

Canterbury liquefaction susceptibility revealed by cone penetration tests (CPT) and seismic cone penetration testing (SCPT)

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ABSTRACT: The cone penetration test (CPT) is a method used to determine the geotechnical properties of sediments and are useful for the identification of soils susceptible to liquefaction in seismically active areas (e.g. New Zealand). The CPT method consists of pushing and instrumented cone into the ground at a controlled rate. We collected over 500 CPT data points around Canterbury down to depths up to 25 m using our in-house technology. Additionally seismic CPT tests (SCPT), where a shear wave is generated at the surface and recorded in the CPT cone at variable depth intervals, allows the development of accurate 2-D shear wave velocity profiles. Through the collection and analysis of over 400 CPT and SCPT locations, we developed subsurface contour maps of the Christchurch area showing the distribution and depth to the uppermost confined aquifers in the Christchurch area (e.g. Riccarton Gravel). The maximum cone resistance we recorded regionally was 105 MPa. The considerably variable distribution (both vertically and laterally) of liquefiable sediments are particularly apparent in the SCPT data with low velocity layers coincident with observed liquefaction during the 2010-2012 Canterbury earthquakes and provided the most reliable 2-D identification of liquefaction susceptibility to assist foundation design. The special distribution of low resistance sediments we present illustrates the ground variability and associated challenges for both land zonation and for mitigation of liquefaction zones through avoidance, ground improvement, and foundation design.