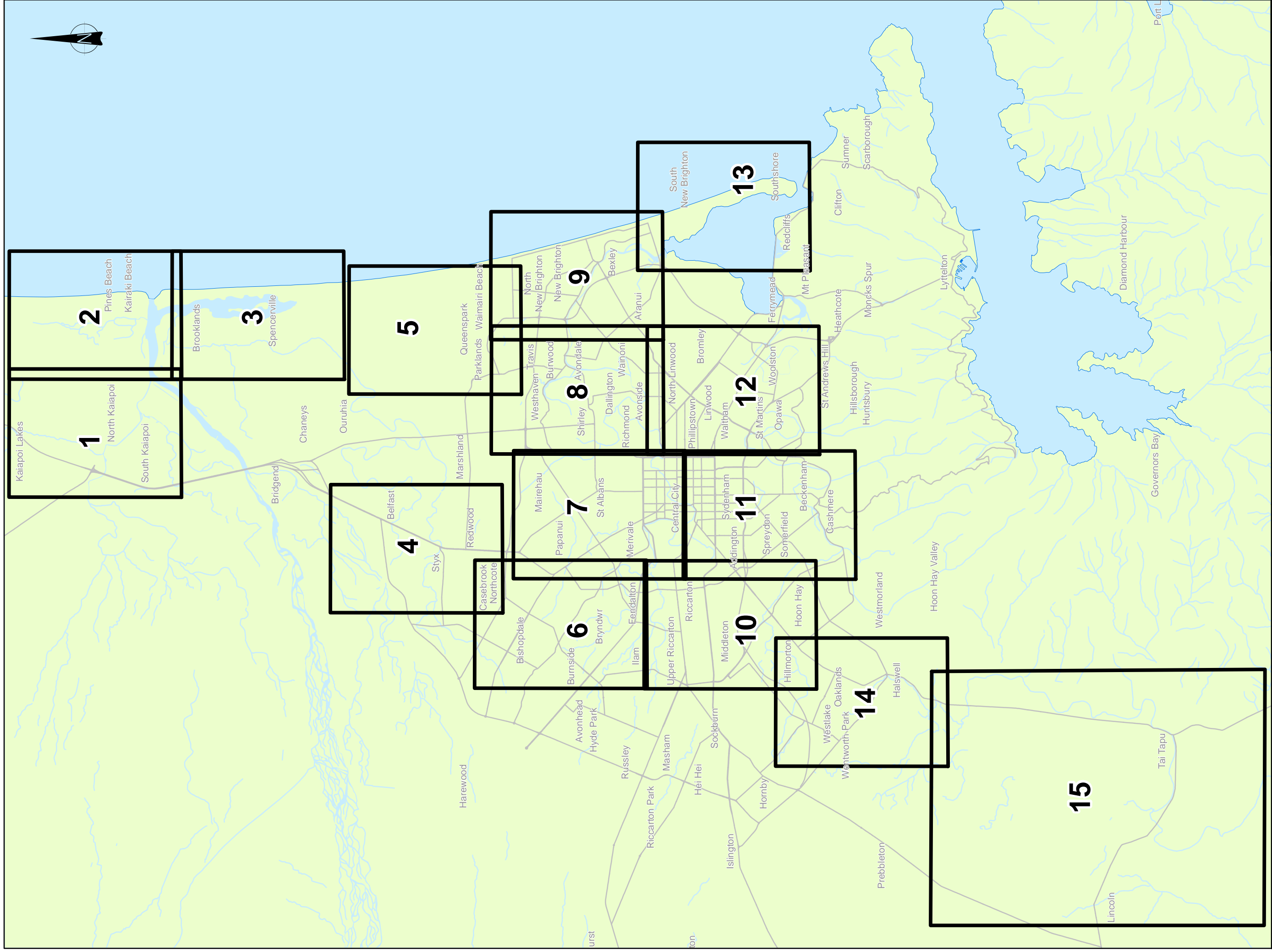


APPENDIX C

The Plains - area-wide suburb
technical land information



NOTES:
 Road Database supplied by Terralink International Ltd.
 Rivers, lagoons and coastline licensed under Creative Commons Attribution 3.0 New Zealand and sources from LINZ

A3 SCALE 1:100,000

EQC
 EARTHQUAKE COMMISSION
 KŌHIRIANGA KŪWHĒNIUA

**TECHNICAL LAND INFORMATION
 FACT SHEETS**
 Area-wide Suburbs

Map Reference Sheet

52020.0200

REVISION 0

Location Plan

Factsheet 13 - Redcliffs to South New Brighton

13.1 Ground conditions and groundwater

Regional geology maps show that the area is generally underlain by dominantly beach or dune sands ranging from active or stabilised to semi-fixed and fixed. In some areas silt and sand of lagoon and estuary deposits is present.

Table C13.1 summarises the area-wide subsurface ground investigations undertaken by EQC in this area following the 4 September 2010 and 22 February 2011 earthquakes. These investigations indicate that the near-surface soil profile in the area generally comprises medium dense to dense sands, with layers of silt in some areas.

Table C13.2 summarises typical ground elevation and groundwater depths in the area (the values listed correspond to the 10th and 90th percentiles and the median). This was derived from LiDAR ground elevation survey commissioned by EQC in February 2012, and a groundwater surface developed from recent EQC groundwater monitoring in conjunction with historic Environment Canterbury groundwater data. This area is generally moderately low-lying, with shallow groundwater.

The ground conditions and groundwater in this area are generally similar to, or slightly more favourable than (in the northeast), most of the eastern suburbs of Christchurch.

While ground surface disturbance has occurred in some areas (e.g. settlement, cracking and ejection of material), the underlying ground which liquefied appears to have now returned to its pre-earthquake strength.

13.2 Post-earthquake observations

Rapid mapping of liquefaction and lateral spreading observations were undertaken following the 4 September 2010 and 22 February 2011 earthquakes, first on a regional and street-by-street level in the days immediately after each

earthquake, and then on a property-by-property level over the following weeks. This mapping was supported by air-photo analysis for all four main earthquakes, and additional regional or street-level mapping for the earthquakes of 13 June 2011 and 23 December 2011. This additional mapping indicated that the overall pattern of liquefaction and lateral spreading for the subsequent earthquakes was generally similar to that observed in the first two main earthquakes.

Figure C13.1 and **Table C13.3** present a summary of the property-by-property rapid mapping of liquefaction and lateral spread observations in this area. The observations following the 4 September 2010 and 22 February 2011 earthquakes have been aggregated by assigning each property the most severe observation from either of these two earthquakes. These observed liquefaction and lateral spread mapping colours have completely different meaning to the colour codes used by the Canterbury Earthquake Recovery Authority (Cera) for residential land zoning and the Department of Building and Housing (DBH) for technical categories.

Table C13.4 summarises the change in ground elevation inferred from the LiDAR survey. The total change in ground elevation which has occurred is a combination of regional uplift or subsidence due to fault movements (tectonics) and local ground subsidence due to liquefaction and related effects. The LiDAR is of limited accuracy (about $\pm 100\text{mm}$). This means that the LiDAR is more suitable for measuring large changes in ground elevation (greater than about 100 to 200mm), and may not accurately represent areas where only minor changes in ground elevation have occurred.

Table C13.5 summarises the extent and severity of observed liquefaction and lateral spread.

Table C13.1 - Area-wide geotechnical investigations undertaken by EQC (December 2011)

Suburb	Number of cone penetration tests	Number of boreholes	Number of groundwater standpipes	Length of MASW geophysical testing (m)
Redcliffs (on the flat)	3	-	3	-
South New Brighton	8	3	9	-
Southshore	10	1	10	-

Redcliffs (on the flat), South New Brighton and Southshore

Table C13.2 - Summary of ground elevation and groundwater depth (February 2012)

Suburb	Ground elevation above sea level	Groundwater depth
Redcliffs (on the flat)	Typically 1.8m to 4.6m (Avg 2.2m)	Typically 0.8m to 2.6m (Avg 1.0m)
South New Brighton	Typically 1.7m to 4.3m (Avg 2.2m)	Typically 1.0m to 2.0m (Avg 1.3m)
Southshore	Typically 1.6m to 2.3m (Avg 1.8m)	Typically 0.9m to 1.5m (Avg 1.2m)

Table C13.3 - Summary of liquefaction and lateral spread observations for residential land, aggregated from mapping undertaken following earthquakes of 4 September 2010 and 22 February 2011

Suburb	Total residential property count	Not mapped	No observed ground cracking or ejected liquefied material	Minor ground cracking, but no observed ejected liquefied material	No lateral spreading, but minor to moderate quantities of ejected material	No lateral spreading, but large quantities of ejected material	Moderate to major lateral spreading, ejected material often observed	Severe lateral spreading, ejected material often observed
Redcliffs (on the flat)	490	6%	25%	2%	47%	<1%	20%	0%
South New Brighton	1430	<1%	70%	5%	16%	<1%	8%	0%
Southshore	643	<1%	10%	7%	53%	0%	30%	0%

Table C13.4 - Changes in ground elevation inferred from LiDAR survey

Suburb	Change in ground elevation from July 2003 to February 2012 (positive values are uplift, negative values are subsidence)
Redcliffs (on the flat)	Typically +150mm to +450mm (Average +300mm)
South New Brighton	Typically -250mm to +100mm (Average -50mm)
Southshore	Typically -250mm to +100mm (Average -50mm)

Factsheet 13 - Redcliffs to South New Brighton

Table C13.5 - Liquefaction and lateral spread observations	
Suburb	Observations
Redcliffs (on the flat)	<p>Extensive areas of minor to moderate liquefaction across most of the lower-lying part of the suburb, causing sand ejection and settlement.</p> <p>Moderate to major lateral spreading towards the estuary, but generally localised to the immediately adjacent properties.</p> <p>In the areas of higher ground further inland, no surface evidence of liquefaction or related land effects was observed.</p>
South New Brighton Southshore	<p>Extensive areas of minor to moderate liquefaction across most of Southshore and parts of South New Brighton, causing sand ejection and settlement.</p> <p>Major lateral spreading towards the estuary, varying in extent from one to several rows of houses back from the estuary edge.</p> <p>In some areas, settlement and minor ground cracking observed without any obvious surface evidence of liquefaction, likely due to minor liquefaction occurring at depth below the surface but not being ejected.</p> <p>For the remainder of these suburbs, no surface evidence of liquefaction or related land effects was observed, often associated with the higher ground of dunes or beach deposits.</p>

For further area-wide geotechnical information, refer to the technical data reports on the EQC website, at <http://canterbury.eqc.govt.nz/news/reports>

Redcliffs (on the flat), South New Brighton and Southshore

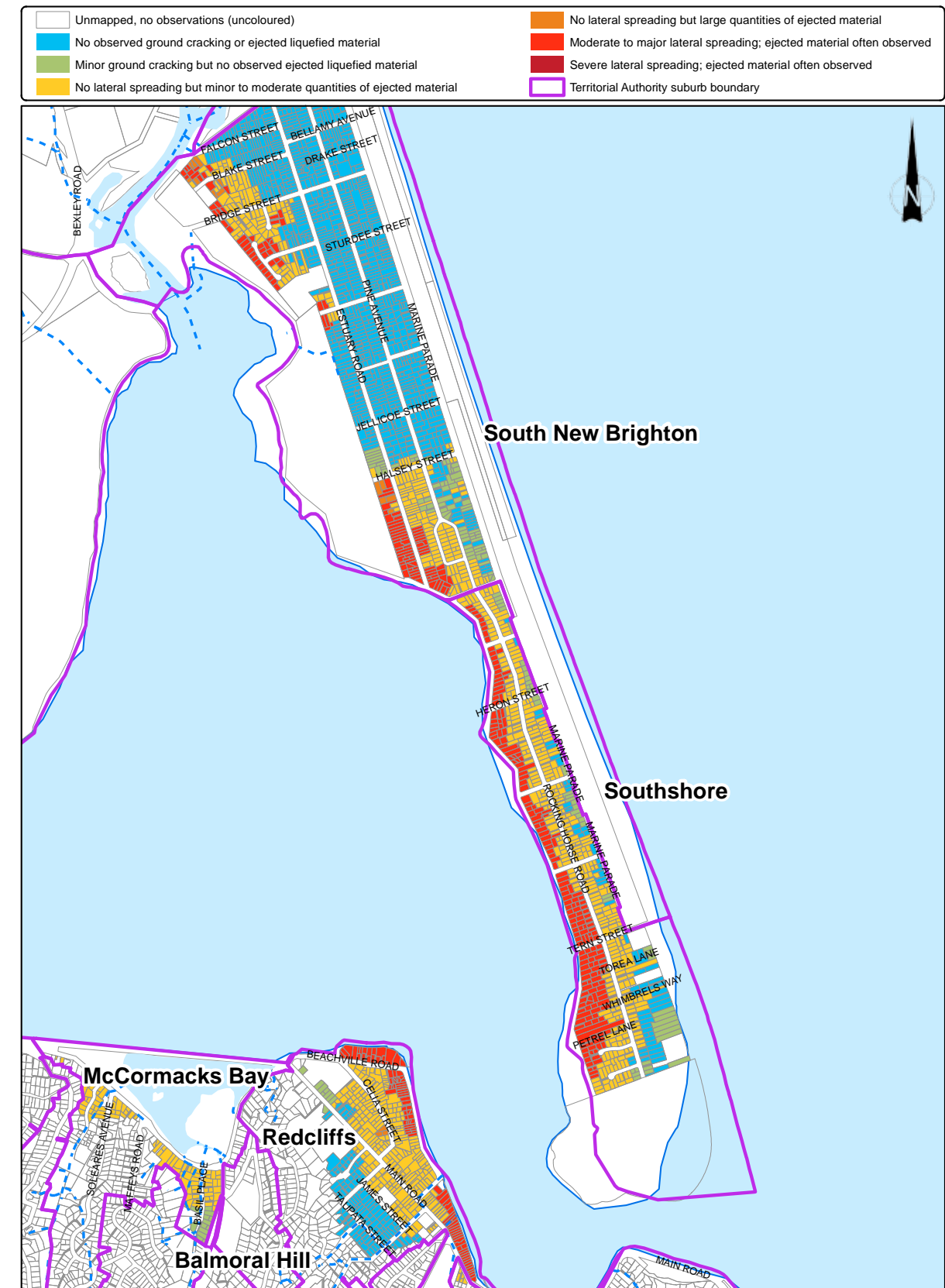


Figure C13.1 - Overview of liquefaction and lateral spreading observations, aggregated from mapping undertaken following the earthquakes of 4 September 2010 and 22 February 2011.

Applicability - This report was prepared and/or compiled for the Earthquake Commission (EQC) to communicate information that may be relevant to residential land claims under the Earthquake Commission Act 1993. The report was not intended for any other purpose and may not be relied upon for any other purpose. EQC and its engineers, Tonkin & Taylor, have no liability to any user of any map(s) and data in this report or for the consequences of any other person relying on them in any way. This information is not intended to form a complete technical report on land changes in all or any part of Canterbury.