

ClosureTurf®
**A PREDICTABLE BENCHMARK OF
PERFORMANCE**



MADE WITH
agru
STRUCTURED MEMBRANES


ClosuresTurf®
ADVANCED FINAL COVER SYSTEM



Soil Slopes Don't Work, Although They Keep You Working

Soil erosion continually plagues the ongoing management of landfills, industrial waste sites, CCR storage areas, and other environmental containment applications requiring constant rebuilding of slopes weakened by rain and wind. In addition to ongoing maintenance headaches, traditional systems utilizing soil as their main component are costly to maintain, slow to install and introduce unwanted slope stabilities. ClosureTurf® is the only solution that provides a predictable benchmark of performance.

A prescriptive cover is effectively an engineered structure reliant upon vegetation and weather to perform as designed. With this in mind, ClosureTurf was designed to provide an engineered solution to Subtitle D requirements that would perform under all conditions. It is quickly becoming the closure system of choice across the country for engineers, owners, government agencies and many others who are seeking the best solution for their containment challenges. The ClosureTurf system offers exceptional stability, long-term protection and natural aesthetics all for a comparable price to traditional designs.



Berkeley County Landfill, SC

ClosureTurf® Makes Erosion Control Easy—It's Virtually Install and That's All.

ClosureTurf is a patented, three-component system comprised of a structured geomembrane, an engineered synthetic turf and a specified infill. The ClosureTurf system provides predictable performance over a vegetated Subtitle D landfill cover by:

- Reducing construction and long-term maintenance costs
- Exceeding technical performance factors
- Withstanding extreme weather conditions
- Lasting well beyond the post-closure care period
- Easily incorporating into existing gas collection systems
- Improving storm water quality
- Allowing for Incremental closures for quicker gas control, odor control and leachate reduction

With a footprint of over 1,200 acres, ClosureTurf has proven to be superior in performance when compared to other cover solutions. Because of its consistent ability to meet and/or exceed compliance and performance standards, ClosureTurf is the preferred method in landfill final cover designs for many.

A PREDICTABLE PERFORMANCE CHECKLIST



Crazy Horse Landfill, CA



Baldwin County Landfill, GA



Portola Landfill, CA

Construction Benefits

- Installs at least 50% faster than traditional soil caps
- Eliminates on average 550 truck trips of soil per acre from local roadways
- Allows for incremental closures
- Eliminates 2 feet of soil; no borrow soil
- Easily adapted during or after construction for solar field development

Technical Performance

- Prevents common erosion, storm water and siltation problems—even during severe weather events
- Utilizes the highest interface friction geomembrane available in the market for greater stability on steeper grades and eliminates the need to rebuild slopes
- With a design life of 100+ years, the lifespan of the ClosureTurf system extends well beyond the post-closure maintenance period
- Protects against driving forces, severe weather conditions heat and wind uplift

Cost Savings

- Reduces maintenance and post closure care by around 90% compared to a soil cap
- Reduces sediment loading clean out to surrounding channels and sedimentation/detention basins

Environmental Impacts

- Provides clean runoff with very low turbidity
- No soil, chemicals or fertilizers to contaminate the water
- Obtain control over gas collection sooner than later (“close as you go”)
- Reduces overall surface emissions
- Lowers the production of leachate with incremental closures
- Durable system construction designed to safely convey internal gas pressures, reduce unwanted releases and avoid slope stability issues
- Requires no irrigation, fertilizing, seeding or mowing
- Reduces environmental carbon footprint by up to 80% during construction



11 NTU

371 NTU

*Runoff from a typical 1" rainfall
(same site); ClosureTurf (left);
traditional soil cover (right)*



Port Angeles Landfill, WA

TAKE A CLOSER LOOK AT CLOSURETURF

ClosureTurf is a patented, three component system comprised of a structured geomembrane, an engineered synthetic turf and a specified infill. The foundation of the system is an impermeable, highly transmissive structured geomembrane. It provides for the highest interface friction values available in the market. The engineered synthetic turf component gives the system its natural look and feel of grass while protecting the geomembrane from extreme weather conditions for the long term. The specified infill component is placed between the blades of the engineered turf and allows the system to be trafficked while also providing additional protection from weathering. While ClosureTurf incorporates easily into existing gas collection systems, the patented gas relief valve protects against build-up/ballooning if the gas collection system malfunctions. ClosureTurf is fast and easy to install for an aesthetically pleasing, cost-effective landfill closure solution.

STRUCTURED GEOMEMBRANE

- Studs on top provide quick drainage of high intensity rainfall events
- Spikes on bottom provide high friction to subgrade
- Exceeds most regulatory thickness requirements by 20 %

ENGINEERED SYNTHETIC TURF

- Dimensional stability
- High interface friction
- Aesthetically pleasing
- Virtually maintenance free
- Superior resistance to:
 - Extreme weather
 - Long-term UV exposure
 - Heat

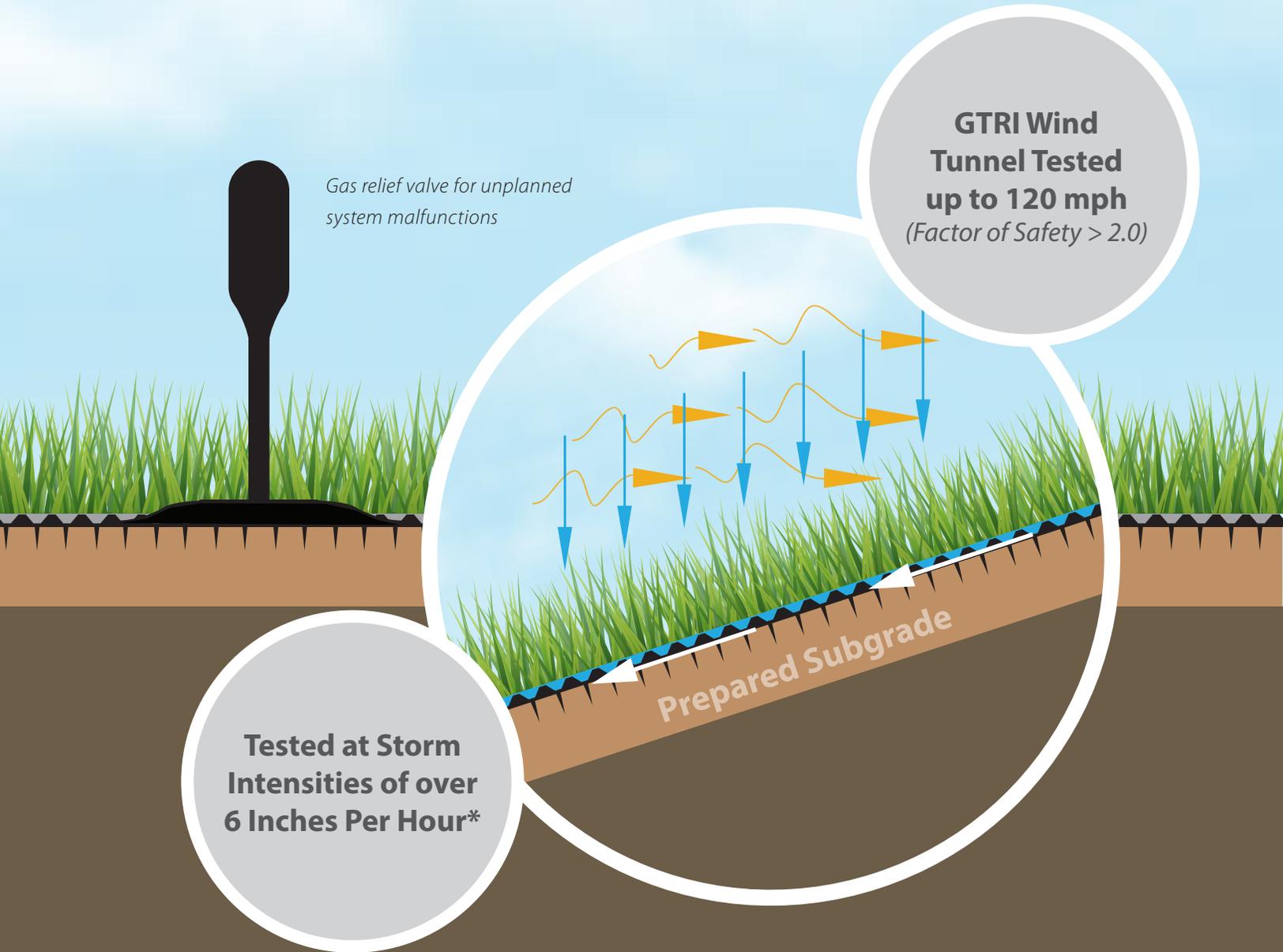
SPECIFIED INFILL

- Supports heavy traffic loads
- Provides additional UV protection
- Lab tested in high rainfall events
- Creates a non-exposed system
- Superior weathering protection
- Reduces heat absorption



WASTE

ClosureTurf is specifically designed for long-term slope stability in the wake of severe weather events such as intense rainfall, hurricane force winds and earthquakes.



** Most significant rainfall event to date is 22 inches over 24 hours with no damage to the ClosureTurf system.*

WASTE

AN INNOVATIVE SOLAR SOLUTION FOR LANDFILLS AND IMPOUNDMENTS

Solatics® is a patented solar system that uses ClosureTurf® as its foundation to turn an environmental liability into an environmental asset. Installing solar generation on capped landfills has proven an effective way to deploy large systems on typically unused space. By combining the proven technology of ClosureTurf with the advanced science of Solatics, the system yields the highest producing, easiest to maintain solar solution available on the market. ClosureTurf's unique cover system enables solar panels to operate in a clean environment free of dust, grass clippings and potential damage from lawn mowing equipment. With a no penetration, friction-based attachment method, Solatics is able to operate and function with optimal performance.

Why Siting Solar on Landfills is Superior to Other Sites, including Greenfields:

- Productive use – financially and environmentally – of land resource with minimal typical reuse
- Receives superior financial incentives in some jurisdictions
- Prevents clear-cutting and grading of forests and greenfields
- Makes use of existing access roads, storm water management and security perimeters

Solatics is the only solar technology of its kind:

- Uses the latest dual glass panel proprietary technology
- Utilizes a low profile direct attachment system to protect against wind uplift and shear
- Does not use bulky racking material
- Does not penetrate the closure system
- Maximizes the landfill footprint with both top deck and slope positioning
- Simplifies wiring and increases the power per unit area by more than 35%



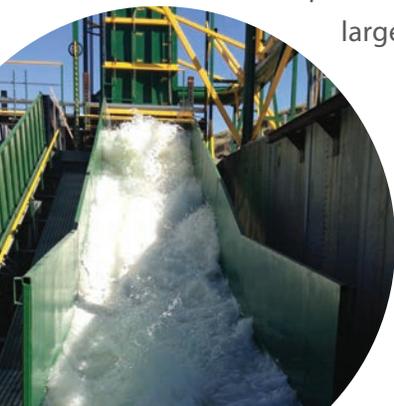


OTHER ENGINEERED LANDFILL SOLUTIONS

HydroTurf® Storm Water Revetment Technology



HydroTurf is an innovative, environmentally-friendly alternative revetment to rock and concrete hard armor linings for landfill storm water management system applications, including downchutes, perimeter channels, bench drains, outfall structures, slopes and basins. It is a patented, three-component system made up of a structured geomembrane, an engineered synthetic turf and a specialized cementitious infill called HydroBinder®. Created specifically for hydraulic applications on landfills, HydroTurf will flex and move with typical differential settlements without compromising performance. It provides superior hydraulic properties capable of handling large flows resulting in very high velocities.



HydroTurf has been comprehensively tested at Colorado State University (CSU). CSU's laboratory has the largest flumes for hydraulic testing in the world. HydroTurf did not reach failure at a maximum steady state overtop velocity of 40 feet/second and for 13 hours in the wave overtop simulator being subjected to a five-hundred-year hurricane event for the New Orleans region.

Benefits Over Traditional Landfill Storm Water Management Systems:

- Excellent hydraulic performance
- Less costly
- 50+ years of functional longevity
- Flexible solution for all settlement conditions
- Impermeable for superior erosion control
- Lightweight for rapid, low-impact and scalable construction
- Easy to install in difficult areas
- Minimal long-term maintenance
- Natural aesthetics to match surrounding environment

VersaCap® Intermediate Cover



VersaCap is a wind and erosion resistant, intermediate engineered turf cover that reduces operational headaches and allows for increased gas collection efficiency before final closure. VersaCap prevents erosion, infiltration, runoff and gas emissions during the operational phases of the landfill, and is designed to have a 15+ year life span. It is fast and easy to install, and does not include tires or sandbags to keep it in place.

ClosureTurf® Surficial Gas Landfill Management System

The ClosureTurf Surficial Gas Collection System is a cutting edge technology that outperforms conventional gas collection systems on every metric. It also integrates well with the latest vertical columns for collection and drainage. In many cases, you can reduce the reliance on deep gas wells. The system relies upon positive internal landfill pressures to push the gas to the surface below the geomembrane where collection strips guide the gas to collection points. Benefits include reduced condensate management and treatment, higher collection efficiencies, a potential elimination of landfill oxidation and higher compliance standards (surface scans). It also allows for quicker gas control.



AFFILIATIONS:

Geosynthetic Institute (Partner)
Georgia Tech Research Institute (Partner)
Industrial Fabrics Association International (Member)
Colorado State University - Engineering Research Center (Partner)
Florida Atlantic University (Partner)
Iowa State University (Partner)

CLOSURETURF IS TESTED IN ACCORDANCE WITH:

GTRI-SSWT - Aerodynamic Shear & Uplift
CSU USACE - Hydraulic Wave Overtopping
ASTM D5261 - Mass per Unit Area
ASTM D4632 - Grab Tensile Properties
ASTM D4595 - Wide - Tensile
ASTM D2256 - Tensile and Elongation
ASTM D4716 - Hydraulic Transmissivity
ASTM D5321 - Interface Shear
ASTM D6460 - Large Scale Channel Hydraulics
ASTM D6241 - CBR Puncture
ASTM D6459 - InFill Stability
ASTM D4884 - Seam Strength
G147(02) & G145/G7 - UV Resistance & Stability
UL94 Modifiers - Flammability
ASTM D7277 - Steady State Hydraulic Overtopping
ASTM E 108 - Burning Brand

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