

Officine Maccaferri Group Profile

Founded in 1879, **Officine Maccaferri** was soon to become a reference worldwide in the design and development of advanced solutions for erosion control and reinforcement structures. Over time, however, the company has innovated and evolved so that today it is also a **reliable partner** for complex **civil and environmental engineering applications**. **This aptitude for technological innovation** is the result of continuous dedication, which, alongside experience and technical **know-how**, has enabled the Maccaferri Group to leverage high levels of **efficiency**. Concepts transformed into **versatile solutions** meet our customers specific requirements, whilst maintaining a **sustainable environmental balance**.

Consultancy and partnership

Maccaferri does not just offer its customers simple collaboration but a real **partnership** which goes beyond merely supplying products. Maccaferri is a partner that works alongside its customers from the very start. It is a reliable partner thanks to its **extensive portfolio** of top quality products. As well as versatile solutions that can be adapted to local situations, it makes its **technical know-how** available to create a virtual circle in which each factor (products, experience and innovative practice) is improved by each activity. Maccaferri tackles every project with the aim of **identifying, dealing with and resolving** each customer's actual needs, and the results of this attitude produce benefits which can be appreciated over time.

Organizational Structure

Maccaferri researches, designs and develops solutions for the construction, erosion protection and soil stabilisation sectors in over 100 countries across the world. The organizational structure has been designed to be global and local at the same time. It is made up of subsidiary companies which make **Maccaferri's** products and design and offer the company's solutions throughout the world. This ensures greater flexibility, a widespread presence and a better awareness of continued market development. **Maccaferri's** presence throughout the world allows the company to deal with problems which results in new know-how that, in turn, feeds into further innovation for other solutions offered on the market. As well as the parent company in Italy and subsidiaries in North and Latin America, France, Great Britain, Russia, Spain, South Africa, India, Malaysia, China and Australia, the company is active in all five continents, with 47 operating companies. Where there is no internal sales force, there are distributors in all the continents so that all markets are monitored indirectly.



ANY REPRODUCTION, INCLUDING PHOTOCOPY, FILM AND MICROFILM, IS FORBIDDEN. ALL RIGHTS RESERVED WORLDWIDE.



Landfill: design & engineering

Bureau Veritas Certified Quality System Company with
SINCERT's and UKAS's accreditation.

MACCAFERRI

A member of
Maccaferri
Industrial Group



HYDROGEO S.R.L.
via G. Rossa 76 – Casalecchio di Reno (BO)
40033 - ITALY
Tel: (+39)051 6130116–Fax: (+39)051 6130166
E-mail: info@hydrogeo.net
Web site: www.hydrogeo.net

© 2009 Officine Maccaferri S.p.A. - Bologna - Italy - Print: Litografia Zucchini - Project: graficamonti.com - Photo: Officine Maccaferri Archives

MACCAFERRI

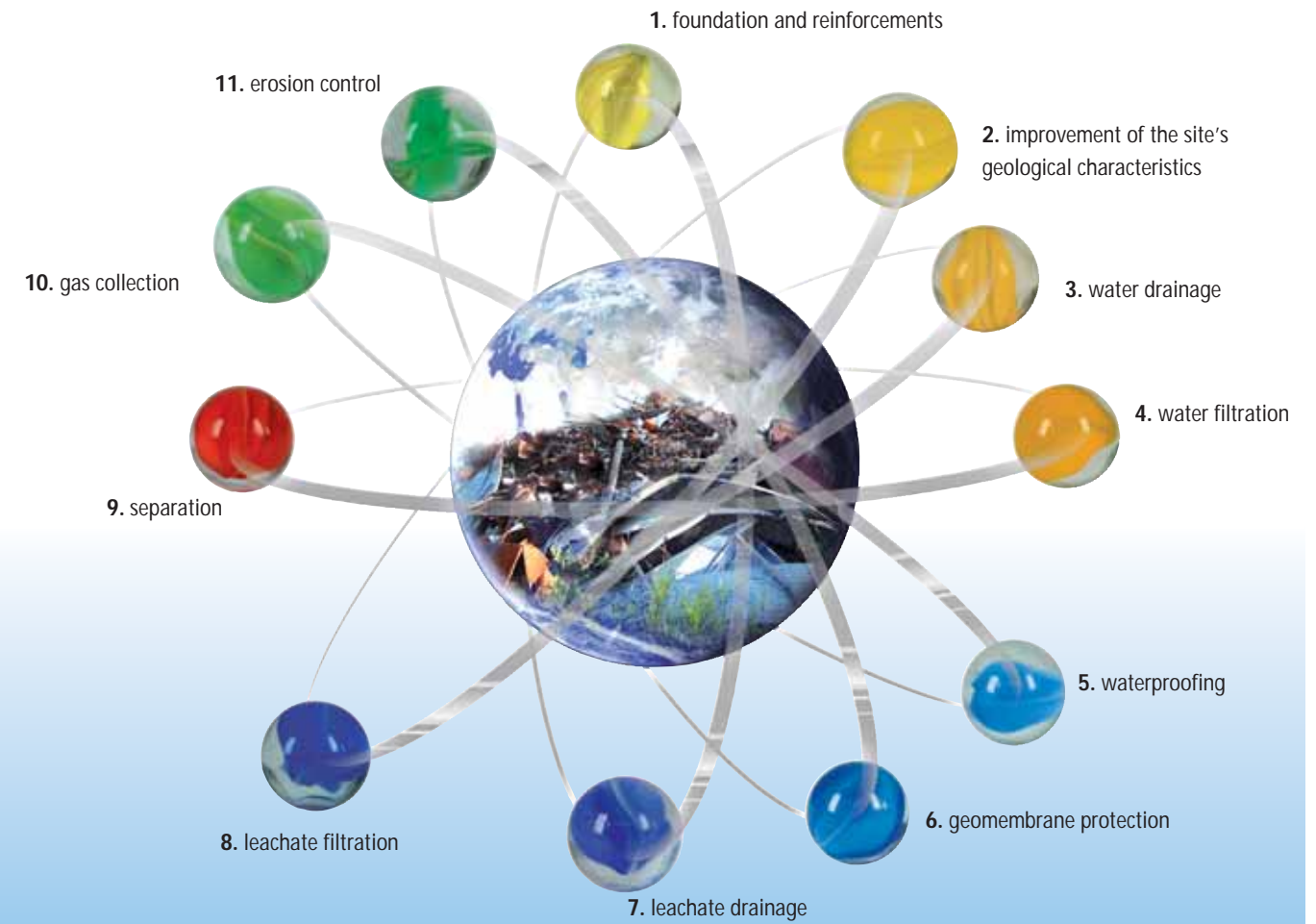
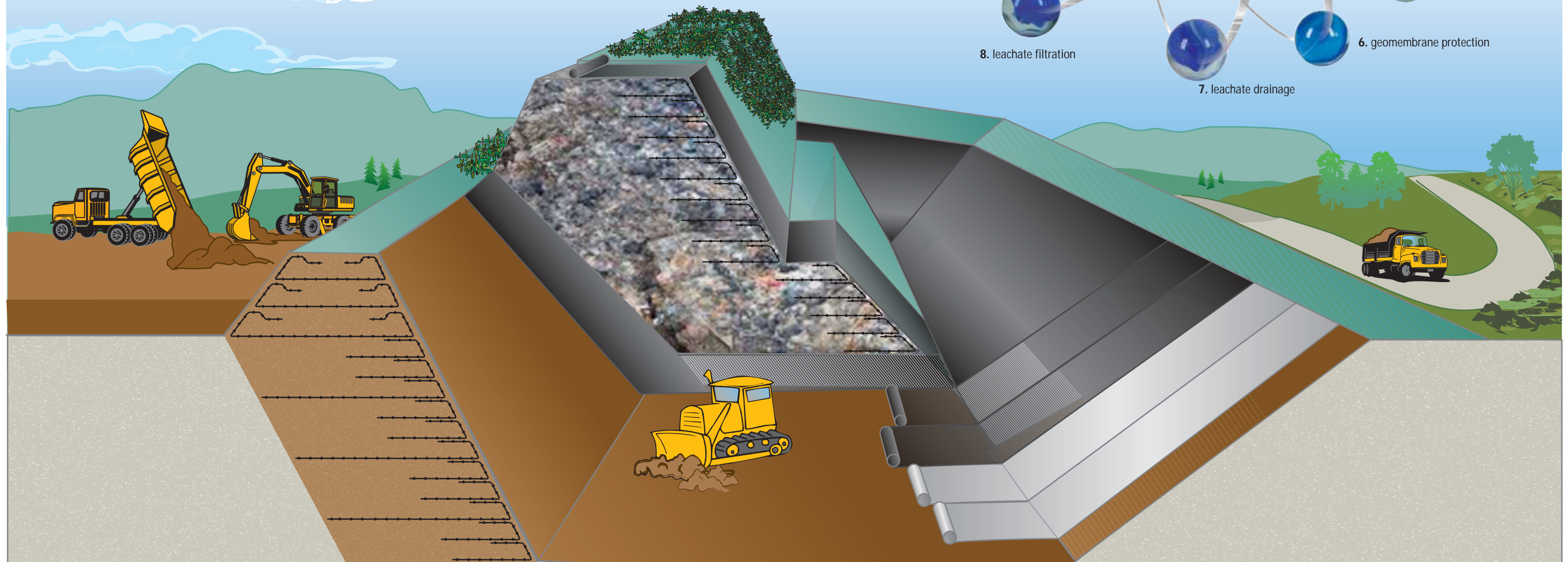
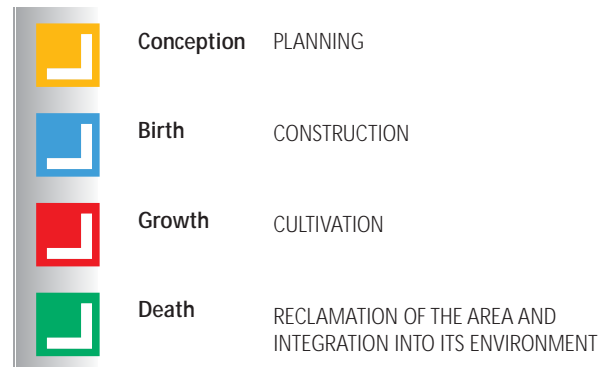
Landfill

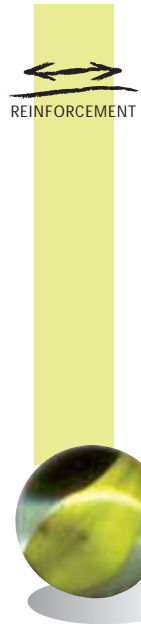
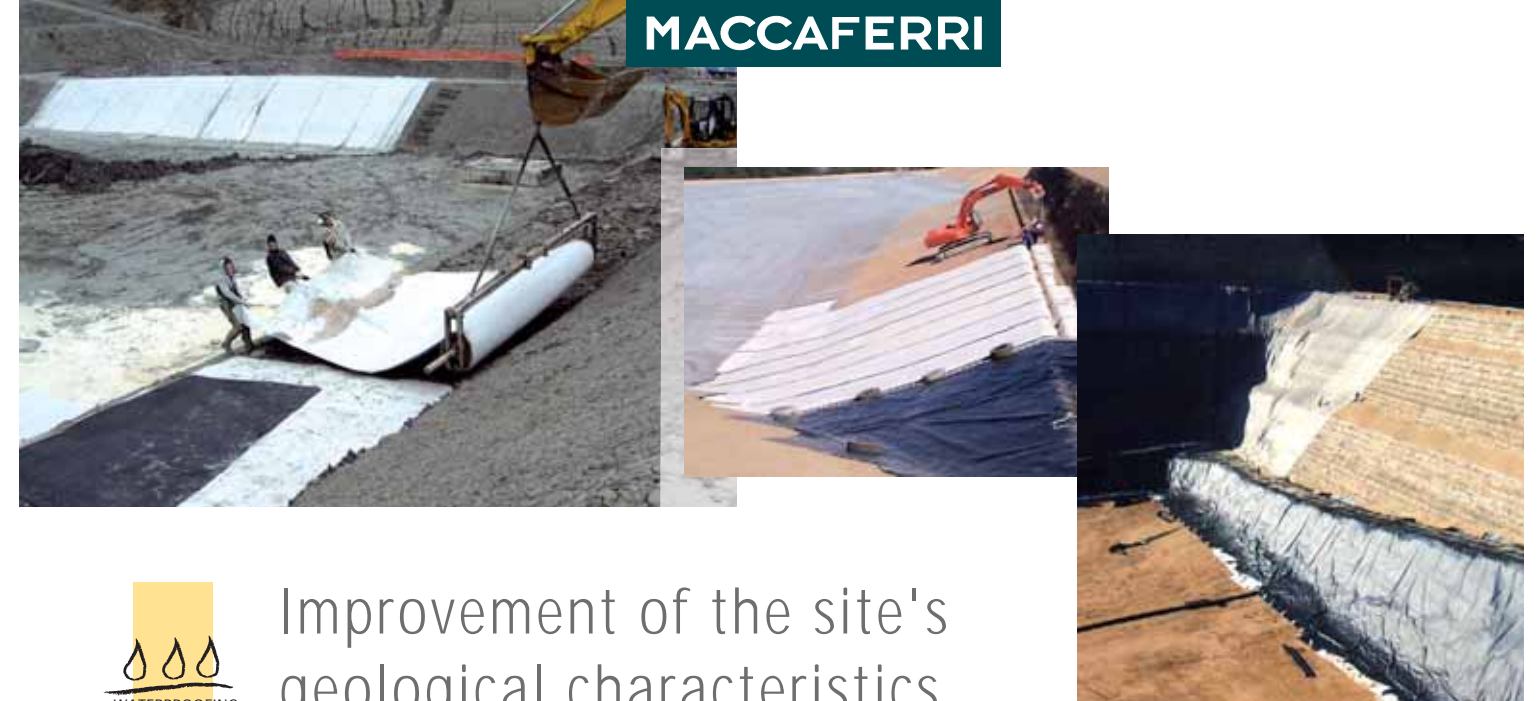
Introduction

World-wide the disposal of waste materials is an important problem that results in the demand for greater landfill capacity. Our society requires proper administration of these areas in order to improve environmental conditions that affect our quality of life. To achieve this aim, it is important to understand that the landfill is not a "dump" but a living organism which has separate phases;

The landfill core and the main problems to be solved at each individual phase

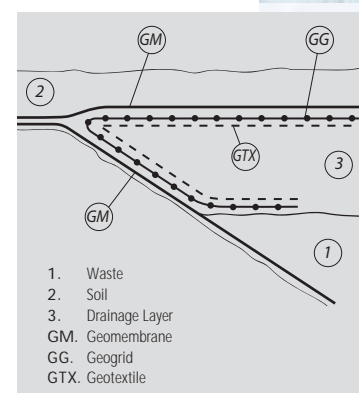
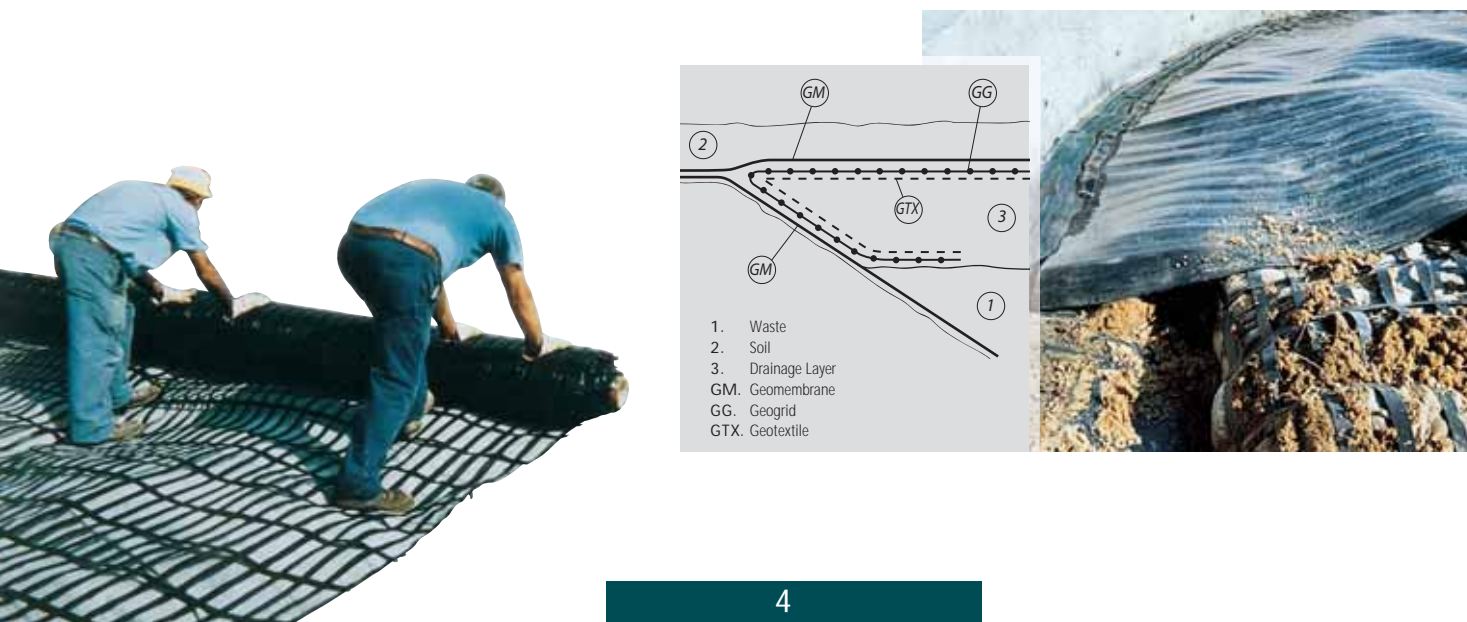
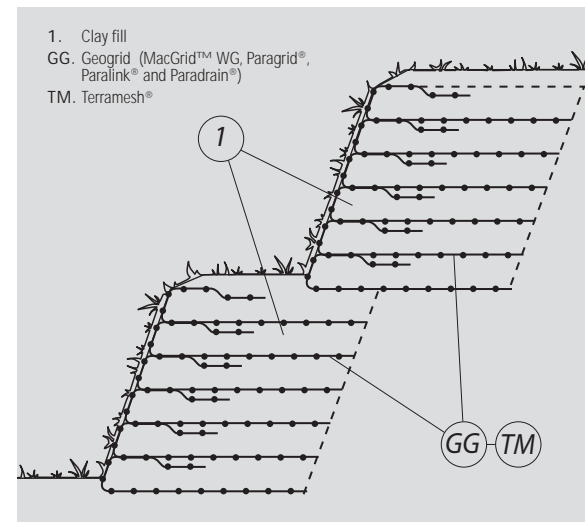
As with every complex organism, even a landfill has to be considered by the planner as a series of cells, sometimes very complex, interacting together, in order to fulfil the requirements shown;





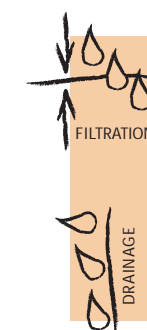
Foundation support and reinforcement

This includes the consolidation of the base of the landfill or of the waste, in order to provide a stable foundation layer and/or the overall stability of the landfill. This aspect is particularly relevant where a new landfill has to be constructed on a soft surface (e.g. an old landfill, unstable clays soils) or in soils subjected to landslides or when existing facilities need enlarging. Geogrid products such as MacGrid™ WG, Paragrid®, Paradrain®, Paralink® or even Gabions or Terramesh® units can provide, in various combinations, an answer to many problems faced by the designer during initial planning stages or in emergencies or unforeseen situations.



Improvement of the site's geological characteristics

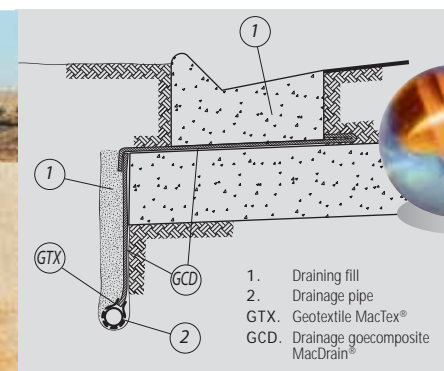
To limit the impact of leachate losses that are ultimately anticipated to take place through any barrier system, the standards allow for either a natural low permeability layer or alternatively a geo-clay-barrier composite chosen from the Macline® GCL family. This second application is on slopes within the landfill cell where it is necessary to take into consideration the serious difficulties of placing and compacting cohesive soils (typically clay) on such surfaces.



Water drainage and filtration

Leachates arising from rainfall or from phreatic surfaces or water tables adjacent to the landfill must be diverted to avoid pollution by the waste and to avoid possible landfill stability problems or problems with the buoyancy of the barrier. It can be overcome with the use of natural materials or by the use of drainage geocomposites chosen from the large family of the MacDrain® geocomposite products. These

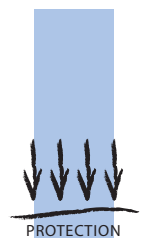
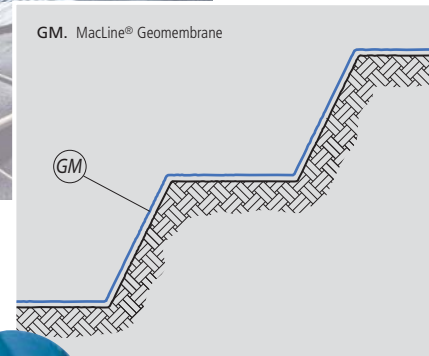
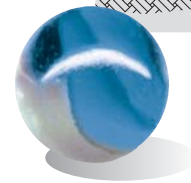
provide drainage paths within the cell to reduce water pressure. In case of conventional drainage trenches, the traditional filtration systems can be conveniently replaced and with greater efficiency by the use of MacTex® the non-woven geotextiles. In special circumstances, when used in contact with the waste MacTex® HF woven geotextiles can be used.





Waterproofing

This is the heart of the barrier system, and it is usually constructed with a synthetic geomembrane generally manufactured by the extrusion of a high density polyethylene raw material. Many different types are available in order to match the technical requirements - smooth (MacLine® SDH), textured (MacLine® RH or TH range), fully black or coloured.



Geomembrane Protection & Separation

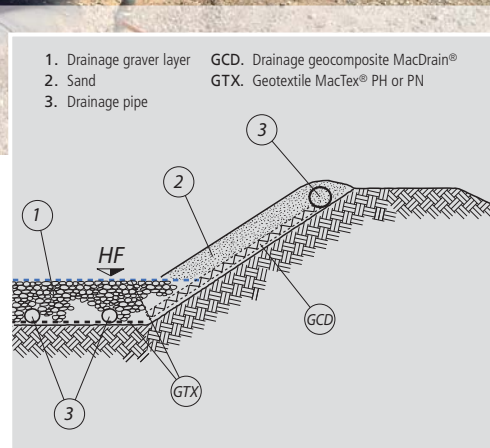
The geomembrane must be protected from being punctured by granular materials which form the drainage system or by sharp materials found within the waste. The range of MacTex® PN and PH geotextiles enables this fundamental protection to be provided at low cost, the same can also be provided as a secondary function, by MacDrain® drainage composites.

The possible intermixing of separate material layers with different particle-sizes can be detrimental to the correct functioning of those layers and can nullify their effectiveness. MacTex® standard range geotextiles, made from chemically inert materials, can be used to solve this problem. These geotextiles can also be used as a separation layer between the geomembrane and other materials in order to modify the friction angle thereby minimising the stresses transmitted to the membrane.



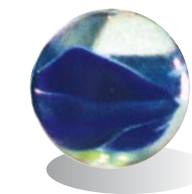
Leachate drainage

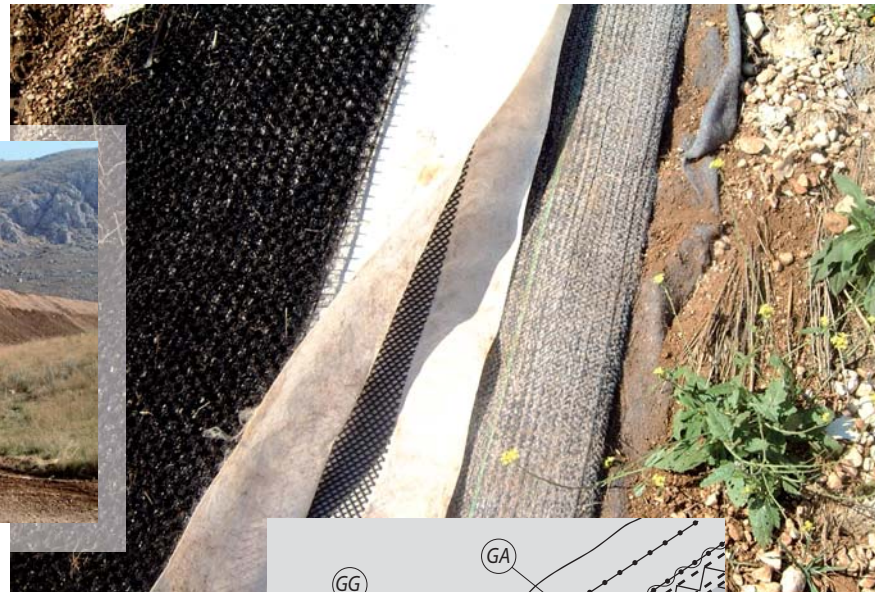
In order to avoid the retention of leachate within the waste, it must be collected and taken to a treatment plant. This can be achieved using a drainage system built with either inert granular materials and HDPE pipes or, typically on sloped surfaces, MacDrain® drainage geocomposites.



Leachate filtration

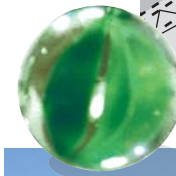
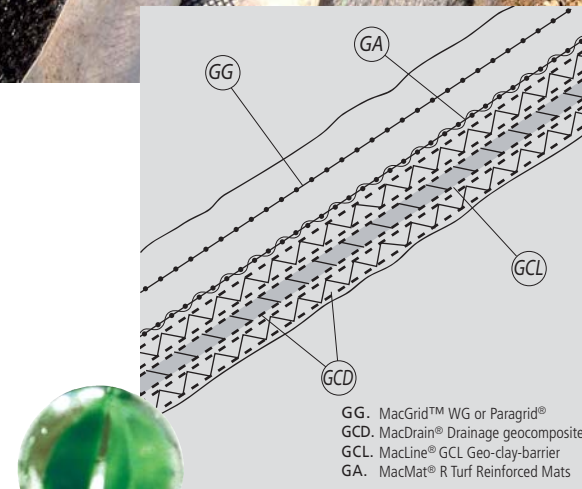
The leachate can easily clog the filter layers with which it is in contact due to the growth of bacteria. For this reason, filtration layers utilise naturally inert materials or particular MacTex® HF geotextiles characterised by high permeability and larger pore openings, in contrast to the poor performance of standard nonwoven geotextiles in this application.





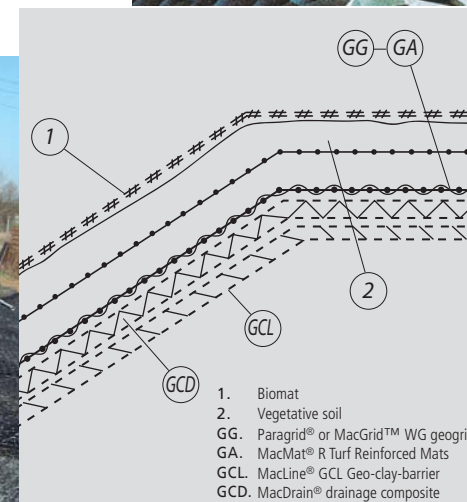
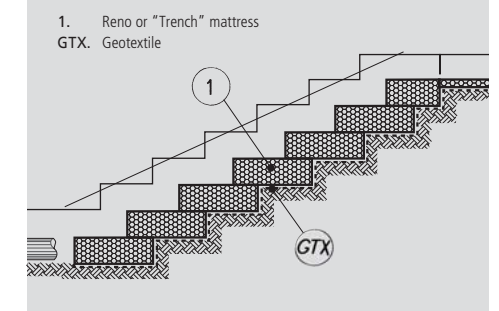
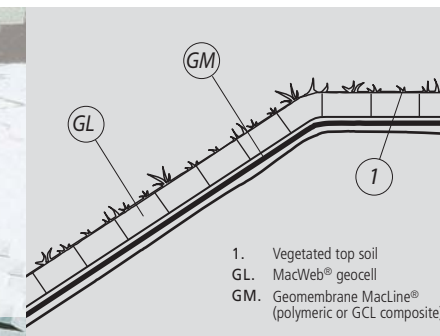
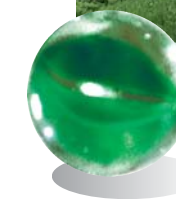
Gas and water run-off collection

The need to collect and ventilate the gas (methane) produced within the landfill, makes it essential to construct a biogas pipe system and chimneys. A gravel layer of 50 cm is the typical solution for a drainage layer suitable either for gas or for rainfall water collection. In this application MacDrain® drainage geocomposites can provide an efficient alternative to fine gravels or other inert natural materials. Even when a mineral layer is the only acceptable solution, surface reinforcement layers like Macmat® R geocomposite (in combination with geogrids if required) can be used on the sloped surfaces. For the construction of chimneys, special gabions can provide an easy and efficient method of construction.

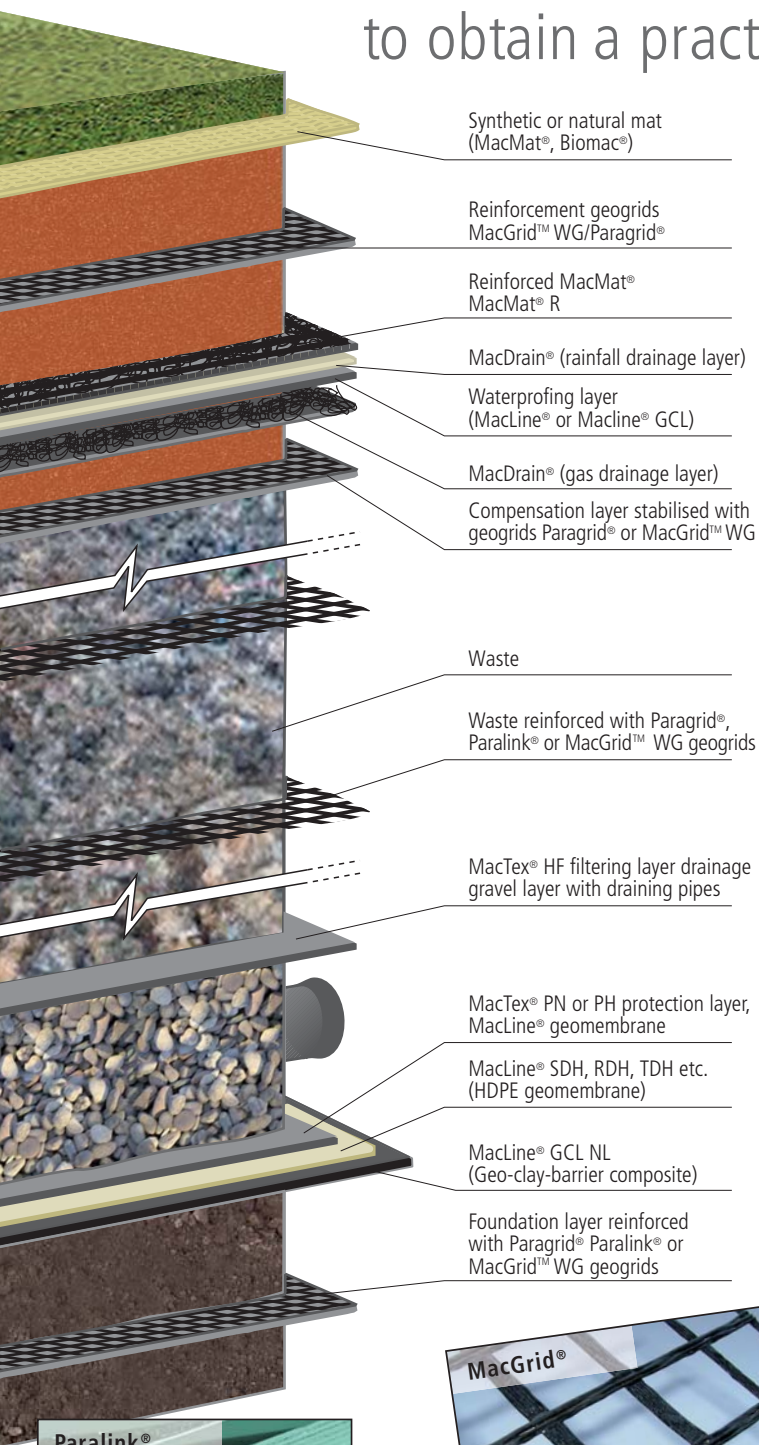


Erosion control

This is a problem that arises at the time that a landfill cell has to be closed and capped. After construction of the final impermeable barrier, a skin of vegetative soil has to be applied typically 1 m thick either on flat or sloped surfaces. In this situation there are a number of technical solutions to limit slumping, wash off and surface erosion; MacWeb® geocells, Macmat® R geomats reinforced with double twisted wire mesh or synthetic geogrids, steep soil slopes reinforced with Paragrid® or MacGrid® WG geogrids and Terramesh® units, vegetated Reno mattress revetments or simply the soil bioengineering blankets of the Biomat® range. Each of these materials can offer an appropriate solution to the specific site problem but require specialist input to select and design the right solution.



How to combine the different materials in order to obtain a practical landfill?



Industrial products provide solutions for most of the problems encountered but appropriate selection requires a knowledge, not only of the characteristics of individual products, but also how they interact. Each component has specific requirements that can be in conflict with general requirements. In order to assist the user, some of the main problems that need to be addressed when a landfill is to be designed are:

Minimal stresses should be applied to the geomembrane and all situations where loads might be transferred to it thus causing shear loads must be avoided. How can we safeguard the membrane from mechanical damage without over-stressing it?

In the construction of different kinds of barriers, several layers of geosynthetics may be used together with potential stability problems and the inherent risk of sliding. In this situation there is not one single answer but the solution will depend on the type of materials which form the layers. Which is the best solution?

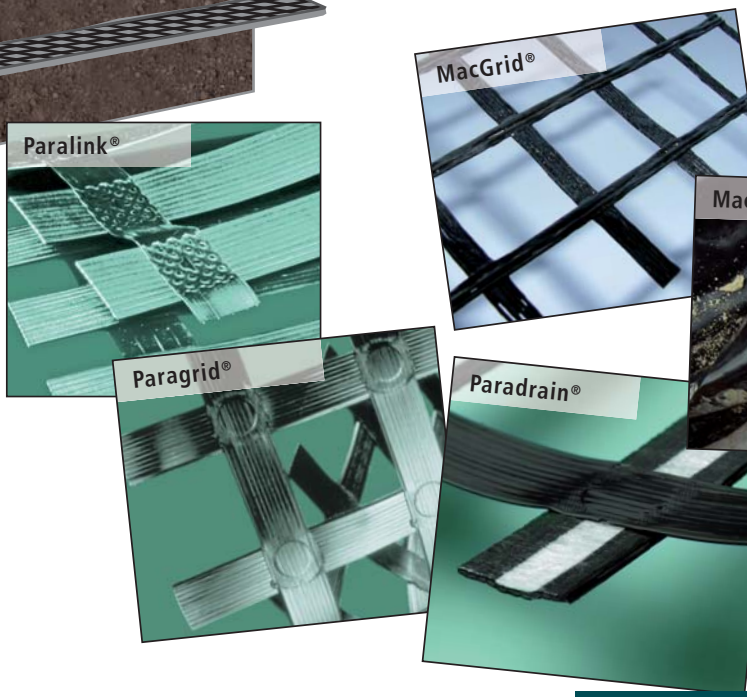
When the final capping has to be placed, there can be a number of stability problems related to the soil layer placed on the waterproof lining system; the geomembranes in the latter typically being characterised with friction angles varying from 8 to 15 degrees in working conditions (even if textured). How can we place and maintain the proximity of one metre of soil on a sloped surface and to guarantee long term stability performance of the full layer in static and seismic conditions?

What is the long term performance of the reinforcement materials in the peculiar and chemically aggressive environment of landfill?

What is the long term performance of the filters in contact with the water and the leachate? How do the drainage geocomposites characteristics change when they are used in a landfill and subjected to heavy loads in an anaerobic habitat with temperatures which can exceed 40 to 50 degrees?

How is the settlement of the body of the waste fill considered when the capping is placed? What are the practical effects on the external components in terms of maintaining the waterproofing and resistance of the system?

Long term experience and skill in either geotechnical or waterproofing applications is required not only to solve the problems but also to identify them. Maccaferri technical staff, with their experience in the designing and construction of these structures can provide valuable support to designers and construction companies.



Product functions and solutions

Keys

● Materials specific for the indicated applications

* Materials that can be used for the indicated applications

	adaptation to site's geological characteristics	foundations or slope reinforcements	water filtration / separation	water / gas drainage	water proofing	leachate filtration	leachate drainage	geomembrana protection	erosion control
NATURAL MATERIALS									
Clay	●				*				
Sand			*	*				●	
Gravel				●		*	●		
Bentonite mixture	●				*				
Grass coverage									●
INDUSTRIAL MATERIALS									
MacLine® GCLs Geo-clay-Barrier	●				●			*	
MacLine® Geomembranes	*				●				
MacTex® non woven geotextile			●					●	
MacTex® HF woven geotextiles			*			●			
MacMat® geomat									●
Paragrid® Paralink® and Paradrain® geogrids		●							*
MacGrid™ WG geogrids		●							*
Terramesh® reinforcements		●							
Double twist wire mesh gabions		●		*		*	*		
Double twist wire mesh Reno® and Trench mattresses				*			*		●
Biomac® biomats									●
Mac Web geocells		*						*	●
MacDrain® N, M and W range drainage composites				●			●	*	
Drainage composite MacDrain® N, W and M type 1xxM				●	*		●	*	

