Wainui Beach Management

Presentation from Specialist Advisers

12 September 2012

DOCS_n265124

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Purpose

Opportunity for Wainui/Okitu community & other Wainui Beach stakeholders to learn more about how Wainui Beach works.

Initial plan - Key Stakeholder Forum & Working Group only

22 August Meeting recommended presentations open to all

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Agenda

1. Welcome
2. Apologies
3. Agenda
4. Process for meeting
5. Presentations
    i. Dr Amber Dunn
    ii. Richard Reinen-Hamill
6. Questions from the floor
7. Wrap up

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Meeting Process

Focus tonight is on hearing from our 2 specialist advisers

Opportunity for questions after both presentations

Ask that you hold your questions until then

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Dr Amber Dunn

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Wainui Beach

Past, Present, Future

Dr Amber Dunn

eco–i intelligence for green growth

Environment Advisers & Data Scientists

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Dr Amber Dunn

Nanny Mattie

Surfing Champ

Coastal Scientist

Wainui Beach

MSc-Wainui

The University of Waikato
Te Whare Wānanga o Waikato

NIWA
Taihoro Nukurangi

Auckland

Kaia & Nikau

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Introduction

1. Beaches 101 – Laws of the Coast
2. Wainui Erosion – What is known
3. Wainui & Engineering History
4. Future of Wainui Beach

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Beaches 101:
Laws of the Coast

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The Coast

Public Domain

Private Property

Recreational beach, Surfing, fishing

Houses, infrastructure, etc

1. **We all SHARE it - responsibilities**
2. **Must ensure one's salvation & pleasure is not another's grief**

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The Coast

Public Domain

Private Property

Recreational beach, Surfing

Developments

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WE CAN HAVE IT ALL... "Genius of the AND"

We need WISDOM

UNDERSTANDING and FOLLOWING the LAWS OF THE COAST lead to wise decisions:

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Genius of the AND: Public beach + private houses + surfing +??

Law of Coast #1:

There are no parts in nature, only WHOLES

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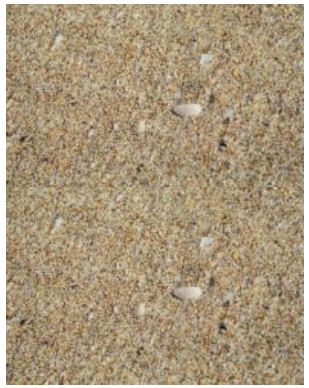
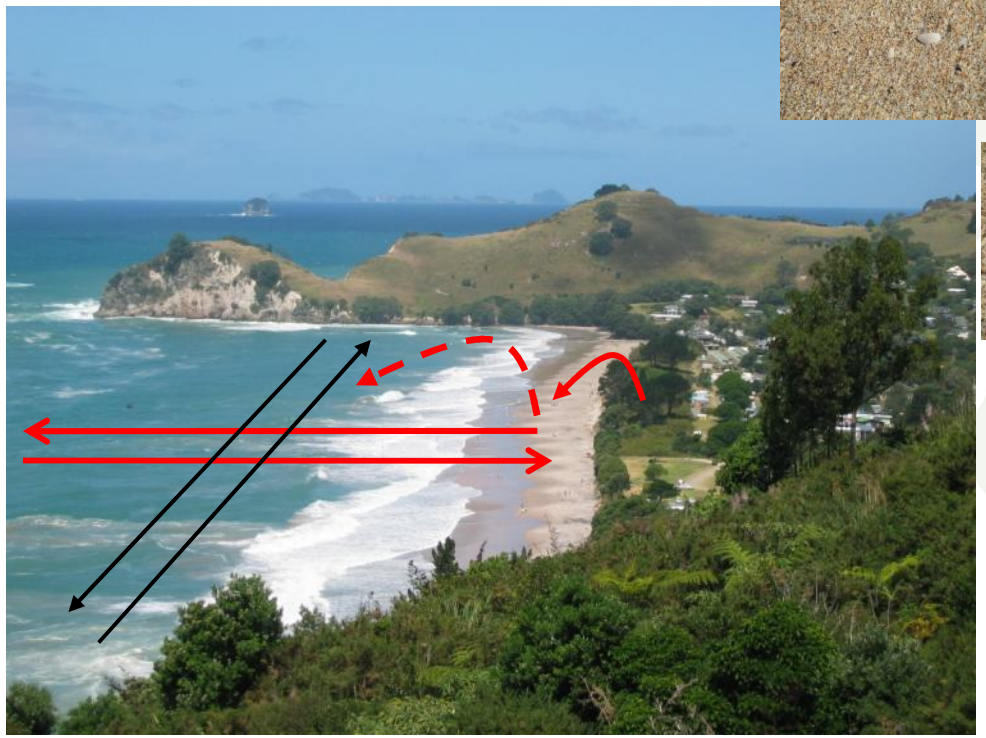
Beaches behave as units - consider entire coastal area, not just one part

Law #2:

The nature of sand is to MOVE





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Beaches (& dunes) = giant piles of sand ∴ beaches (& dunes) move too

Law #2:

The nature of sand is to MOVE

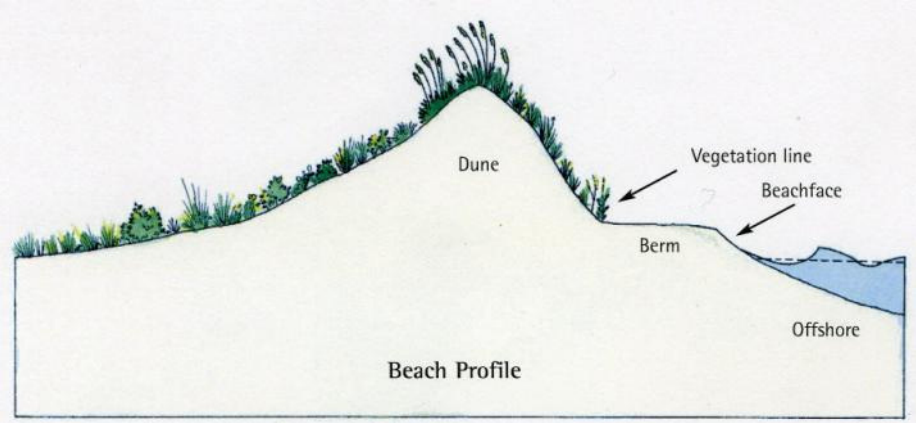
- Sand-movers = waves
- Breaking waves:
  1. put sand in motion
  2. create currents to move sand

As wave size ⇧ (e.g. storms) amount of sand in motion ⇧

Breaking waves + sand = sand motion

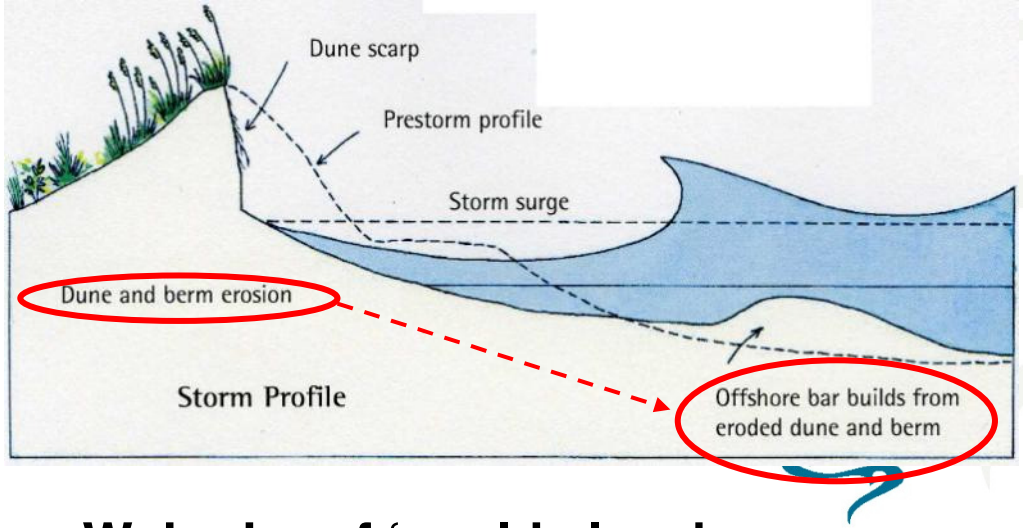
Law #3:

Moving sand offers natural protection



1. To *build* offshore bar
2. Bar breaks waves in <u>deepwater</u>
3. To flatten beach shape
4. Max wave energy spent offshore

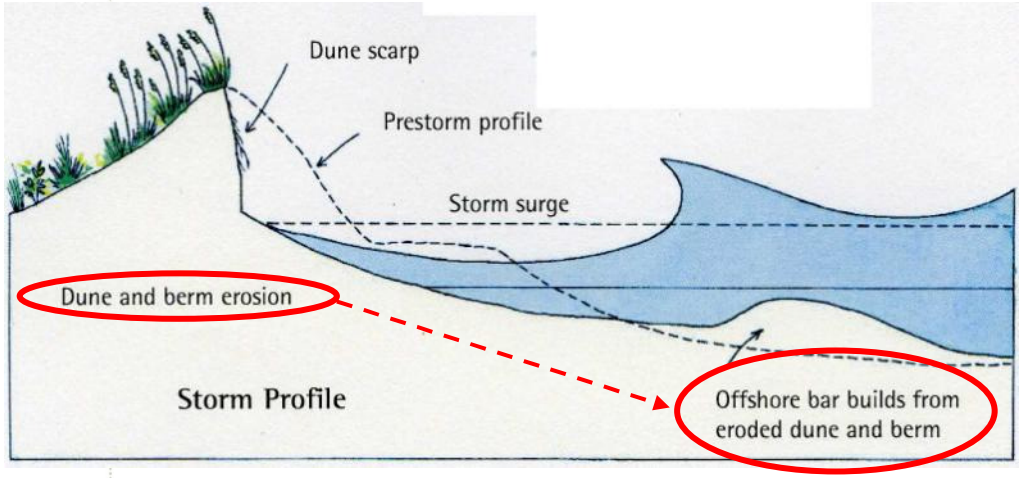
Zone of energy dissipation



Moving sand makes Wainui surf 'world class'

Law #3:

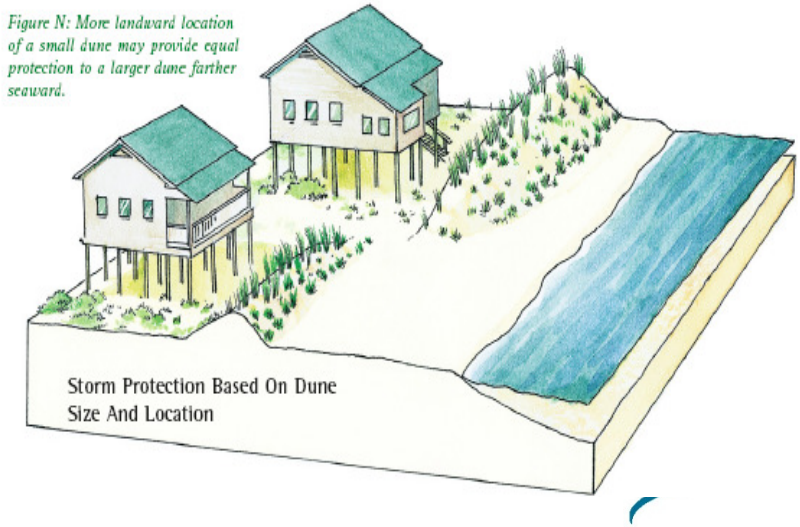
Moving sand offers natural protection



1. Max. wave energy in surf zone
2. Appears as shape change
3. Not distance – VOLUME

With ⇧wave size, bar size ⇧

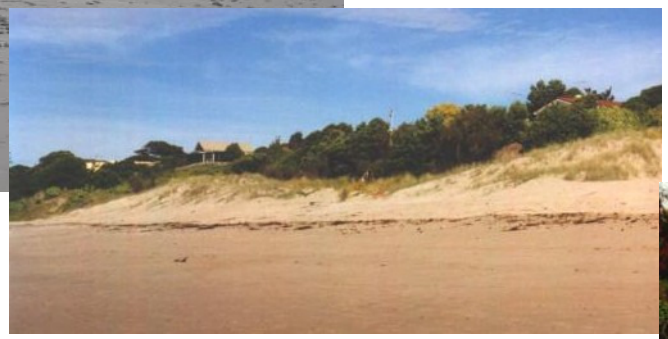
Bigger bar size reliant on large volume of sand

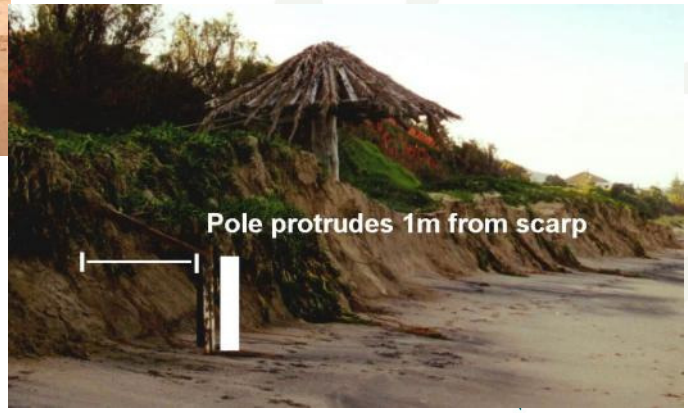


Offshore sand bars = natural protection mechanism

Law #4:

Dunes are STORE of sand for beach



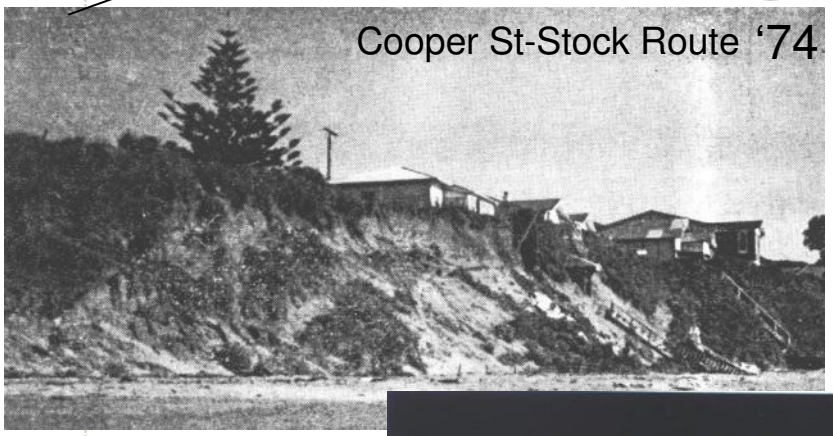


1. Vital part of beach system
2. Flexible moveable landform
3. Last line of natural protection

Dunes – made of sand – are meant to move

Law #5:

History of coast is history of STORMS



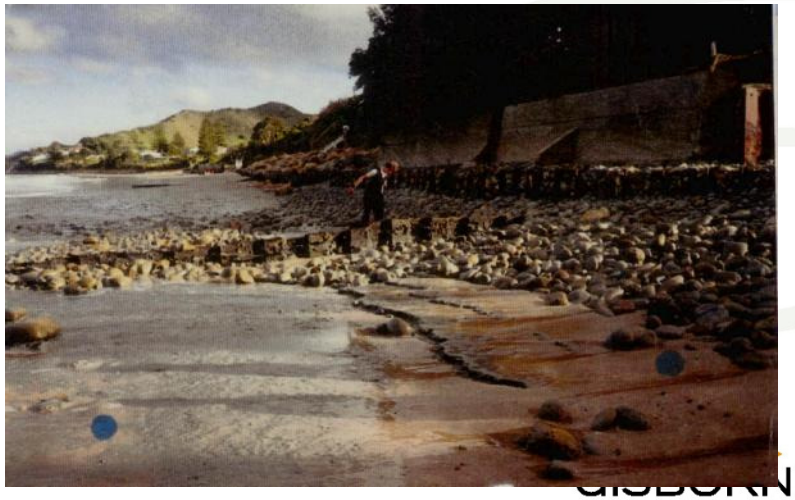
1. Storms will always strike
2. Numerous storm processes
3. Pulses of high energy

Change beach shape in hours & teach how mobile beaches are

Law #5:

History of coast is history of STORMS

1. Storm waves
2. Rip Currents (+ LS Current)
3. Surge's



Storm processes, acting in combo, are destructive forces

Summary

Laws of the Coast

- Beaches – consider the whole
- Sand is meant to move
- Moving sand = natural protection
- Dunes vital part of beach (sand store)
- Storms will strike = erosion

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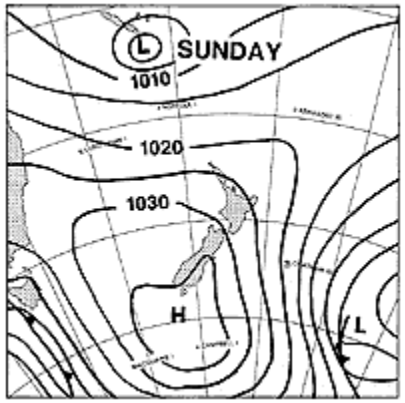
Wainui Erosion

"*Magnitudes of storm erosion are far greater than long-term trend*"

Dunn (2001)



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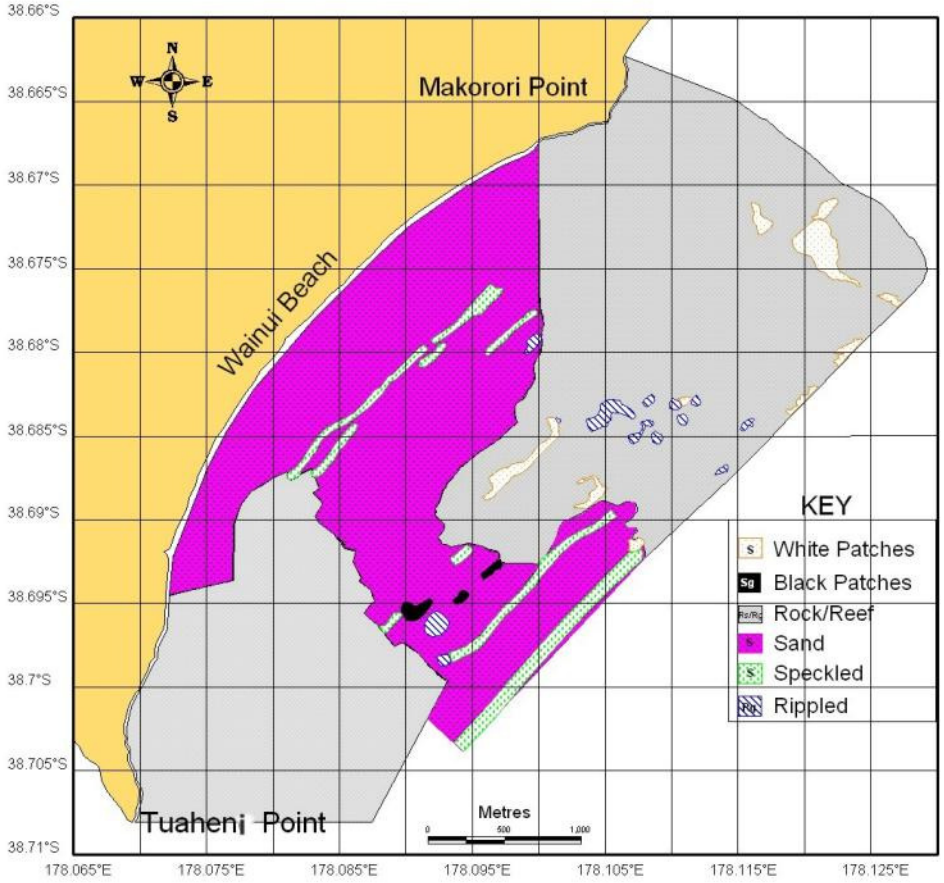
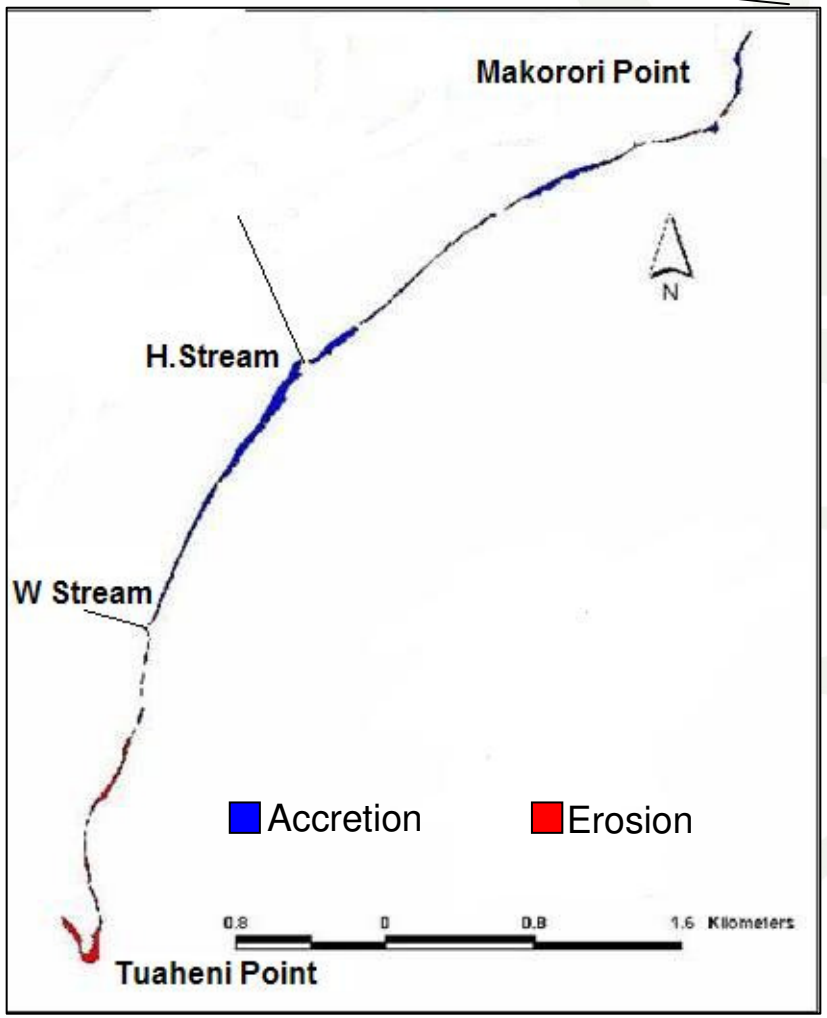
Bathymetry & Sediments

- Rocky basement with thin veneer of sand
- Structural features create localised sand belt
- Closed beach - Tuaheni & Tatapouri?
- Covering & uncovering of rocky floor



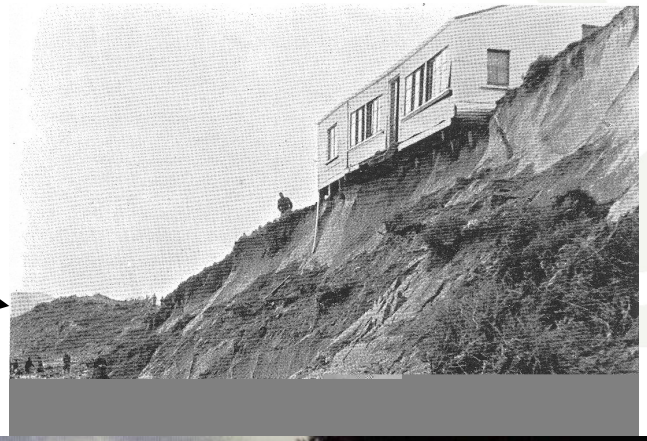
Stable LT Trend ('42-99)

- Sandy embayment:
  ~0.2 m/yr
- Rocky headlands:
  +0.07 to -0.24 m/yr
- Stable to very slow accretion ∴ not driver of erosion



Storm-generated Erosion

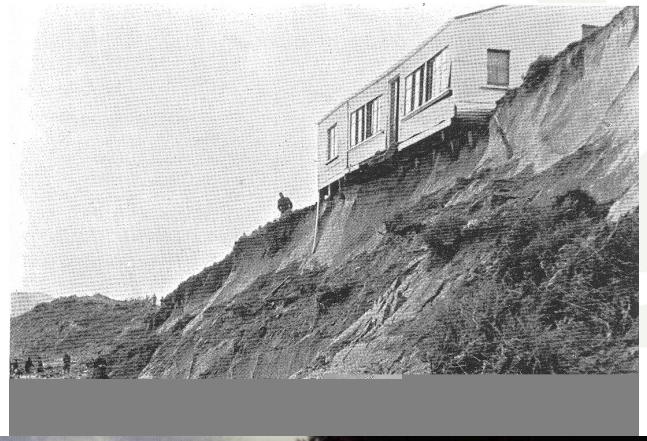
- Intense single events
- Long storm season
- Major erosion from "storms"



Storm-generated Erosion

- Magnitudes: 8-15m = large
- Much > LT trends

  ∴Storm ‘cuts’ create erosion hazard
- In past, interpreted as LT retreat or with smaller magnitudes

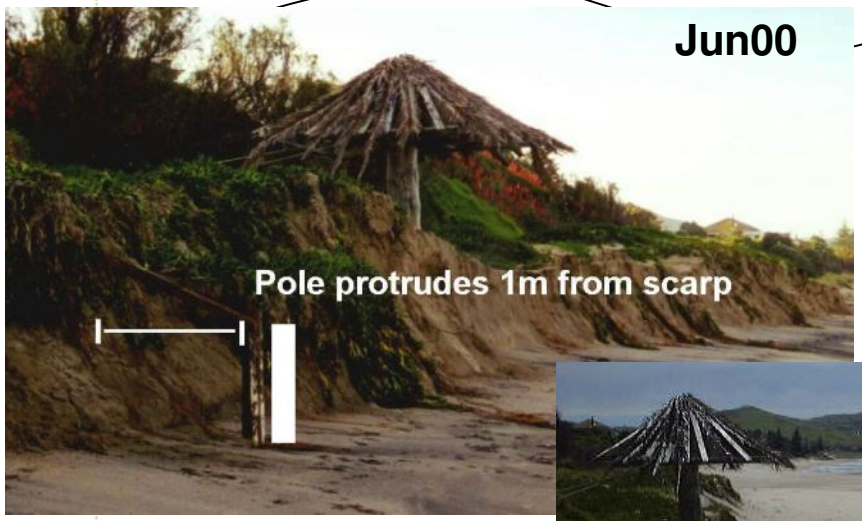


Storm Erosion

- "Cut & Fill" cycle
- Storm 'cut' = hazard
- Temporary redistribution of sand (post-storm return):

  not LT sand loss

Storm Erosion



Storm "cut"

Oct 00

Sand removed in June 2000….

eventually returned!

Storm "fill"

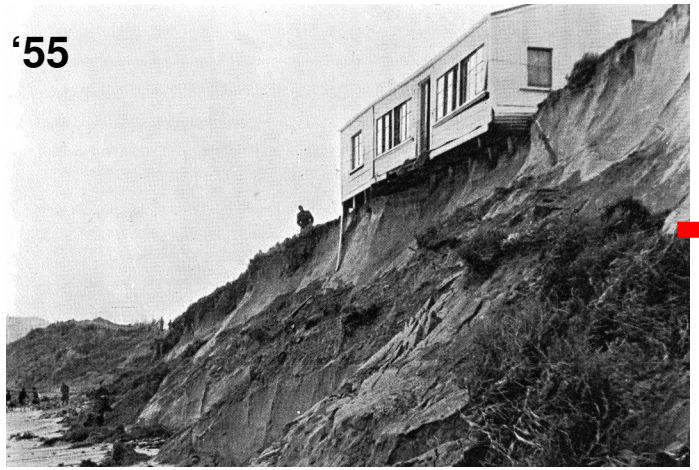
Generate large <u>temporary</u> beach changes

Temporary Shift

Time

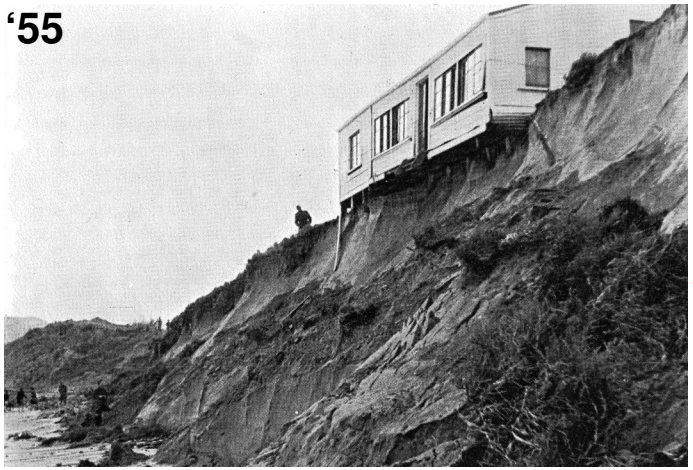
LT

PSR

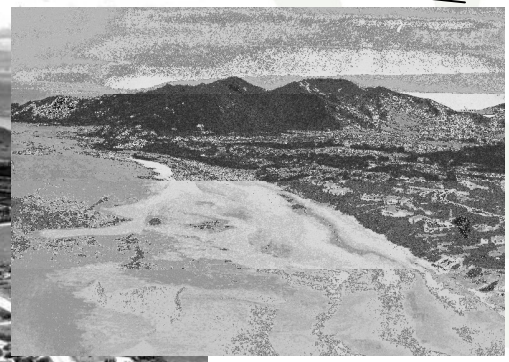


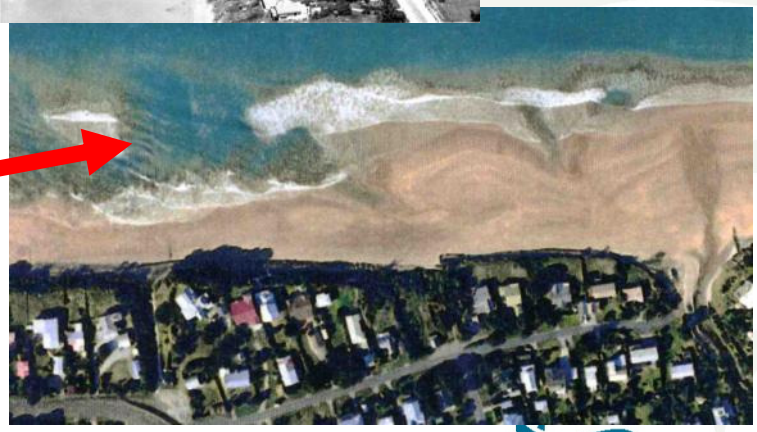
Serious problems when storm freq > recovery period e.g. '92-94

Storm Processes - Rips



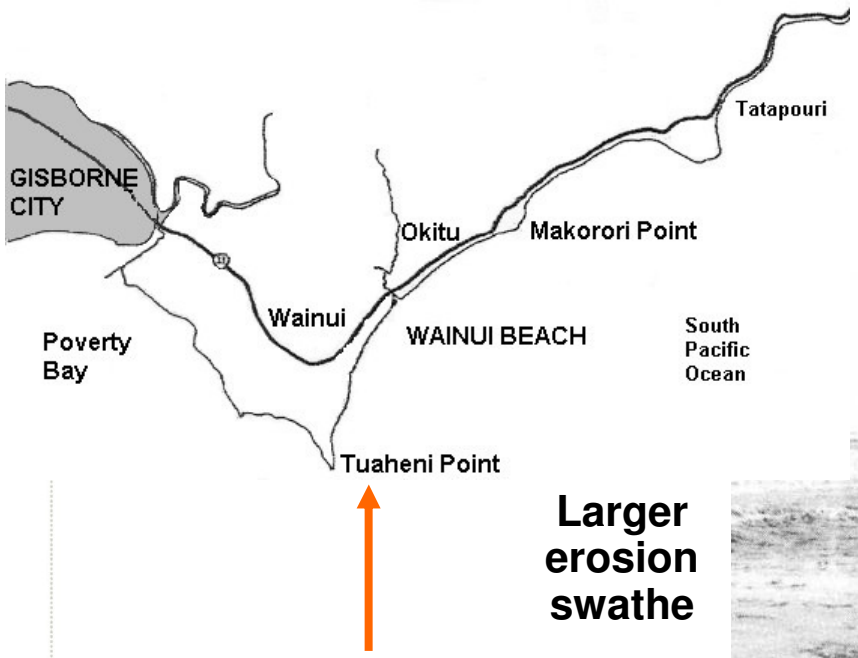
Localised erosion





Rips appear anywhere – most prevalent in E, NE and SE swells

Storm Processes - Currents



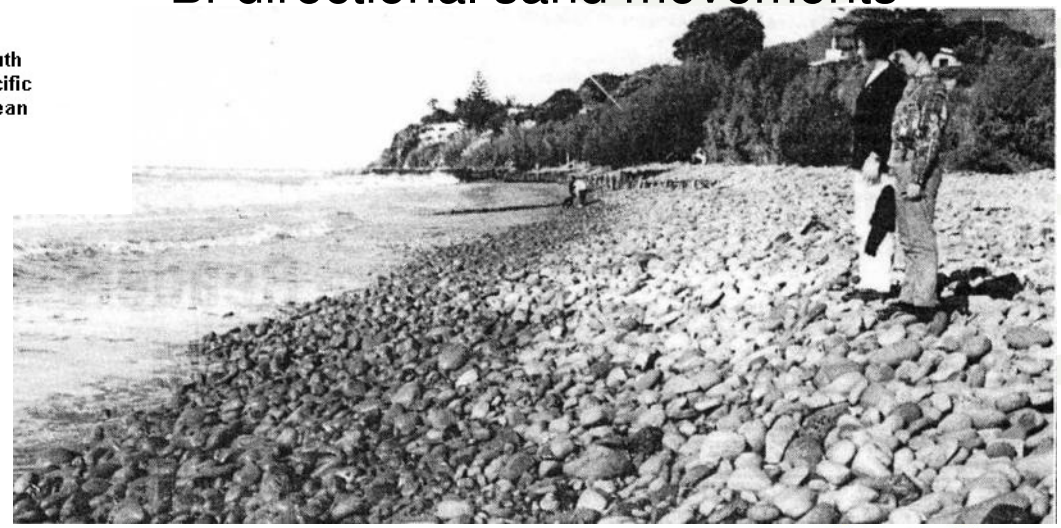
Larger erosion swathe

Southerlies: sand moves N-ward

NE: sand moves S-ward

=

Bi-directional sand movements



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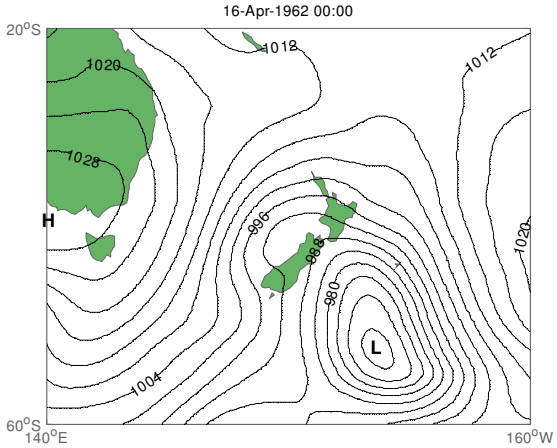
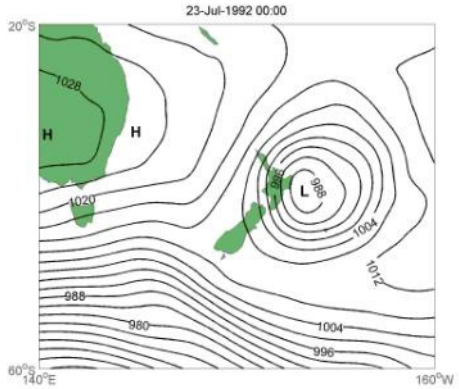
Can result in seasonal re-orientation of shoreline

Coastal Storms





- 3/yr (75% from S)
- Southern Ocean troughs (~50%)
- EC lows (40%) – Tasman Sea & Subtropics
- Most intense = ECL
- Blocking highs eastward

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These weather patterns make Wainui world class surfing beach

Stormwater/Stream Erosion

- Another coastal hazard
  - well recognised on Australian coasts
- Impact on water quality
  - discolouration etc
- Multiple discharge points
  - Localised erosion, swell dir. dependent
- Volume Δ felt at coast

Summary

Wainui Erosion

1. **Thin sand veneer over rocks – closed beach**
2. **Storm-generated erosion hazard**
3. **Cut & Fill cycle over-active – temporary erosion**
4. **Currents, storm waves, etc**
5. **Storms – South, SO Troughs, ECL, clusters**

Wainui Engineering History

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Coastal Structure's

1900 — Solid Concrete Seawall = ~~1926;~~
Concrete & wooden seawalls;
Sand/Stone-filled drums

'50 — Branch wall & stone-filled drums; 1 house retreated

'60 — 1st Public Scheme '61-62 = 28
Groins & log seawall

'70 — 2nd Public Scheme '76 =
Gabion Basket System

'80 — Groins removed, rip-rap '82-83

'90 — Rip-rap many places '92-95

2000 — 1 house retreated
Exposure ancient structures

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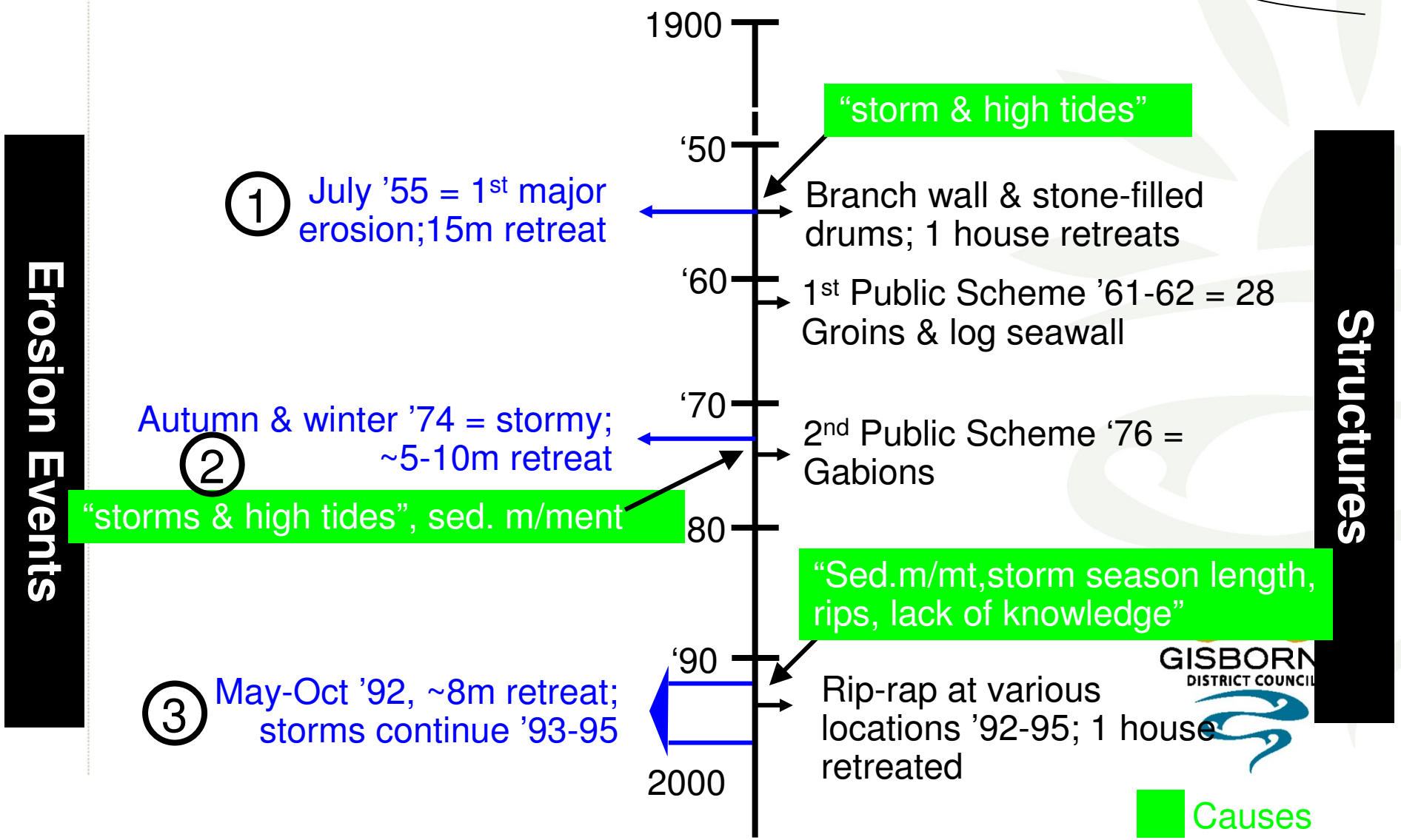
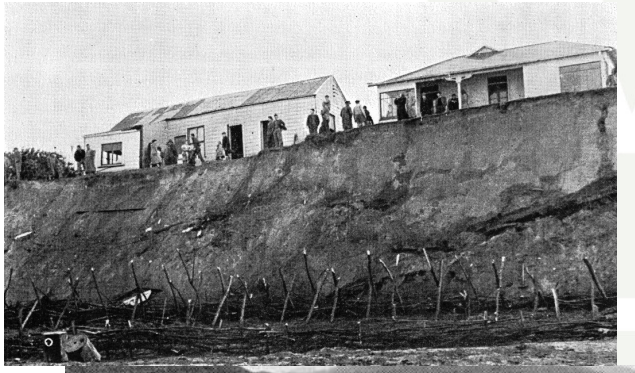
Structures, Storms & Causes



Structures, Storms & Causes

- Responses to storm-generated erosion = structures
- Options not based on “causes” or limited science

  e.g groins – “*tendency for some littoral drift*”
- ’92 & ’96 consents: “*lack of knowledge*”
- New research = cut & fill cycle, rips



Structures – Effective?

Structure	Purpose	Effective (Y/N)	WHY?
Groins	Trap sand moving <u>along</u> beach	**No**	**No dominant alongshore sand movement**
Seawall	Protect land directly **<u>behind</u>** them	**YES & No**	**One wall destroyed = erosion behind it**
Rip-rap	Reduce wave energy & stop erosion	**YES & No** **(during storms)**	**Waves get behind rocks = erosion**
Gabions	Reduce wave energy & stop erosion	**No**	**Wave overtopping; not suited to high-energy wave zones**

Unsuccessful because lack of understanding of beach dynamics – especially <u>sand movement</u>

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Structures – Effective?

"IF PLANNED WITHOUT A FAIRLY GOOD UNDERSTANDING OF CAUSE(S) OF EROSION PROBLEM & KNOWLEDGE OF SAND TRANSPORT PROCESSES, THEY ALMOST CERTAINLY WILL FAIL TO RELIEVE THE PROBLEM OR WILL CAUSE AN EQUALLY SEVERE PROBLEM ELSEWHERE"

- Dean (1976)

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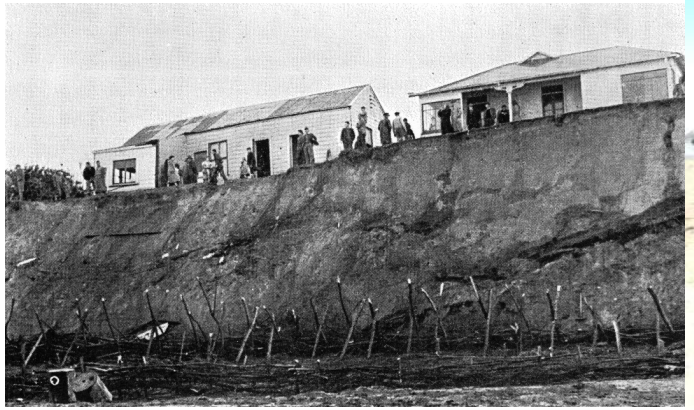
Summary

Wainui & Engineering Structures

- Range of historical structures – success and failure
- Limited science in the decision making process
- Hard structures interfere with sand movement
- Historically: mismatch between causes and structures



Future Management

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Future Management

- Understand coast & erosion causes first
- Remember the “Laws of the Coast” – sand is meant to move
- Public-private boundary: we want houses AND beach AND surfing
- Surf-break of national significance

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Future Management

- Sand volume protects homes
- M/Mt based on fundamental principles
- Can we use ‘temporary’ protection structures for ‘temporary’ erosion events?
- Do we have an erosion ‘problem’?

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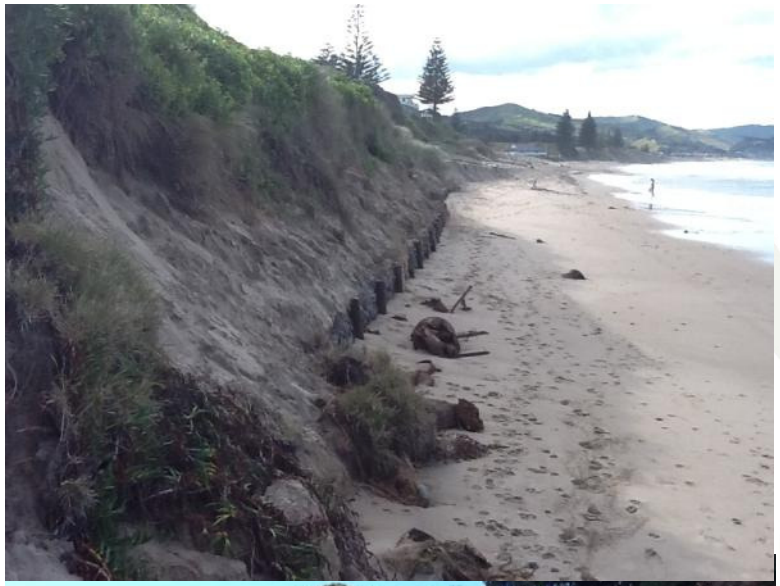
July 2012



Thanks

Richard Reinen-Hamill

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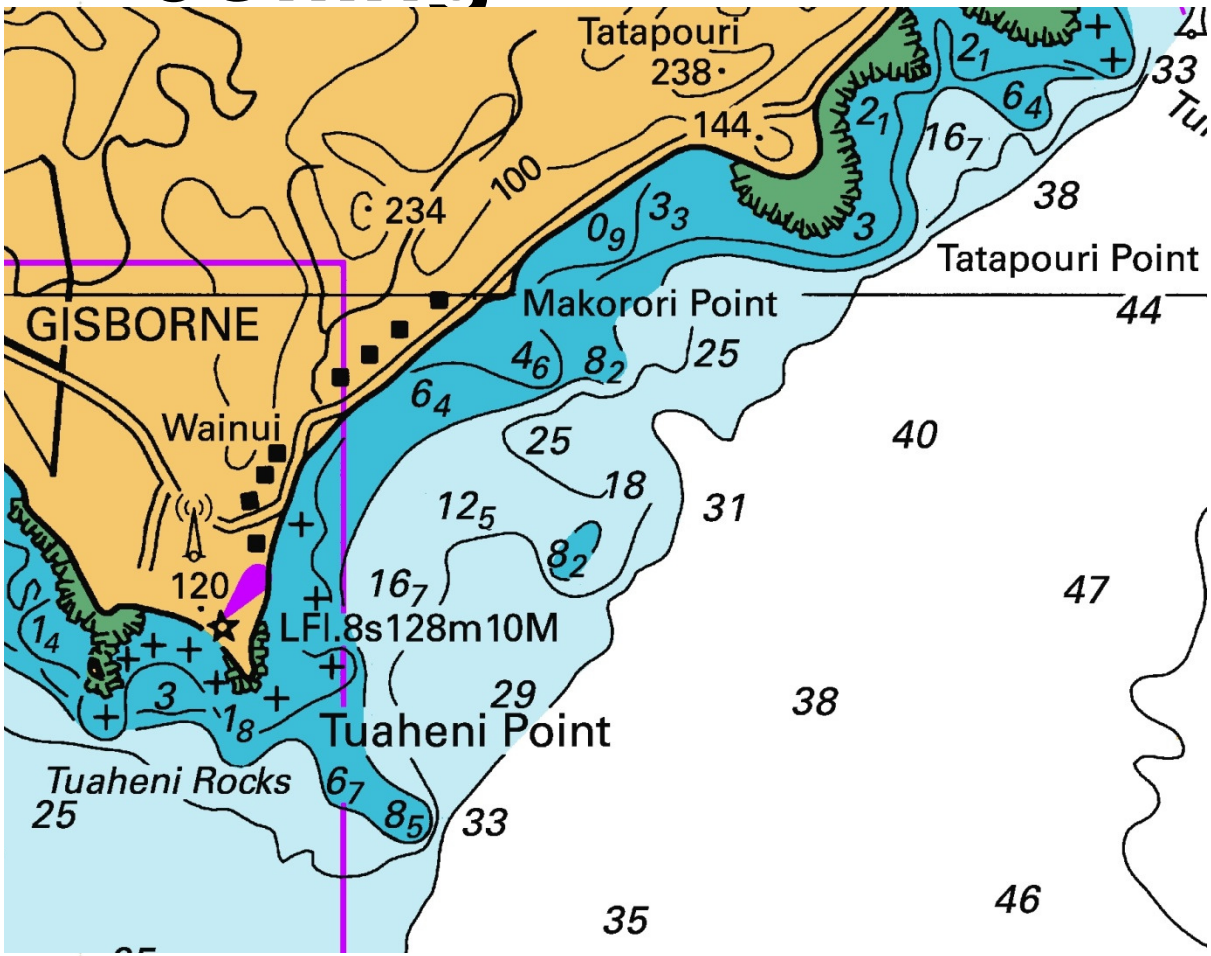
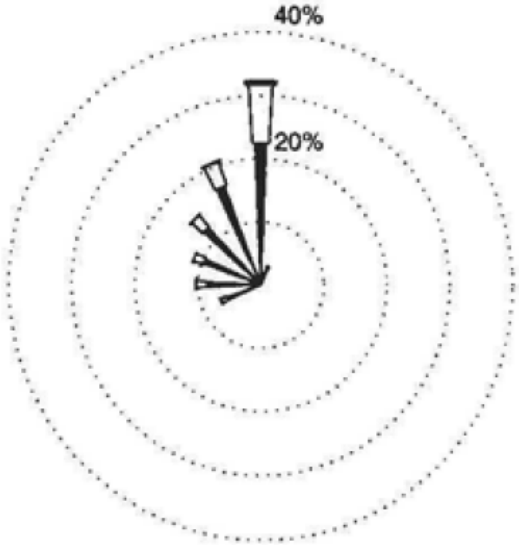
Setting



Source: NZ55, Hydrographic office

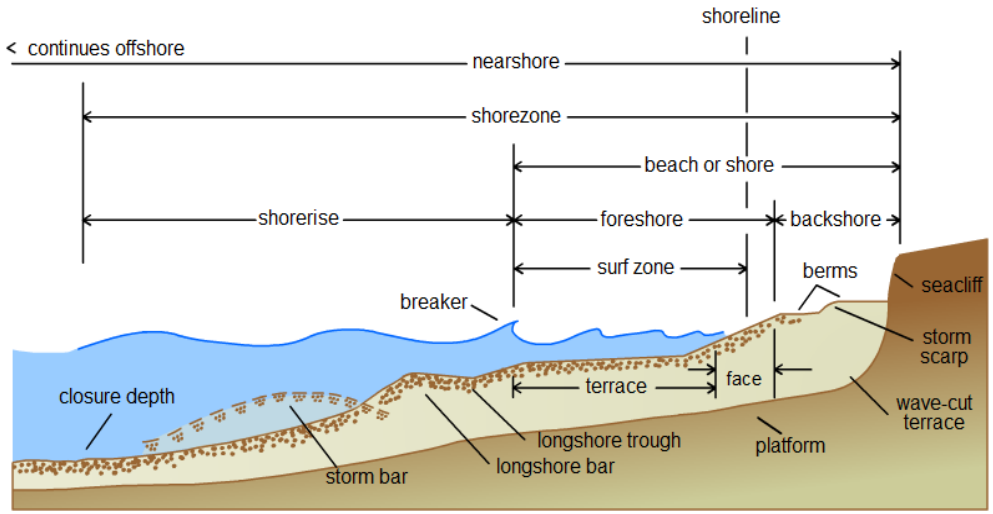
HAT: 2.23 m
MHWS: 2.10 m (2011/2012)
MHWS: 1.94 m (2002/2003)
Source: Hydrographic Office



Hs = 1.6 with 3 m exceeded 5%

Source: Tatapouri @ 39 m
Gorman et al. 2003

Typical beach face definitions



http://coastalchange.ucsd.edu/st3_basics/beaches.html

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Possible erosion factors

- Storms (cross shore transport)
- Rips
- Longshore transport
- Headland retreat
- Imbalance between sediment supply and loss
- Changes in mean wave energy direction
- Influence of tidal cycles (18.6 years)
- Stream/beach interactions
- Sea level rise

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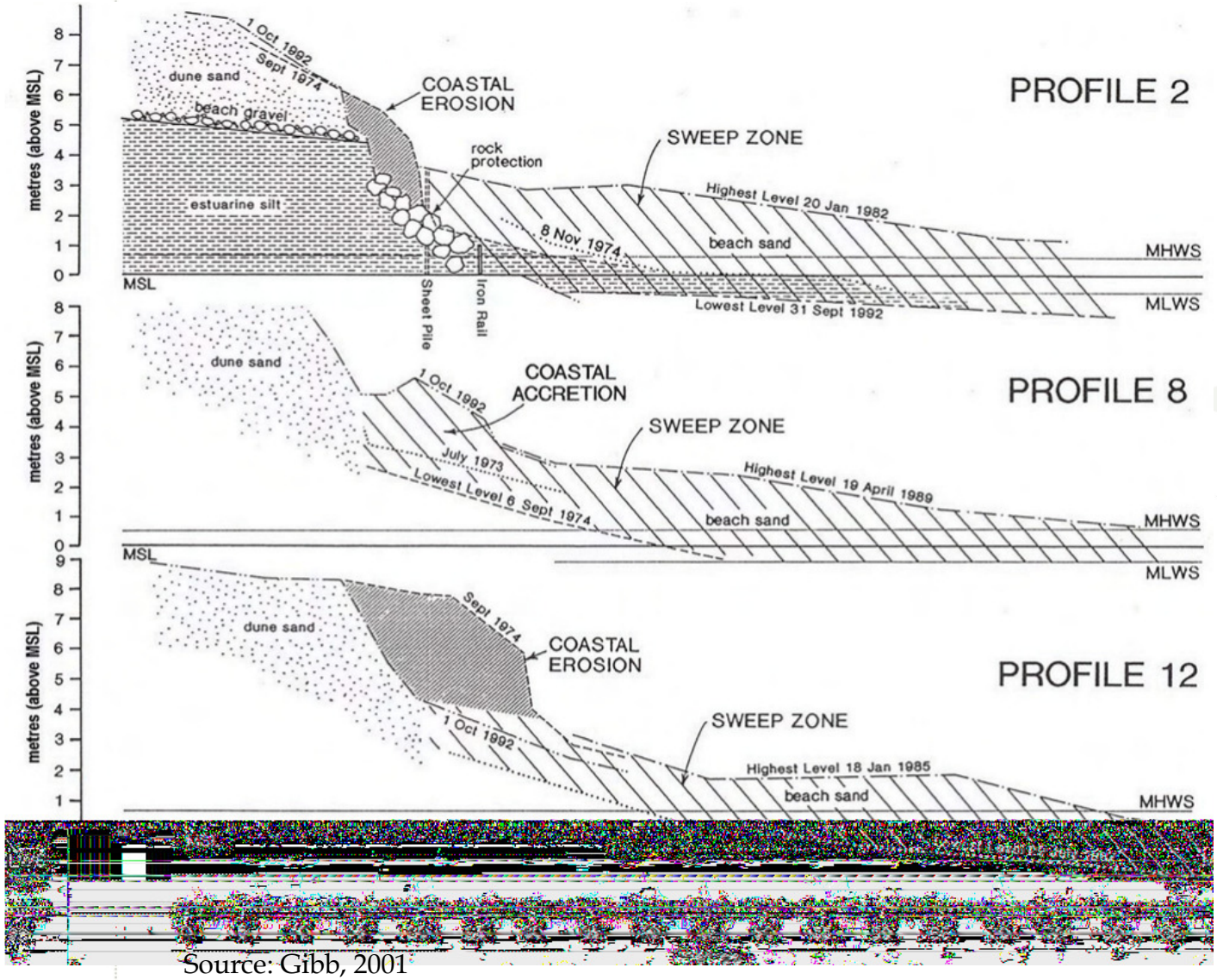
Cross-shore transport



Source: Gibb, 2001

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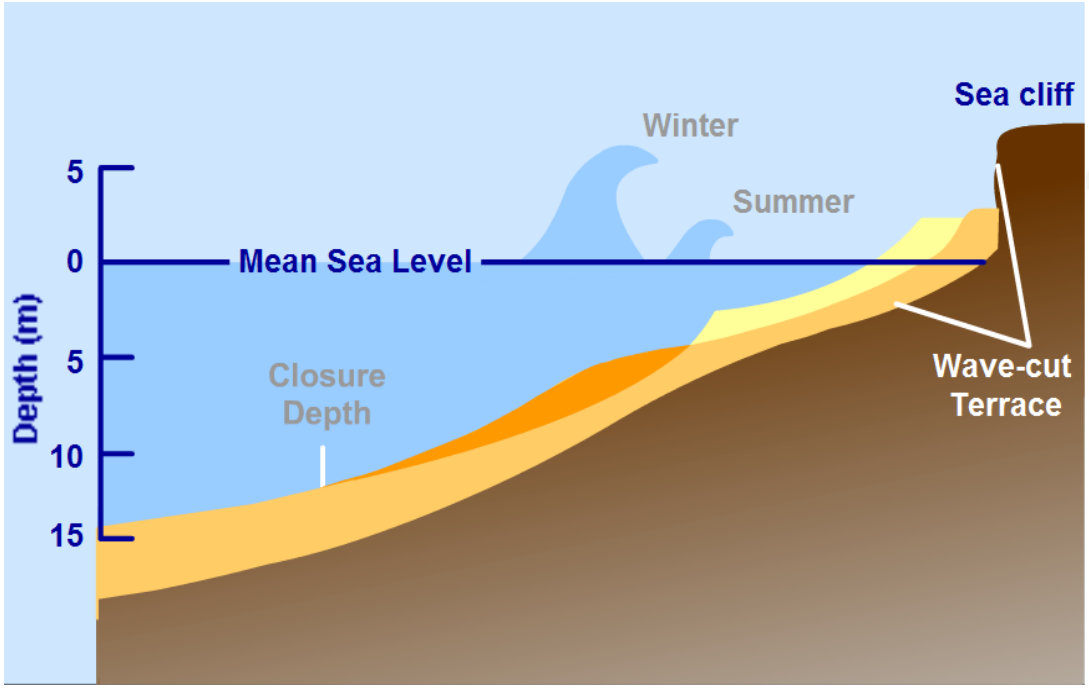
Comparison of summer and winter beach profiles



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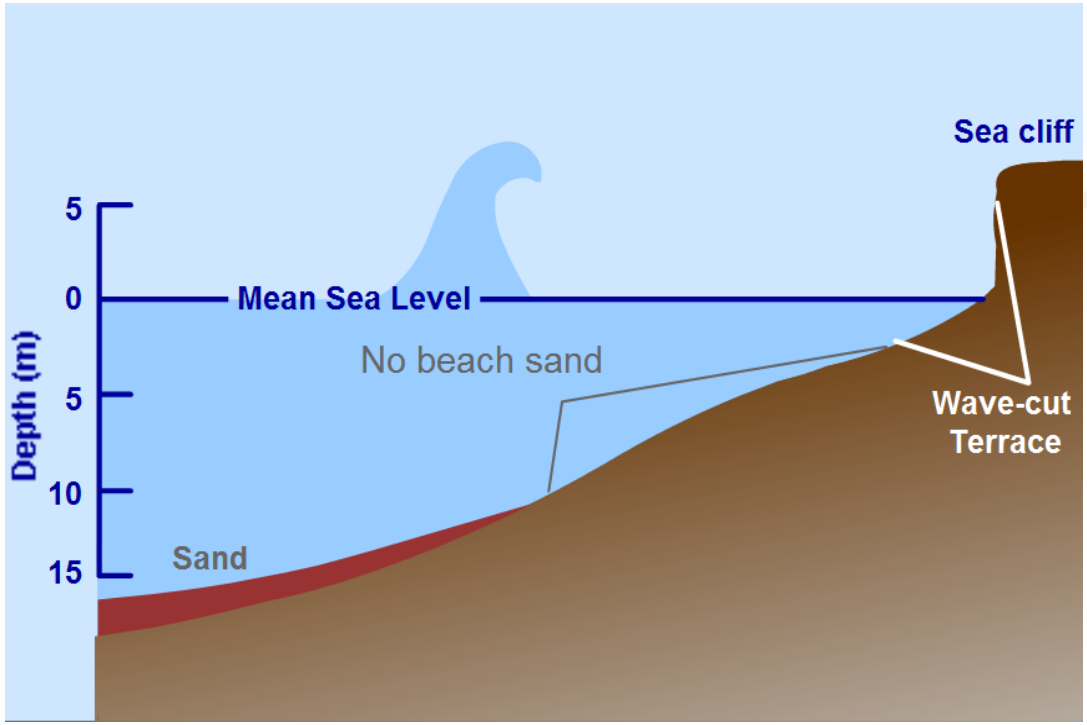
Effect of severe winter storms



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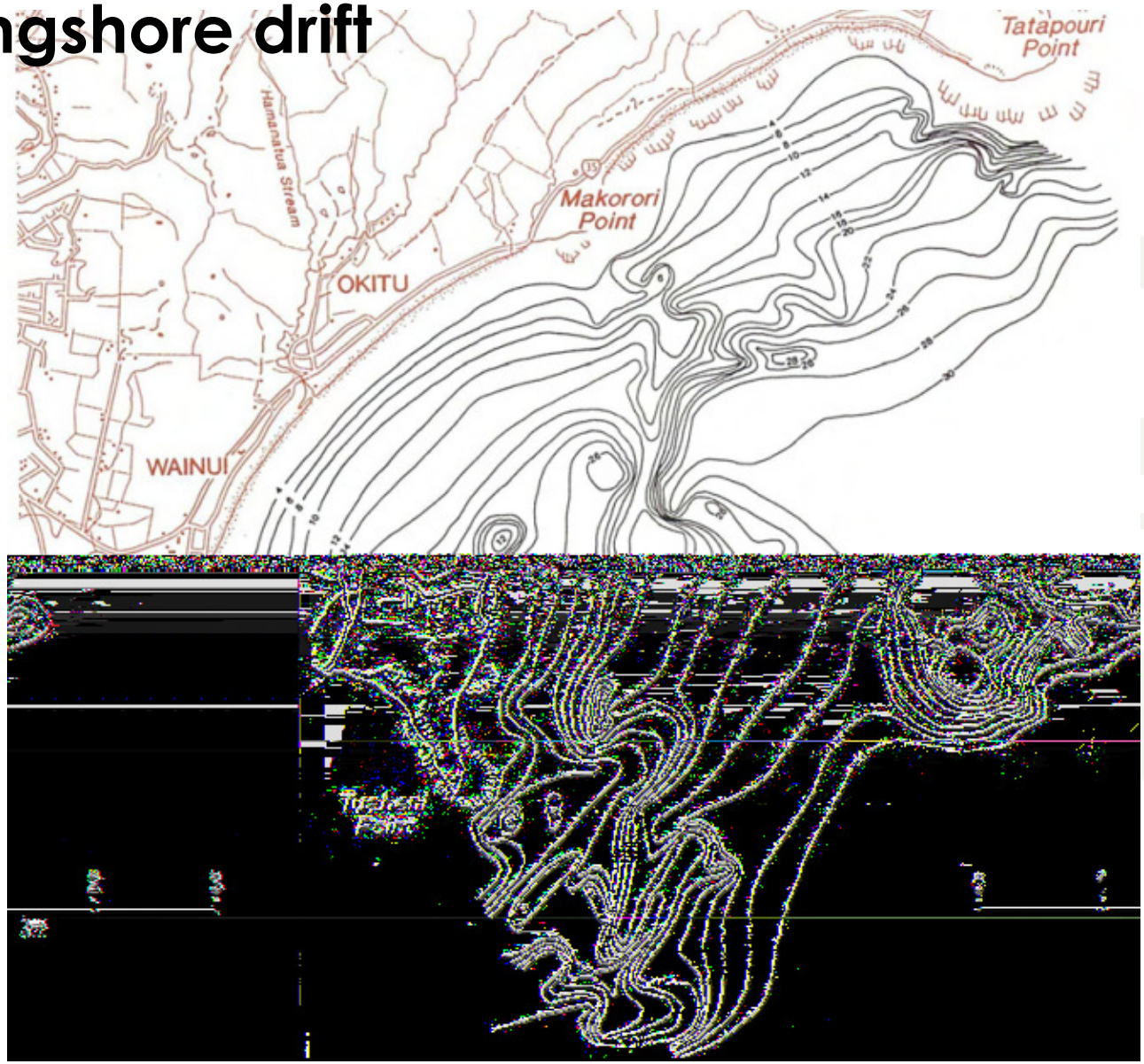
Headland retreat and longshore drift



Closure depth around 10 m RL from sediment analysis and Survey = around 11 m CD.

Check with Hallermeier Limit (6.75 x Hs mean) = 10.8 m

CETN II-32 (Rev 3/95)

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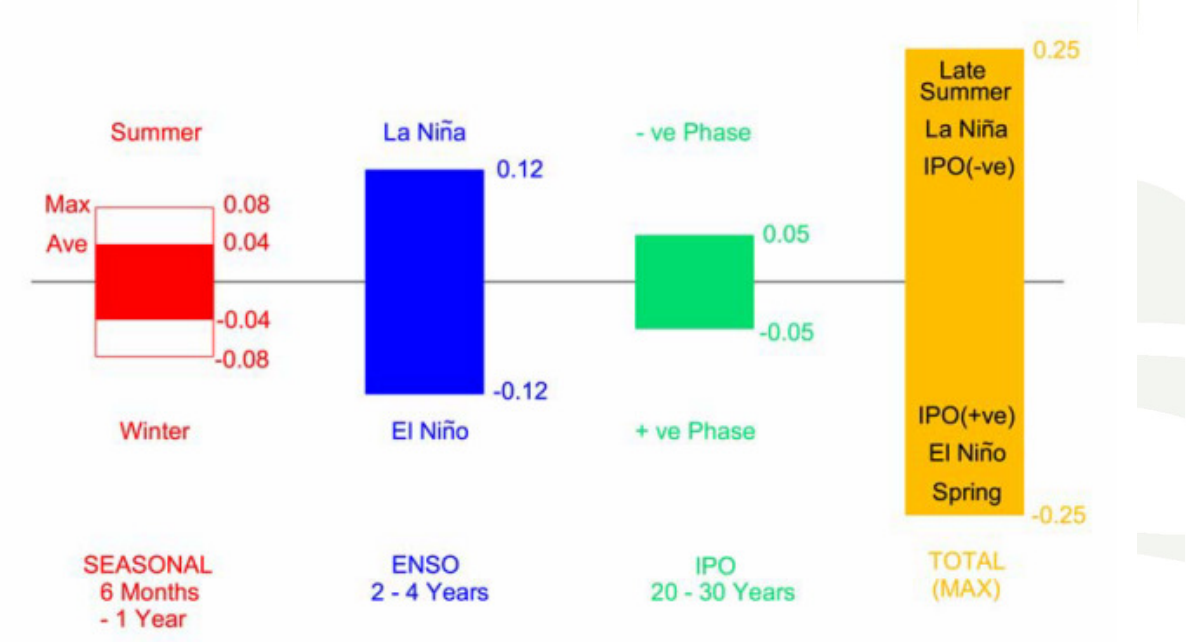
Tidal cycles and water levels

- Seasonal
- El Nino and la Nina
- Southern Oscillation
- 18.6 year astronomic cycle



Source: NIWA, 2008

MHWS (2002/03) = 1.94 m
MHWS (2010/11) = 2.10 m (0.16 m diff)
HAT = 2.23 m (0.29 m diff)

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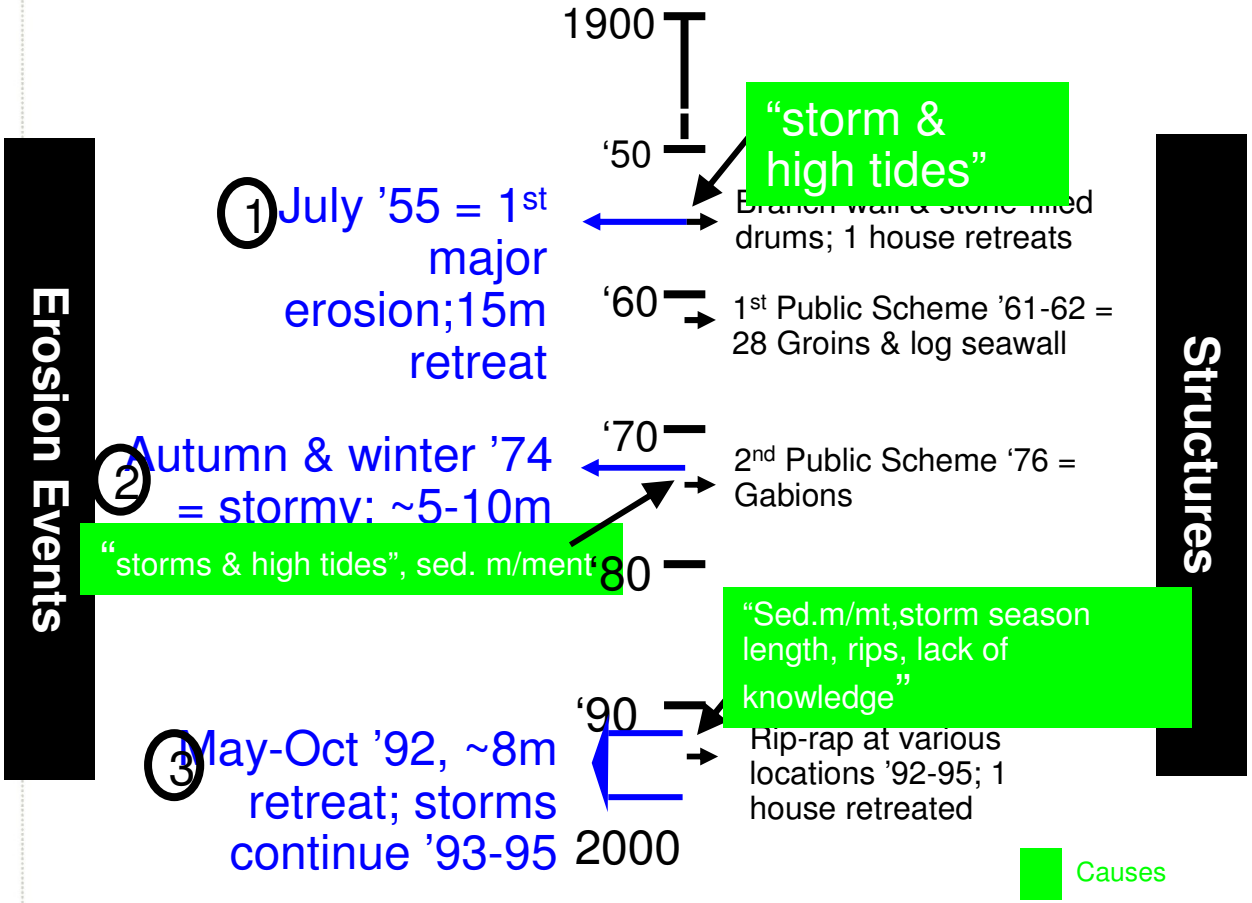
Erosion events vs 18.6 yr astronomic tidal cycle



Approx peak of cycle

Feb 1956

Sept 1974

April 1993

Dec 2011

Possible stream effects

- Permanent removal of sediment from beach system
- Temporary of permanent removal of sand from upper beach
- Dune toe erosion due to migrating stream channel

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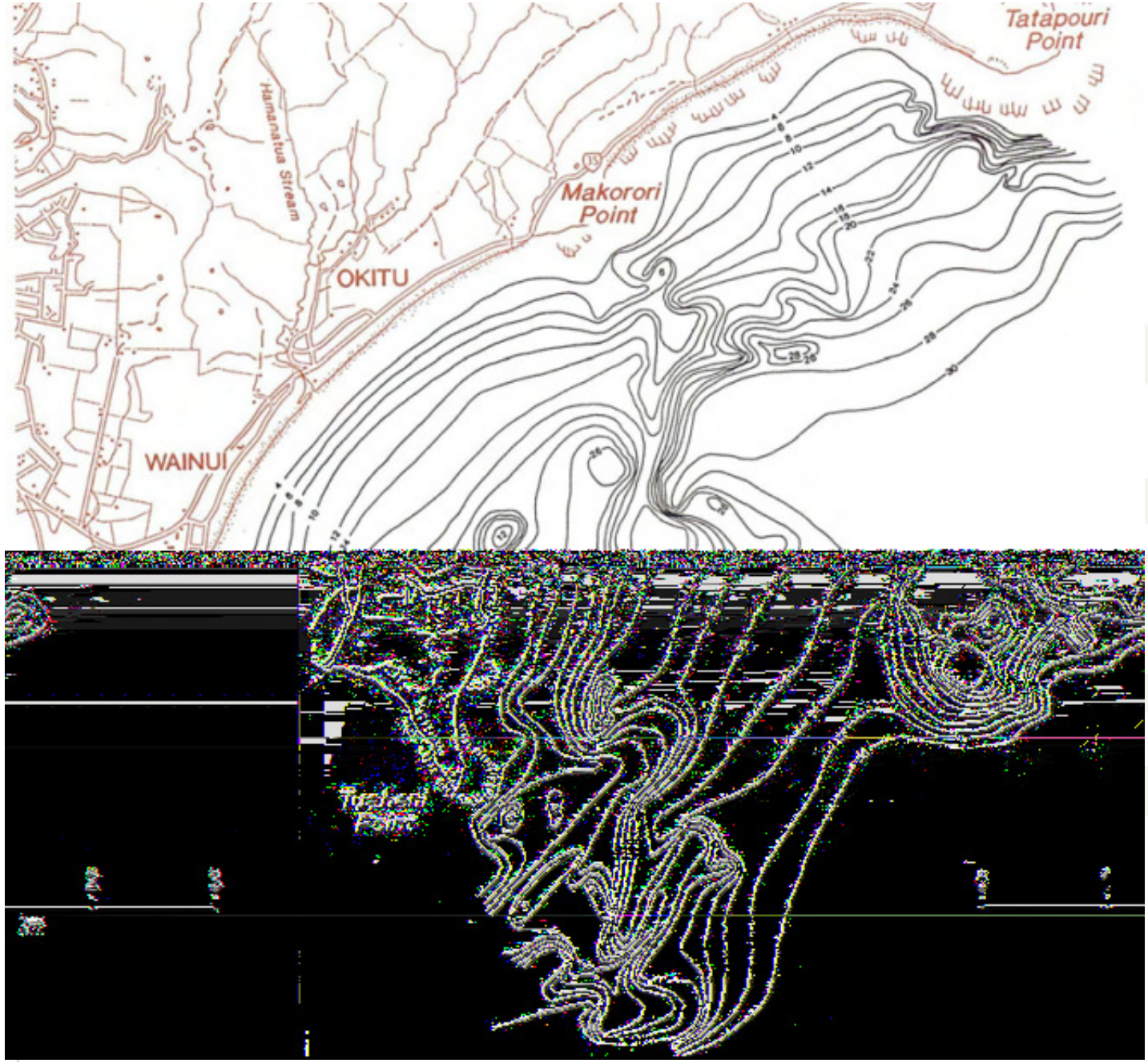

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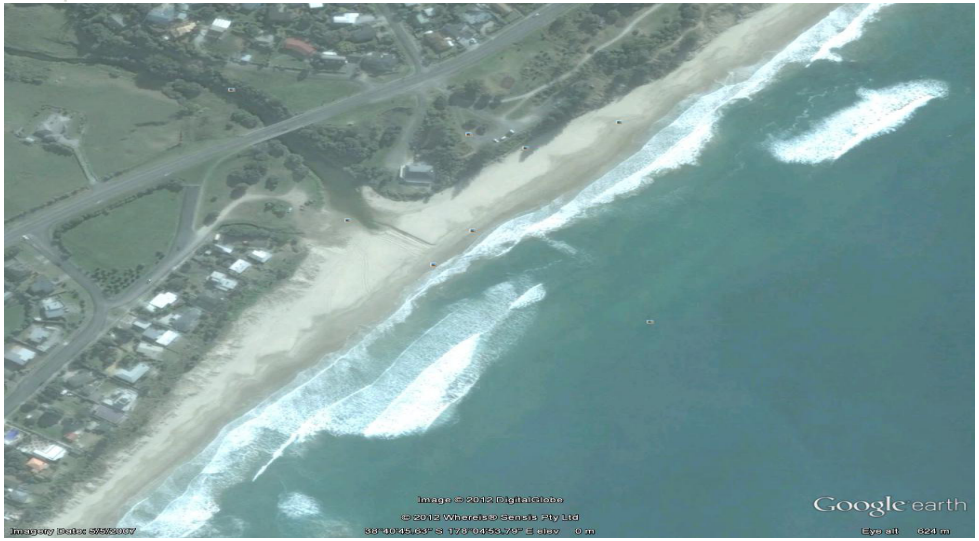
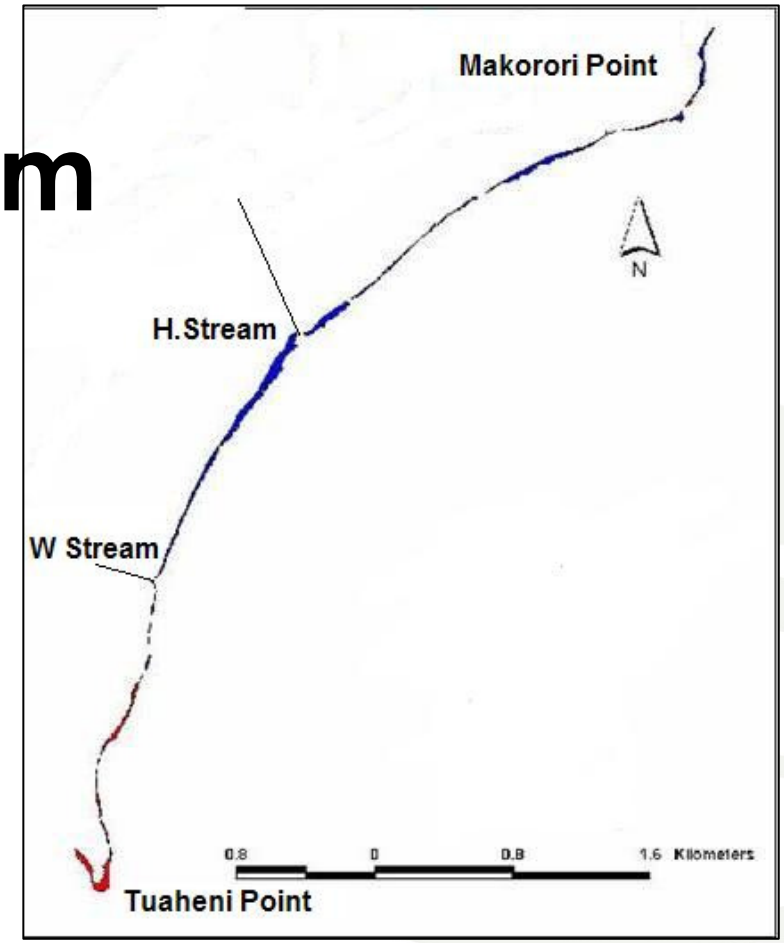
Hamanatua Stream





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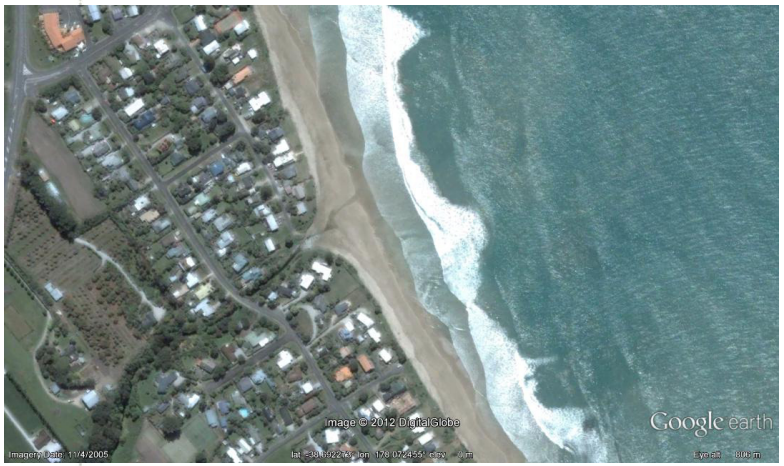
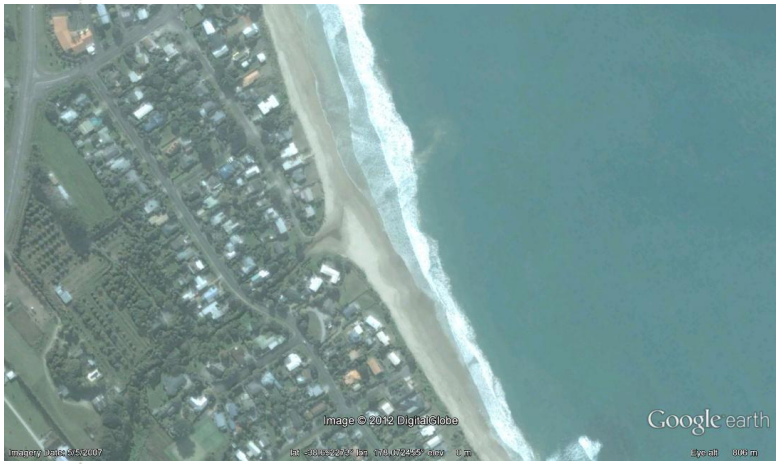
Wainui Stream





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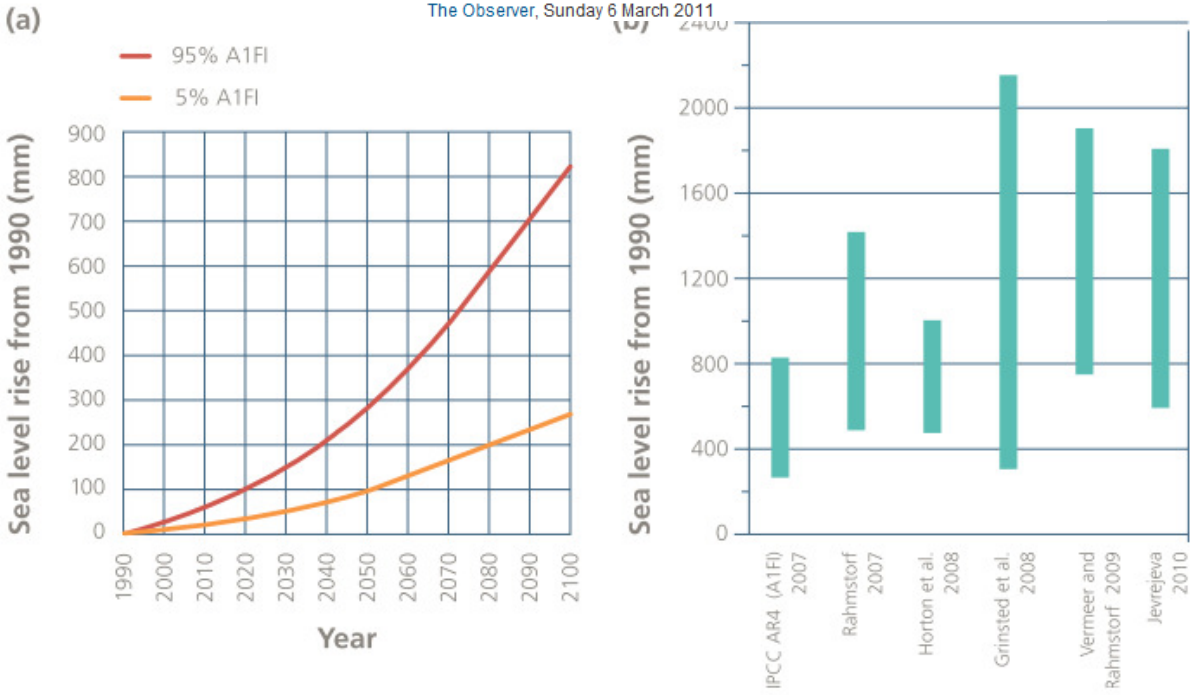
Sea level rise – will make it harder

Climate change 'will wreak havoc on Britain's coastline by 2050'

Millions living near the coast are likely to be hit by rising sea levels, erosion and storm surges, warns a new study by the Joseph Rowntree Foundation

Jamie Doward
The Observer, Sunday 6 March 2011



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Possible options

- Do nothing
- Status quo
- Management/planning responses
- Dune enhancement/planting
- Beach scraping/transfer
- Beach nourishment
- Cobble Berm/dynamic revetment
- Geobag walls
- Rock revetments
- Groynes
- Offshore reefs
- Beach drainage Management
- Undercurrent stabilizers

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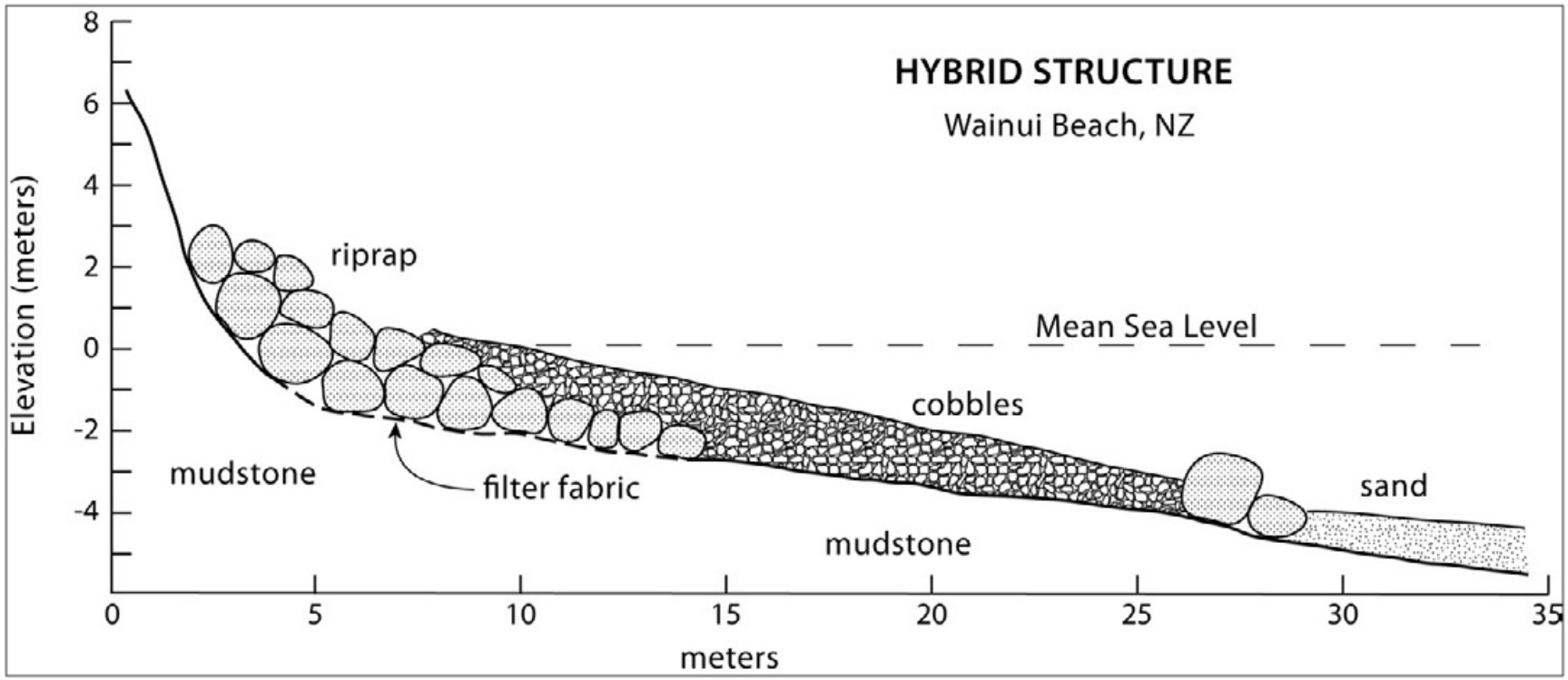
Cobble berm



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Rock revetment at Waihi Beach

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Groynes

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

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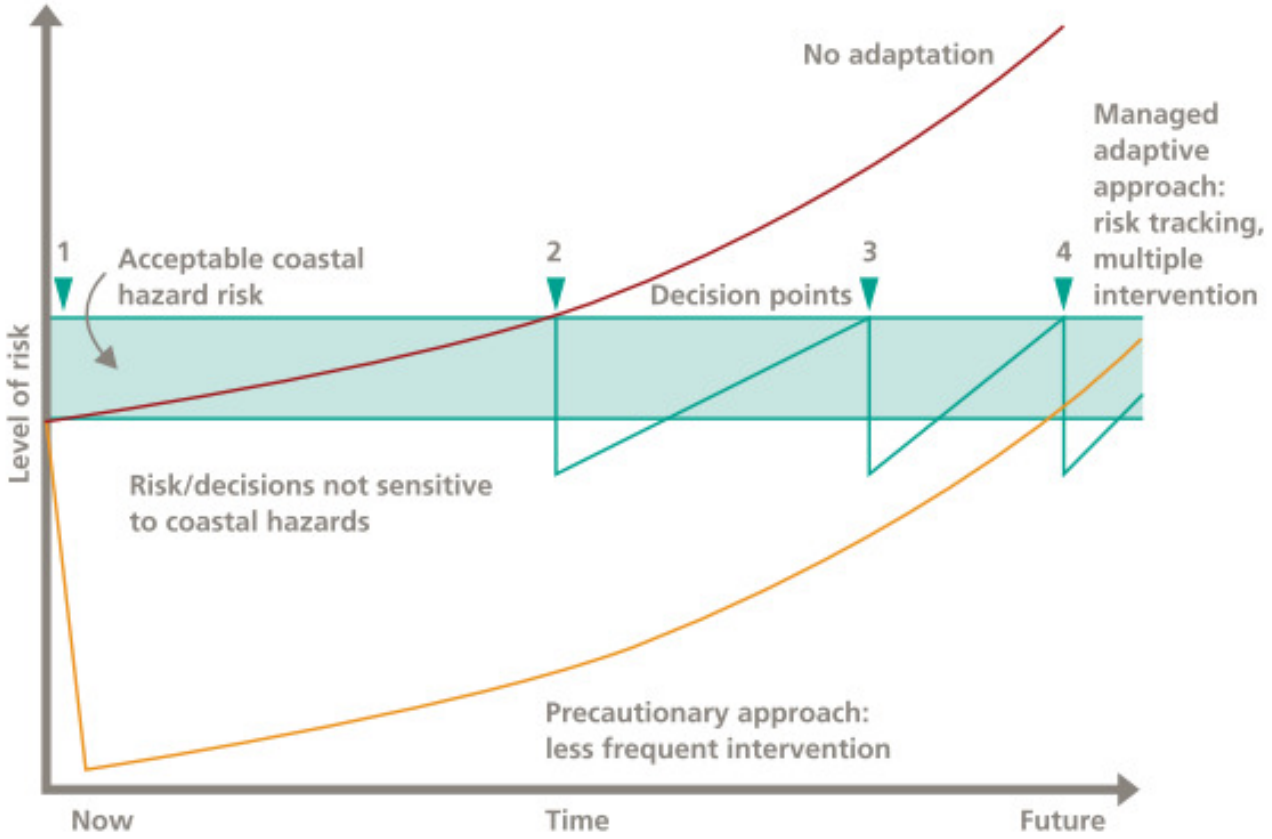
Principles of adaptive management



Source: Moon (2004)

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Questions not statements

One question per person

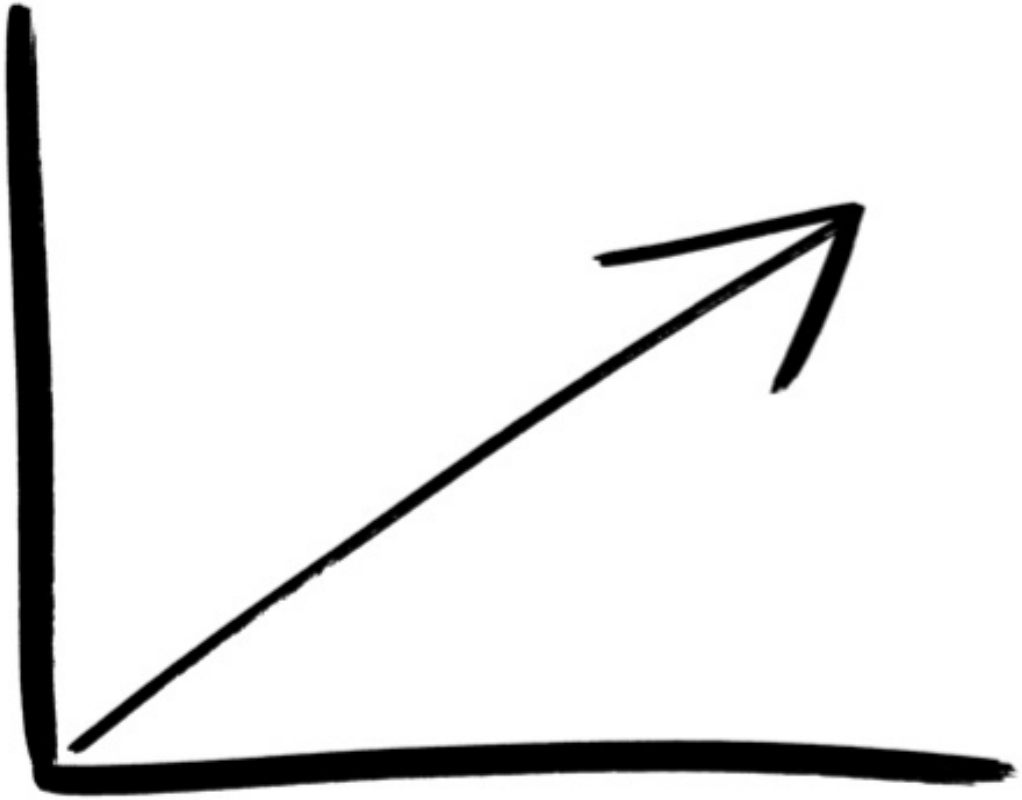
until each person had an

opportunity

Outside of today's topic?

→ Fridge for another day

Where to From Here?



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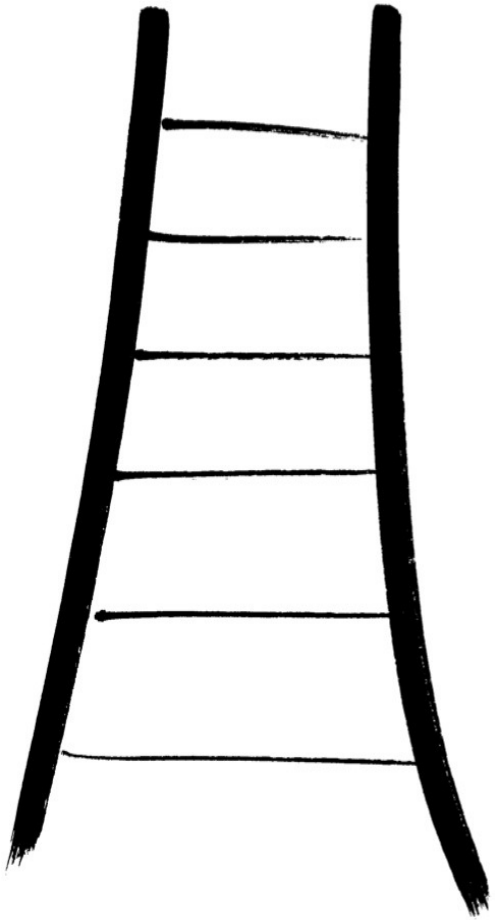
Next Steps?



Key Stakeholder Forum

Monday 17 September

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