



**Guidelines for Geotechnical Site Investigation
for
Residential Building Consents
in
Hastings District
(Draft)**

December 2017

Acknowledgements

These guidelines have been prepared with assistance from Tonkin & Taylor and RDCL.

Commencement

These guidelines take effect from 1 December 2017. The guidelines will be finalised following close of the submissions.

Submissions

The Council is currently undertaking public consultation on the content and extent of these draft guidelines. Submissions should be made in writing and addressed to:

Malcom Hart
Building Consents Manager
Hastings District Council
Private Bag 9002
Hastings 4156
Email: malcolmh@hdc.govt.nz

Submissions close 5pm Friday, 23 February 2018

Approval for Release

These guidelines have been approved for release by the Group Manager, Planning and Regulation on Friday 1 December 2017.

Guideline Review

These guidelines will be reviewed following release of the MBIE guidelines *Planning and engineering guidance for potentially liquefaction-prone land* ISBN 978-1-98-851770-4, or when further technical information is received supporting a need for a review of these guidelines.

CONTENTS

ACKNOWLEDGEMENTS	2
COMMENCEMENT	2
SUBMISSIONS	3
APPROVAL FOR RELEASE	3
GUIDELINE REVIEW	3
EXECUTIVE SUMMARY	5
1 INTRODUCTION	6
2 SCOPE OF GUIDELINES	7
3 BACKGROUND	8
4 HAWKE'S BAY SEISMIC HAZARD	9
4.1 SEISMICITY AND GEOLOGY	9
4.2 WHAT IS LIQUEFACTION	10
5 BUILDING CONSENT APPROVAL PROCESS	11
5.1 ASSOCIATED PLANNING DOCUMENTS AND RESOURCE CONSENT CONDITIONS	11
5.1.1 District Plan and Subdivision Consents	11
5.1.2 Earthworks / Geotechnical Completion Report	11
6 LIQUEFACTION HAZARD MAPPING IN HAWKE'S BAY - 2017	12
7 GUIDELINES FOR THE INVESTIGATIONS FOR RESIDENTIAL BUILDINGS	14
7.1 ESTABLISHING COMPLIANCE WITH THE NZ BUILDING CODE	14
7.2 GEOTECHNICAL INVESTIGATIONS	14
7.3 MINIMUM GEOTECHNICAL INVESTIGATIONS OF LIQUEFACTION HAZARD	14
7.3.1 Liquefaction unlikely - Low to Very Low Liquefaction Vulnerability (Yellow Areas)	14
7.3.2 Liquefaction Possible - Medium Liquefaction Vulnerability (Orange Areas)	15
7.3.3 Liquefaction Possible - High Liquefaction Vulnerability (Brown)	15
7.3.4 Geotechnical Investigations Required for Liquefaction Hazard and Foundation Design	16
7.3.5 Geotechnical Report for Building Consent Applications	17
8 GUIDELINE EXCLUSIONS	18
8.1 SITE SPECIFIC GEOTECHNICAL INVESTIGATION IS NOT REQUIRED FOR:	18
8.2 LIMITATIONS FOR EXCLUSIONS	18
9 CLOSE OF SUBMISSIONS	19
10 REFERENCES	20

Executive Summary

These proposed draft guidelines have been prepared by Hastings District Council to provide guidance regarding the **minimum** geotechnical site investigation requirements that Council will apply when assessing light weight residential building consent applications.

Residential buildings that are masonry structures and/ or of tilt slab type construction will require site specific geotechnical investigation in all instances. Ground conditions intending to support hybrid building types will need to be considered by Chartered Geotechnical and Structural engineers on a case by case basis.

The purpose of the guidelines is to enable Building Officers to assess compliance with the structural requirements of the New Zealand Building Code in relation to liquefaction vulnerability for residential buildings.

These guidelines are a non-statutory document and may be subject to change following close of the submission period, and as new information becomes available.

Included in these guidelines are exclusions for some specific types of proposed building projects. It is however recommended that you always obtain advice from a chartered professional geotechnical engineer in regard to site assessments and ground conditions.

The table on page 15 summarises the minimum geotechnical site investigation requirements for residential buildings.

For Brown liquefaction susceptibility areas, subsurface deep boring investigations to at least 15m using CPT testing may be required to support site specific foundation design - for details refer section 7.3.3. Chartered Professional Geotechnical engineers are to confirm site suitability with foundation design recommendations.

For Orange liquefaction susceptibility areas, a staged investigative approach with the initial phase based on shallow investigations, including scala penetrometer, hand auger and test pit investigations, may be preferred - for details refer section 7.3.2. Chartered Professional Geotechnical engineers are to confirm site suitability with foundation design recommendations.

For Yellow liquefaction susceptibility areas, minimum investigations need to include Scala Penetrometer and hand auger investigations to confirm the bearing and determine if any further liquefaction vulnerability investigation is required - for details refer section 7.3.1.

Note: Commercial building applications require site specific geotechnical investigation in all instances.

1 Introduction

These guidelines are provided to assist applicants for building consent to ensure sufficient information is provided in the form of geotechnical investigations.

Hawke's Bay is situated in an area with complex geology. Hazards associated with the geology include, but are not limited to:

- Flooding;
- **Susceptibility to liquefaction;**
- Consolidation settlement;
- Slope stability/land slippage; and
- Bearing capacity.

The purpose of these guidelines is to provide clear guidance to help designers, builders, developers and engineers fulfil the Council's information requirements for building consent purposes, by explaining how those requirements can be met.

These guidelines set out the **minimum** requirements for geotechnical investigation, reporting and documentation of liquefaction hazard that should be provided in support of a building consent application. A building consent application that follows these guidelines should provide sufficient information for Council to have 'reasonable grounds', from an engineering perspective (in relation to liquefaction), to be satisfied that the structural requirements of the building code will be met.

Introducing these guidelines will provide consistent practice across building sector within the district. The information included in these guidelines is for members of the public and "professionals", being developers, architects, architectural designers, planners and engineers.

These guidelines do not address geotechnical investigations that may be required under the District Plan and Resource Management Act 1991 for resource consent for land development.

2 Scope of Guidelines

These guidelines are applicable to building consent applications for light weight residential buildings. Residential buildings that are masonry structures and/ or of tilt slab type construction will require site specific geotechnical investigation in all instances.

These guidelines do not apply to Commercial building consent applications as these buildings require site specific geotechnical investigation in all instances.

These guidelines do not limit the right of Hastings District Council to obtain independent peer review of any building consent application at the owner/agent's expense.

3 Background

The geotechnical shallow investigation, testing and reporting requirements to determine the suitability and bearing capacity of near surface soils for timber framed buildings is set out in NZS 3604:2011.

The NZS 3604:2011 procedure has an emphasis on establishing "good ground" (soil with an Ultimate Bearing Capacity (UBC) of 300kPa or greater). However, it is possible to build foundations on soil with a lower bearing capacity, subject to an appropriate investigation and specific engineering design.

NZS 3604:2011 does not consider liquefaction and its associated effects. These guidelines specifically address the liquefaction hazard, clarify the minimum investigation, testing and reporting requirements.

Following the Canterbury earthquakes, there is a greater awareness of the damaging effects that liquefaction and associated hazards phenomena can have on buildings. The Ministry of Business, Innovation and Employment (MBIE) has issued guidance for the repair and rebuild of houses damaged by the Canterbury earthquakes.

Currently, the MBIE guidance applies to the Canterbury earthquake region only, although work is underway to develop guidance that can be applied nationally. Until such national documentation is available, these guidelines set out how Council expects liquefaction effects are to be addressed for foundation design.

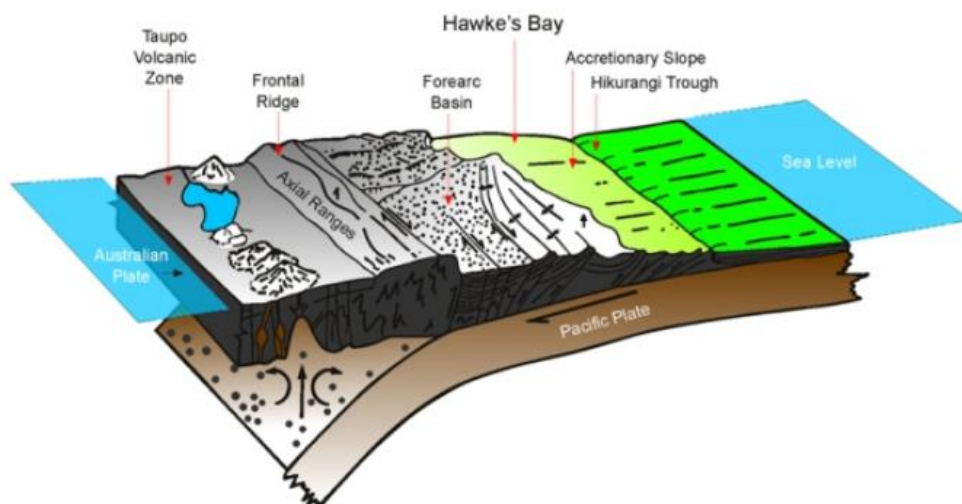
4 Hawke's Bay Seismic Hazard

4.1 Seismicity and Geology

New Zealand lies along the boundary between the Australian and Pacific tectonic plates. In the North Island the relative displacement between these plates is taken up along the Hikurangi subduction zone where the Pacific plate is moving under the Australian plate at an estimated rate of about 40mm per year (Figure 1). The interface passes approximately 20km beneath Hastings. Recent studies suggest that the subduction interface is capable of producing megathrust earthquakes as large as moment magnitude (M_w) 9.0.

Hastings is located above this subduction zone and within the forearc region which is crossed by numerous active faults that propagate upwards from the subduction zone to the ground surface. The main nearby zones of active faulting are the Axial Ranges to the west dominated by strike-slip faulting (e.g. the Mohaka Fault which is the northern segment of the Wellington Fault), the Poukawa-Heretaunga Trough (e.g. source of the M_w 7.8 1931 Napier earthquake) and the Coastal Ranges to the south-east. These make Hawke's Bay (and Hastings) one of the most seismically active regions in the country.

Figure 1 - Illustration of plate tectonics



The geology of the Hawke's Bay Region typically comprises:

- Interbedded sand, silts and gravels deposited by of the Tutaekuri and Ngaruroro Rivers that cover most of the Heretaunga Plains;
- Interbedded sand, silts and gravels of the estuary plain of the old Ahuriri Lagoon west of Napier; and
- Pliocene aged rock which makes up the hills around the plains.

4.2 What is Liquefaction

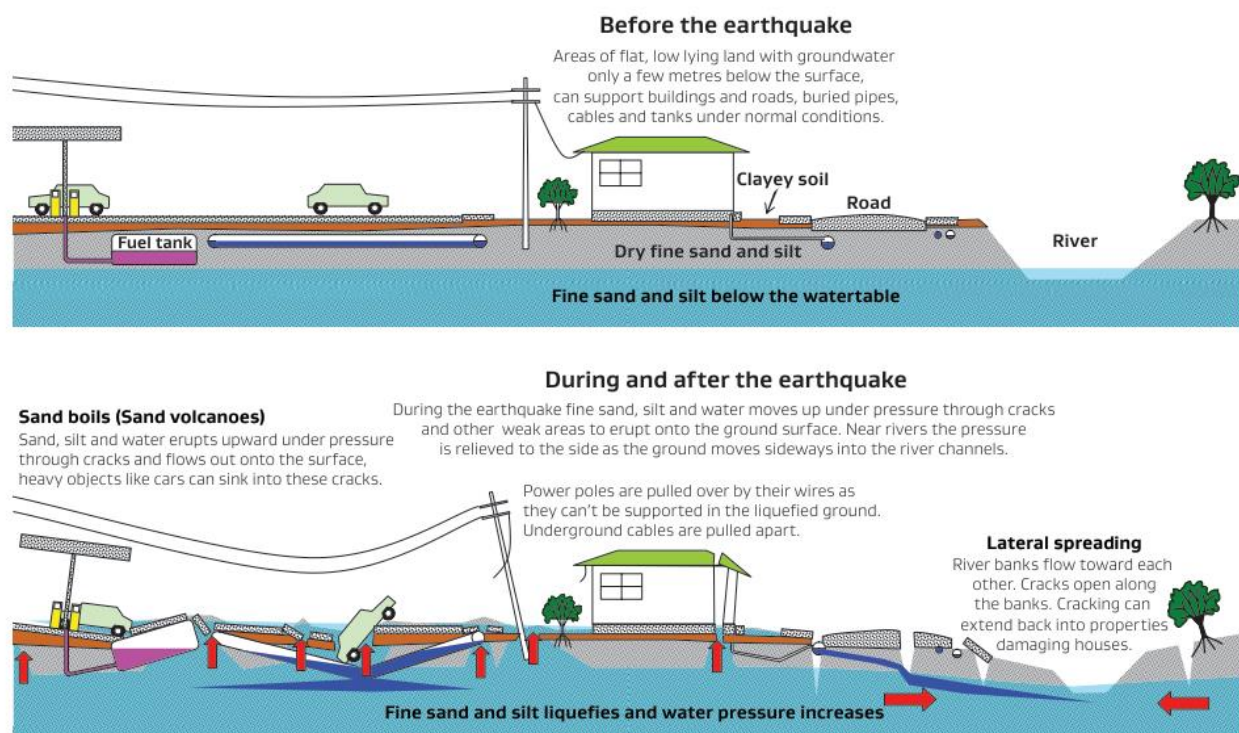
Liquefaction is the process by which earthquake shaking increases water pressure in the ground in sandy and silty soil layers (i.e. the sands and some silts that make up the Heretaunga Plains as well as the estuary plain of the old Ahuriri Lagoon) resulting in temporary loss of soil strength, which can cause significant land and building damage.

Consequences of Liquefaction

There general effects of liquefaction are summarised as follows and illustrated in Figure 2 below:

- Loss of foundation strength resulting in settlement, cracking and tilting;
- Sand boils, ground settlement and undulation;
- Ground cracking;
- Lateral spreading (where the ground moves downslope or towards an unsupported face);
- Uplift of buoyant buried structures.

Figure 2 - Liquefaction and its effects



5 Building Consent Approval Process

The building consent approval process (s49, s91 and s92 of the Building Act 2004) requires that Council, acting as a Building Consent Authority, grant building consent where it is satisfied on reasonable grounds that the provisions of the building code would be met if the building work was properly completed in accordance with the plans and specifications accompanying the application.

5.1 Associated Planning Documents and Resource Consent Conditions

5.1.1 District Plan and Subdivision Consents

The District Plan provides policy direction for managing natural hazards which includes liquefaction. The criteria under the District Plan rules for assessing subdivision consents requires consideration to be given to this potential hazard. Therefore, any relevant subdivision consent should be considered as it may be subject to conditions with specific requirements for foundations.

The consent may also require a consent notice to be placed on the certificate of title to require on-going compliance with a consent condition. A consent notice may dictate the level of subsurface investigations and instability remedial measures required for the site at building consent stage. Copies of the consent notice can be obtained from Land Information New Zealand.

5.1.2 Earthworks / Geotechnical Completion Report

Any subdivision earthworks or geotechnical completion report should be checked for specific foundation recommendations. A completion report provides a statement on the suitability of land for building development. The report will provide information and recommendations that could be relevant to the foundation design.

Key recommendations from a geotechnical completion report typically include:

- An assessment of the natural hazards affecting a site;
- Presence, extent and competency of any fill, whether engineered or non-engineered;
- Presence and extent of unsuitable materials, e.g. organics, peat, soft compressible soils, with recommendations for how these should be dealt with;
- Estimated settlements (short term and long term from site filling if required and timber frame residential structures);
- Minimum set back requirements from slopes;
- **Seismic considerations including the liquefaction vulnerability and lateral spread potential;**
- Suitable foundation types;
- Ultimate Bearing Capacity (UBC) for foundations under static and dynamic conditions;
- Flood levels and minimum building platform levels; and
- Effects of stormwater runoff, soakage and on-site effluent.

Please note that in some cases an earthworks / geotechnical completion report for a subdivision consent may *not* provide sufficient site specific information on liquefaction hazard to support a building consent application. Therefore, geotechnical investigations may be required on a site specific basis to obtain building consent.

6 Liquefaction Hazard Mapping in Hawke's Bay - 2017

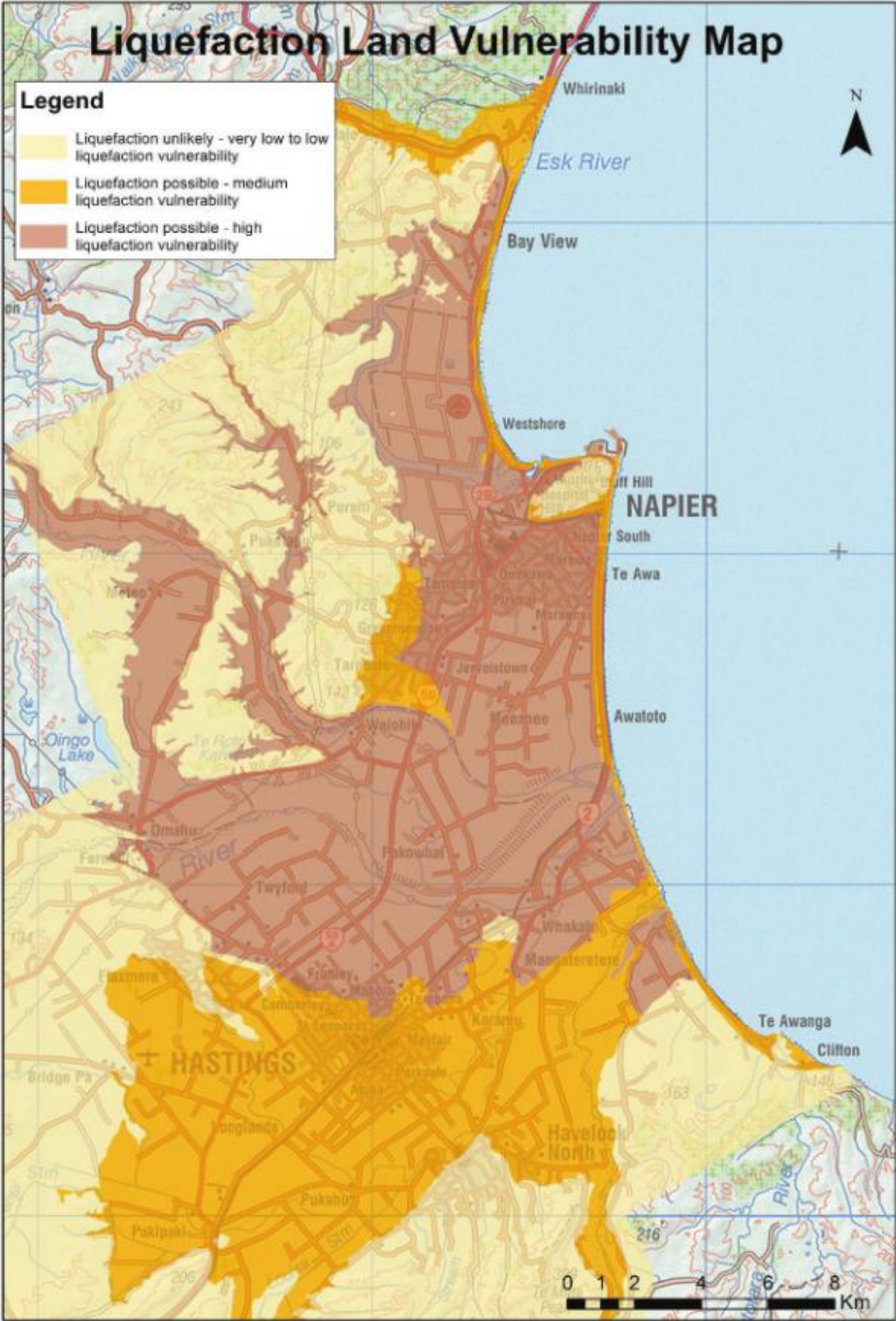
An assessment of liquefaction susceptibility considers the surface geology of an area. The boundaries are not exact and need to be tested on a site specific basis.

Liquefaction hazard severity has been reported and mapped by Geological & Nuclear Science (GNS Science) (Rosser and Dellow 2017) (see below Figure 3: ***Liquefaction Land Vulnerability Map***). The full GNS Science report is available on the Hawkes Bay Regional Council (HBRC) Hazard Information Portal <http://www.hbemergency.govt.nz/hazards/portal>.

As outlined in Section 4, the Hastings district geology is dominated by the distribution of our river systems and the estuaries where they discharge to the sea. Simply, the:

- Liquefaction is possible in lower parts of the plains which are underlain by sediments either as a result of previous sea levels, or flood overflow. In those parts of the plains (coloured orange or brown in Figure 3) there are two possible methods of managing the liquefaction hazard in the context of a building consent application, either:
 - Undertaking ground investigation to assess liquefaction risk and developing specific foundation measures; or
 - Using specified mitigation (similar to MBIE guidance for the Christchurch rebuild) provided it is accompanied by a statement by a suitably qualified engineer. It is likely that over time as more data becomes available, guidance similar to that developed for Christchurch may be developed by MBIE.
- No liquefaction is expected in the hills surrounding the plains and accordingly, liquefaction mitigation is not stipulated.

Figure 3: Map showing liquefaction hazard vulnerability for the Heretaunga Plains



7 Guidelines for the Investigations for Residential Buildings

7.1 Establishing Compliance with the NZ Building Code

Building code compliance for residential buildings has generally been based on either:

- NZ Standard NZS3604 for ground with a Ultimate Bearing Capacity (UBC) greater than 300 kPa, outside any building setbacks or specific foundation design zones **AND** no liquefaction potential i.e. 'good' ground in terms of NZS 3604:2011; or
- A geotechnical assessment by a Chartered Professional engineer where site specific engineering is required because the ground does not meet the requirements of NZS 3604.

7.2 Geotechnical Investigations

Within the Hastings district, appropriate geotechnical investigation by a suitably qualified geotechnical engineer is required to confirm the suitability of the ground for:

- Residential Buildings -new or relocated,
- Major additions to existing residential buildings when the proposed addition comprises a floor area greater than 30% of the ground floor area of the original building.
- All buildings in close proximity to potential or recognised geological hazards, evident from the site or from either known or recorded hazards (available on the Hawkes Bay Regional Council (HBRC) Hazard Information Portal), or through Preliminary Geotechnical Appraisal of new subdivisions and requirements of consent notices. In general, areas of hazard include:
 - On or at the base of sloping land or on ridge tops;
 - Fill material;
 - Coastal environments particularly within identified erosion zones;
 - Areas at risk of inundation by flooding, adjacent to watercourses;
 - Known or interpreted fault traces; and
 - Liquefaction and lateral spread risk.

7.3 Minimum Geotechnical Investigations of Liquefaction Hazard

The intensity of geotechnical investigation required for residential buildings depends on the likely liquefaction hazard associated with the area in which the site is located. For Residential Buildings in areas where:

7.3.1 Liquefaction unlikely - Low to Very Low Liquefaction Vulnerability (Yellow Areas)

Liquefaction is unlikely in the area coloured yellow in Figure 3 above due to Low to Very Low Liquefaction Vulnerability. Therefore:

- Shallow investigation in accordance with NZS 3604:2011 for ground with an Ultimate Bearing Capacity greater than 300 kPa is acceptable to confirm there is no liquefaction potential i.e. the ground is 'good' ground in terms of NZS 3604:2011. This also applies to ground outside any building setbacks or specific foundation design zones imposed by a geotechnical assessment; or

- If 'standard testing' confirms the ground is not 'good ground' for the purposes of NZS 3604:2011 a Chartered Professional Geotechnical Engineer will be required to carry out site specific engineering design.

7.3.2 Liquefaction Possible - Medium Liquefaction Vulnerability (Orange Areas)

Where liquefaction is possible in the area coloured Orange in Figure 3 above due to Medium Liquefaction Vulnerability, the scope of geotechnical investigations for a Residential Building will need to be confirmed by a suitably qualified and experienced Chartered Professional Geotechnical Engineer.

For Medium Liquefaction Vulnerability a suitably qualified and experienced Chartered Professional Geotechnical Engineer may prefer a staged approach to investigation with the initial phase based on shallow investigations.

A staged investigation would comprise shallow investigations to be carried out to assess typical geotechnical considerations such as settlement, bearing pressure etc. If these investigations identify different soils than anticipated, further investigation may be required to determine liquefaction risk. These additional investigations may include, but are not limited to, the following:

- "Deep" investigations comprising either machine drilled boreholes to a minimum depth of 15 m with Standard Penetration Testing (SPT) at 1.5 m intervals or Cone Penetration Tests (CPTs) to refusal (typically, when cone tip resistance, q_c , exceeds 20 MPa) or a minimum depth of 20 m;
- Measurement of groundwater following the investigations, noting that testing methodology and groundwater levels are subject to seasonal fluctuations; and
- A minimum of 2 investigations across the proposed building footprint is recommended or in very close proximity to the proposed building footprint (when an existing structure on site may prevent testing being undertaken across the building footprint).

7.3.3 Liquefaction Possible - High Liquefaction Vulnerability (Brown)

Where liquefaction is possible in the area coloured brown in Figure 3 above due to High Liquefaction Vulnerability, it is required that the scope of geotechnical investigations for a Residential Building is confirmed by a suitably qualified and experienced Chartered Professional Geotechnical engineer, and should at a minimum comprise:

- "Deep" investigations comprising either machine drilled boreholes to a minimum depth of 15 m with Standard Penetration Testing (SPT) at 1.5 m intervals or Cone Penetration Tests (CPTs) to refusal (typically, when cone tip resistance, q_c , exceeds 20 MPa) or a minimum depth of 20 m;
- Measurement of groundwater following the investigations, noting that testing methodology and groundwater levels are subject to seasonal fluctuations;
- A minimum of 2 investigations across the proposed building footprint is recommended or in very close proximity to the proposed building footprint (when an existing structure on site may prevent testing being undertaken across the building footprint); and
- Additional test pits and Dynamic Cone Penetrometer tests are beneficial to confirm near surface conditions and shallow bearing.

It is likely that the minimum level of investigations for the area coloured orange in Figure 3 above will be amended as more data is included in the hazard mapping and MBIE foundation design guidance is developed by MBIE (similar to the MBIE guidance for Christchurch).

The following table summarises the requirements for geotechnical investigation and foundation design in Hastings district. Note section 8 which sets out specific building work that is excluded from these requirements.

7.3.4 Geotechnical Investigations Required for Liquefaction Hazard and Foundation Design

Table 1: Summary of Minimum Testing Required for Residential Buildings

Level of Geotechnical Investigation for Residential Buildings		
Area and Liquefaction Susceptibility	Minimum testing required	Notes
Yellow Areas Very Low to Low	<p>Hand held investigation using a Dynamic Cone Penetrometer (Scala Penetrometer) and hand auger to confirm the bearing pressure and in-situ strength to confirm 'good' ground.</p> <p>Refer section 7.3.1</p>	<p>If "good" ground can be proven (i.e. allowable bearing $\geq 100\text{kPa}$) "normal" foundation design to NZS 3604:2011 may be acceptable.</p> <p>Note: If as a result of investigation the site is considered prone to liquefaction, additional site investigations and/or foundation design may be required.</p>
Orange Areas Medium	<p>Staged investigative approach with the initial phase based on shallow investigations may be preferred covering typical geotechnical considerations.</p> <p>Scala penetrometer, hand auger, test pits to 3-4m and/or CPT</p> <p>Assessment of liquefaction potential to be made by Chartered Professional Geotechnical Engineer.</p> <p>Refer section 7.3.2</p>	<p>If as a result of investigation the site is considered prone to liquefaction, additional site investigations and/or foundation design may be required.</p>
Brown Areas High	<p>Liquefaction potential is to be assessed in accordance with New Zealand Geotechnical Society Earthquake Engineering Guidelines.</p> <p>"Deep" investigations comprising either machine drilled boreholes to a minimum depth of 15 m may be required; CPT testing.</p> <p>Assessment of liquefaction potential to be made by Chartered Professional Geotechnical Engineer.</p> <p>Refer section 7.3.3</p>	<p>Specific Engineering design of foundations.</p>

7.3.5 Geotechnical Report for Building Consent Applications

All building consent applications for Residential Buildings should be accompanied by a geotechnical report addressing the site specific liquefaction hazard and including:

- Description of the geotechnical testing undertaken;
- Site subsurface conditions;
- Assessment of the liquefaction hazard associated with the ground conditions and proposed building;
- The implications of the liquefaction hazard on the proposed building;
- Details of liquefaction hazard mitigation measures if required, ; and
- Geotechnical foundation design recommendations.

Engineering logs including field descriptions in accordance with New Zealand Geotechnical Society (NZGS) guideline, the position and elevation will also be required to accompany the application.

Applications for building consent will not be accepted without sufficient information.

These guidelines do not limit the right of Hastings District Council to seek independent peer review of the liquefaction hazard and its ramifications for any building consent application at the owner/agent's expense.

8 Guideline Exclusions

8.1 Site specific geotechnical investigation is not required for:

- Out-buildings less than 150m² e.g. pole sheds without concrete floor or with concrete floors but not attached to foundations; portal frame metal clad sheds (these guidelines do *not* apply to any tilt panel buildings);
- Stand-alone garages and carports;
- Repiling of Residential Buildings;
- Sleep-outs with a maximum floor area of 20m², in association with an existing Residential Building and may include a toilet and shower.
- Small Residential Building additions with proposed increased floor area $\leq 30\%$ of the existing Residential Building ground floor area, providing the existing foundations can be adequately assessed. In this case the new foundations can be constructed to the same design as the existing foundations, or to the equivalent required by the New Zealand Standard – NZS 3604:2011 Timber Framed Buildings (providing adequate structural connection can be made between the existing and the proposed additions).

8.2 Limitations for Exclusions

Despite the exclusions from site specific geotechnical investigation listed in 8.1, proposed building work related to a residential building may require further liquefaction hazard investigation in the following circumstances:

1. If there is an existing geotechnical report relating to liquefaction hazard for the property, then the report and any recommendations must be considered by the engineer for the proposed building work.
2. When the value of the proposed building work, or additions, or the residential building to which additions are attached is significant, then it is recommended that building owners consider appropriate geotechnical investigation is undertaken.

9 Close of Submissions

These proposed guidelines are current at the time of release, but will be reviewed and updated as necessary following close of submissions. The guidelines will also be reviewed on release of MBIE guidance and as new information regarding the liquefaction hazard in Hastings district is received.

Submissions on the proposed guidelines close at **5pm Friday, 23 February 2018.**

10 References

1. Ministry of Business Innovation and Employment “Planning and engineering guidance for potentially liquefaction-prone land Resource Management Act and Building Act aspects”. Published September 2017.
2. GNS Science. Assessment of liquefaction risk in the Hawke’s Bay: Volume 1: The liquefaction hazard model. GNS Science Consultancy Report 2015/186 October 2017.
3. Ministry of Business Innovation and Employment 2017: *Planning and Engineering guidance for potentially liquefaction-prone land*. ISBN 978-1-98-851771-1
<https://www.building.govt.nz/building-code-compliance/b-stability/b1-structure/planning-engineering-liquefaction-land/>
4. Ministry of Business Innovation and Employment (formerly Department of Building and Housing). ‘*Revised Guidance on repairing and rebuilding houses affected by the Canterbury earthquake sequence*’, published November 2011.
5. MBIE Guidance 2012: Repairing and rebuilding houses affected by the Canterbury earthquakes.
6. NZ Geotechnical Society. Geotechnical earthquake engineering practice. Module 1 – Guideline for the identification, assessment and mitigation of liquefaction hazards. <http://www.nzgs.org/publications/guidelines>