Appendix 11

Geotechnical Assessment

19 November 2010 Project No. 1078102449

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PROFESSIONAL SERVICES: GEOTECHNICAL ASSESSMENT OF SUITABILITY OF LAND FOR RESIDENTIAL DEVELOPMENT

Dear Fred

We understand that the Selwyn District Council requires a geotechnical assessment of your site to identify whether any potential issues exist with respect to earthquake risk, and to confirm the geotechnical suitability of the land for its "intended purpose"[1]. We understand that its "intended purpose" relates to residential development.

This letter summarises the results of our geotechnical assessment of your Darfield site. The land area covered by this report is indicated by the red outline in Figure 1.

Site walkover

The site walkover was conducted on 18 November 2010, by Clive Anderson (Principal Geotechnical Engineer) and Tim McMorran (Principal Engineering Geologist).

The site is level and flat, and currently in pasture separated by pine shelterbelts.

No earthquake related ground deformation or liquefaction was observed.

Other residential dwellings are located on similar soils around and on this parcel of land.

Geology

The vast expanse of the Canterbury Plains comprises coalesced floodplains. Large parts of the plain are abandoned braided river floodplains (Fosyth et al., 2008[2])

The geology in the area of the site comprises Quaternary grey to brown fan alluvium (Figure 2).

We have reviewed the subsurface logs provided. The stratigraphy in this area comprises less than half a metre of silty loam top soil underlain by dry sand bound gravel with 35 – 50% cobbles.

[1] Selwyn District Council Letter dated 20 October 2010

[2] Forsyth, P.J., Barrell, D.J.A., Jongens, R. (compilers)2008: Geology of the Christchurch area. Institute of Geological and Nuclear Sciences 1:250,000 geological map 16. 1 Sheet + 67p.

We have reviewed groundwater levels in monitored Environment Canterbury wells. The nearest site is well I35/0163 at Kirwee (at a distance of approximately 7km from the site) which has a long term average depth of greater than 70 m below ground level.

The Darfield Earthquake

The M7.1 Darfield earthquake on 4 September 2010 was the result of a rupture on the previously unknown Greendale Fault. The fault location and epicentre are shown in Figure 3. The Greendale Fault was not previously recognized as an active fault because there was no surface evidence for its presence beneath the Canterbury Plains. The fault ruptured the ground surface for approximately 28 km. It has been proposed that the Greendale Fault had not had a major earthquake in the last 16,000 years because no evidence of earthquake-related geomorphic features (offset stream channels or fault scarps) had been observed on the ground surface of the Canterbury Plains around the modern fault scarp. It is therefore likely that the recurrence interval for the Greendale Fault is in the thousands of years.

The exact earthquake triggering mechanism is not known, although the theory of multiple, instantaneous fault ruptures has been postulated by scientists in the media. At this early stage however, no firm data exists on the locations of 'blind' faults (that did not rupture the surface) and it is likely to be some time before scientists publish their findings on triggering mechanisms, and associated blind faults.

The proposed residential subdivision site in Darfield is approximately 10-15 km from the area of the surface ruptured by the Greendale Fault.

There are no known faults passing through the site.

Conclusions

The near surface soils are gravelly and have suitable bearing capacity for residential dwellings.

Typically liquefaction occurs in saturated unconsolidated silts and sands, at depths of less than 10 m. The types of soils inferred at this site are sandy gravels, well above the groundwater table. Such material is expected to exhibit good earthquake performance, and is not vulnerable to liquefaction or liquefaction induced ground deformation such as subsidence or lateral spreading.

There are no known faults known faults passing through the site.

Therefore we conclude that this site is suitable on geotechnical grounds for residential development.

Yours faithfully,

GOLDER ASSOCIATES (NZ) LIMITED

Clive Anderson
Principal Geotechnical Engineer

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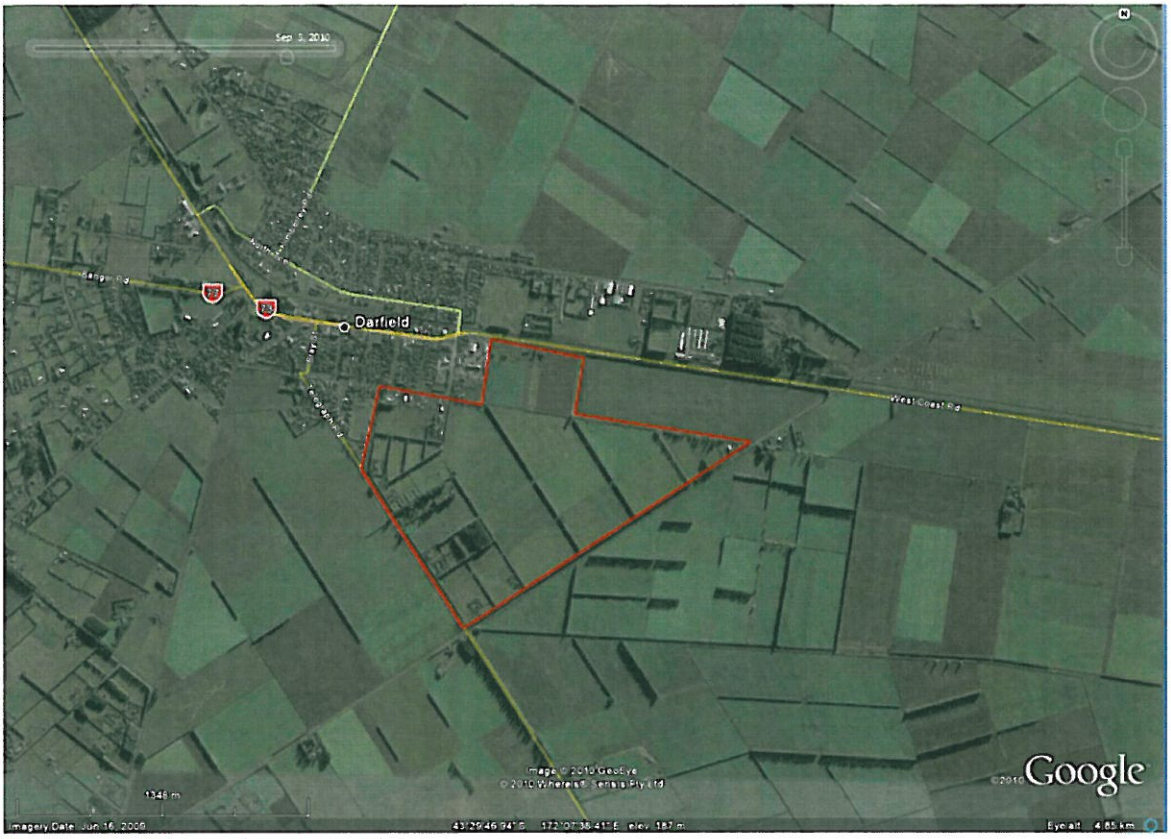

Figure 1: Site location (approximate)

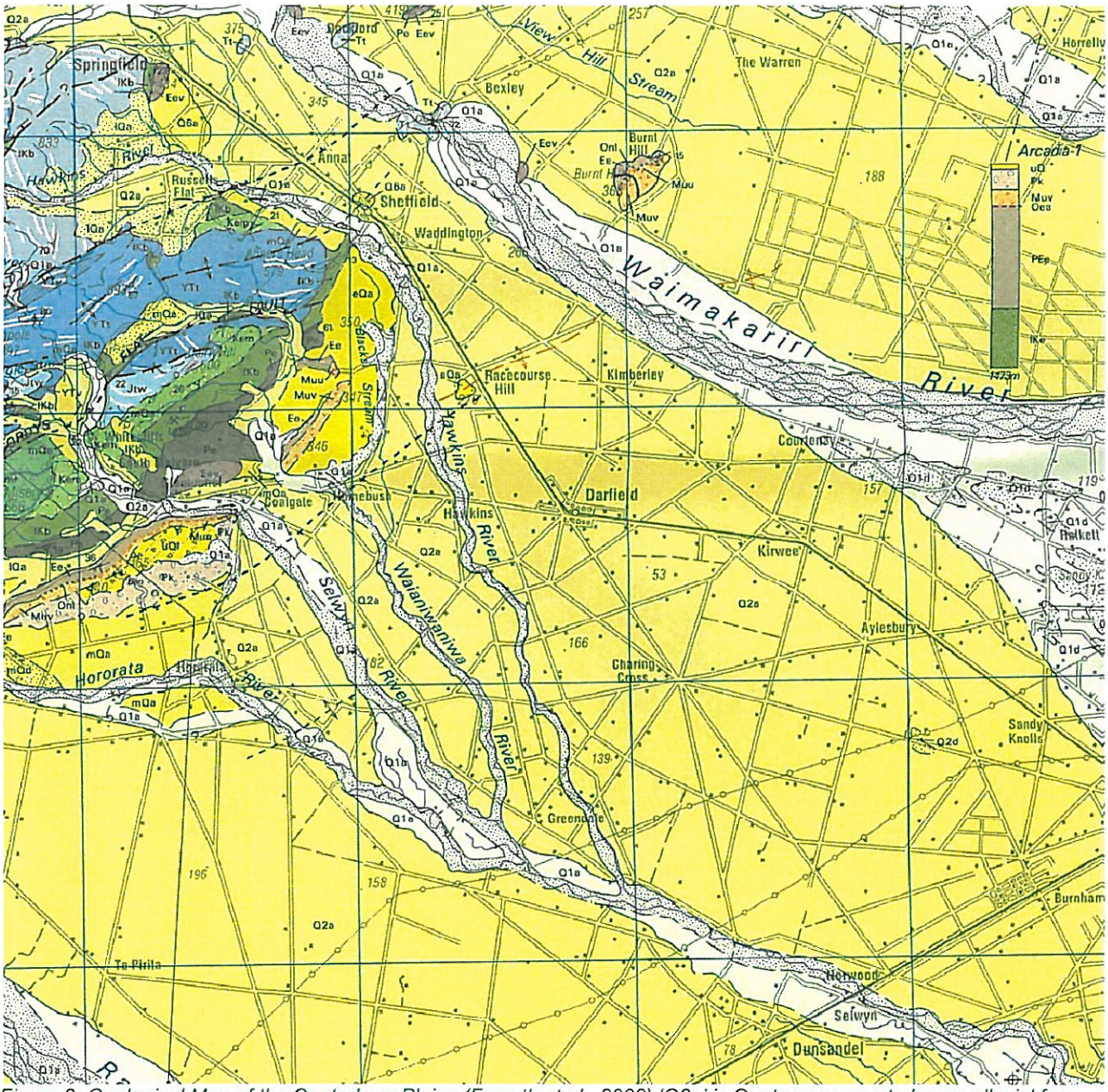

Figure 2: Geological Map of the Canterbury Plains (Forsyth et al., 2008) 'Q2a' is Quaternary grey to brown alluvial fan deposits.

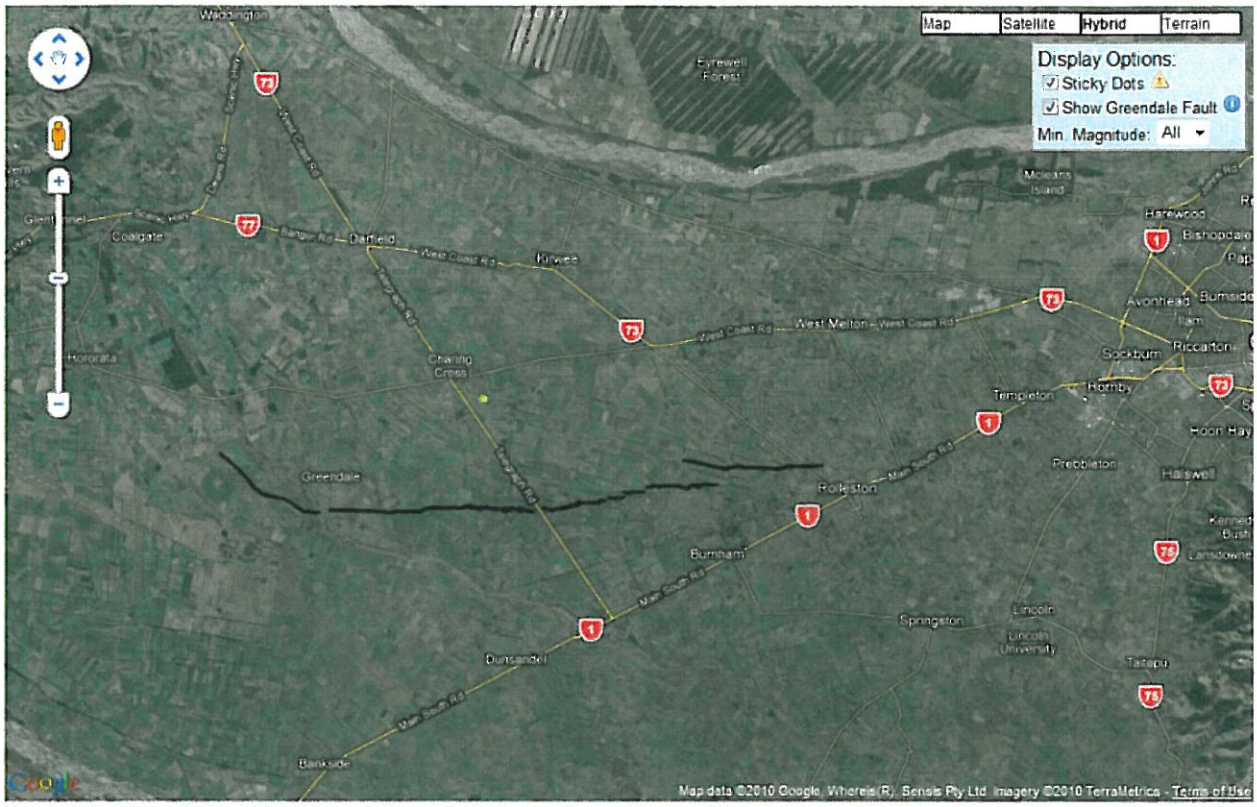

Figure 3: Epicentre of the Darfield Earthquake (epicentre represented by the light green dot southeast of Charing Cross. The Greendale fault trace is indicated by the black line). Image sourced from http://www.christchurchquakemap.co.nz/