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**Beach profile surveys and morphological  
change, Otago Harbour entrance to Karitane**

**May 2014 to June 2015**

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*Prepared for*

Port Otago Ltd

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## **Executive Summary**

This report presents an assessment of beach change for the period May 2014 to June 2015 for the beaches of Blueskin Bay from the entrance to Otago Harbour north to Karitane.

The present state of the beaches can be considered to be accretional but in a state of recovery after a moderate to large storm at some time between May 2014 and June 2015. Since the 2014 survey, there has been erosion of the dunes at Aramoana and Long Beach, but subsequent deposition and accretion to the beach surface. Erosion of beach volume at Karitane may be associated with movement of beach sands along the shore from south to north, but there is no evidence of long-term erosion or retreat of the backshore.

The dunes at Warrington and along Shelly Beach show evidence of accretion, with an increase to the height and bulk of the secondary line of dunes.

The changes since 2014 are indicative of beach response to a variety of wave energy events including erosive storm events and depositional swell conditions. They do not indicate a change in the sediment supply to the coast or changes in the beach response / wave energy relationship at any particular site.

# 1. Introduction

## 1.1 Background

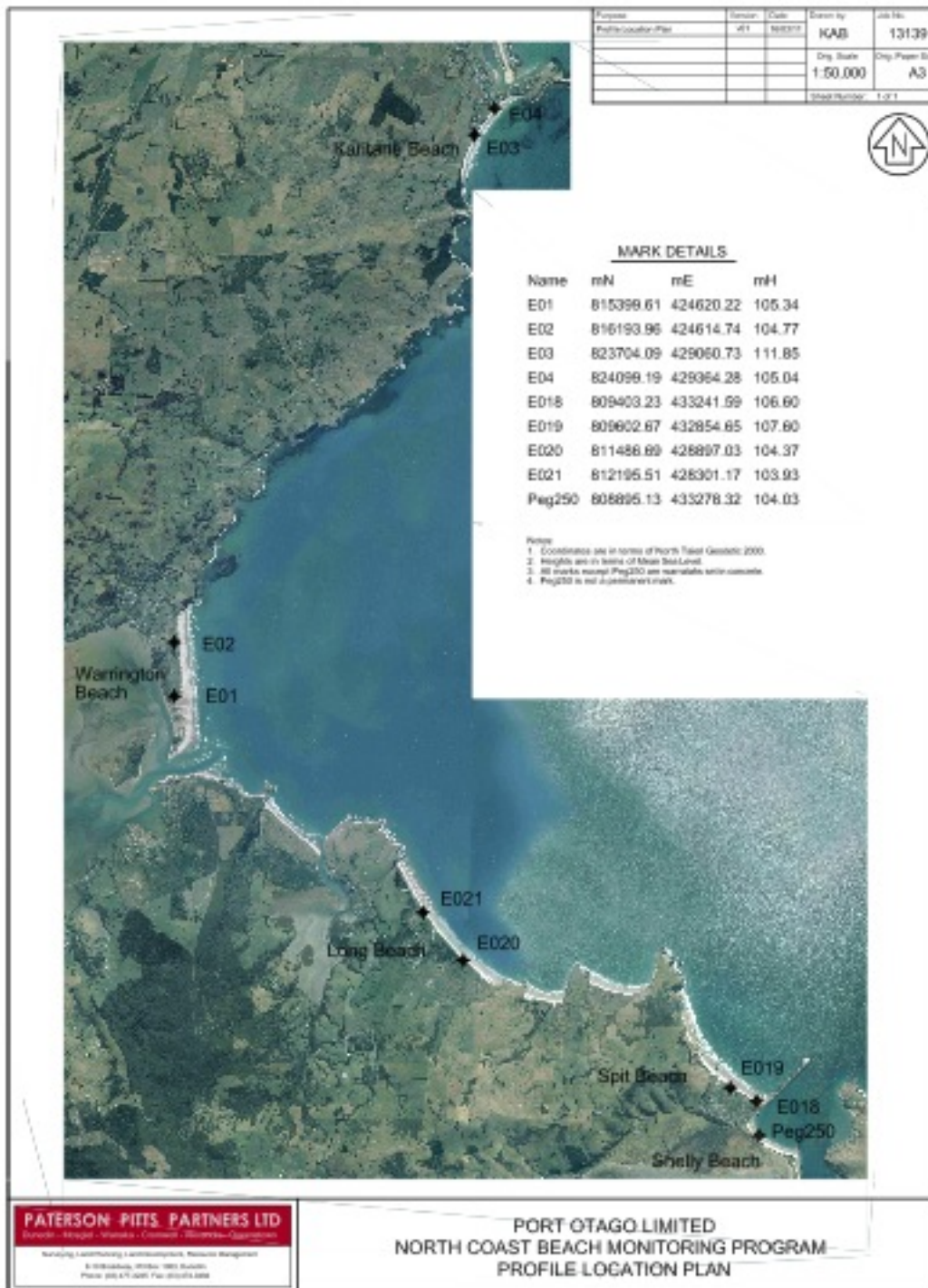
This report adds to the assessment of changes to the ocean beaches between Otago Harbour and Karitane based on changes to surveyed beach profiles. The report examines the changes between surveys carried out in May 2014 and June 2015.

The morphology of the nearshore and beaches of the area between Otago Harbour and Karitane Peninsula have been previously described in the reports *Port Otago maintenance dredging consents – Physical coastal environment* and *Port Otago maintenance dredging consents – Beach morphology, Otago Harbour entrance to Karitane* (Single 2011a and 2011b). Assessments of changes to the beaches based on beach profile surveys up to 2013 and 2014 are presented in earlier reports (Single 2014a and 2014b).

The surveyed beach profile transects were established by Otago Regional Council (ORC) in 1990 and have been re-surveyed at various dates since. The beach profiles have been assessed with regard to Port Otago Ltd maintenance dredging sediment deposition since 1996, and since 2013 for the present consent process. Eight profiles from Karitane to Aramoana were re-surveyed along with a further fourteen profiles at Shelly Beach in June 2013. Figures 1.1 and 1.2 show the locations of the profile sites. These profiles were resurveyed in late May 2014 and again in June 2015 (with the Shelly Beach profiles surveyed in August 2015). Kurt Bowen of Patterson Pitts Group undertook the surveys, consistent with surveys carried out in previous years.

Single (2014a) presents a description of the survey network and monitoring carried out since it was established, while an assessment of the changes between 2013 and 2014 is presented by Single (2014b). Profiles of the beaches are examined to give a two dimensional analysis that includes the relative height above and below mean sea level and the width of the beach. The profile is used as an analogy of the beach as a whole, but represents only a section of the shore. However as the beaches of Blueskin Bay have very similar sediment characteristics and are subject to similar wind and wave conditions, they exhibit spatial similarities in their profiles and beach morphologies. The beaches also exhibit comparable temporal variability in morphology due to the relatively consistent wave climate around the bay and to changes in the supply of sediment. Therefore the beach profiles can be used to assess the general character of beach change over the inter-survey period.

Assessment of the long-term and inter-survey change is also augmented by field examination and comparison of the general character of the shore from photographs and field notes from previous site visits, including inspections of the beaches in September 2014.



**Figure 1.1** Location of surveyed profiles. Spit Beach is more commonly known as Aramoana Beach



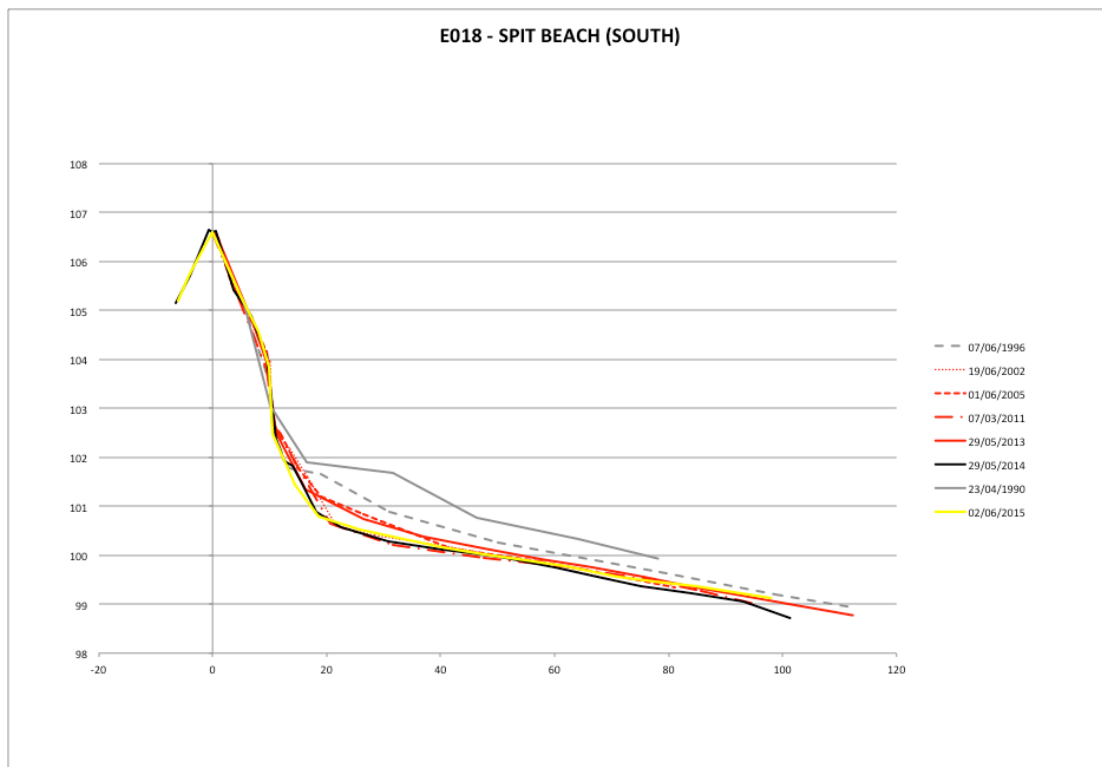
## 2. Observed beach profile change

### 2.1.1 Aramoana (Spit) Beach (Profiles EO18 and EO19)

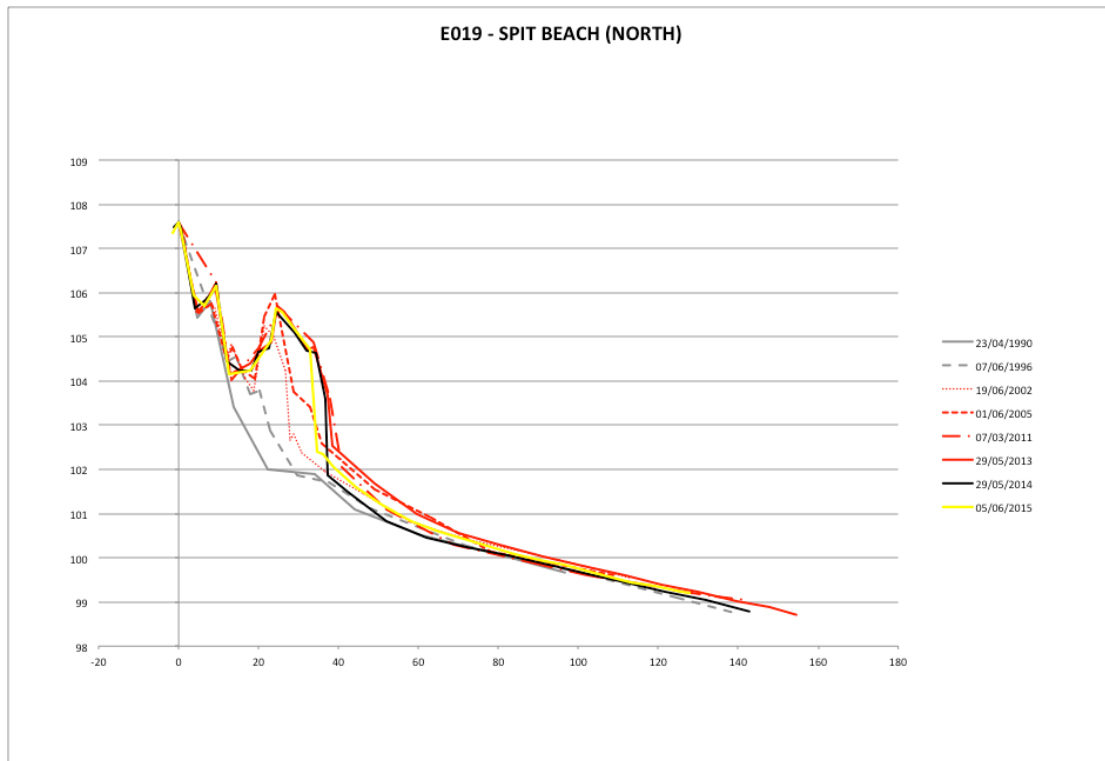
*Aramoana Beach extends from the Mole north to the volcanic headland that forms the base of Heyward Point. This crescent shaped beach is orientated northwest to southeast and is backed by an extensive, well-vegetated dune system. North of Lion Rock, the dune system comprises blown sand ramped against the rock cliffs.*

*The typical beach profile of Aramoana has a low gradient, backed by a relatively steep dune system with a height of approximately 5 metres. The dune system appears to be relatively stable in its position, although is “trimmed” by large storms that can erode the foredune and result in a vertical seaward face of the dune field.*

Figures 2.1 and 2.2 present overlay surveys of profiles EO18 and EO19 representing Aramoana Beach. The main change between the 2014 and 2015 surveys is retreat of the face of the dune in the southern part of the shore and deposition on the foreshore. There is greater change along the southern part of the shore than to the north. This type of change is indicative of storm erosion of the dunes and subsequent deposition and recovery. The build up along the base of the dunes is a precursor to development of a small foredune. Vegetation takes hold in this area and stabilises the sand helping the dune system recover and have sand available as a buffer to release during the next large storm. This type of change is within the longer-term envelope of change since 1990.



**Figure 2.1** Over-lay surveys of Profile EO18 located at the southern end of Aramoana Beach, approximately 50 from the Mole



**Figure 2.2** Over-lay surveys of Profile EO19 located at the northern end of Aramoana Beach

Figure 2.3 shows the foredune at Aramoana in September 2014. The face of the dunes is very steep, and the vegetation has died back. This is evidence that the dune has been subject to storm wave erosion. However the foreshore appears well nourished. This is indicative of accretion, and an overall indication that the beach has eroded during a storm, but recovered subsequently. The straight line of the storm erosion along the backshore shows that there is no focused area of erosion except where the waves are influenced by the presence of the Mole.



**Figure 2.3** View along Aramoana Beach from the Mole, September 29 2014.

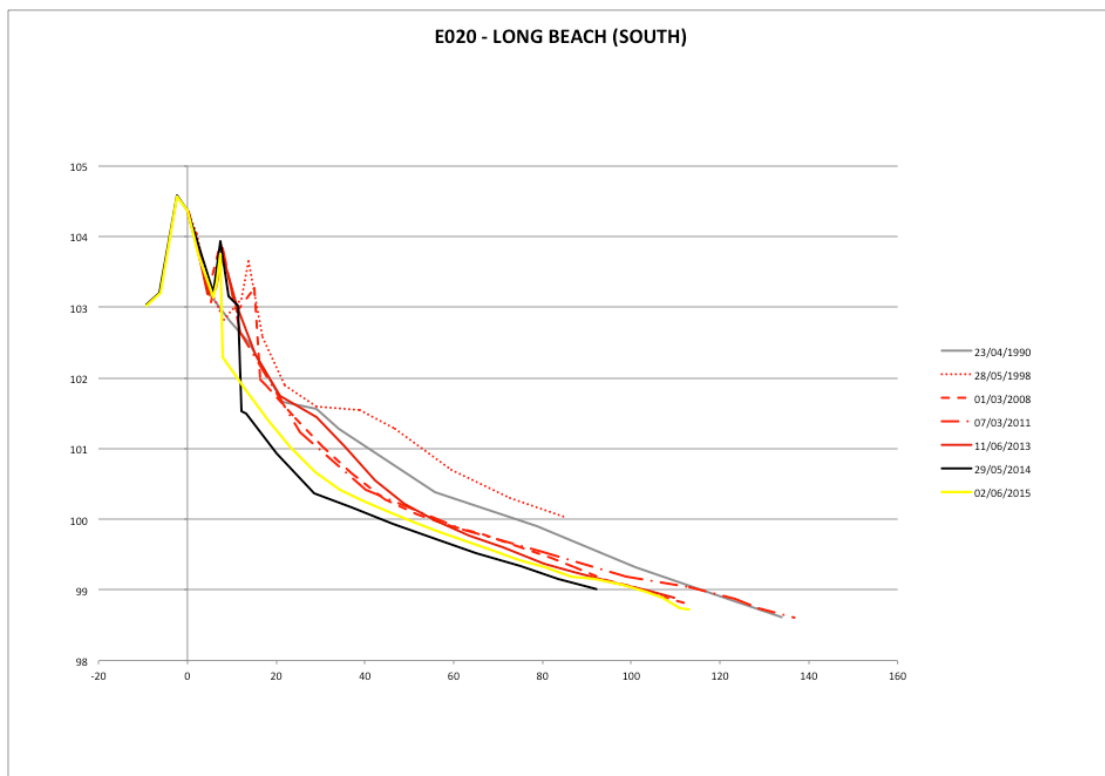


### 2.1.2 Long Beach (Profiles EO20 and EO21)

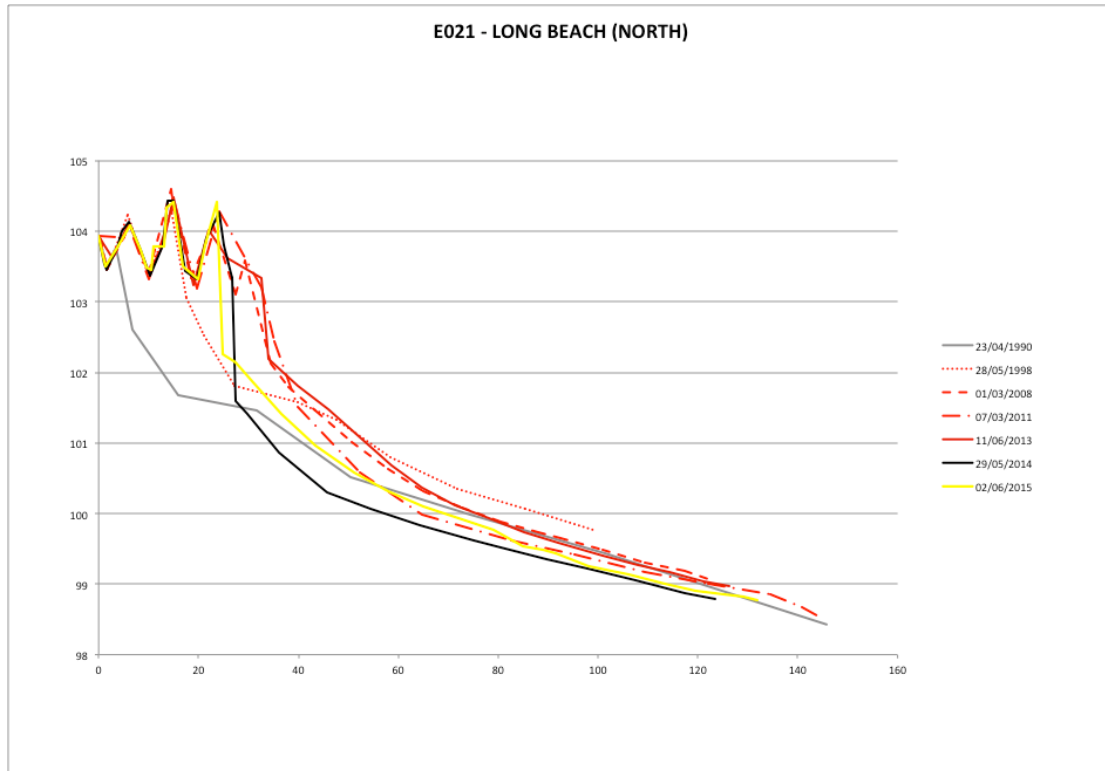
*Long Beach is backed by a mixture of low dunes and wetland, with two permanent stream channels that cut through the dunes providing a source of sand from the hinterland to the beach, while also creating two low sections of the foredune area where the stream channel positions oscillate along the shore. There is a small community of permanent houses and holiday baches (cribs) nestled in the middle of the bay. The dunes are very well vegetated with marram grass. Surveys prior to 2013 show development of a new or embryo foredune system that provides a buffer of sediment against storm wave erosion of the main dunes. The beach appears in a stable condition, although the northern area of the beach (EO21) shows a greater sand accumulation than the south (EO20).*

Figures 2.4 and 2.5 show the surveys of profiles EO20 and EO21. Change since 2014 is similar to that at Aramoana, with erosion and retreat of the seaward face of the dunes but an increase in the level of the beach surface across the foreshore. This is indicative of a large storm and systemic erosion in Blueskin Bay and subsequent recovery from storm erosion. There appears to have been recovery of the beach sediment at the base of the dune scarp and a net recovery to the beach volume since May 2014

Figure 2.6 shows views along Long Beach from the main beach access point. The eroded dune scarp is readily apparent, with newly deposited sand along the base identifiable by the deep footprints showing the softness of the surface of the beach. In all, the beach shows recovery from the large storms prior to the 2014 survey, and the changes are within the envelope of change measured since 1990.



**Figure 2.4** Profile of Long Beach as represented by survey line EO20, the southern most profile of Long Beach



**Figure 2.5** Profile of Long Beach as represented by survey line EO21, the northern most profile of Long Beach



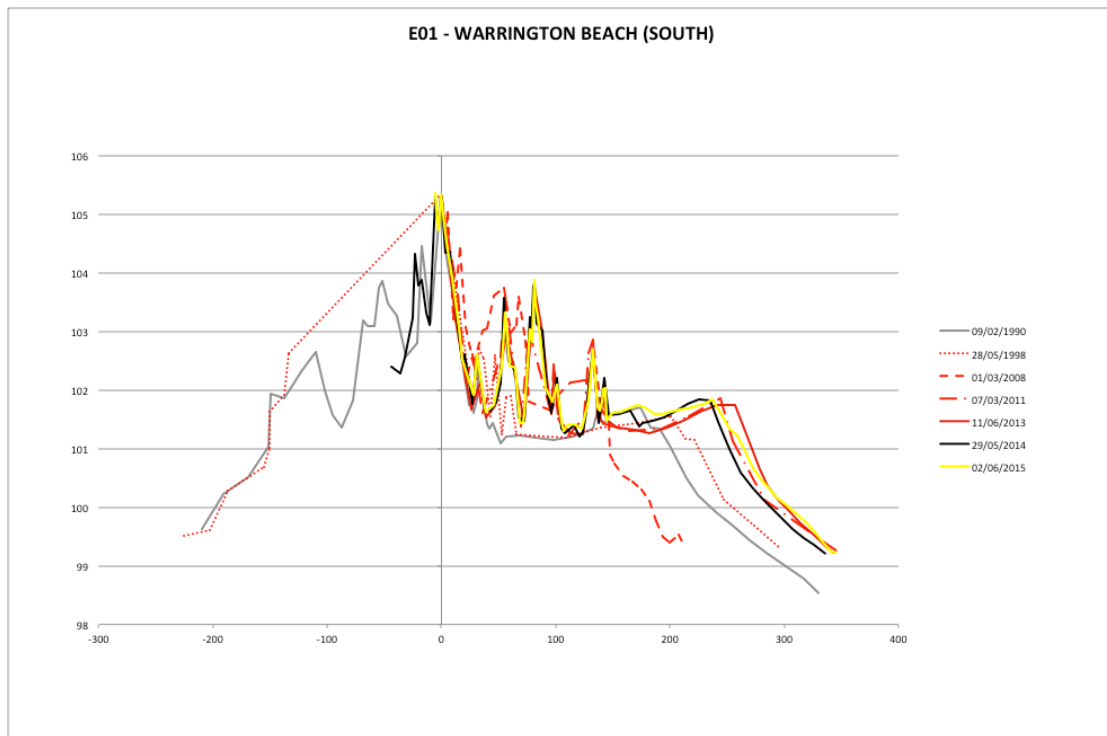
**Figure 2.6** Views to the south and north from the main beach access point to Long Beach, September 2014.

### 2.1.3 Warrington Spit (Profiles EO1 and EO2)

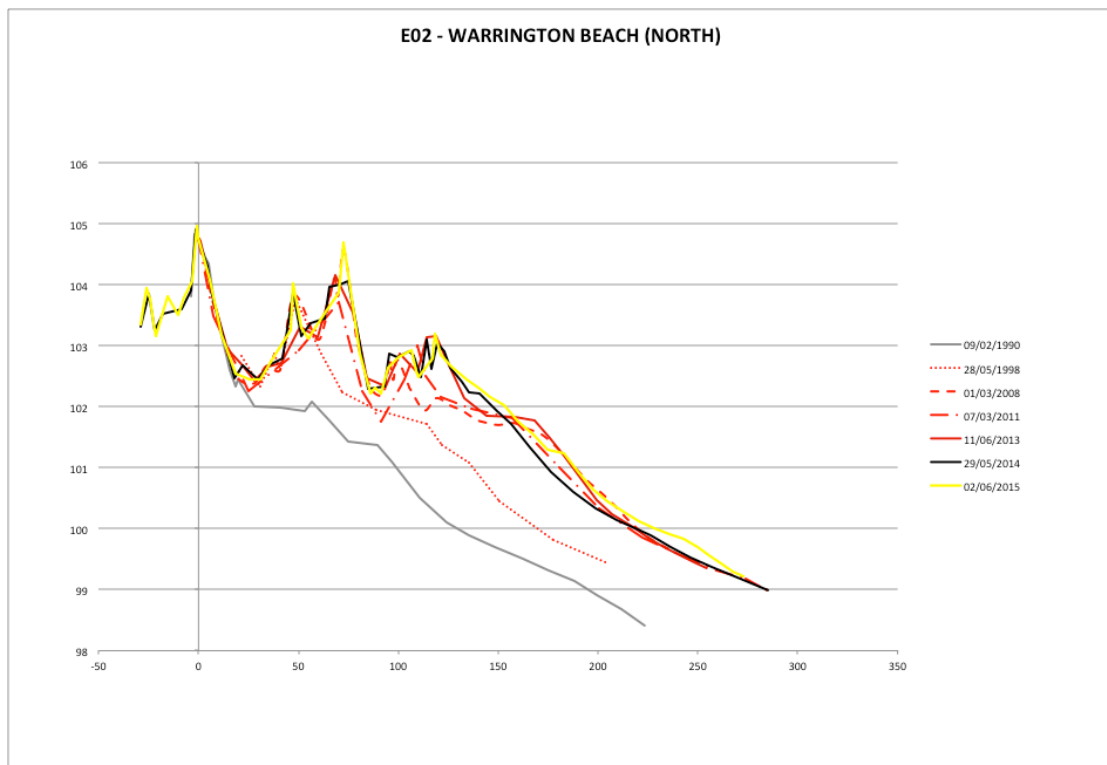
*The seaward face of Warrington Spit presents a low flat beach bounded by a rocky headland to the north and the inlet of Blueskin Bay Estuary to the south. The beach is backed by an extensive dune system that is well vegetated with marram grass. The beach consists of soft, dry, loose sand that onshore winds can easily transport inland to the dunes. It is likely that the beach is stable in position and form but is accreting in sand volume through accumulation on the backshore dunes. A stable vegetation cover is likely to have enhanced the dune growth.*

Figures 2.7 and 2.8 show representative profiles of the spit including the wide area of dunes. Apart from some growth in height of the middle dune complex, the main changes to the profiles since 2014 are seaward of the main dunes. The primary dune at the southern end of the spit appears to have contributed sand to the second row of dunes, but has grown in volume with seaward accumulation of sand. The level of the beach surface is also higher than in 2014. However there is not as much dune volume as shown in the 2013 survey. The northern section

shows similar seaward growth of the dune and deposition to the beach surface, with a similar profile to that of 2013. These changes are consistent with continued recovery of the upper foreshore after storm erosion.



**Figure 2.7** Profiles of Warrington Spit Beach as represented by survey line EO1 at the southern end of the spit



**Figure 2.8** Profiles of Warrington Spit Beach as represented by survey line EO2, the northern most profile of the beach

Figure 2.9 shows the development of embryo dunes near the northern end of Warrington Spit. This is an area of long-term progradation, with low dunes and sparse vegetation cover as the limit of the dune extent progresses seaward. The dune system in this area is fragile but vegetation growth will help to stabilise the dunes.



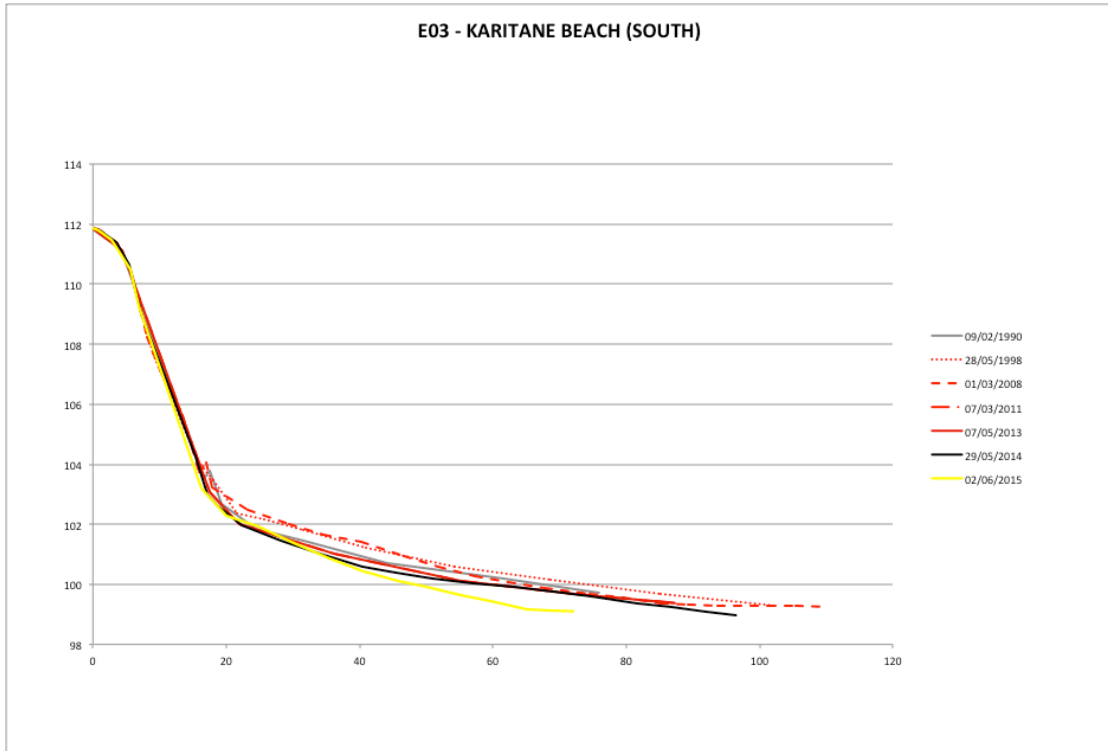
**Figure 2.9** The low prograding dunes at the northern end of Warrington Spit

#### **2.1.4 Karitane (Profiles E03 and E04)**

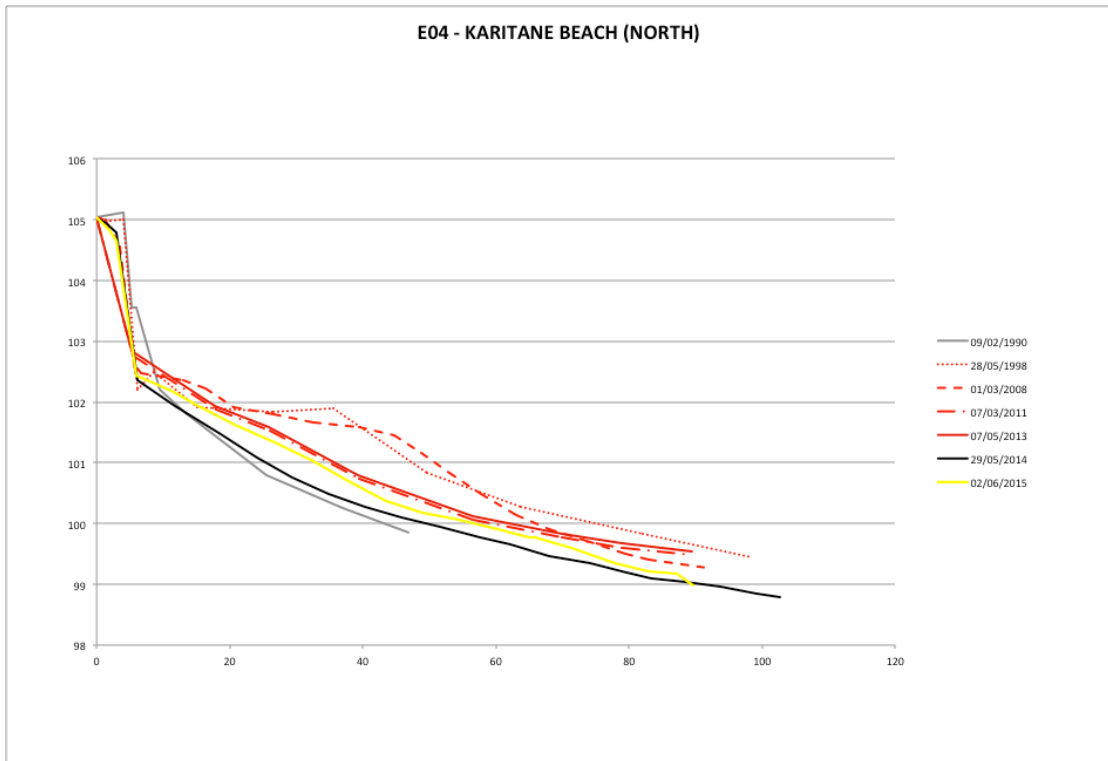
*The beach of Karitane fronts a picnic area and the southern area of the Karitane community. The upper foreshore is very similar to the beaches located further south in that the foreshore is of very gentle slope with a relatively wide inter-tidal area in the order of 30-40 metres. However, Karitane is different from the rest of the beaches between Taiaroa Head and Karitane, in that a steep clay bank backs the beach at the northern end, and there is no dune system. The clay bank has evidence of failure and slumping in the past, at times producing a scarp with a height of over 2 metres at the northern end of the beach, and 10 metres at the bluffs located at the southern end. Erosion of the backshore has been managed in the past by the placement of rock fill at the base of the bank, and a concrete seawall in front of the picnic ground (as can be seen in Figure 2.12).*

*Surveys since 1990 show that the backshore bank remains a dominant feature of both profiles, and that although there had been accumulation of sand at the base of the bank, it is not likely to be indicative of any long-term beach accretion.*

Figures 2.10 and 2.11 show the surveyed profiles (E03 and E04), while Figure 2.12 shows the beach adjacent to and north of the beach profile E04. The beach surface at the southern site is lower than in 2014, and is lower than any of the previous surveys. It is likely that this is a result of recent processes rather than an indication of long-term erosion. However with changes to the land-use in the backshore there is potential for increased hazard in this area. The northern section of the beach appears to have accreted since 2014. These changes may be indicative of movement of sediment along the shore from south to north in response to recent wave action. It is likely that there is beach sediment transport in both directions along this stretch of shore as a result in variations in the direction of wave approach.



**Figure 2.10** Profiles of Karitane Beach as represented by survey line EO3 near the middle of the beach



**Figure 2.11** Profiles of Karitane Beach as represented by survey line EO4 near the northern end of the beach



**Figure 2.12** Karitane Beach, looking north from survey site E04. Note the seawall at the base of the backshore (September 2014)

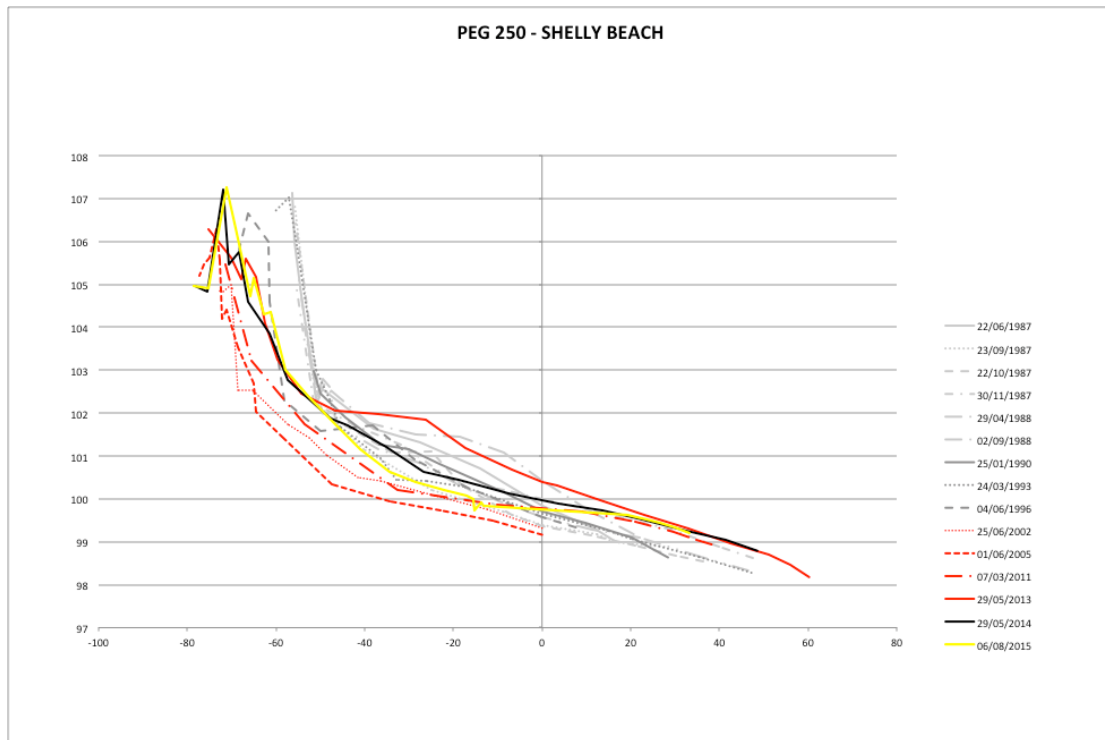
### **2.1.5 Shelly Beach (Profile Peg 250)**

*Shelly Beach is located southeast of Aramoana Beach between the Mole and the Long Mac groyne adjacent to the entrance to Otago Harbour. The contemporary seaward face of Shelly Beach presents a moderately steep beach orientated northwest to southeast. A single line of sparsely vegetated high dunes backs the beach. The dune vegetation is mainly marram grass.*

Figure 2.13 shows the northern end of Shelly Beach as of September 2014. Figure 2.14 shows the profile at Peg 250, a site north of the middle section of Shelly Beach. The main difference between the 2014 and 2015 surveys is loss of sediment from the upper section of the beach. This is similar to the type of change evident between the 2013 and 2014 surveys. There continues to be deposition of sand to the dune system, with an increase in the volume of the main dune. It is possible that the small seaward dune evident in Figure 2.13 has undergone some erosion between September and the survey (August 2015), but the overall, long-term health of this beach is likely to continue to be augmented by deposition of dredged sediment in the nearshore.



**Figure 2.13** View south along Shelly Beach from the Mole. The survey line at Peg 250 is approximately at the extreme left of the photograph.



**Figure 2.14** Profiles of Shelly Beach as represented by survey line Peg 250

### **3. Conclusions regarding beach change in Blueskin Bay 2014 to 2015**

The analysis of the shore-normal beach profiles in Section 2 shows a generally consistent set of changes, with evidence of erosion of the backshore and dune face in response to a large storm event, and subsequent deposition on sediment to the foreshore and upper beach. This beach change is consistent with the long-term variability to the shore, and shows no trend in change that may be adverse or attributable to factors other than changes in the wave environment.

#### 4. References

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- Single MB 2014a** *Beach profile surveys and morphological change, Otago Harbour entrance to Karitane*. Report for Port Otago Ltd. Shore Processes and Management Ltd January 2014.
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