# APPENDICES
# MINUTES

## Council Meeting

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# Coastal Hazard Risk Assessment For The Kapiti Coast

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## EXECUTIVE SUMMARY

Management of natural coastal hazards is mandated through three main statutes: the Resource Management Act (RMA) 1991, the Building Act 2004, and the Civil Defence Emergency Management Act 2002. Each defines natural hazards slightly differently, reflecting their legislative aims. This report follows the RMA's definition of hazards, which includes a broad range of events impacting human life, property, or the environment; risk assessment as a combination of the probability and consequences of hazards; and climate change as human-induced alterations to the Earth's radiation balance since ~1750 CE. This report focuses on the requirements of Policy 24 of the New Zealand Coastal Policy Statement, which requires identifying high-risk areas, including considering the likely effects of climate change.

The Kāpiti Coast District Council (KCDC) identifies earthquakes, tsunamis, floods, and climate change as significant hazards. However, the district plan manages erosion and marine inundation separately without explicit hazard designation. Historically, extreme weather has been the most likely hazard associated with death, injury and property damage for the Kāpiti Coast. This report assesses extreme weather events affecting coastal erosion and inundation, alongside relative sea level rise and altered sediment dynamics, and considers climate change impacts on these hazards.

Extreme weather, particularly very low atmospheric pressure, strong to extreme winds, and intense or long-duration rainfall, contributes to coastal erosion through the combination of increased wave heights and wave steepness and increased water levels due to storm surge and wave set-up. It also contributes to inundation through increased water levels at the coast, accumulation of rainfall in low-lying areas, and increased freshwater discharge. Climate change may change the frequency and/or magnitude of extreme weather and contribute to relative sea level trends through changes in the volume and density of water in the oceans (which determines absolute or eustatic sea level). Relative sea level trends are also dependent on vertical land movement.

Historically, the Kāpiti Coast:

- Experiences predominantly locally generated waves due to north-westerly winds, with lesser influence from swell waves generated in the Tasman Sea and the southern Indian Ocean.
    - Wave heights are typically moderate, with significant wave heights usually below 3 m, although storm events can produce higher waves up to 4.5 m.
    - Available wave energy and the occurrence of extreme wave events varies in response to climate oscillations, including the El Niño-Southern Oscillation (ENSO) and the Southern Annular Mode (SAM).
    - There has been a trend towards fewer extreme wave events over recent decades, potentially related to changes in local wind patterns.

- Experiences relatively small storm surges, with only a few events exceeding 0.3 m in height.
    - Storm surge characteristics vary with wind direction for the Kāpiti Coast.
    - Extreme water levels (combining storm surge, tide and waves) increase northwards along the coast, primarily due to increasing tidal range.

  - There is a strong correlation between extreme wave heights and extreme water levels (storm surges).
  - Extreme water levels are predominantly associated with blocking weather patterns, particularly with low-pressure systems west of the Kāpiti Coast blocked by a high-pressure system north of the Chatham Islands.
  - There is no significant historical trend for the magnitude or frequency of storm surges; natural variability in wave patterns and storm surges currently dominates climate change trends for the Southwest Pacific region, including New Zealand.

- Has recorded coastal erosion since at least the early 20th century, with formal documentation of protective structures built since the 1940s and 1950s.

- There is no evidence that elevated groundwater levels contribute to coastal erosion.

- It is predominantly exposed to tsunami hazards from local sources rather than distant Pacific Rim events, owing to the shielding effect of New Zealand's landmass against most Pacific-generated tsunamis.
  - The shallow South Taranaki Bight and the Norfolk Ridge and Lord Howe Rise wave guides attenuate Tsunami energy from northern Southwest Pacific sources (e.g., Vanuatu, Solomon Islands, Samoa).
  - Known faults (e.g. Fisherman Fault and Manaota Fault) pose significant local tsunami risks, potentially with limited warning time and high inundation potential.
    - This assessment may need updating in light of revised seismic risk probabilities, particularly for events associated with the Alpine Fault and Hikurangi subduction zone.
    - Tsunami hazards for the Kāpiti Coast due to local earthquakes include potential inundation heights of 0-5 m, with an Annual Exceedance Probability (AEP) estimated around 4%.
  - Palaeotsunami deposits, archaeological evidence, and geomorphology suggest a major local tsunami event in the late 15th century (1470-1510 CE) affecting the Kāpiti Coast. The source of this event is not well-constrained.

The Kāpiti Coast is affected by vertical land movement (VLM) due to tectonic activity, including both seismic and aseismic deformation, which results in temporal and spatial variations for the coast:

- Significant seismic events like the 2016 Kaikoura Earthquake have caused substantial VLM for the Kāpiti Coast, with initial subsidence followed by uplift due to post-event seismic relaxation.
- Continuous GPS (cGPS) data indicate complex interactions of subduction-driven subsidence, seismic rebound, and slow slip events (SSEs). The data time series are too short to predict future VLM reliably.
- InSAR (Interferometric Synthetic Aperture Radar) estimates of VLM are available but cover a very short time period and show discrepancies with cGPS data for Kāpiti Coast District, indicating they are not suitable for reliably predicting long-term trends.