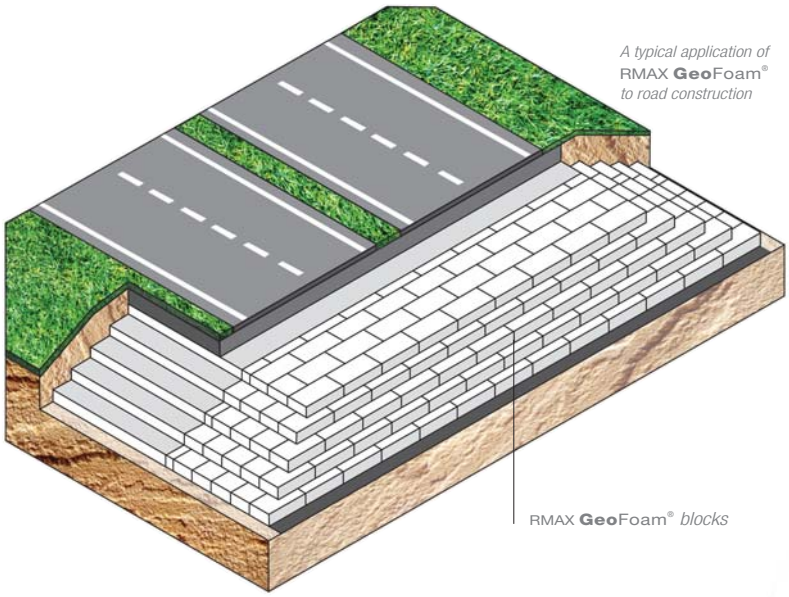
RMAX **Geo**Foam®

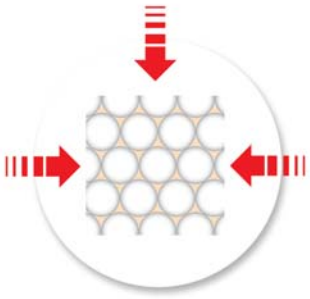
RMAX
Innovation working for you

EPS BLOCK SYSTEM FOR CIVIL ENGINEERING APPLICATIONS

RMAX **Geo**Foam® is a high performance expanded polystyrene (EPS) fill material specifically designed for civil engineering and commercial building construction. Its **remarkable strength to weight ratio** makes it the ideal choice for absorbing heavy structural and mechanical loads and **reducing underlying soil stresses** which in turn helps to stabilise roads, steep embankments, bridge abutments and sensitive below ground pipe work. It is also a highly versatile material that can be easily used as a **quick** and easy **cost-saving** method for concrete form-work or weight reduction on foundations. Its uses are endless.



A typical application of RMAX **Geo**Foam® *to road construction*



The cellular structure of RMAX **Geo**Foam® *helps to absorb and dissipate crush loads and it's cellular structure results in Isotropic physical properties - the physical properties are the same in all directions.*

RMAX **Geo**Foam® is made as blocks from EPS beads that have been expanded and bonded together under heat and pressure to produce a high performance construction material with a unique set of structural properties such as;

- Exceptional strength to weight ratio
- Resistance to water absorption (substantially reduces the problems of leaching)
- Unattractiveness to insect, bacterial and fungal attack
- Safe and simple to handle

RMAX **Geo**Foam® has Isotropic physical properties which means that the physical characteristics of the material are the same in all directions – not all materials provide this feature.

These superior characteristics ensure the durability, performance and longevity of RMAX **Geo**Foam® and has seen its popularity grow as increasing numbers of civil engineers and construction specifiers recognise its performance and cost saving benefits.

In simple terms RMAX **Geo**Foam® is your complete high performance fill solution.

7 good reasons

...to choose

RMAX **Geo**Foam®

1. Superb compressive strength

RMAX **Geo**Foam® is a low density (12kg/m^3 to 38g/m^3), and **high strength-to-weight ratio** material that has the capacity to withstand and dissipate enormous forces. Its cellular structure provides tremendous structural integrity and when installed correctly can reduce loads (as a result of low density/weight) and **reduce stress** (due to the compressible inclusion function) on unstable sites **by up to 95%**.

2. Reduced construction times - cost effective

RMAX **Geo**Foam® consists of 98% air and 2% polystyrene and as such is extremely light and easy to work with yet incredibly strong. These characteristics quickly translate into **reduced construction times** that can dramatically **reduce overall project costs**. There is reduced need to allow for medium term settlement associated with the normal (heavy) fill that is traditionally used.

3. Durable and non-biodegradeable

RMAX **Geo**Foam® is an inert, organic material that will not rot and since it has no food value it does not attract ants, termites or rodents. It does not support mould or mildew growth. It is unaffected by the normal range of climatic conditions and when specified and installed correctly can be considered a permanent long-life fill solution. RMAX **Geo**Foam® is able to withstand the effects of long term temperature cycling.

4. Inhibits water absorption

RMAX **Geo**Foam® is non-soluble and is manufactured from closed cell EPS particles that absorb little water and inhibit the mass migration of liquids through its structure. Even under prolonged saturation the cells maintain their shape, size, cohesion, physical appearance and structural integrity.

5. Safe, non-toxic, environmentally friendly

RMAX **Geo**Foam® is non toxic, odourless and non-irritating to the skin or eyes. It is biologically inert, contains no HCFCs and is safe for the environment. Blocks can be cut with a handsaw; the only PPE required for this is a dust mask for nuisance particulates.

6. Versatility, concrete formwork and more

RMAX **Geo**Foam® is a versatile construction material that is well suited to a variety of applications. Everything from 3D concrete formwork, weight reduction on sensitive pipe work through to light weight fill for internal bridge shuttering, ground stabilisation and void fill for suspended slabs.

7. Improves design flexibility

RMAX **Geo**Foam® is the ideal fill material when planning ambitious design concepts that previously may have been prohibitive due to excessive cost or difficult location and terrain considerations.

Standard block dimensions of RMAX **Geo**Foam® *- 5000mm x 1220mm x 600mm*
Density and Grade are matched to the specific physical requirements of each project.

How does RMAX GeoFoam® work?

The advanced technologies used in the manufacture of RMAX **Geo**Foam® result in a **unique material** that is 98% air captured within a 2% cellular matrix.

It is this cellular structure that provides RMAX **Geo**Foam® with the unique set of attributes of compressive strength, lightweight and block rigidity. The combination of these characteristics enables an even distribution of load forces with minimal to no deformation or creep over time.

In most cases RMAX **Geo**Foam® significantly out performs traditional fills in structural stability and versatility allowing it to be used in a wide variety of applications.

The diagrams opposite indicate just some of the typical applications of RMAX **Geo**Foam®.

Has RMAX GeoFoam® been proven?

For over 30 years Expanded Polystyrene (EPS) has proven itself to be a reliable and dependable material. EPS use in civil engineering commenced in Scandinavia in 1971 and in the United States of America in 1974. Since that time EPS has been used in geotechnical applications across the world.

RMAX **Geo**Foam® has been used in geotechnical applications in Australia since 1992 commencing with the construction of Lynch's Bridge in Maribyrnong, Victoria. It has been extensively researched and tested and meets many of the industries most rigorous standards.

Some of the projects where RMAX **Geo**Foam® has been used are:

Victoria:
▪Southbank Interchange ▪Western Link Freeway,
▪Power Street Bridge-North Abutment (4,000 cubic metres)

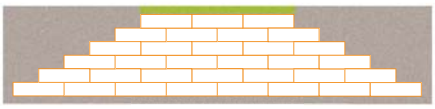
New South Wales:
▪Moore Park Tunnel construction ▪Cross City Tunnel
▪Kiama Bypass

Queensland:
▪Port Motorway Project ▪Clem Tunnel ▪Northern Busway
▪Kuripla Bridges

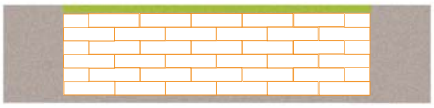
Some typical applications of RMAX **Geo**Foam®

BRIDGE ABUTMENTS

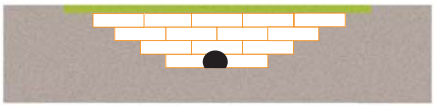
LIGHT WEIGHT ROADS



FOUNDATIONS

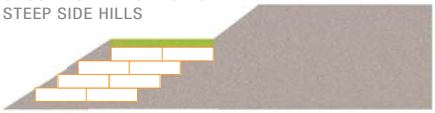


WEIGHT REDUCTION FOR UNDERGROUND UTILITIES



RETAINING WALLS

GROUND STABILISATION OF STEEP SIDE HILLS



WEIGHT REDUCTION

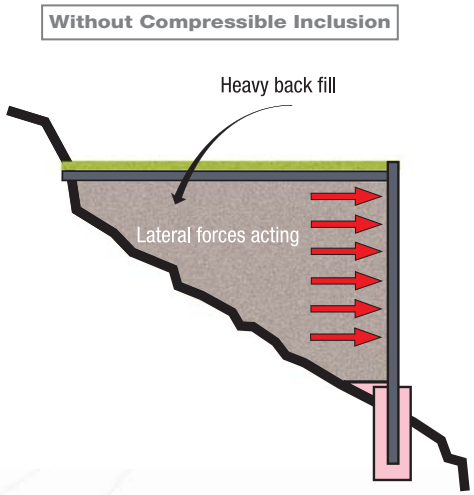
ELEVATION CHANGE / STADIUM SEATING

The Compressible Inclusion Function of RMAX GeoFoam®

In general a compressible inclusion is any material that is significantly more compressible, at least in one direction, than other materials that it is in contact with. Using a compressible inclusion can result in **significant reduction** in earth pressures under static and dynamic loading. A compressible inclusion can also be used to accommodate ground or structure movement. Using a compressible inclusion can be cost effective for both new construction as well as rehabilitating or upgrading existing structures.

Geotechnical applications for a compressible inclusion include behind earth retaining structures, around foundation elements, and above pipes, culverts and tunnels. Because the inclusion is the most compressible component of the structure-inclusion-ground system, the inclusion will deform more readily than the other system components under applied stress or displacement.

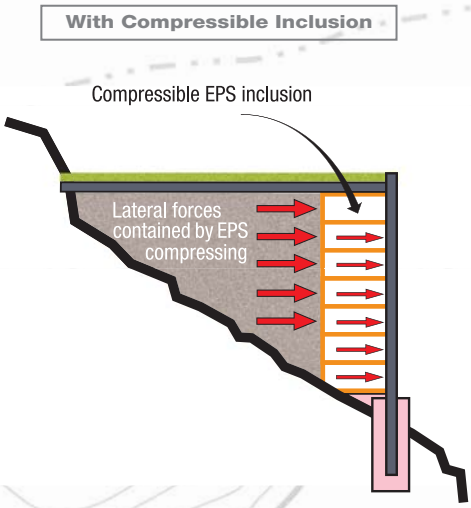
This selective compression of the inclusion can result in a variety of benefits. Most often, this is a load on the structure that is **significantly less** than if no inclusion were present. In many cases use of a compressible inclusion is a more cost effective alternative than designing the structure to withstand the greater load.



Selection Of Compressible Inclusion Materials

RMAX **Geo**Foam® is an excellent material for compressible inclusions because it has **predictable** and **controllable** stress strain behaviour and maintains predictable behaviour when wet. It also does not decompose when wet; some other materials such as hay bales and cardboard do decompose in this situation.

For compressible inclusion applications stiffness of the geofoam in the primary displacement direction is the most relevant property.



Compressible Inclusion Applications

For compressible inclusion applications, the lowest density EPS is generally desirable as the Initial Young's Modulus and Compressive Strength (typically defined as compressive stress at 10% strain) both decrease with decreasing density. Experience indicates that the minimum EPS density that strikes a balance between stiffness and durability is approximately 12 kg/m3.

Examples of the use of Compressible Inclusions:

1.Volume change of earth materials.
There are several situations where volume changes of soil and rock are caused by physical changes within the material.

Examples include:

- swelling and freezing soils, and
- rocks that swell due to water absorption, mineral changes, or release of tectonic stresses.

When such materials are adjacent to earth retaining structures, especially rigid, non-yielding ones, the lateral pressure generated by the expanding soil or rock can be significant.

The use of a **compressible inclusion** between the structure and ground can allow the soil or rock to deform laterally while **transmitting only a fraction of the stress to the structure**. The use of a compressible inclusion to reduce lateral pressures due to swelling soils is particularly attractive given the extensive occurrence of such soils worldwide. Designing to eliminate, or at least minimize, the effects of such soils, or remediating structural damage they cause, represents a significant cost in many areas.

2. Accommodating structure movement.
There are situations where lateral displacement of an earth retaining structure is caused by external factors other than lateral earth pressures.

This occurs primarily in rigid, indeterminate structures subjected to temperature-induced strain. Examples include bridges, especially those with internal abutments.

In some cases, this movement can result in lateral earth pressures on the retaining structure in excess of at rest and approaching the passive state. The traditional approach is to design the structure for these elevated potential earth pressures. In some cases, it is necessary to repair structures that are distressed because of inadequate design.

A more cost effective alternative for both new and remedial construction may be to use a **compressible inclusion** to allow the structure to move yet transmit a **reduced magnitude** of displacement to the retained soil.

RMAX Geo Foam® **is cost effective and particularly well suited for both earth volume changes and structural movement.**

RMAX **Geo**Foam® **Construction principles**

In most applications, long term design loads should not exceed the linear elastic range of RMAX **Geo**Foam®. Combined live load and dead load stresses should not exceed the compressive resistance at 1% to 1.5% strain.

General

The bottom of the installation of an RMAX **Geo**Foam® should be above the mean height of the water table. If there is any possibility of flooding the buoyancy effects must be considered. Common methods to counteract buoyancy are the use of sufficient overburden or use of mechanical constraint. Suitable drainage measures must be taken; on sloping sites this is particularly important.

1. Supporting layers

The bottom layer of the RMAX **Geo**Foam® installation has to be supported over its entire lower face, so a plane surface, inclined as appropriate, must be prepared. Departures from planarity should not exceed (±1 cm in 400 cm). The material used is generally sand, its thickness depends on the ground and the machines to be employed.

2. Construction of RMAX **Geo**Foam® Installations

The RMAX **Geo**Foam® installation must be laid flat, with staggered joints; no voids or open joints may be left. The joints must be offset by at least 50 cm. Where there is more than one layer of RMAX **Geo**Foam® blocks alternating layers of RMAX **Geo**Foam® should be staggered. To prevent displacement of blocks during construction they should be fixed together at intervals with polyurethane-based adhesive or mechanical fasteners (e.g. barbed dowels, diameter 117 mm at distances of 1—2 m).

Any water at or near the ground surface must be pumped off until the RMAX **Geo**Foam® installation is covered by material whose weight is sufficient to prevent floatation. RMAX **Geo**Foam® does not swell when exposed to water or water vapour.

Since individual EPS blocks are light enough to be easily lifted by wind when they are being transported or installed, appropriate precautions must be taken. Once EPS blocks are in place, they should be covered as soon as possible.

RMAX **Geo**Foam® will discolor and yellow when exposed to sunlight for extended periods of time. Although this is a surface effect only the RMAX **Geo**Foam® should be covered with an opaque material if exposure to sunlight for extended periods is expected.

Offcuts should not be left on site or burnt: they should be collected for recycling. Smoking and the use of naked flames should be forbidden until RMAX **Geo**Foam® blocks have been completed covered by non-combustible materials.

RMAX **Geo**Foam® should be protected from exposure to direct contact or vapours of hydrocarbons such as petrol and diesel fuel during the construction and design life of the project. RMAX **Geo**Foam® can be protected from hydrocarbons by the use of a hydrocarbon-resistant geo-membrane or through other physical barriers.

3. Construction above the RMAX GeoFoam® installation

As a rule, the sub-grade of the road distributes the load on and protects the RMAX **Geo**Foam® installation, while its surface constitutes the road formation. During construction it is important to protect the RMAX **Geo**Foam® from damage from traffic - this can be done by having adequate thickness of suitable materials, such as concrete over the RMAX **Geo**-Foam®. Loads are spread particularly well by reinforced concrete slab, 12—15cm thick, formed in situ, otherwise strengthened layers of other suitable materials maybe used instead. Traffic in direct contact with RMAX **Geo**Foam® foam blocks is not permissible.

The construction of the pavement above road formation accords with usual practices and rules, but to allow adequate compaction the thickness of material in contact with the upper surface of the EPS block or of the concrete slab over it should not be less than 30 cm.

4. Embankment Slopes

The stepped sides of the installation of RMAX **Geo**Foam® blocks must be bounded by planes whose slopes are consistent with stability, the required profile, the covering material, and the kinds of vegetation intended.

The depth of soil covering the sides may not be less than 25 cm, measured normally to the planes bounding the installation of RMAX **Geo**Foam® blocks. If slopes greater than 1:1.5 are proposed and soil-mechanical considerations allow them, the soil should be secured against slip by appropriate measures, such as reinforcement with geo-textiles or gabions. Where the sides of the embankment are to be greened by other than shallow-rooted plants, the soil covering over the RMAX **Geo**Foam® installation must be deep enough to allow the roots to provide adequate anchorage.

5. Subsidiary highway components

If the depth of material covering the top of the RMAX **Geo**Foam® installation EPS core is 1.50 m or more, no special arrangements need be made for anchoring subsidiary components such as safety fences, direction signs, etc. Depths of less than 1.50 m necessitate provision of concrete anchor blocks, which can be factory-made components resting on the load-spreading course or cast in situ in EPS forms.

Cables can be laid within the EPS if necessary provided the ducts or channels required are bridged in such a way that the load-bearing capacity of the whole system is not adversely affected. Note that without special precautions, work involving welding or soldering will not then be permissible.

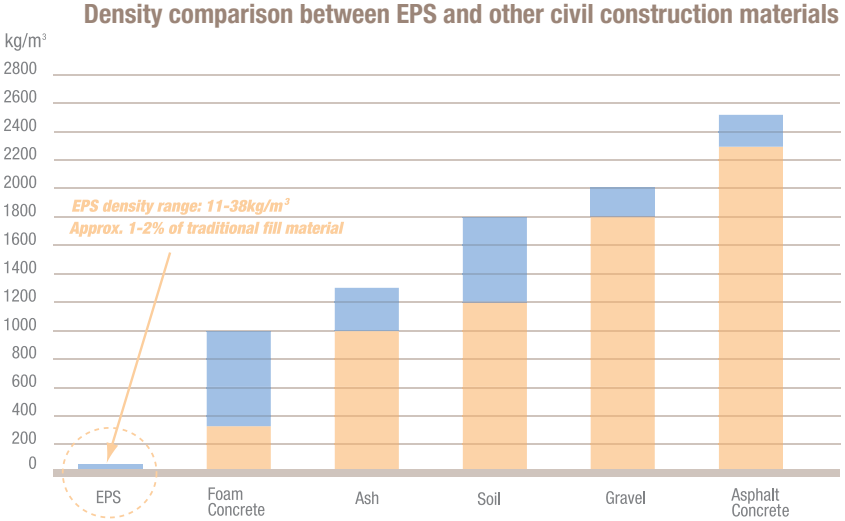
RMAX **Geo**Foam® meets or exceeds the requirements of AS 1366.3 and American Standard ASTM D6817" Standard Specification for Rigid, Cellular Polystyrene Geofoam". RMAX conducts routine, rigorous testing of RMAX **Geo**Foam® to ensure quality is maintained to these standards.

EPS PROPERTIES: RMAX EPS GeoFoam®

Property / Grade	Unit	L	SL	S	M	H	VH	X38	Test Method
Density	kg/m³	11	13.5	16	19	24	28	38	ISO 845
Compressive Stress at 10% deformation (min.)	kPa	50	70	85	105	135	165	280	AS 2498.3
Compressive Stress at 2% deformation (min.)	kPa	30	40	60	70	100	115	190	AS 2498.3
Compressive Stress at 1% deformation (min.)	kPa	14	23	30	35	48	55	82	AS 2498.3
Flexural Strength (min.)	kPa	60	150	178	218	304	337	430	ASTM D6817
Elastic Modulus (min.)	kPa	1450	2200	3100	4250	5850	7250	10200	ASTM D6817
Water absorption by total immersion (max.)	Volume %	4.0	4.0	4.0	3.0	3.0	2.0	2.0	ASTM C272
Cross-breaking Strength (min.)	kPa	95	135	165	200	260	320	460	AS 2498.4
Rate of Water Vapour transmission (min.) measured parallel to rise at 23 degC	µg/m2.s	710	630	580	520	460	400	350	AS 2498.5
Dimensional Stability of Length, Width, Thickness (max.) at 70degC, dry conditions 7 days	%	1	1	1	1	1	1	1	AS 2498.6
Thermal Conductivity at Mean Temperature of 23degC	W/m.K	0.0427	0.0407	0.0394	0.0380	0.0366	0.0350	0.033	AS 2464.5
Flame Propagation Characteristics:									
Median Flame Duration (max.)	SD	2	2	2	2	2	2	2	
Eight Value (max.)	SD	3	3	3	3	3	3	3	
Median Volume Retained	%	15	18	22	30	40	50	50	AS 2122.1
Eight Value (min.)	%	12	15	19	27	37	47	47	
Bouyancy Force	kg/m³	989	986.5	984	981	976	972	963	

EPS exhibits a very high and predictable compressive strength to weight ratio

Density comparison between EPS and other civil construction materials



California Bearing Resistance (CBR)
CBR is a measure of the resistance of a material to load. It is used to compare materials used as subgrade. The value for EPS depends to an extent on density. Typical values are between 2% and 4%.

Further Reading

AS 1366.3
ASTM D7180-05 Standard Guide for Use of Expanded Polystyrene (EPS) Geofoam in Geotechnical Projects

National Cooperative Highway Research Program (NCHRP) Report 529 – Guideline and Recommended Standard for Geofoam Applications in Highway Embankments 2004.

International Geotechnical Symposium Polystyrene Foam in Below Grade Applications – Hawaii, 1994

Properties and Applications of Geofoam – D. Negussey, Ed. Society of Plastics Industry, Inc, 1997

Vicroads Engineering Excellence Awards 1997- Repairing Roads with Polystyrene

Geopave Technical Note 25 Embankment/Landslip Repair using Expanded Polystyrene Vicroads 2006

Websites:
www.fhwa.dot.gov/crt/lifecycle/geofoam.cfm - Website of the USA Federal Highway Adminstration's Research and Technology Program
www.geofoam.syr.edu – Website of The Geofoam Research Center (GRC) at Syracuse University

What about Sales & Service?

You can have full confidence in the long term sales and service of RMAX **Geo**Foam® because it is Australian made by RMAX – Australia's largest producer of Expanded Polystyrene products.

With offices across Australia, quick and easy delivery of RMAX **Geo**Foam® is assured and with over 50 years of experience, we can advise and answer your most difficult questions. Simply contact your state office and ask to speak to a RMAX **Geo**Foam® consultant today.

RMAX Environmental EPS

RMAX and the Environment

EPS (Expanded Polystyrene) is highly energy efficient in insulation applications. In civil engineering applications RMAX **Geo**Foam® is efficient and effective providing clean, fast solutions to geotechnical problems. RMAX EPS products do not contain ozone depleting substances and none is used in its manufacture. RMAX promotes the use of EPS for the construction of buildings and in civil construction.

Recycling EPS

EPS products are recyclable and RMAX has established recycling facilities in all of our plants throughout Australia. RMAX is a member of PACIA (Plastics and Chemical Industries Association) and helped establish the EPS Industry Group, known as EPSA (Expanded Polystyrene Australia). RMAX, through EPSA play a major role in facilitating the collection and recycling of EPS in Australia.

Energy Efficient Manufacture

The manufacture of EPS is a low pollution process. Steam is the key ingredient and the water is used many times. There is no waste in production as all cut offs or rejects are re-used.

RMAX - Innovation Working for You

RMAX is a company driven by innovation. We have pioneered Rigid Cellular Plastics product technologies, leading the development of innovative product solutions for our customers and international partners. RMAX introduced Australia to RMAX **Geo**Foam® for civil construction in 1992 and has been instrumental in the promotion and development of RMAX **Geo**Foam® since that time.

In the Australian building industry, RMAX was the first to introduce termite resistant expanded polystyrene (EPS) - Isolite PerformGuard® EPS. The exclusive patented technology incorporates a safe, non-toxic inorganic additive that is a deterrent to termites. We are committed to working with our customers to deliver high quality creative solutions to construction problems. Contact us and see how our innovative approach using EPS in building construction can help you.

REPSA Recycling Expanded Polystyrene Australia

All Greenhouse Gas omissions associated with printing this product have been offset.

This product is 100% Carbon Neutral

Australia's Largest

Rigid Cellular Plastics Manufacturer

Expanded polystyrene does not contain any ozone depleting substances and none is used in its manufacture.

RMAX pursues a policy of continuous improvement in the design and performance of its products. The right is therefore reserved to vary specifications without notice.

RMAX innovation working for you

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FSC Mixed Sources
Product group from well-managed forests and recycled wood or fiber
www.fsc.org Cert no. SGS-COC-2586
© 1996 Forest Stewardship Council

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