Noboru Togawa

Academic Back Ground

- Ph.D Student at the University of Alabama, expected graduation, spring, 2010
- Master in Environmental Engineering at the University of Alabama

Work Exprience

- Research / Teaching Assistant
- Hydraulic Facilities Designer

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HIGH-RATE STORMWATER TREATMENT DEVICE

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Dept. of Civil, Construction, and Environmental Engineering

University of Alabama, Tuscaloosa

- Dept. founded in 1837 (5th oldest in US)
- More than 500 undergraduates
- More than 100 graduate students
- 21 primary faculty
- Roughly 5 million in annual research expenditures

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Overview

- Introduction and significance of the research
- History
- Up-Flow™ Proto-Type Filter
- Location and Size of the Filter
- Full Scale Up-Flow Filter Components
- Installation of Filter
- Treatment Flow rate Requirments
- Controlled Flow Test
  - Sediment
  - Methodology
  - Result
- Future Research Subject

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Introduction & Significance

- Many types of stormwater controls are available, but most are relatively large or insufficient in their treatment capacity.
- Adequate treatment of runoff requires the removal of many types of pollutants as well as large amounts of debris and floatable materials, over a wide range of flows.
- Traditional downflow filters, which can provide high levels of treatment, can quickly clog, reducing their treatment flow rate and overall treatment capacity. They also usually operate at a low treatment flow rate requiring a large area to treat substantial portions of the runoff from a site.

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History

- This stormwater filtration device was developed by engineers at the University of Alabama through a Small Business Innovative Research (SBIR) grant from the U.S. Environmental Protection Agency.
  - Installed to about 0.9ac parking lot.
  - About 90% of volume reduction with 10% bypass.
  - Maximum filtration rates of about 25 gal/min.

Proto-Type Up-Flow Filter

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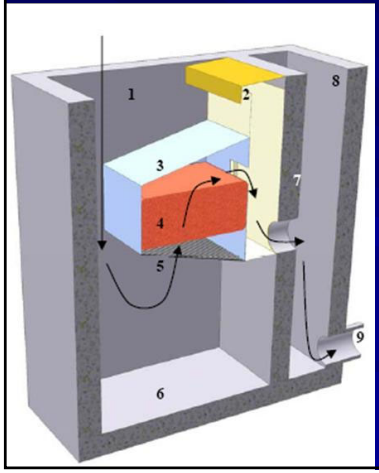
Up-Flow™ Proto-Type Filter



- Sump can collect the heavy debris
- Small objects are filtered by Screen and Media
- During prototype field tests, measured:
  - 68-94% sediment removal
  - 70-90% pollutant reduction

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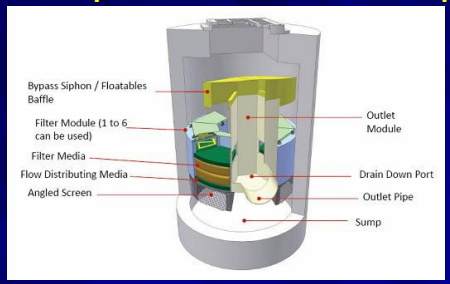
Full Scale Up-Flow Filter Components



- Buoyant trash is captured by flotation in the chamber and retained by the floatables baffle during high-flow bypassing
- Coarse solids and debris are removed by sedimentation and settle into the sump
- Capture of intermediate solids by sedimentation in sump resulting from controlled discharge rates
- Neutrally buoyant materials are screened out by the angled screens
- Fine solids are captured in the filtration media
- Dissolved pollutants are removed by sorption and ion-exchange in the media

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Location and Size of Filter

- A 7-foot tall 4-foot diameter standard inlet containing a six module.
- Installed at the Riverwalk parking lot near the Bama Belle on the Black Warrior River in Tuscaloosa, Alabama.

Land Use	Area (ft^2)	Area (acre)	% of Land Use
Parking Area	11,800	0.27	30.5
Other Paved	1,300	0.03	3.4
Side Walks	2,100	0.05	5.4
Entrance Road	10,990	0.25	28. 5
Green Space	12,400	0.29	32.2
Total	**38,610**	**0.89**	**100.0**

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Installation of the Filter

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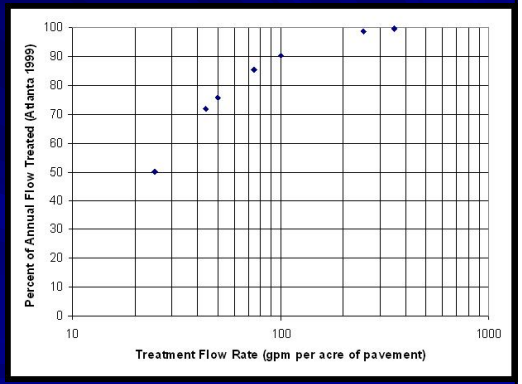
Treatment Flow rate Requirements

- The 100 gal/min for the test site is expected to treat about 90 percent of the annual flow for a typical rain year, with about 10 percent of the annual flow bypassing filtration.



Treatment flow rate requirements for typical southeastern US conditions (Atlanta, GA), based on continuous simulations (Pitt and Khambhammettu 2006)

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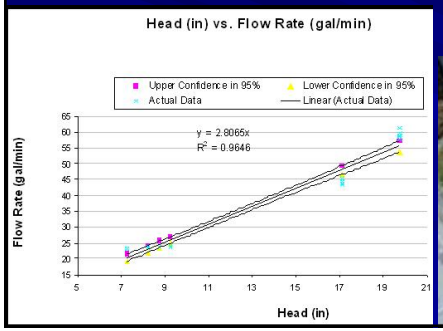
Controlled Flow Test

- The water flow rate was measured by measuring the time needed to fill a measured volume as well as by the flow sensor.



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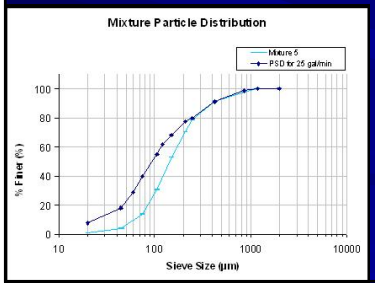
Controlled Test Sediments

- The test sediment in the stormwater stimulant used a mixture Sil-Co-Sil 250, Sil-Co-Sil 106 (both from U.S. Silica Co.), and coarse and fine concrete sands. The mixture was made by mixing the four components with different ratios to obtain a relatively even particle size distribution representing the complete range from about 20 to 2,000µm.



Sediment mixture was manually and consistently added to the influent water over the 30 minute test period.

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Test Methodology for Controlled Test

- Flow rate measured averages of 24gal/min, 50gal/min & 100gal/min.
- Each experiment conducted over 30 minutes.
- River water is used as the "inflow" water.
- Effluent samples collected using a dipper grab sampler every 1 minute.
- During these tests, four different influent sediment concentrations were tested: 50 mg/L, 100 mg/L, 250 mg/L, and 500 mg/L.

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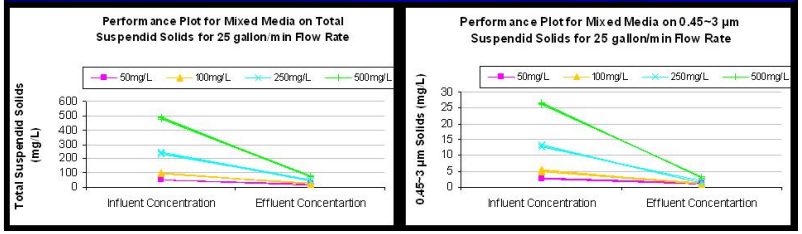
Initial Controlled Test Result

- Controlled tests can measure the filter behavior under known conditions. Mixtures of ground silica available from U.S.Silica Co. were used for these initial tests, reflecting filter performance for a variety of particle sizes.



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Result Summary

25 gallon/min Flow Rate and 100 mg/L Concentration

Particle Size (µm)	Average Influent Concentration (mg/L)	Average Effluent Concentration (mg/L)	Average Reduction (%)
< 0.45	220	160	27
0.45 to 3	5.2	1.1	78
3 to 12	19	11	38
12 to 30	26	8.3	68
30 to 120	16	1.3	92
120 to 1180	28	0.18	99
> 1180	5.7	0	100
sum >0.45 µm	99	21.9	78

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Result Summary cont.

25 gallon/min Flow Rate and 500 mg/L Concentration

Particle Size (µm)	Average Influent Concentration (mg/L)	Average Effluent Concentration (mg/L)	Average Reduction (%)
< 0.45	240	120	49
0.45 to 3	26	3.2	88
3 to 12	92	32	65
12 to 30	130	28	79
30 to 120	81	3.9	95
120 to 1180	142	0.55	100
> 1180	30	0	100
sum >0.45 µm	500	67.7	86

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Future Research Subject

- Additional controlled flow tests are being conducted using different flow rates and with different media
- Pollutant removal will be measured during actual storm events

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  - Small Business Innovative Research program, US EPA

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References Describing Earlier Tests

- Pitt, R. and Khambhammettu, U. (2006). *Field Verification Report for the Up-Flo™ Filter. Small Business Innovative Research, Phase 2 (SBIR2) Report*. U.S. Environmental Protection Agency, Edison, NJ. 275 pages. March 2006.
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Thank you