7.0 DISCUSSION AND CONCLUSIONS

7.1 SUMMARY

7.1.1 Subduction earthquakes

The massive tsunami in 2004 in the Indian Ocean, in 2009 in the South Pacific and in 2011 in Japan have overturned many assumptions regarding the potential for severe tsunami to be generated on subduction zones throughout the Pacific. We cannot rely on a 200-year historical record to draw firm conclusions regarding the subduction zones around New Zealand. Instead, research on paleotsunami, as well as geodetic and geophysical studies, are needed to understand the potential for tsunami. New research into New Zealand's subduction tsunami sources will take time, and in the interim, in matters of public safety, it is best to assume that all subduction zones around New Zealand could generate severe tsunami from earthquakes of M_W 8-9.

7.1.2 Probabilistic tsunami hazard model

The probabilistic tsunami hazard model in this report covers all parts of the New Zealand coastline and all known seismic sources. It takes into account the changed picture regarding subduction zones, and incorporates several new crustal faults, many from the New Zealand Seismic Hazard Model. For most parts of New Zealand, the overall levels of hazard are quite similar to the assessed hazard levels in the 2005 report, but the estimated hazard has generally increased in those areas most exposed to tsunami from local subduction zones – notably the east-facing coasts of the North Island, and the southwest corner of the South Island.

The hazard model can be deaggregated, based on the contributions of various tsunami sources, and used for inundation modelling. This provides a basis for a simple form of probabilistic inundation modelling that could be used as a starting point for land-use planning (see Appendix 7.2). The hazard model and its deaggregation incorporate effects such as non-uniform slip and modelling uncertainty, at least to a first level of approximation.

7.2 DISCUSSION

7.2.1 Self-evacuation

Currently mitigation of local tsunami hazard is by self-evacuation in the event of strongly felt earthquakes. This is because local tsunami have very short travel times, which necessitate immediate evacuation before there has been adequate time and data available to issue official warnings.

Two circumstances have been identified in which a local tsunami may be generated but the earthquake that caused it is not strongly felt. One is if the earthquake is a "tsunami earthquake"—a special class of very shallow earthquake on the subduction interface that does not cause strong shaking; two earthquakes near Gisborne in 1947 were probably of this type and both caused tsunami. The other is of a subduction earthquake on the southern Kermadec Trench; in this case the shaking may not be strongly felt along the Coromandel and Northland coasts because of seismic attenuation in the offshore Taupo Volcanic Zone.

These are in addition to the possibility of a landslide-caused tsunami that is not triggered by a major earthquake.

Reliance on self-evacuation in big cities is problematic. The majority of strongly felt earthquakes will probably not cause severe tsunami, however the public needs to be educated to evacuate from every strongly felt earthquake as if it were generating the worst-case tsunami. Mass evacuation of cities in the aftermath of a major earthquake is likely to result in many problems, and this will often appear to be unnecessary in hindsight. Yet at present self-evacuation still appears to be the best option in terms of public safety.

As the technology for assessing large local earthquakes improves, and more instruments for tsunami monitoring become available, there will be a problem of public expectations. Without continuing education the public may come to expect to receive a tsunami warning for local events, and may therefore not self-evacuate if no official warning is issued. To some extent the installation of tsunami warning sirens, useful for warning of events too far away for the earthquake to be strongly felt, already contributes to this problem.

7.3 RECOMMENDATIONS

- The following actions are recommended:
- Seismic modelling should be used to evaluate how a large subduction zone earthquake on the southern Kermadec Trench will be felt at coasts on the opposite side of the offshore Taupo volcanic zone (principally the Coromandel and Northland coasts).
- Risk factors for "tsunami earthquakes" should be determined and their presence around the New Zealand coast evaluated.
- Geophysical and geological research to understand the relationship between earthquakes on upper plate faults close to the trench and earthquakes on the subduction interface would be helpful for improving the hazard model. In particular, it would be useful to discover which faults tend to rupture simultaneously with plate interface movement during subduction earthquakes.
- The potential for outer-rise earthquakes to generate tsunami close to New Zealand warrants further investigation.
- Planning and exercises to make mass self-evacuation of vulnerable urban areas as safe and easy as possible in the aftermath of an earthquake should be undertaken.
- Education regarding self-evacuation after a strongly felt earthquake, without waiting for an official warning, needs to continue.
- Geonet’s capability to identify and quantify large subduction zone earthquakes should be maintained and enhanced.
- Real-time inundation models for major cities should be trialled and evaluated.
- The national probabilistic tsunami hazard model developed for this report should be periodically updated with new information. Integration with a probabilistic model for landslide-caused tsunami should take place. Further research to develop probabilistic inundation modelling should be supported.