The Problems and Pitfalls of Soil Erosion in the Solar Industry

Soil erosion can wreak havoc on a solar farm development at every step of its life cycle, from construction to operation. Here's an outline of the impact erosion can make on a solar farm project in order to better prepare your project today and for the future.

Why Erosion Control Matters Now

Today's more frequent, higher intensity storms necessitate effective erosion control planning and implementation on all medium- to large-scale solar farm developments. As far back as 2004, researchers predicted climate change's effect on erosion rates, with soil loss expected to escalate in areas with increased precipitation as well as locations subjected to more drought. According to a paper published by the Journal of Soil and Water Conservation, climate change is expected to increase soil erosion. "Where rainfall amounts increase," the researchers write, "erosion and runoff will increase at an even greater rate: the ratio of erosion increase to annual rainfall is on the order of 1.7." Worse still, the researchers concluded that "[e]ven where annual rainfall would decrease, system feedbacks related to decreased biomass production could lead to greater susceptibility of the soil to erode." Today, we are living with those predictions, so soil erosion must absolutely be addressed.

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The importance of erosion control isn't just confined to global stewardship; erosion affects photo-voltaic (PV) facilities financially and existentially. Solar sites are under increased scrutiny by local governments and a critical public. In Guam, for example, the Attorney General's office recently sued Korea Electric Power Company and Samsung E&C America for damage caused to an underground drinking water source due to improper erosion control measures. Samsung E&C subsequently paid out a settlement to the Guam Contractor's License Board. There is still an EPA notice of violation and a pending

lawsuit filed by the Office of the Attorney General, including solar project owner Korea Electric Power Corporation's Guam subsidiary. This type of backlash is also common in the contiguous United States. A stop-work order was recently served to an Arizona-based power company during the construction of a solar farm in Campbell County, Virginia due to road damage caused by erosion and runoff. In fact, since breaking ground in 2020, the project has been issued six stop-work orders and 26 notices of violations by Campbell County. They have since spent resources implementing additional measures including truck washing stations and road sweepers. Deliberate planning (and the right solution) for erosion control can save your PV site and make sure that the project goes off without a hitch.

What Solution is Right for Your Development?

Until now, engineers for solar developments have had to choose between hard armor solutions that provide typically reliable, immediate to long-term protection, and lightweight solutions with superior aesthetics. There are several arguments to be made for each solution.

HARD ARMOR SOLUTIONS

Hard armor erosion control materials like rock riprap have their advantages; they are instantly effective and generally reliable. Riprap is ubiquitous in many parts of the country and proven in many applications. But rock's disadvantages (literally) outweigh its benefits. Depending on your PV facility's distance to the nearest quarry, rock can be prohibitively expensive in materials alone. According to one calculation, "the transportation of rock riprap creates [an average of] more than 36 tonnes of emissions" for a coverage area of ~65,000 sq. ft, whereas the equivalent coverage of RECPs would produce around one ton of emissions. Once you factor in the labor and fuel costs of all the added miles traveled transporting hard armor materials, the price adds up quickly.

The transportation of rock riprap creates an average of more than **36 TONNES OF EMISSIONS**

Environmental concerns regarding rock riprap don't disappear after installation. On the contrary, in the Environmental Protection Agency's (EPA) document "Storm Water Technology Fact Sheet - Turf Reinforcement Mats," the agency states that although "these permanent measures can withstand great hydraulic forces, they are costly, and they do not provide the pollutant removal capabilities of vegetative systems." Through filter action, vegetation manages to stop the spread of pollutants. Furthermore, because many PV facilities are being constructed on or around agricultural land, it is vital that local pollinator populations are fostered. A paper in Environmental Science and Technology highlights the importance of "the development of solar-pollinator habitat to improve the compatibility of USSE facilities in agricultural landscape." In short, the way to create habitats for pollinators is to promote growth of native vegetation. The researchers go on to mention that "Other ecosystem services resulting from the planting and development of pollinator habitat at USSE facilities may include, but are not limited to, improvements to local biodiversity, water control, and carbon storage." Hard armor solutions are incapable of doing double-duty on your job site.

Maintenance is also an issue with rock riprap. Inevitably, some maintenance will be required during the hard armor installation's lifetime. This maintenance usually takes the form of replacing disturbed rock and the removal of weeds and other unwanted vegetation. Because riprap provides uneven footing, maintenance is difficult and potentially hazardous. Rock's inherent weight may also necessitate the use of heavy equipment during maintenance. Furthermore, using mowing equipment around rock near solar arrays greatly increases the likelihood of damage to the panels and/or supports by ejected rock, potentially resulting in costly repairs.

Maintenance is made more difficult by rock's tendency to generate and harbor dust that can be blown about and eventually land on the PV panels, which may increase the need and/or frequency of panel surface cleaning. According to the National Renewable Energy Laboratory, "[t]he energy lost annually from [solar panel] soiling amounts to as much as 7% in parts of the United States to as high as 50% in the Middle East." This is a significant loss in efficiency and is only exacerbated by rock's properties. Rock's simplicity and permanence are attractive but ultimately leave much to be desired when it comes to a well-rounded erosion solution.

TURF REINFORCEMENT MATS (TRMs)

TRMs and other rolled erosion control products (RECPs) are the most common "soft armor" erosion control solutions used today. RECPs are much easier to install than hard armor solutions. They usually don't require heavy equipment for installation or maintenance. The vegetation around and growing through the RECP can be maintained with standard mowing equipment. They also have clear economic advantages over hard armor solutions; they are generally cheaper per square foot and easier to transport. Where one truckload could hold less than 200 square feet of rock riprap, a similar truck can transport square footage of TRMs in the 10,000+ range. There are, however, certain drawbacks to traditional TRMs.

Most conventional TRMs have relatively
LOW SHEAR STRESS RATINGS
of 2 – 3 lbs/sf before vegetation establishment

Crucially, most TRMs require a 6-12+ month vegetation grow-in period before they can provide a high level of erosion resistance. According to the Erosion Control Technology Council's (ECTC) specifications for permanent RECPs, TRMs must have a minimum unvegetated permissible shear stress rating of 2 lbs/sq. ft, as most conventional TRMs have relatively low shear stress ratings between 2 and 3 lbs/sq. ft before vegetation establishment. This means that for an extended period after installation conventional TRMs are at a greatly increased likelihood of failure. With today's more frequent, high intensity storm events in many areas, and drought-induced slow vegetation establishment in others, you simply don't have time to wait for vegetation to mature for your solar project to become protected from erosion.

Most TRMs require a
6-12+ MONTH
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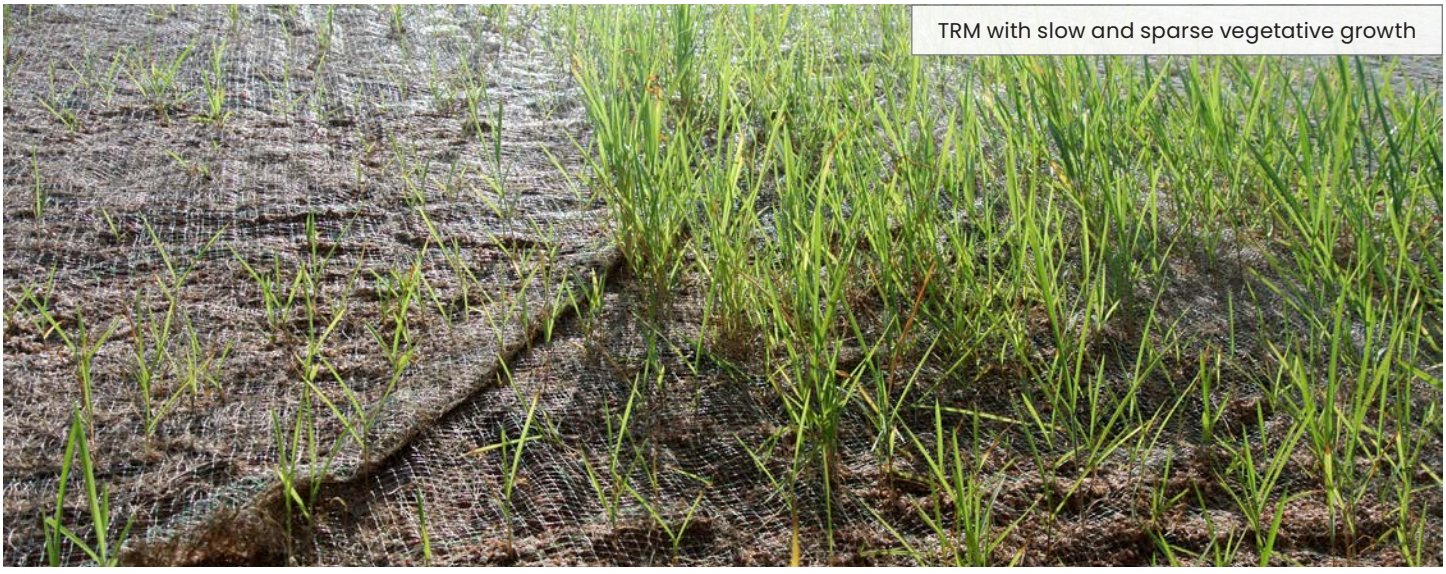


TRM with slow and sparse vegetative growth

The New Solution: InstaTurf®

We've developed a new solution that avoids the pitfalls of both hard armor solutions and conventional soft armor alternatives. InstaTurf is an innovative new hybrid turf system that offers the immediate and long-term erosion protection of hard armor solutions along with the light weight and cost-effectiveness of TRMs. InstaTurf utilizes a simulated three-dimensional grass structure to form a shear plane above the soil in conjunction with a specially engineered filtration fabric backing to immediately protect the soil from erosion much like natural grass. Because the mat is permeable, vegetation can simply grow through its simulated turf structure, further securing the product in place and increasing its already outstanding erosion resistance. Once vegetation grows in, InstaTurf permanently reinforces it, substantially increasing the vegetation's long-term erosion resistance. Thus, InstaTurf can enable the use of native plants in erosion-prone areas where unreinforced vegetation would eventually wash out, providing more habitat for local pollinators. This vegetation growth also filters sediments and other pollutants that would otherwise spread to populated areas or ecologically critical water sources. InstaTurf can be applied all over a solar development: along the panel drip lines, beneath the arrays, around pilings, in channels and other drainage systems, around detention ponds, outfall areas, and anywhere high flow-induced shear stresses and soil loss may occur.

InstaTurf®

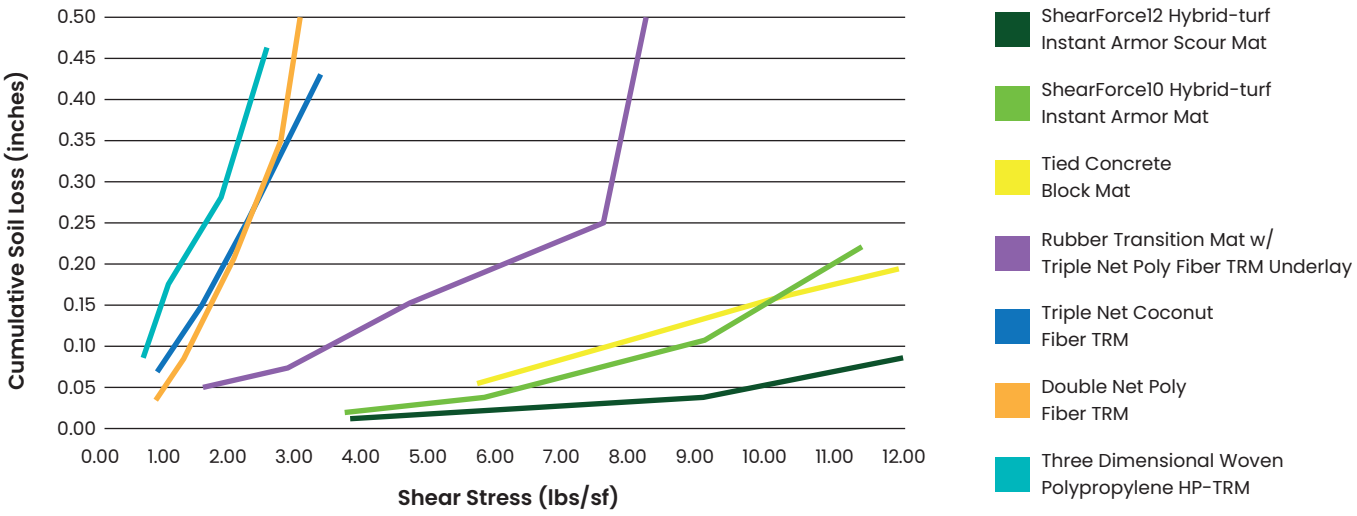
SHEARFORCE™ 10

SHEARFORCE™ 12

Soil Loss vs Shear Stress

in ASTM D6460 Large-Scale Channel Testing of Unvegetated Permanent Erosion Control Mats

(0.50 Inch Cumulative Soil Loss Failure Criteria)



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Note: All referenced large-scale channel tests conducted as TREI Environmental's Denver Downs Research Facility using ASTM D6460 testing protocol or modified versions thereof.
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AASHTO-NTPEP Large-Scale Channel Erosion Testing of Western Excelsior's PP5-10, Double Net Poly Fiber Matting, May, 2014.
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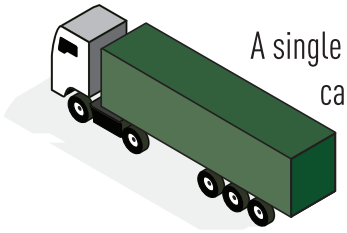
As you can see in the graph on the previous page, the InstaTurf ShearForce 10 and ShearForce12 (the two green lines) provide a much greater level of immediate (without vegetation) soil erosion protection than conventional TRMs and HP-TRMs, with performance more similar to a heavier and more costly tied concrete block mat under similar applied shear stresses. What's more, InstaTurf only becomes more effective as vegetation grows in. The immediate protection that InstaTurf provides means that you won't run the risk of your erosion control solution failing before vegetation can grow in. Once vegetation does grow in, landscaping and maintenance is simple because InstaTurf can be walked, mowed, and driven over normally.

LIGHTWEIGHT AND FLEXIBLE

InstaTurf is lightweight and easily transportable; a single truckload of InstaTurf ShearForce10 can cover approximately 26,000 sq. ft. Unlike hard armor solutions, InstaTurf can be placed on a slope and still allow for the installation of arrays on said slope. With a hybrid turf system, you can widen the potential scope of your solar project. The use of InstaTurf will allow you to take advantage of cheaper, more sloping land that would otherwise be unsuitable for PV facilities. Additionally, you can spend less time and money grading the land for the installation of arrays. Less grading also means you can avoid soil disruption that would expose more erosion-prone soil.



A single truckload of InstaTurf can cover approximately **26,000 SF**

AESTHETICS

Aesthetics are a concern for many utility-scale solar projects. Both hard armor solutions and conventional TRMs can prove to be an eyesore for locals. This isn't simply an offhand concern for looks; site aesthetics can make or break a utility-scale solar project. Massive solar developments have been canceled because of public image. What would have been the US's largest solar farm was canceled in 2021 due to the locals' issues with the aesthetics of the development. Rock solutions are conspicuous and harsh looking, and TRMs can look ragged until vegetation fully grows in. InstaTurf's simulated 3-D grass structure mimics the look of grass during the critical stage of construction when locals are most likely to complain about site appearance.

InstaTurf's Unlikely Origins

After 28 years with a leading manufacturer of TRMs, Tim Lancaster theorized that a material that looks like grass would protect soil just like natural grass. He picked up an artificial turf doormat from his local hardware store and performed small-scale tests in his backyard to determine if vegetation would grow through the artificial turf matrix. After promising results, he partnered with St. Louis-based Grassworx LLC, the manufacturer of the artificial turf doormat he tested. Grassworx LLC produced a prototype specifically designed to prevent soil erosion and Tim subjected it to rigorous ASTM D6460 channel testing. Everyone involved was blown away by the results.

InstaTurf is a paradigm-shift in the erosion control space and a boon to solar developers everywhere. Its ability to provide rock-like erosion protection coupled with the vast benefits of natural vegetation is changing how engineers and developers think about protecting their solar farm projects. Schedule a consultation with Tim to determine if InstaTurf is the right fit for your solar development.

For more information,
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- Scientists Studying Solar Try Solving a Dusty Problem
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- Control Nettings (MCNs), Open Weave Textiles (OWTs), Erosion Control Blankets
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