



**MSE**  
Mechanically Stabilized Earth Systems

Permanent and Temporary MSE Walls  
Reinforced Soil Slopes  
Embankments



Soil reinforcement applications have specific needs and objectives. No one understands that better than TenCate™ Geosynthetics.

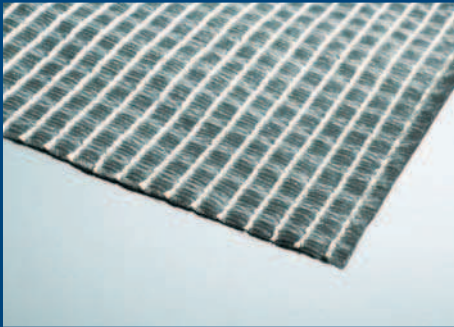
Developed to increase performance, reduce costs, and enable engineers to achieve what was once unachievable, TenCate™ Geosynthetics address the demands of both large-scale commercial sites as well as smaller residential projects. Our geotextiles and geogrids are solutions to such problems as maximizing useable land for site development, soil utilization, and erosion control.

Through engineering and research that span more than 50 years, TenCate™ Geosynthetics continues to lead the way in mechanically stabilized earth system solutions.

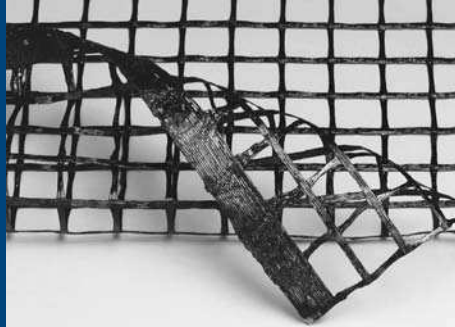
Using our deep knowledge of materials and production methods, combined with a resourceful, hands-on approach, TenCate™ Geosynthetics delivers materials that make a tangible difference in our customer's businesses. Our products enable walls, reinforced soil slopes, and embankments to be constructed cost-effectively and quickly.

Regardless of the project type, the soil being reinforced, or the design life of the structure, TenCate™ delivers the materials that solve your construction challenges.





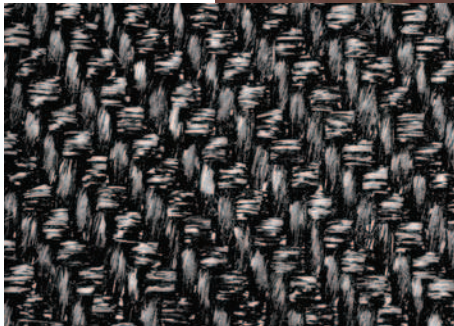
**Mirafi® PEC**  
High strength reinforcement and drainage geocomposite comprised of a nonwoven geotextile and high tenacity polyester fibers.



**Miragrid® XT**  
High strength reinforcement geogrid comprised of high tenacity polyester fibers coated with a polymer coating.



**Mirafi® PET**  
High strength reinforcement geotextile comprised of high tenacity polyester fibers.



**Mirafi® HP**  
High performance reinforcement geotextile comprised of polypropylene fibers.



**Miramesh® GR**  
Biaxial reinforcement geosynthetic comprised of green polypropylene fibers.



The idea of incorporating layers of elements to reinforce soil has been around for years and can be seen in use today within highway alignments, building sites, and residential communities. Our mechanically stabilized earth (MSE) systems are based on this “reinforced soil” concept.

MSE systems significantly strengthen the soil and allow the construction of slopes angled at varying degrees. Whatever the slope angle your project requires, our MSE systems are designed to address your needs.

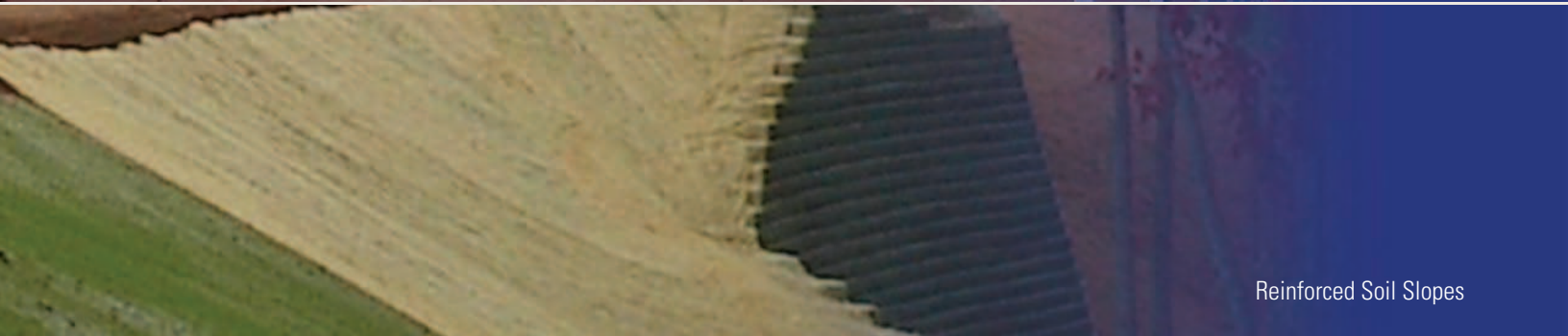
Key benefits of MSE systems:

- Cost-effective construction technique
- Improved soil shear resistance
- Improved performance of on-site soils
- Minimization of land acquisition
- Reduced construction time

Mirafi® geosynthetic MSE system solutions are used as integral components in MSE applications such as:



Permanent & Temporary MSE Walls



Reinforced Soil Slopes



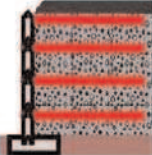
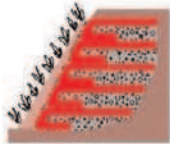
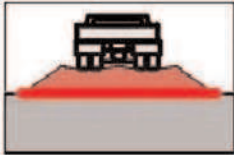
Reinforced Embankments

Mirafi® geosynthetics (i.e., geogrids and geotextiles) MSE system solutions cost significantly less than conventional cast-in-place structures, and their rapid, simple installation process greatly shortens construction schedules. Their flexibility allows them to be used in both large industrial and small residential applications, with a proven performance in walls, slopes, and embankments.

We use our extensive knowledge of geosynthetics and MSE system solutions to make a difference in your business. How? By creating materials that allow your MSE systems to be constructed more efficiently and effectively.

## Guide for Reinforcement Selection:

### “Product Solutions for Each Application”

Type of Structure	Type of Fill	Reinforcement Product
	Permanent MSE Wall	Miragrid® Geogrids
	MSE Temporary Wall	Mirafi® HP Series
	Intermediate / Fine Soils	Mirafi® PEC Series Mirafi® MMESH (face wrap)
	Granular / Free Draining	Miragrid® Geogrids Mirafi® MMESH (face wrap)
	Embankment on soft soil ( $H_{emb} > 1.5 \text{ m}$ ) Granular / Free Draining Intermediate/ Fine Soils	Mirafi® PET Series
		Mirafi® HP Series

# Permanent and Temporary MSE Walls

## Segmental Retaining, Wrapped Faced, Temporary Retaining

The MSE wall has a slope angle that is typically greater than or equal to 70 degrees and includes multiple horizontal layers of man-made elements—usually geosynthetics—that act as reinforcements for the soil used as infill materials.

Advantages of Mirafi® MSE Wall Solutions vs. Traditional Retaining Structures:

### Segmental Retaining Wall

- Durability
  - Manufactured to create a long-lasting system
- Aesthetics
  - Variety of colors, shapes, and styles
- Performance
  - Flexible systems that can tolerate movement

### Applications

Blast/Sound walls  
Coastal protection/sea walls  
Commercial development  
Crusher/Quarry/Batch plant abutments  
Head walls/bridge abutments  
Solid waste transfer stations  
Stream channelization

### Wrapped Faced Wall/Temporary Retaining Wall

- Construction
  - Minimum excavation needed behind exposed face
  - Native backfill used (including non-plastic fines)
  - Drainage provided with geotextiles
  - Skilled labor requirements reduced
- Performance
  - Flexible systems that can tolerate movement

### Applications

Highway bridge construction  
Temporary detour roadway  
Temporary stream channelization

The three types of MSE walls include:



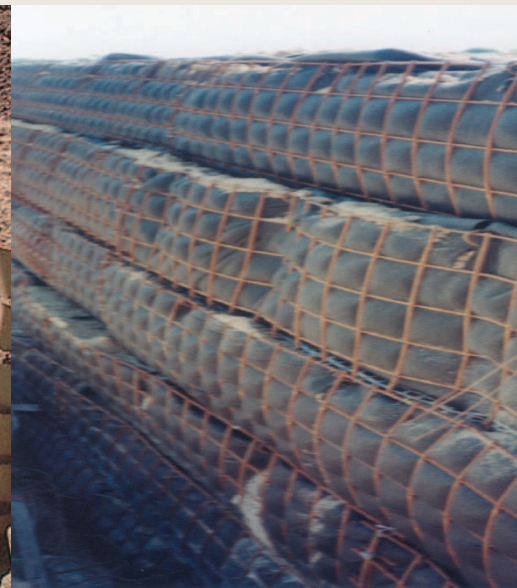
Segmental Retaining Wall



Wrapped Face Wall

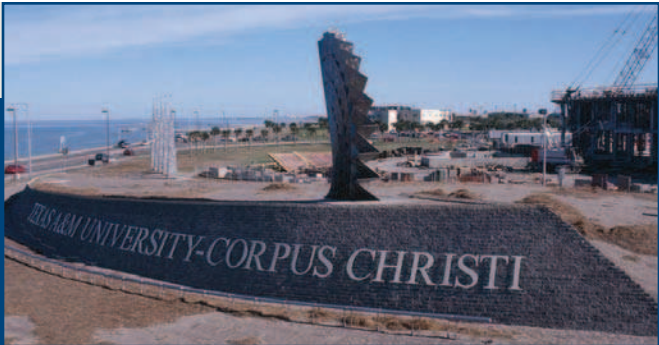
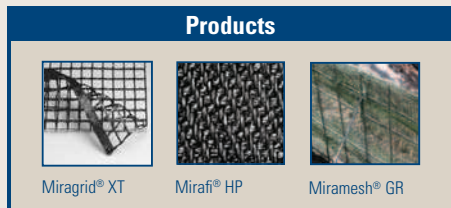
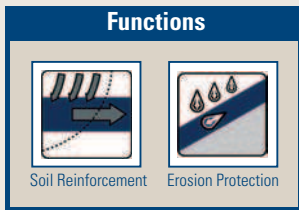


Temporary Retaining Wall



Mirafi® geosynthetics solve permanent and temporary retaining wall strength, stability, and containment challenges.

- Segmental retaining walls constructed with Mirafi® geosynthetics maintain soil tensile strength in the backfill area, which takes pressure off the wall face and allows for more options in the wall facing.
- Wrapped faced walls made with Mirafi® geosynthetics help increase the usable site area.
- Temporary walls reinforced with Mirafi® geosynthetics are a valuable tool for construction sites that need to divert traffic or water flow while maintaining the existing surroundings.



## Case Study

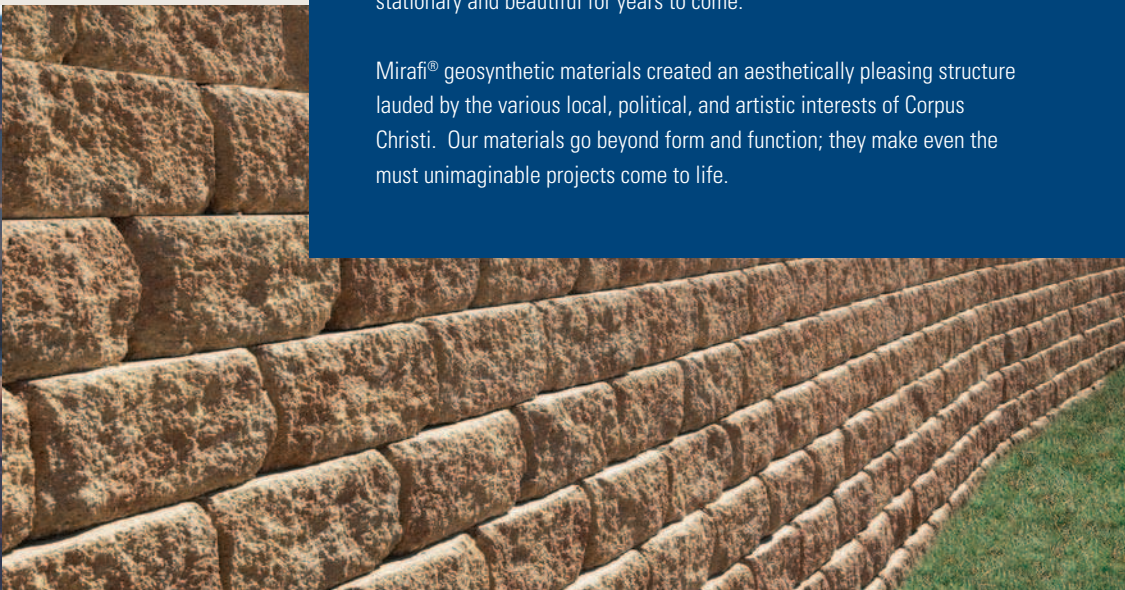
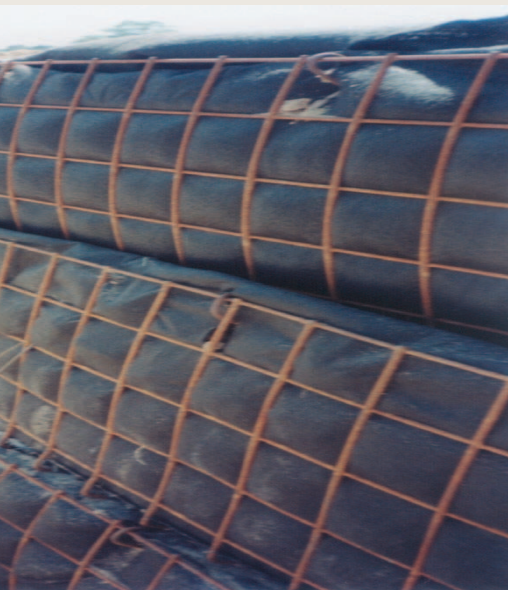
application	Segmental Retaining Wall
location	Corpus Christi, Texas, USA
products	Miragrid® XT Geogrids

When Texas A&M University, Corpus Christi, needed a facelift for its oceanside campus, its benefactors envisioned a structure of a ship with towering spires and intricate sculptures resting atop an elaborate hull. However, this "hull" was a segmented retaining wall 4.3 m. (14 ft.) high, 89.3 m. (293 ft.) long, and with a 23-degree outer slope.

Miragrid® XT Geogrids enhanced the wall design and created a stable soil mass behind the wall, which greatly minimized bulging and other unsightly problems. The contractor was also able to maneuver the steep slope and affix the geogrid between the individual blocks more easily than with stiffer materials.

Because of its stability and flexibility, the materials allowed the project to stay true to the artists' vision—a retaining wall that will remain stationary and beautiful for years to come.

Mirafi® geosynthetic materials created an aesthetically pleasing structure lauded by the various local, political, and artistic interests of Corpus Christi. Our materials go beyond form and function; they make even the most unimaginable projects come to life.



# Reinforced Soil Slopes

## Vegetated, Wrapped Faced

As with MSE walls, the reinforced soil slope (RSS) utilizes multiple horizontal layers of geosynthetics that act as reinforcements for the soil used as infill materials. However, the RSS has a slope angle that is typically less than 70 degrees.

Advantages of Mirafi® RSS Solutions vs. Traditional Retaining Structures:

### Construction

- Maximization of limited right-of-way sites
- Lower site-development costs
- Reduced construction timelines

### Performance

- Ability to increase slope angles
- Minimization of land acquisition costs and maximization of useable land space
- Cost effective alternative to traditional retaining walls

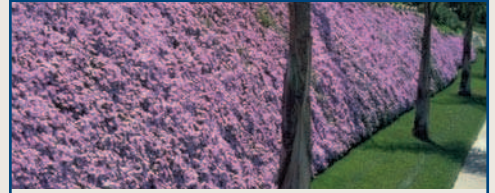
### Aesthetics

- Pleasing appearance with a "green wall"
- Environmentally friendly vegetated surfaces

### Applications

- Commercial/Office parks
- Berms
- Dikes and levees
- Earth dams
- Highway embankments
- Landfills
- Landslide repair
- Mining/Mine reclamations
- Residential developments
- Stream channelization

The two types of RSS include:



Vegetated Slopes



Wrapped Face Slopes

### Functions



Soil Reinforcement



Drainage



Erosion Protection

### Products



Miragrid®



Mirafi® PEC



Miramesh® GR





Mirafi® geosynthetics provide tensile strength and stability, thereby allowing the construction of steep reinforced slopes within limited property line boundaries. Moreover, our materials enable slopes to be constructed to any height at any slope angle. By permitting the slopes to be vegetated or covered by another facing material, Mirafi® geosynthetics also factor in safety by preventing sliding, rotation, and erosion.

At TenCate™ Geosynthetics, we take a hands-on, active approach to every challenge. Our Mirafi® PEC geocomposite products provide not only internal reinforcement but internal drainage to assist in construction of slopes with intermediate/fine soils. Whether it's retaining soil at a slope face, providing secondary reinforcement, or diminishing erosion problems while vegetation takes root, our people and our products are there to provide answers.

The key component with RSS is engineering, and TenCate™ understands that better than anyone. Our experts see the demands faced by our customers and go above and beyond what is expected to deliver the best solutions possible. In fact, our expertise is a resource for our entire value chain.



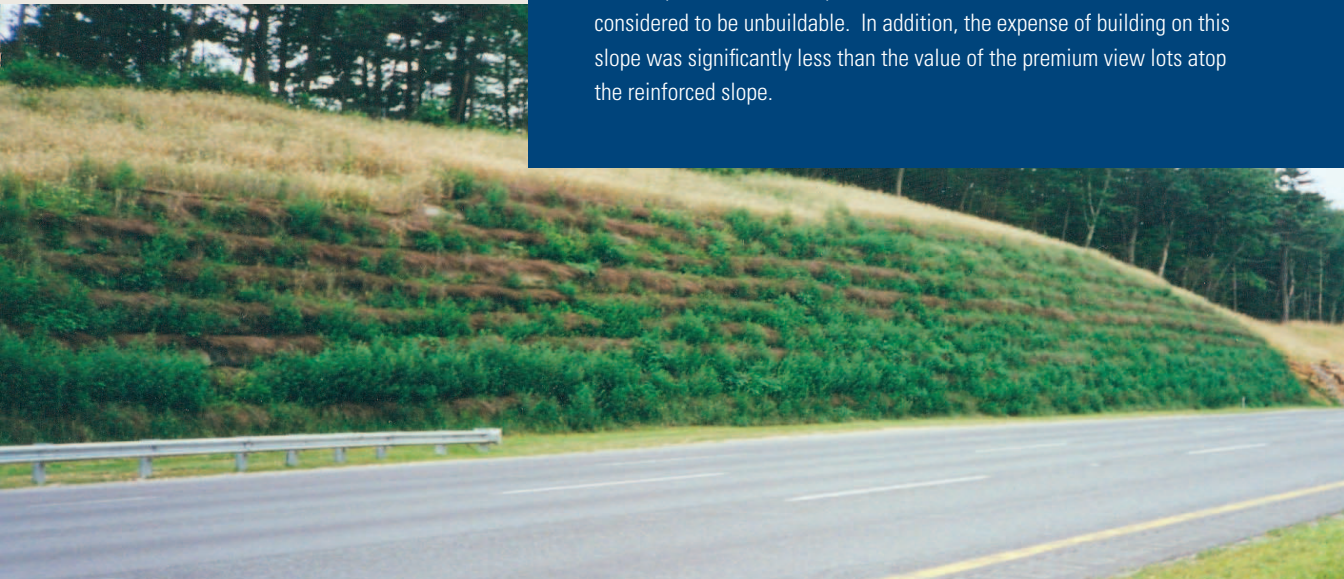
## Case Study

application	Slope Reinforcement
location	Newport Coast, California, USA
products	Miragrid® 10XT, 20XT, & 22XT

A company was charged with developing pricey southern California coastal property along a golf course in an area riddled by landslides, tight property lines, steep slopes, and poor soils without compromising the views of the adjacent golf course or the Pacific Ocean.

To do this, Miragrid® 20XT and 22XT were used to design a MSE slope on the project's north side—a slope designed to withstand displaced soil from a collapsing adjacent property line. While the materials not only stabilized this very high slope and achieved acceptable safety design factors, they were also easy to install, with the contractor able to position more than 5,000 square yards of Mirafi® materials a day.

The north-facing slope is now vegetated and blends in with the natural look of the hills of Newport Coast. More importantly, Miragrid® geogrids made it possible to create premium view lots in an area that was considered to be unbuildable. In addition, the expense of building on this slope was significantly less than the value of the premium view lots atop the reinforced slope.



# Reinforced Embankments

## Embankments

Reinforced embankments—just like MSE walls and RSS—contain multiple layers of geosynthetics that act as reinforcements for the soil used as infill materials. However, in reinforced embankments, soil fill pads are constructed over soft, yielding foundations.

Advantages of Mirafi® Reinforced Embankment Solutions vs. Traditional Retaining Structures:

### Construction

- Working platforms created
- Higher embankments and steeper side slopes permitted

### Performance

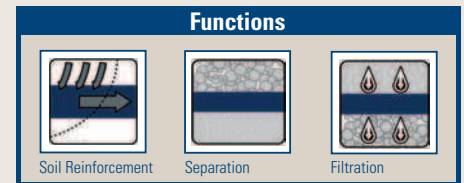
- Promotion of more uniform settlement
- Reduction of construction time and required space
- Improved short- and long-term embankment stability

### Applications

- Airport runway embankments
- Berms
- Containment dikes
- Earth dams
- Flood control/hurricane protection levees
- Highway embankments



Reinforced Embankment



Building embankments on weak foundations can be a construction challenge. Long-term effects of settlement and erosion can put surface improvements at risk. However, TenCate™ Geosynthetics can not only provide long-term stability, they can eliminate the need for costly over excavation and soil replacement.

Depending on the project specifications, Mirafi® geotextiles can be used directly on the soft foundation, over the foundation piles, or over the areas subject to void formation prior to the placement of the embankment fill. The fill material can then be added. Consequently, the low shear strength of the foundation material is offset and the subgrade is kept separated from the structural fill. When used in this manner, TenCate™ geosynthetics offer stability and limit differential settlement—just two of the measurable benefits our materials bring to our customers.



Marsh Embankment



## Case Study

application	Embankment on Weak Subgrade
location	Timmins, Ontario, Canada
products	Mirafi® PET 600/100

When the Provincial Highway 101 Bridge crossing Frederick River came to the end of its service life and required replacement, site constraints dictated that the replacement bridge be constructed in the same location as the former bridge. Therefore, a detour, including a three-span temporary bridge, had to be constructed on weak subgrade directly adjacent to the aging steel truss structure.

To accommodate the loads of the approach embankments, a very strong geogrid was required. However, none that strong existed, and it was thought that the long-term design strength could only be met by using multiple layers of geogrid. TenCate™ developed a new woven polyester geotextile, PET 600/100, which exceeded the necessary long-term design strength.

Individual panels of the geotextile were sewn together and formed into larger panels that were then concertina folded, rolled onto steel cores, and placed directly onto the subgrade. Because of the ease of installation, the largest area covered (190m. x 30m.) was done using nine sewn panels in less than one day.

The total material supplied exceeded 9,000 square meters (10,764 yd<sup>2</sup>). Consequently, the use of this geotextile brought about a savings of approximately 35 percent over the cost of supplying and installing geogrids.

TenCate™ develops and produces materials that increase performance, reduce costs or enable people to achieve what was once unachievable. Our goal is to contribute significantly to progress in the industries in which we work.

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 **TENCATE™**  
materials that make a difference