# The Shifting Sand of St Clair

*Why repair the groyne?*

The St Clair poles are famous. People love them but this iconic structure also had function. Not a wharf, it was a sand trap groyne built to raise up the beach and protect the Esplanade.

Councillor Jules Radich, B Sc

# Why repair the sand trap at St Clair?

## Contents


Executive Summary ..... 2

Beloved Icon ..... 3

The Problem - Seawalls cause erosion, 1880's ..... 6

Groynes accumulate sand, 1902 ..... 10

Memories are short, erosion returns ..... 12

Repair the groynes and erosion stops, 1921 ..... 13

Fail to maintain groynes and erosion reappears ..... 15

Repair groynes and sand returns, 1955 ..... 17

Groyne Installation Summary Table ..... 20

Lack of groyne repair this century leads to rampant erosion ..... 21

Otago Daily Times links to articles on St Clair damage ..... 28

Some Relevant Emails: ..... 29

Benefits of rebuilding the groyne ..... 31

FAQ's ..... 32

- What are groynes? ..... 32
- How will the groyne work? ..... 33
- Why do groynes work so well on St Clair? ..... 33
- Why hasn't it been reinstated already? ..... 33
- Where does the sand come from & go to? ..... 34
- Is the NEW Esplanade seawall to blame for erosion? ..... 35
- Is it easy to reinstate the groyne? ..... 35
- How can it NOT NEED a Resource Consent? ..... 36
- What about climate change and sea level rise? ..... 37
- What about St Kilda? ..... 38
- What about the surfers & life savers? ..... 39
- What happens in the really big storms? ..... 39
- What do the consultants' say? ..... 40

Conclusion ..... 42

References: ..... 43

Endnotes ..... 44

# Executive Summary

The St Clair poles are famous. People love them but this iconic structure also had function.

Not a wharf, it was a groyne. It was built as a sand trap to raise the beach level in order to protect the Esplanade as well as the sand dunes.

A series of wooden groynes performed this task for ~100 years in cycles of repair and neglect corresponding with sand accumulation or erosion. The poles that remain on the beach were installed in 1955 as a repair on a groyne constructed in 1921 but since about the year 2000, the poles have steadily deteriorated with ever-increasing dune damage.

Textbooks state that groynes accrete sand on one side with erosion occurring on the other. This pervasive belief has cost Dunedin dearly because it is simply not the case at St Clair. Not a single photo exists showing leeside erosion on a St Clair groyne yet some commentators insist it will occur. Distinguished experts who have studied this beach agree that longshore drift occurs in both directions here, and that loosely planked wooden groynes accumulate sand evenly, just as the photographic record proves.

Therefore, it follows that the first step in dealing with the current erosion problem should be to rebuild the one remaining groyne. It is easy to restore these poles as no resource consent is required to repair an existing structure and it is inexpensive with estimates ranging from $100 - $150, 000 depending on pole type.

A vast quantity of sand lies just offshore showing no decrease from the Clutha dams. This repeatedly successful mechanism will trap some of that sand and grow the beach to become wider and deeper giving much needed protection to the seawall, sandhills and South Dunedin. With climate change bringing larger storm surges and sea level rise threatening the hinterland, accumulating more sand on the beach is an effective defence that uses the power of natural forces to work for us instead of against us.

Reinstatement can be undertaken as a trial because not only is it quick and economical to install, it is easily removable if and when better overall solutions are determined. At the very least, knowledge gained will usefully inform future discussions.

Even if you are sceptical, it is well worth the investment because Dunedin Ratepayers have spent hundreds of thousands on consultants and millions repairing coastal damage over the last 20 years with the situation only getting worse.

## Beloved Icon

People love the poles. They have been the most photographed object in Dunedin.

Whether it was kids playing…

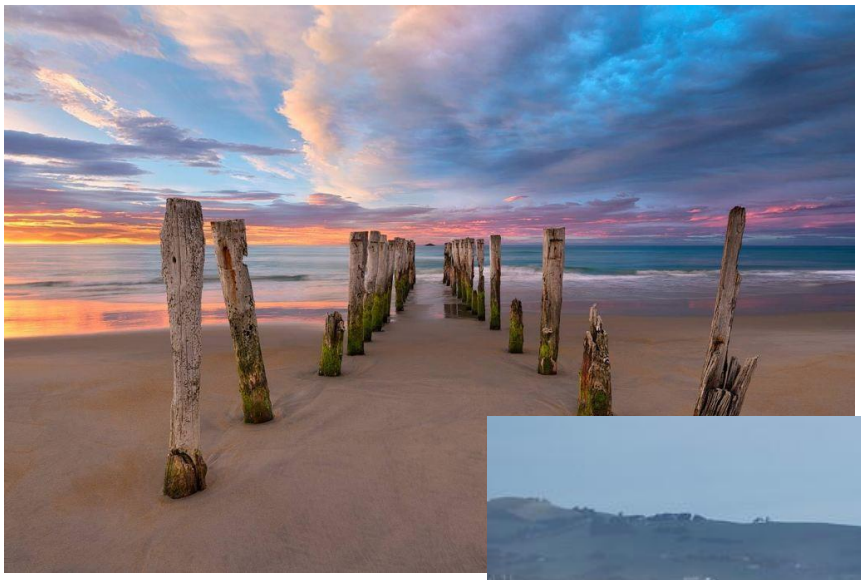
Friends sitting…

Or newlyweds[1] enjoying the moment…

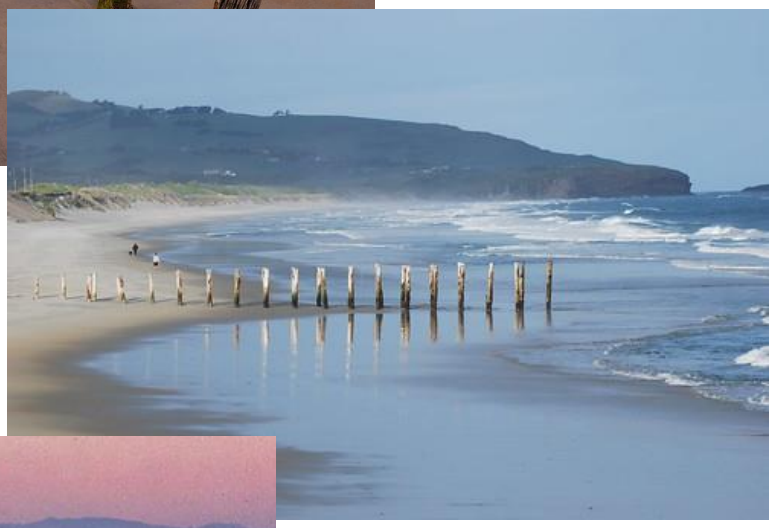
(note depth of missing sand)

[1] Chris Garden – Dunedin Wedding photographer

People appreciated the poles.

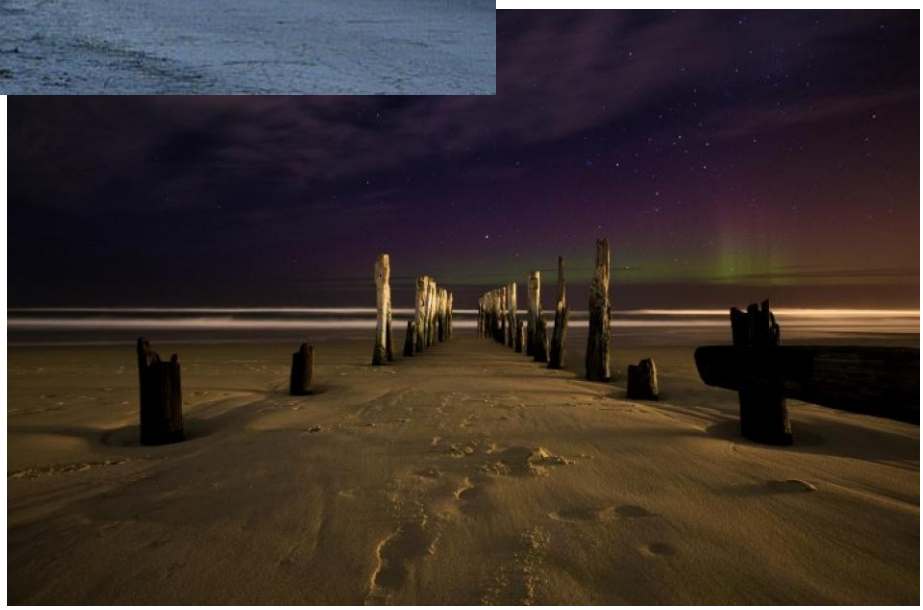


At dawn when our southern sky can be so dramatic[2]



In daylight where you can see the sand built up around them

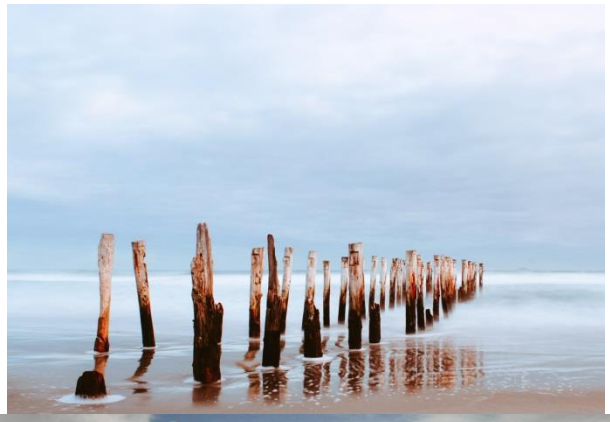
At dusk where the full width of possible beach is visible[3]

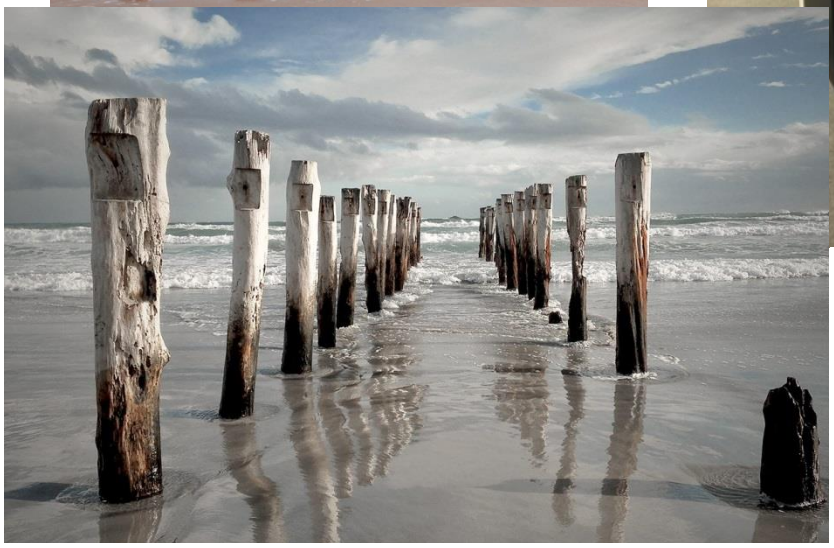


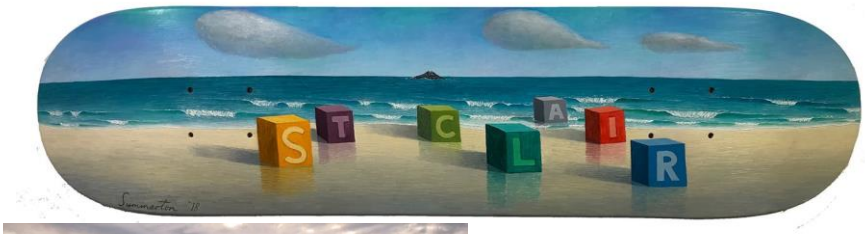
And even at night with an aurora glowing in the distance[4]

[2] Elia Locardi
[3] Leroy W Demery Jr
[4] Nicola Pye

Photographs of these beloved poles adorn many a wall in Dunedin including within the DCC and ORC. They also form the subject of many cherished works of art[5].








"The poles are as iconic as Dunedin gets. They are my overall No 1 best-selling subject". Trev Hill Photography

These practical poles are very dear to peoples' hearts and they are keen to have them restored.[A]

[5] Clockwise from top right: Trev Hill, Jo St Baker, Delia A, Dunedinisforlove.blog, Justin Summerton, Steven Smith Photography, Finnie Photography

## The Problem - Seawalls cause erosion, 1880's

In the beginning, there was a wide sandy beach as shown in this photo from the 1870's

However, the landowner at St Clair, a gentleman named Smith built the first seawall (Smith's Wall) in that decade, about 1878, and thereafter the problems began.

People wanted a wall so they could promenade along it and enjoy a pleasant view of the beach and ocean just as today many enjoy the view without getting their footwear sandy or wet.

Unfortunately, a wall reflects wave energy and scours sand away from in front of it allowing even larger waves to hit the wall.

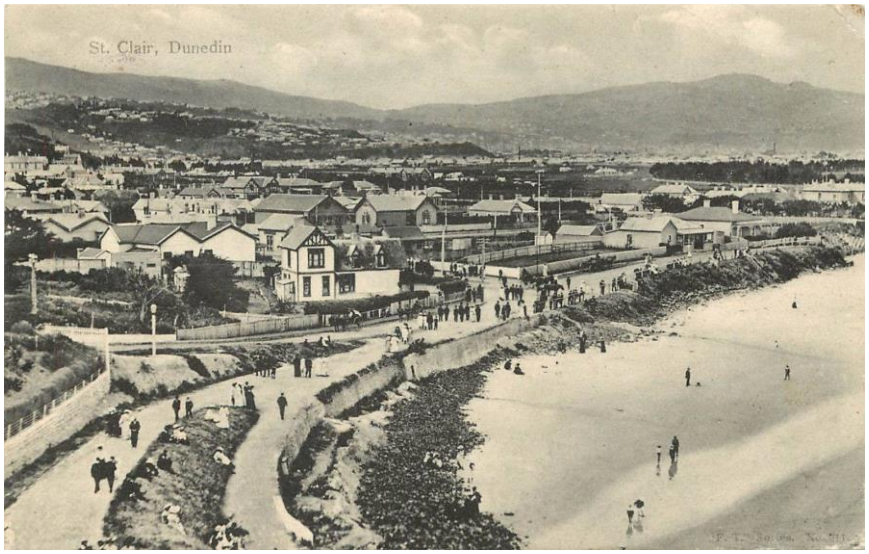
That wall shown on the previous page was damaged earlier then smashed to rubble in 1886, as seen in this photo.


A new, stronger wall made with gabion baskets was built in 1888.

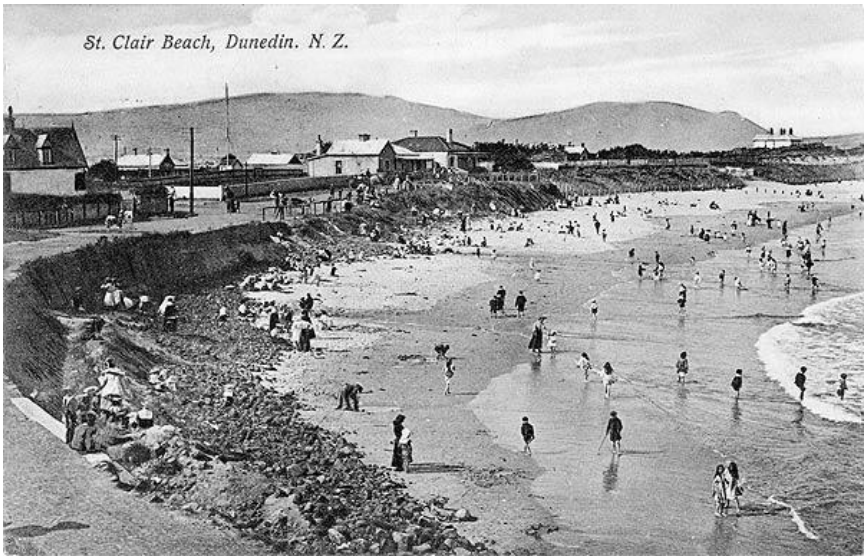
Such was the confidence in its strength, a railway line was built on top of it so excursions could be run out from the Octagon.


Here is another view of that 1888 wall, also from the Burton Brothers studio which can be relied upon for high resolution images and accurate dating.

Some of the rubble from the previous wall can be seen in the foreground.




That nice, strong wall lasted just one year intact and was practically all gone by 1891.




This image from about 1895 shows the mess made and how much closer to the houses waves were coming.

This photo, probably from 1898, illustrates clearly how big the seas can get at St Clair. You might imagine the anxiety residents must have felt with the Pacific Ocean coming ever nearer.

Elsewhere in the city that winter, the problems were even greater.

In May of 1898, the sea breached the dunes in front of where the dinosaur playground is now and there was 3ft of water in Larkworthy St and across to Normanby St.

It happened again in July only worse and large areas were inundated. The water went all the way to Hillside Rd.

To quote NZ's oldest Conservation Organisation, The Dunedin Amenities Society: "Public acrimony and outrage was vitriolic".


St Kilda, 1898

Perhaps today's public would be less critical but probably not.

No wonder people were worried. This photo below, from 1902, shows how much sand had been scoured away from in front of and even underneath the beach-front houses.

St Clair, 1902

Note the rubble from the 1888 seawall down at the waters edge.

## Groynes accumulate sand, 1902

At the direction of distinguished City engineer J. Blair Mason[B], in a comprehensive report[C], Groynes were installed.

This image from 1902 shows the pile driver working on the line of remnants from the old seawall.

The groyne sand traps were a great success and featured glowingly in the Otago Daily Times as well as in the Sandhills, a history of the Ocean Beach Domain Board[D]:

Groin at St. Clair.—This work, erected by the Public Works Department, has had a decidedly good effect on the foreshore, and it is a great pity that it has not been supplemented by others before this. It is true south-westerly storms carry away a quantity of sand from time to time, but immediately calm weather sets in the groin seems to attract and hold the sand in such a way that we have had a lovely beach all the past summer. I am borne out in this opinion by an old resident on the foreshore, who says that the waves have not touched his property since its erection.

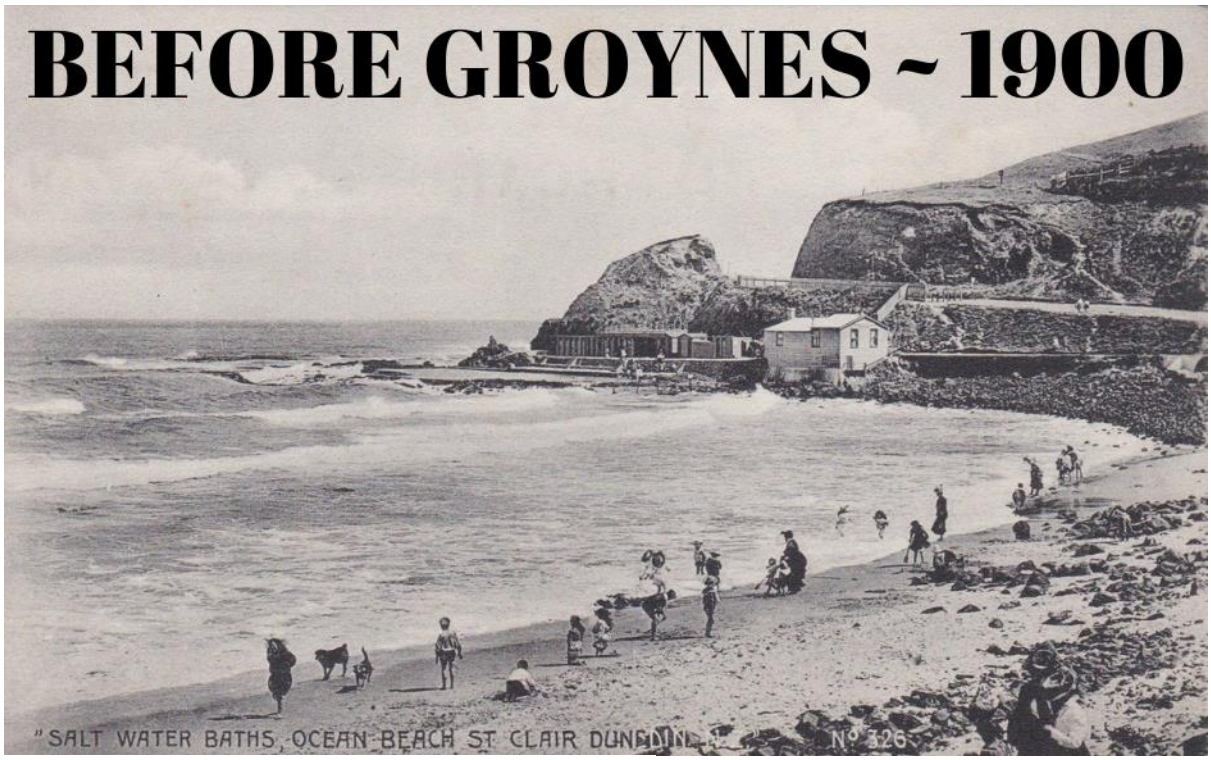
ODT - 1904

The Pile Groins at St. Clair.—These structures, which were for some time considered by some people to be costly experiments, have proved their utility in a very marked degree, and whereas a few years ago the board or the Government was faced with a probable and suggested expenditure of £20,000 to stop sea encroachment, Groins, at a total cost of £500, have not only effectively stopped erosion of the foreshore, but have built up the beach from 4ft to 6ft over an area of many acres. The

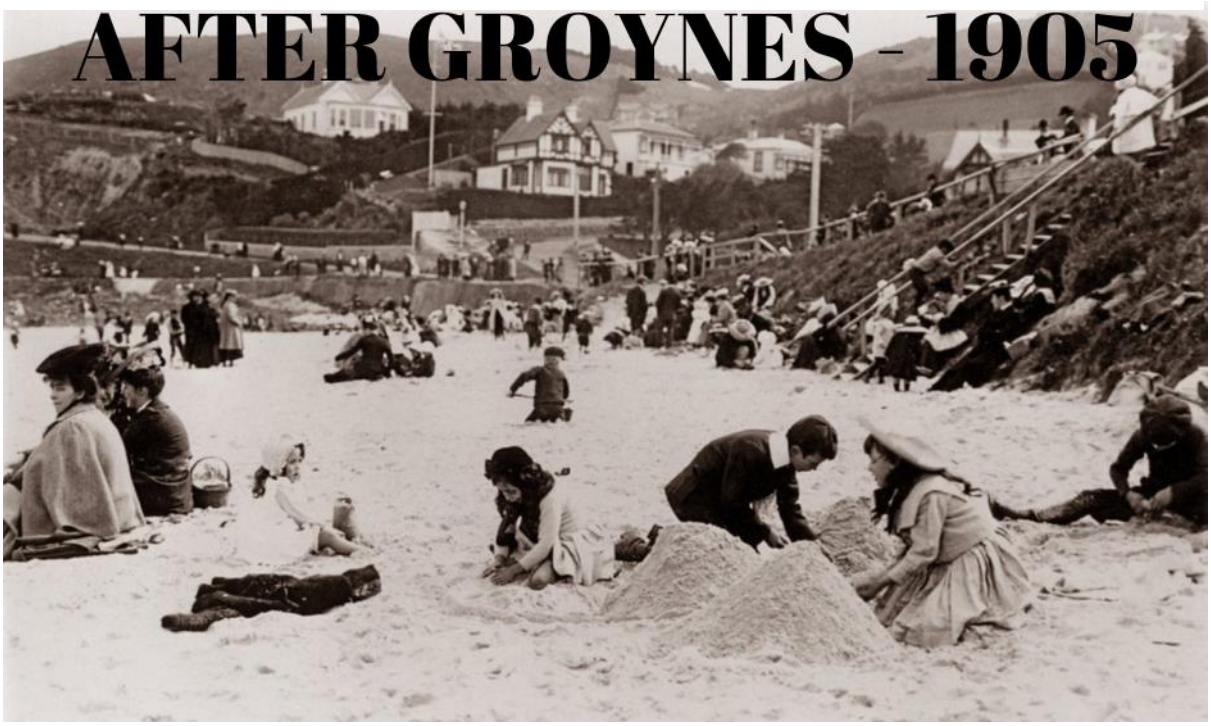
ODT – 1906

(Please read carefully)

Before and after images do the work of many words…



St Clair, ~1900

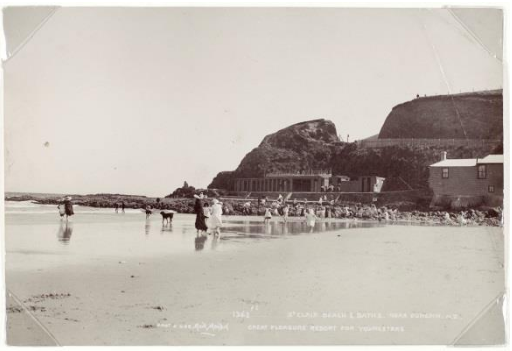


St Clair, 1905

## Memories are short, erosion returns

People enjoyed the beach for nearly 20 years:


1907



1908

1912

1914

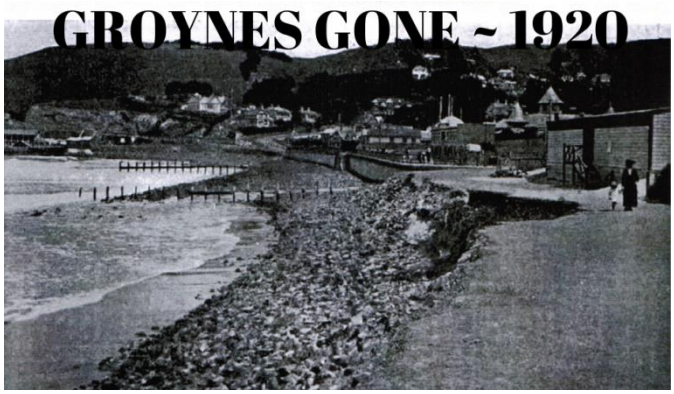
Notice how the groynes disappear under the sand they build up as the beach becomes much deeper.

However, by the end of that decade, planking on the groynes had been broken by winter storms and not repaired. Commentators were blaming groynes and calling for walls as in this 1919 ODT clipping.

"Aquatic" does not believe that groynes would prove effective in preventing the destruction that is going on at the Ocean Beach. His observations, extending over a number of years, show that the sand comes and goes according to the set of the currents, and if it were possible to take soundings it would be found that when the beach is at its lowest sand level the sand has formed in bars at no great distance out. He has also noticed that the receding waves or back currents cause far more scour round the groynes than takes place on other parts of the beach where there are no groynes. He expresses the opinion that the erosion which has taken place since 1913 should make it easier now to construct a wall capable of resisting any attacks by the ocean. The reinforced wall of the present St. Clair esplanade has been subjected to the severest tests, and has amply proved its reliability. He understands that similar walls, slightly different in design so as to reduce the back scour, have proved a great success elsewhere under conditions corresponding to those at the Ocean Beach. He suggests that a conference of local bodies interested should be arranged, or that the Mayor should call a public meeting to decide whether the work should be proceeded with in a manner worthy of Dunedin and how such a work should be financed.

Letter to ODT, 1919

Without planks on the poles, sand did not accumulate the way it had and the beach was now back to a rocky horror as this picture from 1920 shows.




St Clair, 1920

# Repair the groynes and erosion stops, 1921

The **Otago Southland District Engineer, Frederick Furkert**[E] wrote that the St Clair groynes had trapped sand as planned and stopped erosion in the area, though at times sand had built up higher than the piles and been washed away - extending the groynes could have solved that he said.

By 1919 however, the groynes had been totally neglected and that same District Engineer was most upset. He reported to Government[F]:

> **There was constant erosion before the groynes were installed.**
>
> **As soon as the groynes were installed the erosion stopped.**
>
> **As soon as the groynes fell into disrepair the erosion recommenced.**

So, in 1921, our famous double row of St Clair piles were first built, expensively during the winter due to political procrastination. They were immediately smashed by winter storms and vilified by some but repaired and eventually allowed to do their job which is to accumulate sand thrown up during summery conditions.


Pile driver 1921

## DOMAIN BOARD

### ANNUAL MEETING.

The annual meeting of the Dunedin Ocean Beach Domain Board was held at St. Clair this morning, and was attended by the chairman (Mr J. H. Hancock), Messrs W. B. Taverner, J. Wilson, and J. Dove.

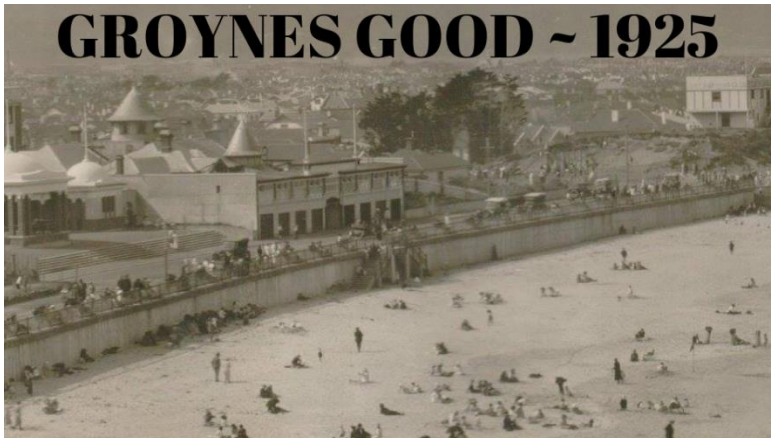
### ANNUAL REPORT.

The annual report was as follows:—

St. Clair Groynes.—Since the completion of the pile groynes at St. Clair Beach, two years ago the work carried out has been mostly of a maintenance nature, or fencing, planting, mowing, etc. The groynes at St. Clair, when aided by fascines or bundles of manuka scrub, appear to fulfil the purpose for which they were placed there, as is evidenced by the quantities of sand accumulated and held by the whole three groynes. Especially is this the case at No. 1 groyne, opposite Forbury road, where both rows of piles are supported by fascines, the sand being held the whole length of the esplanade.

St. Clair Sandhills.—The marram grass planted on the face of the sandhills at the back of the groynes (Nos. 2 and 3) is growing and building up the sand for a distance of a chain or more, which means that there has been no further erosion. As the whole of the ocean drive at this part has been washed away, a rough path has been made from the beach on to the children's playground, about twenty chains from Forbury road.

Ocean Beach Domain Board
Annual Report 1923




St Clair, 1925

Just compare the amount of sand here in 1925 with the photo from 1920 shown on a previous page.

Here is a wider angle of the same photo from 1925:

St Clair to St Kilda, 1925

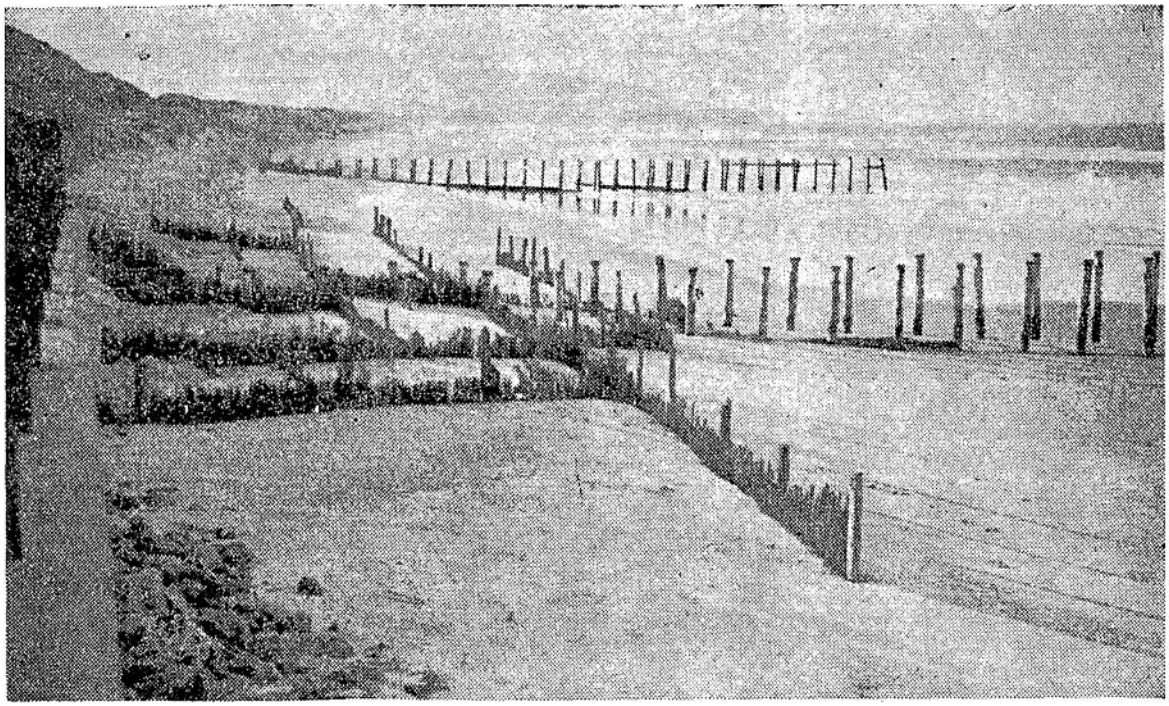
Note how the tops of the poles of the groynes can barely be seen, such is the quantity of sand they have accumulated on the beach.

St Clair, ~1930's

St Clair, ~1930

## Fail to maintain groynes and erosion reappears

In 1936, heavy winter storms smashed planking and eroded the beach



EROSION AT ST. CLAIR.—This picture, taken recently, shows in a striking manner how the ravages of the sea affect the St. Clair beach from time to time. (See article this page.)

**However re-planking was performed in 1936 and sand returned**.

St Clair, ~1940


St Clair, 1946

It is only natural that top planks will need regular repair since they are always struck first by the full force of our howling Southerlies. Simply replacing them as required is all that is needed but has typically been neglected.

Sand accumulates on our beach naturally during the summer due to North Easterly weather and sand is eroded from the beach naturally during the winter due to Southerly storms. The groynes worked so well because they held the summer sand in place so that more and more built up until the beach became about 3 metres higher.

When winter storms hit, there was plenty of beach width to absorb the energy. This gave a huge amount of protection to the dunes. With groynes in place, the beach was eroded instead of the dunes. All that sand was pulled off the beach but was quickly returned to the beach because it had not gone very far and North Easterly conditions could push it back quickly.

Sandbagging at St Clair 1953

By the mid 1950's, the situation had deteriorated once again, erosion returned and the Chief Engineer of New Zealand, Charles Turner[G], a marine expert, was called in to make a report[H]. Turner was world famous for his engineering projects, perhaps you have heard of the Manapouri Hydro Power Station or the Wairakei Geothermal Power Station.

He rebuilt 2 groynes and made a particularly strong job of the one closer to St Kilda. Some of it is still standing, 65 years of Southern Ocean pounding later.

## Repair groynes and sand returns, 1955

Once the poles & planks were restored, sand became trapped on the seashore almost immediately and thereafter St Clair enjoyed its longest period of broad beach since Smith's wall was built.

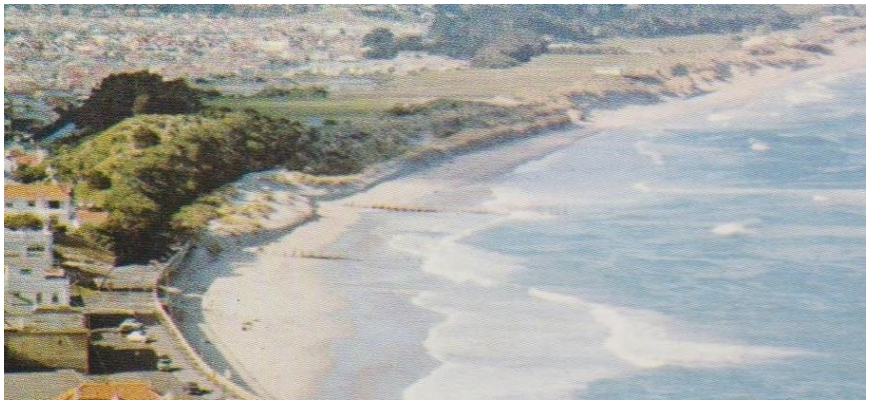
THE DUNEDIN OCEAN BEACH DOMAIN BOARD

Annual Report for the Year Ended 31st March, 1958.

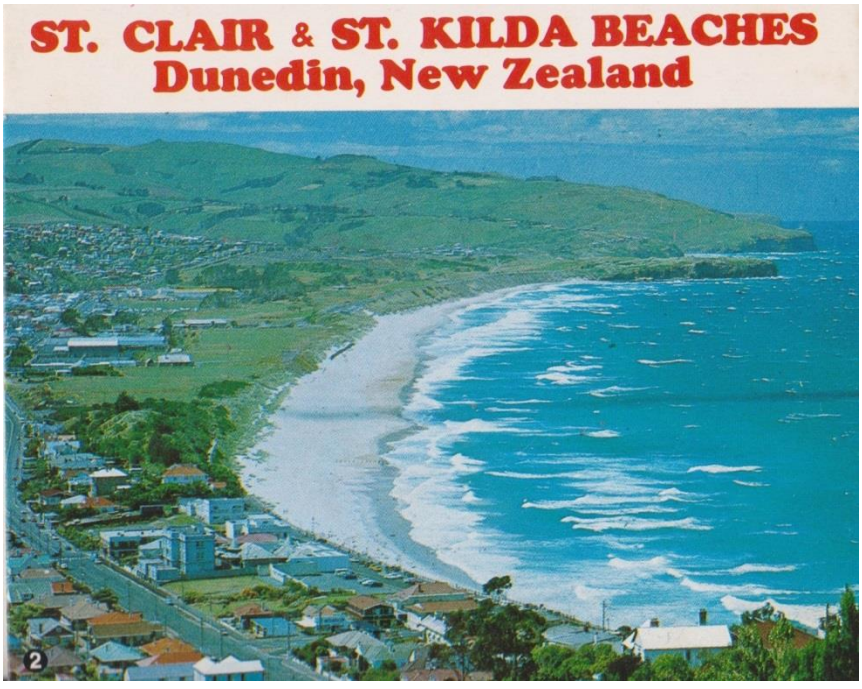
I have the honour to submit the following report of the Board's activities for the year ended 31st March, 1958:-

FOREDUNE AND BEACH:

The beach level was particularly good during the year and at St. Clair the level remains high. The cut of 1955 is filling up with the assistance of a good growth of lupins and marram grass. The extensive planking of the groins has proved well worthwhile. The new dunes forming outside the main dune from Lawyers Head westwards has continued to build up.



St Clair ~late 1950's or early 60's




Postcard of St Clair ~late 1960's

Detail of postcard showing groynes buried ~late 1960's

Panorama of the beach ~mid 1970's[6] - Note beach width at groyne location.

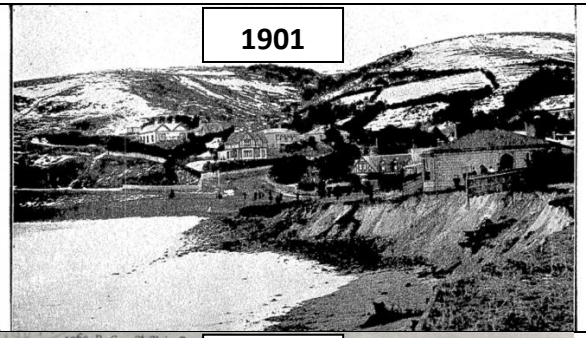
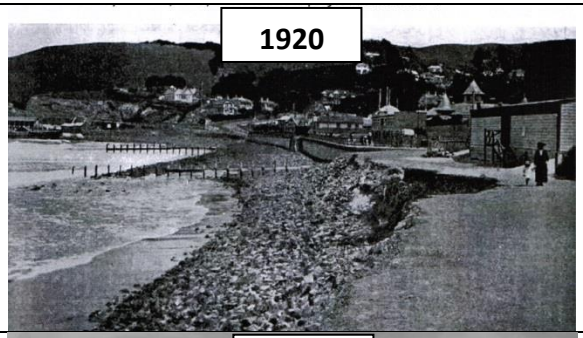
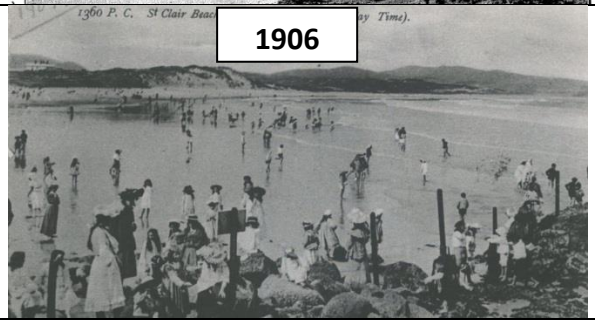
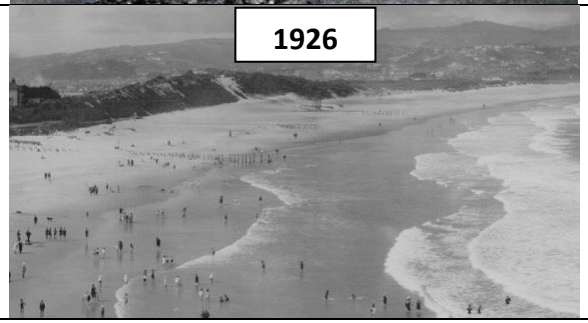
[6] Photo: Peter McDonald

Beautiful winter evening shot from 1980 showing beach at full width


St Clair[7], late 1980's showing Moana Rua Surfclub (demolished 2001). The dunes are now further back than the light poles which were undermined by waves. New poles were installed 10m further inland and are now under threat. The land under the surfclub has been completely lost to the sea. Note sand accumulation exactly at the groyne.

[7] Photo: Colin Monteath

## Groyne Installation Summary Table

| | 1902 | 1921 | 1955 |
|---|---|---|---|
| **Report Prior** | **City Engineer Mason, 1901:**<br>"The method of promoting sand accumulation by means of groynes extending out beyond the high water mark is evidently peculiarly adapted to the conditions prevailing at the Ocean Beach, and should assuredly be tried before attempting the construction of sea-opposing walls." | **District Engineer Furkert, 1919:**<br>• There was active erosion in progress before the groynes were erected<br>• The erosion stopped immediately the groynes were erected, and<br>• The groynes fell into disrepair and erosion recommenced. | **NZ Chief Engineer Turner, 1955:**<br>"Groynes are the most successful method as has been well proved over the past 50 years" |
| **Erosion Prior** | **1901**<br>  | **1920**<br>  | **1953**<br>  |
| **Sand After** | **1906**<br>  | **1926**<br>  | **~1959**<br>  |
| **Report After** | **OBDB Annual Report 1906:**<br>"Groins, at a total cost of £500, have not only effectively stopped erosion of the foreshore, but have built up the beach from 4ft to 6ft over an area of many acres."<br><br>"The first and second rows of piles having almost disappeared in the accumulation of sand…" | **OBDB Annual Report 1923:**<br>"The groynes at St Clair, when aided by fascines or bundles of Manuka scrub, appear to fulfil the purpose for which they were placed there, as evidenced by the quantities of sand accumulated and held by the whole 3 groynes."<br>"…sand being held the whole length of the esplanade." | **OBDB Annual Report 1958:**<br>"The beach level was particularly good during the year and at St Clair the level remains high."<br><br>"The cut of 1955 is filling up…"<br><br>"The extensive planking of the groins has proved well worthwhile." |

## Lack of groyne repair this century leads to rampant erosion


Sand disappearing, 2006[8]

Notice the light poles in the photo below. The same light poles as shown on the previous page to illuminate the playing field.

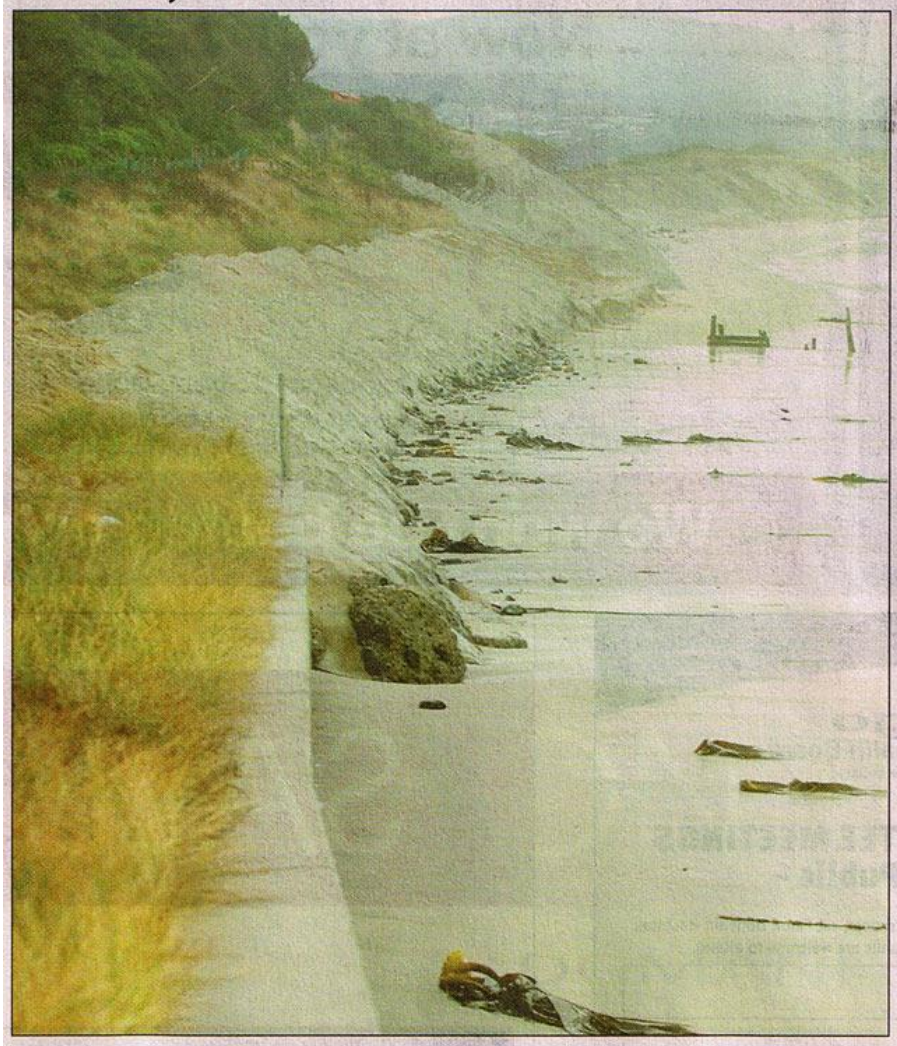
They have been replaced by a new set of light poles, 10 metres further inland. All the land in the photo below has been taken by sea encroachment.

Kettle Park light poles being undermined, 2007

Sand trucked from harbour, 2008. Note: Dunes eroding. Beach has reduced further from here.


[8] All photos: http://save-ocean-beach.blogspot.com/

26th July 08 ODT



Stabilising . . . The sand dunes at St Clair beach yesterday. PHOTO: PETER MCINTOSH

# Still bringing sand to beach

By HAMISH MCNEILLY

THE Dunedin City Council is still in a holding pattern over what to do about erosion at St Clair beach.

Last week, storms stripped sand from the dunes, exposing rubble in several places, but by yesterday most of the sand had been washed back in, council community and recreation services manager Mick Reece said.

"We are in the storm season, but the weather has been kind to us so far."

Last year, vandals slashed exposed sand sausages at St Clair, resulting in major damage to the dune system. The council had little option but to take remedial action. More than $1 million of sand has since been trucked to the area to stabilise the dunes.

"We have contractors who are on call because we are in a holding pattern. We are still in emergency mode," he said. About $40,000 worth of sand was brought in last week.

Remedial work has continued on the beach since last July and it would be at least another year before a draft plan went to the council, he said.

The council had begun collecting data from the St Clair and Middle beaches this month but it was too early for findings to be analysed.

"This is a big project. We will be giving all the data to a project team who will come up with a draft plan to council before any public consultation."

ODT Clipping, 2008, $1Million of sand

Left is a view of Kettle Park in 2010. The Moana Rua surf club shed has long gone.

Below is a similar angle from 2019 showing another 10 metres of sandhill and asphalt lost.

Aerial Photograph Comparison:

WITH GROYNES: St Clair, 1957


GROYNES NEARLY GONE, St Clair, 2000

Here is a closer look at the upper image from 1957 when our St Clair poles were in their best condition.

Not only is dry sand stretched all the way to the end of the groyne, but you can see that the beach is nice and wide over a long length, centred on the groyne.


The sandhills have been eroded back further and further each year since ~2000.

The red shed shown in these photos was behind the St Clair tennis courts.

It was demolished in June 2020. All the scrub shown between the shed and the water in 2005 is now gone.

- **For 100 years prior to 2000, groynes did an excellent job of holding sand on the beach and preventing erosion of the dunes.**
- **Over the recent 20 years, millions of ratepayer's money has been spent on erosion remediation.**
- **Let's spend a little on 1 groyne then monitor its performance carefully and accurately.**


Note how the well-established sand dune faces were all covered in marram grass and other vegetation in 2005 having enjoyed a ~50 year period without waves hitting them.




Today, in July 2020, dune faces remain steep and we await the next winter storm event with trepidation.

The Damage Done & Liabilities Looming:

Esplanade sinkhole 1994

Esplanade sinkhole 2013

Dune erosion 2014

(The sand loss was massive. Since then, geotextiles have been placed in front of this gaping excavation which will move the end wall effect erosion along to the orange roofed building on the right. At that point the dune is only ~10m wide. An inundation catastrophe could easily occur.)

Rubbish emerging from Landfill 2019

Plenty of building rubble emerging 2019

Sandbag defence 2019

Buried Treasure emerges 2019

Storm 2013

Storm 2019

Here's a 2 minute video from 2007: https://youtu.be/4UQesQ-MmdU

If we retreat, we have to give Kettle Park back to the ocean so it can sort out a lower, flatter dune system. The landfill would need to be excavated and put somewhere else. We also have to remove the esplanade seawall and all buildings. That is quite an expense. Mike Hilton's estimate was $2-300 Million. (Toitu 2019)

## Otago Daily Times links to articles on St Clair damage

| | | |
|---|---|---|
| May, 2008 | https://www.odt.co.nz/news/dunedin/dunedin-beaches-seriously-eroded | $1.2 million |
| July, 2008 | https://www.odt.co.nz/news/dunedin/still-bringing-sand-beach | $40,000 |
| Jan, 2009 | https://www.odt.co.nz/news/dunedin/council-weighs-costly-esplanade-options | |
| July, 2009 | https://www.odt.co.nz/news/dunedin/encroachment-heavy-seas-checked | $60,000 |
| Sept, 2011 | https://www.odt.co.nz/news/dunedin/sea-may-win-fight-coast | |
| Oct, 2011 | https://www.odt.co.nz/news/dunedin/st-clair-ramp-damaged-again | |
| Oct, 2011 | https://www.odt.co.nz/news/dunedin/battered-beach-access-ramp-may-be-moved | |
| Oct, 2011 | https://www.odt.co.nz/news/dunedin/sand-dumped-dunes-shore-middle-beach | $60,000 |
| Mar, 2012 | https://www.odt.co.nz/news/dunedin/sea-wall-costs-still-unsettled | $250,000 |
| May, 2013 | https://www.odt.co.nz/news/dunedin/assessments-seawall | |
| June, 2013 | https://www.odt.co.nz/news/dunedin/storm-showers-st-clair-dirty-white-foam | |
| June, 2013 | https://www.odt.co.nz/news/dunedin/sun-surf-and-not-much-sand-all | $300,000 |
| June, 2013 | https://www.odt.co.nz/news/dunedin/public-gets-no-say-over-st-clair | $500,000 |
| July, 2013 | https://www.odt.co.nz/news/dunedin/calls-accountability-over-failure-sea-wall | $150,000 |
| Aug, 2014 | https://www.odt.co.nz/news/dunedin/esplanade-collapse-linked-long-term-seepage | $680,000 |
| June, 2015 | https://www.odt.co.nz/news/dunedin/walking-battered-ramparts | |
| Aug, 2015 | https://www.odt.co.nz/news/dunedin/waves-continue-skittle-st-clair-piles | |
| Aug, 2015 | https://www.odt.co.nz/sport/rugby/rugby-coastal-erosion-causing-problems-club | |
| Oct, 2015 | https://www.odt.co.nz/news/dunedin/battle-beach-shoring-against-nature | |
| Oct, 2015 | https://www.odt.co.nz/news/dunedin/injury-fears-over-esplanade-rocks | |
| Dec, 2015 | https://www.odt.co.nz/news/dunedin/waves-continue-skittle-st-clair-piles | |
| March, 2016 | https://www.odt.co.nz/news/dunedin/580k-reinstate-st-clair-coastal-defences | $680,000 |
| August, 2018 | https://www.odt.co.nz/news/dunedin/beach-protection-work-start-today | $28,000 |
| Sept, 2019 | & Taylor (2002) | |

Total for these ODT articles, which are not an exhaustive list by any means = $3–4 million. Every year, considerable money is spent of repairs. Some years emergency funds are required.

**It is likely that over $3 million of ratepayer's money could have been saved by repairing the groyne for just $100 thousand.**

# Some Relevant Emails:

Heritage NZ

**Jules Radich**

**From:** Jane O'Dea <JODea@heritage.org.nz>
**Sent:** Wednesday, 13 December 2017 11:35 AM
**To:** Jules Radich
**Cc:** Matthew Schmidt; Jonathan Howard
**Subject:** RE: St Clair Piles

Hello Jules

Thanks you for contacting Heritage New Zealand in relation to your proposal to reinstate the groyne at St Clair beach.

There are a couple of areas where Heritage New Zealand might have an interest in such a proposal - one being if the existing piles are entered on the New Zealand Heritage List or recognised in the District Plan or Regional Coastal Plan as heritage features; and the other being if the works would modify or destroy any archaeological site, in which case an archaeological authority would be required under the Heritage New Zealand Pouhere Taonga Act 2014. Accordingly this response is framed to address these matters.

New Zealand Heritage List Rārangi Kōrero

I can confirm that the St Clair beach piles are not entered on the New Zealand Heritage List Rārangi Kōrero. I have also checked the Dunedin City District Plan and Regional Coastal Plan and the piles do not appear to be scheduled as heritage features in those plans. Accordingly any modification of the piles is not a matter that Heritage New Zealand is likely to have any involvement in in terms of any resource consent required for the project.

Heritage New Zealand Pouhere Taonga act 2014 – Archaeological site protection

Under the Heritage New Zealand Pouhere Taonga Act (2014) an archaeological site is defined as any place in New Zealand that was associated with human activity that occurred before 1900 and provides or may provide, through investigation by archaeological methods, evidence relating to the history of New Zealand. For pre-contact Maori sites this evidence may be in the form of bones, shells, charcoal, stones etc. In later sites of European/Chinese origin, artefacts such as bottle glass, crockery etc. may be found, or evidence of old foundations, wells, drains or similar structures. Burials/koiwi tangata may be found from any historic period.

The HNZPTA 2014 makes it unlawful for any person to modify or destroy, or cause to be modified or destroyed, the whole or any part of an archaeological site without the prior authority of Heritage New Zealand. Any work that may modify or destroy an archaeological site must be authorised by an authority from Heritage New Zealand.

In respect of the above requirements I have discussed the proposal with our Archaeologist, Matt Schmidt, who confirmed that the reinstatement of the groyne would not require an archaeological authority pursuant to the Heritage New Zealand Pouhere Taonga act 2014. Furthermore, the existing piles are not pre-1900 and accordingly are not an archaeological feature.

I hope the above information is of assistance. If you have any queries please don't hesitate to contact me.

Regards
Jane O'Dea

Jane O'Dea | Planner (Otago & Southland) | Heritage New Zealand *Pouhere Taonga* | PO Box 5467, Dunedin 9058| Ph: (64 3) 477 9871 | DDI: 470 2366 | Visit www.heritage.org.nz and learn more about New Zealand's heritage places

***Tairangahia a tua whakarere; Tatakihia nga reanga o amuri ake nei***
***Honouring the past; Inspiring the future***

1

Professor Abigail M. Smith, University of Otago:

Author of numerous papers on sedimentation and coastal processes for ORC and others.

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

18 December 2017

Kia Ora Jules:
I am happy to write in support of your proposal advocating additional sand-retention structures on Ocean Beach at St Clair.

Ocean Beach is a very dynamic environment, as your wonderful collection of photos shows clearly. The main determinant of how much sand we see on the beach is the dominant wave direction; there are scouring waves and depositing waves. The beach is part of a dominantly-northward longshore drift cell that stretches from (at least) the Clutha up to Karitane. Sand is literally always flowing along that beach and offshore.

The best thing that can be done in a longshore environment like St Clair is to retain some of the sand, and to make sure that plenty of sand is coming from downstream. A coastal structure, like a groyne, will assist in retaining sand (and indeed we have the past to show us that it does work, if maintained). It would also be wise to limit sand extraction from beaches further south of Ocean Beach (e.g., Brighton), to ensure supply.

As always there are trade-offs among users of a public amenity, and groynes could impede surfing and possibly life-saving boats for a short stretch of the beach. Also, the build-up of sand on one side of the groyne is sometimes accompanied by the scour of sand on the other side – placement of the groynes will be important to ensure that any scour is relatively harmless.

Nevertheless, it is certainly true that higher and more dependable beach sand levels would improve the beach for bathers and walkers, as well as provide protection to the very expensive coastal structures in place, especially the seawall and sand tubes. It could reduce the risk of sea-water flooding in South Dunedin, particularly in the context of sea-level rise.

Another point that should be investigated is whether the wooden piles are likely to be non-polluting and provide an attractive surface for marine organisms to colonise.

You quite rightly note that there is a long history of alternating stabilisation and neglect on Ocean Beach. There is no point in emplacing coastal structures if there is no budget for maintenance. We have seen over and over again (the St Clair seawall, the Oamaru breakwater) that the relentless onslaught of the sea cannot be resisted without regular maintenance and repair. While finding the capital outlay to build the proposed groynes may be straightforward, it is essential that ongoing maintenance is also part of the budget.

Finally, I draw your attention to the following resources, which show that the Department of Marine Science has a long history of interest in this issue. If further research is needed, we have the students to carry it out.


Allen C, 1999. Longshore drift at St Clair beach. PGDip Marine Science Report, Otago
Anderson A, 1995. Coastal structures of the Otago coast and their vulnerability to sea level rise. PGDip Marine Science Report, Otago
Dyer MJ, 1994. Beach Profile Change at St Clair Beach Dunedin. MSc, Geography,Canterbury
Smith AM, 2007. Marine Sedimentation and Coastal Processes on the Otago Coast. Report to Otago Regional Council, 2007.
Townsend BJ, 1997. Toward effective management of the Ocean Beach sand dunes, Dunedin. MSc thesis, Geography, Otago


Best Wishes,


Professor Abigail M. Smith
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University of Otago, P. O. Box 56, Dunedin 9054, New Zealand
phone: +64 3 479 7470 email: abby.smith@otago.ac.nz
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Portobello Marine Laboratory
PO Box 8 Portobello 9048, New Zealand
Tel 64 3 479 5810 Fax 64 3 479 5825

New Zealand Marine Studies Centre
PO Box 8 Portobello 9048, New Zealand
Tel 64 3 479 5826 Fax 64 3 479 5844

Email marine-science@otago.ac.nz http://www.otago.ac.nz.marinescience

Richard Reinen-Hamill, Coastal Engineer

Author of the Tonkin & Taylor Report to DCC: "Ocean Beach Domain Reserve Management Plan - Coastal issues and options" (2011)

Dear Mr Radich,

I have briefly reviewed your proposal of reinstating the timber groynes at St Clair's Beach and I support the proposal as a trial, or pilot, to enable observation of shoreline change resulting from the reinstatement. A structure at this location is likely to trap some of the alongshore moving sediment, but would still allow bypassing of sand around the seaward edge of the structure. It would also not be effective in arresting cross-shore transport of sand during onshore storm events.

I believe with an effective monitoring regime to record the observed changes to the shoreline adjacent to the structure, the reinstatement proposal has merit in providing a trial structure that will provide information to actual shoreline change and characterise both the benefits and the risks. The use of timber in this environment is inadequate for a long term design, but has an advantage can be readily removed should adverse effects in the form of unacceptable lee side erosion (erosion to the north) occur.

Ngā Mihi | Kind regards,
**Richard Reinen-Hamill | Coastal Engineer**
BE(Hons), ME, FEngNZ
**Tonkin + Taylor** - ***Exceptional thinking together***
Level 2, 105 Carlton Gore Rd, Newmarket, Auckland 1023 | PO Box 5271, Wellesley Street, Auckland 1141, New Zealand

## Benefits of rebuilding the groyne

There are 5 key benefits for most people:

1. It will save money on rates
2. It will protect the sand hills from erosion
3. It will widen the beach and give people more room to play
4. It will save the environment by keeping old rubbish buried
5. It's iconic and people love the look of it

Not only these, but it will also provide highly valuable information which will be helpful with future planning.

# FAQ's

## What are groynes?

Here is an excerpt from Tonkin & Taylor's 2011 Report to DCC[9], in which they offer groynes as an option for Ocean Beach.

**9.9 Groynes**

Groynes are protection structures which are used to control the natural movement of beach material (Fleming, 1990). Groynes are typically constructed from stone, concrete or timber that extends perpendicularly from the shore. The purpose of the groyne is to retain sand and reduce the effect of longshore drift. Figure 9-9 and Figure 9-10 show a typical conventional groyne field and detail of an individual groyne.

Westhampton Beach, Long Island, New York, 18 Jan 1980 (courtesy USAED, New York)

*Figure 9-9 Example of a groyne field along a high energy coast (Source: CEM, 2006)*

The textbook description of groynes suggests that while gathering sand on one side, they also cause erosion on the downdrift side. This generalised situation is simply not experienced at St Clair. We are in the special circumstance of having drift in both directions along the beach. That is why there are no photos of differential accretion of sand around a groyne at St Clair despite 100 years of use.

Unfortunately, the textbook view, has caused errors in response to erosion over recent decades such that millions have been spent when a fraction of that might have made a dramatic difference.

Here is an excerpt from world renowned sedimentation expert Prof Dr Leo Van Rijn's bulletin on Timber Groynes[10]:

*"Timber groynes are fence-like structures, and can often provide substantial advantages over other forms of groynes. These include the ease with which the level and profile of the groyne may be adapted (by adding or removing planks), ease of maintenance and their appearance.*

*The main function of a groyne system is to stabilise a stretch of beach against erosion by:*

- *prevent or slow down the alongshore drift of material;*
- *build-up material in the groyne due to cross-shore transport."*

[9] Tonkin and Taylor Ltd. (2011) *Ocean Beach – Coastal Issues and Options*. A report to the Dunedin City Council, 48pp. + appendices.

[10] Van Rijn, Leo C. (2018) TIMBER GROYNES. www.leovanrijn-sediment.com

## How will the groyne work?

This simple wooden fence will trap the longshore drift sand which moves in both directions on St Clair – up and down the beach. As a result, a tongue of sand will grow around the groyne, mainly during the summer when the north-easterlies blow. This will extend the beach out into the surf so that the poles and planks will disappear as the beach builds up. This extended beach will spread both up and down the beach.

That means that waves will no longer be hitting the dunes at high tide and eroding them.

This extra tongue of sand on the beach will protect the dunes and hopefully extend as far as the Esplanade seawall.

When winter storms arrive, they will still scour sand off the beach and expose the planks again but because that sand does not move far offshore, it will rapidly return once north-easterly weather comes back.

Essentially we will have a sacrificial buffer of sand that gets eroded before the dunes. That buffer zone will take the sting out of winter storms and allow the dunes to build up again.

## Why do groynes work so well on St Clair?

The short answer is that **groynes trap sand on both sides at St Clair** which is somewhat unique.

Groynes help to hold sand carried into the corner in front of the Esplanade. As M.J. Dyer (1994)[11] says:

*"The main accretion at St. Clair however results from sand being transported into the western corner by westerly flowing longshore currents set up by easterly quarter swells. Under these conditions the beach can rapidly accrete."*

Dyer (1994) and Kirk (1979)[12] agreed that sand moves along St Clair beach in either direction depending on the conditions. Kirk actually underlined the point in his report:

*"…longshore drift occurs in both directions along the shore (northward during southerlies and southward in north-easterlies)"*

If a fence (aka: a groyne) is put into the surf, it will catch sand evenly on both sides as evidenced by every photo of groynes on the beach for 100 years. (1904 – 2004)

Dyer also wrote: *"In 1904 wooden groynes were erected at St. Clair with the beach rebuilding substantially by 1906."*

## Why hasn't it been reinstated already?

Groynes are out of favour in certain quarters because:

1. They can look ugly
2. Groynes typically accumulate sand on one side only
3. In many situations groynes starve downstream beaches of sand,

**All incorrect in our case.** These are the textbook objections but St Clair is exceptional on all counts. The researchers who conducted detailed field studies concluded that St Clair has longshore drift in both directions. (Kirk & Dyer) Institutional Knowledge has been lost – people forget that groynes saved the beach and the Esplanade for 100 years.

---

[11] Dyer, M.J. (1994) *Beach profile change at St Clair Beach, Dunedin*. Unpublished MSc thesis (Geography), University of Canterbury, 229pp.

[12] Kirk, R.M. (1979): *Physical stability of sandy beaches in the Dunedin Metropolitan Are*a. Unpublished report to Dunedin Metropolitan Regional Planning Authority by Morris and Wilson Consulting Engineers, Christchurch. 39pps

## Where does the sand come from & go to?

This diagram from Lionel Carter, shows the sand movement towards our beaches from the south.[13]

A million tonnes per year.

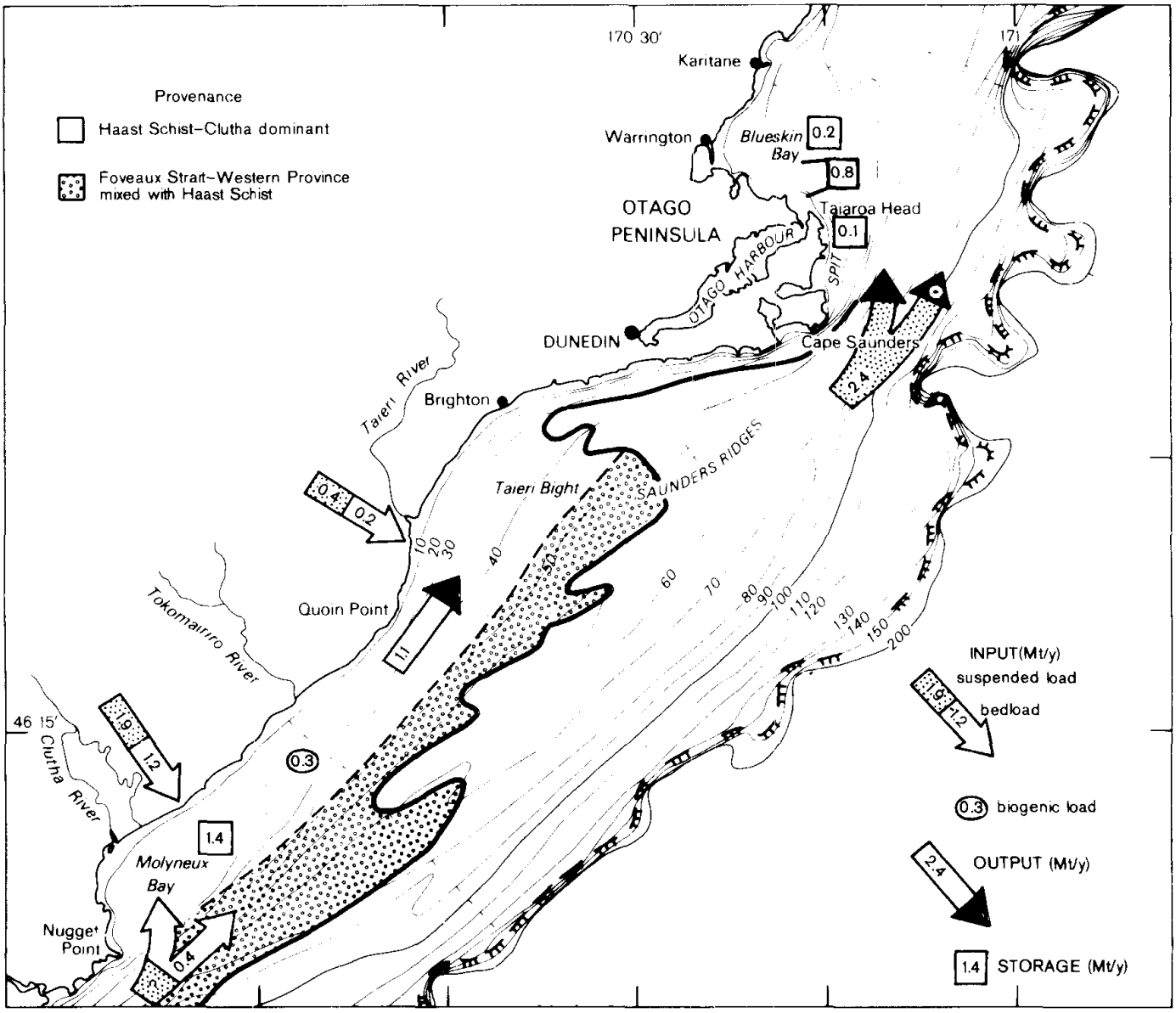



**Fig. 2** Major elements of the South Otago sediment budget, together with the principal provenance belts on the sand wedge as deduced by Williams (1979; University of Otago pers. comm.). Budget values are in Mt $y^{-1}$ and are rounded to the first decimal place.

Kirk stated in 1991[14]: *"It is well known that Ocean Beach receives its sand primarily from net northward drift along the continental shelf, much of it (but by no means all) originating from the Clutha River"*

He went on to say: "*Certainly there is no evidence to date of any reduction in sediment supply to any of the beaches around the urban area"* (due to the Clutha dams)

---

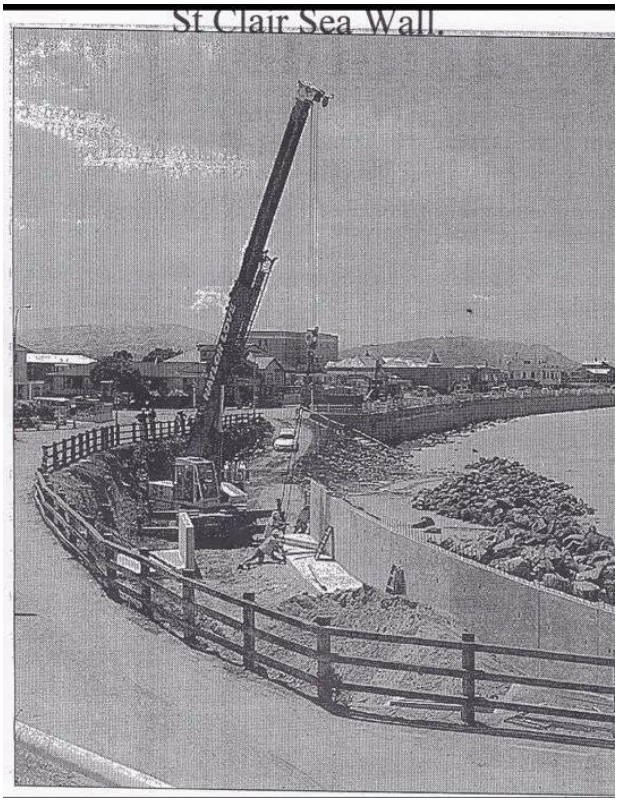
[13] Carter L. (1986) *A budget for modern-Holocene sediment on the South Otago continental shelf.* New Zealand Journal of Marine and Freshwater Research 20: 665-676.

[14] Kirk, R.M. (1991) *Coastal management and control of shoreline erosion, Ocean Beach – St. Clair, Dunedin.* Unpublished report to Constantine Coutts, Consulting Planners, Dunedin, and to the Dunedin City Council, 17pp.

Sand is continuously being carried by the ocean current going northward past St Clair. Once the sand gets past Otago Peninsula, it swirls like an eddy into Blueskin Bay or falls into the offshore canyons.

You can see how Warrington Beach has steadily increased in size over the years. Trapping a little sand at St Clair will have no ill effect in Blueskin Bay.

## Is the NEW Esplanade seawall to blame for erosion?




In 2004 a new seawall was built in front of the old one but with quite a different curve in the corner as can be seen in this ODT photo. Many people think that this extra encroachment into the sea has triggered all the erosion since its construction.

It may well have had an effect but moving it back to the previous location would be a very expensive proposition. That earlier seawall was also being hammered which prompted the new construction.

Behind that, at least 2 earlier walls were each further back.

It is an absolute fact that every seawall has caused erosion.

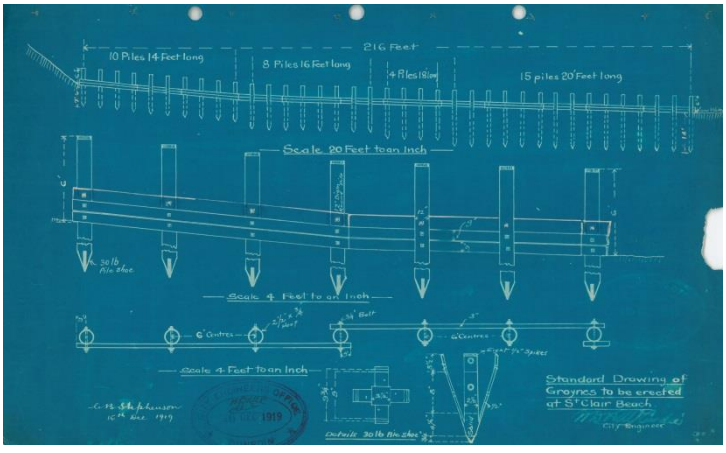
The original high tide line was behind the front door of the present-day Esplanade Restaurant. How much would it cost to go back to there?

The past 20 years have also coincided with the final deterioration of the groynes which were installed and repaired to protect the seawall by building up the beach level so that wave energy dissipated onto sand instead of smashing into the wall.

It is a far, far less expensive alternative to repair the remaining groyne (~$100K) and see how it goes over the next 5 years than to start planning a seawall shift. The last shift cost ~$ 7M against a budget of ~$4M.

A groyne will hold sand on the beach and protect the wall just as it & the others did for 100 years.

## Is it easy to reinstate the groyne?




Yes.

There are hardwood poles available from Aurora.

The original plans are in DCC archives.

## How can it NOT NEED a Resource Consent?

Reconstruction of an existing coastal structure is a permitted activity

**8.5.2.3** The maintenance, alteration, replacement or reconstruction of a structure, or part of the structure outside a Coastal Development Area, that is fixed in, on, under, or over any foreshore or seabed, other than as specified in rule 8.5.2.1 or 8.5.2.2 is a ***permitted*** activity provided:

(a) It does not result in a change to the overall dimensions or outline of the structure; and

(b) The disturbance of the foreshore or seabed is confined to within the perimeter of the structure, and after completing





the activity the foreshore or seabed is smoothed over to leave a depression no deeper than 0.5 metres; and

(c) As far as is practicable the work on the structure results in the structure blending in with the character of the adjoining landscape.

It is relatively straightforward to repair the existing groyne and see how it performs.

It might not be in the best possible place or be the best possible design but it's the definitely the best possible experiment at far less cost than the money spent so far to achieve more and more erosion.

Any other design or alternative coastal structure will require a notified resource consent with accompanying years of consultation and hearings before installation. That is fine except that whatever might be proposed will be untested on St Clair.

The only thing actually proven to increase sand on our beach, other than cartage, is a groyne.

It is also easy to remove if that is desired at any time in the future.

## What about climate change and sea level rise?

The best form of defence is not walls or engineered structures, as the constant force of the sea will always wear them down. Sand in the form of a beach is nature's way of absorbing wave energy.

**Kirk (1991)**[15]

*"The most prudent course of action to take in respect of sea-level rise and climate change is to institute buffer zoning and active sand conservation on beaches because this will generate the best possible protection against whatever changes do eventuate."*

That is why groynes have been regularly rebuilt at St Clair, because they raise the beach so effectively here.

In other parts of the world that are also under threat from the sea, it is similarly preferable to have beach as the protective mechanism rather than walls, rocks or bags.

The Netherlands, with its 350 km long coastline, nine million residents living in the coastal areas and vast regions located below sea level, is severely exposed to the risk of coastal flooding.

The "Sand Motor"[16] is a 'mega-nourishment' implemented on the Delfland Coast in 2011 as a pilot project to test upscaling their regular sand nourishment. The intervention involved a huge amount of sand extracted offshore and deposited along the coast in a single operation, to form a hook-shaped peninsula of sand which then disperses along the shore to maintain beach height. It cost 80 million euros. After 9 years is it still working well with the next assessment due in 2021.

Here in Dunedin, thanks to the extraordinarily beneficial natural phenomenon of bi-directional littoral drift on St Clair, we can enjoy watching a beach self-nourish right in front of our eyes if we simply reinstate the poles.

**Hilton (2016)**

*"Hannah & Bell (2012) have established that sea-level rise has averaged close to 1.7mm/yr in New Zealand ports since tide gauge records commenced."*

If we continue the way we are, repair and maintenance costs will rise with the sea level.
If we retreat, the sea will keep pushing forward as it rises. Where and how will we stop it? Should we bother?

Surely it is preferable to hold the sea as far away from built up areas as possible. If we raise up the beach where it is, we retain our amenities and make a better buffer zone to protect them. South Dunedin is worth about $6 Billion.

---

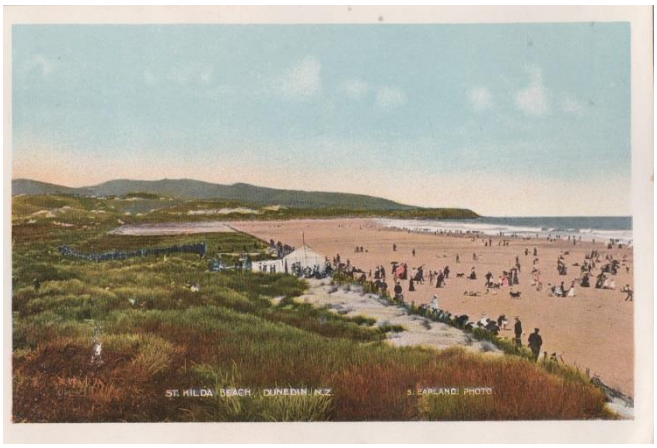
[15] Kirk, R.M. (1991) *Coastal management and control of shoreline erosion, Ocean Beach – St. Clair, Dunedin*. Unpublished report to Constantine Coutts, Consulting Planners, Dunedin, and to the Dunedin City Council, 17pp.

[16] https://climate-adapt.eea.europa.eu/metadata/case-studies/sand-motor-2013-building-with-nature-solution-to-improve-coastal-protection-along-delfland-coast-the-netherlands

## What about St Kilda?

The eastern end of Ocean Beach used to be a wide flat expanse of sand until marram grass and brush fences were used to build up land closer and closer to the sea.

1885




1895

1906


Photograph 28: ca. 1917 (Hocken Collections, Uare Taoka o Hakena, University of Otago)

1917

Photograph 29: (ca.1921) Hocken Collections, Uare Taoka o Hakena, University of Otago

**Millions of tons of sand were accumulated by this method** to the point where John Wilson Drive and all the amenities this side of it were created. Sand is still accreting seaward of JWD today, capturing wind-blown grains and building up a foredune buffer zone to protect the road from southern storms. Sand is the best defence.

The eastern end of Ocean Beach does not have an erosion problem because it does not have a wall.

## What about the surfers & life savers?

Surfers loved it when the Tahuna outfall pipe was extended in 2008. The piles of the jetty accumulated sand and made an excellent surf break[17]. Many have commented that they look forward to the groyne being repaired.


As the poles deteriorated, sand levels on the beach dropped so that the St Clair Surf Lifesaving Club boat ramp was no longer useable and in front of the clubrooms became typically rocky instead of sandy.

A broader beach is more attractive for everyone and will bring bigger crowds although more sand will mean further to run to get to the water so that is a downside. Swimmers will also need to keep away from the poles in big waves.

## What happens in the really big storms?


IMAGES FROM OUR PAST

High seas generated by southerly winds have removed hundreds of tons of sand from St Clair Beach since the summer, exposing piles which were intended to stabilise the beach when they were put in more than 50 years ago. Mr Duke Gillies (pictured), a life member of the St Clair Surf Lifesaving Club, considers the beach is now [July 1976] in the worst condition he has seen for more than 40 years. A ramp used to launch a jet rescue boat has disappeared and will have to be replaced. Mr Gillies is standing on the remains of the ramp at the northern end of the Esplanade. The arrow indicates the level of sand during the summer — about 8ft [2.4m] above its present level.

PHOTO: OTAGO DAILY TIMES

On a fairly regular basis we get massive storms which strip huge quantities of sand off the beach. If we have plenty in a buffer zone, that gets taken first.

As soon as the weather turns to the north, sand starts coming back as you can see in the winter photo from 1980 on Pg 24.

In 1976, just the few planks shown in this ODT clipping were enough to restore a wide beach.

In 2014, with no groyne to hold a buffer zone on the beach, dunes next to the sand sausages were badly eroded. The houses behind were gravely threatened.

[17] Photos: Nic Reeves, http://phoam.blogspot.com/

## What do the consultants' say?

(Note: West & South describe the same end of the beach with East or North being the other end)

**Hodgson (1966)**[18]

*"She (Elliott) concluded that the anomalous nature of the spits around the Otago Peninsula is a result of longshore drift caused by the swell modified by north-east winds",* (causing drift to the south)

*"The importance of longshore drift promoted by south-west swell during storms should not be ignored as it is probably responsible for …the northerly dispersion of coarse sand and gravel mentioned by Elliott (1958)"*
(causing drift to the north)

**Kirk (1979)**

*"…longshore drift occurs in both directions along the shore (northward during southerlies and southward in north-easterlies)"*

**Smith (1994)**[19]

**"***…wave-induced longshore drift may be to the north or south in Otago"*

**Dyer (1994)**

*"… erosion at St. Clair is the result of large steep southerly swells transporting sand offshore and enhanced longshore currents transporting sand to the east away from the western St. Clair comer under extended periods of strong southwest winds."*

*"The main accretion at St. Clair however results from sand being transported into the western corner by westerly flowing longshore currents set up by easterly quarter swells. Under these conditions the beach can rapidly accrete."*

**Smith (2007)**[20]

*"Coastal erosion on the Dunedin beaches, particularly Ocean Beach, has been an issue since at least the 1920s, when protective piles were installed at St Clair."*

**ASR (2002)**[21]

*"A long-term and sustainable solution at St Clair, that also addresses local amenity and economic development aspects, must be aimed at protecting and restoring the shore below the seawalls* (TRUE)

*"Therefore construction of a groyne to the east of the seawalls would most likely capture sand moving to the east and result in accretion of this area, creating a buffer zone in front of the seawalls that could provide a long-term erosion protection solution."* (TRUE)

*"However, the response of these kinds of works would 'shift the problem down the coast'. Indeed, the groyne would form an artificial headland that would result in erosion of the eastern side"* (TEXTBOOK & NOT TRUE HERE)
(They preferred an off shore submerged reef and nourishment)

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[18] Hodgson W.A. (1966) Coastal processes around the Otago Peninsula, New Zealand Journal of Geology and Geophysics
[19] Smith, A.M. (1994) *Eastward to the Sea: A Scientific Review of Otago's Coastal Marine Area*. A regional coastal plan for the Otago Regional Council, 86pp
[20] Smith, A.M. (2007) *Marine Sedimentation and Coastal Processes on the Otago Coast*. A report to the Otago Regional Council, 46pp.
[21] ASR (2002) Issues and Options Report: Assessment of a Long-Term Solution to Erosion Control at St Clair Beach, Dunedin.

**Duffill, Watts & King (2002)**[22]

*"The option of a groyne field located at the end of the seawall addresses the issue of sediment supply and retention in the area affected by end effects. For maximum effectiveness of the groyne field, the design of the field needs to have sufficient spacing between the groynes and sufficient groyne length to allow the desired volume of trapping, and the beach needs to have a strongly developed unidirectional longshore transport system. While this option could be successful for dealing with "end effects" by trapping material in the effected zone east of the seawall, groynes are commonly also associated with the down drift transfer of the erosion zone due to sediment starvation effects. For St Clair Beach groynes would not be an acceptable solution. The groynes option will also not address the over steepened nature of the exiting dunes and will also produce issues with the visual appearance and maintenance."*

(TEXTBOOK & NOT TRUE HERE)

**Tonkin & Taylor (2011)**[23]

*"The groyne approach may have the potential to provide a medium to long term solution to managing beach and dune erosion. However, the risks of potential adverse effects as well as its effectiveness would need additional investigation."*

Tonkin & Taylor recommended "a '*holding pattern' of works during the 10-year period 2011 and 2021, involving maintenance and remedial work. … estimate the cost of this strategy at $200K per annum."*

**Hilton (2016)**[24]

*Most of the artificial surfing reefs constructed since 2002 have failed. Unless the structure was massive it is unlikely that a submerged reef would survive at St Clair because of the dynamic nature of the surf-zone at St Clair.*

*The incremental decay of the current sea wall indicates it is an unsuitable structure for this context. Moreover, the reclamation at the western end of the sea wall has likely exacerbated erosion in front of the wall, at least in part. The sea wall itself is probably responsible for the erosion of the beach and dunes to the east of the wall over the last three years. This is a classic end-wall effect.*

*We have not yet seen a trend of coastal erosion at Ocean Beach that might suggest a declining mass of sand in the nearshore sand system. We do observe episodes of beach erosion, invariably followed by periods of beach/dune recovery. In other words, a reduction in the contribution of sand to the coastal system, resulting from the constructions of dams on the Clutha River, need not adversely impact Ocean Beach.*

*The Council faces the choice of either protecting the current coastline (by either hard structures or beach nourishment); maintaining the status quo; or accommodating coastal processes by retreating.*

*Evidence for a **net** alongshore (west to east) drift of sand along Ocean Beach is lacking*

*The frequency and severity and impact of storm surge events warrants further research. It is interesting that the process that in large part explains coastal erosion along Ocean Beach has attracted the least attention.*

*We clearly do not fully understand the processes that drive inshore-beach sedimentation, or how structures may alter these processes.*

[22] Duffill Watts & King Ltd: 2002 St. Clair Sea Wall Study. Report to Dunedin City Council. 48pps appendices reports
[23] Tonkin and Taylor Ltd. (2011) *Ocean Beach – Coastal Issues and Options*. A report to the Dunedin City Council, 48pp.
[24] Hilton, M.J. (2016) *The Ocean Beach Coastal System, with recommendations for future research.*
A Report to the Dunedin City Council. University of Otago, Department of Geography, 50pp.

## Conclusion

As Mike Hilton points out, we have 3 options: Hold, Retreat or Protect.

1 - Currently Council is maintaining a holding pattern with the beach.

As Tonkin & Taylor suggested in 2011, this is costing ~$200,000 per year to maintain

This could continue for the next few years and it is likely that ever more rubbish will emerge from the landfill to contaminate Middle Beach after southerly storms. Similarly, regular repairs will be required to the sand sausages and the dunes immediately beside them due to end wall effects.

Further to that, the esplanade seawall is deteriorating from constant “water blasting” by wave action, “scratching” with rock movements and percussive “bashing” due to the full force of southerly storms.

It is inevitable that a larger than average storm will hit sooner or later and cause dramatic damage with accompanying costs.

2 - Retreat would require excavation and relocation of the landfill as well as removal of the Esplanade seawall and buildings.

This option would accommodate natural coastal processes and take us back to where the beach should be, however, not only would the cost would be enormous, the general public are likely to be quite reluctant to lose their beach amenities let alone pay heavily for the privilege.

Consider also the carbon consumption shifting landfill contents all the way to Southland because Green Island is full and Smooth Hill is not ready.

3 – Protecting what we have is a viable option especially if the starting point is repair of the existing groyne.

Other structures such as walls and sausages cause more erosion and off-shore reefs are problematic.

The groyne on St Clair is essentially a beach self-nourishment device. It is proven to capture and hold sand on our beach.

The cost to rebuild it is less than current annual maintenance and when it’s working, the beach will cost us considerably less to look after.

The general public love the look of the poles on the beach and they welcome their return.

As Mike Hilton says, there is much that we do not understand about beach processes. What we definitely DO know is that groynes were built at least 3 times on St Clair and celebrated as greatly successful each time until lack of maintenance let them down.

So, I suggest that we repair the remaining groyne to its original specification then observe and measure the results carefully for 5 years as a trial. Then we will know a lot more about the shifting sand of St Clair.

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# Endnotes

## [A] Petition

A petition was established to enlist support for reinstating the poles, here are some comments from a few of the 2384 signatories who made the effort to write something:

| Name | Comment |
|---|---|
| Clive Copeman | "This solution works with natural processes instead of against them and is proven by historical practice. It is also a fraction of the cost of other responses." |
| Andy Parsons | "Sounds like a 'no-brainer'.....let's make it happen" |
| C Higgins | "I live across the road and the beach/sand dunes need some major help" |
| Gregory Crawford | "because we need this fixed not talked about, needs to be done now" |
| Tom Macaulay | "THis Wesson to happen pronto." |
| Kristie Macaulay | "I live on St Clair and if nothing is done we could lose our homes in the not too distant future!!!" |
| Elizabeth Williamson | "because the beach has been ruined" |
| Darryl Tackney | "This is a great idea" |
| Alister Calvert | "Building beaches not walls is my preferred option. Work with nature not against it. I'm a beach walker of 25 years and a keen observer of the constant changing nature of our beach" |
| Sandra Sutherland | "This method works. You can't stop water. But you can affect the flow" |
| Catherine Bennett | "I'm signing because it's a "no brainer"" |
| Kees Meeuws | "Preservation of our beach is important for many reasons. The main one is to stop further erosion." |
| Laura T | "A great idea to help bring back our much loved beach :)" |
| Jon Bracey | "It's been effective in the past and is a low-cost option to get in place almost immediately - there's nothing to lose and potentially so much to lose." |
| Keiran Kennedy | "Old ideas have a place in our modern challenging world" |
| Russell Duff | "It is logical to replace these posts to help the ocean NOT swirl out the beach and sand and stop the face from the being washed away. This is one issue, the other is the raising of the sea level with Global Warming. This has got must be reversed otherwise we are doomed to a watery future.." |
| Martin Sparks | "Simple action is better than not doing anything. The pier that was erected while sewage outfall pipe created offshore sand banks in no time at all. Reinstate timber sand traps now!" |
| Pat Laney | "I think this is the best option" |
| Kirsten Timms | "I grew up at St Clair. It's sad to see the erosion that is occurring, the poles are a Dunedin landmark and if repairing them brings back the sand then all the better." |
| Tamzen Katipa | "Come on DCC! Do something" |
| Judith Smith | "Don't want it to be lost forever." |
| Linden Davey | "I'm signing because as a x Stclair resident and landowner at Teroane Beach .I have watched awe to the massive of land that has been lost while the council have been sitting on there hands and doing absolutely nothing." |
| Pamela Walker | "I love our beach" |
| Sue Quinn | "I spent a lot of my childhood on that beach...lots of memories..it's worth saving." |
| caz brigham | "All that building rubbish below Moana Rua and Kettle Park is horrid" |
| Vivienne reiber | "They have always been there!!!" |
| Cherie Valster | "It's a special family place ❤□" |
| Ant Field | "Save the beach!!!" |
| Nichola MacArthur | "I love our beaches, and we need to retain the sand." |

| | |
|---|---|
| Rebecca Twemlow | "Giving this option a good nudge makes sense - financially it is a drop in the ocean (ha ha) and emotionally for the residents it is worth the effort. Such an iconic part of our city and fantastic memories for so many of us. Don't let this go so easily." |
| Bridget Schaumann | "I want a sensible decision and I can't bear for nothing to be done. This is my neighbourhood and I'm desperate to preserve it." |
| Geoff Weston | "Because the sand trap Goynes are the most proven method around the world of retaining sand. They are also the cheapest and easiest to maintain or shift." |
| Darryl Jones | "Something needs to be done, it will require some extensive and innovative work, something to satisfy the surfer, the fish species and stabilisation" |
| Lynda Mason | "I believe the groynes are the most effective option." |
| Denise Burnham | "its sad to see the erosion" |
| Jessie Lenaghglue | "We need to do everything possible to keep the sand on the beach. Groynes are low impact and proven" |
| rex askerud | "I'm signing because I think this suggestion has merit based on historical evidence and the alternative of retreating is too costly and will not gain support." |
| Mark Ford | "It's time the DCC took action to protect the beach and attraction to locals and visitors" |
| Damian Phillips | "Something needs to happen and this is one of the best ideas on the table." |
| Vanessa Elliott | "The poles at St Clair were an iconic feature to the St Clair beach, it's such a shame to have these structures the way they are at the moment. Please fix the poles and look after our beach ??" |
| Jules Averill | "The poles are iconic and a nod to the past" |
| Mark Patton | "Groynes are the better option." |
| Leigh Nemeth | "Please bring them back, they are a symbol to some of us, a place we can go to, a place that helps us to clear our minds, to make a day easier to cope with. It may not mean much to some but means a lot to me. Bring back the beach pole please. ??" |
| Marama Pou | "I have many fond memories surfing St Clair it will great to see it returned to its former sandy beach state. getting in and out of the water onto those rocks at high tide is terrifying!!" |
| Shirley Blick | "It sounds like a great idea. If it has succeeded before why not do it again. Sometimes old methods are the best" |
| Margaret Drummond | "We need this to happen, no long months of discussion just DO IT." |
| Judith Currie | "We need to retain a vibrant and safe beach which is an asset to the city. With climate change we need to make the beach safe for the next generation urgently" |
| Chris Stephenson | "Worth a crack - gotta be cheaper than sausages and constant contracting of excavator operators." |
| Annabel barton | "I love St Clair beach" |
| Alan Moir | "Want the sand back. Beach back" |
| Jill Herbert/Geary | "I believe in saving a Dunedin icon" |
| Sandy Penny | "Want the sand back" |
| trevor baines | "It worked in the past so has to be worth trying again. This council lacks common sense and balls." |
| Brittany Whelan | "I want the sand back" |
| Dana Corfield | "Why wouldn't ya" |
| Dana McLeod | "It seems like the most viable and cost effective option for this iconic natural beauty." |
| Christine Ingle | "I love the beach !" |
| Judy Sapsford | "Love our beaches. I believe this idea is of great significance" |
| Sahayog Sahay | "Have some good memories of this place" |
| Anya Georgeson | "I remember how great St Clair Beach used to be ....sandy!!! If this would work that would be awesome ?" |
| Clint van Zyl | "It's about time the council realised long shore drift can be fixed and beaches can be brought back to their former state." |
| Sean Arlidge | "I agree ." |

| | |
|---|---|
| penny kirtley | "I like my beach...seems like a no brainer" |
| Lars Voorkamp | "It's a no brainer, stop the erosion with cost effectiveness." |
| Marika Bevin-Jukes | "I enjoy this beach everyday and want my kids to be able to do the same." |
| Annie Naylor | "Not only save the beach but restore another city icon" |
| Gaynor Saunders | "The beach needs our help" |
| Steve Parkinson | "It is a St Clair beach landmark and needs to be there." |
| Sarah Smith | "Bring back our landmark" |
| Anna Taylor | "I love St Clair beach and something needs to be done. This is worth a shot!" |
| Lisa Fletcher | "Stupid not too!" |
| Deborah Nicholson | "It's how I remember Dunedin. So many photos taken of this view/ posts. Bring back the posts." |
| Diane Yeldon | "D" |
| Clare Pascoe | "Save St Clair beach for future generations." |
| Trisch Inder | "We need to learn from what we know works best balanced with having the least interruption to the natural flow of things." |
| Giselle Cooper | "I believe building a groyne or TWO is worth a try. If the surf had been affected and more rips were created from previously, wouldn't this have been reported in the old newspapers? Give it a try Dunedin!" |
| Monica Stowers | "I spend a lot of time in Dunedin and specifically St Clair. I lived in Dunedin so it's a special place to me." |
| Julie Kelly | "Not enough is being done to reduce or stop coastal erosion . It is action like this that helps reduce it. Also in more coastal areas ." |
| Kirstien Holloway | "I have visited this beach with my family and to leave it wash away seems such a shame when something so simple can be done to prevent it." |
| Keni Pee | "I miss my childhood beach" |
| Jamie Gough | "Worth a try" |
| Sharon Rohtmets | "the groynes will work better when replaced but we need more." |
| Kathy Baughan | "I love the poles" |
| Lynn Patrick | "We need to put those poles back to save out beach.. I'm sure we have plenty of old power poles around to be driven into the ground...." |
| Julie wroblenski | "I care about the beach." |
| Jamie Heaps | "Need the build up of sand to protect coast line" |
| Jeanette Campbell | "I'm signing because I love that beach, for many reasons" |
| Andrew Clark | "This has been a functional asset for the city in the past. It should be brought back to stabilize the beach environment." |
| David Lott | "I love Dunedin" |
| ANNABELLE Crichton | "They have worked for year The DCC just want to make a name for them selves by trying all new ideas" |
| Marion Harper | "It is very important to be proactive." |
| Apollonia White | "I would like to see this area looking great" |
| ellie brown | "I agree this should happen" |
| Garry McLennan | "Bring back Saint Clair" |
| Lorna Allan | "Save our beach and our city from the damage being caused here. I have lived in Dunedin almost all of my life. Fixing these sand trap groynes is an easy and cheap resolution and will work as it has done for over a century. Please! Use some common sense. What has worked in the past for so long will work again. We have these beautiful beaches right on our doorstep and a beautiful city. Just get it fixed before we have neither." |
| Sally Pearce | "Love .my beach lets save it" |
| carol Padgett | "It's a lovely beach" |
| Dan Warren | "I want to see a change made" |

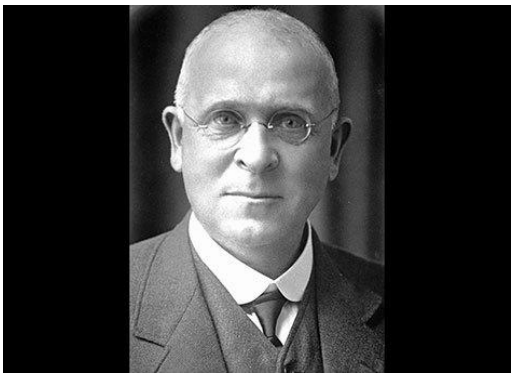
| | |
|---|---|
| Corey Wilson | "Every year I go home more and more sand has disappeared..... Come on enough is enough, re build the groin and get the sand back Dunedin." |
| scott mcdonald | "we need our beach back" |
| matthew elliott | "It just makes sense !" |
| Mark Patton | "Just here because I care." |
| Naomi Mulqueen | "Save St Clair" |
| Barbara Buckleycunningham | "I think it's a great idea" |
| Lesley Driver | "I go to Kettle Park most days with my dog and I'm getting very concerned about the scary state of the Sandhills. Imperative the groynes are installed. Now!" |
| Marilyn J Cook | "Time something worthwhile was done!" |
| Karen Musk | "I care about Dunedin and think this is a great idea" |
| Peter Watkins | "The DCC obviously have "No idea, what they are doing"" |
| DENISE MACDONALD | "Bring back our beach." |
| Renee Browne | "My home town and great beach" |
| Helen Iaseto | "They worked before at our beach and around the world they are also used for sand retention we must try as every ting so far has failed" |
| Dave Duthie | "It worked before, old school ideas that people forget about." |
| Louise Lunam | "They are part of St Clair" |
| Dorothy Denniston | "I was bought up in StKilda spent all the good weather weekends at the beach where we had lots of beautiful white sand to play on. It would be most disappointing to allow it to erode away when there seems to be a solution." |
| jan foote | "Agree totally ...Preserve our beautiful beach ..." |
| trevor firman | "Something needs to be done" |
| Stuart Loudon | "Because the science does say they work" |
| Chris moody | "The sand needs to come back for the surf and protection of our coastline" |
| Brett Sherriff | "It's the common sense thing to do, stop trying to re invent the wheel" |
| Scott manson | "Give it a shot." |
| Braden Grubb | "I love a good groine" |
| Lisa Candace | "I completely agree focus on our beaches and land for good reason instead of manipulating our land for the cyclists. Our waters are rising too fast and if nothing's done it will be too late." |
| michelle Ludlow | "So we can still enjoy the beach" |
| Steve Croy | "I care !" |
| Carolyn McMillan | "They are part of Dunedin" |
| Michelle debono | "Often solutions can be found by looking back" |
| Stuart Davis | "I can't understand why this hasn't been a council priority if they are so effective and far cheaper in the long run!" |
| Kirsty Thomson | "Not only are the poles a visual Dunedin icon, but they can also help stop the erosion happening at St Clair beach." |
| Rhonda Umfreville | "Let's save our beautiful beach here in Dunedin. It has worked for years, then lets do it again." |
| Rosie Ross | "Do all you can while they are still there to help save the beach" |
| Lucinda McConnon | "I love this beach and it seems absurd that a system that has previously worked in mitigating erosion and sand loss has been allowed to fall into such a state of neglect that many people have no idea that the poles even were a groyne, or what purpose that served!" |
| jp perry | "We need this" |
| Colin De Freyne | "I've been going to St Clair for about 10 years. It is one of the Dunedin jewels and the beach should be preserved for both current and future generations." |
| Karen Musk | "I care about Dunedin" |

| | |
|---|---|
| Johannes Van der Voorn | "It's the simplest way to solve the erosion problem. I am a civil engineer so have a good understanding of the issues." |
| Glynn Babington | "It is well worth trying and cot of doing this with old power poles would be more viable than other options." |
| Riki Nicholson | "Has to be done really, why not try it and see if it works because everything else the council has done obviously doesn't" |
| Christine Galbraith | "It makes sense to work with nature using groyens which are economical, eco friendly proven effective uncomplicated technology to grow & protect the sand dunes, the coastline and adjacent property. I would like to see the placing of a covenant on the groyens to ensure the maintenance / replacement of the groyens is mandatory." |
| Ian Loan | "This should be fixed" |
| scott james | "I want to see the esplanade given the respect it needs . A major asset to the city that's been left to erode . Shame on those that are responsible . It time to take it back and get it fixed !" |
| Pamela Marie Clark | "I agree it should have been done years ago." |
| don woodward | "good for surfing" |
| Brigid M | "The poles need to be repaired" |
| Jared Dixon | "I want St Clair to return to its former best" |
| Olivia Goddard | "it is a feature of dunedin that needs to be celebrated and looked after" |
| Lysa Nicoll | "I love this beach, such a special place for so many." |
| Esther Moore | "Dunedin is my home town and I spent a lot of my youth at St Clair Surf Club" |

Despite what many think, the poles were never for a wharf, they were installed for a different but very significant purpose – to build up the beach and save the esplanade.

## B John Blair Mason

John Blair Mason was born in Dunedin on 22 September 1858. He served his apprenticeship in an Otago foundry, attending Otago University at the same time.



John Blair Mason, circa 1918. Past Presidents Album IPENZ.

In 1882 he was articled to Messrs. Barr and Oliver. Mason then became the Otago Harbour Board's Assistant Mechanical Engineer and Marine Surveyor, working under engineer George Morrison Barr.

For health reasons, Mason went to Australia in 1887 and was engaged on Harbour surveys until 1890. He was then appointed Marine Engineer and Surveyor to the Ports and Harbours Department, Victoria. Mason received admirable testimonials and a certificate of service from the departmental heads when he resigned.

In 1901 he commenced private practice in Otago. Mason was the Otago Harbour Board's Engineer, Secretary and Treasurer from 1904 to 1913, then focused solely on the engineering role. In 1916 Mason went into private practice again, but was retained by the Otago Harbour Board as their consulting engineer.

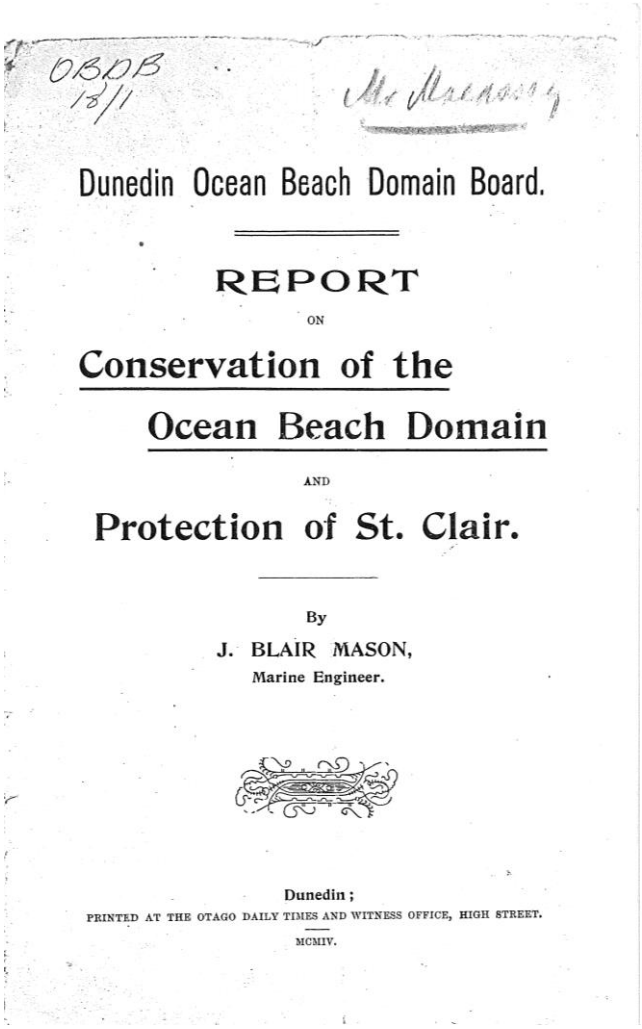
In 1919 Mason went into partnership with former Otago Harbour Board Assistant Engineer, George Allen Lee, based in New Plymouth. They undertook harbour works projects in Auckland, Hawke's Bay, Tauranga, Whakatane and other places around the country. Electrical engineer, AC Owen, joined their hydraulic and marine engineering practice in 1920.

During this period Mason was also on special commissions with William Ferguson and Cyrus Williams in connection with Gisborne, Waikokopu and Napier harbours, and with Ferguson and Frederick Furkert reporting on improvements for Greymouth Harbour. His work in Otago Harbour was notable for greatly improving it, at moderate expense, by using groynes. Mason was also involved in dredging, reclamation and wharf upgrade projects.

Mason was elected a Member of the Institution of Civil Engineers (ICE, Britain) in 1913. The following year Mason was a foundation member of the New Zealand Society of Civil Engineers (NZSCE, now the Institution of Professional Engineers New Zealand (IPENZ)) and was President in 1917–18. In 1915 Mason received the ICE's Telford Premium award for his paper on Harbour improvements and works at Otago Harbour.

Mason died at Devonport, Auckland, on 24 December 1927. The NZSCE obituary states: "Mr Mason was widely known throughout New Zealand and Victoria [Australia], and was esteemed by all for his kindly disposition, as well as his professional ability" (*Proceedings of New Zealand Society of Civil Engineers*, Vol. XIV, p289).

## C Report on Conservation of the Ocean Beach Domain



ORDB 18/1

Mr Mirams

Dunedin Ocean Beach Domain Board.

# REPORT

ON

# Conservation of the Ocean Beach Domain

AND

# Protection of St. Clair.

By

J. BLAIR MASON,

Marine Engineer.

Dunedin;

PRINTED AT THE OTAGO DAILY TIMES AND WITNESS OFFICE, HIGH STREET.

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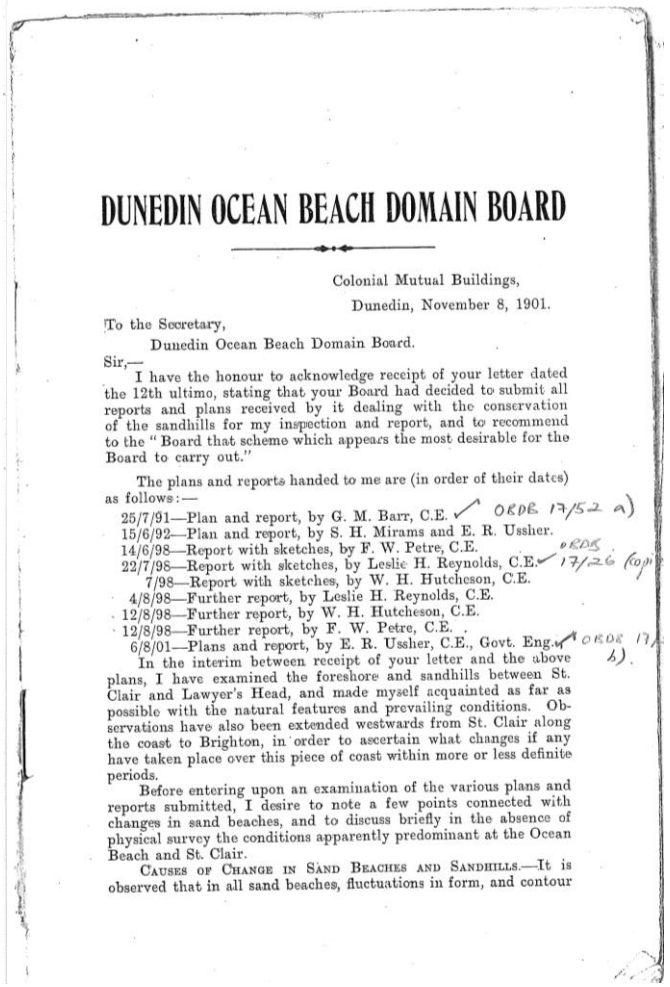


## DUNEDIN OCEAN BEACH DOMAIN BOARD

Colonial Mutual Buildings,

Dunedin, November 8, 1901.

To the Secretary,

Dunedin Ocean Beach Domain Board.

Sir,—

I have the honour to acknowledge receipt of your letter dated the 12th ultimo, stating that your Board had decided to submit all reports and plans received by it dealing with the conservation of the sandhills for my inspection and report, and to recommend to the "Board that scheme which appears the most desirable for the Board to carry out."

The plans and reports handed to me are (in order of their dates) as follows:—

25/7/91—Plan and report, by G. M. Barr, C.E. ✓ ORDB 17/52 a)
15/6/92—Plan and report, by S. H. Mirams and E. R. Ussher.
14/6/98—Report with sketches, by F. W. Petre, C.E.
22/7/98—Report with sketches, by Leslie H. Reynolds, C.E. ✓ ORDB 17/26 (copy)
7/98—Report with sketches, by W. H. Hutcheson, C.E.
4/8/98—Further report, by Leslie H. Reynolds, C.E.
12/8/98—Further report, by W. H. Hutcheson, C.E.
12/8/98—Further report, by F. W. Petre, C.E.
6/8/01—Plans and report, by E. R. Ussher, C.E., Govt. Eng. ✓ ORDB 17/ b).

In the interim between receipt of your letter and the above plans, I have examined the foreshore and sandhills between St. Clair and Lawyer's Head, and made myself acquainted as far as possible with the natural features and prevailing conditions. Observations have also been extended westwards from St. Clair along the coast to Brighton, in order to ascertain what changes if any have taken place over this piece of coast within more or less definite periods.

Before entering upon an examination of the various plans and reports submitted, I desire to note a few points connected with changes in sand beaches, and to discuss briefly in the absence of physical survey the conditions apparently predominant at the Ocean Beach and St. Clair.

CAUSES OF CHANGE IN SAND BEACHES AND SANDHILLS.—It is observed that in all sand beaches, fluctuations in form, and contour

at high and low water inevitably occur, depending chiefly upon the degree of exposure, recurrent meteorological changes, and the variation in strength and direction of the wave force and of the coastal currents. These agencies produce either local movement and transport of sand from one portion of the beach to another, and augment or diminish the supply of sand from the sea, promoting changes sometimes more or less permanent, but generally of an evanscent character, the tendency being towards the assumption of its original state under normal conditions of wind and weather. Usually a state of practical equilibrium is attained when Nature is left to herself. But with the increase of settlement along the coasts of our colonies marked changes have taken place in the sandy shore formations. I have noted changes in the foreshore over large portions of the Victorian coast from Cape Northumberland to Cape Howe. On the southern coast of that State the sand dunes are steadily growing and extending inland in places, while on the east coast encroachments of the sea are occurring between Corner Inlet and the Ninety Mile Beach. And on our own coasts analogous changes are in progress. Mr C. W. Adams, then Chief Surveyor at Dunedin, writing in the "Otago Daily Times" of 11th June, 1891, alludes to changes at Port Molyneux and near Taieri Mouth, where extensive denudation is reported as taking place. And we have similar evidence in the alterations visible between Brighton and Lawyer's Head. In the neighbourhood of Green Island and Lawyer's Head sand is accumulating, while the result of denudation is observed at St. Clair.

It is abundantly evident to any intelligent observer that these changes are consequent largely upon the disturbance of natural conditions from the landward side, brought about by the advance of settlement and civilisation. The removal of the fringe of forest, bush or scrub continguous to the coast and sandhills, the destruction of the natural sand grasses by cattle and traffic, and the breaking of the sand crust by the same agency, may be cited as potent factors in producing the undesirable changes manifest along our coasts.

Dealing specifically with the Dunedin Ocean Beach, the present instability may be considered due to—

(a) Alterations to natural conditions from the landward side by the destruction of the original fringe of vegetation, especially at St. Clair.

(b) Loosening and destruction of sand grasses by cattle and traffic.

(c) Removal from the beach of sea wrack, marine debris, drift-wood, etc. (Debris of every kind aids materially in preventing the travel of dry sand.)



(d) Breaking up of the sand crust by traffic.
The saline crust formed in dry weather where sand is exposed to the ocean spray and the receding wave prevents drift to a considerable extent.

(e) Artificial removal of sand, especially at St. Clair and Musselburgh.

(f) Variations from seawards in the original wave action, caused by alterations and removal of rocks at St. Clair Baths. It is much to be regretted that the rocky shelf upon which the baths are formed has been interfered with, either by the removal of rocks or by excavations, without mature consideration being given as to the result of such action in affecting the trend and force of the sea in certain weathers upon the contiguous beach. From inspection I am of opinion that during the prevalence of heavy westerly and southerly weather, the rush of water over the shelf is greater now than before the construction of the baths, and acting on the beach obliquely drives the sand before it, aiding materially at times the process of denudation.

## PREVAILING CONDITIONS.

It is to be regretted that no full and complete survey embracing observations on the force and directions of inshore currents, sand movements, etc., is available as preliminary to the formulation of any improvement scheme.

Currents.—The Admiralty Sailing Directions (see page 267, 5th Ed.) and Mr Petre's extended observation bear out the general statement that, the coastal currents are up the coast easterly, and that therefore within the limits of breaking seas, which in time of storm may extend out to the six fathom line, the sandy bottom is in motion in the same direction.

Exposure.—It may be conceded that the exposure between St. Clair and Lawyer's Head is not the same under all circumstances. In westerly to southerly weather the St. Clair portion of the beach is under the lea of the rocky buttresses to the west, which act in deflecting the coastal current seawards, and altering the direction of the wave motion, so that during such weather the above portion of the beach is more or less sheltered from the full force of the sea. From Mr Petre's observations it would appear as if such influences were felt through two-thirds of the distance from St. Clair towards the Central Battery at which distance the full force of the sea is encountered, with increased sand deposit.



## SAND DEPOSITS.

One must clearly endeavour to arrive at a knowledge of the conditions under which sand deposits are formed in any particular locality before attempting to assist or retard Nature in her work, and the data to hand and observations made should be fuller and more extended, before the exact positions and lines for permanent works are laid down.

In the course under consideration we have to deal with the two classes of sand deposits or drifts—viz., water-borne drift, and wind-borne drift, the quantity of the latter depending upon the supply of the first.

Water-Borne Drift.—As already noted the drift of sea sand is up the coast, being lifted from the bottom within the area of broken water, and transported laterally by the current close in or off the shore, depending upon the force of the sea and the character of the coast. Opposite a bold and cliffy coast I have usually found the bank of drift out from the foot of the cliffs, the distance varying directly as the wave force. Facing a shelving or sandy shore the drift may be found close to, in rough weather frequently forming a ridge parallel with the shore, and approaching nearer thereto as the sea moderates, until with fine weather it may be heaped up above low-water mark, until finally by the wave action incorporated to form the beach at high-water mark. This process can be seen in action very plainly between Lawyer's Head and Musselburgh, where the building up of the beach from seawards appears to be greatest. In the case of the beach opposite St. Clair it has been pointed out that the rocks to the westward tend to deflect the current and the trend of the wave during southerly and westerly weather when the drift of sand from seawards must necessarily be greater than at other times. But such drift will probably, by the above agency and also by the heavier wave reactions at such seasons, be kept well clear of the shore a considerable distance north of the rocks, while the waves impinging on the beach obliquely, cause any sand that may be washed up to work away from the bight. Under pristine conditions such action would probably not have proved detrimental to stability, as the sand deposited during fine northerly or easterly weather together with wind-borne drift would have gone to maintain the natural balance.

Supply of Water-Borne Drift.—I cannot see any reason to fear that the supply of water-borne drift is not as great as in the years before settlement, or that for years to come there will be any diminution thereof. The sands brought down by our rivers and streams such as the Molyneux and Mataura, the never-ceasing disintegration and erosion of the cliffy shore, shown near home at the cliffs south of Mr Cargill's residence, and the disturbance of



old deposits along the coast to the south will provide a more or less constant supply. Every southerly gale must bring its quota of drift opposite the beach, a portion of which working inshore as the sea goes down will replace the sand carried away by the same gale to the eastward.

Wind-Borne Drift.—The distribution of the wind-borne drift, as well as its confinement within limits require consideration in the work of conserving the sandhills and foreshore. I think the tendency at the Ocean Beach is as a whole towards aggregation, but at the same time it is apparent that the beach suffers from unequal distribution of the sandy spoil. The preponderance of drift in the open must of necessity be in the direction of the prevailing winds—i.e., from St. Clair towards Lawyer's Head, unless modified by the influence of environment. During the prevalence of winds from north to east, the wind-borne drift deposited in the bight at St. Clair will not necessarily be all displaced by winds of equal rate from opposing quarters, owing to the comparative shelter afforded by the surrounding hills. (It might be worth asking in passing whether the clearing in recent years of the original bush from the surrounding gullies and hills, may not allow the westerly winds more scope in sweeping the bight than in former years, and thus hasten the process of denudation.) I am inclined to the opinion that the primal reason for the fretting at St. Clair is the displacement of the wind-borne drift from some of the causes connected with settlement (see page 4), and no doubt helped by the removal of rocks at the baths, erection of sea opposing walls, and efflux of drainage.

## REPORTS AND SCHEMES.

The reports submitted are addressed to various persons and bodies, and cover a period extending from July, 1891, to August of this year. They cannot in every case be considered complete schemes, the writers, no doubt, being confined by the tenor of their instructions. In only one instance has a general scheme been submitted in a competitive manner, and to regard the remaining reports obtained at different times and under different instructions in the same light cannot be intended. The location and character of design for a sea wall or embankment is discussed in all the reports, and appears the only question that is generally treated with fair detail. I have, therefore, endeavoured in the first place to concisely define and compare their essential propositions dealing with the general maintenance and conservation of the domain, and in the second place to indicate from submitted designs the class and character of sea wall which in my judgment would be the best for the Board to adopt, if such were found to be necessary.

ADDENDUM.—In the addendum to this report will be found some notes on the maintenance of the Ocean Beach and fuller details of conservation operations, together with other cognate information which may aid the Board in the initiation of improvements and management of the Domain.

## OPERATIONS.

The subject will be dealt with under two heads—viz.:—

(a) PROTECTION AND CONSERVATION OF SANDHILLS AND BEACH.

(b) PROTECTION OF ST. CLAIR AND RE-ERECTION OF SEA WALL.

### (a) PROTECTION AND CONSERVATION OF SANDHILLS.

1st. PROTECTION.—The three methods suggested in the reports as applicable for raising the beach and securing the protection to the sandhills are—

(a) Arrest of wind-borne drift by means of wind-brakes inshore of high-water mark.

(b) Arrest of sand travel generally by means of groynes extending out beyond high-water mark.

(c) Protection of sandhills and flat by means of sea walls or embankments, with or without protecting groynes.

(a) Of the above methods there is no doubt that the first (a) is unquestionably the method that should primarily be adopted or tried wherever favourable conditions obtain, such as immunity from inundation and of exposure to sand travel. Mr Barr, referring to the breaches in the sandhills between Musselburgh and St. Clair, says: "But I will point out the proper principle to adopt in this will be to endeavour to induce the sandhills to extend from the beach, outwards." And this expresses the views of Mr Hutcheson and Messrs Mirams and Ussher on the same point, with which I concur. The success of the fences already erected at Musselburgh is an earnest of what may be expected by their further extension, and favours the belief that the depression forming the lagoon may thus be ultimately filled up to a level sufficient for the growth of vegetation.

The barriers across the depressions might with advantage be made of more substantial materials than brushwood, so as to last for some time and sustain the effect of a possible submergence before the sand has had time to accumulate (See clause 15 of Messrs Mirams and Ussher's report).

(b) The second method (b) of promoting sand accumulation by means of groynes extending out beyond high-water mark is evidently peculiarly adapted to the conditions prevailing at the Ocean Beach, and in places where the first method is not applicable, should assuredly be tried before attempting the construction of



sea-opposing walls. The raising of the beach and consequent retirement of the high-water mark is necessary to prevent undermining of the sandhill slopes, the stability of which must be maintained and their surfaces more or less "fixed" before grass-planting thereon can succeed.

The portion of the beach between St. Clair and Central Battery, where the slopes of the sandhills are washed by the sea at high water, might be raised by means of the groynes referred to in Messrs Mirams and Ussher's report (clause 16) and Mr Leslie H. Reynolds's further report of 4/10/98. These consist of framed timber work or hollow cribs filled with stones or of stones alone. An extensively-used and safer construction of groyne for exposed positions consists of a row of piles spaced a few feet apart, with or without bracing and sheet piling between. This latter class of groyne I would personally be inclined to advocate for the situation in question, but at the same time think it advisable for a crib groyne to be tried in the first place as a test of its strength and efficiency in withstanding the wave force to which it may be exposed. I have not the slightest doubt that the construction of groynes as suggested would, wherever placed on the outer beach, stop further encroachment and build it up by arresting the travel of drift eastwards. One may point to the efficient protection of portions of the Kentish coast, the coast of Sussex, Norfolk, and north of the Humber brought about by analagous means. And in the same manner, no difficulty has been found in stopping sea encroachment in the State of Victoria. Swan Island, at the entrance to Port Phillip, lost acres year by year until protected by groynes, when accretion commenced, and is still in progress where thus protected. Indeed, the trouble has been to prevent sand accumulations owing to the effect produced by numerous jetties and piers run out from the exposed sandy coast. These interfere with the natural movement of the drift by acting as groynes, resulting in a making of the beach and decreased depths of water in the vicinity of such piers.

(c) The third method (c) of opposing further sea encroachments by means of a sea wall is one that, in my opinion, should only be resorted to when the conditions are such as to admit of no other alternative, which is not so in the case of the Ocean Beach. The stoppage and holding of the sand continually supplied from the sea, and meanwhile drifted by wind and tide, are all that is necessary to build up and maintain the beach, a result which no wall in itself could effect. The tendency of a wall would be to lower the beach, unless flanked by groynes, which would in turn, by encouraging sand deposit, probably render such wall unnecessary. I am convinced that the methods (a) and (b) already described will accomplish the desired object, and am therefore not prepared to advocate walls or embankments as a defence against sea encroachments at the Ocean Beach, the effects of which may be serious and far reaching.



RECLAMATION AND CONSERVATION OF THE SAND FLATS AND SANDHILLS.

The subject is touched upon in clauses 15, 16, 17, 18, and 19 of Messrs Mirams and Ussher's report, and also by Mr Hutcheson on pages 3 and 4 of his report, with which I fundamentally concur. It seems to me necessary, however, that something more than a bare outline of such operations is necessary, and I have therefore treated the matter of sand fixing and horticulture more fully in the addendum (page 17).

PROTECTION OF ST. CLAIR AND RE-ERECTION OF SEA WALL.—The provision of a sea wall for the protection of St. Clair and the Ocean Beach, is either the main or exclusive subject of the reports submitted, and the choice of design or scheme, and location of such, would appear to be the only definite questions upon which the Board require determination.

As before stated (see pp c page 9) there are reasons for counselling delay in the construction of walls until the beach has been raised and conserved. No doubt the comparatively sheltered position at St. Clair would be more favourable to the maintenance of a wall than at any other part of the beach. But I hold strongly that the raising of the beach by the interception of sand drift or other means, should precede the erection of the esplanade wall. (See addendum, page 14).

DESIGNS.—The various designs submitted provide for walls or embankments in timber, masonry, concrete, and rubble, with or without stone protecting aprons.

The efficiency of any sea wall depends primarily upon stability of foundation, and as sand forms one of the best foundations *when confined and not allowed to escape*, the design best calculated to maintain this condition, other things being equal, should have the preference.

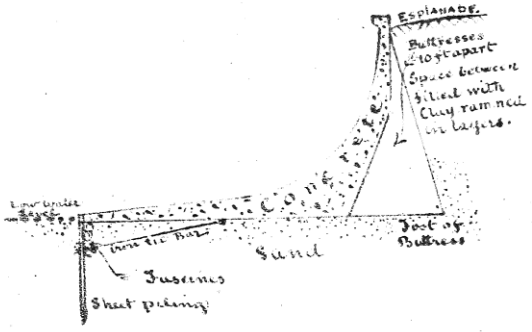
A loose rubble or stone wall, laid on the bare sand, and exposed on its face to the wash of waves on a sloping beach, would certainly sink as the reaction of the waves lowered the sand level, thus allowing the sandy foundation to be washed away through the interstices of the wall. While this danger is greatly averted by means of fascine mattrasses or clay puddle, I should hesitate to recommend works of this character as suitable to the conditions of exposure and formation met with at the Ocean Beach. *The structure one would advocate would present a solid surface to the sea,* and secured as far as possible from undermining from the waves and the percolation of fresh and salt water.

The designs in concrete, timber, and masonry fulfil these conditions more or less.

WALL IN CONCRETE.—The concrete monolith proposed by Mr Hutcheson is unquestionably (considered as a sea defence) the most



satisfactory design, and if carefully built and placed, would, in my opinion, give the maximum of security at the minimum of cost. The sketch (copied from Mr Hutcheson's report, page 5) shows the cross section of the above wall. It will be seen that the toe of the wall is shown as sunk to the level of low water.




Mr Hutcheson roughly estimates the cost for ten (10) chains of the above wall at £2500, a sum which at present rates for labour and materials, would have to be increased to £3000, with an allowance for formation of esplanade and wing wall at Forbury road, bringing the total approximate expenditure up to £3500.

The difficulty and risk in constructing the wall to the level proposed will no doubt be great, and, moreover, I am not at all sure if much will be gained by it, in the event of such structure being required.

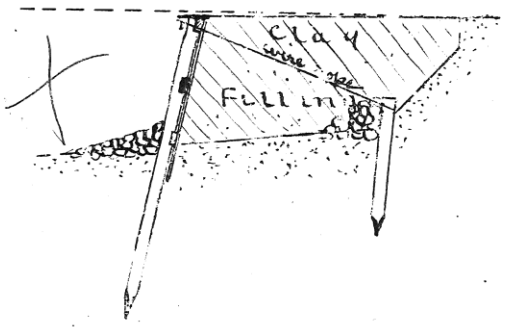
MASONRY WALLS.—Designs in masonry are furnished by Mr Barr and Mr O'Connor.

Mr Barr's designs (see plan No. 4 P W) consist of nearly vertical walls upon a foundation of concrete in bags, and protected

in front by close sheet piling driven eight or nine feet into the sand. The only difference between the designs is their height and location with regard to high-water mark as it existed when Mr Barr drew up his report.

Mr O'Connor provides a curved masonry wall, upon a rubble foundation, with an apron of rubble in front. (See plan No. 2a P W). I do not consider this design at all suitable for the locality in question, where stability of foundation is the chief consideration.

Timber Walls.—Alternative schemes for a timber wall are furnished by Mr Barr (see plan No. 4 P W), all of similar design but differing in height and location. The sketch below of "Scheme E" is typical of the others.




The estimate given for the wall as above is £1810. For a wall exposed to wave action it would, in my opinion, be necessary to put in double sheeting, and carry the same somewhat deeper. A fascine mattrass under the stones forming the apron would give greater security against undermining and escape of the filling. The adoption of the above suggestions would increase the above estimate by £300, making a total of £2100.



Recommendations.—I submit for the Board's consideration, the design in concrete by W. H. Hutcheson, and "Scheme E" in timber by Mr Barr as alternative designs for sea walls should such be required.

Concrete.—The wall in concrete has the merit of durability, strength, and stability, but is costly. Estimated cost, £3500 (for ten chains).

Timber.—The timber wall, while not so durable as the above, will, if built of approved hard woods, be good for thirty years. I consider it a safer and more stable construction than the various designs in masonry, and in the event of damage or undermining would be more easily repaired and made good again. Estimated cost, £2100 (for ten chains).

In the event of the raising of the beach by means already suggested, a timber structure similar to the foregoing would form an admirable breastwork for the esplanade, with the omission of the apron or stones. I would not favour a lower level for the esplanade than provided for in "Scheme E," and have therefore allowed a sum of £1800 in the table of expenditure, as provision for an esplanade wall of similar construction. (See addendum, page 21).

I am, Sir,

Your obedient servant,

J. BLAIR MASON.

The Secretary, Dunedin Ocean Beach Domain Board.



# ADDENDUM.

## RESTORATION OF THE BEACH AT ST. CLAIR.

With the exception of the portion opposite St. Clair, no apprehension need exist as to the stability of the beach under prevailing conditions, in which the waves spend themselves gradually upon the sandy slopes, leaving in the aggregate more than they take away.

In the case of the frontage to St. Clair, this aggregate is evidently not sufficient to make up the loss from other causes, and the question becomes: Can the supply be increased from seaward? My own experience, and what is being done elsewhere convinces me that it can. The character of the works of my scheme one could conscientiously recommend, would be such, that, while offering a minimum resistance to the impact of the sea, they would intercept and arrest some portion of the water-borne drift in its progress eastwards, causing it to work into the bight at St. Clair and build up the foreshore.

Groynes.—To accomplish the above I would advocate the construction of a groyne or groynes, run out from the shore or toe of the sandhills until the desired effect is obtained. The projection of such groyne just beyond the Forbury road towards the Central Battery, would intercept portion of the drift that at present finds the shore further east, and distribute and pile up such drift along the shore to the westward of the groyne.

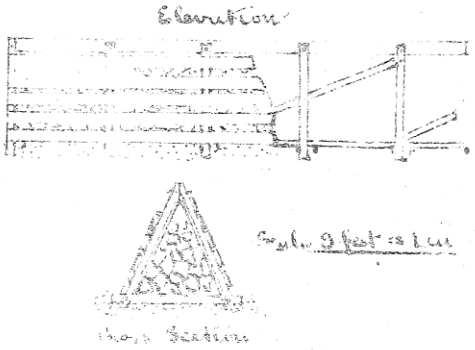
Jetty Groyne.—I am inclined to believe that one groyne would suffice to restore the beach at St. Clair. A good type would be that of a jetty, consisting of a row of piles, say ten feet apart, with a parallel row, say twenty feet apart, for staying purposes, and to carry the truck for the pile driver. The piles to be braced and walled or sheet-piled between. Heavy rubble or boulders obtained as suggested by Mr Reynolds from the boulder beach, could be laid along the outer portion at a later date if required. The distance out such a groyne would require to be taken would probably not be further than into three or four feet at low water. It would be better, however, not to define any definite length of structure, but watch the effect of each completed portion in building up the beach, before extending it further.

It is manifest that the accumulation of sand beyond what is needful to maintain the foreshore, is not desirable at St. Clair as a pleasure resort, nor is it desirable for other reasons that such groyne should extend beyond the depth I have mentioned.



Any sand working into the bight through the agency of the groyne would in the earlier stages remain there, gradually raising the level of the beach, and enabling a roadway or esplanade wall to be constructed, flanked by a stable bank of sand.

Experimental Groyne.—Extended observation leads me to believe that in fine weather there is sufficient influx of sand into the bight at St. Clair, to warrant the placing of a groyne immediately west of Forbury road, as preliminary to the consideration of other proposed restorative works. Such groyne could be made of cribs, triangular in section and filled with the stones of the old wall now lying on the beach. An economical and suitable construction is shown below.




I anticipate that a length of two hundred (200) feet from the foot of the bank, would be long enough at first, and is estimated to cost £100.

The success of a groyne at the place indicated would simplify the operations of the Board in dealing with the esplanade, and would therefore urge that it be erected at an early date, to get the advantage of the summer season, and that £100 be allocated for the purpose.

Sea Walls.—It is always desirable to maintain a sand beach as the first and best defence against the sea, fostering its renovation by every known means. But under conditions where such is impossible, a bulwark or wall of defence becomes an absolute necessity, whatever may be the consequence to the beach in front.

The formation of a promenade or esplanade between the baths and Forbury road, essential to St. Clair as a watering place and a likely boon to the community, is no doubt a work to be included in any complete improvement scheme. But the effect of the sea wall of such esplanade on the maintenance of St. Clair beach would, in my opinion, be injurious, unless protected by groynes along its unsheltered portions. Without such protection, the prevailing fetch of the sea, being more or less deflected by the wall (depending on its design), would in all likelihood operate in scouring the sand from the base or apron, resulting in the lowering of the beach, and possibility of undermining and danger to the stability of the wall.

*I am convinced from experience that the effect of a wall, inter alia, would be inimical to the conservation of the beach, unless supplemented by groynes, which would probably in turn render void the utility of such wall by sanding it up.*

My recommendation to the Board would therefore be that jetties or groynes (as already indicated) for the restoration of the beach be first constructed, and their effect noted, before finally deciding upon the character and design of the esplanade wall.

## MAINTENANCE OF BEACH AND SAND FLATS NORTH OF ST. CLAIR.

In order to prevent further waste of the sandhills from seawards, it would be necessary to run out groynes from the toe of the sand slope, as suggested in Messrs Mirams and Ussher's report, clause 16, and placed, say 500 feet apart, so as to raise the beach and push out the high-water mark, preparatory to the erection of wind-brakes and fences for fixing the sand, and furtherance of plant growth.

By the judicious extension of groyne construction along the outer beach, towards Lawyer's Head, the sand ridge could be induced to grow, and prevent the wash at high tide from lipping over into the lagoon. But as the formation of such ridge might interfere with the supply of sea-borne drift for the reclamation of the lagoon depression, it might be better left as it is until the wind-brakes and barriers have done their work.



## RECLAMATION AND CONSERVATION.

Area.—The acreage included within the space bounded by Victoria street, Forbury road, low-water mark, and an imaginary line drawn from a point on the beach to Onslow House opposite, is estimated by Messrs Mirams and Ussher at 80 acres, and presumed to be the area intended in the first place to be conserved.

I would suggest that the depression forming the extension of the lagoon eastwards beyond the above imaginary line be included, and added to the above area. For it is apparent that the raising and fixing of the surface westwards of such depression wall will tend to maintain it, possibly as a salt-water lagoon, a contingency which should be avoided by inducing its reclamation.

Levels.—The surface levels sought to be attained by the proposed works need not exceed the fine weather height of the bank at the outer beach fronting the lagoon, in order to secure safety from inundation and render plant life possible.

The reclamation of the lagoon depression, and the growth of marram and other sand-binding grasses will in all probability be accompanied by a rising of the outer beach, while the surface generally may be expected to slowly but continually make. The filling up of the depressions will also tend to the increased displacement of salt by comparatively fresh water, and allow of the growth of trees and shrubs that would not otherwise thrive.

Barriers.—I would recommend that durable barriers of spaced palisading or slab fencing be erected across the depressions, commencing as already suggested at the extreme eastward corner of the lagoon basin and extending their erection westwards as the sand accumulates. Local experience alone will dictate the best directions and distance apart to place them.

Wind-Breaks and Hedges.—After the desired levels have been attained, the wind-breaks or hedges for sand fixing can be erected, and the grass sowing or planting commenced. These hedges need not be high, but must be close enough together to shelter the young plants or grasses and prevent sanding up. Failure to clothe sand surfaces with grasses is generally due to want of adequate shelter for the plants while young, or before they have had time to properly root and spread.

Scrub of all kinds, hedge cuttings, and thorns, can be utilised for these hedges. It is usually found necessary to space them not wider than twelve feet apart, to prevent sand movement while the seed is germinating or the transplanted tufts gaining hold of the sand.

Grass-Planting, etc.—The growth of suitable vegetation after the sands are arrested should present no difficulties with our



abundant rainfall and generally mild coastal temperature, provided discrimination is used in the selection of plants for different degrees of exposure and saltness of soil.

In the historic fixing of the Landes of Bordeaux referred to by Mr Hutcheson, Bremontier divided the area into three zones. The first zone facing the sea was about 300 yards wide and planted with marram grass (Arundo Arenaria).

The second zone of similar width with brambles, heaths, and creepers, and the inner zone, beyond the influence of salt-water, with the maritime pine (Pinus Pinaster).

Marram Grass.—Of all sand-binding grasses, marram or gourbet (Arundo Arenaria), has proved the hardiest and best sand-binder in temperate climates, and the evidence of its suitability for our needs is manifest in its successful growth at Musselburgh.

I would recommend this grass as the staple sand-binder. It is essential, however, to secure the proper kind, and in this connection the letters of Mr Thomas Waugh, attached to Messrs Mirams and Ussher's report, are of interest. Mr Waugh also describes practical methods of sowing and planting the seed and roots.

Tree-Planting.—After the marram or other selected sand-binding grasses have fixed the sands, the planting of picked shrubs and trees could be commenced and extended seawards, as circumstances, such as the growth of sheltering ridges through the binding influences of the grasses, permitted.

It should be clearly understood that *tree-planting should follow after the fixing of the surface by sand-binding grasses, and not before.* The utilisation of otherwise waste land increasing the attractiveness of the Domain as a pleasure resort, the provision of a sand covering more permanent than grass, may be considered the principal objects of tree-planting. But it is absolutely necessary to successful forestry that the sand be fixed, so that it may not choke and blast the young trees.

Sand drift in the neighbourhood of plantations must be prevented and avoided by the growth of grass. The sanding-up of the fringe of the bush or forest near the sea by the sand set free through the destruction of the grasses, is common throughout the colonies, and it is a familiar sight to see a few dry twigs on a sand dune, marking the grave of some tree, green but a few months before.

Prohibited Areas.—It is recommended that the sandhills and flats, with the exception of the outer beach, be absolutely protected from traffic wherever sand-fixing and grass-planting operations are in progress. The sandhills might be specially guarded by a system of barbed-wire fences or entanglements, which have proved elsewhere efficient protection against invasion, enabling the native sand grasses to gain ground as well as foster the growth of shrubs and trees planted thereon.



Nurseries.—In order that a supply of plants may be available when wanted, and their suitability to climate and situation tested, it is suggested that plots of ground in chosen situations be laid off as nurseries. Standard varieties of sand-loving grasses and plants could there be propagated, and the adaptability of native grasses, heaths, shrubs, etc., and of various Australian and foreign plants tested.

## RECOMMENDATIONS.

In order that the Board may possess some general scheme, embodying the extent and scope of their probable operations, the following summary of recommendations is now submitted together with notes on the future management of the Domain that may prove of value to the Board. The proposed works are arrangegd in the order of their priority:—

(1) Construction of Experimental Groyne Opposite St. Clair. (For particulars see addendum, page 14).

(2) Complete Survey of Ocean Beach Domain and St. Clair, embracing current observations and collection of all data necessary for locating groynes and walls, with cross sections at frequent intervals for future comparison and reference.

(3) Construction of Jetty Groyne for the protection of the beach at St. Clair.

(4) Construction of Pontoon or Rough Timber Crib Groynes for building up the beach opposite the sandhills eastwards of St. Clair.

(5) Establishment of Nurseries for the propagation of sand-loving grasses and plants, and for experiments as to the suitability of different plants for various aspects and degrees of saltness of soil. A list of various sand-loving grasses and plants is appended.

(6) Esplanade at St. Clair.—Can be proceeded with when the effect of the proposed groyne in raising the beach has been noted, and its character, either as a retaining wall only, or as a sea defence determined.

(7) Sand Barriers.—Erection of barriers for reclamation of depression, and wind-breaks and artificial hedges for temporary fixing of the sand preparatory to grass-planting.

(8) Management of the Domain.—In the conduct of operations under the Board's control it will be recognised that while their first attention must be directed to the prevention of further sea encroachments, their ultimate aim will no doubt be the *conversion of the Domain into a People's Park by methods* analagous to those described.

The economical success of such methods must depend largely upon the attention and judgment of the Board's employees, as much of the work of conservation will be on empirical lines, and details of procedure dictated by the experience gained as the work proceeds.

CURATOR.—I would suggest, therefore, that the direction of sand-fixing and tree-planting operations be placed in the hands of a gentleman eminent in botanical science, etc., who would be willing to act as curator, and to whom the manager or local officer of the Board could look to for guidance in the above important part of his duties.

MANAGER.—It is also suggested a manager be appointed, possessing a knowledge of landscape gardening and forestry, and powers of initiation and observation. The duties of such an officer could include the charge of the Domain nurseries, supervision of sand-fixing and grass-planting, and acting as ranger and prosecuting officer in the enforcement of the bye-laws, rules, and regulation necessary for the maintenance and protection of the Board's property.

## EXPENDITURE.

As the Board might desire to possess some idea of the probable expenditure required in performing the functions of maintenance and conservation on the lines herein suggested, I have endeavoured to approximate the cost of continuous operations and management, as well as the cost of non-recurring works, over a period of five years from the initiation of such works. The annual cost for management and labour extending over the above period is estimated as under:—

| —— | 1st Year. | 2nd Year. | 3rd Year. | 4th Year. | 5th Year. |
|---|---|---|---|---|---|
| | £ | £ | £ | £ | £ |
| Manager ... ... ... ... | 180 | 180 | 180 | 180 | 180 |
| Honorarium to Curator ... ... | 25 | 25 | 50 | 75 | 75 |
| " " Secretary & Office Expenses ... ... .. | 70 | 70 | 70 | 70 | 70 |
| Labour ... .. ... .. | 230 | 230 | 230 | 300 | 300 |
| Maintenance of Dray and Two (2) Horses ... ... .. | 60 | 60 | 60 | 60 | 60 |
| Contingencies .. ... ... | 35 | 35 | 50 | 50 | 65 |
| TOTALS ... ... | £600 | £600 | £640 | £735 | £750 |

Grand total for five years, £3325.



The total estimated annual expenditure for a period of five years is set forth as under,—

| —— | Estimated Cost | 1st Year. | 2nd Year. | 3rd Year. | 4th Year. | 5th Year. |
|---|---|---|---|---|---|---|
| | £ | £ | £ | £ | £ | £ |
| Surveys ... ... ... ... ... | 100 | 100 | — | — | — | — |
| Jetty Groyne at St. Clair ... ... | 500 | 500 | — | — | — | — |
| Groynes opposite Sandhills ... .. | 1,400 | 350 | 350 | 350 | 350 | — |
| Esplanade at St. Clair ... .. | 1,800 | — | 1,800 | — | — | — |
| Sand Barriers, Wire Fences, and Entanglements ... .. ... | 800 | 200 | 200 | 200 | 200 | — |
| Nurseries, Seeds, and Plants ... | 500 | 50 | 50 | 100 | 150 | 150 |
| Management and Labour, as per Statement ... ... ... ... | — | 600 | 600 | 640 | 735 | 750 |
| TOTALS .. ... | £5,100 | £1,800 | £3,000 | £1,390 | £1,435 | £900 |

| | £ | £ |
|---|---|---|
| Total Non-recurring Expenditure ... ... ... | 5,100 | |
| Management and Labour per Statement ... | 3,325 | 8,425 |
| Total Expenditure for Five Years .. ... | 8,425 | 8,425 |
| Extra for Wall of Esplanade constructed in Cement Concrete (as sea defence)... ... | 1,300 | 9,625 |
| Extra for ditto in Timber ... ... ... ... | 310 | 8,735 |

## LIST OF SAND-LOVING PLANTS AND GRASSES.

### FOR SEA FRONTAGE.

Marram Grass or Gourbet (Arundo Arenaria).
Sea Lyme (Elymus Aronarius).
Sea Wheat (Triticum Junceum).
Californian Giant or Land Lupin.
Australian Coast Titri (Leptospernum Lanigernum).
Branch-spreading Plagianthus (Plagianthus Divaricatus).

### FOR INNER AREA.

Manuka Scrub (Leptospernum Scoparium).
Tasmanian Titri (Leptospernum Laevigatum).
N.Z. Bramble (Rubus Australis).
Sheoak (Casuarina Pendula).
Sheoak (Casuarina Suberosa).
Wattles, such as Acacia Dealbata, Melan, and Mucronata.
Maritime Pine (Pinus Pinaster).
Sand-loving Eucalypti.
Sand-loving Heaths and Creepers.

J. B. M.

## D Extract from The Sandhills



see what people were doing on the other side. These happy folk little realised that they were unconsciously undoing the good work of the Board.

After Blair Mason's report on the groynes was received, the Board considered its attitude towards them and their possible efficacy, and finally, in December, gave to the Public Works Department engineer, Ussher, the job of erection them.

Less than two years later, the Board was able to report that their confidence in the groynes was well founded. They were doing good work at St. Clair in retaining the sand.

That end of the beach, as repeated threats to and breaches of the esplanade had shown, was a good testing ground for the wood groynes. The rocky foundations of the St.Clair beach, which extended out around the outdoor baths, were not the best form of ground for the retention of the sandy covering. As repeatedly as sand built up there, as often as not it was washed away in a stormy sea, at times with a part of the esplanade with it.

The St. Clair esplanade, as a matter of interest, had been built by the original owner of the land, Mr. James Smith, about 1866.

Owing to a faulty survey, his frontage went right to the high water mark.

The wall he erected was of dry stone, unplastered. This allowed the high tides dashing against the wall to suck the sand out when it was suspended in the water. This naturally progressively threatened the stability of the wall and ultimately the whole structure was laid precipitately on the beach.

The Public Works replaced the wall, but unfortunately the department agreed to a request by the Caversham Borough Council to increase the width of the esplanade to seaward by 15 feet.

It was again washed down, this time with more serious consequences. Erosion, unchecked by man-made barriers, began to encroach on other private property, and undermined some of the houses.



But in spite of these incidental worries, Hancock's work against erosion was gradually succeeding. He continued the maintenance of the groynes as an effective means of building up the beach, and also supervised the construction of new fences for sand retention and the transplanting of new areas of marram grass as old ones consolidated with a flourishing face of waving, tough leaf-blades of marram grass.

By June 7th, 1906, the Board was able to report with some satisfaction that the pile groynes at St. Clair, which some people had considered to be a costly and probably valueless experiment, had proved themselves fully.

The Board noted with some pride that only a few years before the Government and the Board was faced with a probable expenditure of about £20,000 to stop sea encroachment. The groynes, costing a mere £500, had not only stopped erosion of the foreshore, but had also built up the beach from four to six feet over many acres.

With justifiable smugness in achievement, the Board said that the first and second row of groynes had almost disappeared into the sand which they had built up around themselves.

This reclamation programme eventually filled in satisfactorily the unsavoury and dangerous pool at St. Kilda which the seas had repeatedly used as a convenient runway through to the Flat at spring tides and in storms.

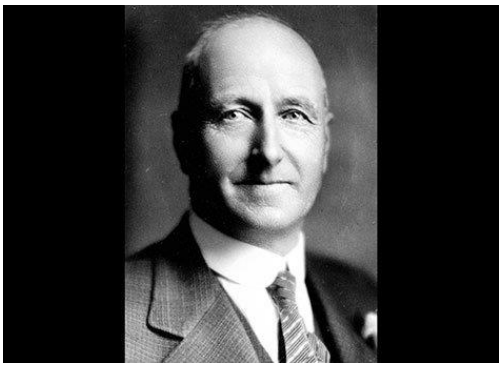
Hancock, with admirable foresight and the approval of the Board, then planted out pine trees. One thousand were set out in the first year's operations, and as time went on, more were added to the plantations.

As they grew, the trees served the dual purpose of providing additional compost for their own moisture and soil improvement, and giving shelter from the winds for new plantings and the natural propagation of marram grass and lupins.

In those days it was a familiar sight to see Hancock striding over the sand dunes in cloth cap and knickerbockers supervising the contour planting of marram grass and the other activities of the Board's workmen.

## E Frederick William Furkert (1876–1949)

Frederick Furkert was born in Ross, Westland in 1876 and educated at Ross Public School, Hokitika High School, Wellington and Dunedin Technical Schools and Otago University.



Furkert joined the Public Works Department (PWD) as an engineering cadet in 1894 and, in 1905, he became Taranaki's Resident Engineer-in-Chief. From 1906 he was the North Island Main Trunk Railway's Engineer-in-Charge of Construction. Following this, from 1908 to 1912, Furkert was District Engineer of Otago and Southland.

In 1912 he was appointed Inspecting Engineer to the PWD, Wellington, and, in 1914 acted for several months as Engineer-in-Chief.

During World War One Furkert volunteered for active service, and was instructed to take up the command of the New Zealand Engineers Tunnelling Company. The Government, however, refused to grant him leave of absence from the Department and he was placed in charge of the construction of the military camps at Trentham, Maymorn and Featherston.

Furkert became Assistant Engineer-in-Chief in 1919 and New Zealand's Engineer-in-Chief and Under-Secretary of the PWD in 1920.

His other associated activities included becoming a member of New Zealand's first Air Board in 1920 and Furkert also served as the Government's chief adviser on marine engineering. Between 1924 and 1932 Furkert was also chairman of the Main Highways Board.

Furkert served overseas during World War Two. Arriving in Fiji in mid-1941 with the rank of Colonel, to advise on breakwater construction for the flying-boat base, Furkert remained in Fiji for two years, as New Zealand Government Agent for defence construction and purchasing.

Reflecting on Furkert's engineering ability in 1959, New Zealand Institution of Engineers (NZIE) President Walter Gordon Morrison believed he had "practical genius" comparable with eminent 19th century British engineer Thomas Telford (*New Zealand Engineering*, 14:4 (1959), 103).

Furkert became an Associate Member of Britain's Institution of Civil Engineers in 1909, a Member in 1921, and was elected to the Council in 1932. His membership of the Institution of Mechanical Engineers dated from 1913.

Furkert was a foundation member of NZIE (now the Institution of Professional Engineers New Zealand, IPENZ) at its constitution in 1914. He had long service on the Council and was elected Vice-President in 1921 and President in 1923. He contributed several technical papers to the Institution, his interest in which was also displayed by his gift, not long before his death, of a sum of £500 to maintain an annual award for the best technical paper in a field relating to water. He was also keenly interested in the establishment of the Engineers Registration Board.

During his last years he set about completing *Early New Zealand Engineers*, a history, largely biographical, of pioneer engineering in the country's early days.

In recognition of his outstanding service to New Zealand, Furkert was the recipient of the Companion of the Order of St Michael and St George (CMG) in 1926. He died on 26 September 1949.

## [F] Report to the Engineer in Chief, 1919

(COPY)

21st August, 1919.

ST. CLAIR BEACH PROTECTION.

Engineer-in-Chief :

With reference to the position at St. Clair Beach, Dunedin, apparently nothing whatever has been done to maintain the groynes that were erected between 1902 and 1906. After their erection, as long as they remained in a good state, no trouble was experienced at all, but of late years a considerable number of piles have been washed out, and some I believe were taken out purposely, and lately a fair amount of erosion has taken place.

It seems to be reasonable when one finds that

(1) There was active erosion in progress before the groynes were erected.

(2) The erosion stopped immediately the groynes were erected, and

(3) The groynes fell into disrepair and erosion recommenced.

it is feasible to attribute the good work to some measure - in fact I might say a considerable measure - to the groynes.

The movement of the sand on this beach was fully dealt with in my report of 18th October, 1910. A prolonged spell of southerly and south-westerly weather must result in more or less denudation of the beach even if an adequate number of groynes was maintained; the action of the groynes being to delay denudation and to assist in the building up of foreshore rapidly whenever conditions are favourable.

The absence for a long period of any heavy easterly weather is bound to tend to unfavourable results, more especially as the greater part of the beach is unassisted by groynes, and where the groynes were erected they have not been maintained. It would, of course, be possible to protect the foreshore by continuous rip-rap work, but very heavy stones would be required, that at present in use being entirely inadequate. I am of opinion that the expense that this would necessitate is unwarranted, while the presence of the heavy rock referred to would not tend to make the beach more beautiful. No doubt the same might be said of the groynes as regards beauty, but not as regards expense.

The protection of the foreshore by a continuous wall such as exists at the St. Clair Esplanade, is still less justified, and, as

I reported in 1910, a vertical wall on which the waves could play must have the effect of denuding the beach of sand, in fact, one well-known authority on coast defence work stated that he could conceive of no more destructive agency of a foreshore than a vertical sea-wall. In other parts of the world where similar problems to that along Ocean Beach exist, it has invariably been found that the proper method of defence, both from the point of view of economy and efficacy, is a system of groynes.

In order to deal with the present position, I consider the first thing to do is to repair the neglected groynes erected fourteen years ago, to extend them both in height and in length, the first time a favourable spell of weather assisted by their action, causes sanding up of the beach. Experience in two localities in New Zealand has shown that a few feet at the outer end of the groyne has the greatest amount of effect.

The definite object to be aimed at is a flat even beach on which the waves can spend themselves before they reach the foot of the sandhills - in other words, low water mark wants to be pushed seawards a safe distance from the sandhills. Very good work has been done in the past by the Domain Board in fixing the sandhills, particularly in the vicinity of St. Kilda, but as these same sandhills formed the reservoir from which a considerable amount of sand would be drawn for making up the St. Clair beach during easterly weather, it will be recognised that this source of supply will now not be available, that is, St. Kilda has been improved to some extent at the expense of St.Clair. As the object and result of the groynes at St.Clair is to prevent the sand travelling towards St. Kilda, the converse might be argued also, but as it is so much easier for the sand particles to find their way on to the St. Kilda beach, than on to the St.Clair Beach (as explained in my report of 1910) I do not think that any weight need be attached to that.

In addition to repairing the existing groynes, and before waiting to extend them, at least three more groynes should be erected at intervals of 250 to 300 feet to the eastward of the present ones; the most easterly one should be erected first. It might be found that there would be a certain amount of erosion to the eastward of the most

easterly groynes; if this became acute it would most likely be necessary to erect further groynes, but probably not to any great extent.

The cost of any work nowadays is extremely difficult to forecast, but if New Zealand timber is used in the groynes, and the piles are put down by water-jet method, obtaining the water from the City Council mains, the cost should not exceed between £600 and £700.

With regard to the suggestion that a breakwater should be run out near the baths, this should not be done. It would only render it more difficult for the sand particles to get on to the beach in the vicinity of St. Clair and would be likely to lead to denudation rather than accretion.

In connection with this matter I cannot do better than quote two paragraphs from a report made by Mr J. Blair Mason in 1901 which exactly described the case :-

> "The method of promoting sand accumulation by means of groynes extending out beyond high water mark is evidently peculiarly adapted to the conditions prevailing at the Ocean Beach, and should assuredly be tried before attempting the construction of sea-opposing walls. The raising of the beach and consequent retirement of the high water mark is necessary to prevent undermining of the sandhill slopes, the stability of which must be maintained and their surfaces more or less 'fixed' before grass-planting thereon can succeed."
>
> "The method of opposing further sea encroachment by means of a sea wall is one that, in my opinion, should only be resorted to when the conditions are such as to admit of no other alternative, which is not so in the case of the Ocean Beach. The stoppage and holding of the sand continually supplied from the sea and meanwhile drifted by wind and tide, are all that is necessary to build up and maintain the beach, a result which no wall in itself could effect. The tendency of a wall would be to lower the beach unless flanked by groynes which would in turn, by encouraging sand deposit, probably render such wall unnecessary."

(sgd.) F. W. Furkert,

Assistant Engineer-in-Chief.

## [G] C. W. O. Turner (1901 – 1994)

Charles William Oakey Turner was born in Cardiff, Wales, on 27 January 1901, the son of William John Turner, a railway inspector, and his wife, Mary Ann Oakey. He won a scholarship to the local grammar school but left early to take up a fitting and turning apprenticeship; he completed his university entrance examination in his spare time.

Intending to become a surveyor for Lloyd's Register of Shipping, Turner won a Lloyd's scholarship and studied mechanical engineering at the University of Wales. Shortly before his final examinations he had an accident on his motorcycle and was hospitalised. He missed his finals, but met Anne Margaret Owen, a theatre sister at the hospital, whom he was to marry. While repeating his final year he also undertook a course in civil engineering, and graduated with honours in both mechanical and civil engineering.

To gain experience for his career with Lloyd's, he worked for three years as a marine engineer on coal-fired ships sailing between Britain and New Zealand. He earned his marine engineering certificate, but cutbacks at Lloyd's meant a job never eventuated. Instead, after his ship was made idle in Wellington by a worldwide strike of British seamen in 1925, he remained in New Zealand and the following year secured a position in the Public Works Department (PWD). On 5 January 1928 Turner married Anne Owen in Wellington, shortly after her arrival in New Zealand. They were to have three sons.

The next seven years were spent mainly in the PWD design office in Wellington, where Turner was involved in a wide range of civil and mechanical engineering projects, including the Mohaka rail viaduct. After the Hawke's Bay earthquake of 1931, Turner was seconded as surveyor for the boroughs of Hastings, Napier, Wairoa and Gisborne, where he was required to check designs and issue permits for reconstruction. He became a key figure in the establishment of seismic design principles which later formed the basis for the first earthquake design code for the country.

In 1934 Charles Turner won a Commonwealth Fund fellowship and travelled with his family to the United States, where he spent the next two years studying at Stanford University and the University of Illinois. He received a master of engineering degree from Illinois, where he had been able to study under leading engineering professors. He was also able to tour widely, viewing a range of civil engineering works.

Shortly after returning to New Zealand Turner was appointed deputy to William Newnham, the head of the PWD design office in Wellington, and in 1937 he succeeded him in that position. He played an important part in the design of reinforced concrete road and rail bridges, including arch bridges on the Napier-to-Gisborne railway. He was later to re-use the arch-bridge falsework for the construction of the Ohakea and Whenuapai aircraft hangars, which were among the largest tied arch spans in the world at the time. He also carried a high degree of responsibility for the design and construction of the large-diameter siphons used in the Canterbury irrigation schemes.

During the Second World War, Turner, as a major in the New Zealand Defence Engineer Service Corps, played a key role in meeting the urgent requirements of the armed services. This included design work for the Ohakea and Whenuapai runways, timber hangars, gun emplacements, camps for American Marines, and radar towers. Anne Turner died of pneumonia in 1942. Charles married Helen Marjorie Porter at Wellington on 20 March 1943; they were to have two sons and a daughter.

In 1944 Turner was transferred to the new Ministry of Works as chief inspecting engineer. In 1946 he was appointed chief civil engineer of the newly formed State Hydro-electric Department (SHD), with responsibility for the investigation and design of urgently required power schemes. When the SHD's civil design section was transferred to the Ministry of Works in 1948, Turner became assistant engineer in chief (power), responsible for the civil engineering part of the power projects. The desperate power shortage of the post-war years made this a challenging job, with work proceeding on projects on the Waikato, Waitaki and Clutha rivers as well as other smaller schemes. Turner was a strong promoter of the use of geothermal steam for power generation. In 1955 he was appointed one of the directors of Geothermal Developments Limited, a joint British – New Zealand company established to develop the Wairakei geothermal field.

In 1951 Turner succeeded Fritz Langbein as engineer in chief of the Ministry of Works. He came to have a special responsibility for the development of major projects, including the aluminium, steel and salt industries and the Marsden Point oil refinery. He was also called on as an adjudicator in construction contract disputes.

When he retired in 1962 Turner was appointed to the Imperial Service Order. He continued to work as an engineering and industrial consultant. He also continued as a contracts arbitrator and became a company director. Having been the prime mover while at the Ministry of Works in the joint development of the Manapouri power station and the Bluff aluminium smelter, he became an expert adviser to Comalco New Zealand, the smelter's owners.

Turner was a brilliant and bold designer and was responsible for a number of advanced design methods being introduced into New Zealand. He was vice president of a United Nations committee on earthquake engineering. Latterly he was a leading figure in contract administration, and his book on engineering contracts was recognised as the authoritative work on the subject. He endowed the Turner Lectures on contract administration, and was actively involved with the New Zealand Institution of Engineers, serving as a member of its council. He was also an active Rotarian. Charles Turner died in Waikanae on 18 May 1994, survived by his wife, four sons and a daughter.

## H Report to Government on Ocean Beach Erosion, 1955

M. 4/968

17th August, 1955.

The Secretary for Marine,
Marine Department,
WELLINGTON.

Erosion Ocean Beach, Dunedin:
St. Clair and St. Kilda Beaches

The Member for St. Kilda, Mr. J. G. Barnes, requested that a report be made on the prevention of erosion at Ocean Beach, and you have asked for a report on this matter. Inspection was made on August 4 by Mr. R. A. Simpson of this office, in company with Mr. E. Smith of District office and Mr. Grindley, Secretary to the Ocean Beach Domain Board and Deputy Town Clerk. It is regretted that a visit from an engineer from Head Office could not have been arranged earlier due to urgent commitments in Wellington. It was confirmed by telephone with the Domain Board that the erosion conditions had abated and the position reasonably under control.

The erosion at the beach is not limited to a short portion of the beach but extends continuously along the full sweep of the St. Clair and St. Kilda beaches, a distance of two miles. Inspection was not made at the eastern-most (St. Kilda) end, but the sharply cut face of the seaward dune was clearly visible in rear of high water mark right along the beach. The beach slope under stable conditions would be about 14 degrees, the seaward slope of the dunes about 1 on 3. Erosion as a rough estimate planed down the beach about six feet in level tapering off to nothing about 10 ft. below low water, and the dunes were cut back about 20 ft. to temporary and unstable batters of 2 on 1. The sand eroded on the beach slope would be about 1800 cubic yards per chain and from the dunes about 500 yards or something of the order of 200,000 cubic yards per mile total.

North of the Esplanade at St. Clair along to the road entrance at St. Kilda the Domain width is three chains, mostly sand hills and the erodable volume of dunes before private property boundaries could be encroached upon is 4,000 to 8,000 cubic yards per chain. As removal of further dune sand under continued storm would be accompanied by further planing down of the beach as well, the concern appears to be not so much a possibility of invasion of the sea through the dunes into private property in any one storm, but rather the need to ensure that the beach and dune losses are made good between storms.

There have been times of heavy erosion in 1904, 1919-20 and 1936 and no doubt attacks of lesser severity at less infrequent periods.

A period of 15 years between major erosions is reassuring but with so short a history of the beach conditions, the onset of several storms at close intervals, or/heavier weight cannot be discounted. It should be noted also that in reports on each of the erosions mentioned, reference has been made to the deteriorated condition of the groynes at the St. Clair end, and repairs to groynes and sometimes addition to groynes has followed. The frequency of storms may be much shorter in time than is

indicated by the damage caused as sea defences have been adequate over portions of the time.

The St. Kilda end of the beach is backed by sand dune areas of considerable width up to 20 chains and erosion of this part of the generally stable beach for this reason is not of concern.

Seas from a southerly quarter have to wheel round the cliffs south of St. Clair and do not reach the southern end of the beach with full force. These weakened seas also have less transporting power and the St. Clair end is partly starved of the sand supplies carried directly in suspension by the heavier seas which strike home on the St. Kilda beach. Continued heavy swells from storms generated far out to sea will have greater transporting power than there is sand supply available and will pick up sand from the beach slope and sand dunes in the rear of the beach right along the beach. At St. Clair even weak storm waves if persistently from the southerly quarter will continue to denude the beach, even though the St. Kilda end may be accreting. From time to time the seas will approach the coast from an easterly quarter with a resulting component of sand movement from St. Kilda to St. Clair or at least a checking of the rate of transport along the beach. At these times the Esplanade and adjacent starved beach areas build up quickly and the accretion will remain for much longer periods if works designed to arrest the northward drift are there to hold the natural gain.

Extremely severe conditions can arise when infrequent storms strike directly on the beach from the south east, particularly with opposing offshore winds to steepen the waves and increase their scouring power. Under these circumstances the St. Clair end with its lesser width and height of beach and with direct reflection of waves from the vertical esplanade wall is quickly depleted. Groynes are of lesser value than at other times in keeping the accreted sand on the beach but without their aid the reservoir of sand would not be available.

The St. Clair end of the beach had the last groynes constructed about 1922, and all these groynes and any others formerly on the beach have now been destroyed or removed exept two immediately north of the end of the Esplanade from which all planking has been removed leaving only the rows of piles standing, one of these being only about two-thirds the orginal length. The beach in front of the Esplanade lost 8-12 ft. of sand cover during the period of storm and the protective rock toe to the concrete sheet pile esplanade wall was exposed. Little indication of drawdown or movement of this boulder carpet was seen and the toes of the piles with grouted boulders around the seaward face were undisturbed. Considerable make up of the beach has since occurred. The rock toe should be made up from time to time when suitable and cheap material becomes available, and it would be advisable to construct five or six rock mound groynes about fifty feet in length when the beach level is low to reduce the scouring sweep of water along the beach. This is suggested in lieu of replacement of longer timber groynes facing the Esplanade where the beach is most frequented.

Reconstruction of the planking on the two groynes immediately north of the Esplanade is in progress and should suffice to check erosion at this point and build up the beach. Recovery already is rapid assisted by easterly seas. The foot of the eroded dune/has been protected by rock fill, a double rail pile at this point

defence and with a layer of scrub. All these methods are well recognised as means of protection and sand accumulation and the works now being undertaken by the Domain Board are sound and on the correct lines.

The problem of the Board is not so much the methods required to protect the beach, but the degree to which these should be carried out without serious obstruction to bathing, surfing and life saving over the long periods when erosion is not important. Groynes are the most successful method as has been well proved over the last 50 years. The continued maintenance of the rock toe with a few short stub groynes of rock to break the run of the sea, and timber groyne protection immediately north of the Esplanade where the run of seas off the Esplanade wall and the narrower dune protection make the natural protection weaker than elsewhere on the beach is the minimum reasonable protection. The scrub shelter fences which were once constructed above high water mark if re-erected would be a bathing amenity and a means of raising the beach above groyning level with wind blown sand.

Should these limited fences properly maintained, still permit heavy inroads of the sea at a later date, the only cheap recourse is construction of further groynes and a correspondingly less amenity value of the beach during the extensive periods of beach stability.

The Ocean Beach Domain Board is a much stronger authority than the usual Domain Board. Rating powers of 3/4d are held of which only one third is raised sufficient to meet normal annual operations of £3,000 p.a., and with an authority to raise £20,000 in loans there would be no difficulty in meeting the cost of protective works.

The Department is indebted to the Secretary of the Domain Board for information given for the loan of documents covering previous erosions, and to Mr. Wraight, Overseer to the Board, for his information on the site.

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