

## Case Study

application	<b>Landslide Repair</b>
location	<b>Jordan, MN</b>
product	<b>Miragrid® 5XT Geogrid</b>

job owner	<b>Dr. Lyle and Esther Kraugh</b>
engineer	<b>Gale-Tec Engineering, Inc.</b>
installer	<b>Rachel Contracting</b>

TenCate™ develops and produces materials that function to increase performance, reduce costs and deliver measurable results by working with our customers to provide advanced solutions.

### THE BACKGROUND

A landslide comprising approximately 400 ft along the banks of the Sand Creek in Jordan, Minnesota occurred in March of 2006. A single family residence was located 50 ft away from the top of slope. The failure resulted in a slump of 30 ft deep occurring in the top of the 75 ft high slope and was on the verge of infringing into the footprint of the \$1,000,000 home.

Gale-Tec Engineering, Inc. a well known geotechnical engineering firm specializing in landslides was retained by the Soil and Water Conservation District. The slope stability analysis indicated that perched water running beneath the residence backyard and into the slope acted to soften the silt and clay, thereby reducing those soils' shear strength and "lubricating" the landslide. That reduction in shear strength along with trapped groundwater decreased the slope's FS to 1.0 in March, 2006, probably during a rainy period, and failure occurred.

Gale-Tec Engineering selected a reinforced soil slope (RSS) to repair the failed riverbank. The RSS consisted of Miragrid® 5XT and Miragrid® 8XT geogrid reinforcement layers placed in conjunction with a compacted granular backfill. The geogrid provides high tensile strength and high interface friction when embedded in soil. The stability afforded by the interaction between the geogrids and granular backfill allowed for re-construction of the slope at a 1H:1V angle. Figure 1 shows the Gale-Tec plan constructed by Rachel Contracting, Inc.

### THE CHALLENGE

The objective of the project was to repair the existing slope failure due to a landslide. The existing slope had experienced several localized washings that continued to wash away the backyard of an existing home. Continued slope failure may jeopardize the building foundation. Consequently, the object of the project was to repair the existing areas that had previously sluffed off, and stabilize the entire face of the slope. The existing slope was failing due to a combination of three factors: creek flow undermining (scouring) the toe of the slope, rain water washing the naturally steep face of the slope, and water (possible spring) weeping

through a sand vein near the middle/upper elevation of the slope.

### THE DESIGN

The design included two phases (lower slope and upper slope stabilization). The lower slope was simple cut/graded to a consistent slope angle while trying to minimize any changes to the existing angle of the slope. Then it was stabilized by placing a layer of 4" cellular confinement over the entire surface. The 4" cellular confinement was filled with topsoil borrow, seeded and covered with a Cat. 4 erosion control blanket. The upper slope was subcut (benched) up to 25 ft from the top of the slope. Then it was built back with successive 8" horizontal layers of cellular confinement with Miragrid® 5XT geogrid reinforcement. The cellular confinement was backfilled with granular borrow, and the face was backfilled with a mixture of topsoil, compost and seed. At the base of the upper slope was a coarse/rock layer to facilitate permanent drainage within the slope repair. This rock layer was relieved by 6" PE drantile daylighted to the bottom of the slope and into the creek.



## THE CONSTRUCTION

The construction started with subcutting the upper slope of existing clay soil. The top of the subcut was utilized as an access point for the top of the lower slope. Then the 4" cellular confinement was installed on the lower slope, backfilled, seeded and covered. At the same time a rip rap layer was installed along the creek slope to minimize future scouring of the toe of the slope. Upon completion of the lower slope, the upper slope was constructed from the bottom layer up. A Cat 330 excavator, Cat 277 skid steer and labor with vibratory plate compactors were used to build up the lower slope. Upon completion of the lower slope, final restoration of the backyard including installation of a spit rail cedar fence at the top of the slope was completed. The repair included a blanket drain at the base of the RSS and extended up the backslope as shown in Figure 1. The purpose of the blanket drain was to help alleviate seepage pressures within the slope soils. The blanket drain consisted of Mn/DOT 3149.2H Coarse Filter Aggregate. Mirafi® 180N geotextile was placed above and below the blanket drain.

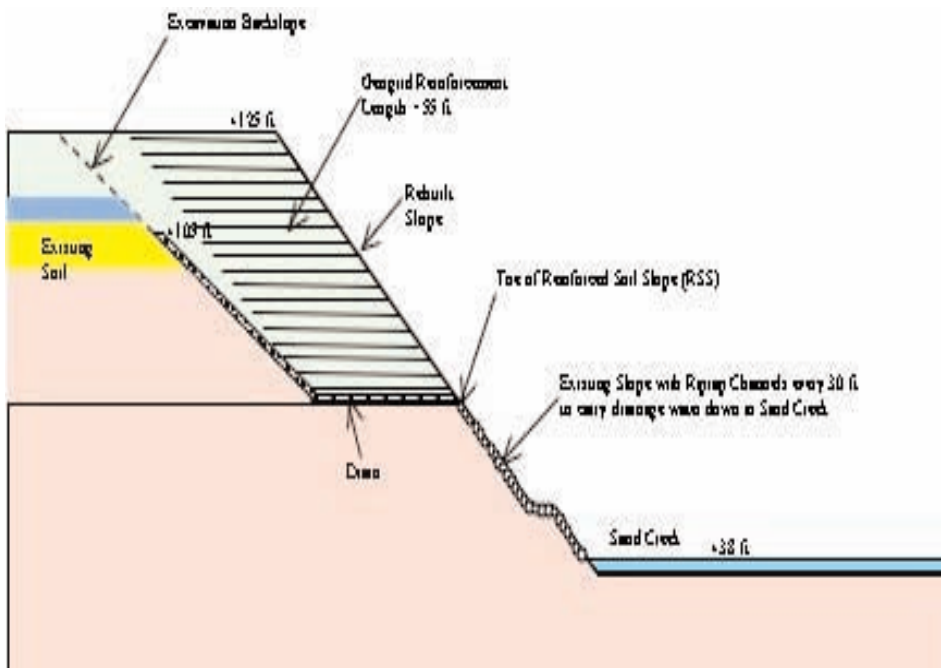


Figure 1.

## THE PERFORMANCE

The slope has been permanently restored and is performing as expected without any further erosion to date.



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