Te Mata and Tapu tsunami hazards
# Table of Contents

PURPOSE .................................................................................................................................................. 3
SOURCE REFERENCE .................................................................................................................................. 3
WHAT IS A TSUNAMI? .................................................................................................................................. 3
WHERE DO TSUNAMIS COME FROM? ......................................................................................................... 3
FURTHER INFORMATION ............................................................................................................................. 3
LOCAL SOURCE TSUNAMI FROM THE KEREPEHI FAULT ......................................................................... 4
  THE KEREPEHI FAULT ................................................................................................................................. 4
  HOW LONG DOES IT TAKE FOR LOCAL SOURCE WAVES TO ARRIVE AT TE MATA AND TAPU? .......... 4
  INUNDATION MAPS: IMPACT OF LOCAL SOURCE TSUNAMI WAVES ON TE MATA AND TAPU ........... 4
    Figure 3: Te Mata .................................................................................................................................... 5
    Figure 4: Tapu ......................................................................................................................................... 6
REGIONAL SOURCE TSUNAMI FROM THE TONGA-KERMADEC TRENCH ................................................ 7
  THE TONGA-KERMADEC TRENCH ........................................................................................................... 7
  HOW LONG DOES IT TAKE FOR REGIONAL SOURCE WAVES TO ARRIVE AT TE MATA AND TAPU? .... 7
  INUNDATION MAPS: IMPACT OF REGIONAL SOURCE TSUNAMI WAVES ON TE MATA AND TAPU ........ 7
    Figure 7: Te Mata .................................................................................................................................... 8
    Figure 8: Tapu ......................................................................................................................................... 9
DISTANT SOURCE TSUNAMI FROM SOUTH AMERICA ............................................................................ 10
  SOUTH AMERICAN SOURCES .................................................................................................................. 10
  HOW LONG DOES IT TAKE FOR DISTANT SOURCE WAVES TO ARRIVE AT TE MATA AND TAPU? ........ 10
  INUNDATION MAPS: IMPACT OF DISTANT SOURCE TSUNAMI WAVES ON TE MATA AND TAPU .......... 10
    Figure 11: Te Mata .................................................................................................................................. 11
    Figure 12: Tapu ..................................................................................................................................... 12
Purpose
To summarise tsunami hazards information for the Te Mata and Tapu communities:
- Where do tsunami come from?
- How long do tsunami waves take to arrive in Te Mata and Tapu from the various sources?
- What impacts do tsunami have on the communities?

Source reference
This summary draws on information contained within the following technical report:


The full report is available here:
http://www.waikatoregion.govt.nz/tsunamistrategy

What is a tsunami?
A tsunami is a series of water waves most commonly caused by seafloor earthquakes. Tsunami waves are different to wind-generated waves in that they are a transfer of energy, and usually travel a lot further inland than wind-generated waves.

Where do tsunamis come from?
Tsunamis caused by seafloor earthquakes occur most commonly around tectonic plate boundaries, particularly around the Pacific ‘Ring of Fire’. Tsunamis can also occur along undersea fault lines that lie just offshore, whether associated with a plate boundary or not.

Te Mata and Tapu have three primary sources of tsunami:
- ‘Local source’ from the Kerepehi Fault
- ‘Regional source’ from the Tonga-Kermadec Trench just off East Cape
- ‘Distant source’, most commonly from large earthquakes in South America.

An overview of the tsunami sources, wave arrival times and potential inundation in Te Mata and Tapu is provided in the following pages.

Further information
Further general information about tsunami hazards is available at:
http://www.waikatoregion.govt.nz/tsunami
Local source tsunami from the Kerepehi Fault

The Kerepehi Fault
A large earthquake along the offshore portion of the Kerepehi Fault is thought to be capable of generating a tsunami. The size of tsunami waves and their arrival time at Te Mata and Tapu depends largely upon the size and position of the earthquake event.

Figure 1 shows the five fault segments considered in the technical report. Of the five faults considered, a magnitude (Mw) 7.1 earthquake rupturing along 16km of segment ‘D2’ has the largest potential impact on the Te Mata and Tapu communities. This scenario is considered the ‘maximum credible event’ for Te Mata and Tapu from the Kerepehi Fault.

How long does it take for local source waves to arrive at Te Mata and Tapu?
Assuming a maximum credible earthquake along segment ‘D2’, Figure 2 shows that

- Water levels begin to rise about 15 minutes following the earthquake to 1.0m after 20 minutes, and reach a peak of around 2.0m above the existing water level around 45 minutes following the earthquake
- The third wave is the largest, and water levels continue to rise and fall rapidly but at lower levels for at least eight hours, due to on-going wave arrivals.

Figure 2: Wave arrival times and inundation levels from segment ‘D2’

Inundation maps: impact of local source tsunami waves on Te Mata and Tapu
Figures 3, 4 and 5 (overleaf) show the potential inundation from a maximum credible earthquake on segment ‘D2’ of the Kerepehi Fault. It is important to note that the maps:

- Assume wave arrival at Mean High Water Springs (the highest level that spring tides reach on average over a period of time)
- Only show inundation of land areas that are normally above sea level.
Figure 3: Te Mata

Kerepehi Fault potential inundation from a maximum credible earthquake on segment ‘D2’
Figure 4: Tapu

Kerepehi Fault potential inundation from a maximum credible earthquake on segment ‘D2’
Regional source tsunami from the Tonga-Kermadec Trench

The Tonga-Kermadec Trench
The Tonga-Kermadec Trench is a subduction zone at a convergent tectonic plate boundary, where the Pacific Plate is being subducted underneath the Australian Plate. A large earthquake along the Tonga-Kermadec Trench to the north-east of New Zealand represents the most significant near-source tsunami threat for the Eastern Coromandel Peninsula, but will also affect the Firth of Thames, including Te Mata and Tapu.

The technical report considers that a magnitude (Mw) 8.9 earthquake rupturing along a 450km segment of the Tonga-Kermadec Trench just off East Cape to be a ‘maximum credible event’ (see Figure 5). This event is similar to the Tohoku earthquake and tsunami that occurred in Japan in 2011.

How long does it take for regional source waves to arrive at Te Mata and Tapu?
Assuming the magnitude (Mw) 8.9 earthquake described above, Figure 6 shows that:

- Water levels begin to fall about two hours following the earthquake, then rise and fall rapidly (5-6 times per hour) for at least six hours
- The first and second waves rise to around 0.5m and 1.0m respectively just prior to and just after the two and a half-hour mark, with the second wave being the largest, and waves of up to 0.5m occur for another four hours.

Figure 6: Wave arrival times and inundation levels from the Tonga-Kermadec Trench (at MHWS)

Inundation maps: impact of regional source tsunami waves on Te Mata and Tapu
Figures 7 and 8 (overleaf) show the potential inundation from a maximum credible earthquake on the Tonga-Kermadec Trench. It is important to note that the maps:

- Assume wave arrival at Mean High Water Springs (the highest level that spring tides reach on average over a period of time)
- Only show inundation of land areas that are normally above sea level.
Figure 7: Te Mata

Potential inundation from a maximum credible earthquake on the Tonga-Kermadec Trench
Figure 8: Tapu
Potential inundation from a maximum credible earthquake on the Tonga-Kermadec Trench
Distant source tsunami from South America

South American sources
Previous studies have indicated that tsunamis produced by large earthquakes along the South American Subduction Zone have the greatest impact of all the distant tsunami sources on New Zealand.

The technical report considers three scenarios from South America (see Figure 9):
1. The 1960 Valdivia, Chile earthquake (magnitude ~9.2)
2. The 1868 Arica, Chile and Southern Peru earthquake (magnitude ~9.4)
3. ‘FF 7’, a theoretical variant of the 1960 Valdivia earthquake placed in Central Peru (magnitude ~9.2).

Of the three scenarios considered, the FF 7 earthquake has the most impact on Te Mata and Tapu at Mean High Water Springs, although this impact is far lower than the local and regional sources.

How long does it take for distant source waves to arrive at Te Mata and Tapu?
Assuming the ‘FF 7’ scenario, Figure 10 shows that:
- Water levels begin to rise about 16 hours following the earthquake, then rise and fall rapidly (4-6 times per hour) for at least 14 hours following first wave arrival
- The initial wave is small (0.1m), and the waves rise slowly to the maximum inundation level of 0.35m above the existing water level after a further two hours.

Inundation maps: impact of distant source tsunami waves on Te Mata and Tapu
Figures 11 and 12 (overleaf) show the potential inundation from a maximum credible earthquake from the Central Peru region of South America. It is important to note that the maps:
- Assume wave arrival at Mean High Water Springs (the highest level that spring tides reach on average over a period of time)
- Only show inundation of land areas that are normally above sea level.
Figure 11: Te Mata

Potential inundation from a maximum credible earthquake from Central Peru in South America
Figure 12: Tapu

Potential inundation from a maximum credible earthquake from Central Peru in South America