StormTank® Hydraulic Performance and Sediment Removal Efficiency

Karl Koch

Executive Summary

Testing for the hydraulic performance and sediment removal efficiency of the Brentwood Industries StormTank® Debris Row was conducted at the Brentwood Industries Research and Development Facilities following ASTM Standard C1746/C1746M-12, Standard Test Method for Measurement of Suspended Sediment Removal Efficiency of Hydrodynamic Stormwater Separators and Underground Settling Devices. Trapping efficiencies for AGSCO Silica Sand #110 was greater than 95% at all flow ranges tested. Hydraulic performance was limited only by the design of the test rig, namely the flow into the 8" slotted effluent pipe, with flow ranges tested up to nearly 27 GPM/ft^2. The hydraulic data was used to determine detention times and ultimately slurry feed and sampling rates.

The StormTank® Debris Row trapping efficiencies were determined using both a direct and indirect method. The direct method physically weighed the sediment injected into the system, the sediment trapped within the Debris Row, and the sediment trapped within the Effluent Sump. Mass Balances for each test accounted for over 97% of all solids mixed into the feed slurry. The indirect method followed Standard D3977-97, Standard Test Methods for Determining Sediment Concentration in Water Samples. Five evenly spaced samples were drawn from the both the Influent and Effluent flow streams, from which the average concentrations were used to determine the StormTank® Debris Row trapping efficiencies.

Introduction

The Brentwood StormTank system is a rugged yet lightweight subsurface stormwater storage unit. The simple to assemble and install modules, designed to exceed the AASHTO HS-25 load rating, are utilized under most surfaces for detention, infiltration, harvesting, and flood mitigation of rain water. Integral to the system is a Debris Row; a series of StormTank modules subsequential to the inlet pipe and isolated by a series of internally installed side panels with a geotextile fabric liner on the bottom and extending 12" up the side panels. The dual purpose of this Debris Row is: (1) the isolation of larger debris; (2) filtration of sediment.

Purpose

The purpose of this study is: (1) to quantify the hydraulic performance, in terms of stage and detention time for testing purposes; (2) to quantify the sediment removal efficiency of a StormTank® Debris Row system subjected to simulated stormwater runoff conditions.

Scope

Construct a 12' x 6' x 4' Test Basin capable of holding 12' x 6' x 1' #2 Angular stone, a three StormTank® module Debris Row, and a seven StormTank® module system surrounding the Debris Row. Set up a system capable of controlled water flow ranges of 90 – 400 GPM (7.0 – 30.6 GPM/ft^2), with a means of injecting a sediment slurry simulating stormwater runoff. Construct a 10' x 6' x 2' sump to capture the simulated stormwater runoff and filter the effluent for recirculation. Have the means to directly weigh the sediment before and after addition to the test apparatus to determine the removal efficiency. Have the means to indirectly determine the influent and effluent sediment concentrations to determine the removal efficiency.

Apparatus (Appendix A – System Overview)

4000 gallon Reservoir Tank
(4) - 4" Ball Valve
Grundfos E-Pump, Model# CRE90-1-1AN-G-A-E-HQQE
DCT-7088 Portable Digital Correlation Transit Time Ultrasonic Flowmeter
Masterflex B/T variable-speed wash-down modular pump, 12-321rpm, Model# K-77110-40
30 gallon Slurry Tank
Dayton Tank Mixer, Model# 2M168D
8" Ball Valve
12" Inlet Connection, Brentwood Industries
12' x 6' x 4' Test Basin with 12' x 6' x 1' of #2 Angular stone
10' x 6' x 2' Sump
8" Slotted High – Density Polyethylene Pipe, 12'
50 micron filter sock
(2) ISCO 4700 Refrigerated Samplers

Considerations

ASTM Standard C1746/C1746M-12 was followed with the following exceptions:

6.1, 6.4 – The influent system consists of an 8” pipe 78” long, with a slurry injection port 60” from the influent point, and a ball valve / mixing valve 40” from the influent point. This valve remains 100% open.

8.1.1 – Specific gravity and particle-size distribution is not necessary as the sediment is a specialty blend with included technical data sheets (Appendix B).

Conclusions

Using the flow/volume relationship to determine the Detention (residence) Time it can be concluded that the water load limiting factor is the test rig itself rather than any aspect of the StormTank® system through the flow levels tested. (See Test Results and Discussion)

At all flow levels tested sediment removal efficiency is greater than 95% by direct measurement and greater than 97% by indirect sampling. (See Test Results and Discussion)

Evaluation

Test Sample

(10) – 18” StormTank Modules, ST-18
(14) – 18” Side Panels
Geotextile Fabric (Appendix C)
AGSCO Silica Sand #110, Item# SSS000110—B5MBNK (Appendix B)

Test Method

Set-up and Test Run

1. Fill out the initial section of the StormTank Water Quality Test Data Sheet (Appendix D).
2. Record the tare weights of the Influent and Effluent sample containers in the StormTank Water Quality Test Data Sheet and place the crucibles and filter papers in the oven to dry. (See Sample Analysis Procedure, steps 40 – 43)
3. Ensure that the Reservoir Tank has ≥2000 gallons of water.
4. Cut approximately ½” behind the ring of a 50micron filter sock to remove the ring.
5. Weigh the filter sock and one Vacuum Filter as a unit and record in the StormTank Water Quality Test Data Sheet.
6. Cut and weigh the following three pieces of Geotextile 601 Fabric and record in the StormTank Water Quality Test Data Sheet:
    a. 2 pieces Geotextile @ 150” x 24”
    b. 1 piece Geotextile @ 150” x 80”

7. Place the 150” x 80” piece of geotextile fabric over the stone in the Test Basin, cutting around the well pipe.
8. Position the three StormTank Modules (STM’s) that make up the Debris Row down the center of the Test Basin. Module DB1 is placed on the influent pipe and placed against the Test Rig wall, with modules DB2 and DB3 lined up behind.
9. Place the two 150” x 24” geotextile fabric pieces on either side of the Debris Row with 12” lying against the Debris Row and 12” lying on the 150” x 80” piece of geotextile fabric. Each side will extend 12” past module DB1.
10. Cut the excess geotextile fabric near the inlet pipe in line with the wall.
    a. Tuck the vertical flaps between DB1 and the wall.
    b. Fold the vertical flaps up against the basin wall.
11. Position STM’s 1 – 3 and 4 – 6 on either side of the Debris Row, on top of the 150” x 24” geotextile fabric. Place one 25 lb weight on top of each STM.
12. Cut the geotextile fabric at approximately 45° from the corners of DB3 to allow wrapping of the fabric around the module. Position STM 7 against this fabric.
13. Cable tie the 12” of geotextile fabric between the debris and outer row to the side panels of the outer row.
14. Insert the Sump Effluent Filter sock frame into the sock and cable tie it around the 4” sump effluent line.
15. Position and attach the Influent Sampler to the Influent Sampler Port on the Influent Pipe. Program the sampler to the parameters listed in Table 1 – Hydraulic Performance for the testing conditions to be performed.
16. Position and attach the Effluent Sampler to the Effluent Sampler Line in the Test Basin Effluent Pipe. Program the sampler to the parameters listed in Table 1 – Hydraulic Performance for the testing conditions to be performed.
17. Attach the Slurry Pump to the Injection Port. Mix sediment slurry per the following:
    a. Add 20 gallons of water to the Slurry Tank.
    b. Plug in the Mixer Motor and Slurry Pump
    c. Slowly add 27.5 lbs of AGSCO #110 sediment.
    d. Fill with water until the mixture reaches the 25 gallon mark, cycling the mixer to achieve the correct volume.
    e. Power on the Slurry Pump but do not start.
18. Attach the flowmeter to the sensors and power on.
19. Open valves 1 and 4.
20. Open the bleeder valve on the Pump to extricate any air in the influent piping and pump.
21. Power on the Pump, and set the desired flow rate.
22. When the fill line is reached in the Sump open valve 2 and slowly close valve 1. To maintain the water level slowly open / close valve 1 as needed.
23. Record the time as the Equilibration Start Time. The test will need to equilibrate for 10 detention times. During this time:

   a. Take the Sump water temperature
   b. Program the Slurry Pump per Table 1
   c. Remove crucibles and filters from drying oven and place in desiccator.
   d. Record the actual flow rate on the StormTank Water Quality Test Data Sheet.
24. After 10 Detention Times record the time as the Equilibration End Time.
25. Start the Influent Sampler and record the time.
26. After 11 Detention Times start the Effluent Sampler and record the time.
27. Start the Slurry Pump.
28. Start the test timer.
29. Record the Sump water temperature and the time taken.
30. Halt the Influent and Effluent Sampler programs until the sampling interval has been met on the test timer.
   a. When the sampling interval has been met restart the Influent Sampler on bottle 2.
   b. After one detention time restart the Effluent Sampler on bottle 2.
31. Measure the maximum stage at the well and record in the StormTank Water Quality Test Data Sheet.
32. At this time the water in the reservoir Tank can begin to be replaced by a garden hose.
33. A few minutes before the end of the test, measure the water level in the StormTank chamber and record in the StormTank Water Quality Test Data Sheet.
34. When the Test Length has been met *and* the Influent Sampler has recovered the seventh sample, shut down the Influent Sampler and the Slurry Pump. Record the time.
35. When one more detention time has elapsed *and* the final Effluent grab sample has been recovered, shut down the Effluent Sampler. Record the time.
36. Record the Sump water temperature and the time taken.
37. Reduce the pump to the minimum flow rate and shut down the pump.
38. Close all the valves.
39. Check the water level in the Reservoir Tank and shut down the water if ≥2000 gallons.

Shutdown and Cleanout Procedure

40. Cut the cable ties holding the geotextile fabric to the STM side panels and carefully rinse each STM onto the Geotextile as it is removed from the Test Basin.
   a. Carefully fold the Geotextile lengthwise and remove from the Test Basin.
   b. Allow the geotextile to dry thoroughly before weighing and recording in the StormTank Water Quality Test Data Sheet.
41. Remove the slurry pump Influent Line and wash out the contents into the Slurry Tank.
42. Empty the contents of the Slurry Tank onto a tarp and allow to dry.
43. Carefully remove the filter sock from the Test Basin Sump effluent pipe and allow to dry thoroughly.

44. Using a sump pump placed in the Sump, begin a flow through the garden hose and then disconnect the garden hose from the sump pump, ensuring that it remains submerged at all times, and set on the floor of the Sump. Allow it to siphon to the sanitary sewer.
45. Disconnect the Flow Meter.
46. Disconnect the Influent Sampler from the influent pipe.
47. Disconnect the Effluent Sampler from the effluent pipe.
48. When the Sump has been drained, vacuum the remaining water and sediment with a vacuum containing the clean tared filter, disposing of the water in the sanitary sewer.
49. Place the Vacuum Filter with the Filter Sock and allow to dry thoroughly.
    a. Weight the Vacuum Filter and Filter Sock as a unit and record in the StormTank Water Quality Test Data Sheet.

Sample Analysis Procedure

50. Weigh and record tare weights for the 7 Influent and 7 Effluent Sample bottles making sure to include the lids. Weights are to be recorded on the data sheet in the Bottle Chart under the column Tare (g).
51. Wash the glass-fiber filter disc with water to remove soluble compounds. Record pore size and diameter on the data sheet.
52. Place the filter inside a crucible.
53. Dry the filter and its crucible in the drying oven for 1H at 105°C.
54. Weigh each of the 7 Influent and 7 Effluent Sample bottles with their samples inside and record on the data sheet in the Bottle chart under the column Gross (g).
55. Transfer the crucible and filter paper to the desiccator, then, after the parts have cooled to room temperature, weigh them to the nearest 0.0001 g and record the reading on the data sheet.
56. Place the crucible inside a crucible holder.
57. Place the crucible holder into the vacuum flask that is attached to the vacuum pump.
58. While a vacuum is being applied to the bottom of the crucible, filter sample into the crucible. Flush the inner surfaces of the sample bottle with water several times to complete the transfer.
59. As filtering proceeds, inspect the filtrate. If it is turbid, pour the filtrate back through the filter a second and possibly a third time. If the filtrate is still turbid, the filter may be leaking. In this case, substitute a new filter and repeat from step 51. If the filtrate is transparent but discolored, a natural dye is present; re-filtration is not necessary.
60. When filtration is complete, place the crucible and its contents in the drying oven for 1H at 105°C.
61. Remove crucible and filter from oven and place in desiccator. After the crucible has cooled, weigh to the nearest 0.0001 g and record on the data sheet.
62. Place crucible and filter back in oven for 1H at 105°C.
63. Remove crucible and filter from oven and place in desiccator. After the crucible has

cooled, weigh to the nearest 0.0001 g and record on the data sheet.

64. If values from steps 61 and 63 are less than 4% or 0.5 mg (whichever is smaller) different, then drying complete.
65. If values from steps 61 and 63 are more than 4% or 0.5 mg different, then repeat steps 52 – 53.
66. Enter all values in the Excel Spreadsheet "StormTank Water Quality Test Data Sheet".

Test Results and Discussion

Looking at the flow/volume relationship, determined by measuring the stage at each flow rate by means of a well installed midway through the test basin, several expected results occur: (1) the stage increases along with flow, (2) the volume increases along with flow, (3) the test length required to inject 21 pounds of sediment at an approximate concentration of 200 mg/L decreases as flow increases, (4) the indirect sampling interval decreases as the flow increases.

Table 1- Hydraulic Performance

Flow (cfs)	Flow (gpm)	Flow (gpm/ft^2)	Stage Relative to Outlet (in)	Total Volume (ft^3)	Total Volume (gal)	Detention Time, *X* (min)	Test Length (min)	Pump Speed to Deliver 20 gallons (GPM)	Sampling Interval (min)
0.21	95	7.0	5.03	30.08	225.00	2.37	139	0.14	23.1
0.30	133	10.0	6.09	36.44	272.52	2.05	99	0.20	16.5
0.42	192	14.0	8.34	49.89	373.14	1.94	69	0.29	11.4
0.50	217	16.6	9.97	59.60	445.81	2.05	61	0.33	10.1
0.61	276	20.3	13.03	77.92	582.77	2.11	48	0.42	8.0
0.69	305	22.9	15.22	91.00	680.59	2.23	43	0.46	7.2
0.80	357	26.6	19.41	116.03	867.86	2.43	37	0.54	6.2
0.92	413	30.6	25.00	149.48	1118.02	2.71	32	0.63	5.3
1.02	453	33.9	29.25	174.89	1308.08	2.89	29	0.69	4.8

However, the Detention Time, expected to decrease as flow increased, follows more of a second-order polynomial (See Chart 1 – Flow vs Detention Time). Considering the mechanism through which the water exits the test basin, an 8" slotted pipe, the increase in Detention Time can be explained by assuming a maximum flow through the total area of the slots dependent on head pressure. After passing through the StormTank® system, the geotextile, and the stone, the water must infiltrate the culvert pipe through the slots. For the first three data points, to 14.0 GPM/ft^2, the maximum flow through the pipe wall is not achieved, therefore, the results are as expected, a linear increase in the stage with decreasing Detention Times (See Chart 2 – Flow vs Stage). For the flows greater than 16.6 GPM/ft^2 the maximum flow through the pipe wall is achieved at equilibrium with head pressure, therefore, we see the stage increasing as a second-order polynomial with Detention Times increasing (See Chart 2 – Flow vs Stage).

Chart 1 - Flow vs Detention Time

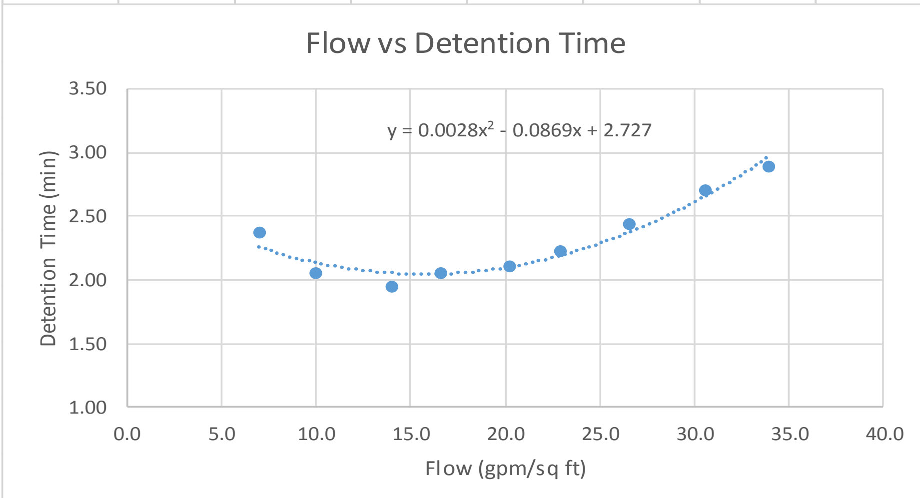
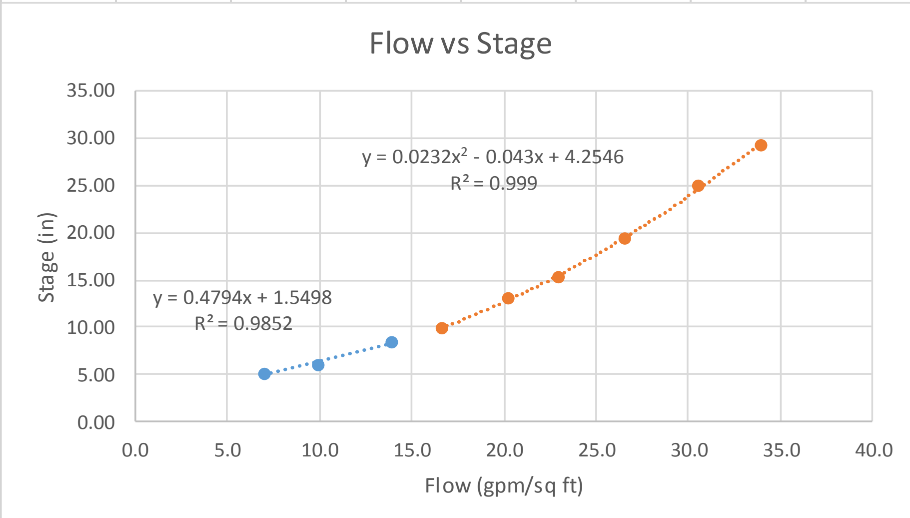


Chart 2 - Flow vs Stage



At all water flow rates tested, both the direct and indirect measurement methods indicated sediment trapping efficiencies greater than 95%. The direct method is the standard method and shows a 2% decline in sediment trapping efficiency, 97% to 95%, as the flow increases 400%, from 7.0 GPM/ft^2 to 26.9 GPM/ft^2 .The direct method also allows a mass balance to be performed between the sediment weighed from the packaging and the sediment collected at the completion of each test run. This mass balance shows that we can account for greater than 97% of the solids used.

Table 2- Sediment Removal Efficiency

Flow (gpm/ft^2)	Direct Sediment Measurements, Weight		Indirect Concentration Measurements		Removal Efficiency		Mass Balance (%)
	Injected in Influent Flow (lbs)	Retained in Debris Row (lbs)	Influent (mg/L)	Effluent (mg/L)	Direct Method (%)	Indirect Method (%)	
7.0	20.1	19.5	128.0	2.7	97.0	97.9	98.2
14.3	22.5	21.9	685.9	12.2	97.3	98.2	98.2
20.6	25.6	24.7	197.9	2.1	96.5	98.9	97.6
20.3*	18.1	17.2	346.4	0.0	95.0	100.0	97.1
26.9	20.5	19.7	410.4	1.5	96.1	99.6	97.8

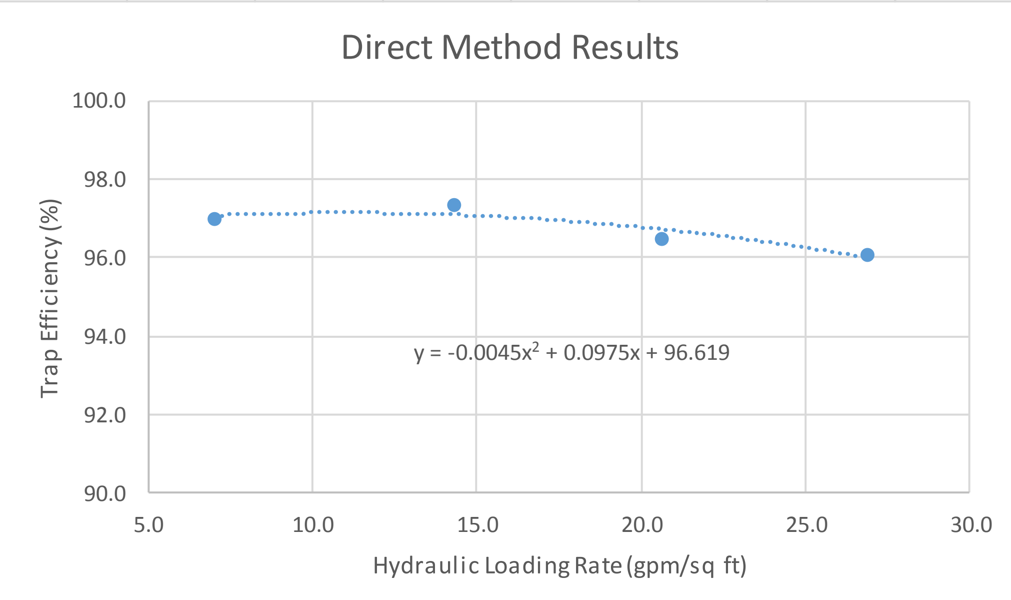
*Witnessed by Craig Momose, P.E.; Systems Design Engineering, Inc., October 15, 2015

The direct method for determining the sediment removal efficiency of the Brentwood StormTank® Debris Row utilizes a calibrated scale to weigh the sediment in the feed slurry, the sediment collected in the Debris Row, and the sediment deposited in the Effluent Sump. The sediment remaining in the slurry tank is also dried and weighed at the end of a test run to calculate the amount of sediment actually fed to the system. Through this measurement system the percentage of injected sediment trapped by the Debris Row is directly measured:

$$\text{Trap Efficiency} = (DB/IS) \times 100$$

Where, DB is the sediment captured by the Debris Row
And, IS is the Injected Sediment (Total added to the slurry tank – Total remaining at the end)

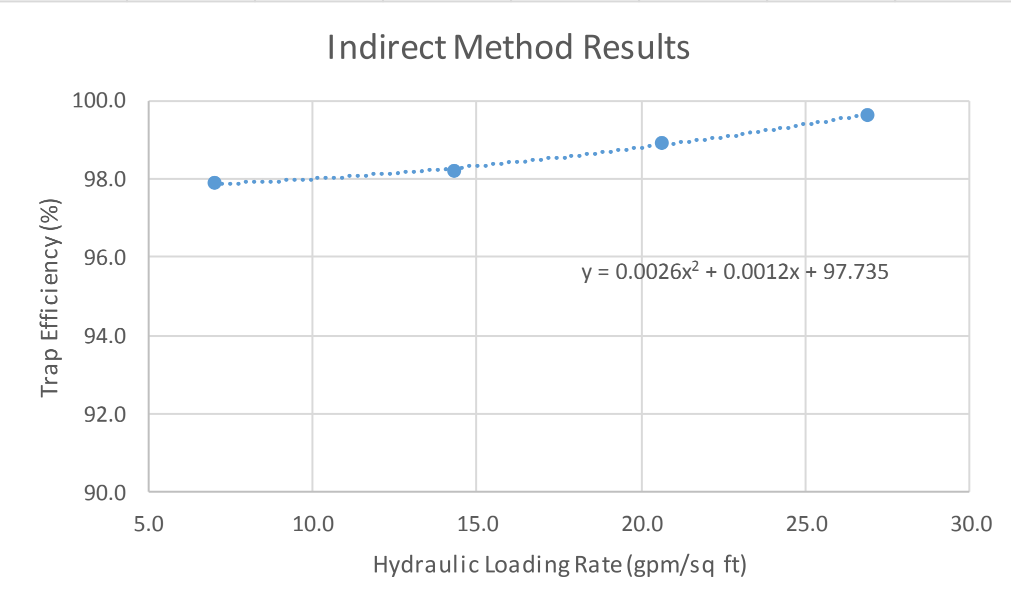
Chart 3 - Sediment Removal Efficiency, Direct Method



For the purposes of the evaluations in Chart 3 and Chart 4 the duplicate run (20.3 GPM/ft^2) for Systems Design Engineering, Inc. was omitted. Only 18.1 pounds of sediment were added, outside of the standard method. Additionally, there was no detectable sediment in the effluent samples, leading to a 100% trapping efficiency, which may lead one to question the validity of the results. However, the purpose of that test run was to allow the outside firm to verify our methods, not our results, and that was accomplished with the run.

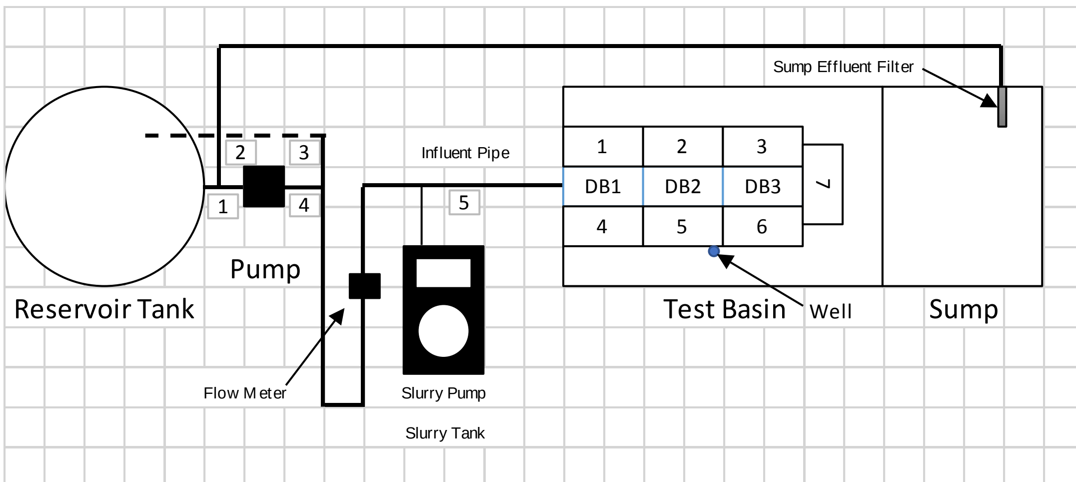
Brentwood utilized dormant resources to employ an indirect method to verify the results of the direct measurements. This was meant to be a broad verification, as the numerous steps involved and small concentrations of sediment, coupled with the difficulty of obtaining discrete well - mixed samples representative of the average concentrations, introduce compounding errors. Surprisingly, most of the results were within 3% of the direct method with the exception of the duplicate test, showing sediment trapping efficiencies greater than 97%. The results show a trend toward increasing sediment trapping efficiency as the flow increases. This could be due to numerous error factors: balance errors to the .00001g, humidity fluctuations, a decreasing sample cross-section as the water level in the effluent pipe increased (the sample line was set in the effluent pipe at the bottom counter to the flow).

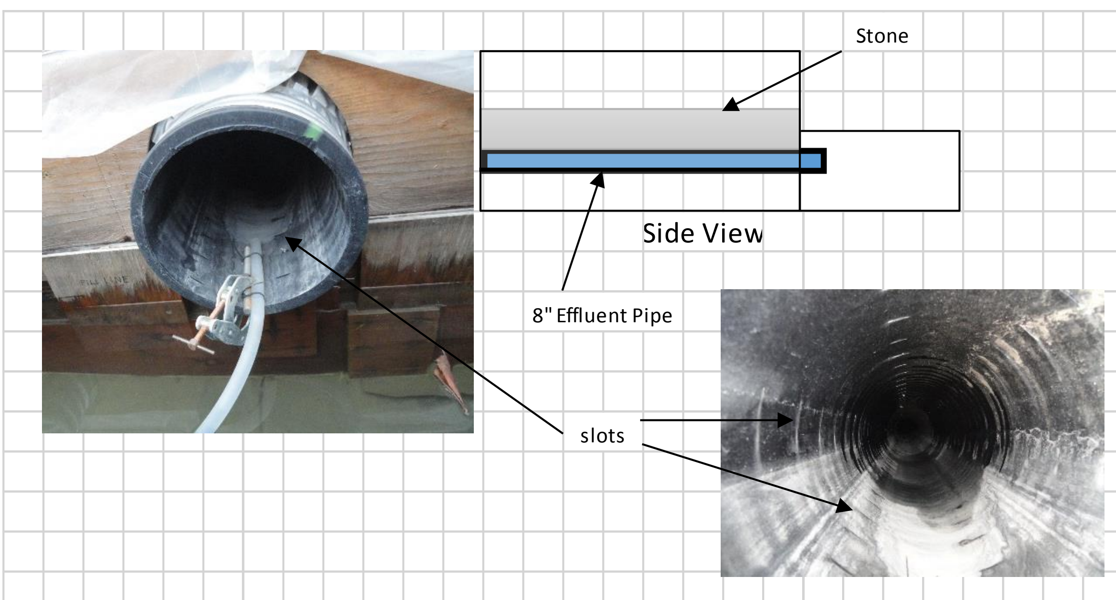
Chart 4 - Sediment Removal Efficiency, Indirect Method



Appendices

Appendix A – System Overview





Appendix B – AGSCO #110 Screen Analysis

AGSCO CORPORATION

TECHNICAL DATA

AGSCO SILICA SAND

TYPICAL SCREEN ANALYSIS

ROUND GRAIN SAND

(Percent Retained)

103,000# For wheeling

US SIEVE	20-40	(#1) 35-50	(#2) 40-70	50-80	(#7) 70-100	(#10) 100-140	(#110) 140-200	(#16) 140-270
12								
14								
16								
18								
20	0.2							
25	7.0	0.3						
30	20.6	2.0	0.3					
35	42.8	20.5	5.2					
40	23.3	35.3	16.5	2.7	2.9	1.2	0.3	
50	6.0	32.7	37.0	39.3	17.4	2.9	1.5	
60		4.7	14.2	23.8	---	---	---	
70		2.2	9.3	16.2	39.9	13.2	4.4	
80		2.3	5.5	9.1	---	---	---	
100			4.8	5.4	27.7	41.4	19.8	
120			7.2	3.5	---	---	---	---
140					11.2	36.3	42.8	27.8
170					---	---	---	---
200					0.9	4.8	20.5	50.9
230						---	---	---
270						0.1	8.3	19.3
325/PAN							2.3	2.0
	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

AFS Grain Number	25	35	47	50	59.6	80.3	111.8	144
Effective Size (mm).	0.43	0.30	.15	.15	.11			

SILICA FLOUR

(Typical Percent Retained)

U.S. Sieve	#70 / 250	#140 / 106	#200 / 90	#325 / 45
70	3			
100	11	T		
140	8	1	T	
200	14	6	3	
270	9	10	7	T
325	5	8	7	2
Passing 325	50	75	83	98
Totals	100	100	100	100

160 West Hintz Road
Wheeling, Ilinois 60090
P: 847-520-4455 • F: 847-520-4970

60 Chapin Road, PO Box 669
Pine Brook, New Jersey 07058
P:973-244-0005 • F:973-244-0091

Appendix C: GEOTEX 601 Product Data

GEOTEX®
BY PROPEX

Product Data
GEOTEX® 601

GEOTEX® 601 is a polypropylene, staple fiber, needlepunched nonwoven geotextile produced by Propex, and will meet the following Minimum Average Roll Values (MARV) when tested in accordance with the methods listed below. The fibers are needled to form a stable network that retains dimensional stability relative to each other. The geotextile is resistant to ultraviolet degradation and to biological and chemical environments normally found in soils.

GEOTEX 601 conforms to the property values listed below[1]. Propex performs internal Manufacturing Quality Control (MQC) tests that have been accredited by the Geosynthetic Accreditation Institute – Laboratory Accreditation Program (GAI-LAP). This product is NTPEP approved for AASHTO standards.

		MARV[2]	
PROPERTY	TEST METHOD	ENGLISH	METRIC
ORIGIN OF MATERIALS			
% U.S. Manufactured Inputs		100%	100%
% U.S. Manufactured		100%	100%
MECHANICAL			
Tensile Strength (Grab)	ASTM D-4632	160 lbs	712 N
Elongation	ASTM D-4632	50%	50%
CBR Puncture	ASTM D-6241	410 lbs	1824 N
Trapezoidal Tear	ASTM D-4533	60 lbs	267 N
ENDURANCE			
UV Resistance % Retained at 500 hrs	ASTM D-4355	70%	70%
HYDRAULIC			
Apparent Opening Size (AOS)[3]	ASTM D-4751	70 US Std. Sieve	0.212 mm
Permittivity	ASTM D-4491	1.3 sec^{-1}	1.3 sec^{-1}
Water Flow Rate	ASTM D-4491	110 gpm/ft^2	4482 $l/min/m^2$

ROLL SIZES	12.5 ft x 360 ft 15 ft x 300 ft	3.81 m x 109.8 m 4.57 m x 91.5 m

NOTES:
1. The property values listed above are effective 04/2011 and are subject to change without notice.
2. Values shown are in weaker principal direction. Minimum average roll values (MARV) are calculated as the typical minus two standard deviations. Statistically, it yields a 97.7% degree of confidence that any samples taken from quality assurance testing will exceed the value reported.
3. Maximum average roll value.

Appendix D – StormTank Water Quality Test Data Sheet

BRENTWOOD®

StormTank™ Water Quality Test Data Sheet

Date

Page 1 of 3

Test Name:			
Test Length:		min	
Detention Time:		min	
Target Influent Concentration:		mg/L	
Slurry Concentration:		lbs/gal	
Slurry Pump Speed:		gpm	
Sampling Interval:		min	
Glass-fiber Filter Diameter:		mm	
Glass-fiber Filter Pore Size:		µm	

Geotex Weight $_{Initial}$:		lbs	
Geotex Weight $_{Final}$:		lbs	
Filter Sock and Vacuum Filter Weight $_{Initial}$:		lbs	
Filter Sock and Vacuum Filter Weight $_{Final}$:		lbs	
Tarp Weight $_{Initial}$:		lbs	
Tarp Weight $_{Final}$:		lbs	
Flow $_{water}$:		cfs	
Water Load:	0	gpm/ft^2	
Maximum Stage $_{Rig}$:		in	
Depth in Chamber:		in	
Total Volume:	0.00	gal	
Equilibration Start Time:			
Equilibration End Time:			
Sump Water Temperature / Time:		°F /	
Sampler $_{Influent}$ Start Time:			
Sampler $_{Effluent}$ Start Time:			
Test / Slurry Pump Start Time:			
Sump Water Temperature / Time:		°F /	
Sampler $_{Influent}$ End Time:			
Sampler $_{Effluent}$ End Time:			
Test / Slurry Pump End Time:			
Sump Water Temperature / Time:		°F /	

StormTank™ Water Quality Test Data Sheet

Date

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Sample Bottle Weight Table

Sample	Tare (g)	Gross (g)	Net (g)	Solids (mg)	Water (mL)	Concentration (mg/L)
Influent 0			0.0000	0.0	0.0	#DIV/0!
Influent 1			0.0000	0.0	0.0	#DIV/0!
Influent 2			0.0000	0.0	0.0	#DIV/0!
Influent 3			0.0000	0.0	0.0	#DIV/0!
Influent 4			0.0000	0.0	0.0	#DIV/0!
Influent 5			0.0000	0.0	0.0	#DIV/0!
Influent 6			0.0000	0.0	0.0	#DIV/0!
Effluent 0			0.0000	0.0	0.0	#DIV/0!
Effluent 1			0.0000	0.0	0.0	#DIV/0!
Effluent 2			0.0000	0.0	0.0	#DIV/0!
Effluent 3			0.0000	0.0	0.0	#DIV/0!
Effluent 4			0.0000	0.0	0.0	#DIV/0!
Effluent 5			0.0000	0.0	0.0	#DIV/0!
Effluent 6			0.0000	0.0	0.0	#DIV/0!

Crucible Weight Table

Sample	Tare (g)	1H @ 105°C (g)	1H @ 105°C (g)	Solids (mg)
Influent 0				0.0
Influent 1				0.0
Influent 2				0.0
Influent 3				0.0
Influent 4				0.0
Influent 5				0.0
Influent 6				0.0
Effluent 0				0.0
Effluent 1				0.0
Effluent 2				0.0
Effluent 3				0.0
Effluent 4				0.0
Effluent 5				0.0
Effluent 6				0.0

StormTank™ Water Quality Test Data Sheet

Date

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Geotex Tare weight (lbs)	Dry Geotex Weight (lbs)	Solids (lbs)
0	0	0.0

Solids Remaining in Slurry Tank (lbs)	0

Vacuum Filter and Filter Sock Tare weight (lbs)	Dry Vacuum Filter and Filter Sock Weight (lbs)	Solids (lbs)
0	0	0.0

	Accounted	Unaccounted	Slurry
Mass Balance (lbs)	0.0	0.0	

Direct Removal Efficiency:	0	%
Indirect Removal Efficiency:	#DIV/0!	%

Appendix E – Sample Completed StormTank Water Quality Test Data Sheet

BRENTWOOD®

StormTank™ Water Quality Test Data Sheet

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Test Name:	WQ 0.4 cfs 2015 09 25		
Test Length:	69	min	
Detention Time:	1.94	min	
Target Influent Concentration:	200	mg/L	
Slurry Concentration:	1.1	lbs/gal	
Slurry Pump Speed:	0.29	gpm	
Sampling Interval:	11.0	min	
Glass-fiber Filter Diameter:	34	mm	
Glass-fiber Filter Pore Size:	1.5	µm	
Geotex Weight $_{Initial}$:	5.2	lbs	
Geotex Weight $_{Final}$:	27.1	lbs	
Filter Sock and Vacuum Filter Weight $_{Initial}$:	0.9	lbs	
Filter Sock and Vacuum Filter Weight $_{Final}$:	1.0	lbs	
Tarp Weight $_{Initial}$:	6.8	lbs	
Tarp Weight $_{Final}$:	11.8	lbs	
Flow $_{water}$:	0.43	cfs	
Water Load:	14.3	gpm/ft^2	
Maximum Stage $_{Rig}$:	9.88	in	
Depth in Chamber:	5.75	in	
Total Volume:	490.0	gal	
Equilibration Start Time:	9:55		
Equilibration End Time:	10:14		
Sump Water Temperature / Time:	71.8	°F /	9:56
Sampler $_{Influent}$ Start Time:	10:14		
Sampler $_{Effluent}$ Start Time:	10:16		
Test / Slurry Pump Start Time:	10:16		
Sump Water Temperature / Time:	72	°F /	10:17
Pause - Influent feed line not working; re-start at 10:31			
Sampler $_{Influent}$ End Time:	11:37		
Sampler $_{Effluent}$ End Time:	11:39		
Test / Slurry Pump End Time:	11:40		
Sump Water Temperature / Time:	72.3	°F /	11:39

StormTank™ Water Quality Test Data Sheet

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Sample Bottle Weight Table

Sample	Tare (g)	Gross (g)	Net (g)	Solids (mg)*	Water (mL)	Concentration (mg/L)
Influent 0	117.1047	211.1727	94.0680	1.0	94.1	10.6
Influent 1	113.7627	199.6820	85.9193	59.5	85.9	693.6
Influent 2	120.2428	205.2000	84.9572	77.9	84.9	917.2
Influent 3	119.0744	210.0568	90.9824	72.5	90.9	796.9
Influent 4	116.4428	212.7409	96.2981	69.1	96.2	718.1
Influent 5	116.5622	203.3854	86.8232	51.1	86.8	589.5
Influent 6	115.9707	206.8581	90.8874	36.3	90.9	400.1
Effluent 0	115.6987	203.4775	87.7788	1.2	87.8	13.1
Effluent 1	116.0757	205.6834	89.6077	1.1	89.6	12.3
Effluent 2	120.8946	215.6025	94.7079	1.5	94.7	15.8
Effluent 3	119.1743	214.1430	94.9687	1.6	95.0	16.8
Effluent 4	119.0589	231.6127	112.5538	0.7	112.6	5.8
Effluent 5	119.7286	214.6678	94.9392	1.0	94.9	10.5
Effluent 6	118.2419	211.6760	93.4341	1.1	93.4	11.8

*Negative values are recorded as zero

Crucible Weight Table

Sample	Tare (g)	1H @ 105°C (g)	1H @ 105°C (g)	Solids (mg)
Influent 0	44.5359	44.5362	44.5376	1.0
Influent 1	44.0679	44.1264	44.1285	59.5
Influent 2	44.9158	44.9929	44.9944	77.9
Influent 3	44.5755	44.6473	44.6486	72.5
Influent 4	43.5355	43.6040	43.6052	69.1
Influent 5	44.3170	44.3674	44.3689	51.1
Influent 6	44.4361	44.4718	44.4731	36.3
Effluent 0	44.3461	44.3469	44.3476	1.2
Effluent 1	44.4199	44.4204	44.4216	1.1
Effluent 2	44.5589	44.5595	44.5613	1.5
Effluent 3	44.4879	44.4889	44.4901	1.6
Effluent 4	44.2916	44.2916	44.2929	0.7
Effluent 5	44.3202	44.3207	44.3217	1.0
Effluent 6	44.2992	44.2998	44.3008	1.1

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Geotex Tare weight (lbs)	Dry Geotex Weight (lbs)	Solids (lbs)
5.2	27.1	21.9

Solids Remaining in Slurry Tank (lbs)	5

Vacuum Filter and Filter Sock Tare weight (lbs)	Dry Vacuum Filter and Filter Sock Weight (lbs)	Solids (lbs)
0.9	1	0.1

	Accounted	Unaccounted	Slurry	
Mass Balance (lbs)	27.0	0.5	27.5	98.2%

Direct Removal Efficiency:	97.3	%
Indirect Removal Efficiency:	98.2	%

Brentwood Industries, Inc.

610 Morgantown Road, Reading, PA 19611, USA

Phone: 610.374.5109

Fax: 610.376.6022