

## **PALMERSTON NORTH AND LIQUEFACTION**

### **Background**

In the mid-1990's Horizons Regional Council commissioned a report on Palmerston North's susceptibility to liquefaction during a seismic event. That report indicated the majority of the lower terrace of the city had a high to moderate potential for liquefaction to occur during an earthquake.

Following the earthquake in Christchurch in September 2010, the Palmerston North City Council commissioned GNS Science, New Zealand's leading provider of Earth, geoscience and isotope research and consultancy services, to provide an update on the information contained in the Horizons' report.

The report was specifically requested to better inform the planning process for the Residential Growth Strategy which was being considered by Council at the time of the September Earthquake.

That report has delivered a general overview of liquefaction susceptibility in the city – but includes specific recommendations on the areas identified for future development in the Council's Residential Growth Strategy (namely the Whakarongo and City West areas).

### **The Report**

In assessing liquefaction susceptibility in Palmerston North, GNS reviewed existing information including geological QMaps, soil maps and brought together the drill-hole database held by Horizons with additional drill-hole and geotechnical data located by GNS. They also used lidar models to determine the effects of previous river paths and other underground aspects that might contribute to liquefaction.

The current document updates that assessment using state-of-the-art technology to determine the effects of previous river paths and other underground aspects that might contribute to liquefaction susceptibility.

The new report has highlighted that the area with the highest susceptibility to liquefaction runs along the river and largely aligns with the flood plain areas. This area is classified as at moderate to very high susceptibility to liquefaction.

The majority of the city sits within two categories: either moderate to high susceptibility to liquefaction, or negligible. Generally, the area to the North of the river is largely classified as moderate to high susceptibility while the area to the South of the river is largely classified as negligible.

The report only provides a broad indication of the likely susceptibility of an area to liquefaction, it does not provide site-specific information. Further testing would be required to determine the ground performance of a particular site or address.

The report does not raise any issues that require a revision of the Council's current Residential Growth Strategy, but it does provide a better quality of information to allow the Council to mitigate against liquefaction susceptibility when planning future developments.

### **Information Use**

The Palmerston North City Council will use the information contained in the report to help inform future developments within the city. The susceptibility of land to liquefaction is just one factor to be taken in to account during planning and must be considered alongside other issues such as land stability, flood risk, air-noise contours, class of soil, connectivity, infrastructural efficiency and accessibility.

To fully inform a building process, further investigation will need to be done on each site to confirm the specific susceptibility of the piece of land proposed for development. This will help determine the appropriate foundation for a new building. Experience from the Christchurch Earthquakes shows that the seismic performance of a structure is closely related to its foundations. In the Christchurch area a large amount of damage to houses was due to the failure of foundations, which were unsuitable for the known ground conditions. Where suitable foundations were used in highly liquefiable areas, such as driven tanalised timber piles capped by a well reinforced concrete slab, the house structure was invariably undamaged.

For properties identified within areas of potential liquefaction susceptibility the Council will include a statement on LIMs that indicates there is potential for liquefaction to occur within the area the property is located. This statement is as follows:

*“Palmerston North has, like most areas of New Zealand, the potential to experience earthquakes. The timing, depth, energy and characteristics of seismic activity (“earthquake factors”) influence the nature and extent of ground deformation that can result in property damage. Earthquake factors cannot be predicted with any certainty. Palmerston North City Council is aware, from analysis*

*undertaken on its behalf that risks of liquefaction from serious seismic activity are elevated in particular soil types, depths and densities and groundwater table depths (“ground conditions”). Ground conditions, together with the nature and quality of foundations will influence the nature and extent of damage in a serious seismic event. Based on existing data sets these ground conditions are more likely to exist in some part of Palmerston North than others, including this parcel of land, however the analysis is not based on site-specific geotechnical investigations. The actual presence or absence of ground conditions that elevate the risk of liquefaction for particular land parcels are generally unknown except where bore log information relating to that parcel of land is held by Palmerston North City Council. Palmerston North City Council recommends that before all new construction is commenced, a geotechnical investigation is undertaken of the site and appropriate specific design undertaken where recommended by an appropriate expert to ensure maximum resilience of structures in the event of serious seismic events.”*

Also, where site-specific drill-hole information is available, this will also be included on the LIMs of those properties that have been tested as this provides specific, relevant information that should be used to identify the appropriate building platform.

It is important to note that the Council has no current plans to develop any area located within the area identified as having moderate to very high susceptibility to liquefaction.

## **FREQUENTLY ASKED QUESTIONS: PALMERSTON NORTH’S SUSCEPTIBILITY TO LIQUEFACTION**

### **1. What is liquefaction?**

Strong shaking during earthquakes can result in the phenomenon known as liquefaction. In this process, strong ground shaking results in water pressure increasing in the sediment and causes the sand grains to lose contact with each other. This can lead to the sediment losing its strength and behaving like a liquid. The soil can lose its ability to support structures, flow down even very gentle slopes, and erupt to the ground surface to form the sand boils seen widely in Christchurch.

Three factors are required for liquefaction to occur:

- loose, granular sediment
- saturation of the sediment by ground water (water fills the spaces between sand and silt grains)
- strong ground shaking — measured by the Modified Mercalli scale at 7 or over

## 2. Is Palmerston North likely to experience liquefaction during an earthquake?

There is no simple answer to this question. Palmerston North experiences a number of earthquakes each year and the only known incidence of liquefaction in the City was during the 7.6 magnitude earthquake in 1934 which was centred in Pahiatua.

Liquefaction *begins* to occur during earthquakes with a ground shaking intensity of MM7 (Modified Mercalli scale – not the richter scale), it is not considered likely that incidents of liquefaction would be widespread in an earthquake with ground shaking intensity of less than MM8. The statistical probability of Palmerston North experiencing an earthquake with ground shaking intensity of MM8 or higher is one in approximately 130 years.

What the report shows is that in an earthquake of significant magnitude, some areas of Palmerston North are susceptible to liquefaction, while others have a low or negligible susceptibility.

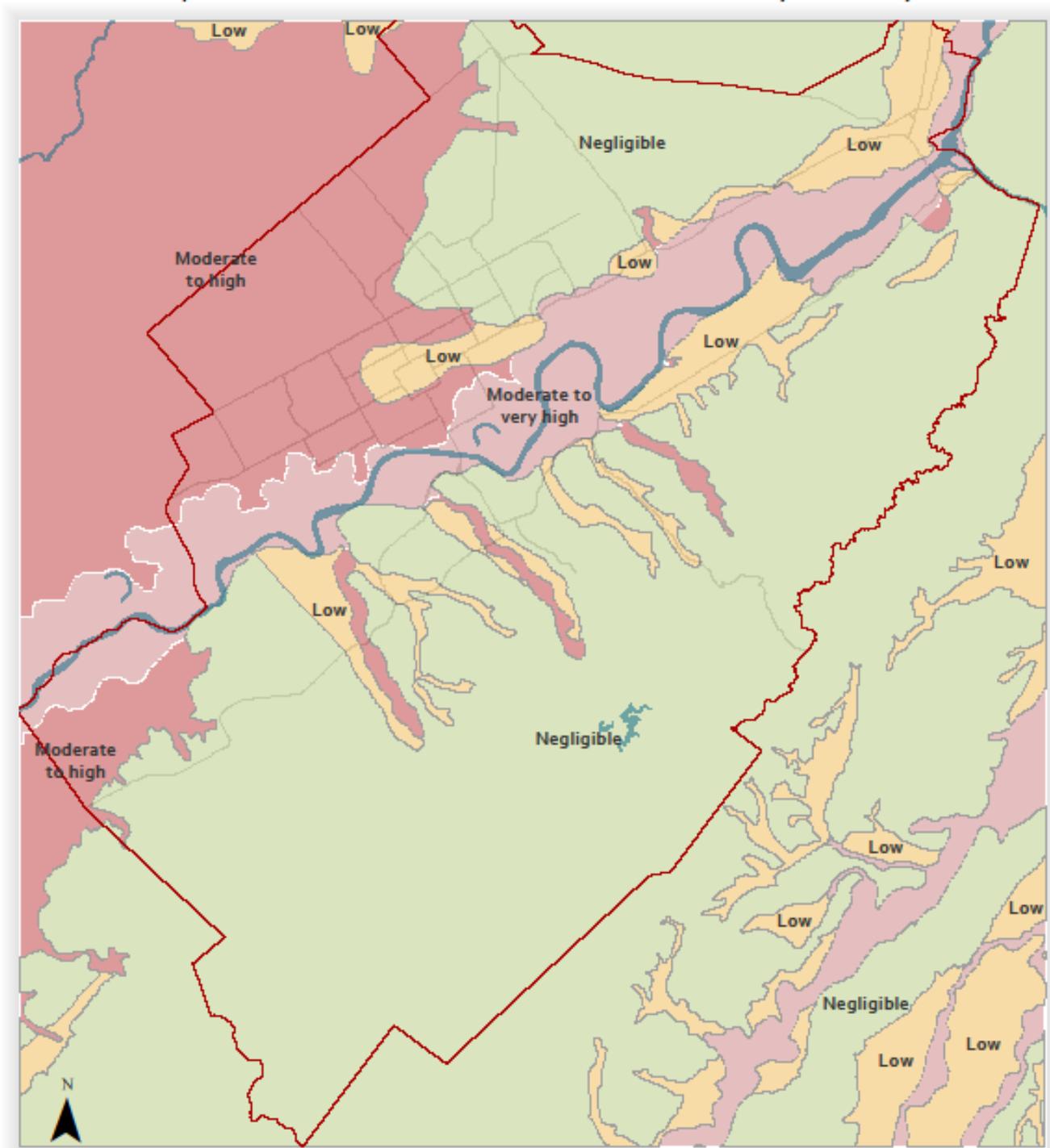
It's important to note that the information received in the most recent report is generalised and largely based on statistical modelling. To determine the actual susceptibility of individual sites, tests need to be done to confirm the exact nature of the soil and therefore its definitive susceptibility to liquefaction. Tests on individual sites consist of bore holes being drilled to take samples of the soil at a specific location.

## 3. What parts of the City are most susceptible to liquefaction?

The area with the highest susceptibility to liquefaction runs along the river and largely aligns with the flood plain areas. The different areas of liquefaction susceptibility can be seen in the map attached below.

It's important to note that even in areas of high general susceptibility to liquefaction there can be pockets of land with low or negligible susceptibility. This can occur when there are areas of gravel deposits – tests would need to be conducted on individual sites to determine their specific susceptibility to liquefaction.

## Liquefaction Zones within the Palmerston North City Boundary



0 2.5 5 10 Kilometers

### Legend

#### GNS Liquefaction Zones

- |   |  |
|---|--|
|  Moderate to high      |  Palmerston North City Boundary |
|  Moderate to very high |  Manawatu River                 |
|  Low                   |  Roads                          |
|  Negligible            |  |

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#### **4. What will the Council do with the information?**

The report was commissioned to inform the Residential Growth Strategy and largely focuses on the areas the Council has identified for future growth.

Planning for proposed development in the city already considers a wide range of factors, and the information in this report will add to those considerations.

Alongside liquefaction, Council also have to consider other aspects such as flood risk, air-noise contours, class of soil, connectivity, infrastructural efficiency and accessibility to name a few.

Although the Palmerston North City Council does not currently have any plans to develop areas classified in the latest report as moderate to very high susceptibility to liquefaction, these areas can be safely developed providing buildings have the right foundations in place.

The Council will include information on LIMs that indicates the liquefaction susceptibility of the *area* a property is in. Where site-specific drill-hole information is available, this will also be included on the LIMs of those properties that have been tested as this provides specific, relevant information that should be used to identify the appropriate building platform.

#### **5. My house is in an area which is shown as being moderate, high or highly susceptible to liquefaction – what does that mean for me and my property?**

The information in this latest report is not new, it simply provides an update to the information contained in a report commissioned by Horizons in the mid-1990's. Advances in technology mean that the current report provides more reliable information, although it does not provide the detailed information required to determine the susceptibility of individual properties to liquefaction.

Existing structures should comply with the building standards in place at the time of construction. This means some properties may not have foundations now considered the most appropriate to mitigate against the risk of liquefaction during a significant earthquake, and this is common across the whole country. Retro-fitting foundations to mitigate against the possibility of liquefaction can be expensive and for many properties would not be logistically possible.

#### **6. Will living in an area shown as being highly susceptible to liquefaction affect my insurance?**

Information on liquefaction susceptibility in Palmerston North has been available since the mid 1990's and insurance agencies would have had access to that information had they requested it. While there is a significantly heightened interest in liquefaction nationally in the wake of the Christchurch earthquakes, it is not yet clear how that might affect the insurance industry.

#### **7. Will living in an area shown as being highly susceptible to liquefaction affect my property value?**

The events in Christchurch mean that people are now more aware of the issue of liquefaction and Councils across the country will be updating their information, so they have a better idea of their area's susceptibility.

We don't know if there will be any effect on property prices, but if there is, that is likely to occur across the country not just here in Palmerston North.

#### **Who do I contact if I have further questions?**

For further information please contact the Planning Team part of City Future at the Palmerston North City Council on 06 356 8199.