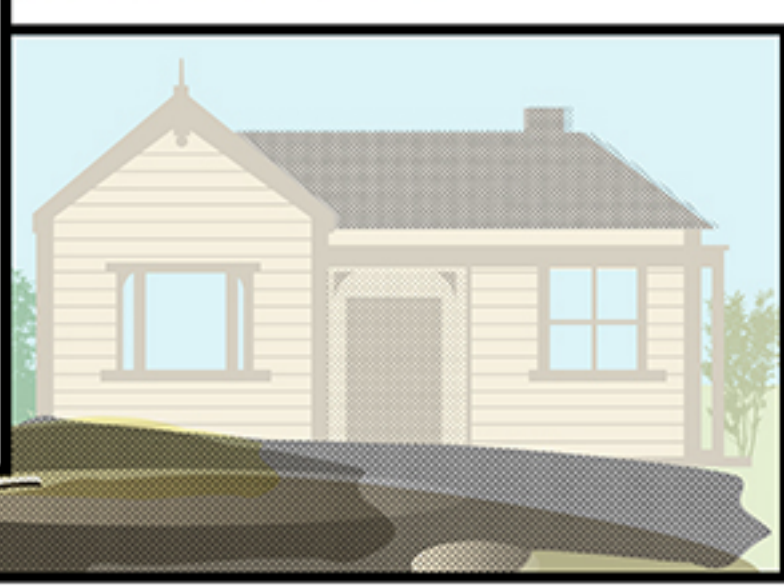


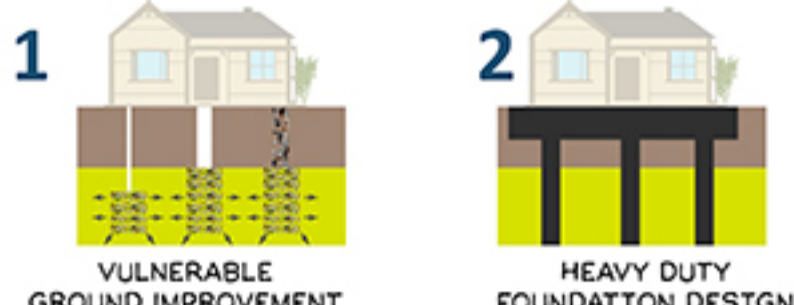
IMPROVING Liquefaction Vulnerable Land

LIQUEFACTION OCCURS WHEN SOIL BELOW THE GROUNDWATER LEVEL TEMPORARILY LOSES STRENGTH AND STIFFNESS WHEN SHAKEN. THIS CAN CAUSE THE SOIL TO TEMPORARILY "LIQUEFY" AND LARGE QUANTITIES OF WATER, FINE SAND AND SILT CAN BE EJECTED TO THE SURFACE, CAUSING THE GROUND SURFACE TO DEFORM, PLACING HUGE STRESS ON BUILDINGS ON TOP OF LIQUEFIED GROUND.



IN PARTS OF CANTERBURY, REBUILDING WILL OCCUR ON LAND THAT IS VULNERABLE TO LIQUEFACTION IN FUTURE MAJOR EARTHQUAKES.

THERE ARE TWO OPTIONS FOR MANAGING THIS RISK.



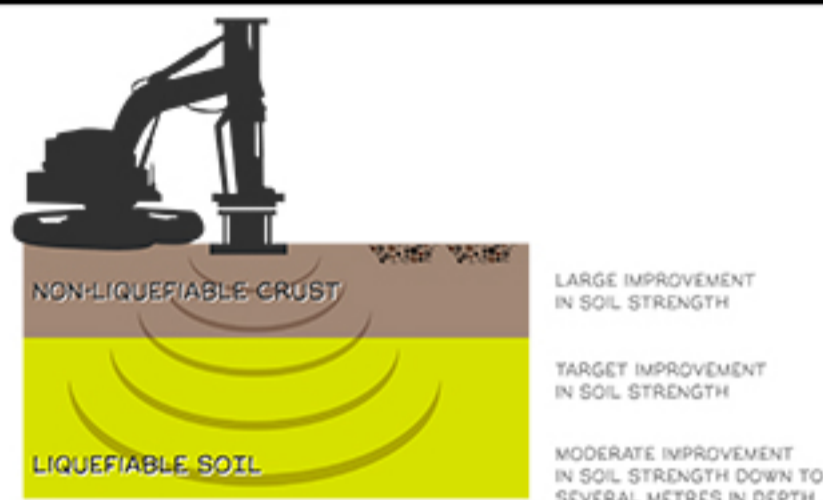
EQC is funding research into new ground improvement methods that can be used with foundation design to get the best outcome for homeowners.

FOUR GROUND IMPROVEMENT METHODS USED IN LARGE SCALE CIVIL CONSTRUCTION PROJECTS ARE BEING TRIALLED TO SEE IF THEY CAN BE SUCCESSFULLY DOWN-SCALED FOR RESIDENTIAL USE IN CANTERBURY - BOTH ON BARE LAND AND BENEATH EXISTING HOUSES.

GEOTECHNICAL ENGINEERS TONKIN & TAYLOR ARE GUIDING THE TRIALS, SUPPORTED BY REVIEWERS FROM THE UNIVERSITY OF CANTERBURY, CORNELL UNIVERSITY, UC BERKELEY, UNIVERSITY OF TEXAS AND OTHER LEADING ENGINEERING CONSULTANCY FIRMS.

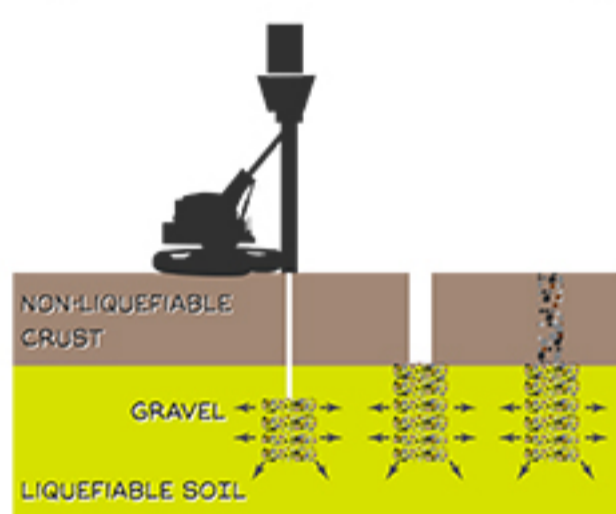
Four ground improvement methods

RAPID IMPACT COMPACTION



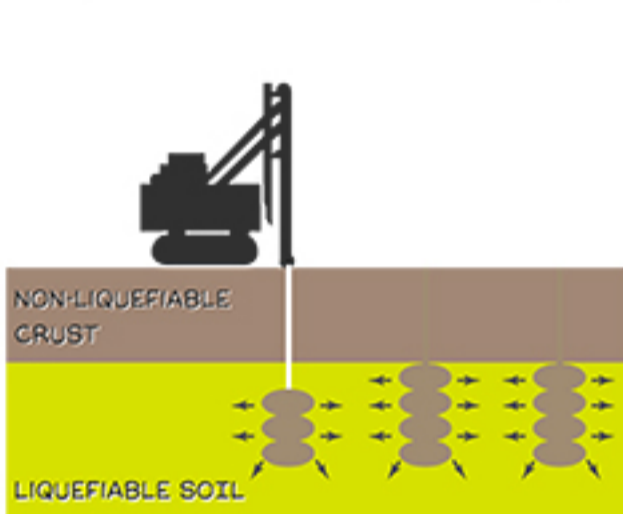
THIS METHOD INVOLVES COMPACTING THE GROUND USING A FALLING WEIGHT ATTACHED TO THE ARM OF A DIGGER. IT WORKS BEST IN SANDY SOILS. VIBRATIONS NEED TO BE MANAGED TO LIMIT DISTURBANCE TO NEIGHBOURS.

RAMMED AGGREGATE PIERS



THIS METHOD INVOLVES PUSHING GRAVEL INTO THE GROUND USING A LARGE HYDRAULIC RAM ATTACHED TO A DIGGER. AS THIS OCCURS, THE SOIL BETWEEN THE GRAVEL COLUMNS IS COMPACTED.

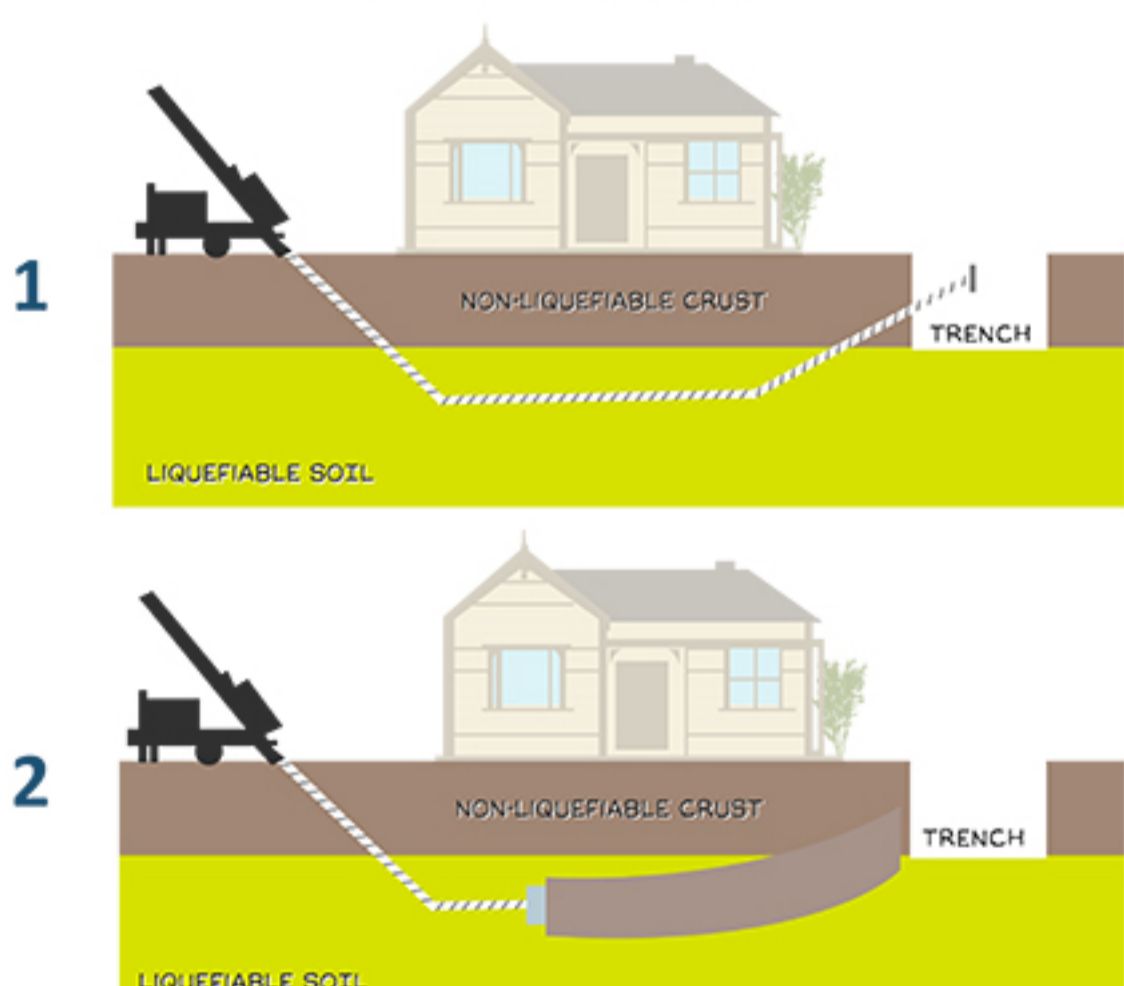
LOW MOBILITY GROUT



THIS INVOLVES INJECTING CONCRETE INTO THE GROUND, UNDER PRESSURE, TO FORM A SERIES OF UNDERGROUND PILLARS OF CONCRETE BULBS. THIS COMPACTS THE GROUND BETWEEN THE COMPACT PILLARS.

HORIZONTAL SOIL MIXING

THIS INVOLVES HORIZONTAL DIRECTIONAL DRILLING UNDER AN EXISTING BUILDING TO A TRENCH. A TOOL IS ATTACHED TO THE DRILL AND AS IT IS DRAWN BACK, CEMENT IS MIXED INTO THE SOIL TO CREATE HORIZONTAL COLUMNS OF CEMENTED SOIL.



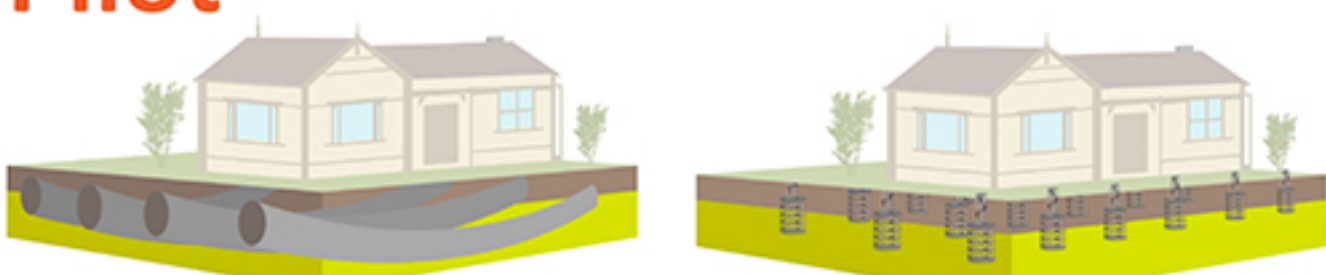
To assist in the trials, we have helped bring a specialised geophysical test "truck" called T-Rex from the University of Texas.

T-REX



ONCE THE GROUND HAS BEEN IMPROVED BY ONE OF THE METHODS, THE EFFECTIVENESS OF THE GROUND IMPROVEMENT IS TESTED USING A T-REX MACHINE. THE T-REX CREATES INTENSE, BUT HIGHLY LOCALISED, SHAKING TO SIMULATE AN EARTHQUAKE ALLOWING THE EFFECTS OF THE IMPROVEMENTS TO BE TESTED AND MEASURED. DATA FROM THE TESTING WILL BE ANALYSED TO DETERMINE THE EFFECTIVENESS OF EACH STRENGTHENING METHOD.

Pilot



ONCE INITIAL TESTING HAS BEEN COMPLETED, AND DATA IS ANALYSED, EQC WILL CO-ORDINATE A PILOT PROGRAMME WHERE THESE TECHNIQUES CAN BE FULLY COSTED AND DEPLOYED IN A RESIDENTIAL SETTING AS A FINAL PROOF OF CONCEPT. EQC ARE EXPECTING FINAL RESULTS TO BE AVAILABLE IN LATE 2013.

For more information go to: www.eqc.govt.nz or freephone 0800 DAMAGE (0800 326 243)

This research programme is supported by: