

28 February 2012

Fulton Hogan Land Development Ltd  
29 Sir William Pickering Drive  
PO Box 39185  
Christchurch 8545  
Attn: Greg Dewe

Dear Greg,

## **STAGE 1A ROSEMERRYN FARM SUBDIVISION – GEOTECHNICAL COMPLETION REPORT**

### **1. Introduction**

As part of the Stage 1A Rosemerryn Farm subdivision development, located at Lincoln, Aurecon has carried out a geotechnical investigation and assessment. The assessment is detailed in the Aurecon geotechnical report “*Geotechnical Assessment Report, Rosemerryn Farm Stage 1A, Fulton Hogan Land Development Ltd*”, Rev1, dated 30 September 2011.

As part of the subdivision consent, conditions relating to geotechnical aspects were included. These conditions include Condition No. 53, 57 and 58 in Consent 115292, and Condition 5 and 6 in Consent 115293.

Site earthworks for the subdivision have been completed and therefore this geotechnical completion report has been prepared in accordance with Consent 115292 and 115293, as part of the final documentation for the subdivision.

This geotechnical completion report is accompanied by a Statement of Professional Opinion on the Suitability of Land for Building Construction, as required by the Selwyn District Council (SDC) Code of Practise.

### **2. Previous Reports**

As part of the subdivision consent the following geotechnical information was provided:

- “*Geotechnical Assessment Report, Rosemerryn Farm Stage 1A, Fulton Hogan Land Development Ltd*”, dated 30 September 2011.
- Additional geotechnical information provided to Nick Traylen of Geotech Consulting Ltd (Peer Reviewer), by email dated 19 October 2011.
- Reply to Peer Reviewer queries, by email dated 21 October 2011.
- Additional geotechnical testing information, in relation to Condition 53, by email to Rosie Flynn from Selwyn District Council, dated 24 November 2011.
- “*Stage 1A Rosemerryn Farm Subdivision, Technical Categories Assessment*” letter dated 29 November 2011. Previous reports were completed prior to the Department of Building and Housing technical categories were defined. Hence this follow up letter was provided to relate the new technical categories, as well as implications for residential foundations.

### **3. Geotechnical Summary for the Site**

Based on the deformation limits provided in Department of Building and Housing '*Revised guidance on repairing and rebuilding houses affected by the Canterbury earthquake sequence*', dated November 2011 and the liquefaction assessment for the site, Stage 1A was defined as Technical Category TC2.

For Technical Category 2 areas the DBH has recommended types of foundation systems for residential houses in their November 2011 publication. Schematics and typical cross sections of these foundation systems are presented in the DBH publication.

As required under the new DBH guidelines for detailed house design, a site specific geotechnical assessment shall be carried out by suitability qualified chartered engineer with experience in residential house development. A chartered professional geotechnical engineer is not required for Technical Category 2 type residential lots.

### **4. Subdivision Conditions**

The following consent conditions are addressed as follows:

#### **4.1 Condition 53**

SDC requested additional geotechnical testing be carried out at the site. Three additional cone penetration tests (CPT) were carried out. The test information and liquefaction assessment results were provided to Rosie Flynn from Selwyn District Council, by email on 24 November 2011.

#### **4.2 Condition 57**

SDC requested that some level of lateral spreading mitigation be carried out along the stormwater drain that runs along the southern property boundary.

Based on site observations, the stormwater drain in question ranges from 1.3m to 1.35m in depth. This depth is taken from the ground level on the subdivision side. Recent excavations in the Stage 1a development indicate the standing groundwater level is in the order of 2m below ground level. These levels were observed after heavy rainfall in early November, which indicates that the groundwater level is lower than previously thought. Based on the depths of the groundwater and stormwater drain we consider that the potential for lateral spreading is low. The low potential for lateral spreading is reflected in the lack of ground damage observed along the drain following the 4 September 2010 Darfield Earthquake (Mag 7.1).

Therefore we consider that the potential lateral spreading mitigation measures defined by the geotechnical report are not required.

There may be a potential slope instability issue with the open drain banks, during an extreme earthquake event. We note that the drainage ditch is relatively shallow and based on observations of other drainage ditches within the Canterbury Region, where bank failure has occurred adjacent to drainage ditches it has typically been limited in extent. However, we recommend to limit any erosion or slope stability issues affecting house foundations, the houses building footprints should be setback from the crest of the drain by a minimum of 10m.

#### **4.3 Condition 58**

We consider all subdivided lots, roads and reserves to be suitable for their intended purposes to service a residential subdivision from a geotechnical perspective. As mentioned above in section 4.2 in relation to the drainage ditch, we consider the risk from lateral spreading to be low and that there is no need for mitigating measures. We do however recommend a building footprint setback of 10m from

the crest of the drainage ditch. These would affect lots 26, 26, 27 and 28. The limitations and specific development requirements for each of the lots are provided in Table 1.

**Table 1 – Lot Assessments**

Lot	Assessed Technical Category	Foundation Options and General Recommendations
25	TC2	TC2 type foundations as defined by DBH (2011) Raft type foundation is preferable Specific foundation investigation will be required as defined by DBH (2011) 10m setback from crest of drain for any residential building
26	TC2	TC2 type foundations as defined by DBH (2011) Raft type foundation is preferable Specific foundation investigation will be required as defined by DBH (2011) 10m setback from crest of drain for any residential building
27	TC2	TC2 type foundations as defined by DBH (2011) Raft type foundation is preferable Specific foundation investigation will be required as defined by DBH (2011) 10m setback from crest of drain for any residential building
28	TC2	TC2 type foundations as defined by DBH (2011) Raft type foundation is preferable Specific foundation investigation will be required as defined by DBH (2011) 10m setback from crest of drain for any residential building
29	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
30	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
31	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
32	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
33	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
34	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
35	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
36	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
37	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)

38	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
39	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
40	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
41	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
42	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
43	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
44	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
45	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
46	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
47	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
48	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
49	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)
50	TC2	TC2 type foundations as defined by DBH (2011) Specific foundation investigation will be required as defined by DBH (2011)

The DBH has recommended types of foundation systems for residential houses built in areas potentially susceptible to seismically induced liquefaction in their publication '*Revised guidance on repairing and rebuilding houses affected by the Canterbury earthquake sequence*', dated November 2011. Schematics and typical cross sections of these foundation systems are presented in the DBH publication.

As the lots have been identified as TC2, an assessment against NZS3604 has not been carried out, as foundations for residential buildings in TC2 require specific investigation and detailing.

The DBH guideline identifies that raft type foundations or piles are suitable for TC2 ground. The raft foundation options are likely to be cheaper than the piled foundation options. A piled foundation for residential housing would minimise expected settlement and damage during a large seismic event. However the DBH guidelines indicate that although piles are an option for TC2 sites, this foundation option will require deep geotechnical investigations and design.

If the piled foundation option is adopted, then the floor slab should be well reinforced to provide continuity across the building floor and foundation elements. The objective will be to provide additional capacity in the floor slab and enhance its ability to redistribute loads, if necessary, during large seismic events. All pile heads need to be adequately tied into the floor slab.

As part of the detailed house foundation design, particular attention should be paid to detailing the connection joints of buried services (water and sewer pipes, power conduits, etc.) between the house foundation and the in situ ground. The design should allow sufficient movement and ductility to account for seismic shaking and liquefaction induced movement, and to allow for the easy reinstatement if they were to be damaged during a future seismic event.

As required under the new DBH guidelines for detailed house design, a site specific geotechnical assessment shall be carried out by a suitability qualified chartered engineer with experience in residential house development. Thereby, allowing site specific geotechnical information to be used in the foundation design.

**4.4 Condition 5**

As per Condition 57 response.

**4.5 Condition 6**

As per Condition 58 response.

We trust this meets your requirements and if there are any further queries please do not hesitate to contact us.

Yours sincerely



**Robert Smith**

*Geotechnical Engineer*



**Jan Kupec**

*Ground Engineering Technical Director*