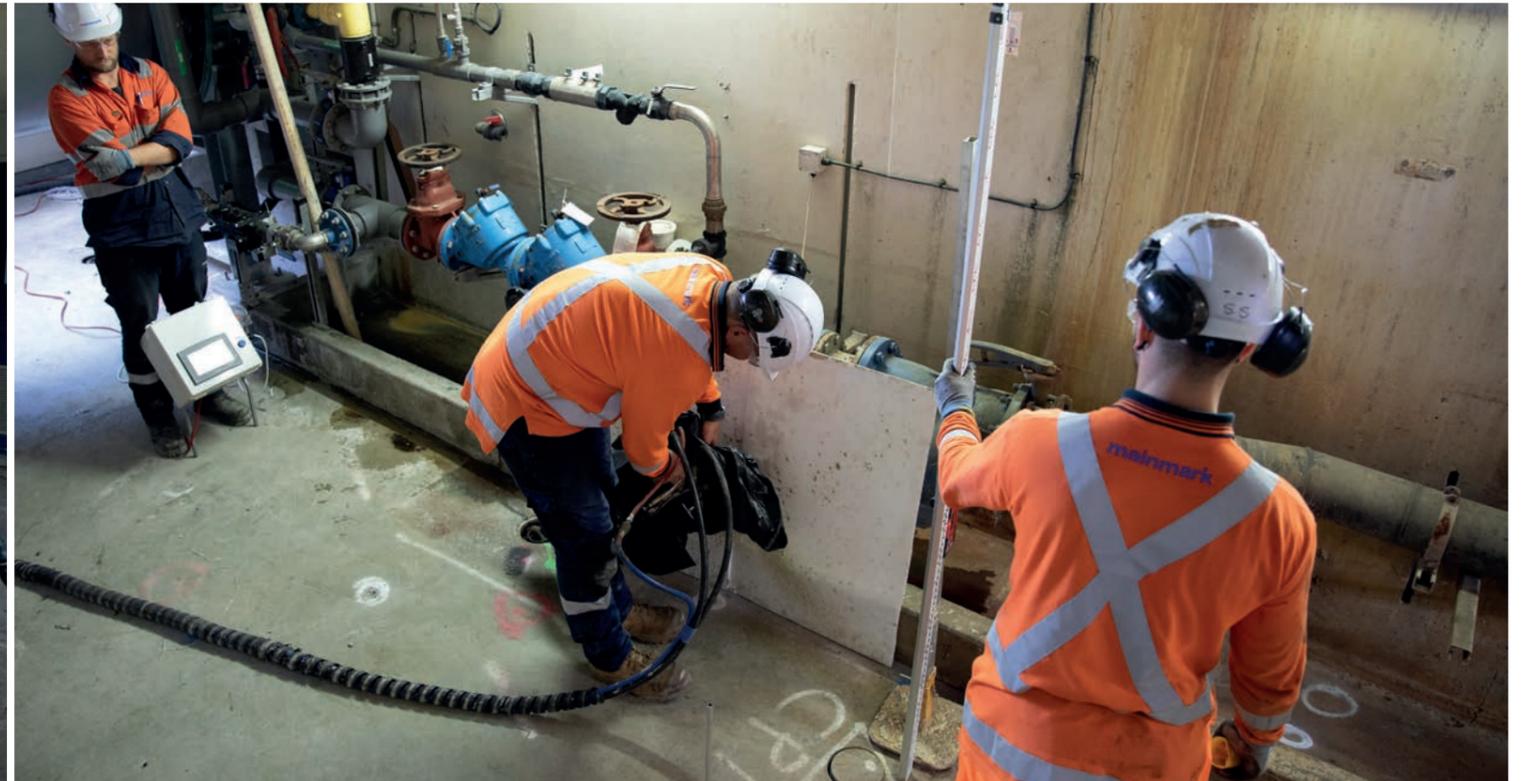




Resin being precisely delivered under computer control, according to engineered specifications.



Resin injection equipment being used in difficult to reach and confined spaces with low headroom.

## Liquefaction mitigation for existing structures

Following extensive testing and field trials, Mainmark Ground Engineering has marketed what it says is the first commercially viable, non-invasive ground improvement and liquefaction mitigation technique that can be applied beneath existing structures.

Terefirm Resin Injection is engineered and validated by geotechnical testing and can protect structures at risk from soil liquefaction, providing an alternative to structural strengthening and more invasive soil treatments.

Developed in response to the 2010/11 Canterbury seismic events, Terefirm Resin Injection has been proven to produce consistent and positive results with the method now included in the Ministry of Business, Innovation and Employment (MBIE) Module 5: Ground Improvement of Soils Prone to Liquefaction.

The internationally peer-reviewed research was conducted in partnership with the Earthquake Commission (EQC) and the MBIE, and can be found online in the New Zealand Geotechnical Society library.

The non-invasive Terefirm Resin Injection method involves a proprietary technique to inject Mainmark's engineered resin with surgical precision in a relatively clean and non-disruptive process, to densify the soil and increase liquefaction resistance.

During injection of the treatment zone, the low viscosity resin both permeates the soil and penetrates under pressure along planes of weakness within the soil profile.

The injected material then reacts by rapidly expanding to many times its original volume, resulting in compaction of the adjacent soils. This improves the soil foundation characteristics and makes the ground less susceptible to liquefaction.

"We've always believed that our unique resin injection technique could be used to provide liquefaction mitigation, and we are very pleased that this is now a proven and ratified theory," says Theo Hnat, technical manager, Mainmark New Zealand.

"Terefirm Resin Injection is the result of years of hard work, commitment and scientific collaboration. Through the success of the Christchurch Ground Improvement trials, engineers and asset owners now have a viable alternative to consider for improving soil density beneath structures affected by or at-risk of liquefaction."

Terefirm has already helped to remediate a number of residential and commercial projects, including the Northwood Supa Centa, a large shopping centre in Christchurch that had suffered liquefaction-related settlement damage following the 2010 and 2011 earthquakes. The site required extensive ground improvement work to densify the soil beneath the centre and bring the buildings back to level. Mainmark undertook the project while retail tenants, including a busy supermarket, continued to trade virtually uninterrupted. The outcome resulted in the shopping centre achieving 100 percent NBS (new building standard).

The focus is also turning towards the building of resilient cities and protecting critical infrastructure, including utilities, roads and hospitals. The operators of the Seaview Wastewater Treatment Plant in Wellington have also addressed liquefiable soils beneath the plant, helping to reduce the risk of damage to the water facility when earthquakes occur.

"Wellington Water's council owners have tasked us with ensuring our key treatment plants will be able to quickly resume operating after a major earthquake," says Tristan Reynard, project director for the Seaview project. "Upgrading this plant while it keeps operating presented a unique challenge, which Mainmark's solution helped us to address."

Mainmark's ground engineering outcomes have been recognised worldwide. The company's post-earthquake resurrection of the Christchurch Art Gallery won the International Project of the Year Award at the 2016 Ground Engineering Awards in London. 🚧

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