Report to Catchment Services Committee

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Date:	16 June 2013
To:	Chief Executive Officer
From:	Group Manager – Scott Fowlds
Subject:	Eastern Coromandel Tsunami Strategy Update
Section:	**B (Recommendation to Council)**

1 Purpose

- To provide an update on the "Eastern Coromandel Tsunami Strategy" project
- To present the final findings of the tsunami inundation modelling report for Tairua/Pauanui as part of the (above) wider project
- To seek Council adoption of the final report (circulated as a separate document).

Members may recall the previous update on the project last year which overviewed the tsunami risk for Whitianga (Stage 1). The Tairua/Pauanui project therefore represents Stage 2 of the wider project with Whangamata being addressed in 2013/14 (as Stage 3).

Recommendations:

1. That this report "Eastern Coromandel Tsunami Strategy Project Update" (DM #2740422) dated 10 July 2013 be received for information.

2. That the Waikato Regional Council Technical Report 2013/24 titled "Numerical Modelling of Tsunami Effects at Two Locations on the Coromandel Peninsula - Whitianga and Tairua/Pauanui" be adopted.

2 Background

The Waikato Regional Council and the Thames-Coromandel District Council are jointly managing the East Coast Tsunami Strategy - the aim of which is to mitigate the risk to life and property in the face of regional and distant source tsunami. Projects within each of the communities have two strands: first, to develop in collaboration with east coast communities, emergency plans to allow for the safe and timely evacuation of a community; second, to develop long-term planning strategies to ensure critical building and infrastructural assets are located away from high-risk tsunami zones. Both aspects see on-going public education and engagement as an important part of the project.

Overall, the community elements of the project aim to build greater community resilience in the face of uncertainty.

3 Issue – the tsunami threat to Tairua/Pauanui

The east coast of the North Island, including the Coromandel Peninsula, is at risk from tsunami hazards. The primary risks to the East Coromandel coast are from distant and local source tsunami. Distant tsunami have travel times (time from event to wave arrival on shore) of greater than 12 hours, while regional tsunami have travel times of up to one hour.

Studies indicate that the main source of distant tsunami is from South America, and that these are frequent events – they occur about once every 50 to 100 years. Distant source tsunamis take 12-15 hours to reach New Zealand, providing time for evacuation of communities.

The primary regional source of tsunami is the Tonga-Kermadec Trench to the North-east of New Zealand. The Tonga-Kermadec Trench is the subduction zone between the Pacific and Australian plates. A very large earthquake in the Tonga-Kermadec Trench is capable of producing a series of waves with maximum wave heights (peak to trough) of up to 18 metres.

Scientific modelling suggests that these types of events may happen about once every 600 to 800 years. Evidence from historical tsunami deposits suggests that a very large event from a regional source last occurred in the 14^{th} Century. A large earthquake event in the Tonga-Kermadec Trench could produce a series of waves with a maximum wave height of 8.5 metres about once every 400 years.

The risk to Pauanui has been assessed as second only to Whitianga in terms of community risk, based on population and low-lying land with few evacuation routes. Tairua community is also at risk, with a relatively high population in low-lying land areas.

4 Key findings of the report

The report details the results of a tsunami inundation modelling study for Tairua-Pauanui and Whitianga using the latest scientific literature on tsunami sources and high-resolution bathymetric survey grids to produce inundation predictions for Whitianga and Tairua–Pauanui. The model settings and parameters are established through sensitivity analyses and comparison of model results to historical data. This includes instrumental data recoded on the Whitianga tide gauge during the 2010 Chile and 2011 Japan tsunamis as well as eyewitness accounts regarding the wave activity and inundation extents from the 1960 Chile tsunami in Whitianga. The model result are also compared and contrasted with the model results previously presented by Prasetya et al. (2008) for Whitianga.

The study examined several historical events including the 1960 and 2010 Chilean tsunamis and the 2011 Japan tsunami. For the 1960 event, a suite of 6 earthquake models was used. Each model has roughly the same magnitude, but with different slip distributions at the earthquake source.

Hypothetical tsunami sources include earthquakes positioned along the Tonga-Kermadec (TK) Trench subduction zone and a large subduction zone event located on the southern coast of Peru in South America. These sources are included as they represent a significant hazard from both the near and far field (distal). The Tonga-Kermadec Trench cases are a significant hazard in that this faulting zone lies adjacent to New Zealand and tsunami waves can begin affecting the study region less than 1 hour after generation. For far field sources, it has been shown that sources located in northern Chile or southern Peru produce higher waves in New Zealand relative to other areas around the Pacific Rim.

The model results for the 1960 Chile tsunami in Whitianga were shown to compare very well with the eyewitness descriptions of the character of the tsunami waves and the timing of the strongest effects. The model however does not match the inundation patterns precisely. This is attributed primarily to discrepancies in the topographic data provided for the study.
The model results suggest that far-field sources have a relatively minor impact on Tairua-Pauanui as compared to Whitianga. Inundation levels from these sources (Chile 1960, Chile 2010, Japan 2011 and Peru Hypothetical) are all well below the crest of the dunes on either Tairua or Pauanui. The most significant effect from these types of sources is the generation

of strong current in the harbour entrance and along the wharf area. Of the far field sources, the Peru source is shown to be the most potentially damaging.

For the near-field sources, we show that the TK Trench scenarios present a greater inundation hazard than the far-field sources. We model a range of scenarios; we positioned the fault at a location where it would cause the greatest impact on the study region as well as running a set of simulations moved to the north. The earthquake scenarios in this section ranged in size from 8.9 to 9.0 to 9.1 with slip amounts of 10.5, 14.3 and 20.8 m respectively. As expected, the fault located further south resulted in stronger and larger waves affecting Tairua.

Our final series of models looked at extreme earthquake events, analogous to some of the largest earthquakes known to have occurred on earth. These sources were positioned along the southern end of the TK Trench, north of East Cape, so as to provide some indication of a worst-case scenario. The model results show that a source similar in size to the 1960 Chile earthquake occurring on the TK trench would result in complete overtopping of the Tairua and Pauanui Sand Spits. While not as extreme, using the same source mechanism as the 2011 Japan tsunami positioned along the southern section of the TK trench results in severe inundation along the Pauanui Peninsula and overtopping towards the southern end.

5 The Tairua/Pauanui tsunami project

The overall goal of the project is to improve on existing emergency response arrangements, and formalise a long-term work programme for land-use planning and public education and awareness, as well as emergency management (warnings and response). Effective risk reduction for tsunami hazards usually involves a combination of all these elements, and this will be the value added by the Tairua/Pauanui project.

Work to date
In March 2012, the Tairua-Pauanui Community Board resolved to support the Tairua-Pauanui tsunami project, subject to confirmation of how communication and consultation with the local community would be undertaken. At the time, staff noted that the Tairua/Pauanui project would be similar in nature to the Whitianga project, and would involve:

- Development of a technical inundation modelling report;
- Formation of a community-based tsunami working group;
- Communication and consultation with the community regarding options for managing tsunami risk; and
- Development of a risk mitigation plan for the Tairua/Pauanui community.

In February of this year, the Tairua-Pauanui Community Board received the draft findings of the inundation investigation which showed many parts of the two settlements affected by tsunami. The author of the report, Dr. Jose Borrero, provided an overview of the draft inundation modelling results for the area. His presentation was very well received. As a result the Board agreed to form a working party to oversee/implement the next stages of the project.

Next steps
The key tasks during 2013/14 for implementing the Tairua/Pauanui tsunami report include (note: timings to be confirmed):

- Report back to the Tairua/Pauanui Community Board on the findings of the final report
- Convene the first meeting of the community working party
- Prepare a communications plan, mitigation strategy outline and public education material such as pamphlets

- Conduct a community open day (usually during one of the long weekends)
- Develop a risk mitigation strategy.

6 Priority communities for tsunami work

The East Coast Coromandel Tsunami Risk Mitigation Project is an ongoing initiative that seeks to progressively reduce risks from tsunami hazards to Coromandel communities.

In order to guide the location and timing of tsunami risk management work, the strategy project team evaluated the likely risks to various communities along the East Coromandel coast in 2010. Communities were ranked by a number of factors, including:

- Population at risk – both resident and peak
- Access to high ground for rapid evacuation
- Ease of road access for evacuation
- Infrastructure at risk
- Amount of low-lying land at risk
- Population growth potential.

The rankings showed the following six communities were likely to be at most risk for the following reasons, and therefore should be prioritised for risk management work:

- Whitianga (1): population, lack of preparation, wave amplification, infrastructure
- Tairua/Pauanui (2): population, low lying spit; few evacuation routes
- Whangamata (3=): population, low-lying land, size of town
- Matarangi (3=): population, low-lying land, few evacuation routes, wave amplification
- Cooks Beach (5): population, low-lying land, few evacuation routes.

The order of work also depends upon the willingness of communities to address tsunami risks, and the availability of detailed land and seafloor elevation information. Detailed elevation information is available for Tairua/Pauanui communities, and both Whangamata and Tairua/Pauanui communities have demonstrated a willingness to address tsunami risks via the installation of siren warning systems.

Dr Jose Borreo (of eCoast Consultancy) will attend the meeting to present the key findings of his report, including likely event scenarios and inundation (hazard) maps.

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