	**0.251**	**-0.010**	**0.522**	**0.388**	0.064	0.525
1200.7	**2.68**	0.185	0.002	0.269	0.005	0.566	**0.461**	0.069	0.564
1503.5	**3.35**	0.287	0.009	0.236	-0.014	0.556	**0.519**		0.713
1813.7	**4.04**	0.418	0.000	0.222	0.059	0.699	**0.699**		0.767
2101.9	**4.68**	0.569	-0.002	0.194	0.117	0.878	**0.878**		0.793
2406.3	**5.36**	0.746	-0.001	0.111	0.261	1.117	**1.117**		0.805
2851.4	**6.35**	1.047	-0.014	0.101	0.424	1.558	**1.558**		0.808
3004.5	**6.69**	1.155	0.009	0.088	0.398	1.65	**1.650**		0.827

5. Design Limitations

Fresh Creek Technologies has an engineering team that works with the project site design engineer to ensure correct product application. The project engineer is required to complete a project survey form that communicates all pertinent site characteristics to the Fresh Creek home office to ensure the successful application of the SiteSaver®. Design constraints are addressed during this process.

Required Soil Characteristics

Local code restrictions and specified design considerations apply to the precast structure. Typically the structure weighs less than the soil it replaces rendering soil bearing of little concern. Our structural Engineer of Record presumes submersion in groundwater to address buoyancy concerns. Standard wheel axle loadings are HS-20 unless otherwise specified. Fresh Creek recommends a standard 6” stone sub-base to level the excavated soil and reach the proper setting elevation.

Slope

The netting trash trap bag that removes floating debris requires that the inflow velocity be below 5 to 7 ft/s. Otherwise some form of energy dissipation must be considered. Fresh Creek’s application consultant will offer methods of design to deal with excess inflow velocities.

Maximum Treatment Flow Rate

The maximum treatment flow rate varies depending on the model size and is based on a consistent hydraulic loading rate of 18.75 gallons per minute per square foot of effective treatment area.

Maintenance Requirements

Maintenance requirements for the SiteSaver® stormwater treatment system depend on site conditions and pollutant characteristics. The system must be inspected at regular intervals and maintained when necessary to ensure optimal performance. Section 6 of this report includes a detailed description of inspection and maintenance requirements for the SiteSaver®.

Driving Head

The driving head required for a given SiteSaver® model at the maximum treatment flow rate or during bypass for online units, depends on the model size and storm sewer characteristics. Driving head as a result of the insert is negligible. **Figure 26** shows that the head loss is dictated by the structure inlet pipe loss and outlet pipe loss. In system hydraulics evaluation SiteSaver® head loss contribution is similar or less than a manhole connection.

Installation Limitations

Property rights may limit installation. Overhead or underground utility lines may limit placement. Fresh Creek provides pick weights and structure sizes and instructions to assure sealing of precast joints in our scope of supply proposals. Contractors use this information to select proper lifting equipment and excavation dimensions. Delivery trucks should be able to access the site under their own power. Fresh Creek requests to attend SiteSaver® installation to insure concerns can be addressed immediately.

Configurations

The SiteSaver® should be installed inline. Fresh Creek advises draining multiple inlets to the SiteSaver®. This method shifts maintenance at inlets to maintenance at each SiteSaver® and can lead to a reduction in maintenance visits.

Structural Load Limitations

Standard SiteSaver® design assumes HS-20 Axle loading and full submersion in ground water. However HS-25 or higher loading can be accommodated. Soil borings from the project plans typically provide design data. Exterior coating may be required in acid soil conditions.

Pretreatment Requirements

The SiteSaver® is a device that removes gross pollutants and sediment and requires no pretreatment. Fresh Creek recommends good housekeeping and street sweeping be practiced because those methods reduce maintenance costs of the SiteSaver®. Preventing uptake of impurities by runoff is wise because it is easier to remove sediment and trash from the street than from the run-off.

Limitations in Tailwater

Back flow will cause some upstream flow of captured trash. Fresh Creek recommends back flow preventers in tidal zones.

Depth to Seasonal High Water Table

The treatment performance of the SiteSaver® will not be affected by high groundwater.

6. Maintenance Plans

When a SiteSaver® is installed, frequent inspection is highly recommended. The design of the SiteSaver® permits easy inspection. It is recommended that during the first year after installation, inspections be performed at least quarterly for the purpose of noting the rate of pollutant capture: oil, grease, trash, debris, vegetation and sediment.

Sediment Measurement

To determine sediment accumulation, a tape measure or stadia rod may be used. Cleaning is recommended when the sediment to water level measurements is less than 39 inches. To avoid underestimating the volume of sediment in the chamber it helps to have a broad foot on the end of the measuring rod to sense the soft top of the sediment bed.

Maintenance (flow capacity regeneration) Cleaning

Although trash and debris collection falls outside the scope of this verification the SiteSaver® is most likely equipped with the Netting Trash Trap®. Depending on the application this net bag fills faster or slower than the need for sediment removal. There is no certainty in this regard. Procedures to regenerate flow by replacing the used net with a new net will be in the Fresh Creek Maintenance Manual http://stormtrap.com/products/freshcreek/. Here we focus on sediment removal.

The clean-out procedure should occur when it does not rain. Aluminum hatches and/or cast iron frames and covers provide access and closure of the interior space. The SiteSaver® is designed with clear access along both ends of the settler insert. A vacuum truck, or similar trailer mounted equipment, can be used to suck the sediment from the floor while an operator uses a spray lance, i.e. a vertical pipe with a 90 degree turn and a spray nozzle. When the lance is connected to the trucks pressure line the operator can spray the sediment towards the suction point on the opposite side. This action can be repeated on both ends until all appears acceptable. Then return the decanted water and close the access openings securely.

Unless local regulations require inspection access and entry into the chamber or if the cleaning company decides to enter the interior space, there is no confined space access procedure necessary to clean the SiteSaver®.

Oil Spill Cleaning

The approximate oil volume that the SiteSaver® can intercept if the hydraulic relief weir is not

crested depends on the model, varying from 103 to 8202 gallons. An oil spill response team must immediately withdraw the oil to prevent drainage from the device in the future.

Oil sheen soaker socks are placed in the netting bag for the absorption of gasoline, diesel fuel, lube oil, jet fuel, transformer oils, chlorinated solvents, aromatic solvents, hydraulic oils, and light crude. They are designed to absorb about ¼ gallon of liquid sheen per sock. The number of socks inserted in the netting bag is arbitrary and requires good judgement by the maintenance manager. Typically Fresh Creek recommends four (4) ¼ gallon soaker socks per treated cubic feet per second.

Disposal of Removed Pollutants

Material removed from the SiteSaver® must be handled according to local, state, and federal regulations.

7. Statements

The following pages comprise the signed statements from Fresh Creek Technologies (the manufacturer), Alden Laboratory (the independent test facility), and NJCAT required to complete the 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.

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®

November 13, 2015

To: Dr. Richard Magee, Sc.D., P.E., BCEE
Executive Director
New Jersey Corporation for Advanced Technology
C/o Center for Environmental Systems
Stevens Institute of Technology
One Castle Point on Hudson
Hoboken, NJ 07030

Subject:

Submittal of the laboratory verification report for SiteSaver® SS8

Dear Dr. Magee;

Herewith Fresh Creek Technologies Inc. certifies that the protocol requirements of "New Jersey Department of Environment Protection Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device", dated January 25, 2013, were met or exceeded.

Sincerely
Fresh Creek Technologies Inc.

Hans de Bruijn
(cell 717 826 4371) hdebruijn@freshcreek.com
Sr. Environmental Manager

cc. Wally Trnka. Dennis Moran, Dan Fajman.

ALDEN

Solving flow problems since 1894

November 17, 2015

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 the manufacturer of any stormwater treatment units that are tested.

Protocol Compliance Statement

Testing performed by ALDEN on the Fresh Creek Technologies SiteSaver 8 (SS8) Stormwater Treatment unit 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 Hydrodynamic Sedimentation Manufactured Treatment Device", (January 25, 2013). A Technical Report and all required supporting documentation has been submitted as required by the protocol.

James T. Mailloux

Senior Engineer
Alden Research Laboratory
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Center for Environmental Systems
Stevens Institute of Technology
One Castle Point
Hoboken, NJ 07030-0000

November 20, 2015

Titus Magnanao
NJDEP
Division of Water Quality
Bureau of Non-Point Pollution Control
401-02B
PO Box 420
Trenton, NJ 08625-0420

Dear Mr. Magnanao,

Based on my review, evaluation and assessment of the testing conducted on the SiteSaver® Stormwater Treatment Device (Fresh Creek Technologies Inc.) at ALDEN Research Laboratory (ALDEN), the test protocol requirements contained in the "New Jersey Laboratory Testing Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic Sedimentation Manufactured Treatment Device" (NJDEP HDS Protocol) were met or exceeded. Specifically:

Test Sediment Feed

The mean PSD of the ALDEN sediment for removal efficiency testing complied with the PSD criteria established by the NJDEP HDS protocol. The ALDEN removal efficiency test sediment PSD analysis was plotted against the NJDEP removal efficiency test PSD specification. The test sediment was shown to be finer (d_{50} of 65 µm vs. 75 µm) than the sediment blend specified by the protocol. The ALDEN scour test sediment PSD analysis was plotted against the NJDEP scour test sediment PSD specification and shown to be within the specifications required by the protocol.

Removal Efficiency Testing

In accordance with the NJDEP HDS Protocol, removal efficiency testing was executed on a Model SS8 in order to establish the ability of the SiteSaver® to remove the specified test sediment at 25%, 50%, 75%, 100% and 125% of the target MTFR. Prior to the start of testing preliminary testing was conducted by ALDEN in accordance with the NJDEP HDS Protocol to establish a 3rd – order removal characteristic curve and corresponding equation. Based on this equation they decided to utilize a target MTFR of 1.00 cfs. This target was chosen based on the ultimate goal of demonstrating greater than 50% annualized weighted solids removal as defined in the NJDEP HDS Protocol. The flow rates, sediment feed rates and TSS influent concentrations all met the NJDEP HDS test protocol's coefficient of variance requirements and the background concentration for all

five test runs never exceeded 20 mg/L. The highest background TSS concentration was 6.9 mg/L. The maximum water temperature during the five removal efficiency tests ranged from 62.0 F to 68.7 F.

Scour Testing

In order to demonstrate the ability of the SiteSaver® to be used as an online treatment device scour testing was conducted at 475% of the MTFR in accordance with the NJDEP HDS Protocol. The average flow rate during the online scour test was 4.77 cfs. Background concentrations ranged from 1.6 mg/L to 2.8 mg/L, which complies with the 20 mg/L maximum background concentration specified by the test protocol. Unadjusted effluent concentrations ranged from 1.2 mg/L to 3.5 mg/L. No attempt to adjust the effluent concentration for the background concentrations was made since it is clear that the effluent TSS concentration is well below 20 mg/L at the 475% MTFR. The recorded water temperature during the scour test was 68.5 F. These results confirm that the SiteSaver® met the criteria for online use.

Maintenance Frequency

The predicted maintenance frequency for all models exceeds 9 years.

Sincerely,

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

8. References

ASTM (2013), "Standard Test Methods for Determining Sediment Concentration in Water Samples", Annual Book of ASTM Standards, D3977-97, Vol. 11.02.

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

ASTM (2007), "Standard Test Methods for Determination of Water (Moisture) Content of Soil by Direct Heating", Annual Book of ASTM Standards, D4959-07, Vol. 04.08.

ASME (1971), "Fluid Meters Their Theory and Application- Sixth Edition".

NJDEP (2013), "Laboratory Protocol to Assess Total Suspended Solids Removal by a Hydrodynamic sedimentation Manufactured Treatment Device".

VERIFICATION APPENDIX

Introduction

- Manufacturer –Fresh Creek Technologies Inc., 1384 Pompton Ave., Suite 2, Cedar Grove, NJ 07009. *Phone*: 800-741-9486, 973-237-9099. Email: fresh@freshcreek.com *Website:* www.freshcreek.com.

- MTD – SiteSaver®. Verified models are shown in Table A-1.

- TSS Removal Rate – 50%

- On-line installation

Detailed Specification

- NJDEP sizing table attached as Table A-1.

- New Jersey requires that the peak flow rate of the NJWQ Design Storm event of 1.25 inch in 2 hours shall be used to determine the appropriate size for the MTD.

- Pick weights and installation procedures vary with model size. Fresh Creek provides contractors with project-specific unit pick weights and installation instructions prior to delivery.

- Maximum recommended sediment depth prior to cleanout is 8.25 inches.

- For a reference inspection and maintenance plan download the Fresh Creek Maintenance Manual at: http://stormtrap.com/products/freshcreek/

- Under N.J.A.C. 7:8-5.5, NJDEP stormwater design requirements do not allow a hydrodynamic separator such as the SiteSaver® to be used in series with another hydrodynamic separator to achieve an enhanced total suspended solids (TSS) removal rate.

Table A-1 MTFRs and Required Sediment Removal Intervals for SiteSaver® Models (Revised January 2017)

SiteSaver® Model by number of Plates	Footprint to Insert area ratio	MTFR (CFS)	MTFR to ETA Ratio	ETA[1]	SiteSaver® Physical Dimensions			50% Max Sediment Volume [2] (CF)	Sediment Removal Interval (Months)	Oil Capacity[4]	Pre-Treatment Chamber Length	Pre-Treatment to ETA Ratio (PT/ETA)
					Concrete Length	Concrete Width	Floor depth Scaling Depth 56"-8.25"= 47.75"					
			gpm/ft^2	Ft^2	(Inches)	(Inches)	(Inches)				Inches	
SS4	0.80	0.67	18.75	16.0	96	24	56	11	117	103 Gallon	30	0.31
SS6	0.67	0.83	18.75	20.0	96	30	56	14	117	129 Gallon	30	0.31
SS8	0.60	1.00	18.75	24.0	96	36	56	17	117	154 Gallon	30	0.31
SS11	0.61	1.39	18.75	33.3	100	48	56	23	117	233 Gallon	34	0.34
SS13	0.61	1.66	18.75	39.8	106	54	56	27	117	309 Gallon	40	0.38
SS16	0.60	2.02	18.75	48.3	116	60	56	33	117	429 Gallon	50	0.43
SS18	0.62	2.34	18.75	55.9	122	66	56	38	117	528 Gallon	56	0.46
SS20	0.61	2.50	18.75	60.5	132	66	56	42	117	622 Gallon	66	0.50

SiteSaver® Model by number of Plates	Footprint to Insert area ratio	MTFR (CFS)	MTFR to ETA Ratio	ETA[1]	SiteSaver® Physical Dimensions			50% Max Sediment Volume [2] (CF)	Sediment Removal Interval (Months)	Oil Capacity[4]	Pre-Treatment Chamber Length	Pre-Treatment to ETA Ratio (PT/ETA)
					Concrete Length[3]	Concrete Width[3]	Invert to floor Variable Depth[3]					
			gpm/ft^2	Ft^2	(Inches)	(Inches)	(Inches)				Inches	
SS23	0.85	4.1	18.75	97.5	180	78	97	67	117	1270 Gallon	114	0.63
SS36	0.92	6.9	18.75	165.8	234	102	125	114	117	2448 Gallon	168	0.72
SS45	1.12	10.5	18.75	252.0	288	126	152	173	117	3996 Gallon	222	0.77
SS55	1.30	14.9	18.75	356.3	342	150	179	245	117	5914 Gallon	276	0.81
SS65	1.47	20.0	18.75	478.5	396	174	205	329	117	8202 Gallon	330	0.83

[1] ETA is Effective Treatment Area equal to the SS footprint area (length x width).

[2] Treatment depth is SS physical depth minus $^1/_2$ sediment depth (8.25")

[3] Test unit length/width, treatment depth/width and treatment depth/length ratios are 2.67, 1.33 and 0.5. For models (SS23-SS65) with the MTFR >250% than the tested model (SS8), within the allowable scaling 15% allowance, the length/width ratio can vary between 2.27 and 3.07, the treatment depth/width ratio between 1.13 and 1.53 and the treatment depth/length ratio between 0.42 and 0.57.

[4] The oil capacity is based on a 33 inch oil baffle depth and a 66 inch inclined plate insert.