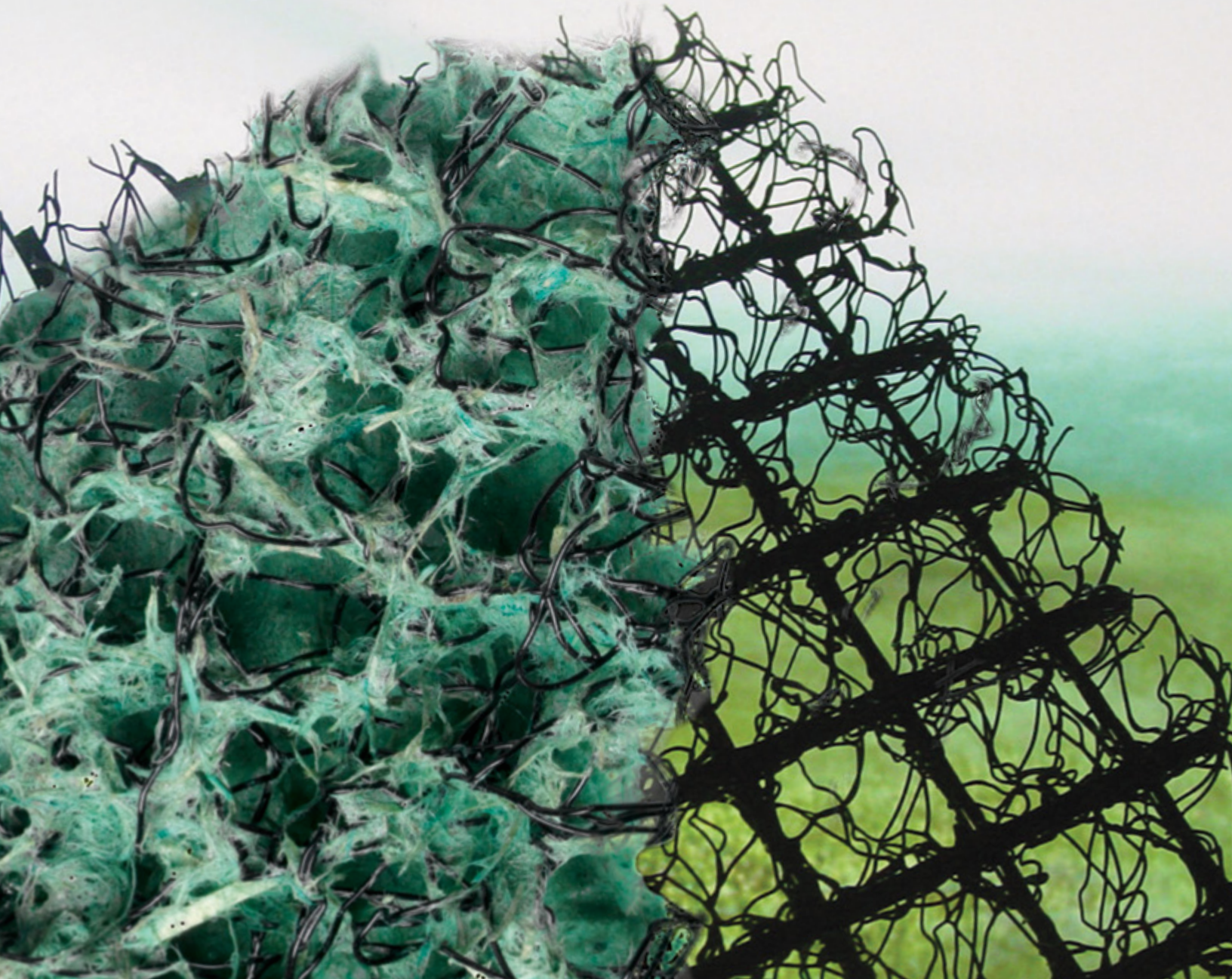
Profile®

Solutions for your Environment®

GreenArmor® SYSTEM

GreenArmorSystem.com

A High Performance, Green Alternative to Hard Armor



Extend the Boundaries of Natural Vegetation

As the world's most cost-effective alternative to hard armor, the **GreenArmor® System** is a solution that combines engineering and agronomic excellence. It's a more aesthetically pleasing and environmentally superior means of protecting high-discharge waterways, levees, embankments and steep slopes.

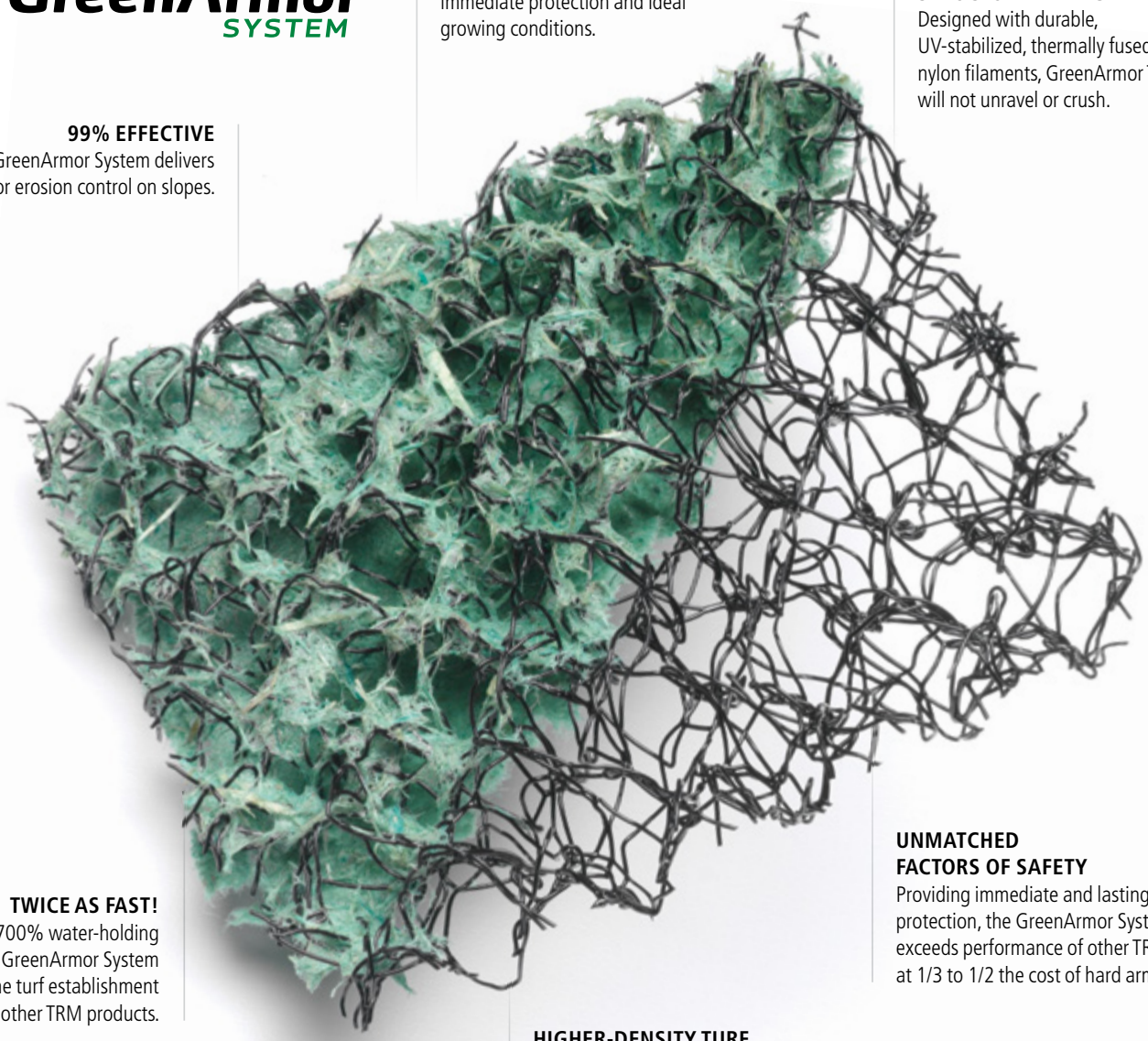
The system begins with **Futerra® Turf Reinforcement Mat (TRM)** which provides a permanent, lofty and open matrix. It's then hydraulically infilled with **Flexterra® HP-FGM® (High Performance-Flexible Growth Medium®)** to intimately bond soil and seeds while accelerating growth. This unique system protects against elevated water velocities and shear forces while encouraging rapid establishment and permanent reinforcement of denser vegetation. This synergistic combination of cost-effective technologies enables the GreenArmor System to provide unprecedented levels of design safety where other TRMs fall short.

GreenArmor® SYSTEM

HYDRAULICALLY INFILLED
Flexterra HP-FGM is sprayed into the Futerra TRM matrix to provide immediate protection and ideal growing conditions.

STRUCTURAL INTEGRITY
Designed with durable, UV-stabilized, thermally fused nylon filaments, GreenArmor TRM will not unravel or crush.

99% EFFECTIVE
The GreenArmor System delivers superior erosion control on slopes.



TWICE AS FAST!
With a 1,700% water-holding capacity, the GreenArmor System doubles the turf establishment rates of other TRM products.

UNMATCHED FACTORS OF SAFETY
Providing immediate and lasting protection, the GreenArmor System exceeds performance of other TRMs at 1/3 to 1/2 the cost of hard armor.

HIGHER-DENSITY TURF
With 95% open space, GreenArmor TRM assures more robust turf establishment and enhanced root reinforcement.

Improve Our Environment

A higher level of design safety means you can replace many hard armor and traditional TRM solutions with the more environmentally friendly GreenArmor® vegetative solution to help offset climate change through:

- carbon sequestration
- oxygen production
- reduction of "heat island" effects
- mitigation of aquatic thermal pollution
- reduced carbon footprint and transportation emissions

The GreenArmor System is more economical and aesthetically pleasing than concrete and rock, but its environmental benefits are what make it such an important innovation. GreenArmor replaces hard armor, as well as temporary erosion control blankets that are known for endangering wildlife through entrapment and polluting water sources with microplastics.

GreenArmor contributes to a healthier environment by what it adds—as well as by what it doesn't add—to the ecosystem. In fact, permanent turf reinforcement mats are recognized by the US Environmental Protection Agency, Army Corps of Engineers and Federal Highway Administration as Best Management Practices (BMPs) for hard armor alternatives.

Futerra TRM being infilled with Flexterra® HP-FGM® to create the GreenArmor® System.

Three months after installation, thriving vegetation withstood flooding from Tropical Storm Imelda.

Replace Hard Armor on a Wide Range of Sites

A low environmental impact is only the first of many benefits provided by the **GreenArmor® System**. This combination of solutions brings together the rapid vegetation establishment capabilities found in Flexterra® HP-FGM® with the dimensional stability of *Futerra® TRM—the most widely used type of turf reinforcement mat on the planet.* This unique combination is proven to provide immediate erosion control, speed establishment of vegetation and deliver superior performance on a range of sites including:


Steep Slopes and Embankments


Landfill Slopes and Diversion Channels


Earthen Dams and Spillways


Ditches and Stormwater Conveyance Channels


Streambanks and Shorelines


Levees and Canal Side Slopes

The Foundation of GreenArmor

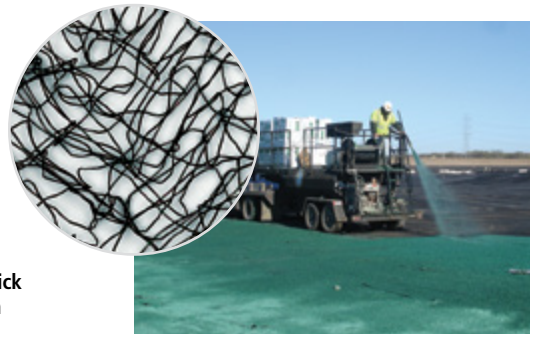
While the GreenArmor System is a reliable replacement for hard armor, it is also an excellent alternative to traditional stitch-bonded and densely woven TRMs. It begins with the unique design of Futerra Turf Reinforcement Mats (TRMs). Futerra TRMs are made of continuous nylon monofilaments thermally fused at their intersections to create a homogeneous matrix. Unique because 95% percent of its three-dimensional matrix is open space, it does not inhibit vegetation establishment and provides maximum reinforcement of plant root systems. When fully vegetated, Futerra TRM can withstand water velocities as high as 30 feet per second and shear stresses of 20 pounds per square foot! Futerra TRMs are available in a variety of designs that offer varying performance to meet your design needs in the most cost-effective manner.

GreenArmor 7003

This lighter weight TRM is a cost-effective solution to provide protection of moderate slopes or where flow conditions exceed the limits of natural vegetation.


0.3" thick
7.5 mm

Critical Shear Stress: 6.0 lb/ft² (290 N/m²)
Critical Velocity: 12.0 ft/sec (3.6 m/sec)


Flexterra® HP-FGM® applied into TRM 7003

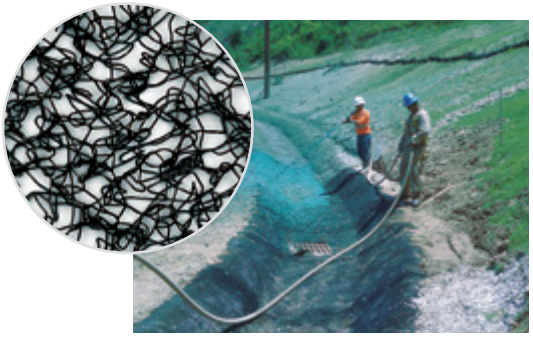

Resulting native grass and wildflower growth

GreenArmor 7010

A mid-range TRM designed to fulfill a broad range of general turf reinforcement requirements, especially on steeper slopes and when moderate flow conditions are anticipated.

0.4" thick
10 mm

Critical Shear Stress: 8.0 lb/ft² (380 N/m²)
Critical Velocity: 16.0 ft/sec (4.9 m/sec)



Slope interceptor ditch on steep slopes

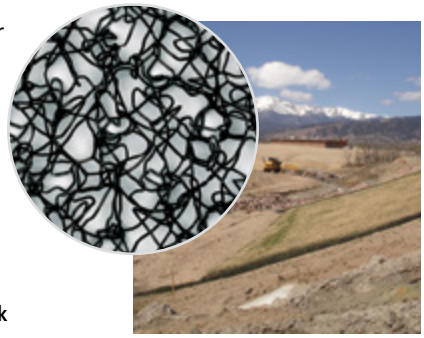
Luxurious growth in just two months

GreenArmor 7020

The industry standard designed for stabilization of more challenging sites, including very steep slopes, where higher flow conditions are expected, and an elevated level of performance is needed.

0.75" thick
19 mm

Critical Shear Stress: 17.0 lb/ft² (810 N/m²)
Critical Velocity: 20.0 ft/sec (6.1 m/sec)



Streambank reconstruction on semi-arid site

One year later with vegetation emerging

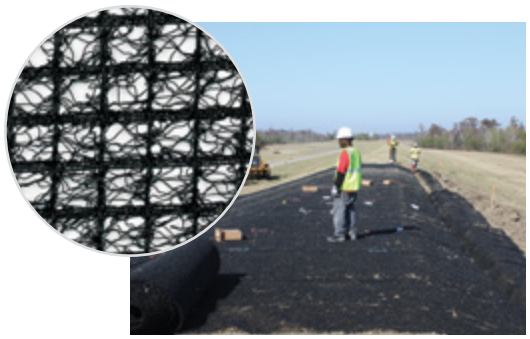
Ten years later exhibiting dense vegetation

GreenArmor R45 HP-TRM

This high-performance TRM was developed for severe slopes and critical structures on challenging sites where extreme flows are anticipated. Enhanced UV stability, low elongation and very high tensile properties provide heightened durability for severe environmental conditions and resistance to wheel loading from maintenance equipment.

0.75" thick
19 mm

Critical Shear Stress: 20.0 lb/ft² (958 N/m²)
Critical Velocity: 30.0 ft/sec (9.1 m/sec)



US Army Corps of Engineers Levee Construction

R45 HP-TRM System to Resist Wave Attack

High Performance System. Unprecedented Results.

Designers need to know TRM performance limits in vegetated and unvegetated conditions. The GreenArmor® System has been comprehensively evaluated at the world-renowned Colorado State University (CSU) Hydraulics Laboratory. All testing was conducted in accordance with ASTM D6460 protocol — *"Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Earthen Channels from Stormwater-Induced Erosion."*

Unvegetated Results

The objective of unvegetated testing is to measure the ability of an RECP to resist soil erosion prior to vegetative establishment. The unvegetated GreenArmor System was installed within an indoor flume above a one-foot thick soil layer and subjected to increasing flow discharges.

FACT: *The GreenArmor 7020 System produced the highest unvegetated critical shear stress and velocity ratings reported in the industry.*

This research demonstrates the unique properties of Flexterra® HP-FGM® to physically bond to the soil surface and protect the underlying soil from concentrated flow, holding seeds and soil in place prior to establishment of vegetation.

Image taken during testing at Colorado State University.

Post-test endurance results concluded that unvegetated GreenArmor 7020 exhibited a critical shear stress of 5.8 lb/ft^2 (280 N/m^2).

Vegetated Results

The GreenArmor 7020 System has proven successful with both cool season (Kentucky Bluegrass) and warm season (Bermuda Grass) species. Each species was seeded and established in portable planter boxes and later placed into a hydraulic flume at a fixed 2H:1V slope. The reinforced vegetation was then subjected to a series of increasing water discharge rates.

Close monitoring of the severe conditions proved both reinforced grass species resisted extreme flow velocities and shear stresses — a testimony to the strength, dimensional stability and true root reinforcement provided by the GreenArmor System.

Image taken during testing at Colorado State University.

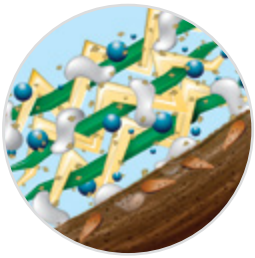
Cross-sectional view of the GreenArmor System, demonstrating extensive root development within and below the Futerra TRM.

3 Keys to the GreenArmor® System

1 Permanent Protection

The lofty matrix consists of 95% open space and readily accepts a hydraulic infill, capturing soil and encouraging vegetative growth. The resilient three-dimensional matrix of thermally fused nylon monofilaments creates the ideal structure for root reinforcement. GreenArmor R45 resists crushing, unraveling and tearing to offer unrivaled structural integrity.

2 Immediate Protection and Rapid Growth



This hydraulically applied infill provides immediate erosion control. Flexterra® HP-FGM® is designed with Thermally Refined® wood fibers, crimped biodegradable interlocking fibers and additives engineered to perform under extreme conditions, delivering > 99% erosion control effectiveness. Holding 1,700% its weight in water, the GreenArmor System produces 800% more vegetation than bare soil and doubles the establishment rates of other TRMs.

3 Unmatched Root Reinforcement

The GreenArmor System is a superior method for reinforcing vegetation. Futerra TRM maximizes root reinforcement while Flexterra HP-FGM offers immediate protection while accelerating vegetative establishment. Together, they provide up to 10 times the erosion resistance of natural vegetation.

GreenArmor R45 HP-TRM root growth (left) vs competitive densely woven high-performance TRM (right).

Integration of ProGanics to Improve Soil Health

Successful plant growth and erosion control are more certain when you pair GreenArmor with the proven effectiveness of ProGanics® Biotic Soil Media (BSM). Soil health is essential to establish sustainable vegetation. ProGanics BSM is engineered with a patented biological nutrient system with Thermally Refined® bark and wood fibers to kick-start vigorous root development and vegetation establishment. Two approaches provide better soil health and more rapid establishment in difficult soil while saving you money compared to supplemental compost or topsoil.

Flexterra HP-FGM

Futerra TRM

ProGanics

Approach #1

Start with an application of ProGanics to enhance the seed bed and then lay the TRM foundation. To further guard against erosion and promote growth establishment, apply Flexterra HP-FGM as infill.

ProGanics DUAL

Futerra TRM

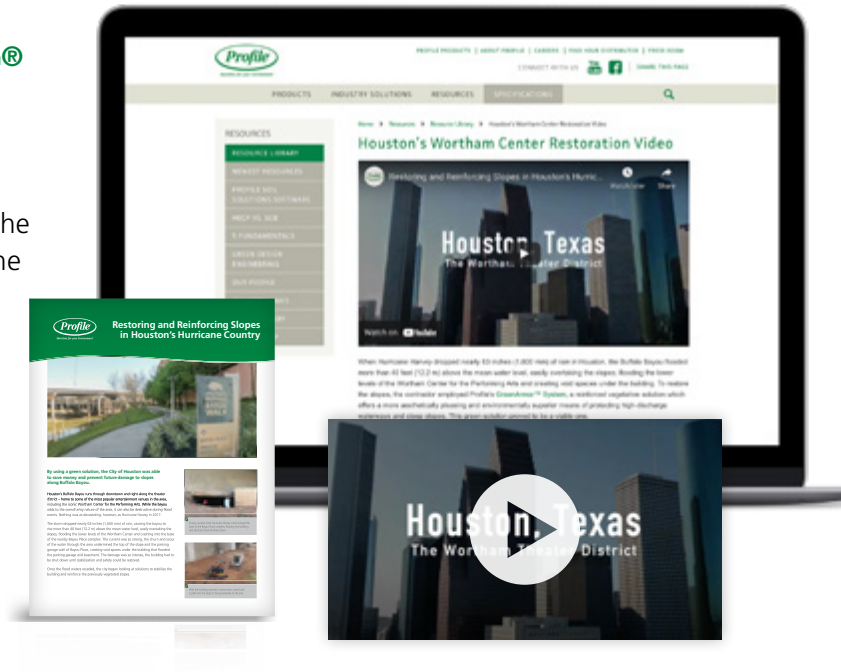
Approach #2

ProGanics® DUAL™ is a 2-in-1 product that combines the proven soil-building benefits of ProGanics with the erosion control effectiveness equal to a Bonded Fiber Matrix. DUAL delivers two functions in a single, time-saving application.

▶ Speak with your Profile representative to discuss site-specific approaches.

See How GreenArmor® Proves Its Resilience

Hurricane Harvey heavily damaged and undermined the parking structure of a performing arts center along the Buffalo Bayou in Houston,Texas. **Read the report**, **see the video** and learn how in just three months after installation, the GreenArmor System provided all the protection necessary to withstand Tropical Storm Imelda's 42 inches (1,067 mm) of rain during yet another major flood event.



"I don't think there could have been a better confirmation of the design, execution and installation than having it tested by a tropical storm that soon after being built... There's no question that the GreenArmor System worked great."

JOHN MOSS | Construction EcoServices

Spec Builder™
***ErosionControl*Specs.com**

Spec Builder™ is a fast, free and easy-to-use online specification drafting tool for erosion control, engineering, restoration and reclamation professionals. Easily build comprehensive, customized, CSI-formatted specifications to suit your exact needs.

To see how easy it is, visit **ErosionControlSpecs.com**.

GREEN DESIGN ENGINEERING™
EARTH-FRIENDLY SOLUTIONS FOR SUSTAINABLE RESULTS™

A holistic approach that combines agronomic and engineering expertise with advanced technologies, **Green Design Engineering™** provides cost-effective and earth-friendly solutions across our team of consulting professionals, innovative products and resources.

PS³
PROFILE SOIL SOLUTIONS SOFTWARE

PS³ is a free, comprehensive, 24/7 online resource you can use to design a project and select the right products that address both the physical and agronomic needs of your site. Develop holistic, sustainable solutions for cost-effective erosion control, vegetation establishment and subsequent reductions in sediment and other pollutants from leaving disturbed sites, plus get free soil testing to ensure this critical step is considered. Learn more and take advantage of a free soil analysis by visiting **Profileps3.com.**

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