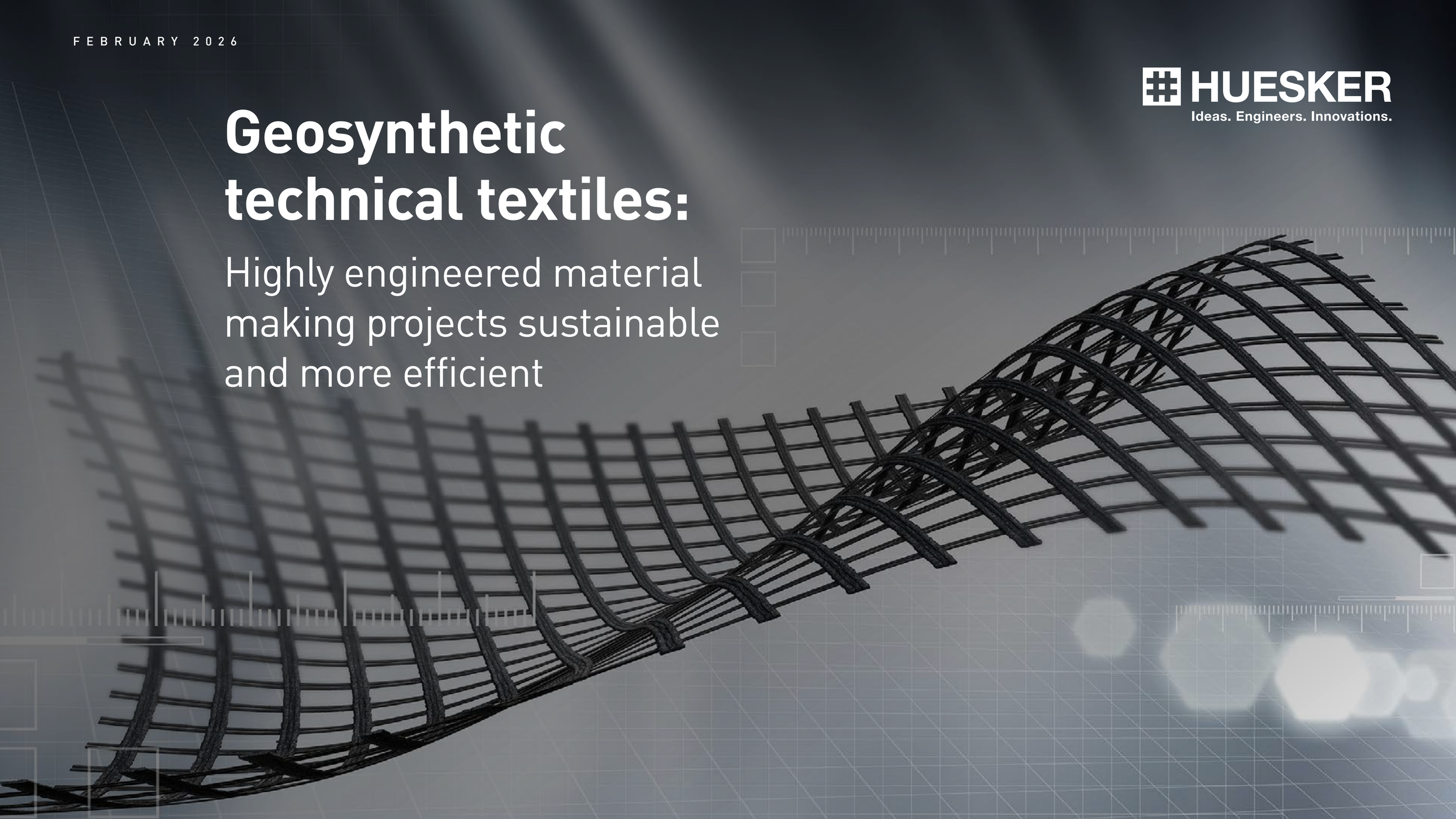
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Geosynthetic technical textiles:

Highly engineered material making projects sustainable and more efficient





Introduction

Australia's infrastructure pipeline is accelerating, and projects are under increasing pressure to perform. Economic constraints, climate concerns and labour shortages threaten to exceed project budgets and delay timelines. This highlights the need for a more efficient and resilient construction approach.

The industry is moving beyond conventional construction methods and adopting modern solutions. Innovative geosynthetic technical textiles are being ultilised to address these challenges by reducing construction time, lowering costs, mitigating risks, and supporting sustainable outcomes.

Geosynthetics are engineered polymeric materials designed to enhance soil performance by improving stability, strength, filtration, and permeability across a wide range of geotechnical applications. Geosynthetic textiles can be used for separation, drainage, filtration, protection, and reinforcement, helping reduce construction times and costs in a sustainable and safe manner.

Areas of application for geosynthetics include:

- Earthworks and foundation engineering,
- Hydraulic engineering,
- Road, railway and pavement construction,
- Environmental engineering and containment,
- Climate response infrastructure, and
- Mining and industrial applications.

HUESKER Australia is applying its global geosynthetics engineering expertise to local asset network maintenance and expansion projects. To meet the growing infrastructure demands, in-house material testing, project-specific design and support, and extensive experience across all infrastructure sectors provide long-term performance and reliability.

This paper provides:

- An introduction to geosynthetics, product categories and functional characteristics,
- Typical application mechanisms and performance outcomes in civil and geotechnical projects,
- Cost and labour implications arising from reduced earthworks volumes and accelerated construction methodology,
- Sustainability impacts, with emphasis on the embodied emissions reductions associated with reduced haulage, import and export of materials, and extended maintenance intervals,
- Recycled-content and biodegradable geosynthetic options, including HUESKER's ecoLine and bioLine products,
- Quality assurance considerations relevant to infrastructure performance over protracted time scales, and
- Case studies demonstrating application outcomes in Australian and comparable infrastructure contexts.

An introduction to geosynthetics

Geosynthetic textiles consist of grid, fabric, filtration, and low-permeability polymeric materials used within geotechnical and civil engineering works. They are used for purposes, such as reinforcement, barrier application, drainage, separation, or containment. These materials are typically manufactured from polymers such as polyester (PET), polypropylene (PP), polyvinyl alcohol (PVA), and high or low-density polyethylene (HDPE/LDPE).

Geosynthetics offer a distinct advantage over conventional materials by integrating tensile strength, interface interaction, and hydraulic functionality into soil systems that are otherwise governed by compressive strength, frictional resistance, and pore-pressure behavior. This integration allows geosynthetics to enhance performance at both the ultimate limit state – improving stability, bearing capacity, and resistance to shear failure – and the serviceability limit state-reducing settlement, rutting, cracking, and progressive deformation. As a result, geosynthetics can modify outcomes at both the ultimate limit state (stability, bearing, shear failure resistance) and serviceability limit state (settlement, rutting, cracking, deformation accumulation).

In practical terms, this allows designs to focus on controlling the mechanisms that most commonly lead to rutting and loss of serviceability in pavements and working platforms, and excessive settlement in embankments. It also addresses internal erosion in hydraulic interfaces and contaminant migration in remediation caps.

The performance of geosynthetics is influenced by factors such as raw material selection, manufacturing methods, stabilisation and coating systems and quality assurance. When manufactured to appropriate standards and correctly selected for the conditions they're being exposed to, (underground, submerged, exposed to chemicals, alkaline environments, or UV) geosynthetics can deliver reliable, long-term performance over multiple decades.

Geosynthetics are often used in hard-to-access locations, such as underground, with limited access for inspection. In these cases, structural and environmental control elements are critical for long-term reliability. Geosynthetics are highly stabilised and inert and can remain buried underground without harming the environment, releasing microplastics, or degrading.



Geogrids:

Geogrids are lattice-like reinforcement structures formed from networks of longitudinal and transverse ribs. They are engineered to provide tensile reinforcement and facilitate interlock with granular materials, enabling improved load distribution and confinement within unbound layers.



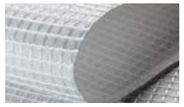
Woven geotextiles:

Woven geotextiles are permeable fabrics characterised by high tensile capacity, controlled tensile stiffness, and durable performance under long-term loading. They are used for reinforcement, separation and filtration functions in applications where tensile properties are critical.



Nonwoven geotextiles:

Nonwoven geotextiles are typically needle-punched materials with filtration and drainage characteristics. Their primary functions include separation, protection, filtration, and drainage, particularly where permeability and robustness against clogging are required.



Geocomposites:

Geocomposites combine two or more geosynthetic components to provide multi-functional performance for example, filtration plus reactive adsorption; drainage plus separation; reinforcement plus filtration. These systems can be used to reduce layer complexity and improve constructability, especially in constrained work areas.



Clay liners:

A low-permeability material that can be used as a barrier for groundwater protection, contaminated site remediation, hydraulic engineering and waste containment. Clay liners seal with swelling clay minerals.



Geosynthetics in action

Infrastructure assets, such as road and rail networks, airports, ports, water and waste facilities, coastal protection structures, and flood-resilience works, require ongoing intervention to maintain serviceability. In many of these contexts, conventional construction and maintenance approaches remain highly dependent on excavation, replacement and importation of suitable fill materials, which can be inefficient where subgrade conditions are weak or where site access imposes constraints.

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Geosynthetic technical textiles provide an alternative engineering pathway by incorporating the existing soil into the structural system, rather than removing and replacing it. In many cases, this approach can reduce required fill thickness, improve bearing capacity, and extend maintenance intervals.

Consider a scenario in which a project requires a road surface to be constructed over soft or low-bearing-capacity soils. A conventional approach often involves the excavation of unsuitable subgrade materials, importation of competent granular fill, placement and compaction to target density and stiffness and construction of pavement layers on the improved platform.

An alternative solution sees a geosynthetic layer installed at the subgrade interface to provide separation and reinforcement, resulting in load distribution across a wider effective area, which reduces localised stress on weak subgrade.

From the perspective of an asset owner or operator, the incorporation of geosynthetics can yield outcomes including:

- improved constructability over marginal ground conditions,
- increased resilience and reduced susceptibility to saturation and flooding,
- lower construction time and reduced labour demand,
- reduced material haulage and associated traffic impacts, and
- potential reduction in construction-related safety exposure due to fewer plant movements and shorter site occupancy.

In addition to these operational outcomes, geosynthetics can provide a more repeatable construction process where performance is sensitive to interface behaviour.

For example, stabilised working platforms can improve trafficking conditions for construction plants, reducing delays and rework associated with wet-weather disruption. In rehabilitation settings, the ability to minimise excavation depth can reduce the likelihood of encountering unforeseen services or contaminated materials, thereby reducing latent risk.

Where projects are delivered in constrained corridors, reduced construction footprint and simplified installation sequences can support staged delivery while maintaining operational continuity and limiting disruption to adjacent assets.

Lower cost, less effort

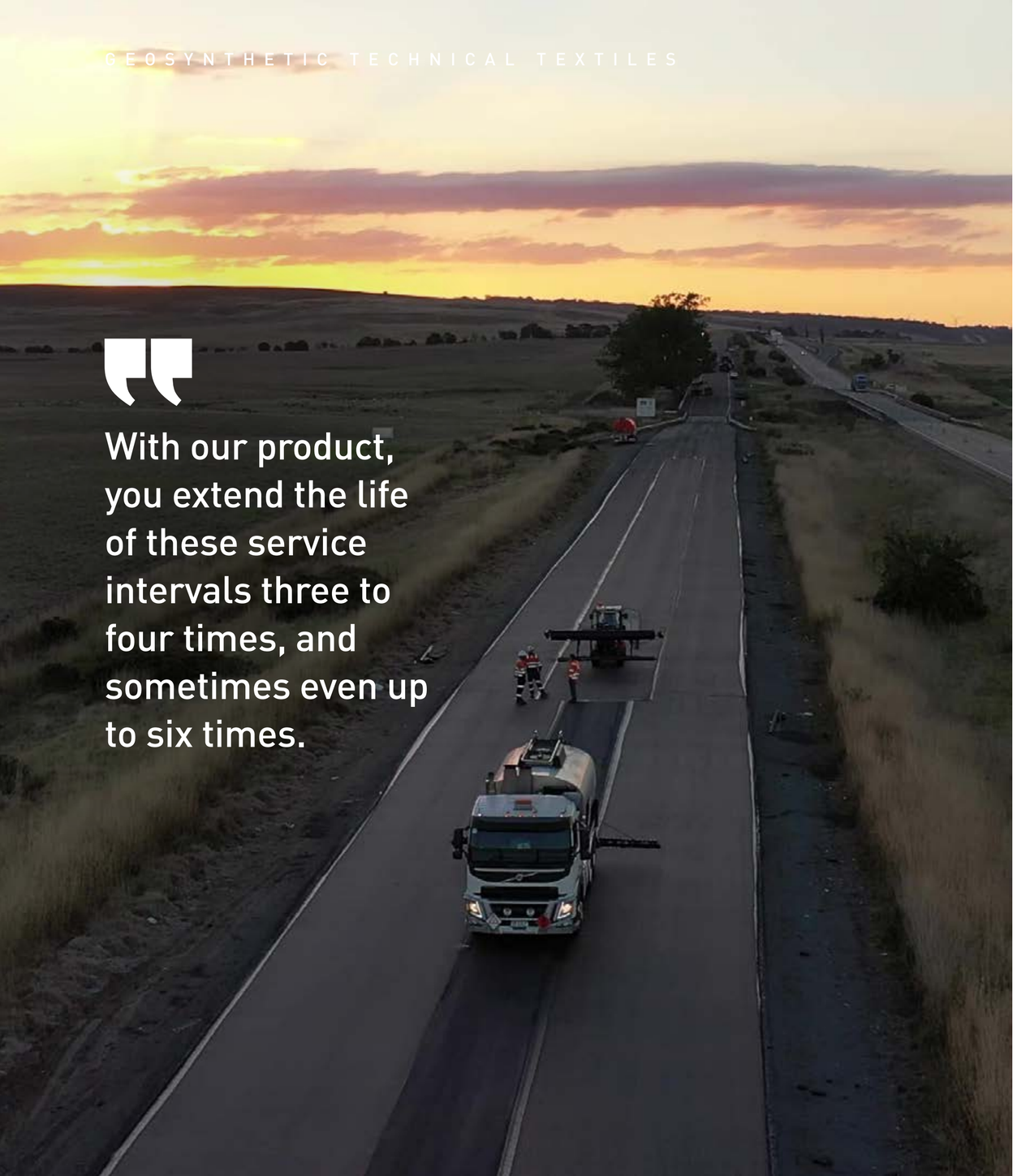
Geosynthetic technical textiles can influence both direct construction costs and indirect program-related expenses. The primary cost savings typically come from reduced earthworks volumes, lower imported fill requirements, and shorter on-site construction time.

Indirect cost savings often come from reduced temporary works, simplified traffic management, lower disposal and contamination handling requirements (where unsuitable materials are encountered), and decreased schedule sensitivity to haulage cycles and weather delays. These factors can have a significant impact on sites where access and logistics limit productivity.

Reduction of earthworks and haulage demand: Geosynthetics allow construction to proceed on poor founding soils with significantly reduced excavation. This leads to lower excavation plant hours, less material movement, and reduced disposal volumes. The use of geosynthetics can reduce temporary works and simplify traffic management requirements, further improving efficiency and sustainability on site.

Labour and productivity considerations: Geosynthetics are typically installed rapidly via roll or panel deployment, and their installation procedures can require smaller crews relative to conventional earthworks and rigid structural alternatives. In practice, this can reduce project exposure to labour shortages and skilled resource constraints.





> With our product, you extend the life of these service intervals three to four times, and sometimes even up to six times.

Time savings through simplified methodology: In projects where the baseline methodology involves excavation, replacement, and reconstruction, the schedule is often dictated by the volume of material moved and the number of transport cycles. By incorporating geosynthetics to reduce excavation and the need for imported fill, project duration can be shortened, allowing for more continuous work fronts and less reliance on material logistics.

Pavement rehabilitation and reflective cracking control: A key maintenance challenge for flexible pavements is deterioration caused by cracking and deformation in the underlying layers. In road networks with long service histories, surface asphalt frequently exhibits progressive distress and cracking, and movement within the base can propagate through the wearing course as reflective cracking.

Asphalt reinforcement geogrid systems are used to delay reflective cracking propagation by introducing a reinforcement layer that reduces stress concentrations and improves stress distribution between asphalt layers.

This helps avoid wider costs. In Australia, traffic delays are projected to cost $53 billion annually by 2031, with the country's 10 most congested roads experiencing 106,200 hours of delay each year. Using asphalt reinforcement for road rehabilitation can reduce these costs by 33–41% over 12 years. For road authorities, this translates into fewer repairs, lower maintenance needs, and longer-lasting roads.

Enhancing sustainability

The sustainability benefits of geosynthetic solutions are driven by two main factors. First, reducing embodied impacts through less excavation, lower imported fill requirements, and fewer transport movements. Second, lowering operational impacts by extending service life and reducing the frequency of maintenance.

By utilising geosynthetics, this allows construction to proceed over even the softest soils, projects can significantly reduce the need for extensive earthworks, imported fill, and heavy transport. This not only streamlines construction but can also lead to up to an 89% reduction in carbon emissions.

Emissions reduction through reduced material movement: Geosynthetics can lower construction-related emissions in challenging ground conditions by reducing excavation and transport needs. They speed up project completion, lessen traffic congestion, and cut the number of transport movements required.

Coastal protection and erosion control: Coastal defense and beach refurbishment works are often delivered through placement of rock armour or imported masonry elements, which are transport-intensive and can create visual and environmental impacts. Geosynthetic container systems enable the use of locally available fill material and can reduce the need for imported rock and associated haulage emissions.

Bridge abutments and reinforced soil structures: Traditional bridge abutment solutions commonly rely on reinforced concrete walls with associated embodied emissions. Geosynthetic-reinforced soil abutments, on the other hand, can use locally available soil or sand as structural fill, with synthetic reinforcement providing stability and load-bearing capacity. An independent analysis comparing a geogrid-reinforced bridge abutment with a conventional concrete solution found that a geogrid-reinforced abutment results in 46% less carbon dioxide emissions with a 50% reduction in environmental costs.

Resilience under extreme weather events: Beyond embodied emissions, geosynthetics can positively contribute to infrastructure resilience. By improving durability and maintaining serviceability under climate-driven hazards, including flood events and prolonged saturation. HUESKER's geosynthetics have helped to boost asset resilience in the face of a changing climate.

A recent case involved an asphalt reinforcement product on a road when a flood struck the region. The sections of the road that had HUESKER's product installed, were able to remain in service; the geosynthetics' durability meant the road surface was not washed away by the deluge.



Recyclable and biodegradable options

Geosynthetics contribute to sustainability by improving lifecycle efficiency and by using more sustainable manufacturing and raw-material options; especially when made with recycled polymers or renewable materials.

Environmental product declarations (EPDs) can provide transparency for cradle-to-grave carbon accounting and enable more consistent comparison across solutions during design and procurement.

ecoLine: recycled PET reinforcement systems

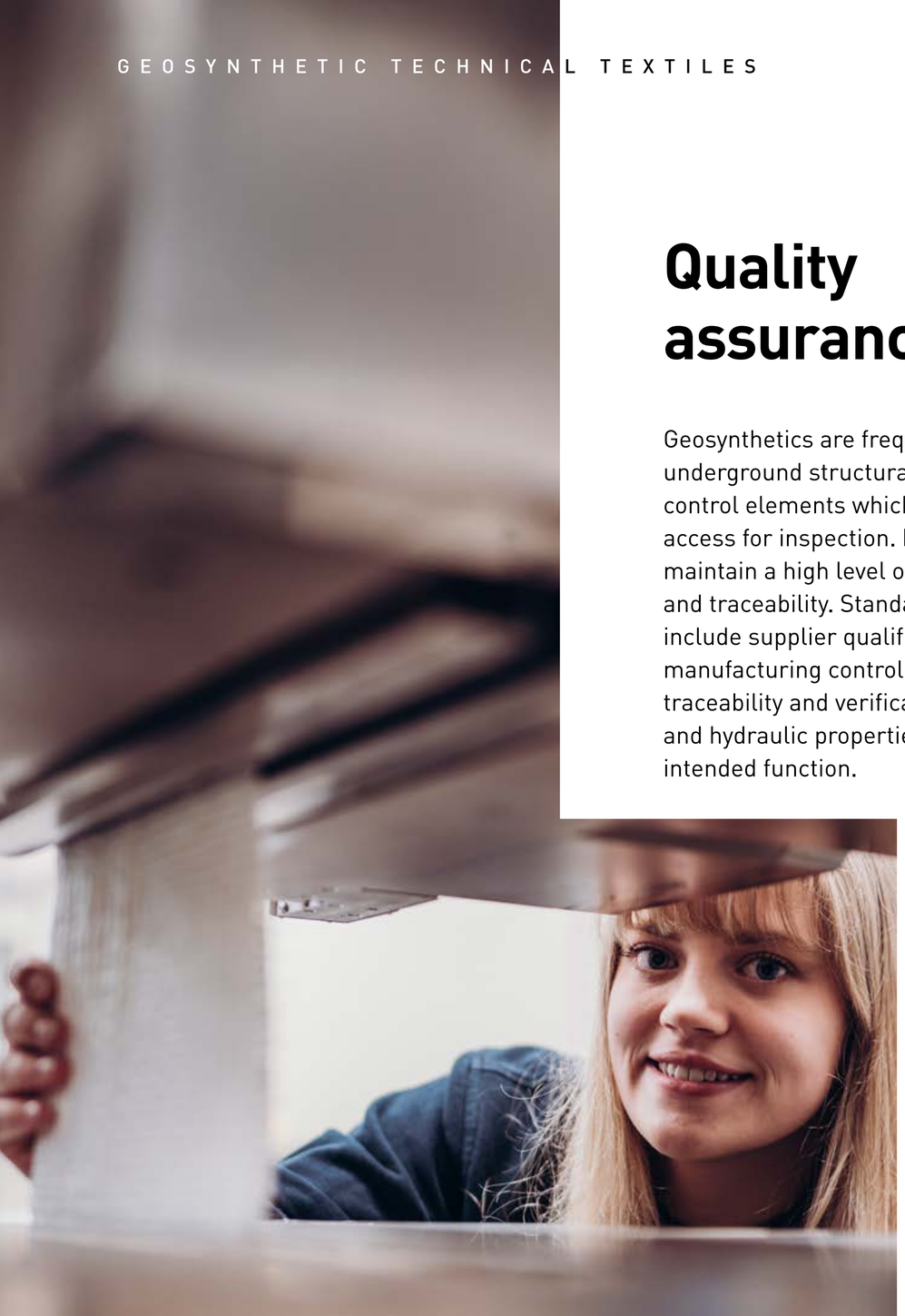
HUESKER's ecoLine reinforcement product is manufactured from recycled PET and engineered to match the mechanical and performance. Characteristics of products manufactured from virgin polymer, reduces reliance on primary raw materials. Achieving property equivalence requires controlled manufacturing and input material qualification to ensure end-product properties meet specification.

bioLine: biodegradable textiles for temporary applications

HUESKER's biodegradable technical textile bioLine is produced from renewable raw materials. Providing required functional performance over a design timeframe, after which biodegradation reduces or eliminates dismantling requirements. Temporary works or applications where removal and disposal are required, create unnecessary cost and disruption.







Quality assurance

Geosynthetics are frequently installed as underground structural and environmental control elements which provide limited access for inspection. It is critical to maintain a high level of quality assurance and traceability. Standards typically include supplier qualification, routine manufacturing control testing, batch traceability and verification of mechanical and hydraulic properties relevant to the intended function.

Quality assurance considerations commonly include:

- Mechanical property verification
- Coating and stabilisation performance
- Hydraulic properties
- Roll-to-roll traceability and batch testing regimes
- Installation guidance aligned with product and project-specific requirements.

HUESKER makes an extensive effort to ensure that its geosynthetic textiles are of the highest quality available. Strict standards are required from suppliers and the manufacturing facility, commitment to quality extends throughout its supply chain.

While some manufacturers ship the geosynthetics to site without testing first, HUESKER monitors its products to ensure they meet the specifications laid out by the designer.

The geosynthetics industry has internationally applied standards, which HUESKER follows while setting its own higher benchmarks for quality. To ensure standards are met, an independent accredited laboratory conducts mechanical and thermal tests on the products. Documented quality-control data and traceability systems support designers and asset owners in confirming that supplied materials align with design specification and long-term performance requirements.

HUESKER employs 500 people around the world, with one in seven employees being an engineer.

The company focuses on engineering first and foremost and develops its solutions in conjunction with client's specific project requirements. Beyond its standard range of materials, HUESKER can adjust its offerings specifically to the conditions required at site.

The work HUESKER has done in Australia demonstrates the versatility and creativity that goes into its cost-reducing, sustainable solutions.

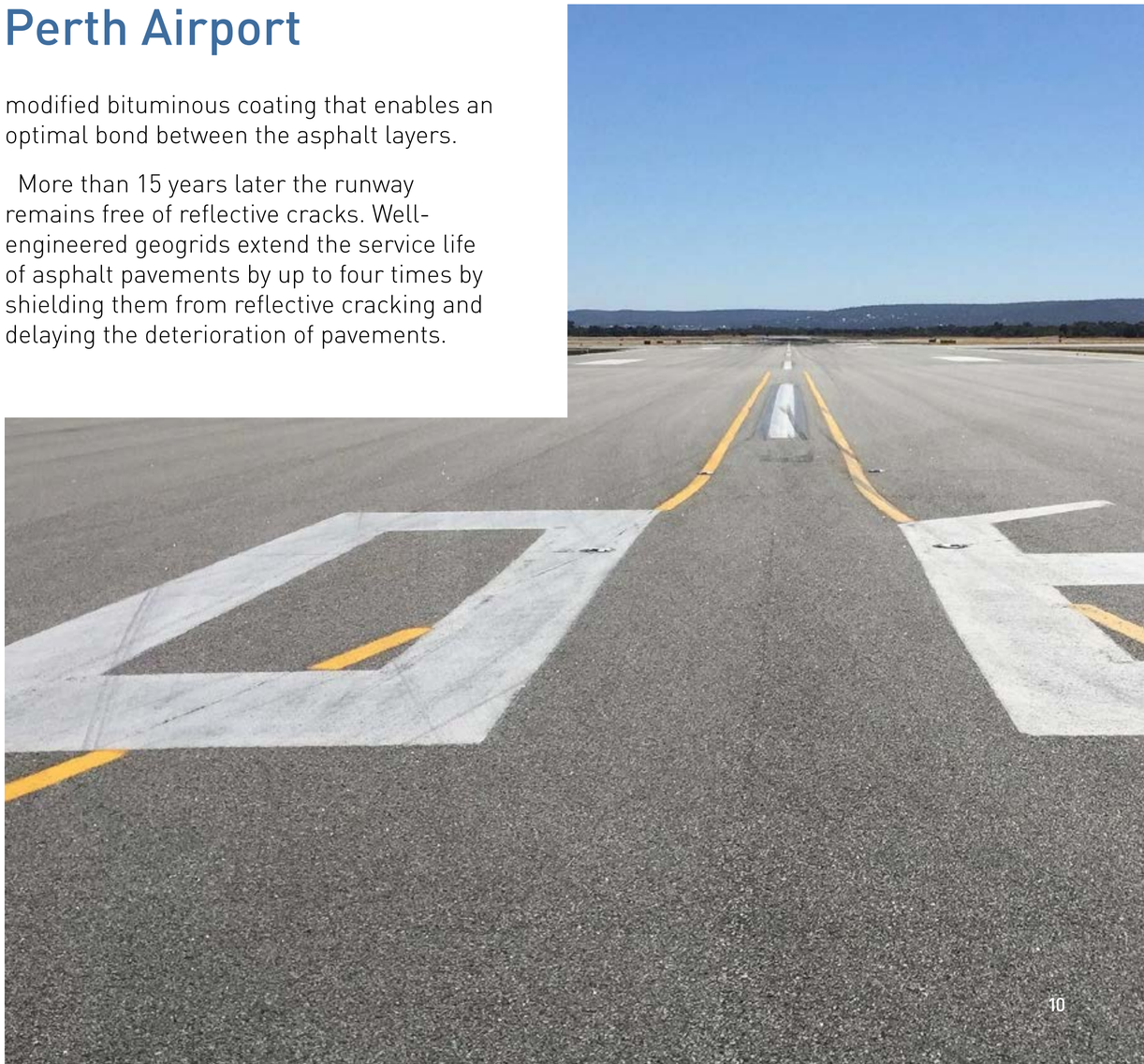
Runway rehabilitation at Perth Airport

Airport pavements operate under high-load, high-frequency traffic and are typically governed by strict serviceability requirements. In 2009, Perth Airport required rehabilitation of an extensively cracked runway to restore serviceability.

The existing pavement comprised 300 mm concrete slabs overlain with 20 mm asphalt surfacing. To retard reflective cracking within the rehabilitated pavement structure, the rehabilitation design incorporated HUESKER's asphalt reinforcement HaTelit C® 40/17 product, an asphalt reinforcement system installed between asphalt layers to improve crack control and extend service intervals.

This flexible reinforcement geogrid is made from high-modulus polyester yarns that have an ultralight nonwoven backing for ease of installation. The grid and the ultralight nonwoven geotextile have a polymer-modified bituminous coating that enables an optimal bond between the asphalt layers.

More than 15 years later the runway remains free of reflective cracks. Well-engineered geogrids extend the service life of asphalt pavements by up to four times by shielding them from reflective cracking and delaying the deterioration of pavements.





Contaminated sediment management in Kendall Bay, Sydney Harbour

Remediation works at Kendall Bay in Sydney Harbour provide an example of harbour-adjacent environmental engineering application. Historical industrial use at this site has resulted in sediment contamination by organic compounds, including polycyclic aromatic hydrocarbons and petroleum hydrocarbons.

The remediation work used an in-situ approach, avoiding dredging by installing an engineered cover system that combined reactive treatment media with filtration layers. Tektoseal® Active Geocomposite are contaminant filters and barriers designed to protect soil and groundwater, absorbing pollutants while allowing purified water, air or gas to pass through. The erosion-resistant filters enable passive treatment of contaminated leachate, preventing the spread of pollutants.

Conclusion

Geosynthetic technical textiles are well established engineered materials capable of delivering structural, hydraulic, and environmental functions within infrastructure systems.

When specified and installed in accordance with project requirements, and supported by robust quality assurance, geosynthetics can deliver significant benefits. Geosynthetics application can reduce the need for excavation and imported fill. It can also shorten construction durations and improve lifecycle performance, leading to lower whole-of-life costs. In addition, they can reduce embodied carbon through lower haulage requirements and extended service life.

Across transport infrastructure, environmental remediation, hydraulic engineering, and climate adaptation works, geosynthetics provide engineers with a flexible toolkit for performance-based design under contemporary constraints.

Summary of engineering outcomes commonly targeted through geosynthetic inclusion includes:

- Improved platform performance over weak or moisture-sensitive subgrades through load distribution and confinement
- Reduced fines migration and pumping at critical interfaces, supporting retained stiffness in unbound layers
- Extended pavement serviceability where reinforcement interlayers are used to mitigate reflective cracking mechanisms
- Reduced construction footprint and simplified staging where access and operational continuity constrain methodology
- Reduced embodied impacts through reduced material haulage volumes and longer maintenance intervals.



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Sectors from mining to transport to climate-response infrastructure rely on geotechnical engineering. Many discovering the advantages of HUESKER Australia's diverse geosynthetics range. The solutions offered by geosynthetics help to address budget constraints, sustainability demands, and labour shortages, making maintenance programs more effective and new builds more feasible.

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