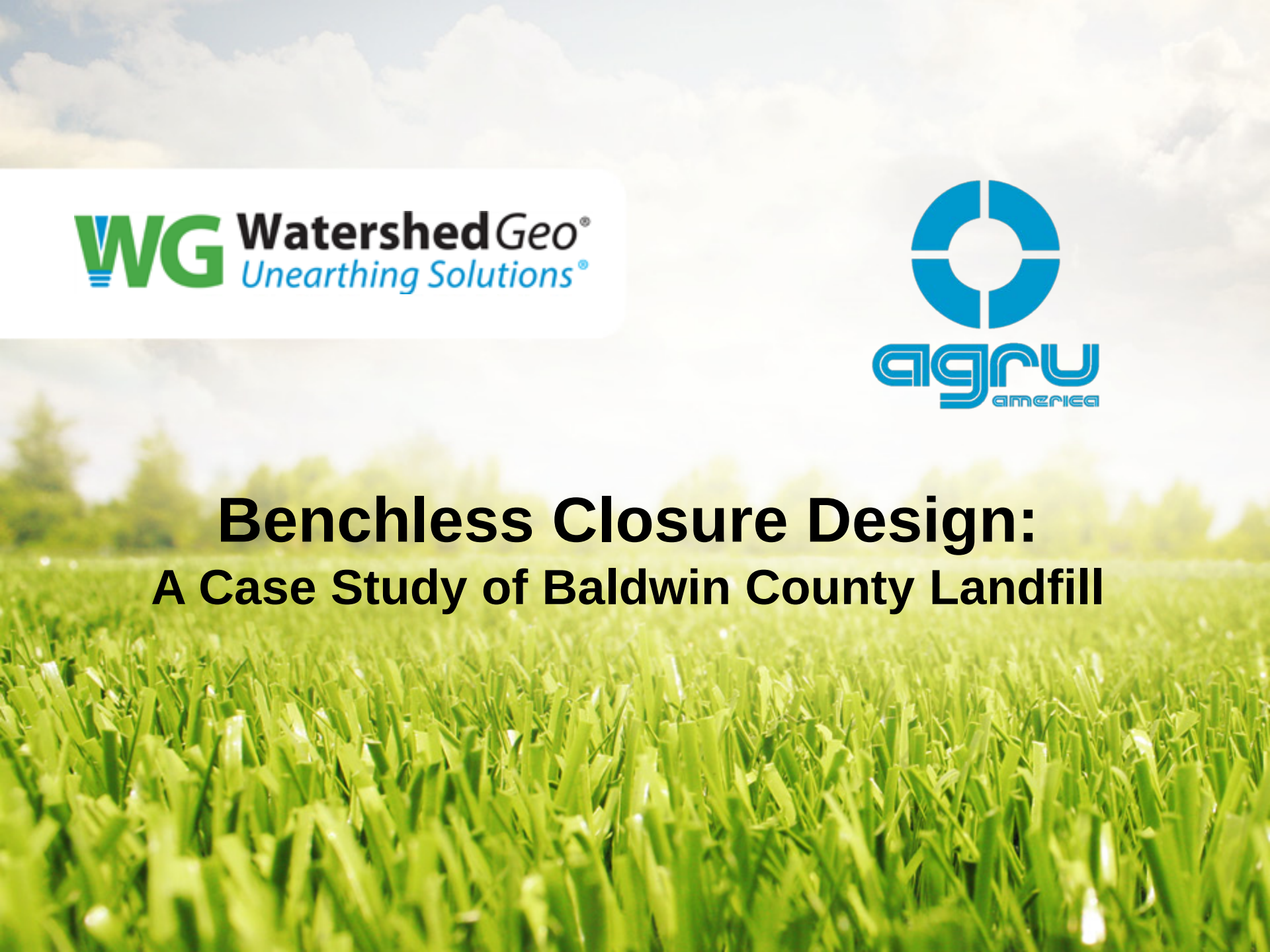

WG WatershedGeo® Unearthing Solutions®

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Benchless Closure Design:

A Case Study of Baldwin County Landfill

Outline & Objectives

Introductions

ClosureTurf® Recap

Baldwin County Landfill Case Study

Recap of Savings & Benefits

About Agru America

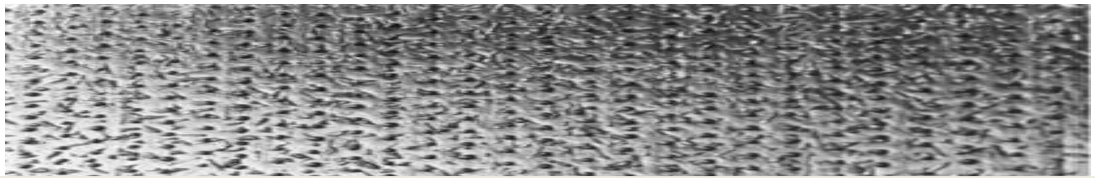
Georgetown, South Carolina

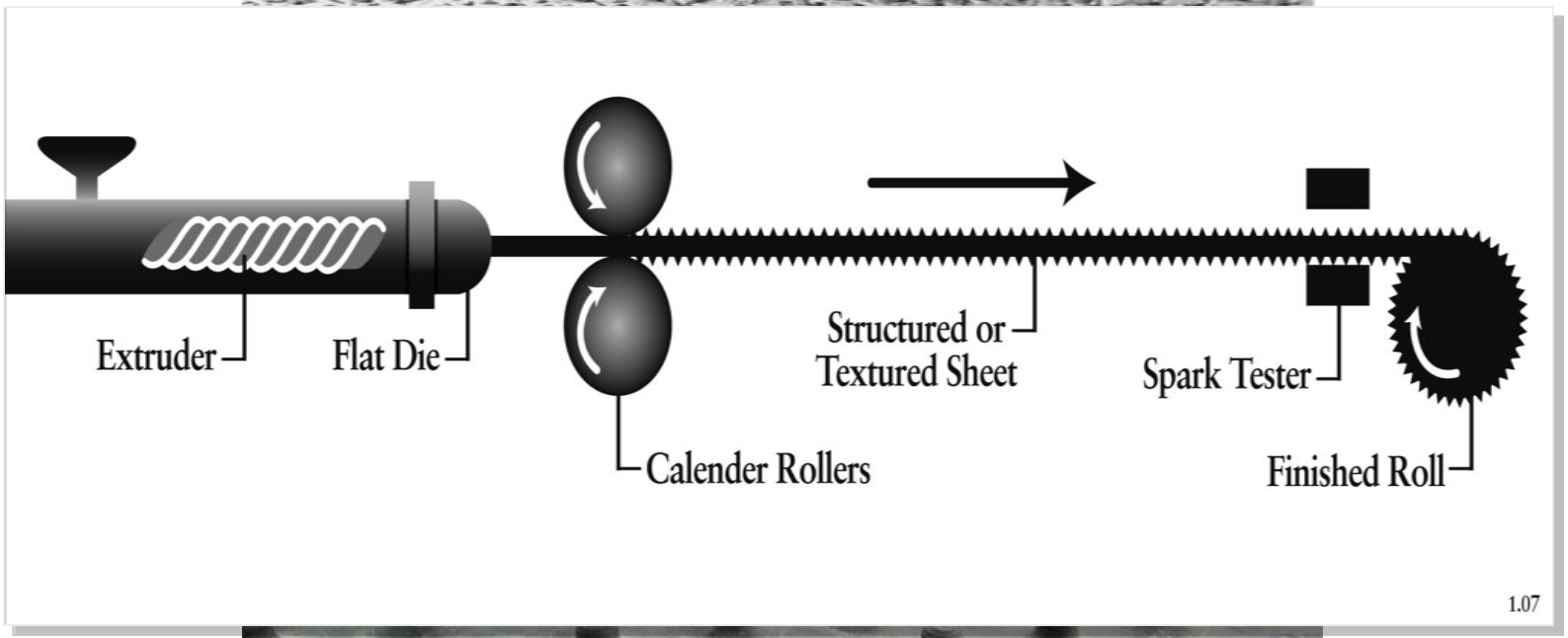
Andrews, South Carolina

Fernley, Nevada

Charleston, SC

Agru Manufacturing Process





About Watershed Geo

- 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
- 20% ownership held by Shaw Industries, A Berkshire Hathaway Company
- Shaw Industries supplies the engineered turf component and Agru America supplies the geomembrane component

Agru & Watershed Geo Partnership

- Watershed Geo and Agru America are business partners
- Watershed Geo is the creator and patent holder of ClosureTurf®
- Agru does market development for Watershed's ClosureTurf® system
- In addition, Watershed uses Agru's structured geomembranes in their ClosureTurf ® system
- Typically, as soon as any ClosureTurf ® discussions become project-specific, Watershed gets directly involved as ClosureTurf ® is an engineered solution, requiring their support from pre-design, through design, bidding, procurement, construction and post-construction operations and maintenance.

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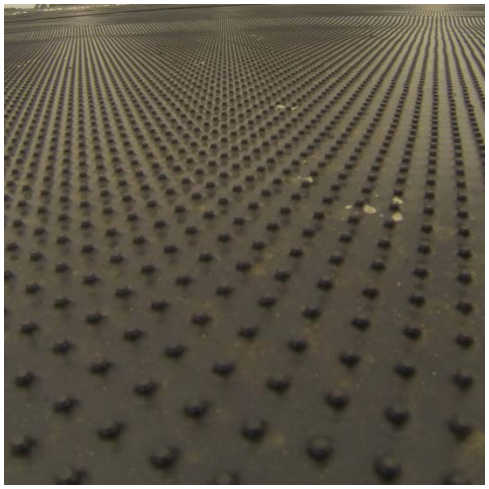
ClosureTurf®

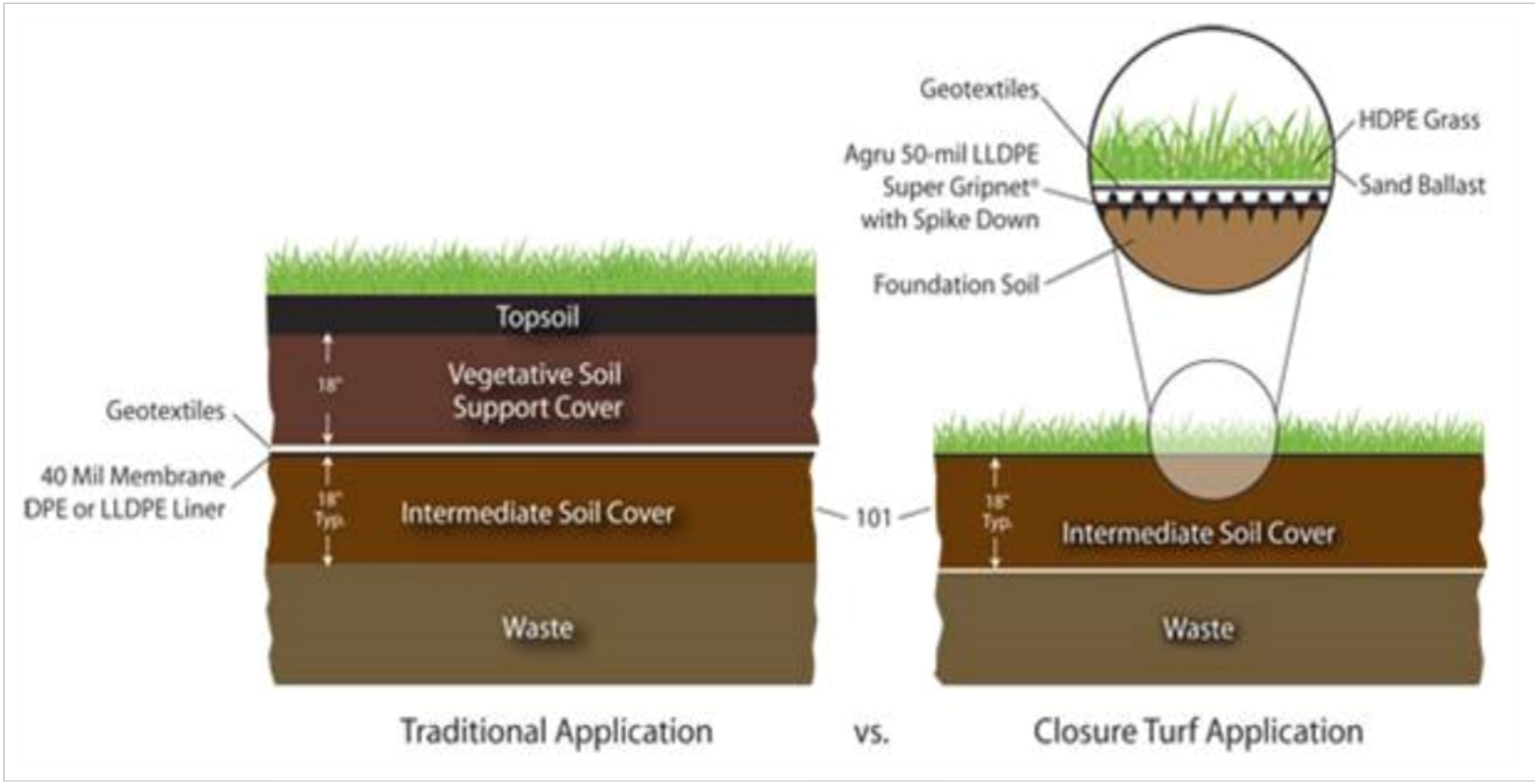
- ClosureTurf is a HYBRID Final Cover System
  - A system that has all the advantages of a soil cover system with out the disadvantages



1. **Structured Geomembrane** – integrated studs on top for drainage/ aggressive spikes on bottom for stability
2. **Engineered Synthetic Turf** – covers and protects the underlying geomembrane
3. **Infill** – ASTM C-33 Sand; HydroBinder® or ArmorFill™

4. *OPTIONAL 4th component to enhance gas collection

Traditional vs. ClosureTurf



ClosureTurf® Advantages

- It's the only solution that provides a predictable benchmark of performance.

- Compare this to a prescriptive cover, which is effectively an engineered structure reliant upon vegetation and weather to perform as designed.

- **Predictable Performance Checklist**
  - Construction Cost
  - Construction Schedule
  - Technical Performance
    - No erosion
    - No turbid runoff water
    - Negligible Infiltration (hydraulic head)
  - Maintenance Cost
  - Design Life

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ClosureTurf® Technology/ Advantages

Baldwin County Landfill Case Study

Recap of Savings & Benefits

Baldwin County Landfill

Owner: Baldwin County
Location: Milledgeville, GA
Municipal Solid Waste Landfill
Completed: 2017
Size: 21.5 acres

Baldwin County Landfill

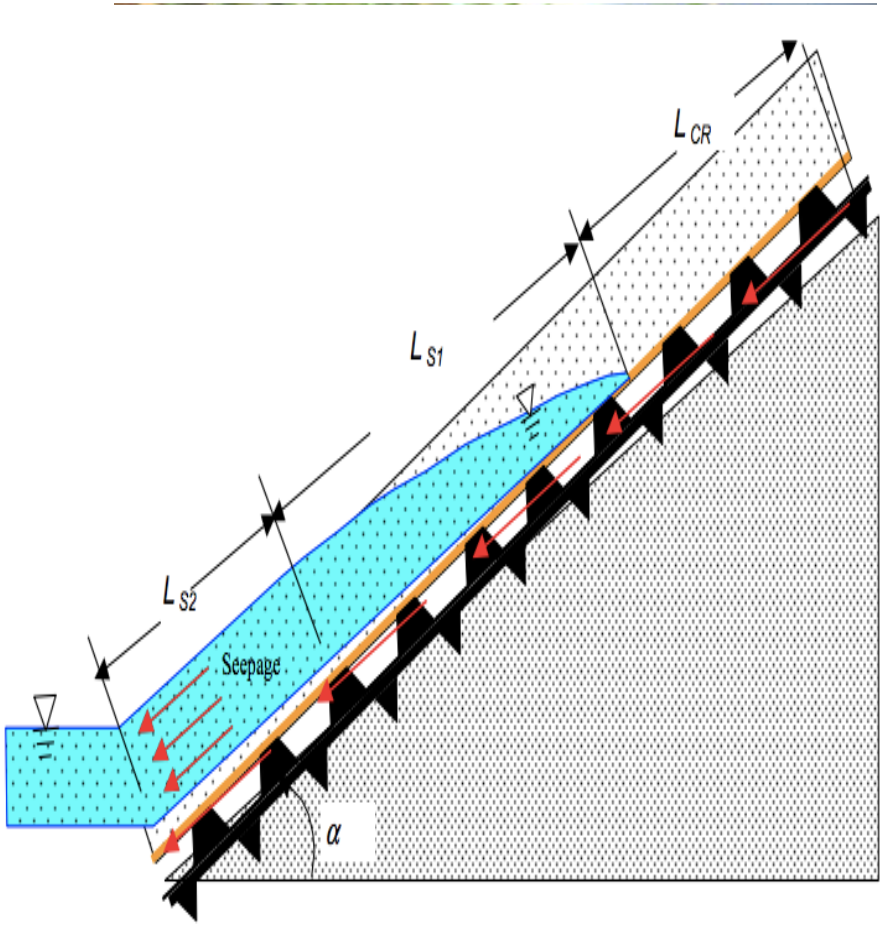
- First Georgia EPD ClosureTurf® approved landfill
- Oasis Consulting Services was the Design/Build Contractor
- Came in $1.5 million under traditional procurement
  - Eliminated the costly standard clay liner
  - Eliminated the vertical in-waste gas collection wells
  - Featured new hydraulic design with ArmorFill™ technology eliminating tack-on berms and downchuttes

ArmorFill™

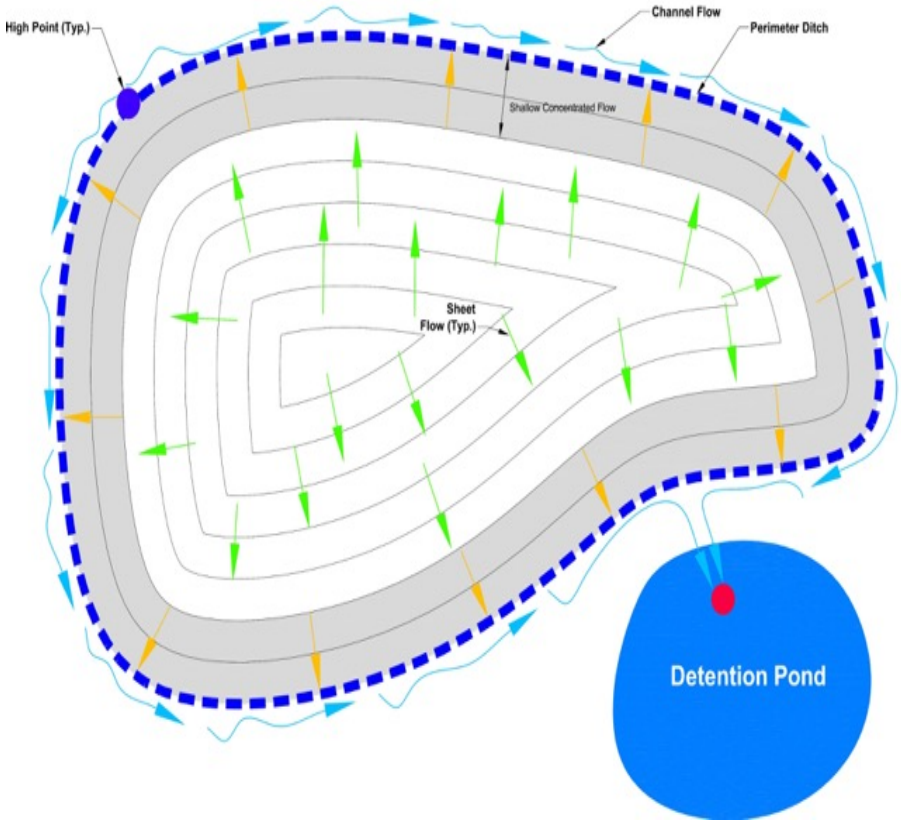
- A polymer-based emulsion developed to bind the sand infill component
- Sand particles are coated to bind in place, however, the product is still permeable allowing storm water to flow through to the geomembrane ($2x10^{-2}$ cm/sec)
- Appropriate for slopes and top decks. Virtually eliminating the critical slope length once required

ClosureTurf® System with ArmorFill™

- Traditional caps and ClosureTurf w/o ArmorFill have critical slope lengths ranging from 90-100 ft.
- With the use of ArmorFill on the ClosureTurf system we can comfortably stretch our critical slope length to over 600 ft.
- If slopes exceed the aforementioned slope length the ratio of pure ArmorFill to water could be increased to increase the shear strength. However, this is fairly rare.



Channelizing Stormwater



- Mitigate the volume & shear forces with diversion berms
  - Channelize the storm water
  - Helps to convey off of cover system
- Benches go to downchutes
- Downchutes go to retention ponds
  - Stormwater has to be retained for a period of time to let sediment settle

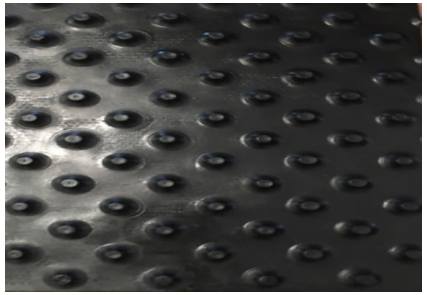
ArmorFill™ Reduced Need for Concentrated Flow

- No drainage length limitation eliminating the critical slope length issue
  - Sand is bound in place
- Diversion berms and downslope channels were no longer required
- Storm water kept in sheet flow & shallow concentrated flow
- No Sediment from storm water run-off eliminating the sediment volume typically needed
- Perimeter ditch discharged directly to a detention pond rather than a retention pond.
  - 11 NTU discharge

Now We Have Choices

- The Baldwin Co. site had slopes steeper than 3:1 in some areas, and greater than 300’ long. Therefore, 50 mil Super GripNet® was used to achieve the desired factor of safety

- However, with ArmorFill you now have two geomembrane choices depending on your site specifics
  - Steepness of slope (3.5:1 or greater)
  - Length of slope (150’ or less)
  - 40-Mil MicroSpike w/ ArmorFill




JCB
JCB


CAS AT7 All-Terrain Placer
CAS Conveyor Application Systems

Award-Winning Design

As acknowledgement for their innovative approach, Baldwin County and Oasis Consulting Services was awarded the 2017 Georgia Chapter American Public Works Association engineering award for innovative, small/rural community projects.

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Savings & Benefits- ClosureTurf® with ArmorFill™

- No soil borrow
- 50% faster construction
- 90% less maintenance
- Cleaner water released into environment- 11 NTU's
- Reduced costs associated with drainage design elements:
  - Reduction/elimination of diversion berms and down slope channels
  - Reduction/elimination of energy dissipation devices
  - Reduction/elimination of sediment storage and water quality volumes
  - Detention of storm water rather than retention allowing for smaller pond volume
  - Reduction of maintenance


WG
WatershedGeo®
Unearthing Solutions®
Thank You!