

# Overview & Update of an Engineered Turf Closure Solution



*SWANA SC - Palmetto Chapter 2016 Spring Conference*

Agru America

Chris Eichelberger

## Outline & Objectives

Closure Systems Discussion

Overview ClosureTurf<sup>®</sup> Solution

Completed Projects

Questions

## Waste Containment



## Landfill Cover Lining

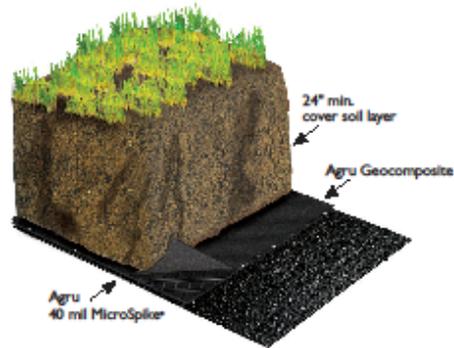


## Landfill & Impoundment Closure



# Agru America Closure Solutions

Subtitle D Compliant Closure Systems for Impoundments and Landfills

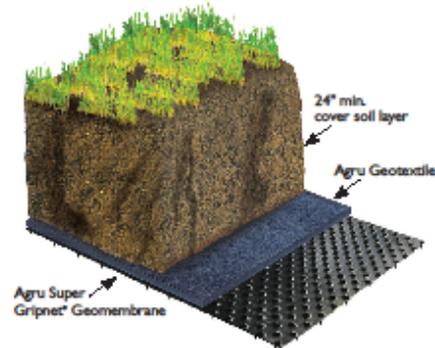


## Traditional Closure System

The traditional method for closures, which utilizes Agru's MicroSpiker® or smooth geomembrane, overlain by a geocomposite drainage layer, soil cover layer and vegetative layer.

### Agru Advantages:

- Cost saving geocomposite drainage layer
- Highest and most consistent asperity height available provides consistent and dependable shear strengths for delivered product

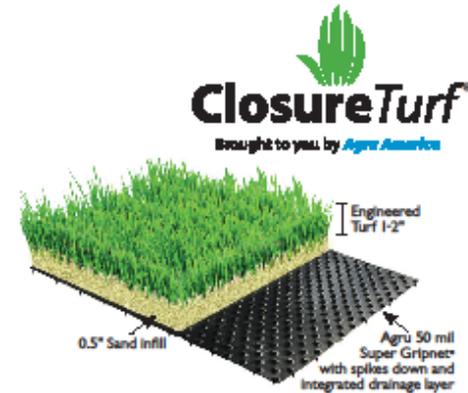


## Integrated Drainage System (IDS)

The IDS solution features an Agru structured geomembrane called Super Gripnet® or Drain Liner® overlain with an AgruTex® geotextile. Simply place soil on top of the geotextile to complete the system. The greatest performing, and most versatile of the traditional methods, the IDS system can feature an aggressive texturing on the underside of the Super Gripnet geomembrane providing unmatched shear strength and stability even on steepened slope applications.

### Agru Advantages:

- IDS reduces drainage material layers and can provide substantial cost savings
- Installs 15% faster when compared to the traditional closure system
- High factor of safety for steep-slope stability



## ClosureTurf® System

A patented final cover system comprised of Agru's Super Gripnet overlain by engineered synthetic turf infilled with sand. ClosureTurf® is a proven "hybrid" composite system that outperforms traditional closure methodologies.

### Agru Advantages:

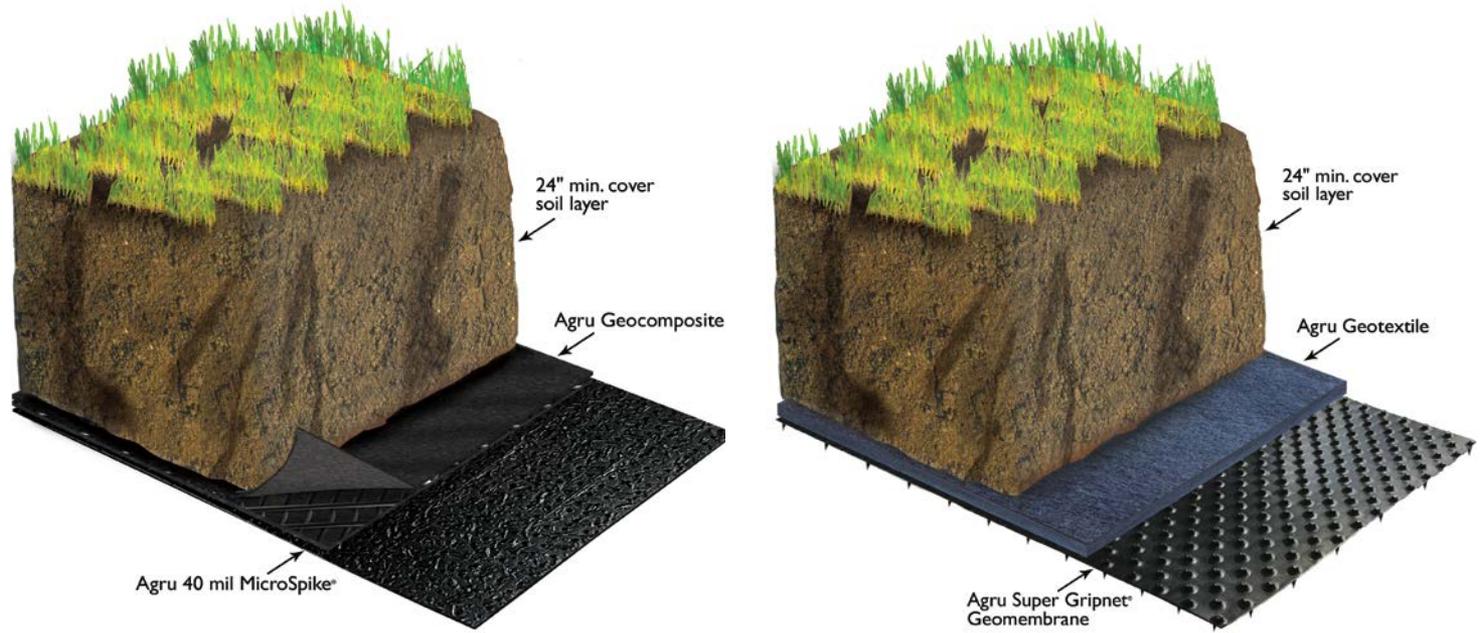
- Approved as an EPA Subtitle-D compliant final cover system since 2009
- Installs on average more than 50% faster than the traditional closure system
- Eliminates the need for large quantities of soil and related equipment activities, dramatically improving site safety, while often lowering construction costs
- Reduces average maintenance costs by roughly \$1,300 per acre per year
- ClosureTurf® dramatically improves runoff water quality, making it an effective BMP for Clean Water Act requirements
- Reduces the carbon footprint by approximately 80%



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# Soil Cover Design Challenges



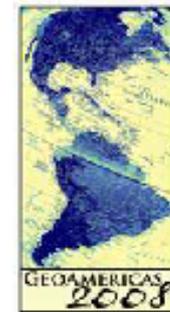
Shear Strength  
 Landfill Gas Uplift Pressure  
 Transmissivity



**SMITH+**  
**GARDNER**  
ENGINEERS

## Case Study: Post-Construction Failure

- To evaluate the effect of the active LFG system shutdown, a single recovery well was removed from an active LFG system and the subsequent increase in LFG observed.
- From an initial vacuum of 9-inch H<sub>2</sub>O (-2,240 Pa), it took only one hour to achieve a zero pressure. Over the next five (5) hours, the LFG pressure increased to 1.5-inch (374 Pa).
- Thus, over a 10-inch increase in LFG pressure required less than six (6) hours. This increase occurred despite the presence of adjacent LFG wells that remained in service and under the full operational vacuum.



## Initial Closure “Design”

- 30 Acre Disposal Footprint
- Maximum Height: 120 feet
- Bench-to-Bench Sideslopes: 2.5H to 3H:1V
- Bench Spacing: 50 feet (vertical)
- Available Cover Soils: Processed (4-inch minus) Shaley Clays





## Integrated Drainage System (IDS)



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## About Watershed Geosynthetics

- Company founded in 2007 by Civil Engineers
- Based in Alpharetta, GA
- Over 100...
  - Years of landfill experience
    - Design, Construction, Maintenance and Management
  - Years of geosynthetic experience
  - Individual sites managed through closure & post-closure
  - Minority ownership held by Shaw Industries, A Berkshire Hathaway Company



BERKSHIRE HATHAWAY INC.

## Why Agro Geomembrane?

- Unmatched plastics history
- Significant financial strength
- Consistent leadership
- Extreme manufacturing capacity
- Engineered products



# Flat Die Calendar Manufacturing



## AGRU Advantage – “Strength in Numbers”...

	Standard GM - 17 Textured Values - LLDPE	Agru MicroSpike Value LLDPE	Microspike Exceeds Standard Blown Film by:
Thickness (mil)	40	40	0%
Break Strength (lb/in)	60	112	<b>87%</b>
Break Elongation (%)	250	400	<b>60%</b>
Tear Resistance (lbs)	22	25	<b>14%</b>
Puncture Resistance (lbs)	44	50	<b>14%</b>
Asperity Height (mil)	18	20	<b>11%</b>

## Introduction to ClosureTurf

- Features and Benefits
- Key Performance Properties
- Projects





- ClosureTurf<sup>®</sup> is NOT an exposed cover system.
- ClosureTurf provides protection of the geomembrane by the added Geosynthetic layer (Engineered Turf). It is a “Hybrid” system that has all the advantages of a soil cover protection with out the disadvantages.

## Slow Erosion Failures



## Desiccation and Poor Vegetative Support



## Veneer Slope Failure



## Early Approaches

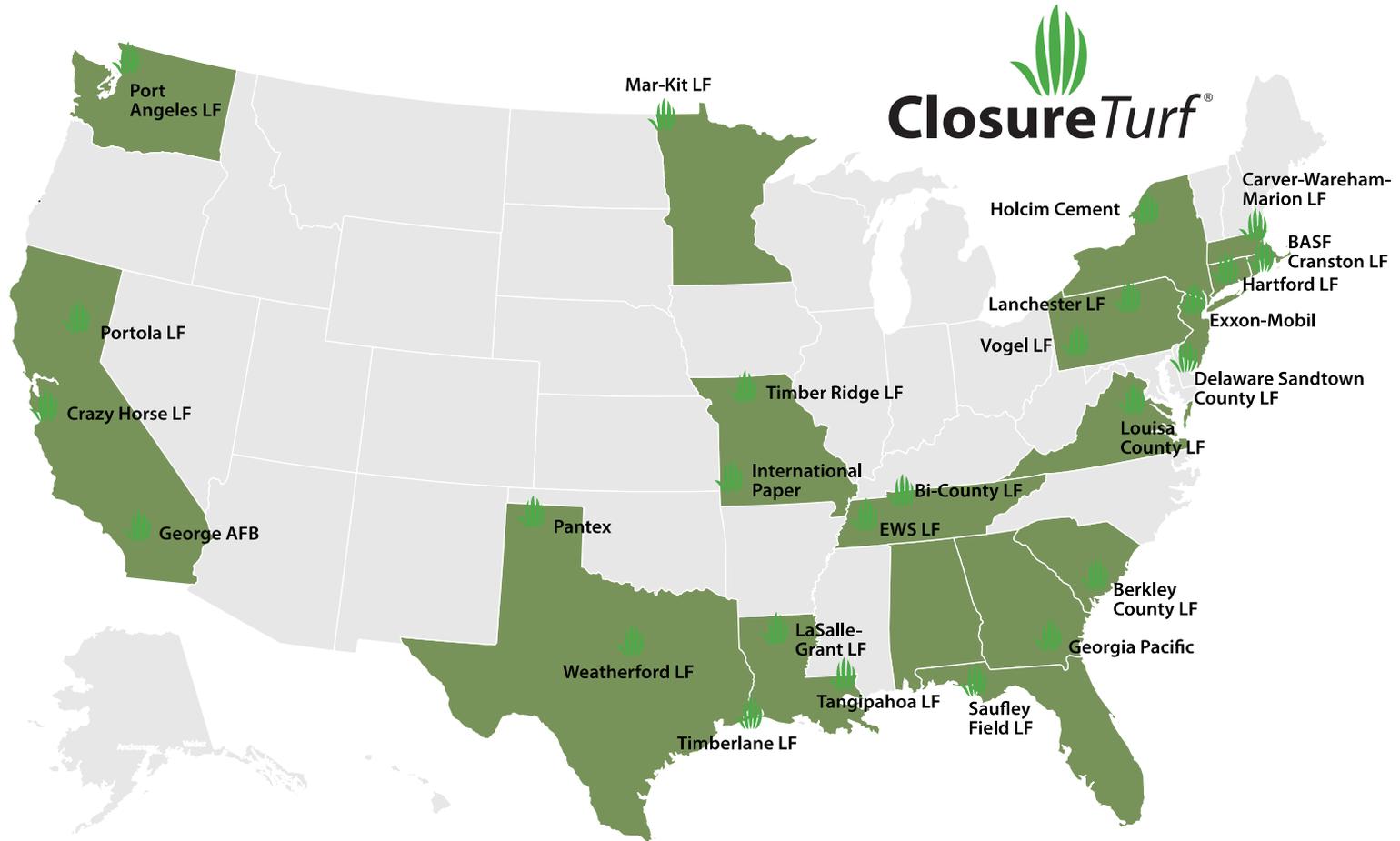
- Steep slopes
- No availability of cover soils



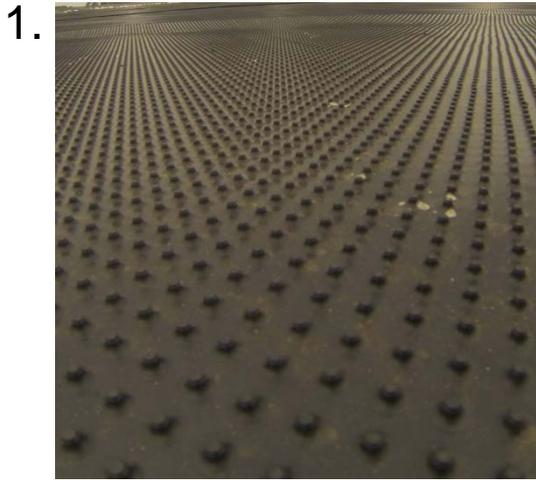
Sabine Landfill, LA



# Over 28 Million Square Feet Installed in 18 States



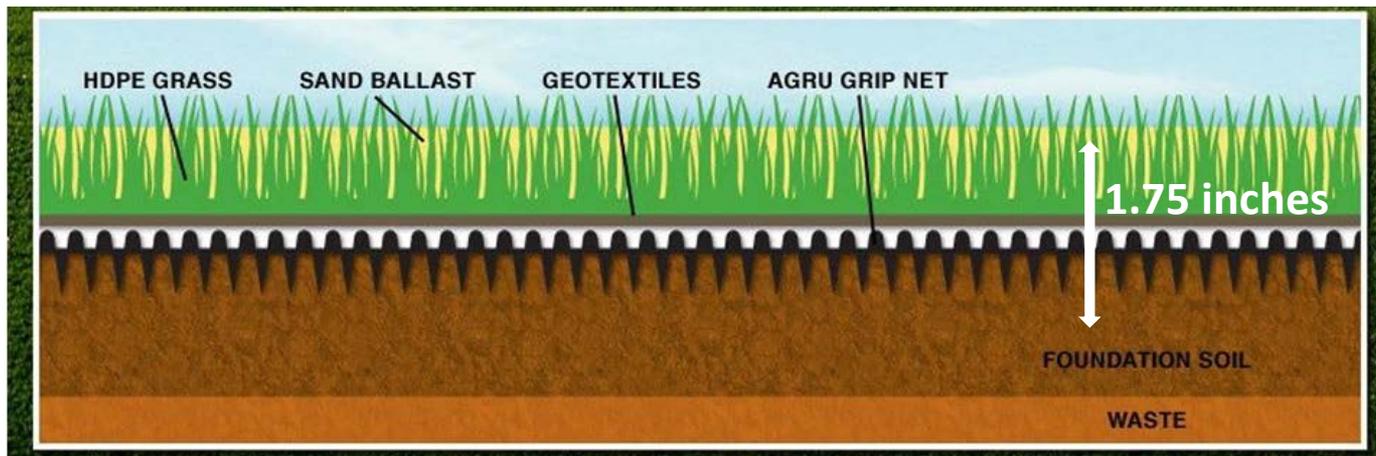
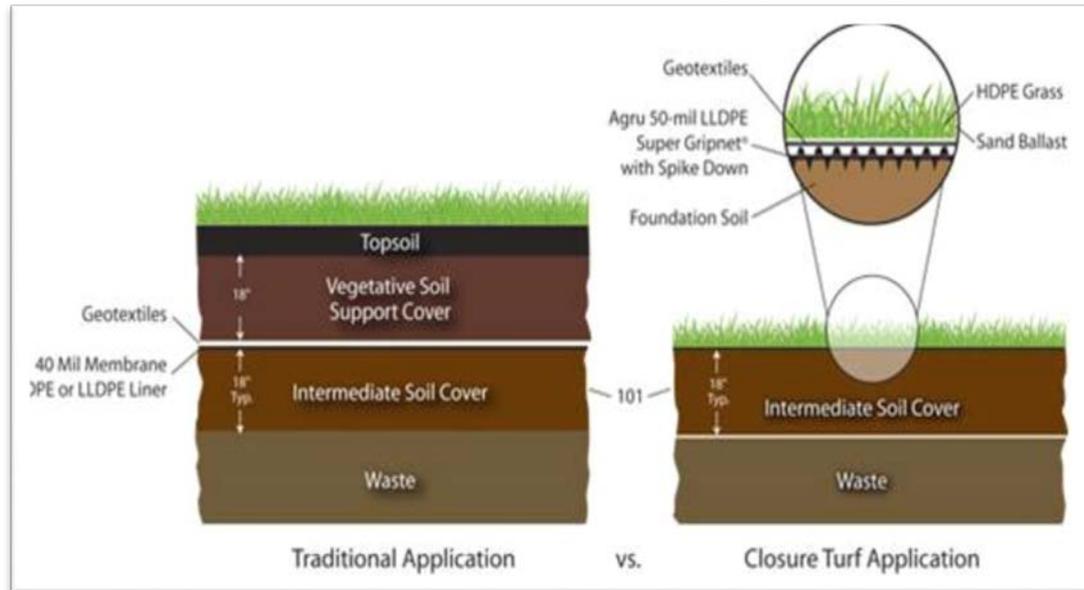
## What is Closure *Turf*® ?



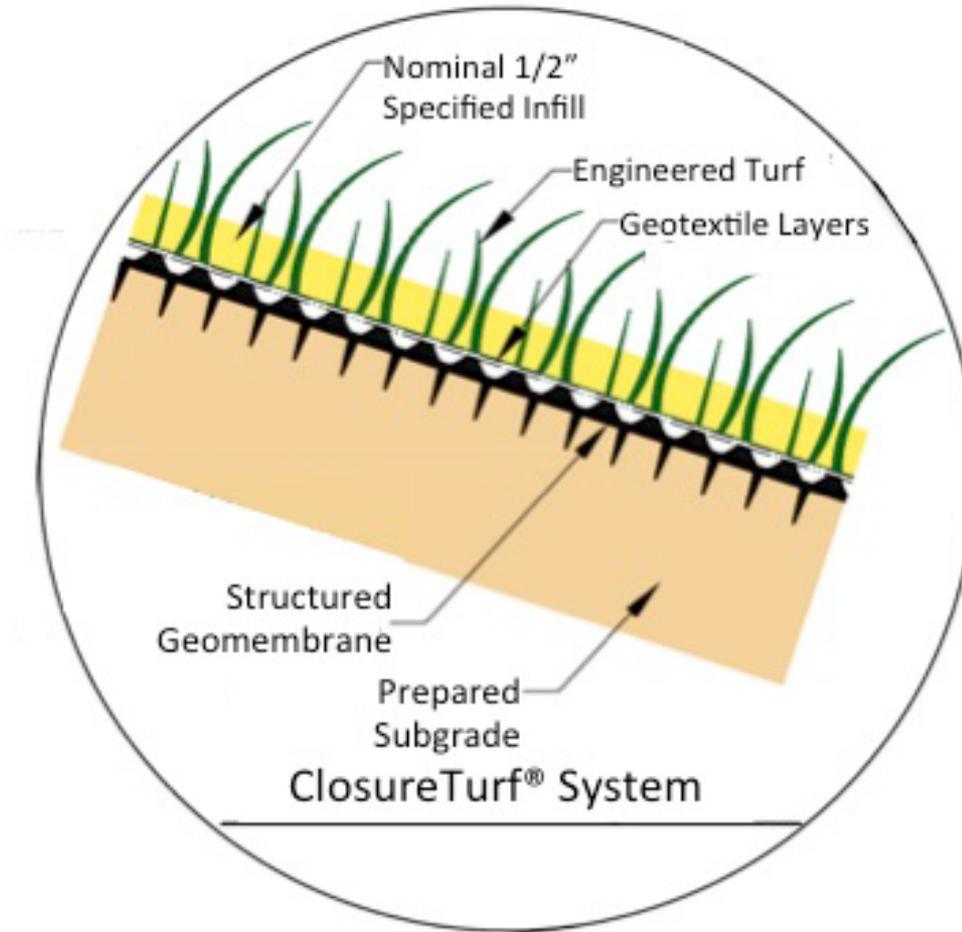
### Three-Component HYBRID System:

1. **Structured Geomembrane (Agru America)** – integrated drainage system / aggressive spikes on bottom for stability
2. **Engineered Synthetic Turf** – covers and protects the underlying geomembrane
3. **Specified Infill** – ASTM C-33 Sand OR a cementitious infill

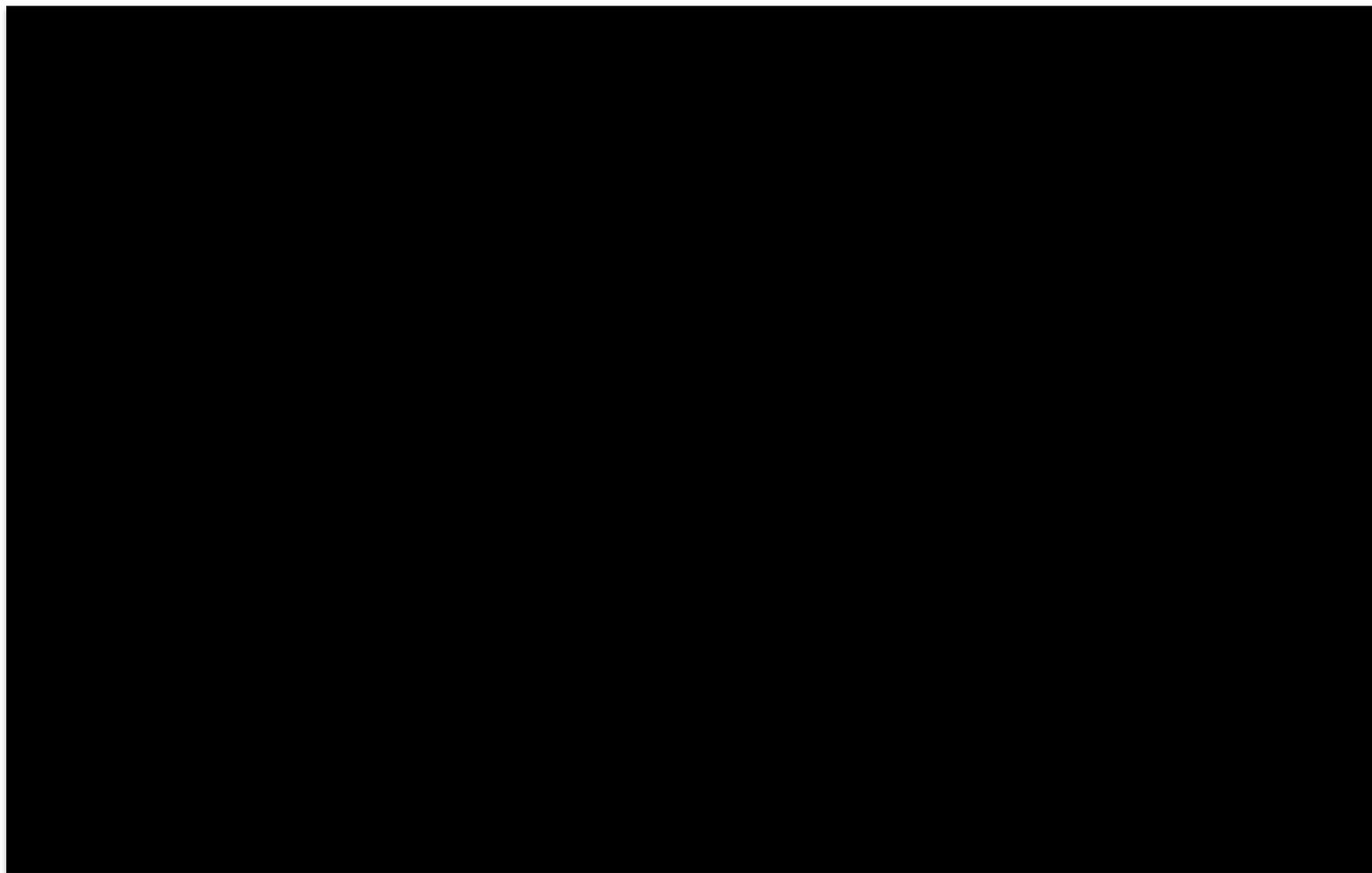
# Traditional vs. ClosureTurf®



## ClosureTurf<sup>®</sup> Cross-Section



## Closure *Turf*® Interviews



## System Features and Benefits

- Exceeds technical performance criteria established by EPA Subtitle D:
  - Significantly less leakage rate (HELP Model and JP Giroud Model)
  - Less Erosion (5 to 10 cy per acre per year for soil cover vs. negligible for CT)
  - Longevity (on-going maintenance in perpetuity for soil versus well over 100 plus years of stability for CT)

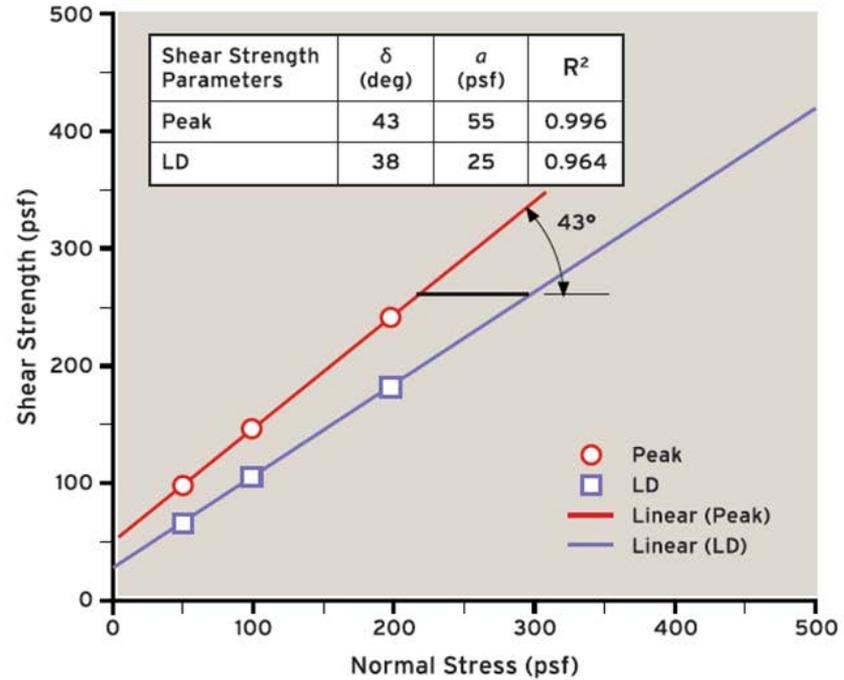
## Cross Section of **ClosureTurf**<sup>®</sup>



Cementitious infill shown above which is used in areas of a closure that are subjected to concentrated flows that exceed velocities of 5 ft/s.

# Turf and SGN Interface Evaluation

Slope angle	Slope	SF
33	1.5H: 1V	1.4
26	2.0 H: 1V	1.9
18	3.0H: 1V	2.8
14	4.0H: 1V	3.7



Interface Friction Evaluation and Slope Stability ASTM D-5321

## Hydraulic Performance Testing Program

- CSU Hydraulic Lab (ASTM D-7276 and ASTM D-7277)
- TRI Facility in South Carolina (ASTM D-6459 and ASTM D-6460)
- Tests replicate rain induced forces and concentrated flow forces
- Results concluded that the System outperforms vegetation and hard armor technologies in both instances





# Wind Tunnel Testing

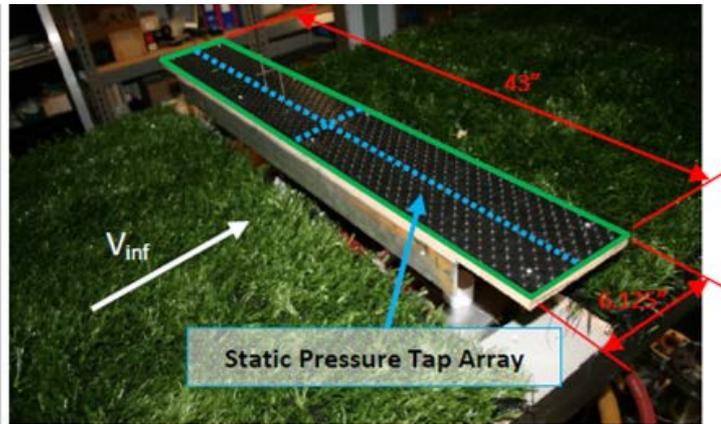


Figure 1a – Model Before Final Turf Layer

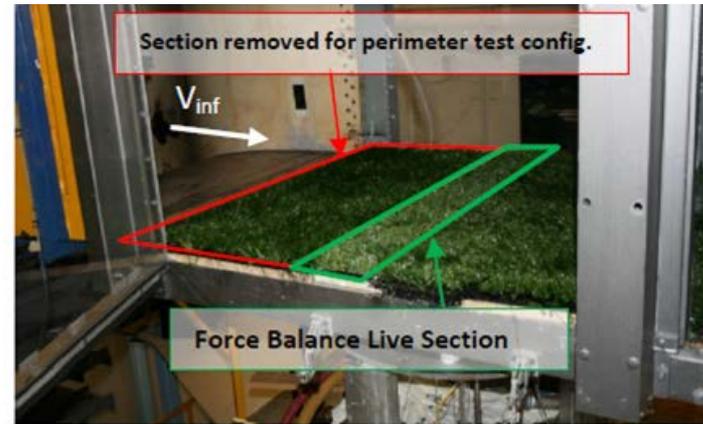
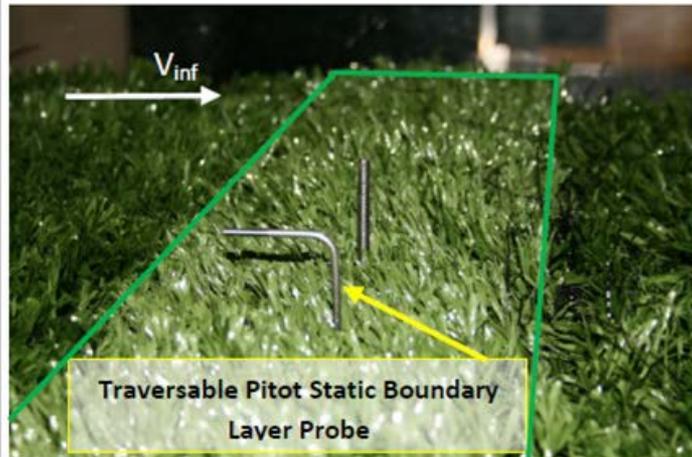
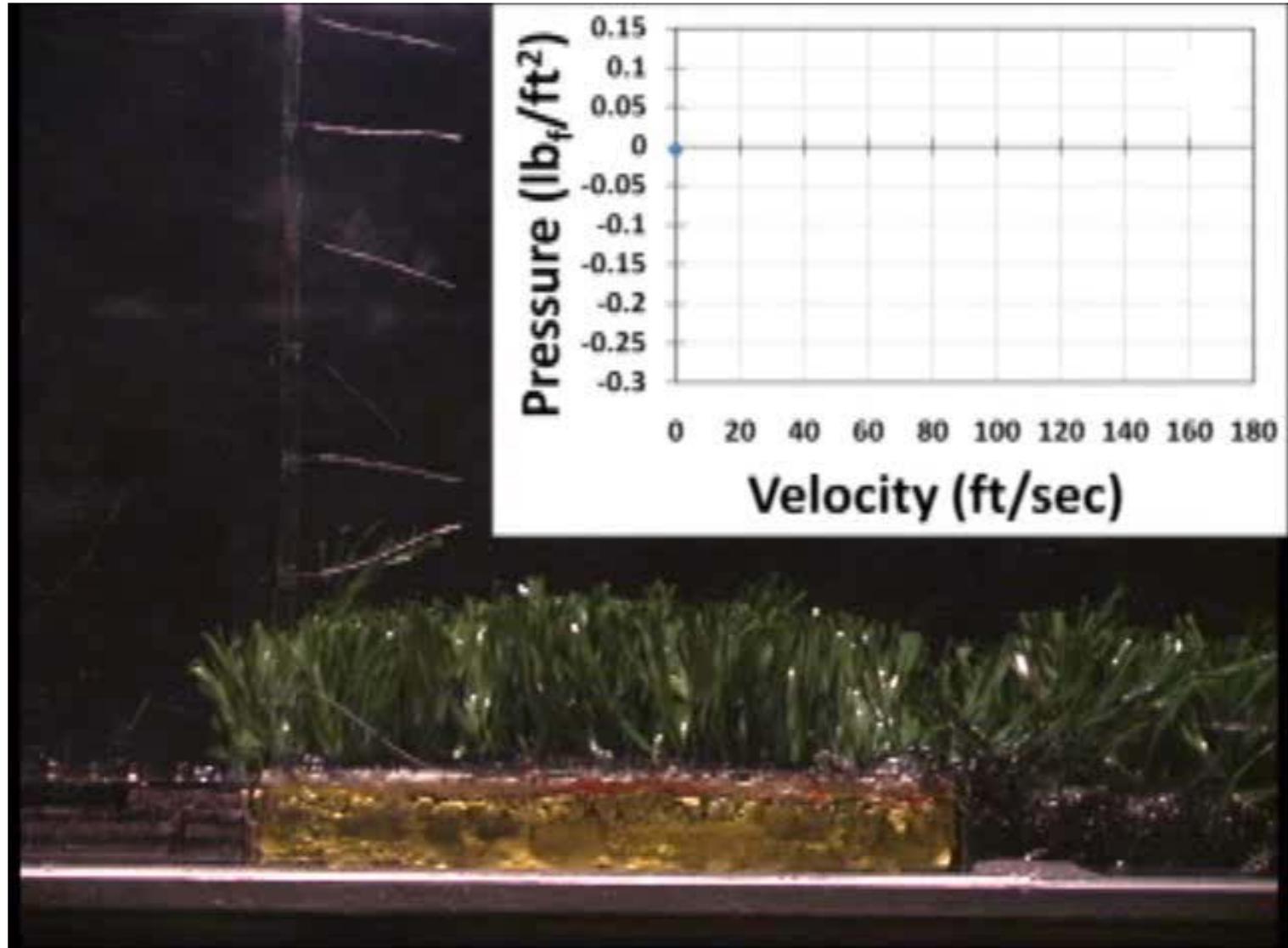
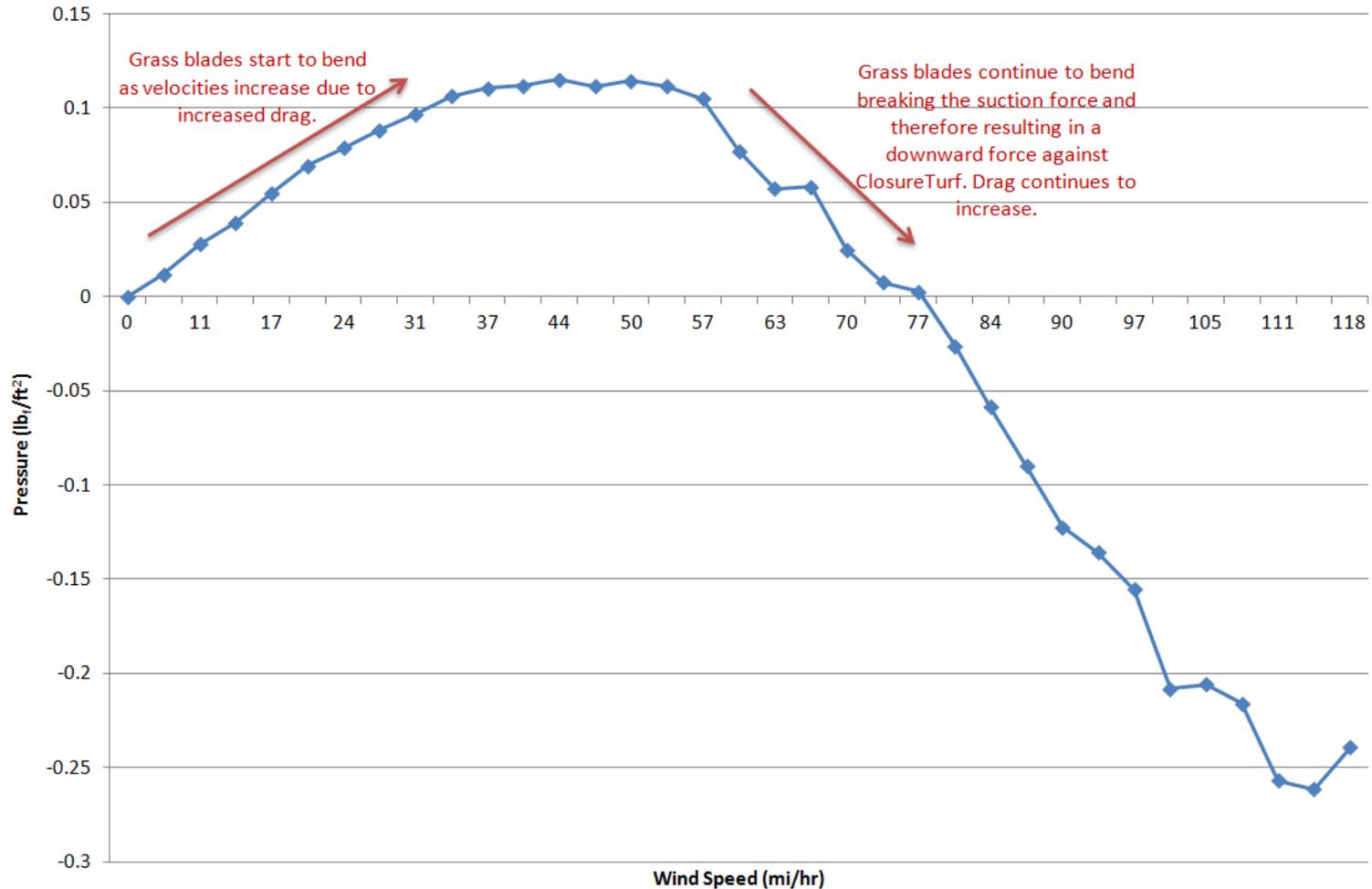


Figure 1b – Turf Installed & Model Lowered





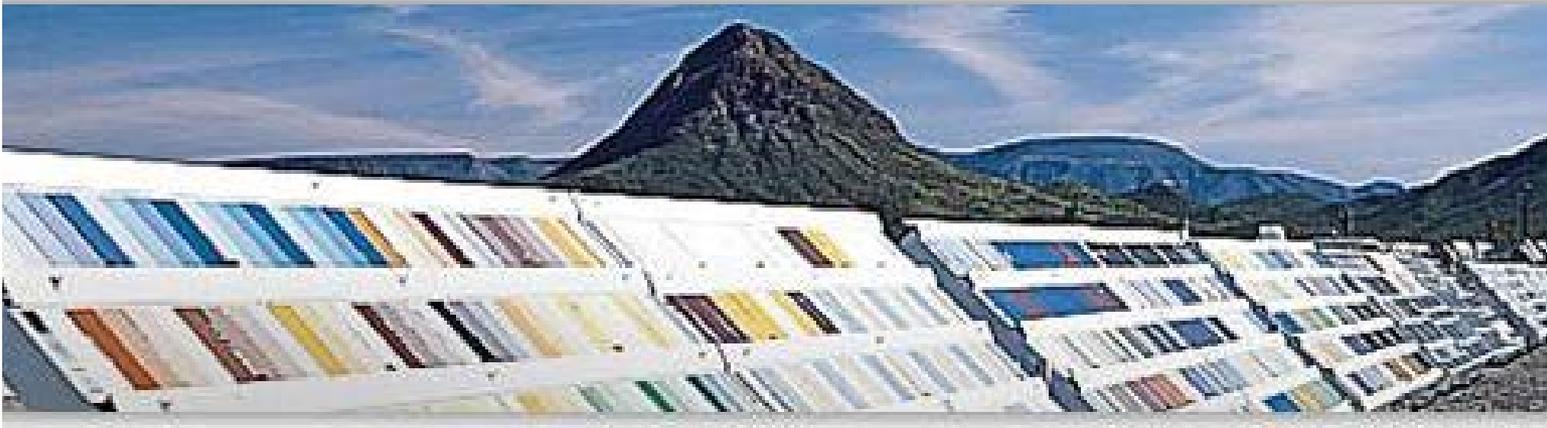
# Wind Tunnel Results



**Resists Hurricane Force Winds (Category 3)**

## Weather and UV Resistance

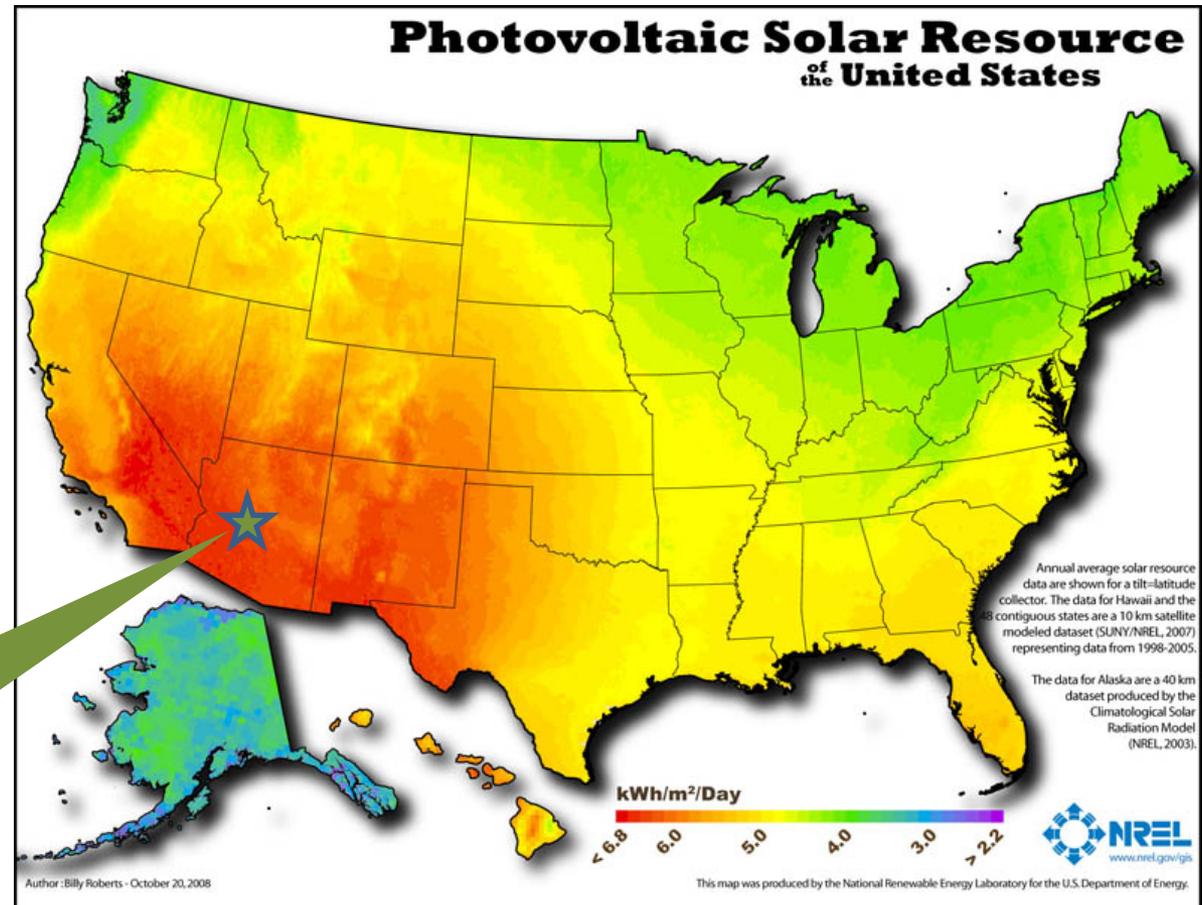
- Great advancements in UV resistance of PE and PP
- Real world testing conducted at the Atlas Weathering Facility in New River, AZ
- Over ten years of data collected
- More than three (3) times the Tensile Strength is retained in the system when projected to 100 years



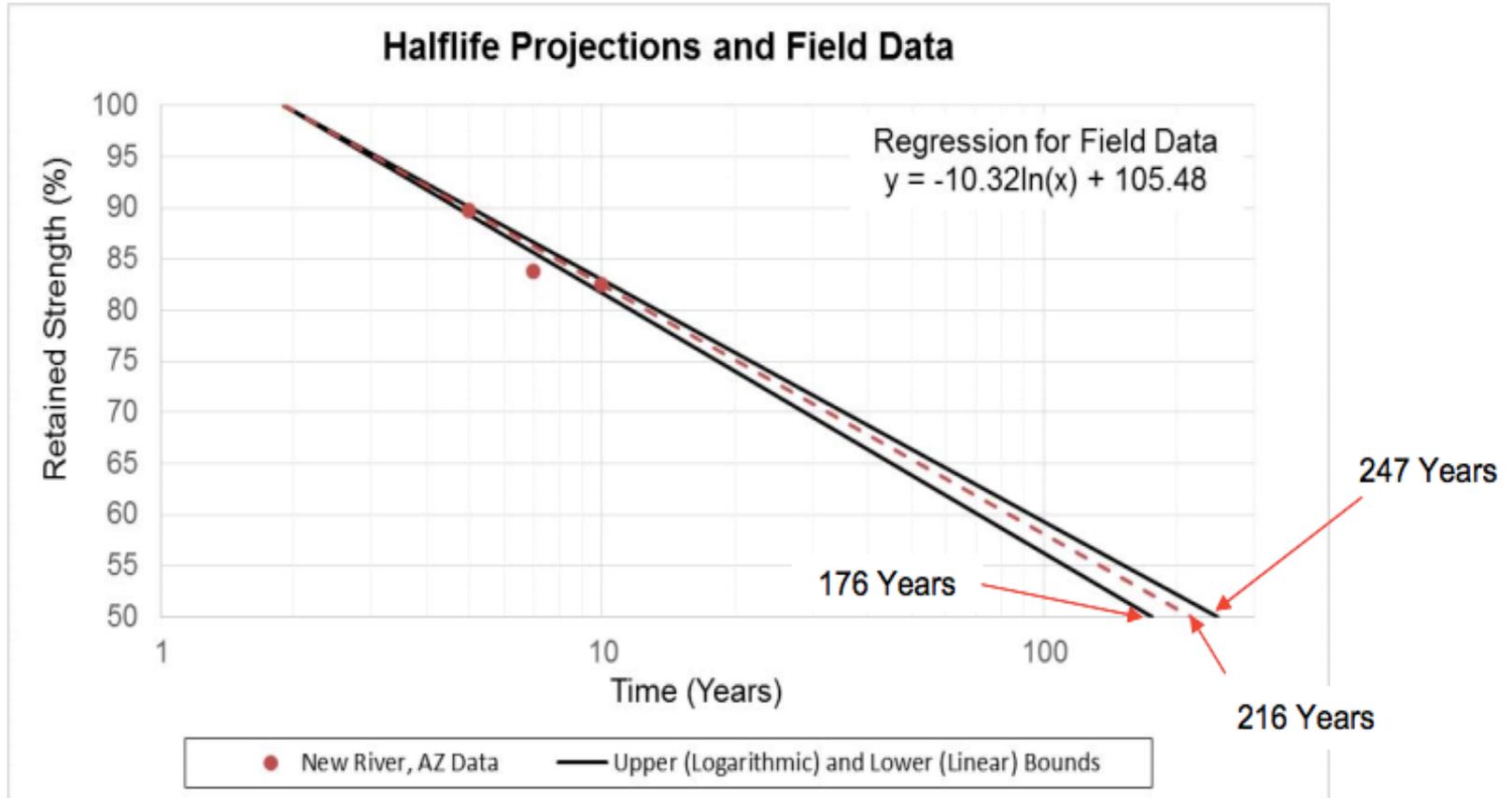
# Synthetic Turf Fibers (PE)- Functional Longevity UV Resistance (1)

- Direct Exposure 45° South
- ASTM G147 and G7
- Four (4) Exposure Durations
  - 11,280 hours (1.3 years),
  - 43,800 hours (5 years),
  - 61,320 hours (7 years), and
  - 87,600 hours (10 year)

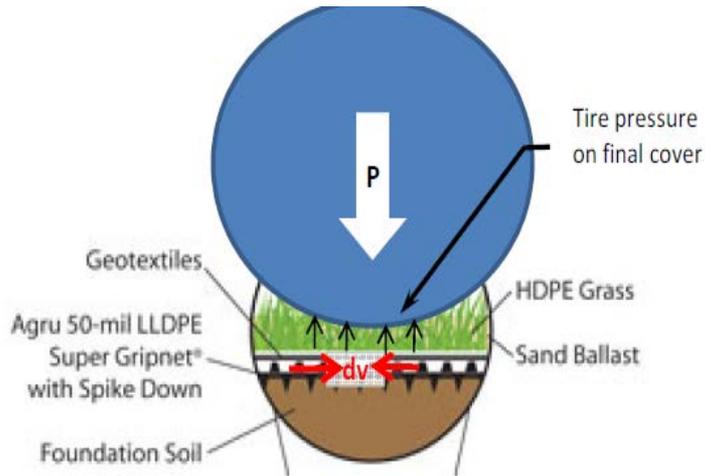
Atlas Weathering Laboratory in New River, AZ



# Longevity Analysis

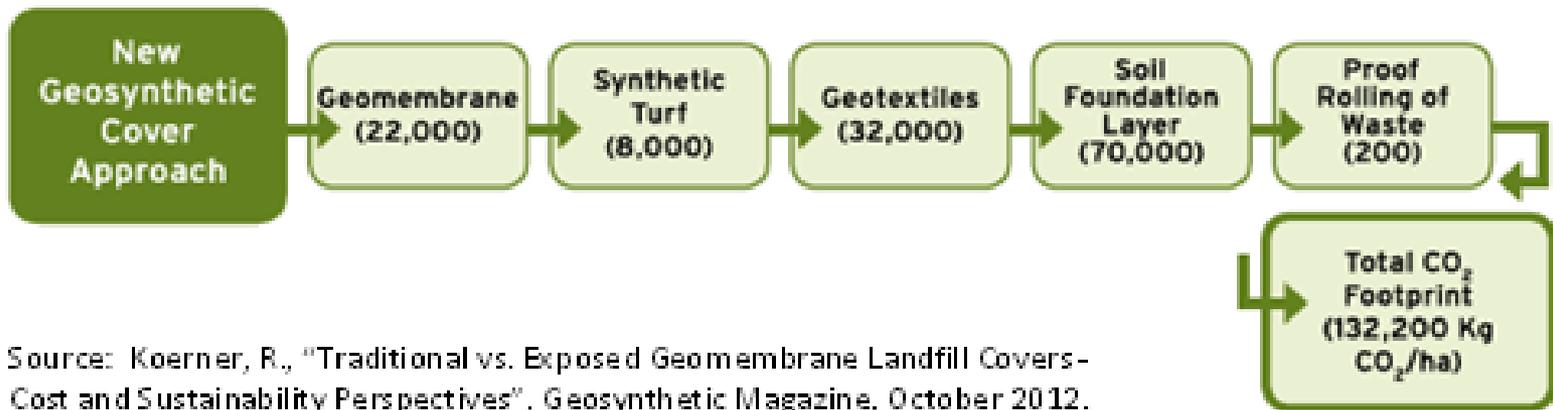
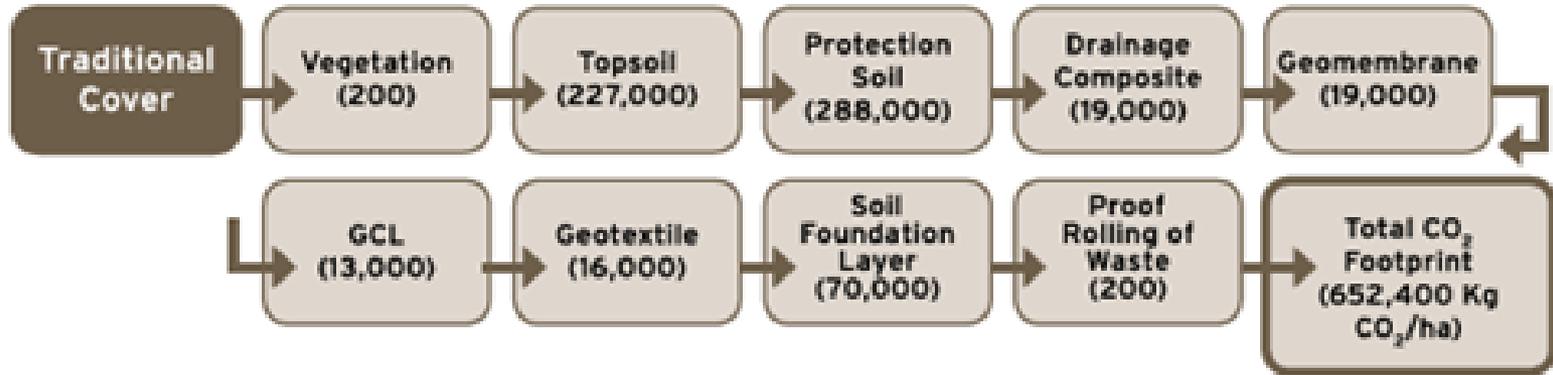


# Operational Ability



Factors of Safety for heavy vehicle static weight and braking forces all above 1.5

# CT's carbon footprint = ~20% of traditional soil cover



Source: Koerner, R., "Traditional vs. Exposed Geomembrane Landfill Covers- Cost and Sustainability Perspectives", Geosynthetic Magazine, October 2012.

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**MONTGOMERY  
COUNTY**  
T E N N E S S E E

## Bi-County Landfill



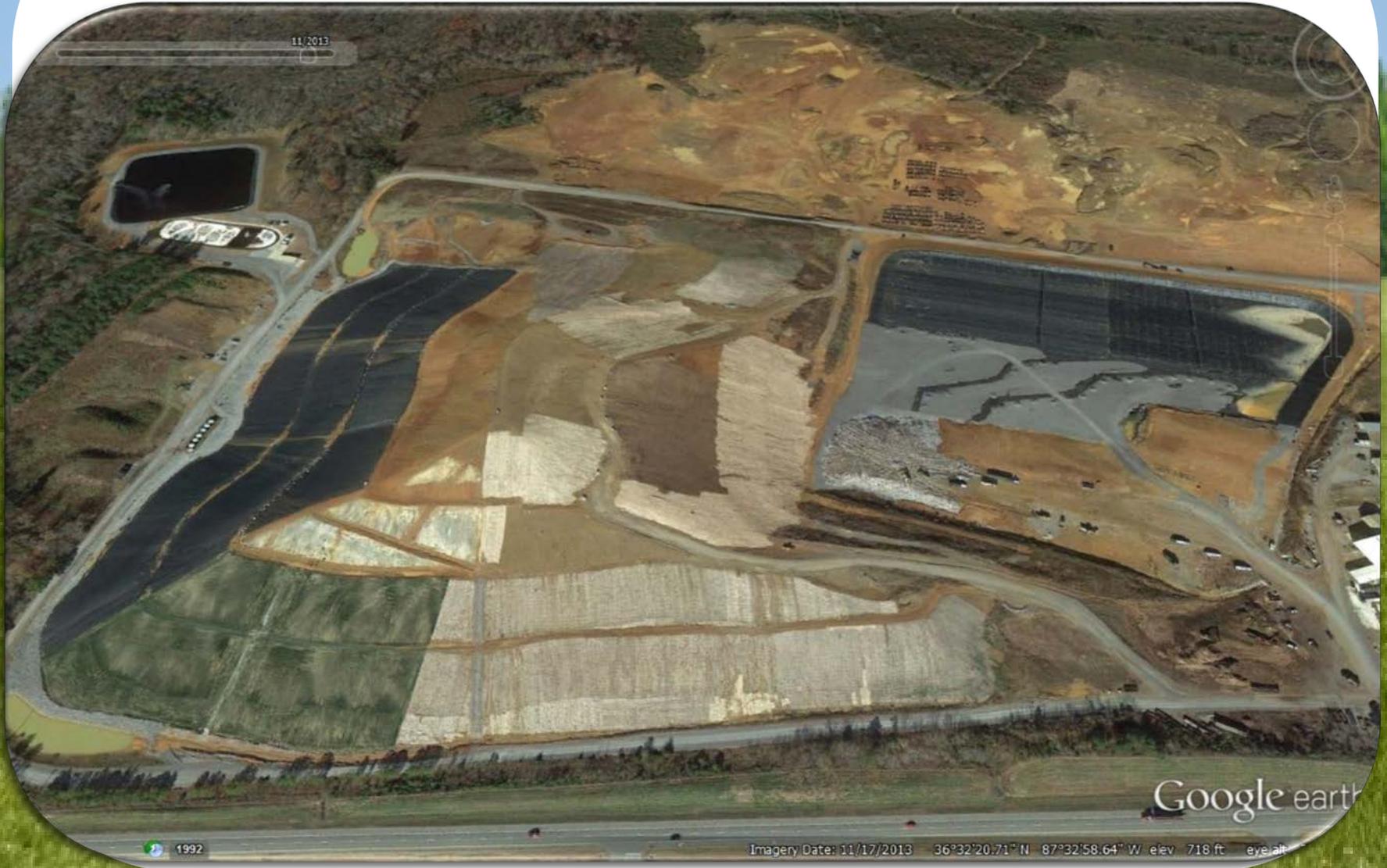
## Bi-County ClosureTurf – Phase 1

- Design Modification: June 2012, approved March 2013
- Construction complete: November 2013
- Project size: Approx 4 acres



Significantly  
Improved  
Aesthetics!!!

# Phase I – Bi County ClosureTurf



## Phase I – Bi County ClosureTurf



## Phase I – Bi County ClosureTurf



## Phase I – Bi County ClosureTurf



## Phase II – Bi County ClosureTurf

- Design Modification: 6/12
- Design approval: 3/13
- Construction complete: 10/15
- Project size: Approx 6.2 acres



LFG Collection  
System

# Phase II – Bi County ClosureTurf



## Phase II – Bi County ClosureTurf



## Added Aesthetical Value of CT System







**CKD Landfill  
Catskill, New York**



## Case Study: Saufley Field Landfill

**Owner:** Escambia County

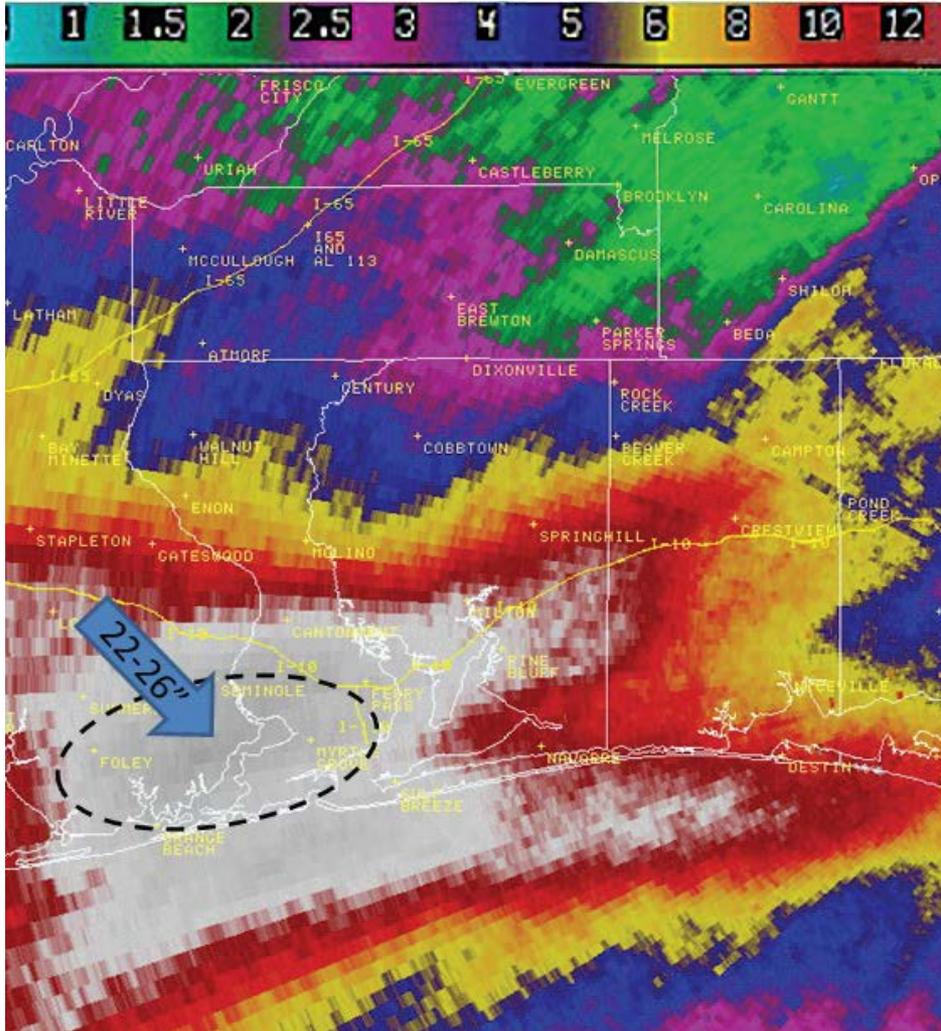
**Location:** Pensacola, FL

**Closure Area:** 25 acres





1 hour intensity - 500 year event  
 24 hour intensity - 200 year event



## Case Study: Berkeley County Landfill

**Owner:** Berkeley County

**Location:** Moncks Corner, SC

**Completed:** 2013

**Closure Area:** 12 acres





## Case Study: Hartford MIRA Landfill



ClosureTurf® was the best solution for a sensitive, high-visibility site.

## Project Overview

**Owner:** Materials Innovation and Recycling Authority (MIRA)

**Location:** Hartford, CT

**Completed:** 2014

**Closure Area:** 36 acres

**Solar Capacity:** 1 MW





Image courtesy of Materials Innovation and Recycling Authority

# PV Solar Panel Racking & Ballasting System



## Post-Closure Cost Comparison

- **Prescriptive (Soil Cap) Cover –**
  - ~\$900/Acre/Year
- **ClosureTurf® System –**
  - ~\$100/Acre/Year
- **\$800/Acre/Year Savings x 30 Year Post Closure Period  
= \$24,000/Acre Savings**

## Engineered Synthetic Turf – 100% Green



## Engineered Synthetic Turf – 100% Tan



## Engineered Synthetic Turf – 75% Green / 25% Tan



## Questions

Thank you!

