Executive Summary

Northland Regional Council contracted NIWA to undertake an initial study on the risk of tsunami inundation facing communities in the Northland Region. The following credible sources were identified:

- Remote source: South American origin. Return period 50-100 years. This represents the most probable tsunami risk in the next 100 years.

- Local/Regional source: Tonga Kermadec. Two events were modelled, M_w 8.5 and M_w 9.0. The return period of these events is much longer (500-2000 years) but these represent a worst-case scenario for a tsunami striking the Northland coast.

Tsunami propagation to the Northland coastline including inundation at 15 specific communities for each of the above scenarios was simulated using a computer model. The simulations were performed for current sea levels and for a mean sea level elevated by 50 cm, representing the 100 year projection by the IPCC Fourth Assessment Report.

The remote South American tsunami did not cause significant inundation for most of the settlements studied; however, some relatively minor flooding was predicted to affect properties in the settlements of Hihi and Dargaville/Ruawai. Modelled inundation from the M_w8.5 Tonga-Kermadec subduction zone event was largely similar in extent and degree to the South American tsunami, but was greater in depth and extent at Bland Bay, Helena Bay and Taupo Bay. The M_w9.0 Tonga-Kermadec event caused major inundation at Bland Bay, Helena Bay, Tauranga Bay, Taupo Bay, Te Ngaire and Hihi. In other locations, the extent of inundation was similar to the M_w8.5 event, though inundation depth was inevitably deeper.

The simulation results presented here cover the likely range of tsunami that might be expected in Northland, increasing from the relatively common but smaller South American tsunami to the largest likely event emanating from the Tonga-Kermadec subduction zone, and therefore provide information on the likely range of impacts on which to base local contingency planning.

In this final part of the three-stage study, the results from the entire project are summarised and recommendations for improving the modelling and reducing the uncertainty in the results are made. Overall, in all three studies, the relatively likely, but smaller South American event caused the least inundation, the M_w8.5 event slightly more, and the M_w9.0 event had much more severe impacts. The modelling study is dependent on, and therefore limited by, the initialisation of the tsunami for each earthquake source, the quality of the LiDAR topographic data and also the quality of bathymetric data in inshore waters. A lack of knowledge of the effects of buildings and land features on wave drag also adds uncertainty to the simulations. Despite these limitations, we believe that the current modelling exercise provides the best possible estimate of inundation in Northland from remote and regionally sourced tsunamis available to date.

Caveat

This report is based on state-of-the-art knowledge and modelling capabilities of tsunamis and tsunami inundation. While every effort is made to provide accurate information, there are many uncertainties involved including knowledge of potential sources, source characteristics, bathymetry and topography. In addition, while RiCOM captures much of the physics involved in tsunami propagation and inundation, it also includes some simplifying assumptions as with all models. The information provided in this report is of a technical nature and should be viewed with the above limitations in mind

1. Introduction

Northland Regional Council contracted NIWA to undertake a modelling-based assessment of tsunami hazard for the Northland region. The focus of the initial study (Lane et al., 2007) was to model maximum wave heights at the shoreline for selected districts in the Northland region for credible regional and remote sources, and to undertake inundation modelling for two specified communities. In the second study (Gillibrand et al., 2008), inundation of sixteen Northland communities from the two tsunami sources was modelled. In the present study, potential inundation of a further fifteen Northland communities is investigated.

From the tsunami source study of Goff et al. (2006), two sources were identified as likely to cause significant tsunamis in the areas of interest:

- Distant – Eastern: South America (Chile). A distant tsunami comparable to either the 1868 Peru (now Chile) earthquake (M_w9.0) event or the 1960 Chile Earthquake (M_w9.5) event (Note that although the 1960 event was larger it was directed more to the north of New Zealand, whereas the 1868 tsunami can be considered an almost direct hit on New Zealand). This represents the most probable tsunami in the 50-100 year timeframe.

- Regional – Eastern source: Tonga Kermadec Trench. Two tsunamigenic earthquakes were studied: a M_w8.5 subduction zone event located just to the north of the Rapuhia Scarp (i.e. in the central portion) and a M_w9.0 subduction zone event in the central and southern portion. These are identified as worst - case scenarios.

For each of these events NIWA modelled wave propagation up to the Northland shoreline and inundation of the following communities:

1. Bland Bay, Whangaruru
2. Opua, Bay of Islands,
3. Mangonui, Doubtless Bay
4. East Beach, Houhora/Pukenui
5. Helena Bay, Whangaruru
6. Tauranga Bay, Whangaroa
7. Taupo Bay, Whangaroa

8. Coopers Beach, Doubtless Bay
9. Langs Beach, Bream Bay
10. Te Ngaire, Whangaroa
11. Cable Bay, Doubtless Bay
12. East Beach, Rangiputa
13. Hihi, Doubtless Bay
14. Dargaville/Ruawai
15. Omapere

Inundation modelling at the above locations was performed assuming that the waves arrive at Mean High Water Springs (MHWS) at present day sea level and also with a sea level rise scenario of 50 cm, which represents the 100 year projection defined by the IPCC Fourth Assessment Report.