

SECTION 4



SHORELINE CHANGE ON COROMANDEL PENINSULA BEACHES

EASTERN COROMANDEL

Dune Barrier Beaches and Pocket Beaches

There are two types of beach and dune barrier systems on the eastern Coromandel Peninsula (Figure 7):

- **Dune barrier beach systems:** These have foredune plains up to 2.8 km wide, which enclose estuaries. The beaches fronting these plains have fine to medium grained sand and are relatively flat. These dune barrier beaches, south to north, are Whangamata, Opoutere, Pauanui, Cooks Beach, Whitianga, Matarangi and Kennedy Bay (e.g. Figure 8).
- **Pocket beach systems:** These beaches occur in small embayments. These beaches are steep-faced, and are made from medium to coarse-grained sand. Pocket beaches with nearshore subdivision and development include Onemana, Tairua, Hahei, Wharekaho, Kuaotunu East and West, Rings, Opito and Whangapoua (Figure 9).

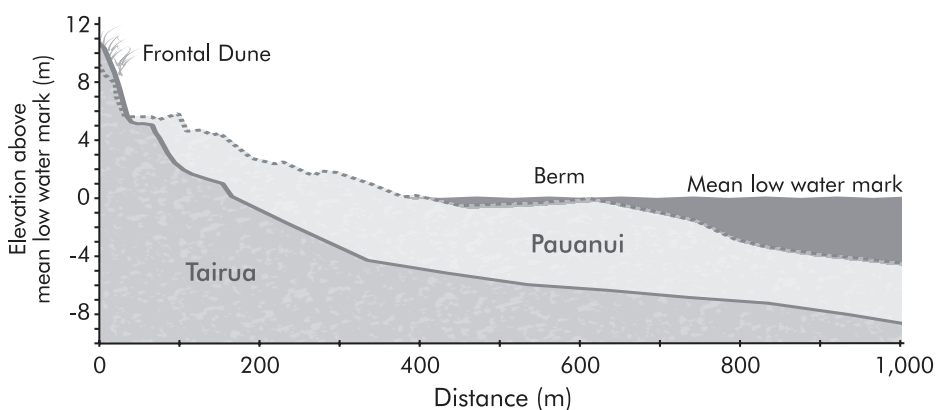


Figure 7: This diagram shows the difference in the shape of a dune barrier beach (Pauanui) and a coarse-grained pocket beach (Tairua Ocean Beach). Pauanui and Tairua are neighbouring beaches, separated by a harbour entrance and a headland. Tairua beach has coarse sand and a steep beach face, with water 4 m deep about 300 m offshore. At Pauanui beach, the sand is finer, and 1000 m offshore, the water is only 4 m deep.



Figure 8: Pauanui Spit before development, showing the dune ridges that formed as the spit prograded and built over thousands of years. Pauanui Beach is long and flat, with relatively fine sand, and is an example of a dune barrier beach system.



Figure 9: Tairua Beach, a pocket beach on the eastern Coromandel Peninsula. Unlike neighbouring Pauanui beach, Tairua beach is short and steep and has coarse sand, and only a narrow strip of dunes.

Key Points

- > **Dune barrier beach** systems have wide dunes and flat beaches with fine sand (e.g. Whangamata and Pauanui beaches).
- > **Pocket beach** systems are relatively short and steep, with coarse sand and a narrow strip of dunes (e.g. Tairua beach).

Formation of Coromandel Beaches

Most of the sand reserves for Coromandel beaches are stored in dunes behind the beach. These dunes were built up over thousands of years, following a rise in sea level, which is described in Figures 10-12.

18,000 years ago sea level was about 120 m lower than at present (Figure 10). Sediments from rivers, volcanic eruptions and other sources accumulated on what is now the continental shelf. As the world warmed, ice melted and the sea level rose, submerging these sediments.

Present sea level was reached about 7000 years ago (Figure 11). The sediments buried by the rising sea level were then rapidly moved onshore by waves and currents to form beaches and dunes. Some sediments also came from the remains of beaches that had formed the last time the sea level was at about the present elevation (about 120,000 years ago). Rivers, cliff erosion and shells from marine organisms also provided some beach sands.

At first, the rate of onshore movement was very high, and beaches built forward rapidly. However, the rate of beach building slowed over time as the sediment supply decreased and the offshore region came into equilibrium with waves and currents.

Over the last few centuries, forward building of beaches has virtually stopped (Figure 12). In other words, in the foreseeable future, most beaches on the eastern Coromandel Peninsula now have all the sand they are going to get.

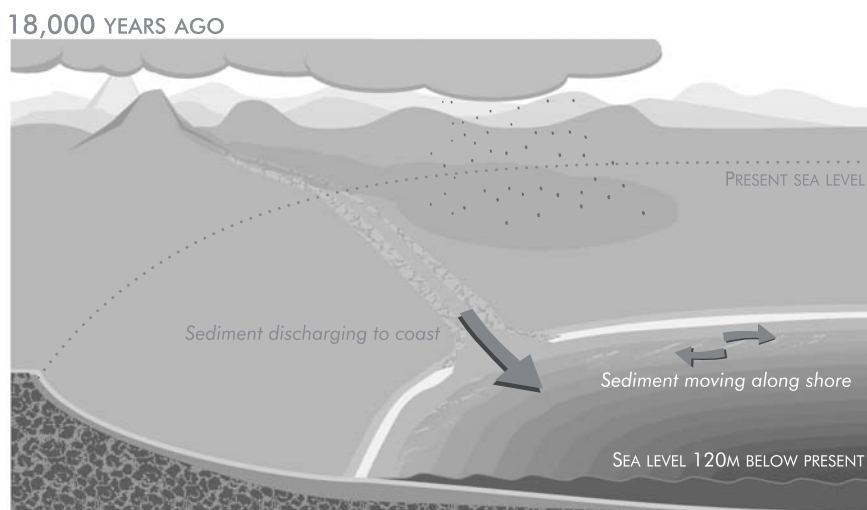


Figure 10



Figure 11



Figure 12

Dune Dating

Radiocarbon dating was used to determine the pattern of beach and dune movement towards the sea over approximately the last 7000 years along the eastern coast of the Coromandel Peninsula.

Sand cores were drilled at eight sites in the dunes along the eastern coast (Whangamata, Opoutere, Tairua, Cooks Beach, Whitianga, Matarangi, Whangapoua and Whiritoa). The cores were used to find and date buried sand deposits that used to be on the active beach face, when the shoreline lay in a different place. By measuring the distance between beach deposits of different ages, the net rate of shoreline movement towards the sea can be calculated.

Dune shape and size (morphology) can also be used to interpret likely rates of seaward movement at the time they were formed. For example, low flat dune ridges are usually formed during periods of fast progradation. Slower rates result in higher, steeper dune shapes. Generally, the changes in dune shape and size observed were consistent with the rates calculated from the dating work.

Results indicate that seaward movement of the major dune barrier systems on the eastern Coromandel Peninsula began 6000 to 7000 years ago. The total extent and rate of dune development has varied along the coast. The major dune barrier systems, (e.g. Whangamata (*Figure 13*), Pauanui, Cooks Beach and Whitianga) all show a very similar pattern. Initial sedimentation was very slow, followed by a period of rapid shoreline advance, and then (over the last 500-2000 years) a clear slowing down.

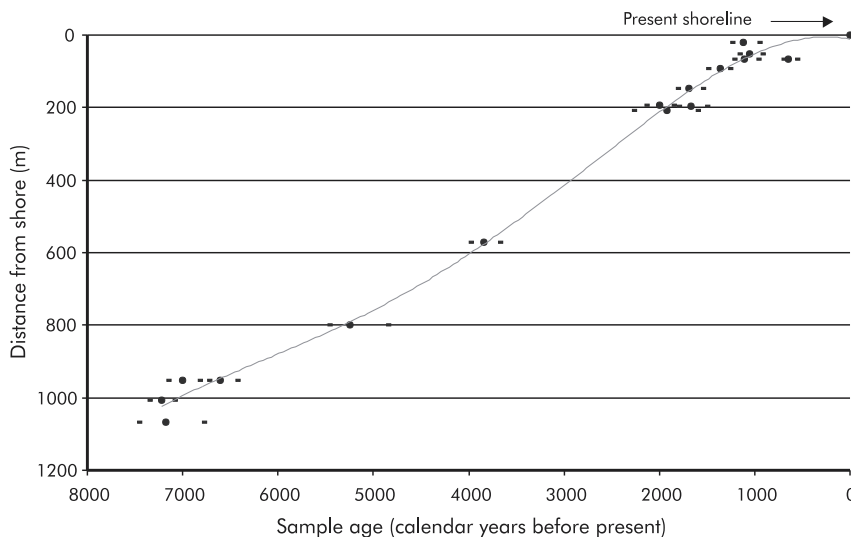


Figure 13: Results from dating of dune core material at Whangamata Beach. This graph shows that the rate of dune movement towards the sea at Whangamata was rapid from 7000 years ago until about 1000 years ago when it slowed considerably. Rates of seaward movement appear to have averaged only about 4 cm per year over the last 1000 years.

Most of the pocket beaches appear to have reached close to their current position by about 4000 to 5000 years ago, though the dunes have continued to grow in height. Many of the pocket beaches have very limited sand reserves, usually only a single dune and this is sometimes only a veneer of sand over older surfaces (see Figure 4).

Seaward movement of the beaches on the eastern Coromandel Peninsula appears to have stopped. At best, most beaches are in a state of 'dynamic equilibrium', meaning they are neither moving towards the sea nor receding. For management purposes, the beaches have all the sand they are likely to get.

Key Point

- > Radiocarbon dating of dunes on the eastern coast of the Coromandel Peninsula has shown that the long-term movement towards the sea that formed the beach and dune systems has now stopped. In the foreseeable future, these beaches have all the sand they are going to get.

Shoreline Change on Eastern Coromandel Peninsula Sandy Beaches

Shoreline changes over the last 55-120 years were investigated at various sites along both the eastern and western Coromandel Peninsula using shoreline information from surveys, aerial photographs and beach profiling.

Detailed shoreline mapping was done at Whangamata, Pauanui, Cooks Beach and Whitianga. Available beach profiling data from Whangapoua, Matarangi, Buffalo, Cooks, Hahei, Tairua, Pauanui, Whangamata and Whiritoa beaches was plotted and examined to estimate the general pattern of change. During this time, short periods of erosion were quite common (in particular between 1979-81 and 1988-90). Since 1995, many sites have shown the short-term trend for erosion, including Whangapoua, Matarangi, Buffalo and Cooks beaches. There was no overall trend that would suggest net progradation or recession.

Both the shoreline mapping work from photographs and the beach profile records indicate no net recession or movement towards the sea over the period of the record. This supports the dune coring and dating findings that sandy beaches on the

Coromandel Peninsula are in a state of 'dynamic equilibrium' - no net supply or loss of sediment. Changes in shoreline position observed in the mapping and profile records show the short term fluctuations in erosion or recovery that occur over periods of years or decades (see the previous Dynamic Shoreline Change section).

The greatest shoreline change observed over the period of available records (several decades) was approximately 30 m. However, larger changes did occur where there were local influences, such as streams, estuary entrances, or large stormwater outlets (in these locations, site-specific estimates of shoreline movements were included in the setbacks).

The available information suggests that the maximum shoreline change at pocket beaches is slightly less than at finer-grained, dune barrier beaches.

The revised development setback lines adopt a figure of 30 m for the dynamic fluctuations at the dune barrier beaches. A slightly smaller figure of 25 m has been adopted for the pocket beaches. These figures will continue to be assessed in the future against ongoing monitoring information.

Key Points

- > At dune barrier beach systems, the maximum natural dynamic fluctuation of the shoreline is 30 m.
- > At pocket beaches, the maximum natural dynamic fluctuation of the shoreline is 25 m.

WESTERN COROMANDEL PENINSULA

The western coast of the Coromandel Peninsula is made up of sand and gravel beaches and rocky coast, with wide intertidal flats fronting the southern and south-western shorelines. Most beaches along the western margin are narrow with limited sediment reserves. Where streams deliver gravel to the coast they have formed low-lying flat areas of land known as deltaic fans (e.g. Te Puru – Figure 14). These areas have been heavily developed, but they are very low lying and prone to both coastal and river flooding, as these are the very processes that formed them.

Most of the developed Thames coast foreshore has been reclaimed from the sea and therefore lies well seaward of the original shoreline (usually by 150 m or more). Much of this reclamation was undertaken in the late 1800s and early 1900s, using mine tailings. In most places this reclaimed foreshore is protected by seawalls, though the standard of this armouring varies greatly. Without this protection, the shoreline would, in time, erode back toward its natural position.

Although the wave environment is more sheltered than on the open eastern Coromandel Peninsula, wave run-up and overwash is an important factor in the extent of flooding during storms. Waves ‘pile up’ against the shore in exposed areas during a storm, creating much higher water levels and more severe flooding than occurs in areas more sheltered from waves.

Shoreline Change on the Coromandel West Coast

All cadastral surveys and aerial photographs that could be found were analysed to gather shoreline change information for the western Coromandel Peninsula (as was done for the East Coast). Natural adjustments in the position and orientation of river channels cause significant changes (25-35 m) in shoreline position on deltaic fans on the western Coromandel Peninsula coastline. The shorelines are generally less active in areas away from the river entrances, but can still naturally fluctuate by about 15 m over decades.



Figure 14: Where rivers meet the coast on the western Coromandel Peninsula large deposits of sand and gravel (deltaic fans) from flood deposits have accumulated. Like many settlements on the western Coromandel Peninsula, Te Puru township is built on a deltaic fan. The processes that formed these areas continue today and they are vulnerable to both river and coastal flooding (Photo: Air Maps, Tauranga).

Flooding

Flooding of low lying areas by the sea around the margin of the Firth of Thames results from the combination of tides, wave action and storm surge effects. Currently, coastal flood levels (floor levels for buildings etc.) are based on the highest recorded extreme sea level measured during a storm in 1938.

Work undertaken on coastal flooding included compiling information on events from historical newspaper reports - an extensive list of over 300 storms dating from 1868. These dates were then checked against newspaper reports of the storms using newspaper archives. Anything found on meteorological information, flooding reports, shipping delays, shipwrecks and storm damage reports were copied and are now held by Environment Waikato. All newspaper reports were then reviewed, looking particularly for information on coastal erosion and flooding around the Coromandel.

Environment Waikato also maintains a tide gauge at Tararu in the southern Firth of Thames and this recorder provided useful information on water levels and wave conditions during the coastal flooding of July 1995 and Cyclone Drena (January 11, 1997). Information on flood levels surveyed around coastal margins was also obtained from various other sources for these floods.

During coastal flooding, such as that which occurred during Cyclone Drena, wave effects in exposed areas can overtop natural coastal margins. Greater heights can be over-topped on protected shorelines that are not fronted by a natural beach to break up wave energy. When this happens, high-speed water flows can carry large amounts of rock and gravel 15 m or more inland, damaging properties and infrastructure (Figure 15). Projected sea level rise over the next 100 years means these low-lying areas in the Firth of Thames will become even more vulnerable to this type of flooding.

Key Points

- > On the western Coromandel Peninsula, the maximum natural dynamic fluctuation of the shoreline is about 15 m, although greater changes (25–30 m) can occur near river entrances and channels.
- > Coastal flooding caused by storm surge and wave overtopping is a major hazard to low lying townships on the western Coromandel Peninsula.



Figure 15: During cyclone Drena, wave flooding across the road caused considerable damage to property in the Thames area.

