



THE EVOLUTION OF GEOSYNTHETICS: FROM THE ORIGINS TO THE MODERN ADVANCED SOLUTIONS

Date

December 20, 2022

MACCAFERRI



20' The evolution of geosynthetics

10' The development of multifunctional solutions

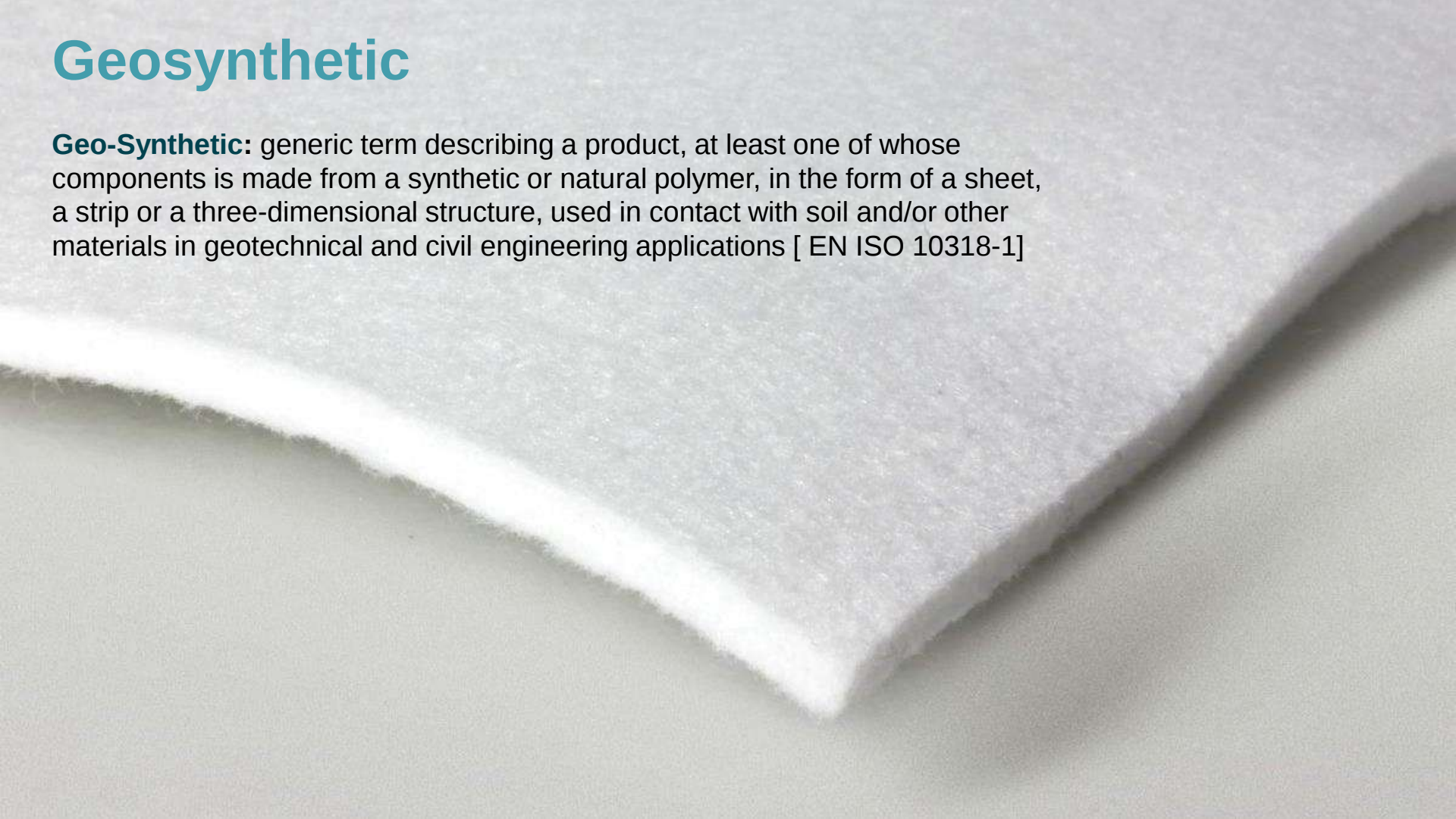
Live Q&A Session

Speaker

S. De Carlo – Civil Engineer and Maccaferri Corporate Manager

Geosynthetic

Geo-Synthetic: generic term describing a product, at least one of whose components is made from a synthetic or natural polymer, in the form of a sheet, a strip or a three-dimensional structure, used in contact with soil and/or other materials in geotechnical and civil engineering applications [EN ISO 10318-1]

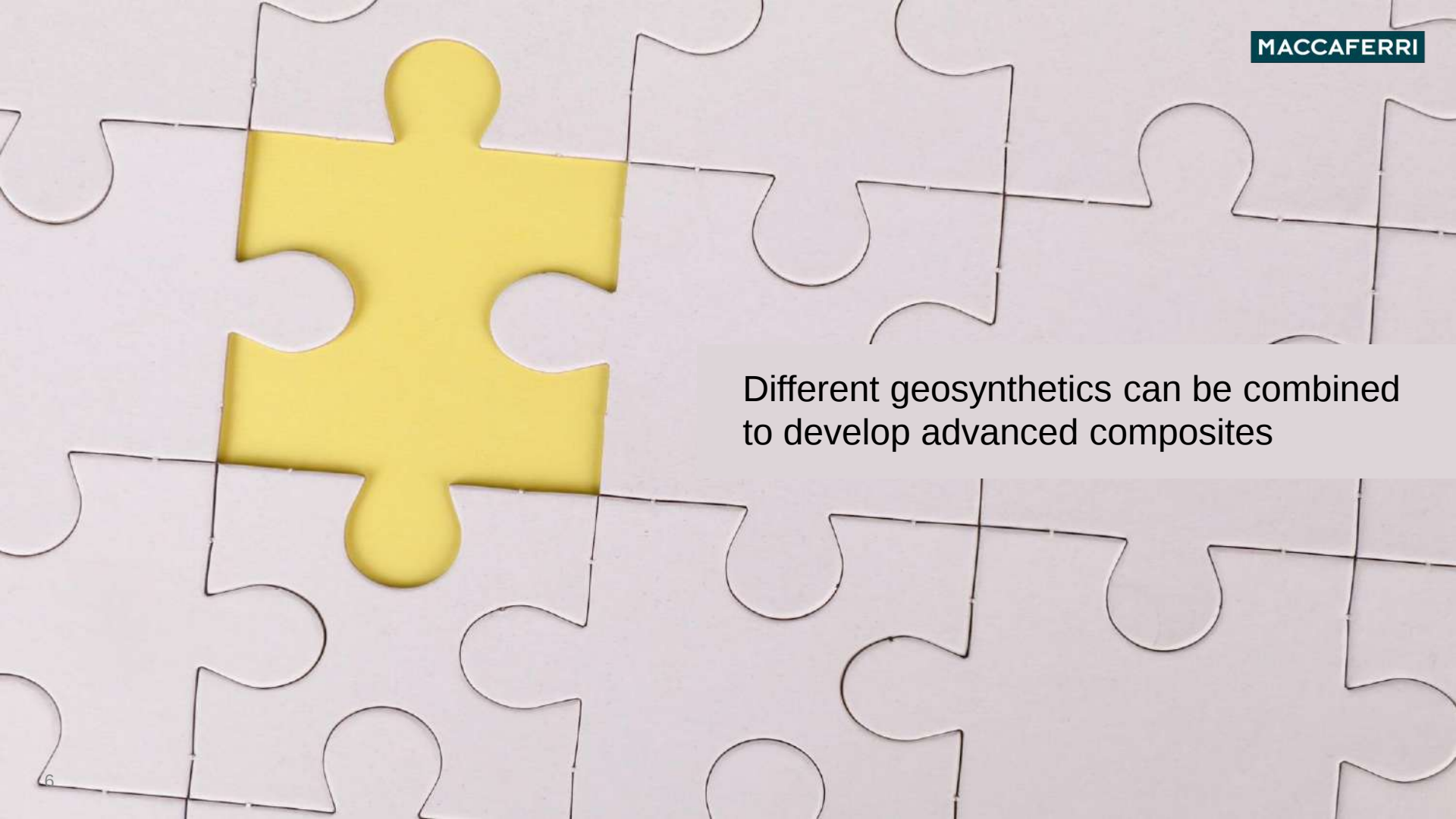


- Past civilisations (Egyptian, Ancient Romans...) used inclusions of **natural materials** to stabilise steep slopes and unstable soils.
- Natural materials do not retain their properties over long time due to **biodegradation**.
- Starting from the 1960', **polymers** started to be used. This enabled the construction of longer lasting structure





Geosynthetic materials have a huge benefit: their great flexibility

A close-up photograph of a white puzzle board with several interlocking puzzle pieces. One piece, located in the upper-left quadrant, is a vibrant yellow color, contrasting sharply with the surrounding white pieces. The lighting is soft, creating subtle shadows that emphasize the three-dimensional shape of the puzzle pieces.

Different geosynthetics can be combined
to develop advanced composites

THE BEGINNING

ENGINEERING
EVOLUTION

FIRST
DEVELOPMENT

NEXT GENERATION



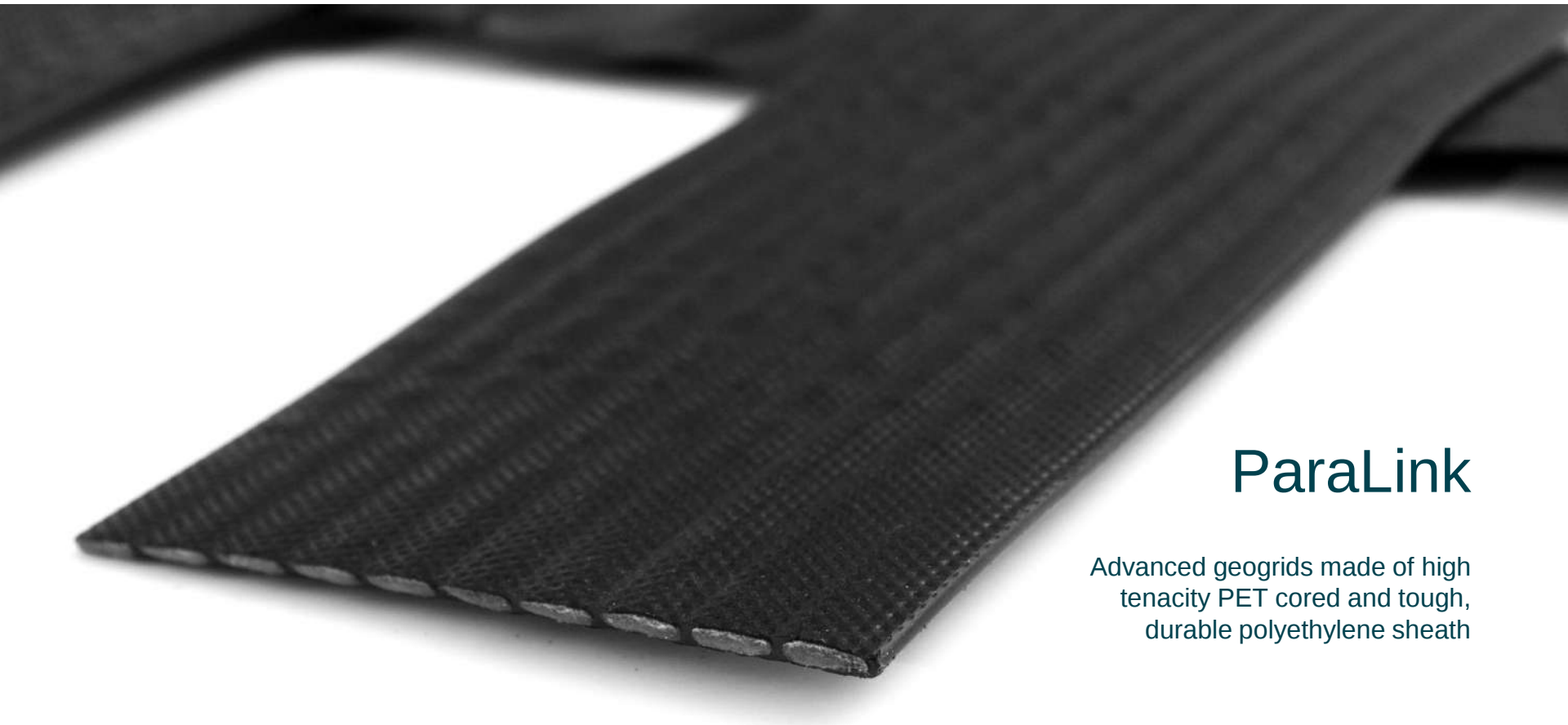
THE BEGINNING



THE BEGINNING

Standard Application of Geosynthetics

MACCAFERRI



ParaLink

Advanced geogrids made of high
tenacity PET cored and tough,
durable polyethylene sheath

THE BEGINNING

Standard Application of Geosynthetics



THE BEGINNING

A light teal arrow-shaped box pointing to the right, containing the text 'THE BEGINNING'. A vertical line extends downwards from its bottom center to a horizontal line that spans the width of the slide.

FIRST
DEVELOPMENT

A dark teal arrow-shaped box pointing to the right, containing the text 'FIRST DEVELOPMENT'. A vertical line extends upwards from its top center to the horizontal line.



MacDrain



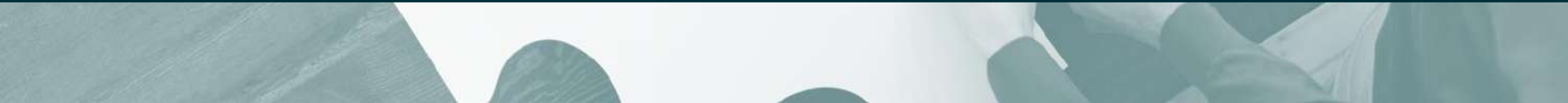
MacMat R



ParaDrain™



REUSE OF WASTE AND SITE WON MATERIALS





IMPORTED FILLS

- ❑ Expensive to quarry and becoming more so as tax penalties increase
- ❑ Environmentally unacceptable as quarrying damages the countryside
- ❑ Costly and environmentally unacceptable to transport
- ❑ Not necessary since marginal fills can be used

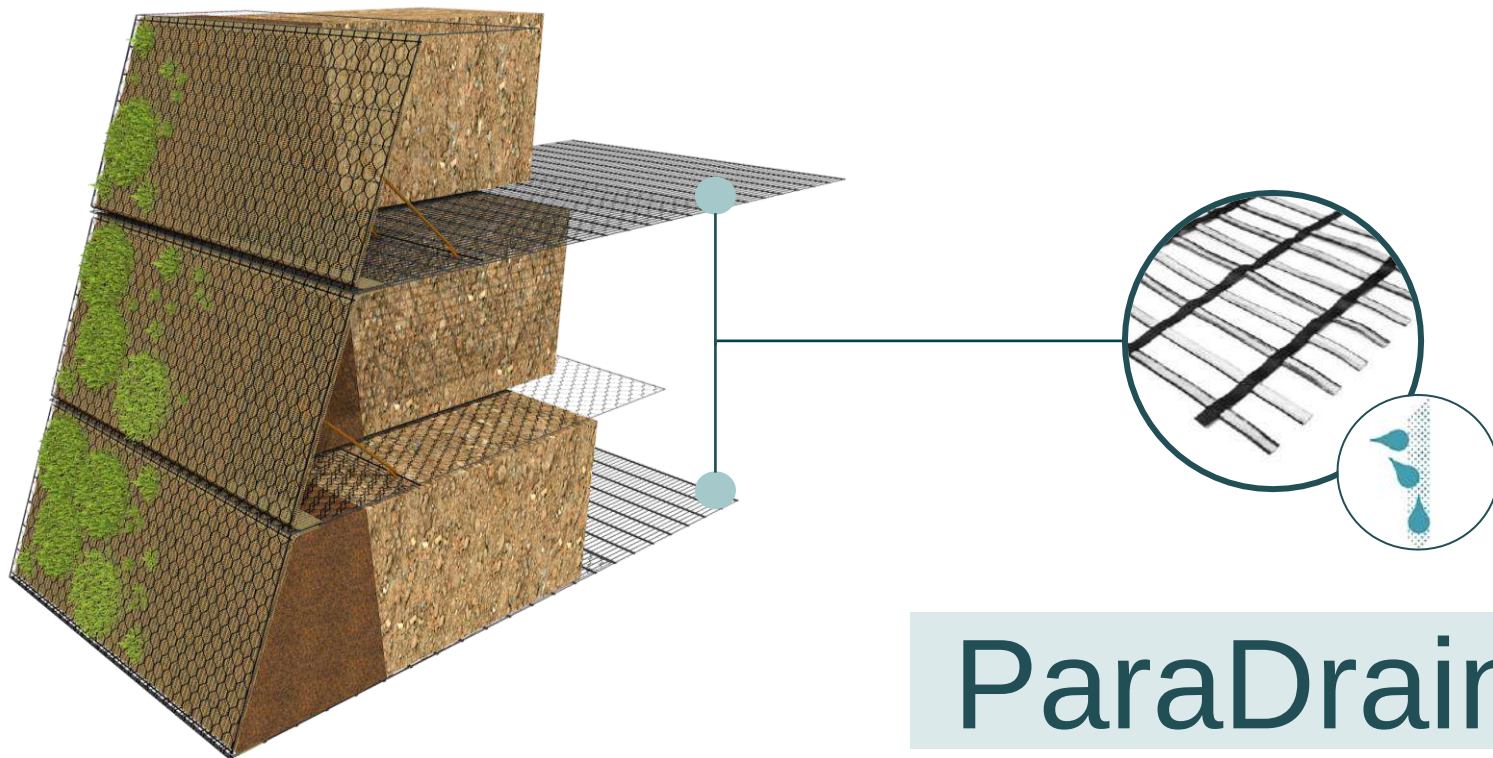




REUSE OF IN SITU SOIL

- They are cheap. They can even be a positive source of income in some situations;
- They are usually readily available;
- Their use results in reduced haulage and the consequent environmental impact of this;
- Their use results in reduced quarrying which helps to preserve the environment.

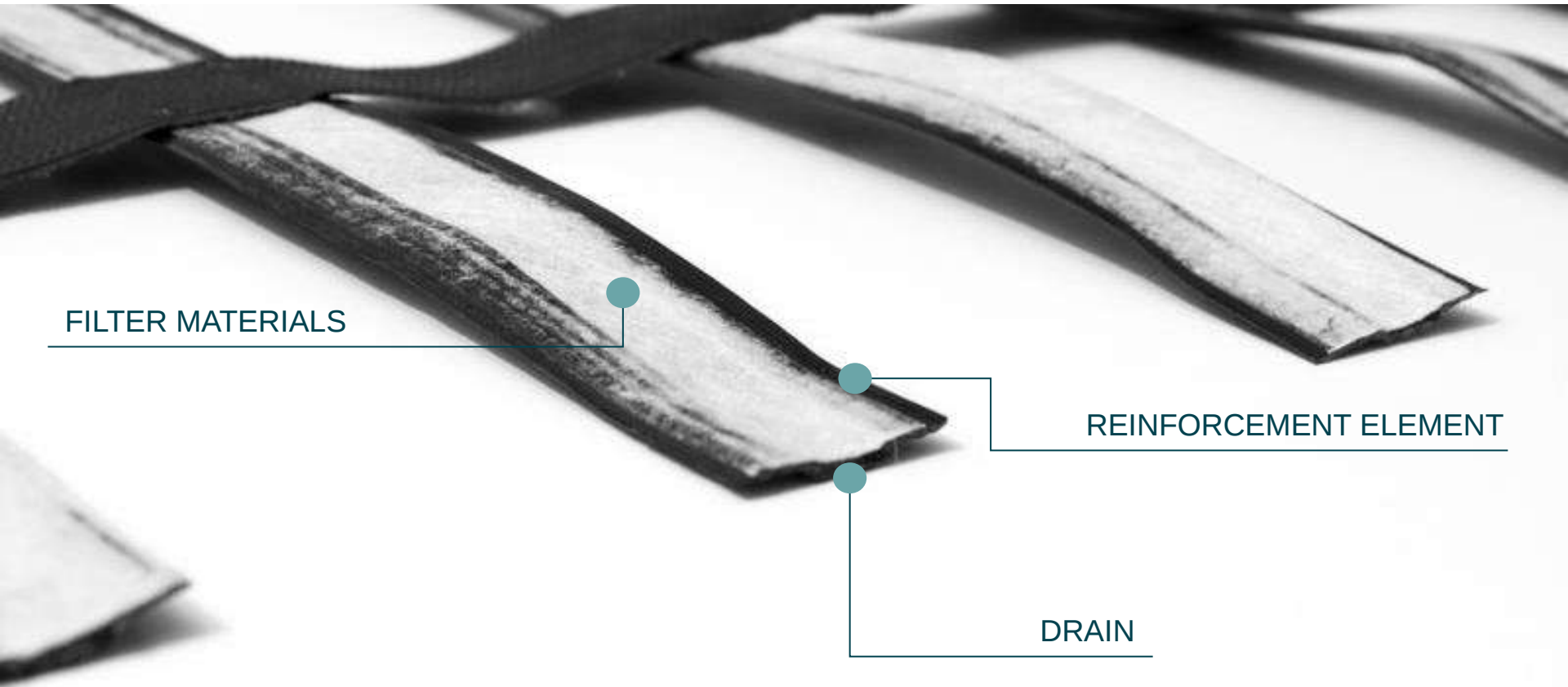




ParaDrain™

The geogrid that drains while reinforcing





FILTER MATERIALS

REINFORCEMENT ELEMENT

DRAIN

A SELF WATERING VEGETATED SLOPE USING PARADRAIN™

MACCAFERRI



Burlington, Ontario
Canada

A natural-looking solution was constructed within a forested area to stabilize a failing slope.

ParaDrain™ in combination with TerraMesh™ Green, acting both as a geogrid reinforcement and as a drainage channel.

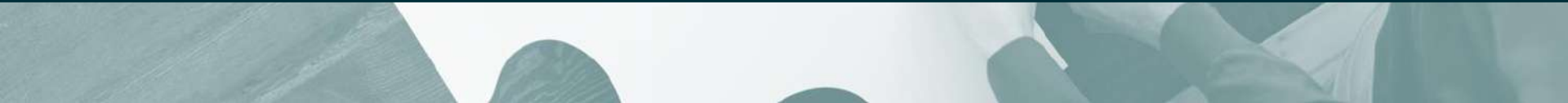
THE SOLUTION: PARADRAIN

MACCAFERRI





REINFORCED EROSION CONTROL



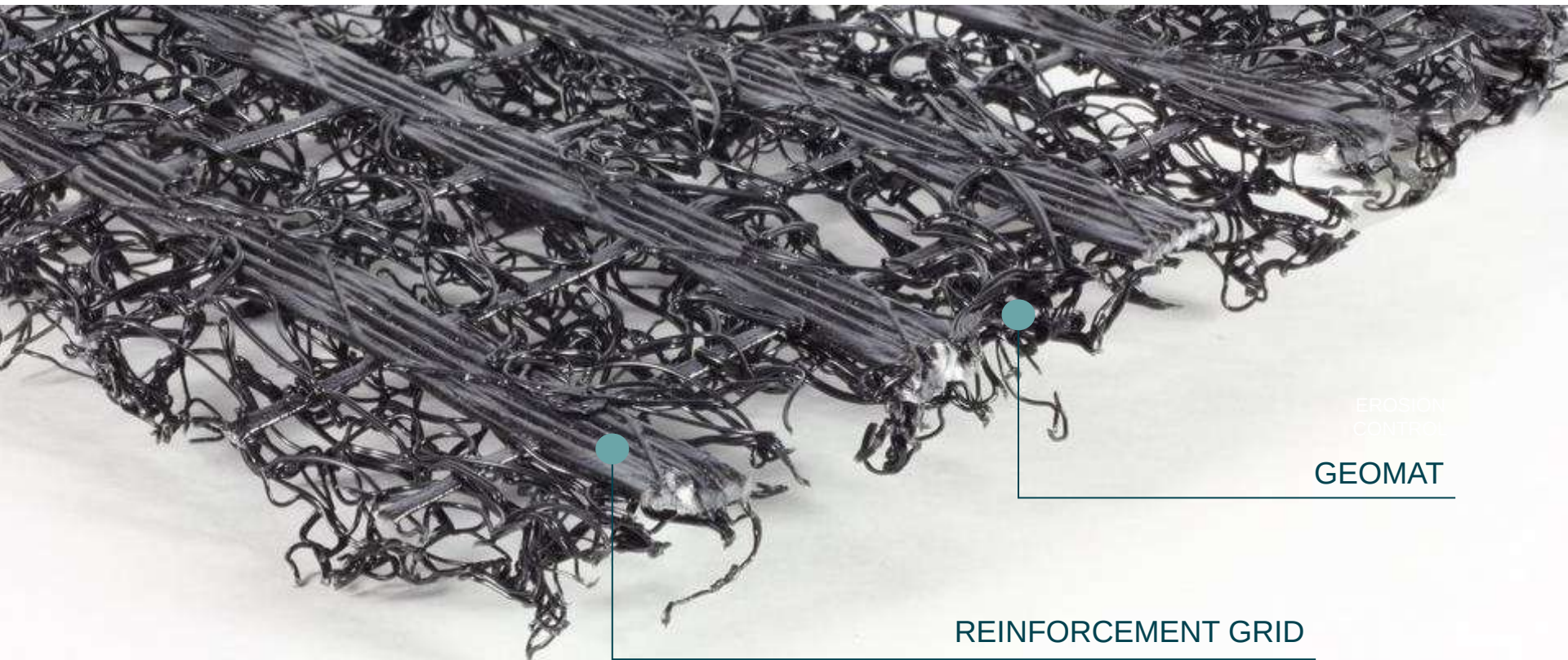
Surficial Soil erosion is a serious issue not only because the loss of topsoil can cause stability issues, but also from an environmental perspective.





THE SOLUTION: REINFORCED MACMAT

MACCAFERRI



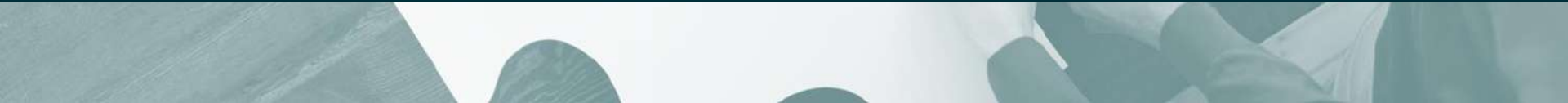


An optimized solution that considers all these factors is often needed.

A solution that meets the project needs, both increasing the shear resistance along the soil surface and boosting the vegetation growth.



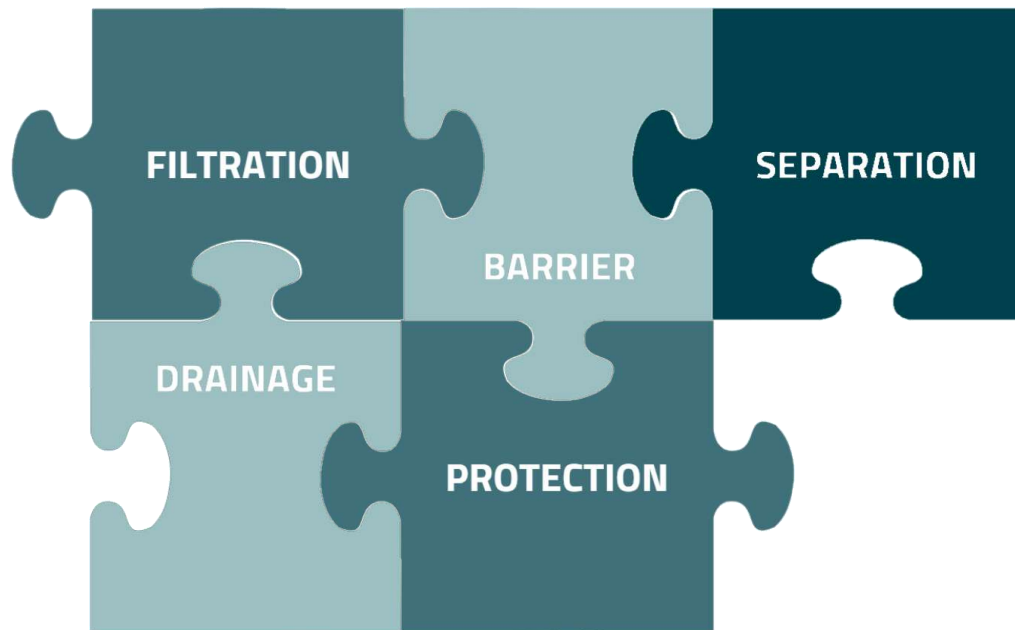
DRAINAGE GEOCOMPOSITES





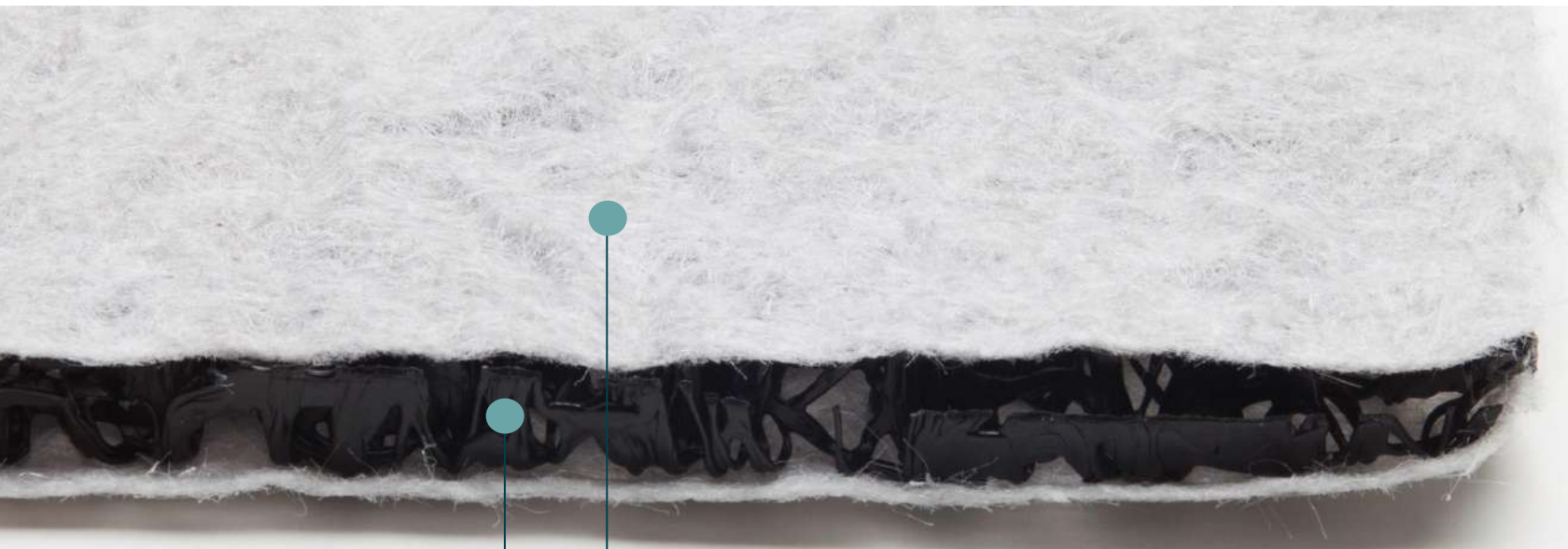
The management of water is one of the most important aspects influencing the long-term performance of a structure.

Providing a complete solution to capture, contain and drain fluids can be essential to save materials and lower the environmental impact of the structure.



THE SOLUTION: MACDRAIN

MACCAFERRI



DRAINAGE CORE

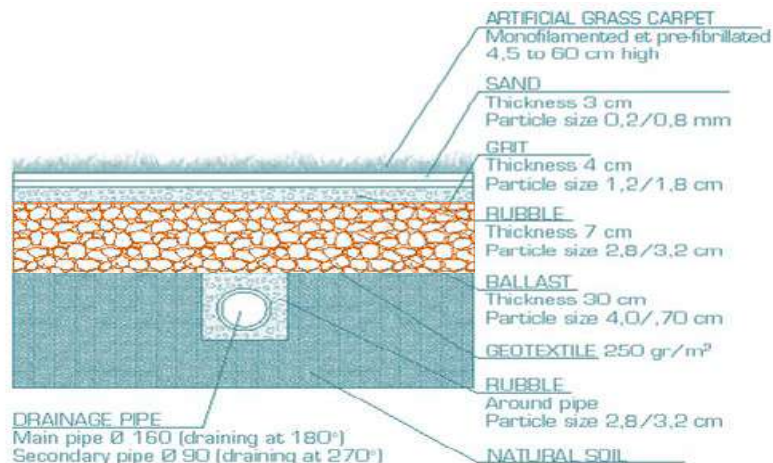
FILTER MATERIAL

VERTICAL VS HORIZONTAL DRAINAGE

MACCAFERRI

Less materials, more benefits

VERTICAL DRAINAGE



30
cm/m²

**FILTERING
GRAVEL**

HORIZONTAL DRAINAGE



0.5
cm/m²

**DRAINAGE
GEOCOMPOSITE**

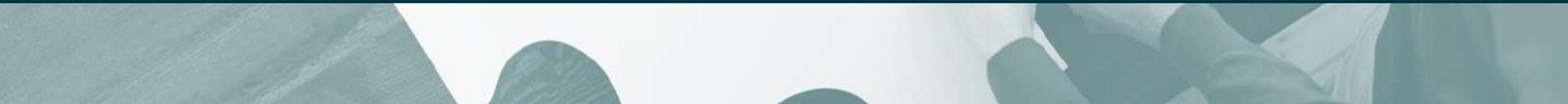
THE BEGINNING

ENGINEERING
EVOLUTION

FIRST
DEVELOPMENT

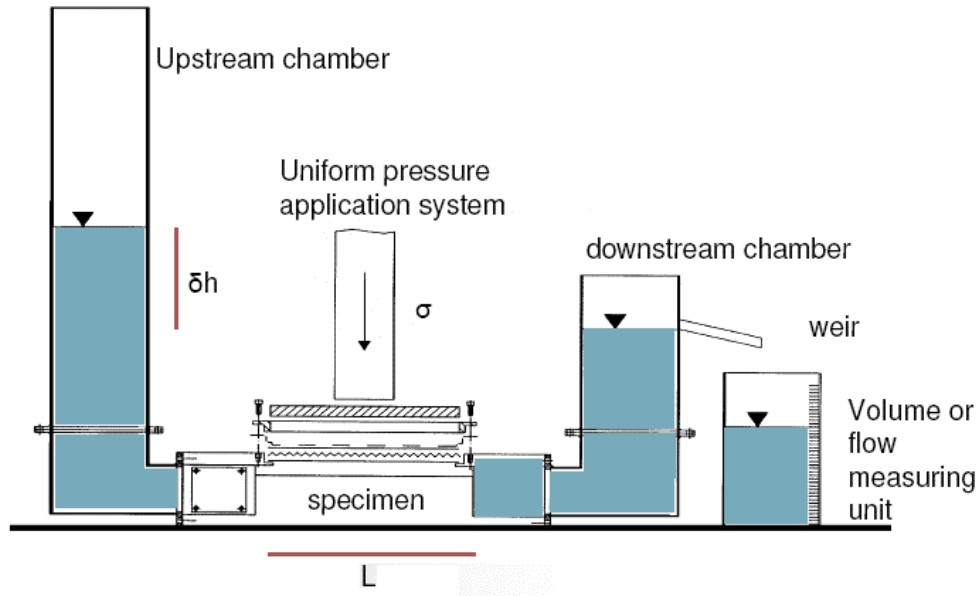


TEST CAMPAIGNS TOWARDS OPTIMISATION



Trasmissivity

The most important property of a draining geocomposite is the short term flow rate, which is measured in laboratory with a specific apparatus



Compressive Creep



TABLE 1: COMPRESSIVE CREEP RESULTS

Material / Test Type	Compressive Load (kPa)	Retained Thickness @ 100 Hours (%)	Retained Thickness @ 1K Hours (%)	Retained Thickness @ 10K Hours (%)
W1101 SIM	50	91.47	90.44	89.31
W1101 SIM	50	91.14	90.17	89.02
W1101 Conventional	50	90.37	89.89	NA
W1101 SIM	100	89.11	87.90	86.65
W1101 SIM	100	89.03	87.72	86.25
W1101 Conventional	100	89.50	88.76	NA
W1101 SIM	200	85.66	83.65	80.13
W1101 SIM	200	85.48	83.51	81.13
W1101 Conventional	200	86.14	84.25	NA
W1101 SIM	500	41.28	39.08	37.22
W1101 SIM	500	31.76	29.62	28.10
W1101 Conventional	500	33.37	32.02	NA

CONCLUSION

TRI is pleased to be of service to this work effort. If you have any questions or require any additional information, please contact me at Tnelson@tri-env.com or telephone to 512 263 2101.

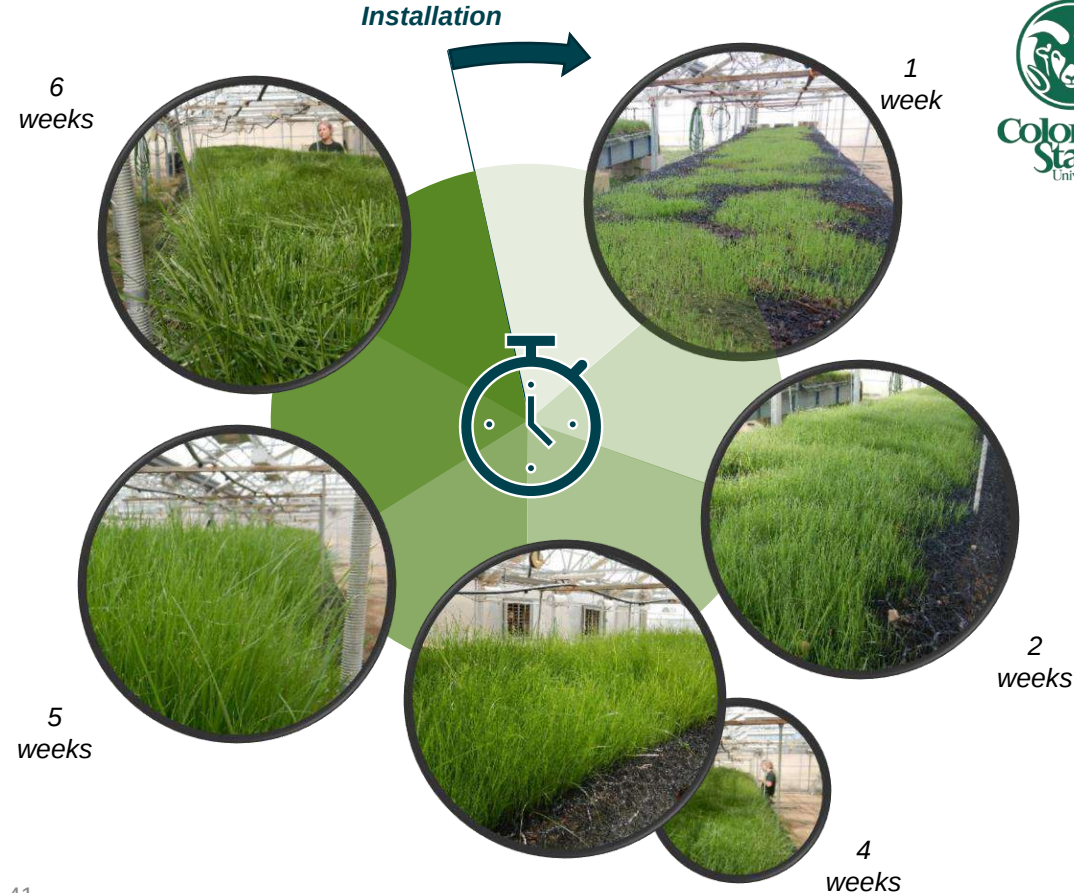
Sincerely,

Janett A. Nelson

Janett A. Nelson
Laboratory Director
TRI Geosynthetic Services
www.GeosyntheticTesting.com

[Attachments]



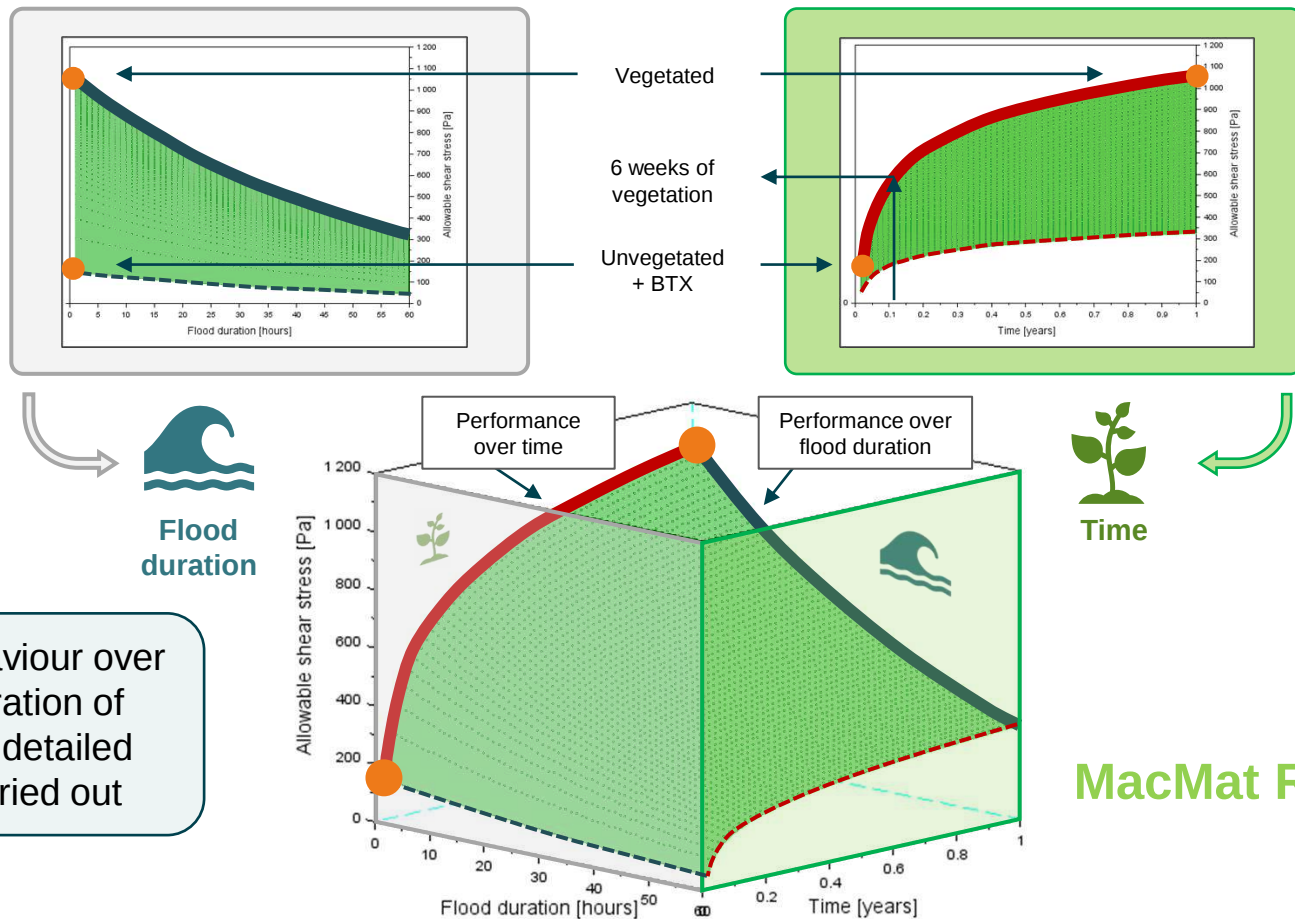


Test conducted by
Colorado State University
between 2019 and 2020
on MacMat-R

- M Fully revegetation in only 6 week
- M In 6 weeks performances reach what traditional EC solution achieve in 1 year (*Limit shear strength* and *Limit Velocity*)
- M 6th week performance achieve 60% of 1 year measured strength



THE OUTPUT OF THE EXPERIMENTAL CAMPAIGN



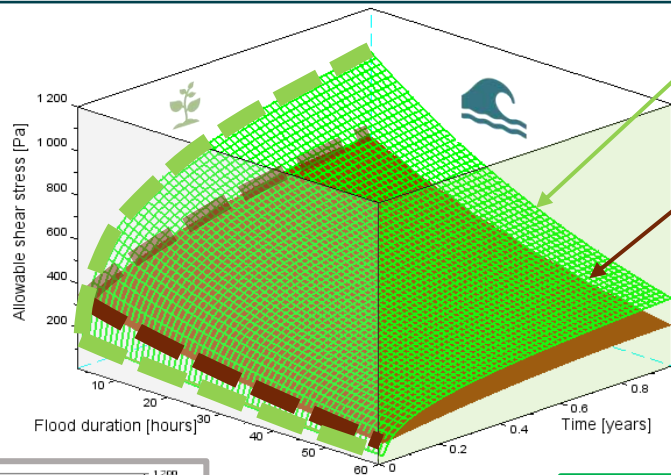
THE IMPORTANCE OF LIGHT PENETRATION

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Flood duration



A lower light penetration can allow a higher performance only at $t=0$...

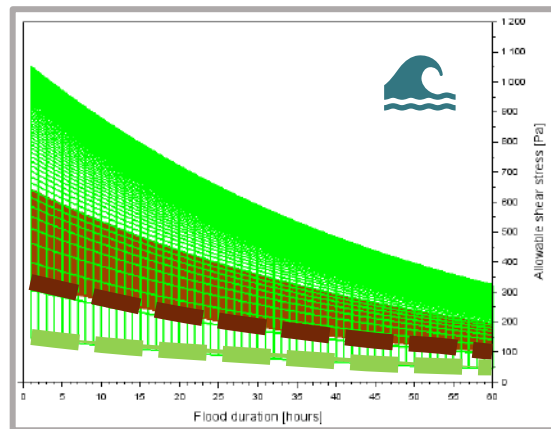


MacMat R vs Low Light Penetration product

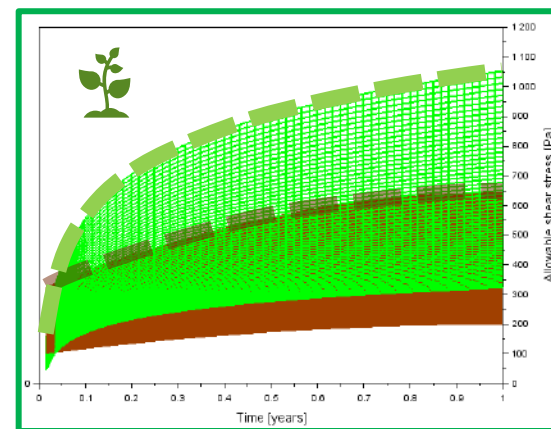


Time

... while a higher light penetration assure a higher performance over time



ISOCHRONE CURVE



ISOFLOOD CURVE

KEY ASPECTS FOR REVEGETATION SUCCESS

How 7 key parameters affect revegetation and erosion control maximization

Site related



ALBEDO



PLANT
GROWTH



SOIL HUMIDITY



SOIL
TEMPERATURE



WATER RUNOFF

Product related

- M** Light Penetration / opening size
- M** Thickness
- M** Color
- M** Water Absorption
- M** Weight
- M** Roughness and run-off
- M** Uniformity



*“Relationships between Erosion Control
Products and vegetation growth”*

Prof. G.B. Bischetti et al, UniMi, 2021

THE BEGINNING

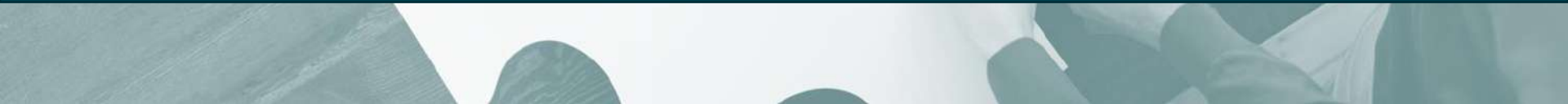
ENGINEERING
EVOLUTION

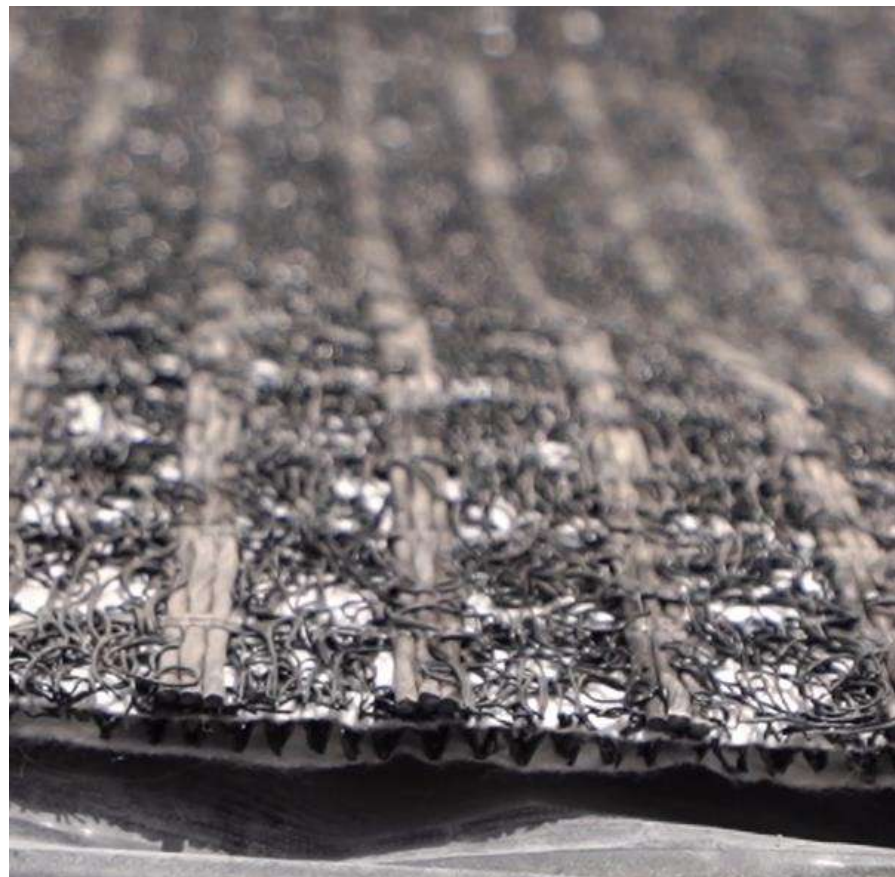
FIRST
DEVELOPMENT

NEXT GENERATION



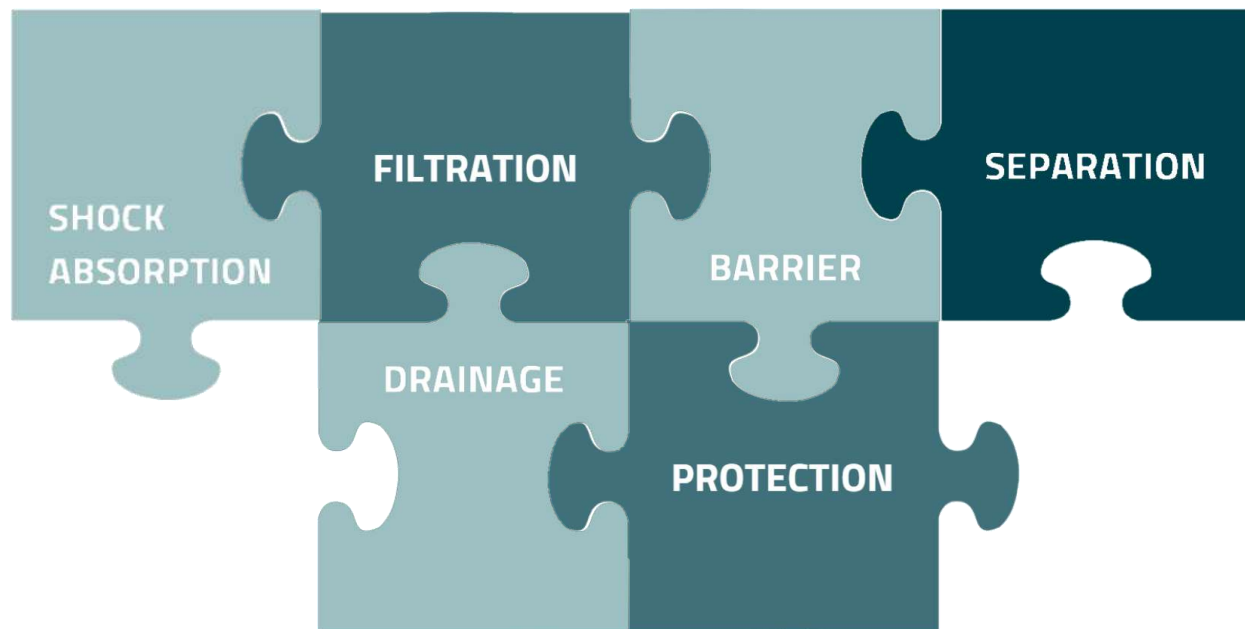
MULTICOMPOSITE REVOLUTION

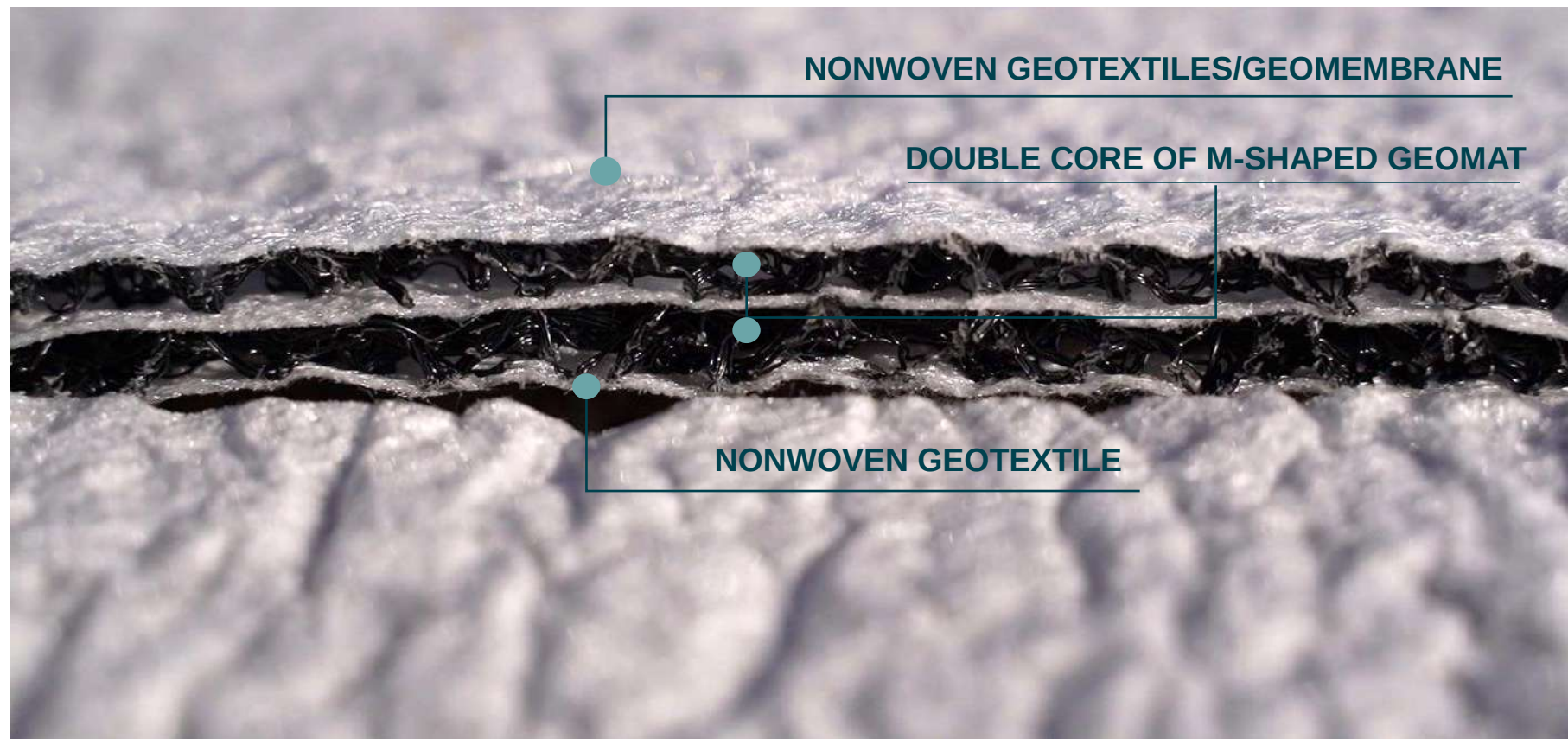




In the latest generation sports fields, it's important to keep the performance of the playing surface consistent over time and thus to ensure the safety of players during sports activities, reducing exposure to injuries.









MULTICOMPOSITE FOR SPORT PITCH

MACCAFERRI



Our 2in1 revolutionary geocomposite combines drainage-enhancing action with shock absorption functions. MacSport is fully compliant with FIFA requirements and with FIGC LND Regulations (Italian National Amateur League) being tested according to the most advanced and international recognized standards.



The landfill capping has important economic and environmental implications. It drains the methane gas and prevents the infiltration of rainwater to stop contamination and the generation of excess pollutant leachate.

Furthermore, a well-designed capping enable the “naturalization” of the site and its rehabilitation into the existing landscape.



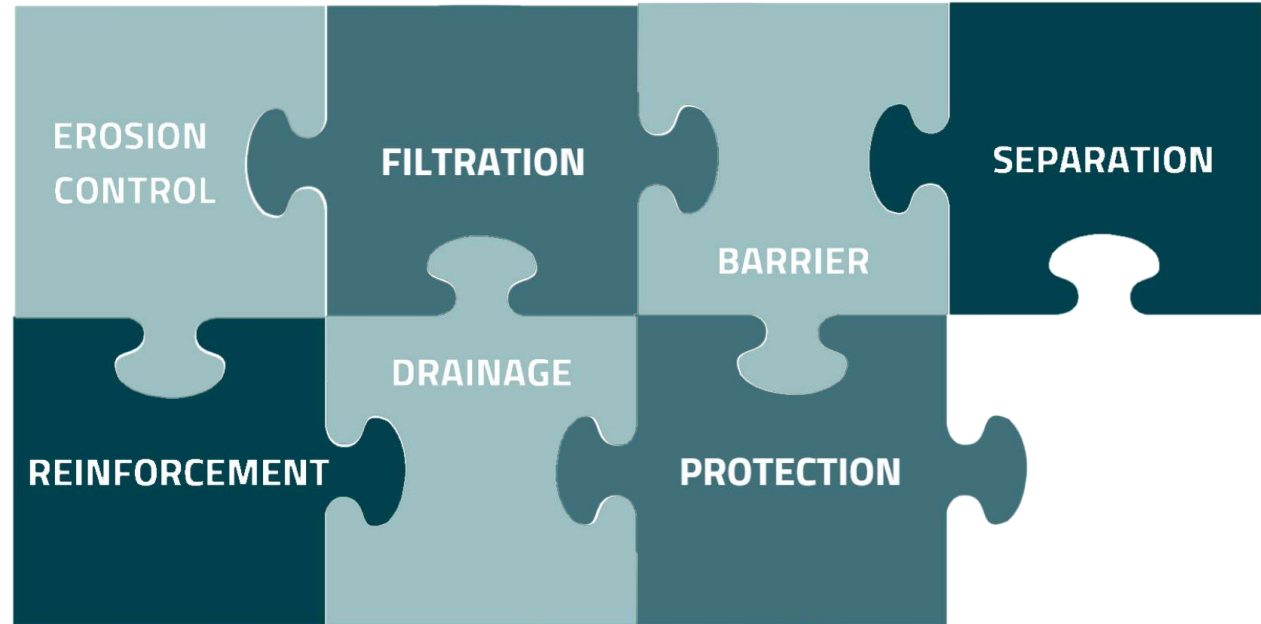
AN ENVIRONMENTAL REQUALIFICATION PROJECT

MACCAFERRI











REINFORCED
GEOMAT

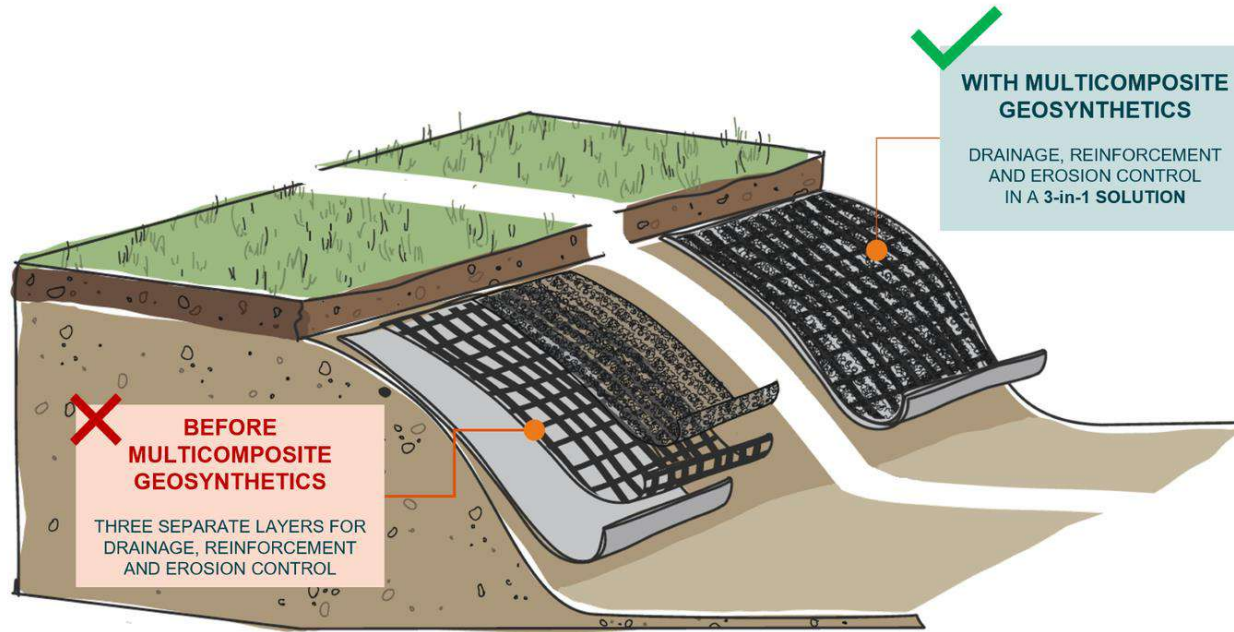
DRAINAGE CORE

FILTER MATERIALS

GEOSYNTHETIC MULTICOMPOSITE

MACCAFERRI

The application of a multi-layer solution dramatically cuts the installation time of the upper part of the landfill capping since enabled **the installation of different geosynthetics at once**



SAFE



SIMPLE



FAST

Watch on our [Youtube channel](#) the video
“Cava de' Tirreni (SA) – Italy”



Cava de' Tirreni (SA) - Italy



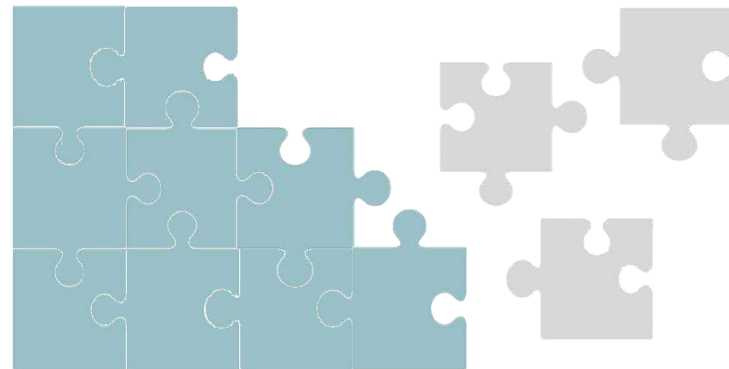
THE BEGINNING

ENGINEERING
EVOLUTION

FIRST
DEVELOPMENT

NEXT GENERATION

There is always one more step to take



All the solutions evolve according to the designer's needs



**THANK
YOU!**