

Geotechnical Aspects of the September 4, 2010 Darfield Earthquake

Scott A. Ashford

Professor and School Head

Oregon State University

GEER Team Member

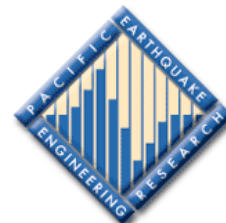
GEER Reconnaissance

- Russell Green, Virginia Tech
 - GEER Team Leader
- Misko Cubrinovski, U. of Canterbury
 - New Zealand Team Leader
- John Allen, TRI/Environmental
- Brady Cox, University of Arkansas
- Bill Godwin, Fugro
- Tara Hutchinson, UC San Diego
- Ed Kavazanjian, Arizona State University
- Tom O'Rourke, Cornell U.



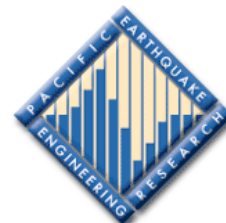
Scope of GEER Reconnaissance

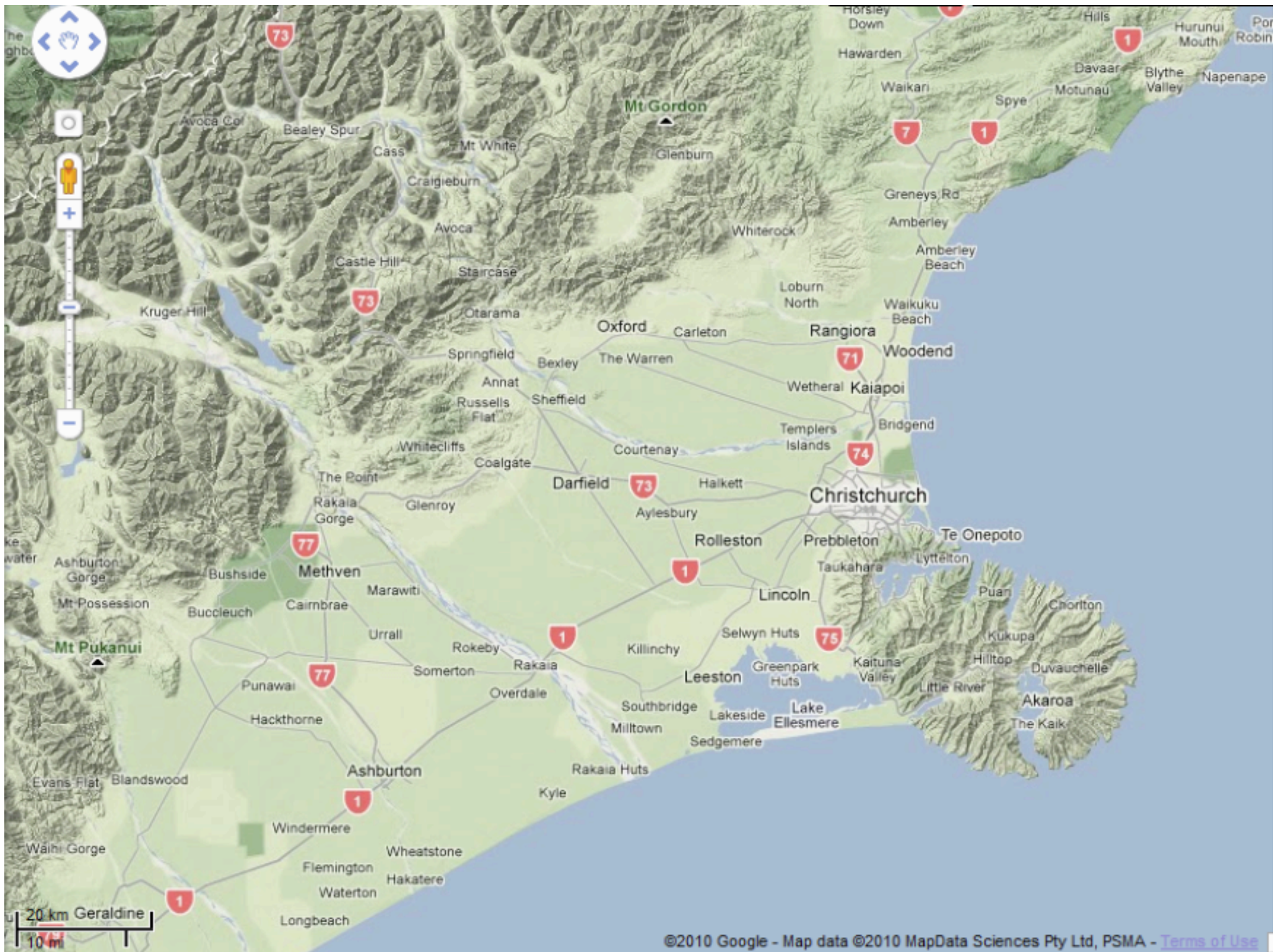
- Focus on geotechnical aspects while collecting perishable data
- Seismology and Geology
- Liquefaction and Lateral Spreading
- Levees and Stopbanks
- Lifelines
- Impact on Structures



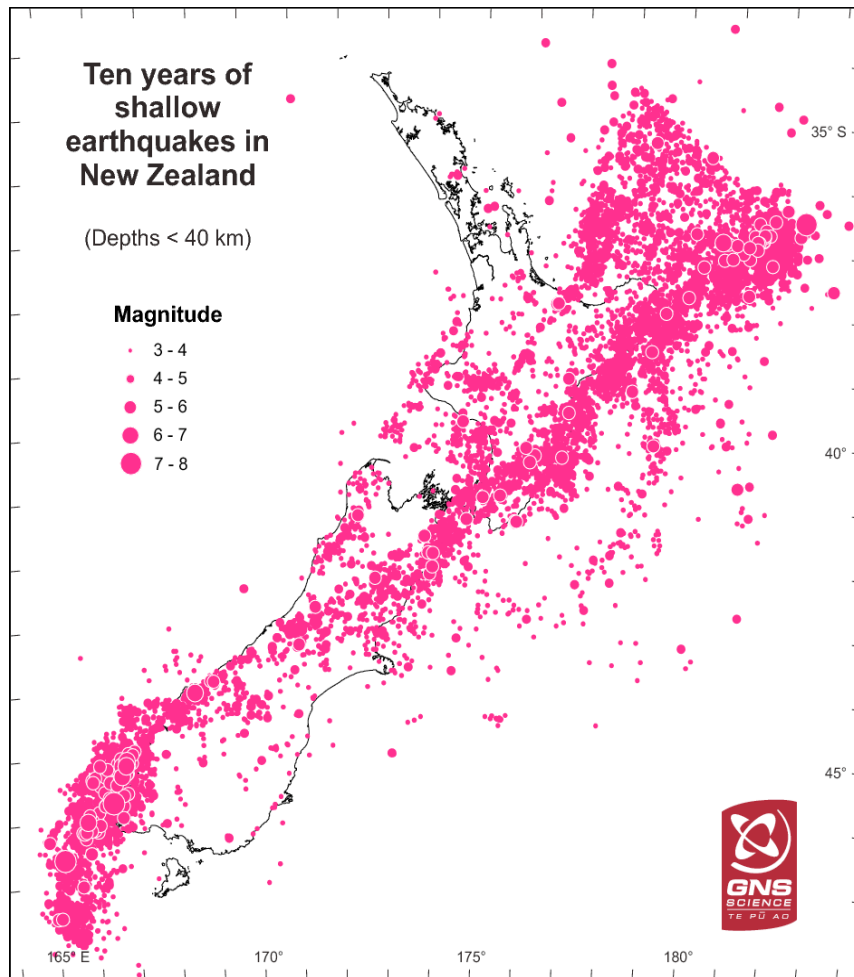
Darfield Earthquake

- 04:35am on Saturday, 4 September 2010
- 50km WNW of Christchurch, New Zealand
 - Population affected nearly 400,000
- $M_W = 7.1$ along new Greenfield Fault
- Primarily reverse mechanism
 - Initially thought to be dextral strike-slip with some oblique reverse faulting

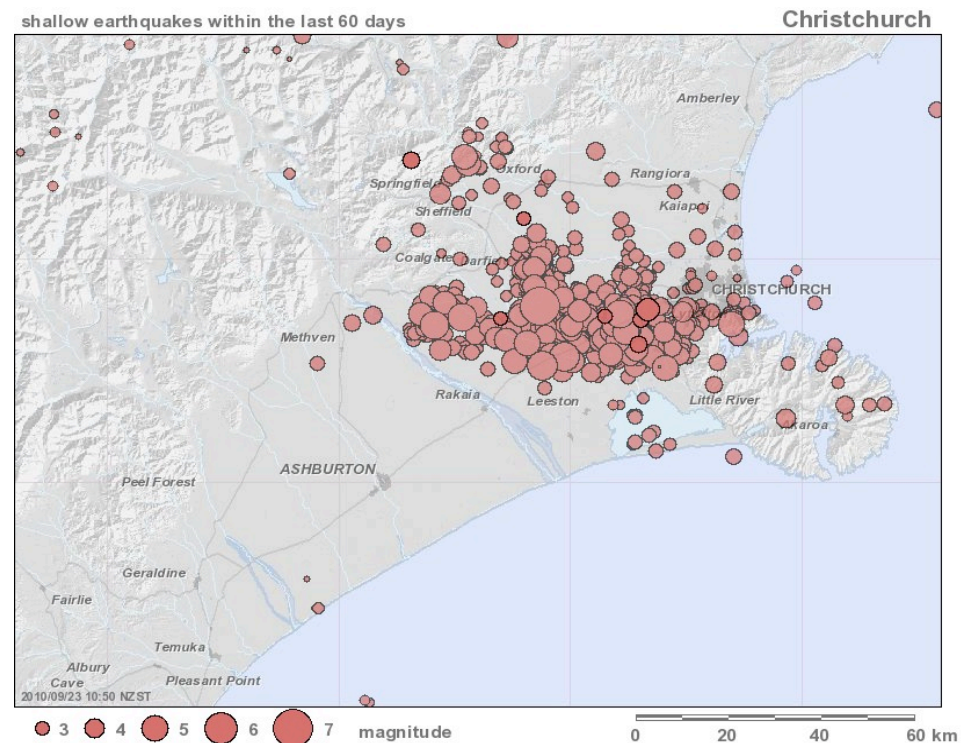




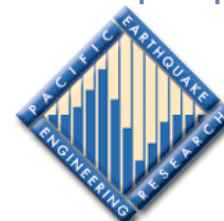
New Zealand Seismicity



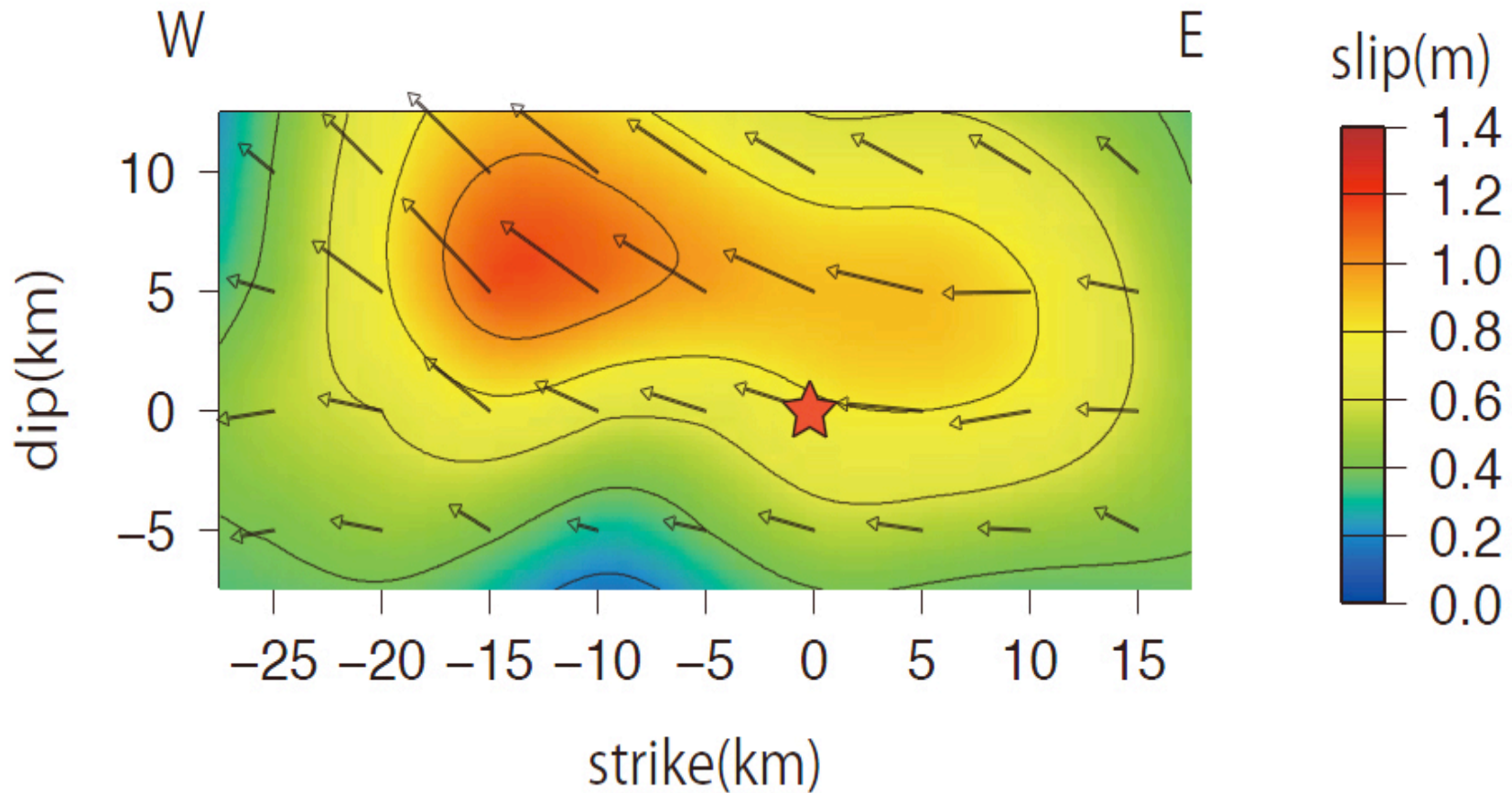
(<http://www.geonet.org.nz/earthquake/>)



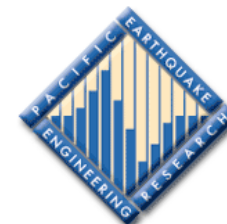
(<http://images.geonet.org.nz/maps/quakes/262-christchurch-quake.jpg>)

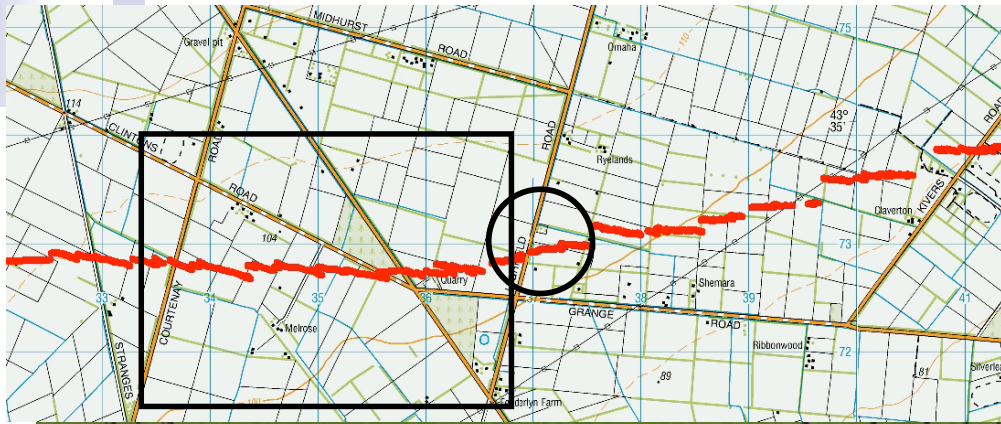


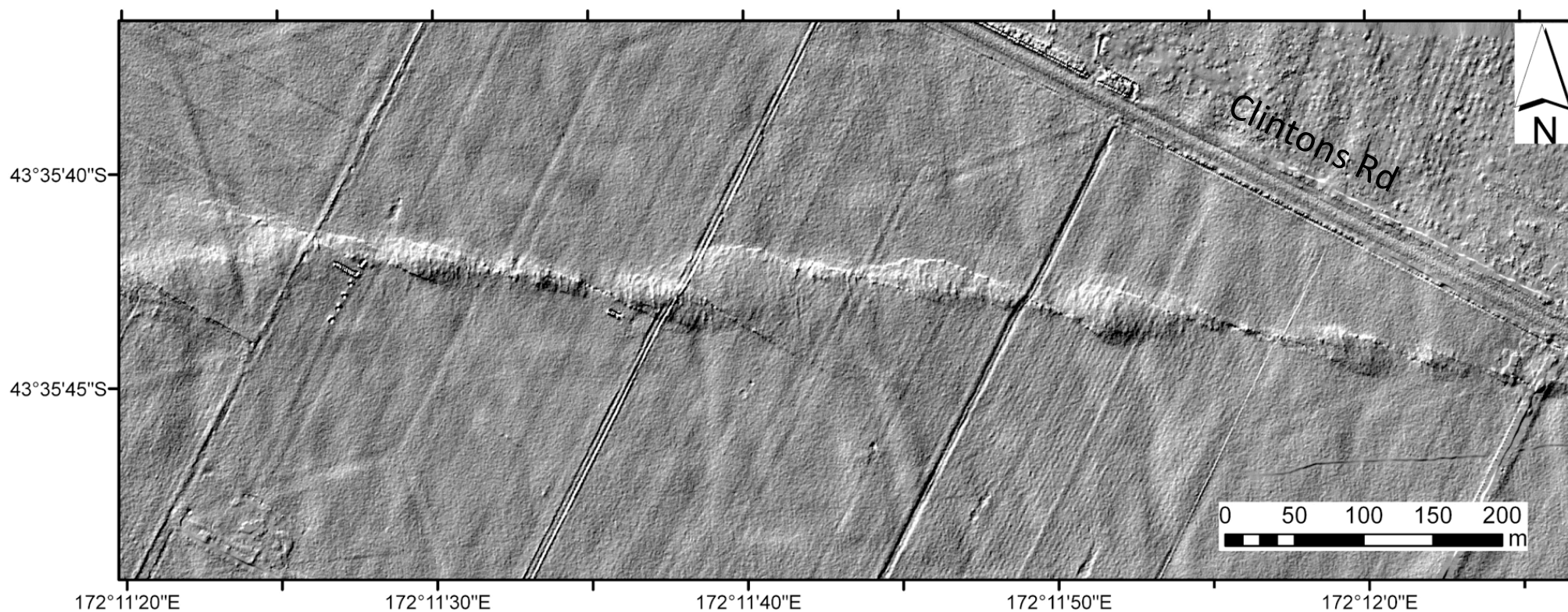
Surface expression about 30 km



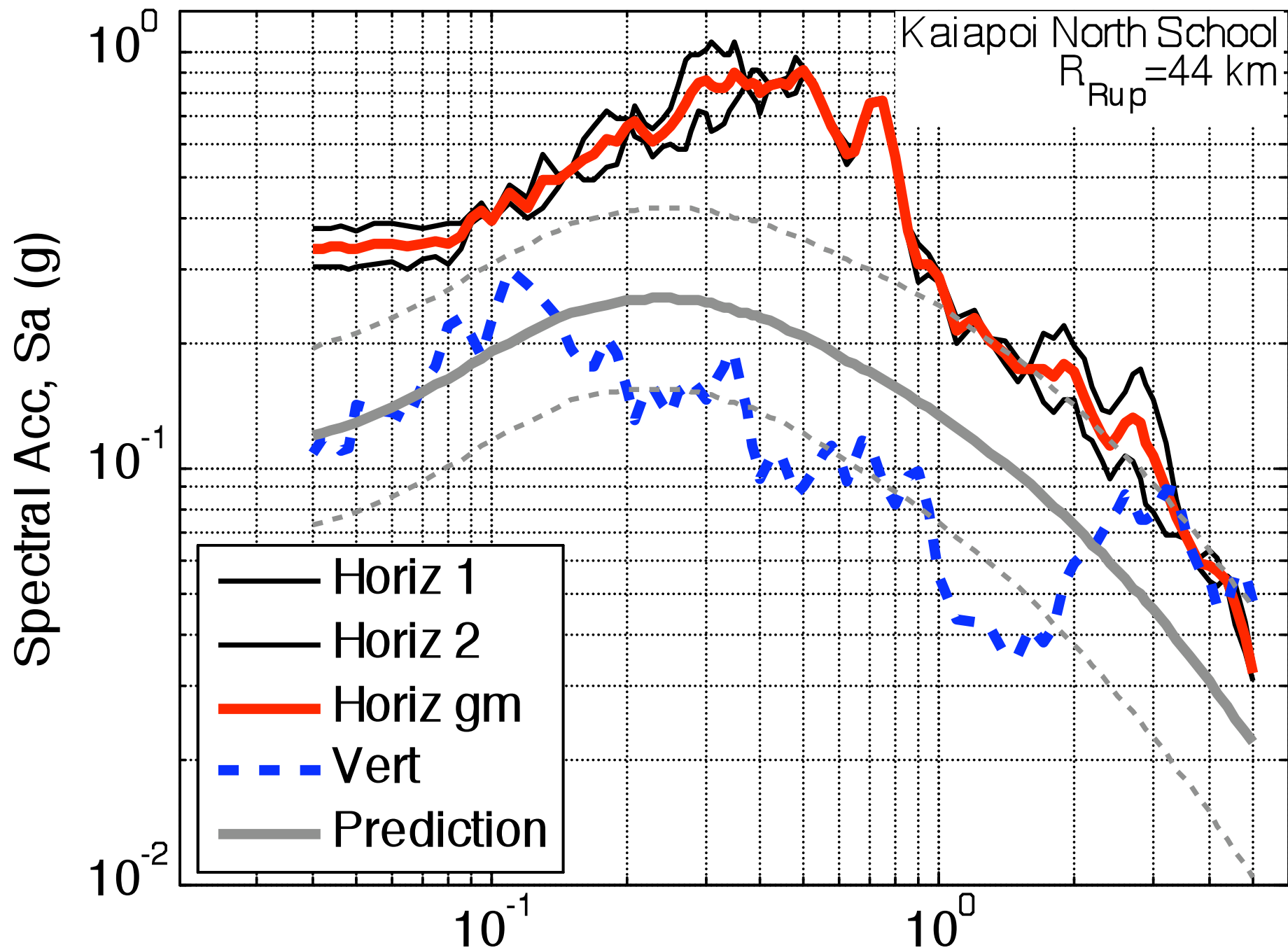
(
http://outreach.eri.u-tokyo.ac.jp/2010/09/201009_nz_eng/)



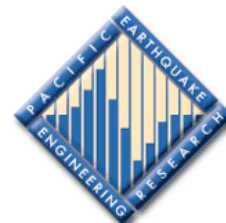


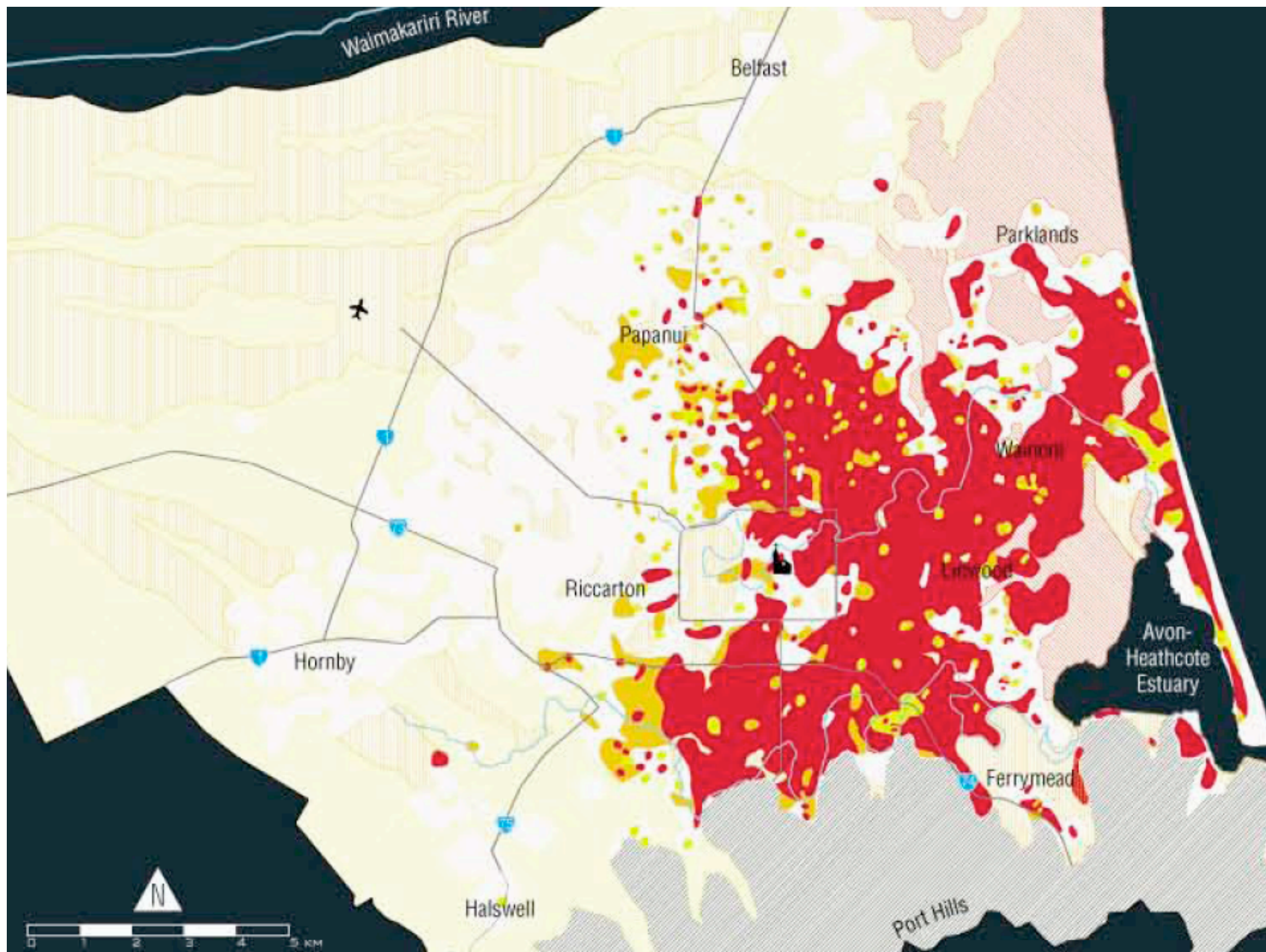


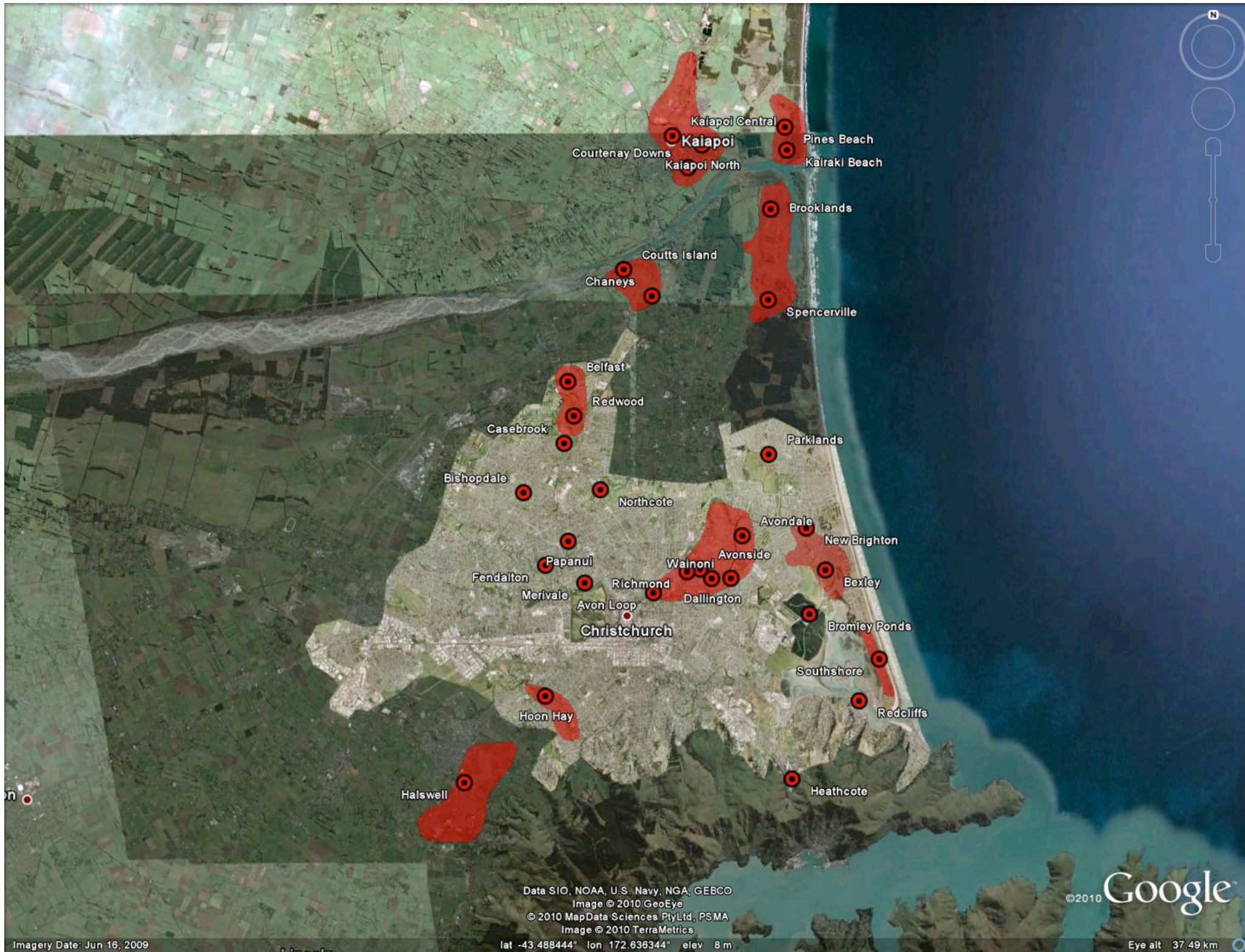




Liquefaction and Lateral Spreading



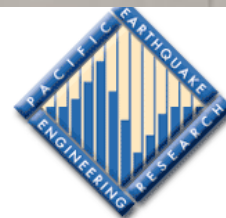


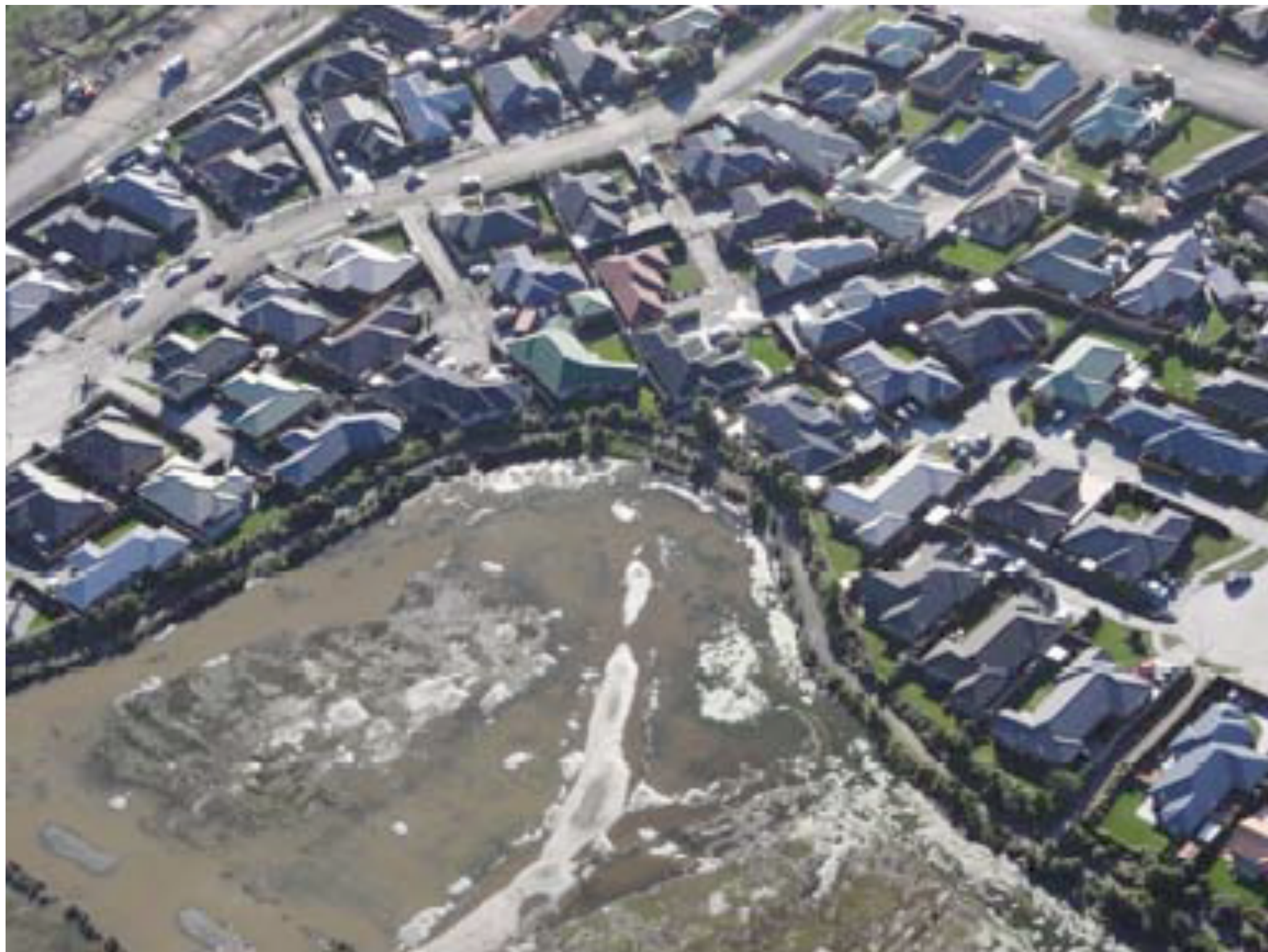






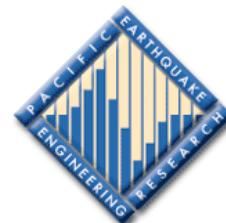
Darfield Earthquake







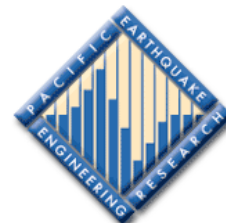
Estimates varied on number of homes damaged from liquefaction



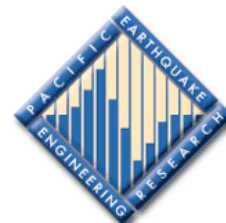
Documented Case History: St. Pauls Church, Dallington



Several lateral spreading case histories were documented for GEER Report



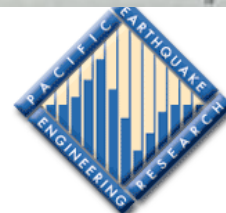
Levees and Stopbanks

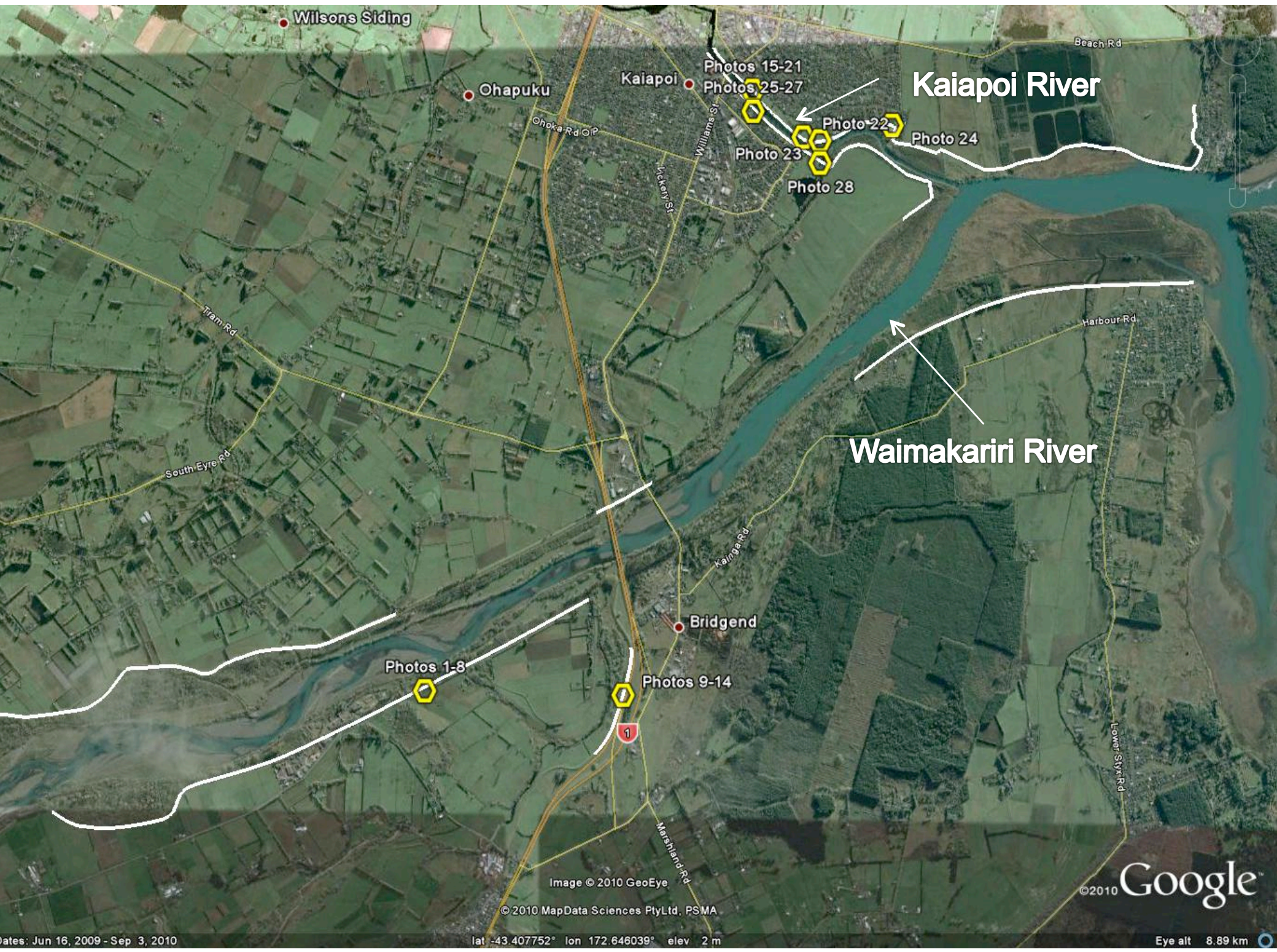


Waimakariri and Kaiapoi River flooding led to stopbanks in 1920s

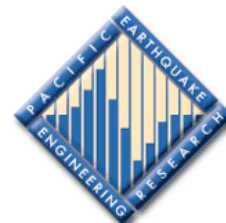


Te Ara Encyclopedia of New Zealand, 2010

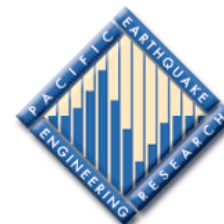




Liquefaction and lateral spreading occurred along stopbanks.
DCPT and SASW profiles obtained.



Lifelines

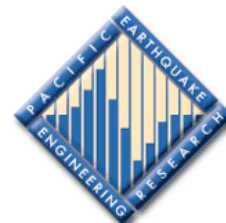


Darfield Earthquake

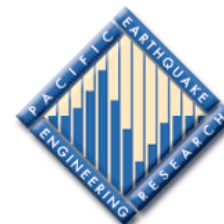


S 43° 31.489' E 172° 43.450'

Bridge Street Bridge performed well, with 1m lateral spread

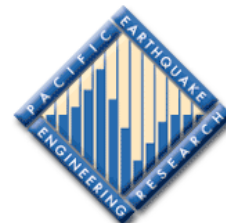


Bridge Street Bridge Abutment



Limited and documented abutment movement

Darfield Earthquake



Railway System



Left photo by I. McGregor, right photo by L. Matthews and J. Overend

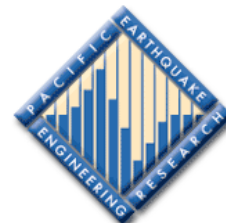


Water and Sewer Mains



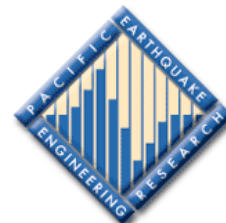
Water and Sewer Damage

- Christchurch City Council
 - 25km of water to be replaced
 - 70km of wastewater lines to be replaced
 - Conducted 1 years worth of repairs in 6 days
 - 11,000 tons of sand ejecta
 - Potentially 9,000 m³ voids created
- Adjacent Waimakariri District Council and Selwyn District Council also hit.



Lifelines

- Mobility unaffected, for the most part
- Electric Power at 90% within 24 hours
- Gas lines performed well.
- Cellular phone networked unaffected
- Waste disposal kept up with demand
- Water/sewer severely affected by liquefaction
- Overall performance of lifelines a credit to 20 year effort at improving resilience





Thank you for your attention

- For more information and our report, go to:

<http://geerassociation.org>

