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SUSTAINABLE TECHNOLOGIES

Low Impact Development with a New Twist

Integrating California Environmental Goals

Craig Kolodge Ph.D.
Regional Director

We Need to Demand More Out of Our Landscapes

Carbon Sequestration (Global Warming)

Cooling of the Environment (Heat Islands)

Support Increase in Biodiversity (Stability)

Reduce Urban Run-off (Low Impact Dev.)

Reduce Environmental Contamination (Pollutants)

Complex Problems Require Complicated Solutions

Why Our Thinking Patterns Don't Help When Dealing with Complex Problems (like climate change)

Problem: Greenhouse Gases are Changing the Climate on Earth

How much Atmospheric CO2 are we talking about?

Time of Industrial Revolution = 280 ppm

Currently = 393 ppm

Future Predictions = 550 ppm

We Need to get some of this CO2 out of the atmosphere – Reverse (Store) not just Reduce

A Linear Approach to Solving the Problem (Tony Lovell)

Greenhouse Gases are damaging to life on earth

Need to get rid of greenhouse gases (carbon pollution reduction schemes)

All Greenhouses Gases are Bad

Methane is a Greenhouse Gas

Cattle emit methane

Cattle are Bad

A Paradox

Without Greenhouse gases like Carbon Dioxide and Methane, the over-all temperature of planet earth would decrease rapidly from a positive 15 C (59 F) to a negative -19 C (-2.2 F)

FACT: Greenhouse Gases are essential to life on this planet

Re-balancing an Overloaded Carbon System

To store Carbon as a solid at room temperature requires Sunlight and Green Leaves. Plants split off Oxygen and store Carbon.

We Need to Mimic Nature To Solve the Problem

Carbon Cycle
Nitrogen Cycle
Water Cycle
Phosphorus Cycle
Nutrient Cycling

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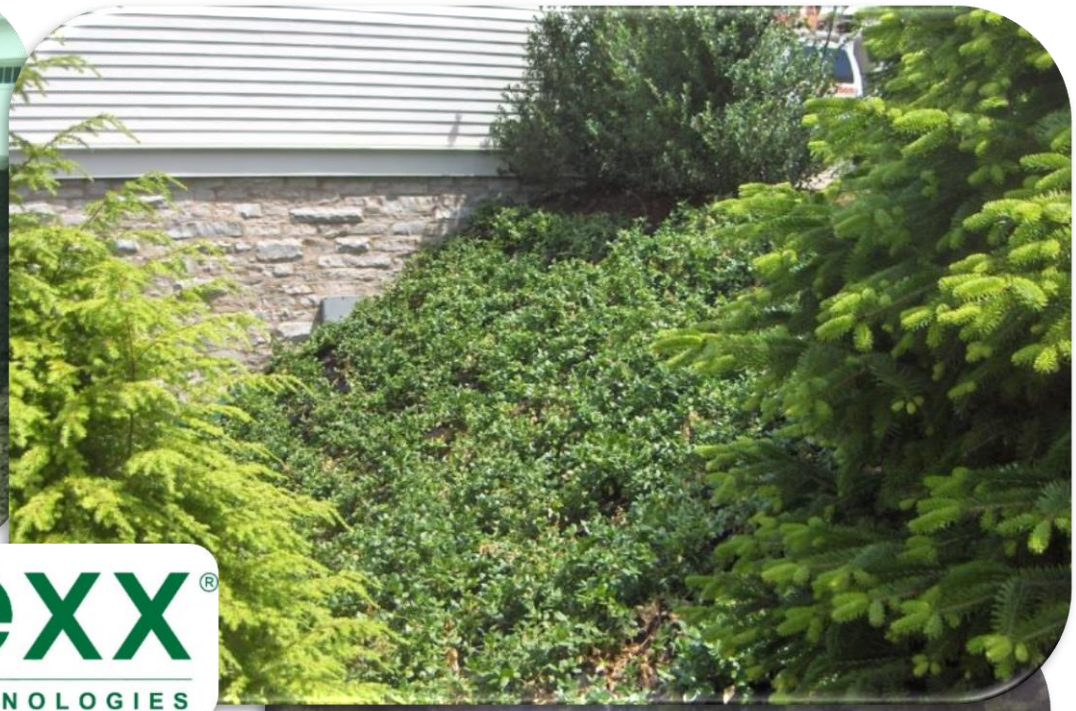
Living Plants Take Carbon in the Air and Put It Back Where it Belongs – in the Earth (Carbon Sequestration)

let nature do it.



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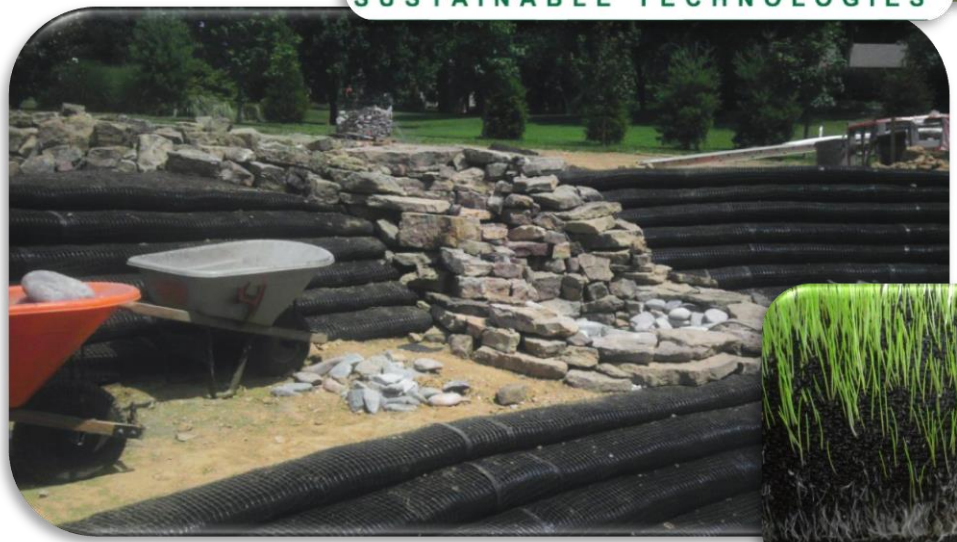

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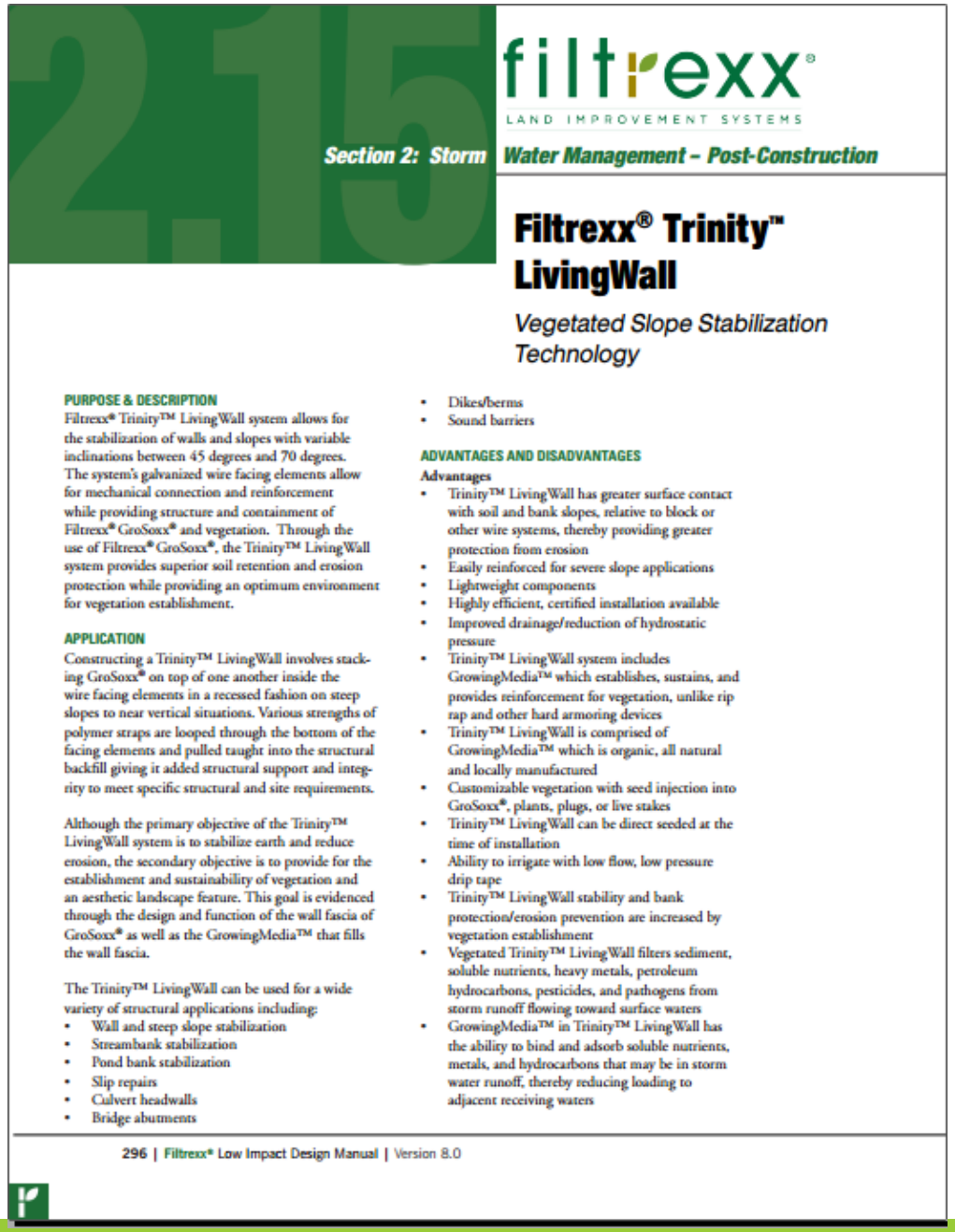

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LAND IMPROVEMENT SYSTEMS

Section 2: Storm Water Management – Post-Construction

Filtrexx® Trinity™ LivingWall

Vegetated Slope Stabilization Technology

PURPOSE & DESCRIPTION

Filtrexx® Trinity™ LivingWall system allows for the stabilization of walls and slopes with variable inclinations between 45 degrees and 70 degrees. The system's galvanized wire facing elements allow for mechanical connection and reinforcement while providing structure and containment of Filtrexx® GroSoxx® and vegetation. Through the use of Filtrexx® GroSoxx®, the Trinity™ LivingWall system provides superior soil retention and erosion protection while providing an optimum environment for vegetation establishment.

APPLICATION

Constructing a Trinity™ LivingWall involves stacking GroSoxx® on top of one another inside the wire facing elements in a recessed fashion on steep slopes to near vertical situations. Various strengths of polymer straps are looped through the bottom of the facing elements and pulled taught into the structural backfill giving it added structural support and integrity to meet specific structural and site requirements.

Although the primary objective of the Trinity™ LivingWall system is to stabilize earth and reduce erosion, the secondary objective is to provide for the establishment and sustainability of vegetation and an aesthetic landscape feature. This goal is evidenced through the design and function of the wall fascia of GroSoxx® as well as the GrowingMedia™ that fills the wall fascia.

The Trinity™ LivingWall can be used for a wide variety of structural applications including:

- Wall and steep slope stabilization
- Streambank stabilization
- Pond bank stabilization
- Slip repairs
- Culvert headwalls
- Bridge abutments
- Dikes/berms
- Sound barriers

ADVANTAGES AND DISADVANTAGES

Advantages

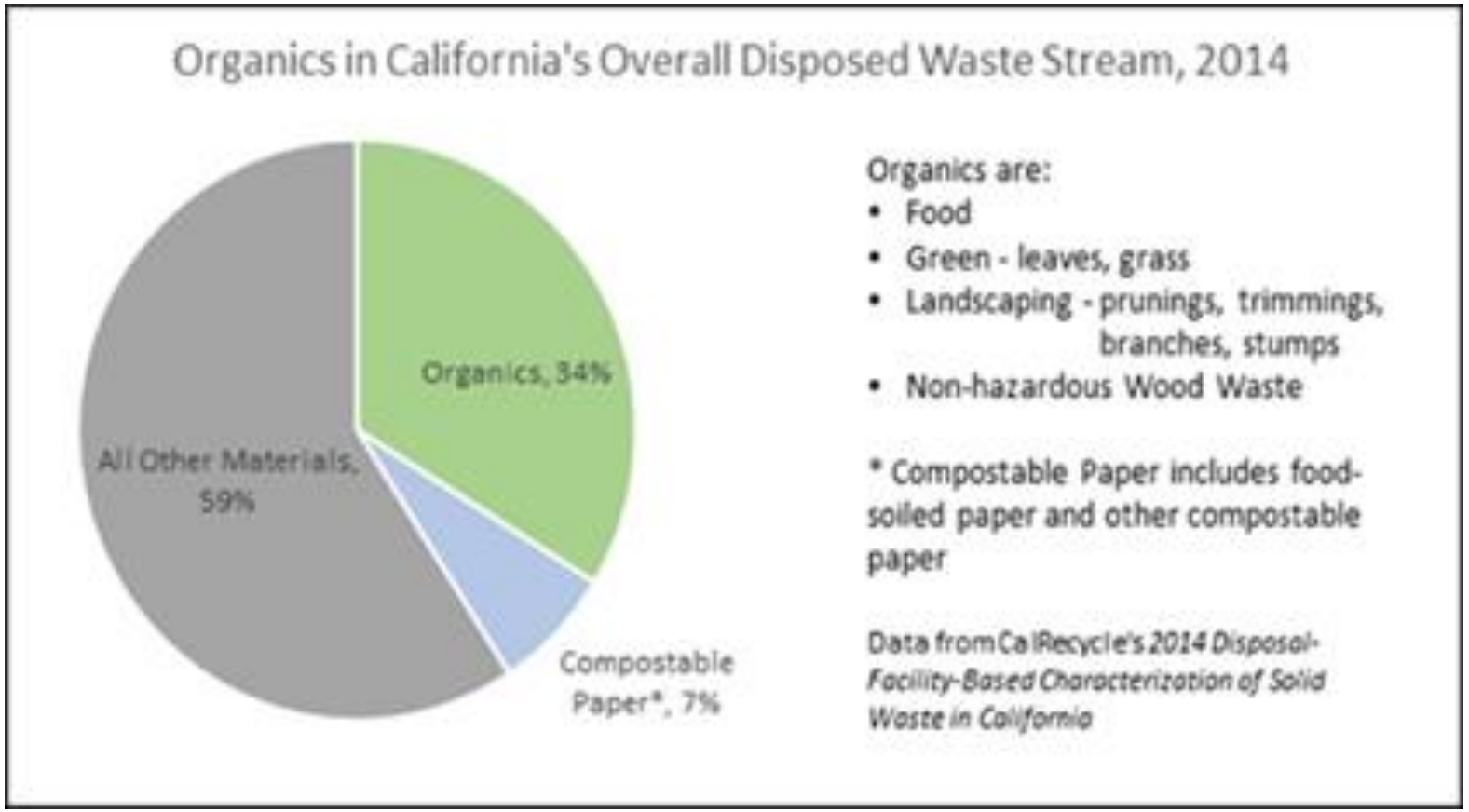
- Trinity™ LivingWall has greater surface contact with soil and bank slopes, relative to block or other wire systems, thereby providing greater protection from erosion
- Easily reinforced for severe slope applications
- Lightweight components
- Highly efficient, certified installation available
- Improved drainage/reduction of hydrostatic pressure
- Trinity™ LivingWall system includes GrowingMedia™ which establishes, sustains, and provides reinforcement for vegetation, unlike rip rap and other hard armoring devices
- Trinity™ LivingWall is comprised of GrowingMedia™ which is organic, all natural and locally manufactured
- Customizable vegetation with seed injection into GroSoxx®, plants, plugs, or live stakes
- Trinity™ LivingWall can be direct seeded at the time of installation
- Ability to irrigate with low flow, low pressure drip tape
- Trinity™ LivingWall stability and bank protection/erosion prevention are increased by vegetation establishment
- Vegetated Trinity™ LivingWall filters sediment, soluble nutrients, heavy metals, petroleum hydrocarbons, pesticides, and pathogens from storm runoff flowing toward surface waters
- GrowingMedia™ in Trinity™ LivingWall has the ability to bind and adsorb soluble nutrients, metals, and hydrocarbons that may be in storm water runoff, thereby reducing loading to adjacent receiving waters

296 | Filtrexx® Low Impact Design Manual | Version 8.0

Full Specification Documentation and Related Testing Data is Available from Filtrexx

Trinity™
LIVINGWALL™ SYSTEM

California Laws Driving the Adoption of Compost-based Low Impact Development



California Laws Driving the Adoption of Compost-based Low Impact Development

AB 939

- 50% diversion requirement

for jurisdictions

AB 341

- 75% reduction, recycling, composting statewide goal by 2020

- Currently California's source reduction, recycling and composting rates are stuck at 50%

AB 1045 (Irwin) California Statewide Compost Policy

- AB 1045 recognizes that to reach state policy goals, a more coordinated effort is needed among the 3 state entities that have jurisdiction over compost and compost facilities:
  - CalRecycle
  - State Water Quality Control Board
  - Air Resources Board
- AB 1045 recognizes the *need to begin to identify how compost should be used to address multiple state environmental goals and maximize soil carbon management.*

California Laws Driving the Adoption of Compost-based Low Impact Development

What Will 75% Take?

- Moving > 20 million tons/year out of landfills
- 1/3 or more organic, plus many traditional recyclables
- CalRecycle preference is to handle waste in CA
- 100s of new or expanded composting facilities

Current Perspective on Compost Use

“How do we use compost and protect water quality?”

Karl Longley, Central Valley Regional Water Quality Control Board

“We need more research and field demonstrations”

Karen Ross, Secretary , CDFA

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Industrial Permit Driving the Adoption of Compost-based Low Impact Development

Construction Permit Driving the Adoption of Compost-based Low Impact Development

Filter Media =

Designed for Optimum Filtration & Hydraulic-flow

Growing Media =

Designed for Optimum Water Absorption & Plant Growth

LID Applications

(Low Impact Development)

Erosion/Sediment Control
SiltSoxx, InletSoxx, DitchChexx, FilterCell, FilterRing, Compost ECB, Compost FilterStrips

Stormwater Management
Compost Stormwater Blanket, Compost Vegetated Cover, FilterCell, Bioretention Ponds

Restoration/Remediation
Compost Stormwater Blanket, LivingWall, GreenLoxx, EdgeSaver, Compost Engineered Soil

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International Meeting
Paper, 2006
American Society of
Agricultural and Biological Engineers

Sediment and Nutrient Removal from Storm Runoff with Compost Filter Socks and Silt Fence

A. Sadeghi, B. Faucette, K. Sefton

Sediment Summary

% Reduction of TSS & Turbidity of Silt Fence, Filter Soxx, & Polymer

Treatment	TSS	Turbidity
Silt Fence	67	52
Filter Soxx	78	63
Filter Soxx + Polymer	97	98
Filter Soxx + BioFloxx	97	94

* Based on rainfall of 3.0 in/hr for 30 min; runoff sediment concentration (sandy clay loam) of 70,000 mg/L.

US EPA GreenScapes Cost Calculator

GreenScapes
Environmentally Beneficial Landscaping

Input	
Lenth of Erosion Control (Linear Feet)	1000
Duration of Project (Months)	12
Cost for Silt Fence Installed	$2.00
Cost for 12" Filtrexx FilterSoxx Installed est.	$3.50
Would Compost be Removed from Site? (usually not required)	no

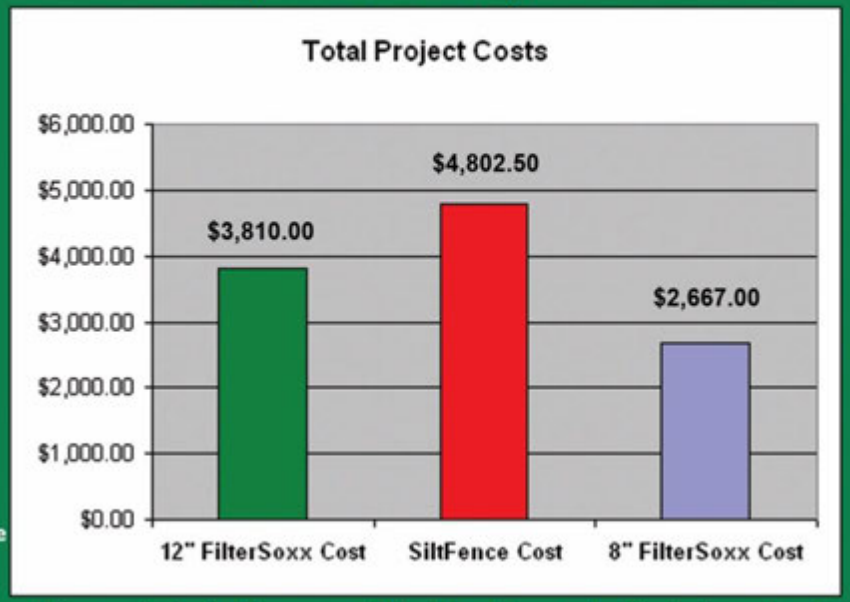
12" Diameter Filtrexx FilterSoxx	Cost Estimate
Materials and Installation Cost	$3,500.00
Repair and Replacement Cost	$270.00
Sock Removal and Disposal Cost	$40.00
Compost Removal Cost	$0.00
12" FilterSoxx Cost	$3,810.00

Silt Fencing	Cost Estimate
Materials and Installation Cost	$2,000.00
Repair and Replacement Cost	$2,000.00
Removal and Disposal Cost	$802.50
SiltFence Cost	$4,802.50

8" FilterSoxx have been recognized to perform better than 24" Silt Fence

8" Diameter Filtrexx FilterSoxx Option	Cost Estimate
8" FilterSoxx Cost	$2,667.00

Erosion Control Cost Graph



*This graph is generated using the average of the high and low cost estimates for each material.

Available from the US EPA at:

http://www.epa.gov/greenscapes/tools

U.S. Environmental Protection Agency

National Pollutant Discharge Elimination System (NPDES)

Compost Filter Socks

Minimum Measure: Construction Site Stormwater Runoff Control

Subcategory: Sediment Control

Description

Installation of filter socks in a road ditch by Earth Corps for Indiana Department of Transportation. The filter socks will be staked through the center. Source: Filtrexx International, LLC.

A compost filter sock is a type of contained compost filter berm. It is a mesh tube filled with composted material that is placed perpendicular to sheet-flow runoff to control erosion and retain sediment in disturbed areas. The compost filter sock, which is oval to round in cross section, provides a three-dimensional filter that retains sediment and other pollutants (e.g., suspended solids, nutrients, and motor oil) while allowing the cleaned water to flow through (Tyler and Faucette, 2005). The filter sock can be used in place of a traditional sediment and erosion control tool such as a silt fence or straw bale barrier. Composts used in filter socks are made from a variety of feedstocks, including municipal yard trimmings, food residuals, separated municipal solid waste, biosolids, and manure.

Compost filter socks are generally placed along the perimeter of a site, or at intervals along a slope, to capture and treat stormwater that runs off as sheet flow. Filter socks are flexible and can be filled in place or filled and moved into position, making them especially useful on steep or rocky slopes where installation of other erosion control tools is not feasible. There is greater surface area contact with soil than typical sediment control devices, thereby reducing the potential for runoff to create rills under the device and/or create channels carrying unfiltered sediment.

Additionally, they can be laid adjacent to each other, perpendicular to stormwater flow, to reduce flow velocity and soil erosion. Filter socks can also be used on pavement as inlet protection for storm drains and to slow water flow in small ditches. Filter socks used for erosion control are usually 12 inches in diameter, although 8 inch, 18 inch, and 24 inch– diameter socks are used in

PWTB 200-1-62
1 October 2008

US Army Corps of Engineers
Engineer Research and Development Center

Filter Socks Technology
Draft 06.29.2007

How Filter Socks Work

Filter socks are an Low Impact Development (LID) tool typically used during the construction phase of the

Filter Sock Construction Procedure:

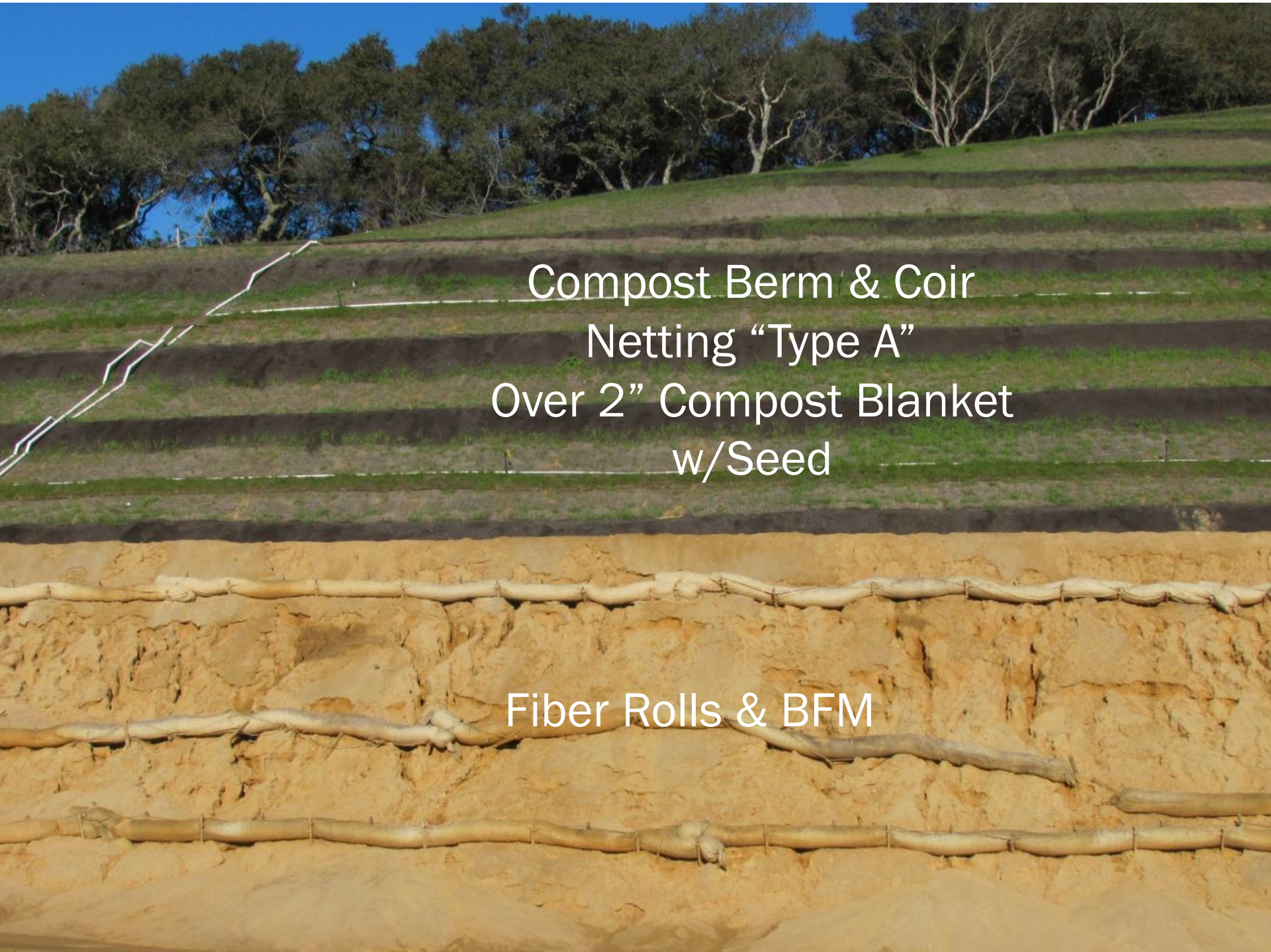
- Inspect area, locate and mark utilities
- Select site for filter sock

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

Agronomy Technical Note No. 4

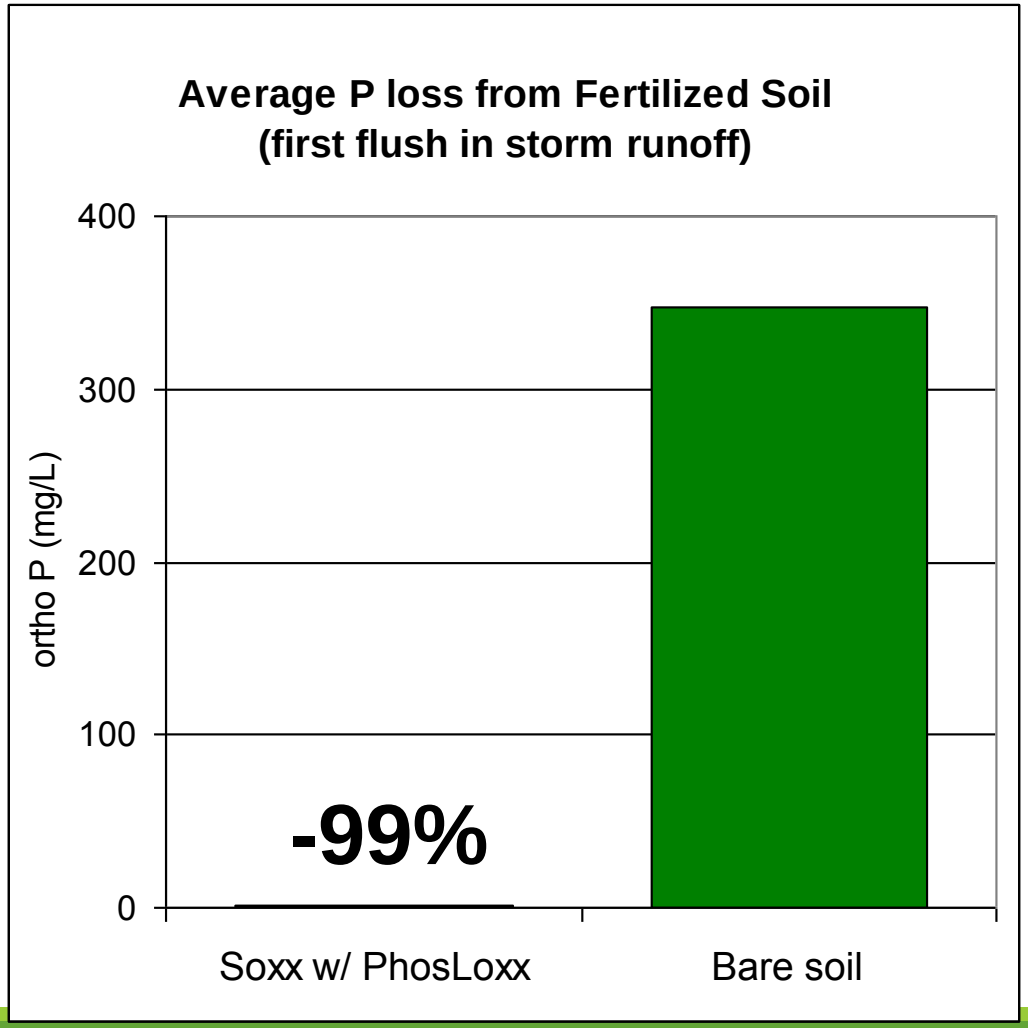
November 2010

Utilization of Compost Filter Socks


Compost Berm & Coir
Netting “Type A”
Over 2” Compost Blanket
w/Seed
Fiber Rolls & BFM

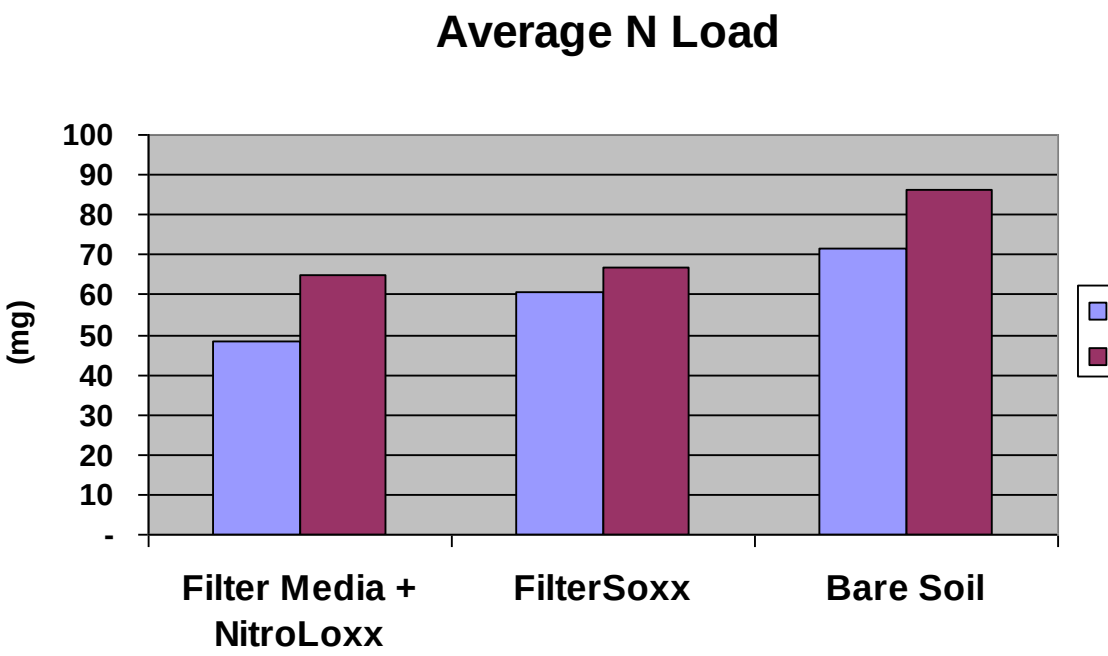
Soluble P

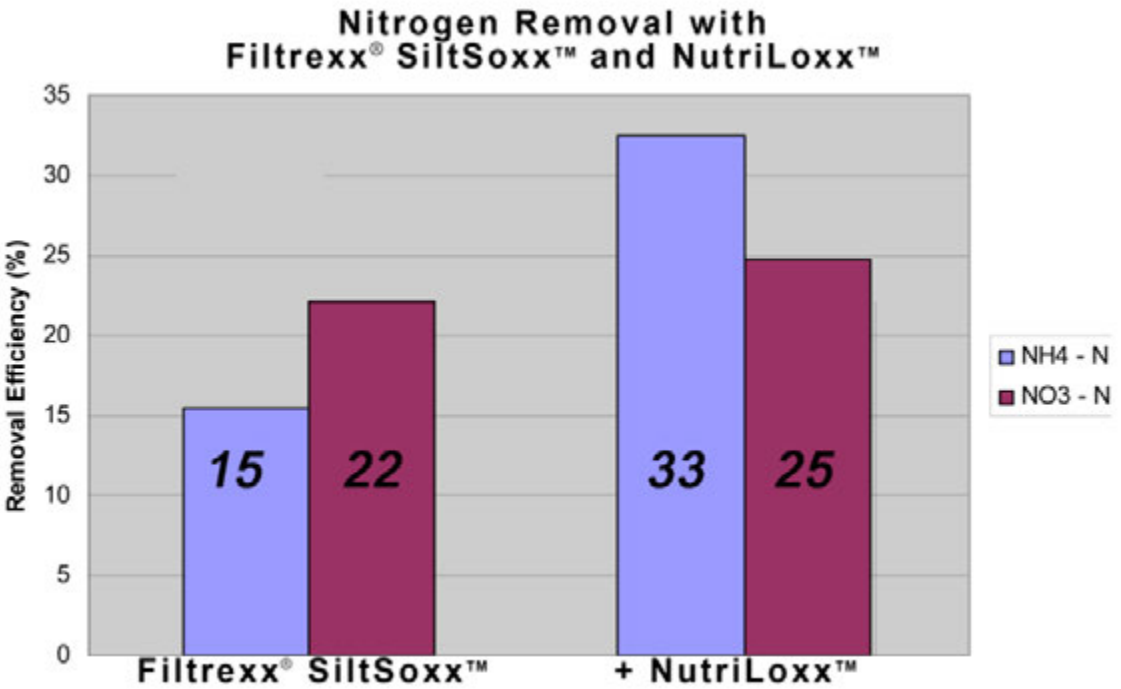
FilterSoxx + NutriLoxx (PhosLoxx) = 99% reduction



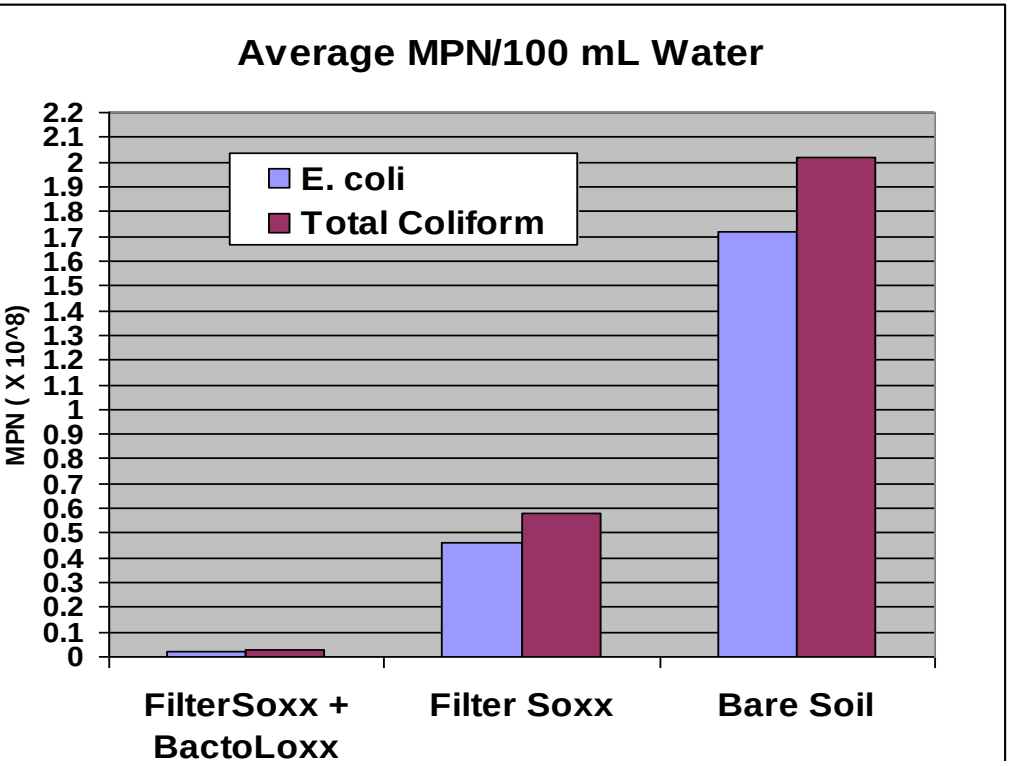
FilterSoxx alone average 30% soluble P, 65% total P removal

Nitrogen Removal



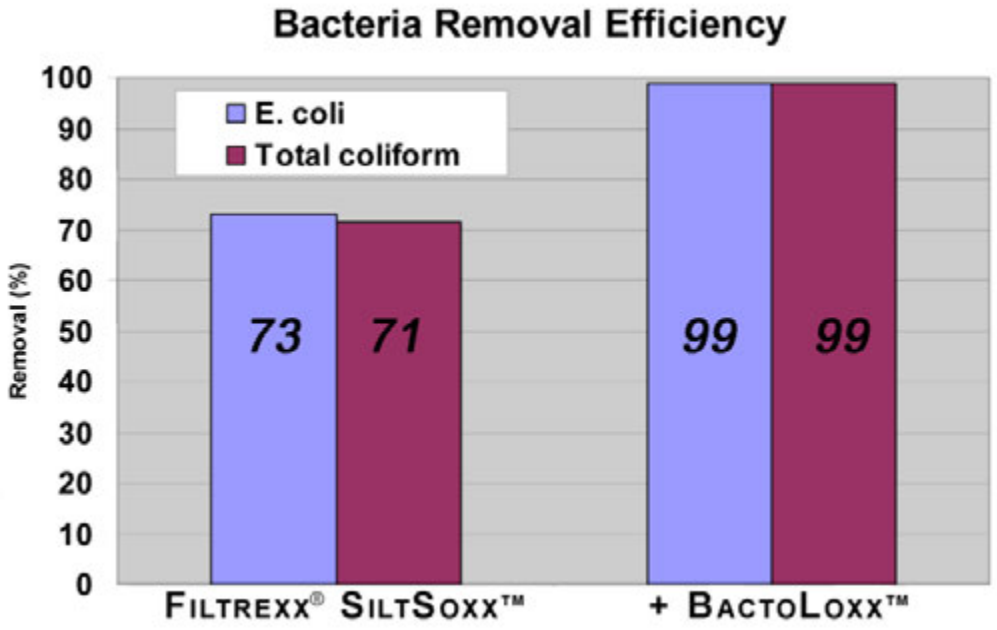


Bacteria Removal

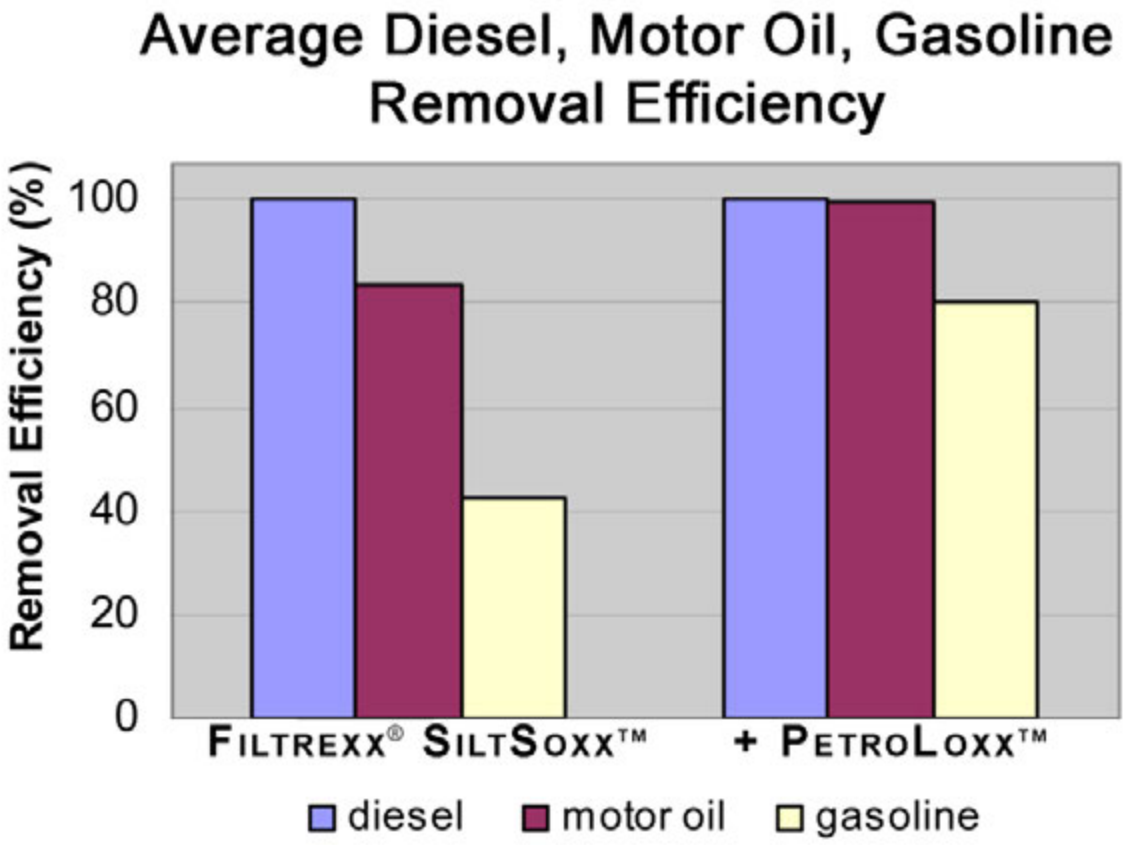


Bacteria (MPN) Exposed to Soxx

- Total coliform – 202 million/100 mL
- E. coli – 172 million/100 mL
- *Typical testing* – 1 million/100 mL



Petroleum Hydrocarbons



- **Runoff Concentrations = 1,410 mg/L (motor oil), 5,400 mg/L (diesel), and 74 mg/L (gasoline)**
- **Runoff Loads = 20,820 mg (motor oil), 77,440 mg (diesel), and 1070 mg (gasoline)**

		METALS (water extractable)					
Treatment	**Parameters (mg)**	**Cd**	**Cr**	**Cu**	**Ni**	**Pb**	**Zn**
FilterSoxx (FS)	Applied	7.915	6.740	7.320	8.070	6.025	6.545
	Soil Surface	0.004	0.020	6.367	0.129	0.171	2.181
	Total	7.919	6.760	13.687	8.199	6.196	8.726
	Transported to Soxx	0.812	0.490	1.625	1.054	0.940	1.699
	Runoff Water	0.266	0.258	0.405	0.381	0.191	0.667
	Removal Efficiency*	**64**	**17**	**68**	**61**	**72**	**53**
	Runoff Sediment	0.016	0.045	0.129	0.031	0.079	0.111
	Removal Efficiency*	**73**	**75**	**42**	**60**	**70**	**64**
	Total Runoff	0.282	0.303	0.534	0.412	0.270	0.778
	Removal Efficiency (%)	**64**	**37**	**67**	**61**	**71**	**54**
FS + MetalLoxx	Applied	7.915	6.740	7.320	8.070	6.025	6.545
	Soil Surface	0.004	0.019	6.491	0.144	0.154	2.028
	Total	7.919	6.759	13.811	8.214	6.179	8.573
	Transported to Soxx	0.812	0.490	1.640	1.056	0.937	1.669
	Runoff Water	0.210	0.221	0.383	0.301	0.144	0.621
	Removal Efficiency*	**72**	**29**	**70**	**69**	**79**	**57**
	Runoff Sediment	0.014	0.039	0.122	0.029	0.105	0.161
	Removal Efficiency*	**77**	**78**	**45**	**63**	**61**	**47**
	Total Runoff	0.224	0.260	0.505	0.330	0.249	0.782
	Removal Efficiency (%)	**73**	**47**	**70**	**69**	**73**	**53**

*Relative to Bare Soil w/out Treatment;

1 hour after a 2-inch rainfall event

Inlet Protection

Sediment Stays Out

San Diego Sediment Trap

LID Applications

(Low Impact Development)

Erosion/Sediment Control
SiltSoxx, InletSoxx, DitchChexx, FilterCell, FilterRing, Compost ECB, Compost FilterStrips

Stormwater Management
Compost Stormwater Blanket, Compost Vegetated Cover, FilterCell, Bioretention Ponds

Restoration/Remediation
Compost Stormwater Blanket, LivingWall, GreenLoxx, EdgeSaver, Compost Engineered Soil

Filtrexx Growing Media

Compost Erosion Control Blankets

Advantages

- Intimate contact allows nearly 100% ground contact, eliminating puckering of other blankets
- Intimate contact reduces sediment loss
- Water infiltration increases, increasing germination from seed
- Water discharge from slopes decreases, reduces potential sediment loss (Iowa State Study 2003)
- Addition of organic matter improves slope ability to revegetate and establish a permanent erosion system


Compost Has 100% Soil Contact

San Diego High Wall Project

San Diego Pilot Results

Scaling Up – 7 Acres

1 Year Later

2 Years Later

Close-up Vegetative Establishment

4 Yrs. Native Vegetative Establishment

Filtrexx Living Wall™

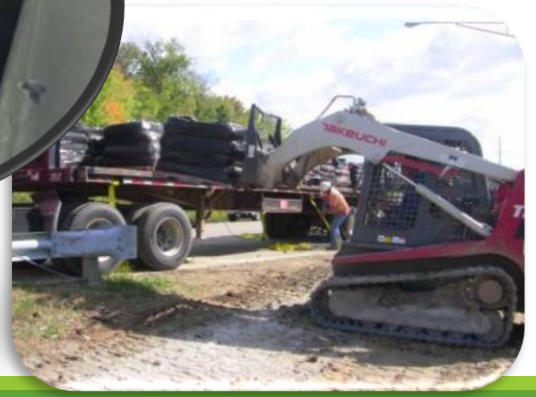
Advantages

- One of the only tools to establish vegetation in steep slope situations – ½:1
- Easy to install and roots help establish bank stability for the long term
- Low cost compared to block walls or other retaining structures where they are not needed
- Resists erosion and prevents bank slippage
- Customizable vegetation makes it an attractive landscape option
- Integrated Drip Tape Irrigation
- Vegetation allows for the permeation of water

Quality Growing Media Ensures Healthy Plants in Both Trinity and EarthBloxx

Filtrexx GroSoxx

Modular Growth Media for our EarthBloxx



The Living Wall Company, LLC | Saint Louis, Missouri | info@thelivingwallco.com | 314-394-8715

Components

Trinity™ LIVINGWALL™ SYSTEM

filtrexx® LAND IMPROVEMENT SYSTEMS

We Utilize Well-Matched Components to Reliably Create Living Retaining Walls

THE LIVING WALL COMPANY

Creating Structural Facing Systems That Support Healthy Plants

We Need to Demand More Out of Our Landscapes

Carbon Sequestration (Global Warming)

Cooling of the Environment (Heat Islands)

Support Increase in Biodiversity (Stability)

Reduce Urban Run-off (Low Impact Dev.)

Reduce Environmental Contamination (Pollutants)

New Perspective on Compost Use

We Need to Demand More Out of Our Compost!

“How can we create and use compost to protect water quality, restore balance to atmospheric greenhouse gas levels on our planet and a whole lot more?”

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SUSTAINABLE TECHNOLOGIES

Compost-based Low Impact Development = Sustainable Management Practices (SMP's)