BIO-SORPTION ACTIVATED MEDIA FILTERS

MARTY WANIELISTA

What is Biosorption Activated Media (BAM)

- Sorption is a physiochemical process that occurs with solid media to build-up or concentrate pollutant(s) onto the media.
- Activation occurs when the media and the working environment are altered to improve removal, sometimes by physical measures or biological means.
- Thus BAM is a media for pollutant removal that has sorption properties in a specific environment.

Some Properties of a Useful BAM for Nutrient Management

- Sorption (Adsorption/Absorption) Properties.
- Life Expectancy is long.
- High surface area.
- No biological toxic effects.
- Ease of filtration.
- Reasonably non-degradable.
- Residual Moisture Content (for biological)

BAM SELECTION

Ones for which we have documented properties from lab experiments

- Expanded Clay
- Peat
- Natural Sandy/Loamy/ Clayey soils
- Sawdust (untreated)
- Paper/Newspaper
- Palm Tree Frauds
- Zeolite
- Tire Crumb
- Tire Chips
- Activated Carbon
- Limestone
- Crushed Shells
- Wood Fiber/Chips/
- Compost
- Coconut coir

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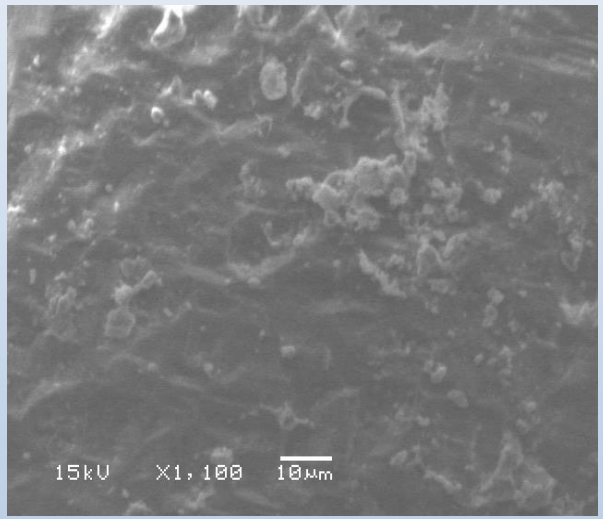
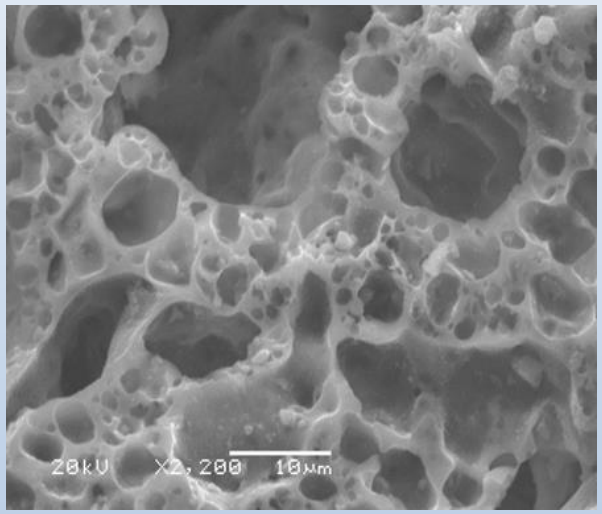
LABORATORY SOIL COLUMNS

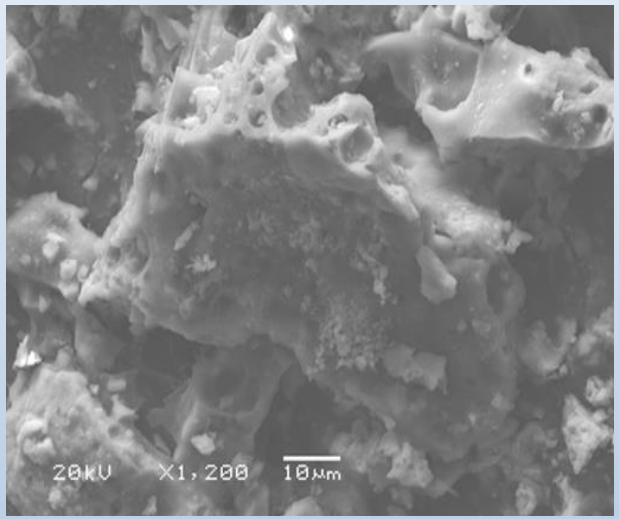
- Test selected media mixtures to quantify their nutrient attenuation capabilities (removal)
- Life Expectancy

Trying to estimate
1. mg P/g media
2. Residence time
3. DO conditions

Scanning Electron Microscope used to identify surface area of BAM



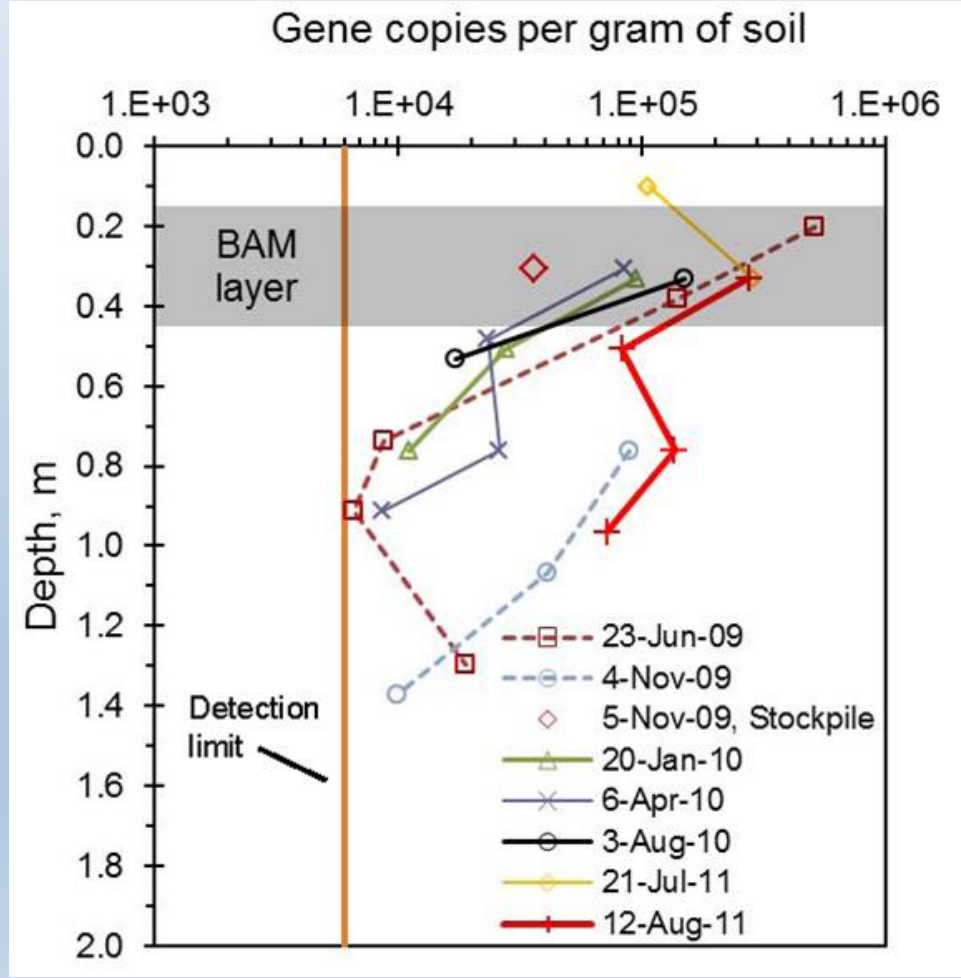




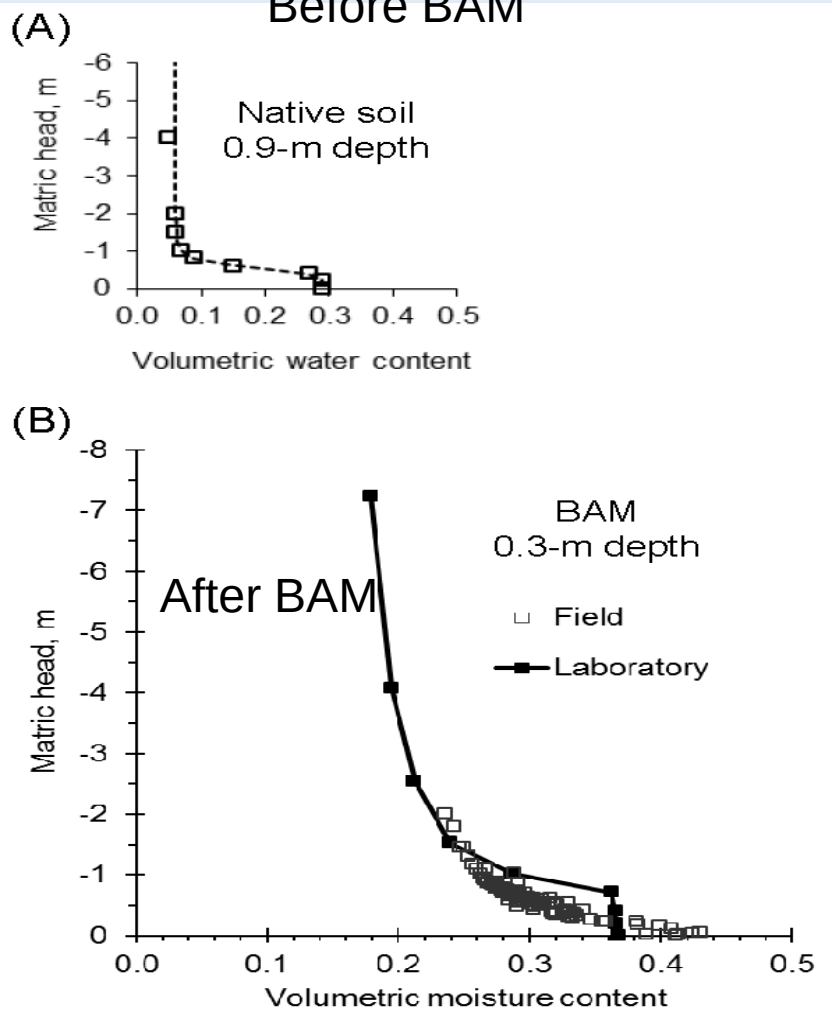
SEM of *(a)* concrete sand1,000 x, *(b)* expanded clay 2,200 x, and *(c)* tire crumb 1,200 x magnification showing the surface structure and characteristics after residing in 24 days of column testing.

Polymerase Chain Reaction (PCR) used to quantify the number of Denitrifying Bacteria

- Real-time PCR data suggests BAM layer is conducive to the growth of denitrifiers that possess the nirK gene (nitrite reducing gene).



Before and After BAM Residual Soil Moisture at a Regional Infiltration Basin



Field measurements were obtained by continuous monitoring using time domain reflectometry and tensiometers.

Laboratory derived soil moisture retention curves were measured for the main drying curve on undisturbed soil cores using the pressure cell method.

BAM for Nutrient Removal

Literature, Laboratory and Field Results: Noted are:

1. Removal efficiencies for phosphorus and nitrogen
2. Documented available surface area for sorption and bio activity
3. Particle size to avoid clogging/excessive head loss
4. Life expectancy
5. Biological removal

Practical Limitation: Local Availability, Space for Treatment and Relative Cost

Example Material Compositions of BAM by Volume for nutrient removal note: Patent Protected Mixes

BAM Mix 1	BAM Mix 2
50% Sand	50% Sand
20% Clay	25% Tire Crumb
15% Tire Crumb	25% Expanded Clay
15% Expanded Clay	

The trade name for these mixes is BOLD & GOLD and license for Suntree (Baffle boxes, upflow filters, modular wetlands) And PTI for greenroofs, retention systems, and OSTDS.

Understand BMP design and Effectiveness as stand alone or combined in series: Use BMPTRAINS Nutrient Model

Objectives: Water Capture, Pollution Control, Aesthetics

Stormwater BMP Treatment Trains [BMPTRAINS©]	CLICK HERE TO START

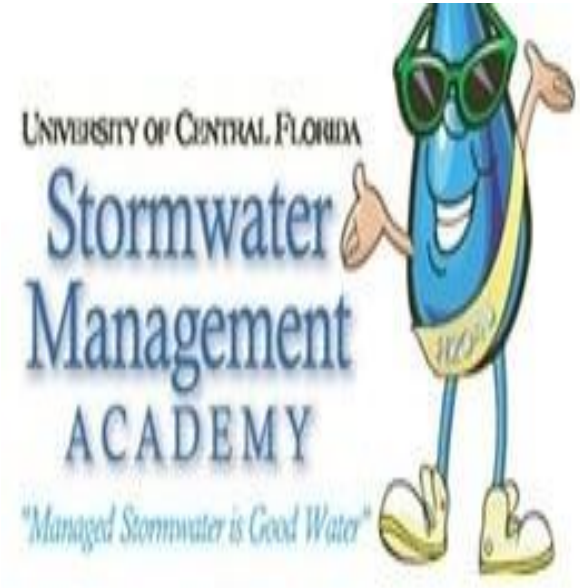
FDOT University of Central Florida

INTRODUCTION PAGE

Model requires the use of Excel 2007 or newer

This program is compiled from stormwater management publications and deliberations during a two year review of the stormwater rule in the State of Florida.
Input from the members of the Florida Department of Environmental Protection Stormwater Review Technical Advisory Committee and the staff and consultants from the State Water Management Districts is appreciated.

The State Department of Transportation provided guidance and resources to compile this program. The Stormwater Management Academy is responsible for the content of this program.



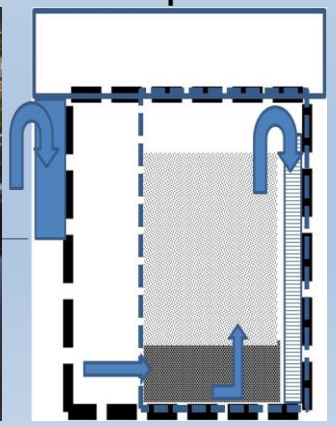
Available from www.stormwater.ucf.edu (no charge)

BAM can be used with all BMPs

RETENTION BASIN	WET DETENTION	EXFILTRATION TRENCH	RAIN (BIO) GARDEN	SWALE	USER DEFINED BMP
PERVIOUS PAVEMENT	STORMWATER HARVESTING	FILTRATION including BIOFILTRATION	LINED REUSE POND & UNDERDRAIN INPUT	NOTE !!!: All individual system must be sized prior to being analyzed in conjunction with other systems. Please read instructions in the CATCHMENT AND TREATMENT SUMMARY RESULTS tab for more information.	
GREENROOF	RAINWATER HARVESTING	FLOATING ISLANDS WITH WET DETENTION			
VEGETATED NATURAL BUFFER	VEGETATED FILTER STRIP	VEGETATED AREA Example tree well	CATCHMENT AND TREATMENT SUMMARY RESULTS		

Rain Gardens in Parking Lots

Up-Flow Filter in a wet detention pond



BAM in an up-flow filter after wet detention

RETENTION BASIN	WET DETENTION	EXFILTRATION TRENCH	RAIN (BIO) GARDEN	SWALE	USER DEFINED BMP
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FILTRATION including Up-flow Filters V7.4

FILTRATION SERVING EITHER WET POND OR DRY POND:	one watershed				
	Catchment 1	Catchment 2	Catchment 3	Catchment 4	
Contributing catchment area:	9.500	0.000	0.000	0.000	ac
Provided treatment depth:	0.50				in
Treatment volume provided for treatment depth:	0.396	0.000	0.000	0.000	ac-ft
Provided water capture efficiency:	66.100	0.000	0.000	0.000	%
Required treatment efficiency (**Nitrogen**):	TBD				%
Required treatment efficiency (**Phosphorus**):	TBD				%
Type of media mixes: View Media Mixes	CTS				
Provided treatment efficiency (**Nitrogen**):	39.660				%
Provided treatment efficiency (**Phosphorus**):	59.490				%
Is this effluent filtration for a wet detention pond?	Yes				

BAM Data in BMPTRAINS

DESCRIPTION OF BAM MIXTURES			PROJECTED TREATMENT PERFORMANCE (SEE NOTES * AND References)			LIMITING INFILTRATION RATE (in/hr) up-flow down- flow
BAM SOIL AUGMENTATION DESCRIPTION	**MATERIAL**	**MIXTURES (% by VOLUME)**	**ESTIMATED TSS REMOVAL EFFICIENCY (%)**	**ESTIMATED TN REMOVAL EFFICIENCY (%)**	**ESTIMATED TP REMOVAL EFFICIENCY (%)**	
CPS (ref A)	Compost[1]	7.5%				
24" deep below	Shredded Paper[2]	7.5%				
6 " of top soil[9]	Sand[3]	85%	40%	20%	30%	N/A 10
OTE (ref B and G)	Organics[10]	5%				
24" deep	Tire Chips[5]	25%				
no top soil	Expanded Clay[4]	70%	50%	45%	45%	96 20
CSL (ref C), 8, **	Compost[1]	20%				
24" deep	Sand[3]	50%				
all blended	Local Top Soil[9]	30%	50%	55%	70%	N/A 0.80
COS (ref D , 11)	Med Plastic Clay[6]	10%				
24" deep under	Organics[10]	4%				
6 " of top soil[9]	sand[3]	86%	85%	35%/60%[11]	45%/60%[11]	10 1.5
SAT(ref E)	sand	100%	87%	31%	61%	20 2.0
CTS (ref F)	Med Plastic Clay[6]	27%				
12 " deep under	Tire Crumb[5]	14%				
6 " of top soil[9]	Sand[3]	59%	>90%	60%	90%	5 0.25

Austin Sand (SAT) and B&G (CTS) BAM Options

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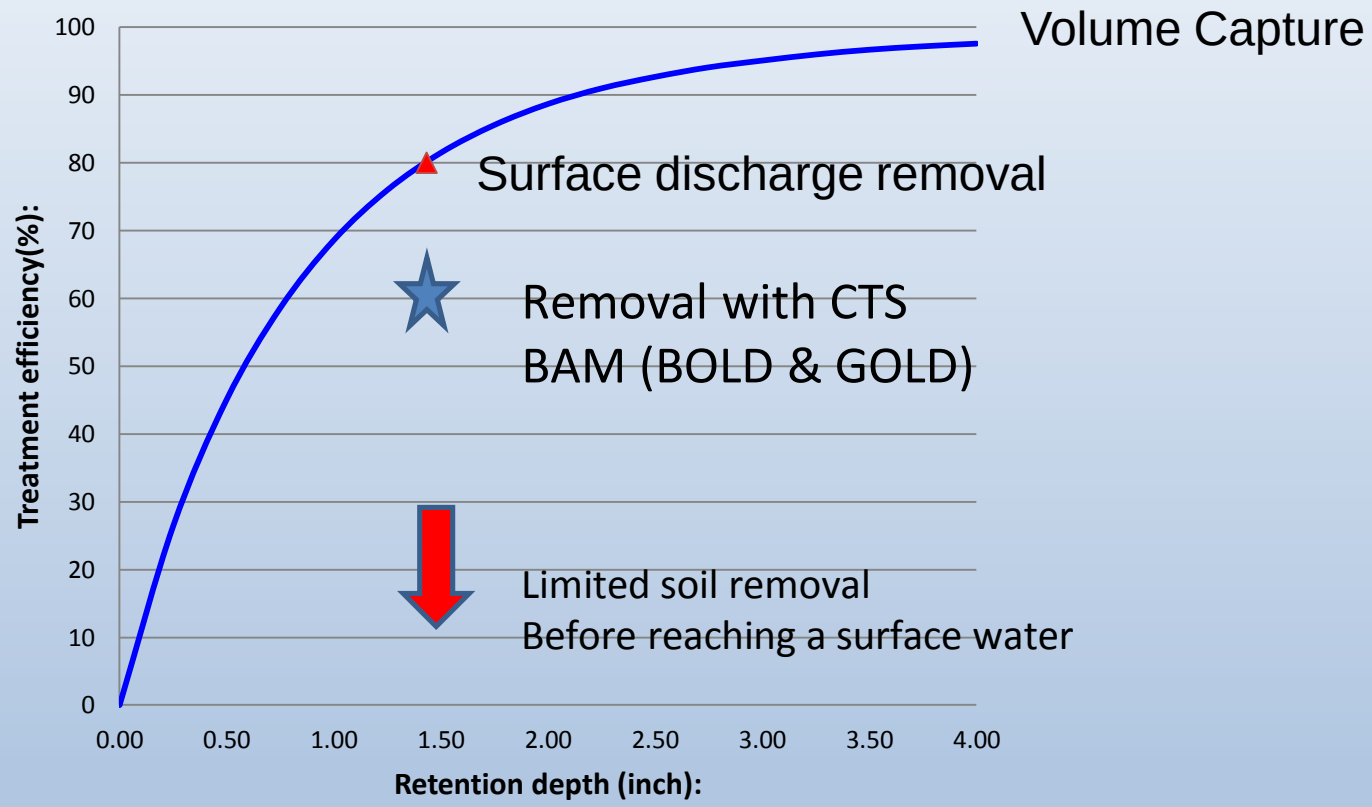
12 " deep under	Tire Crumb[5]	14%				
6 " of top soil[9]	Sand[3]	59%	>90%	60%	90%	5 0.25

MIX:	TN Removal %	TP Removal %	Water storage fraction
CPS	20	30	0.2
OTE	45	45	0.2
CSL	55	70	0.2
COS	35	45	0.2
SAT	31	61	0.25
CTS	60	90	0.2
UDM*			

* UDM User Defined Mix

Example Effectiveness Dry Retention Basin Design Average Annual Basis



Example Capture and Effectiveness