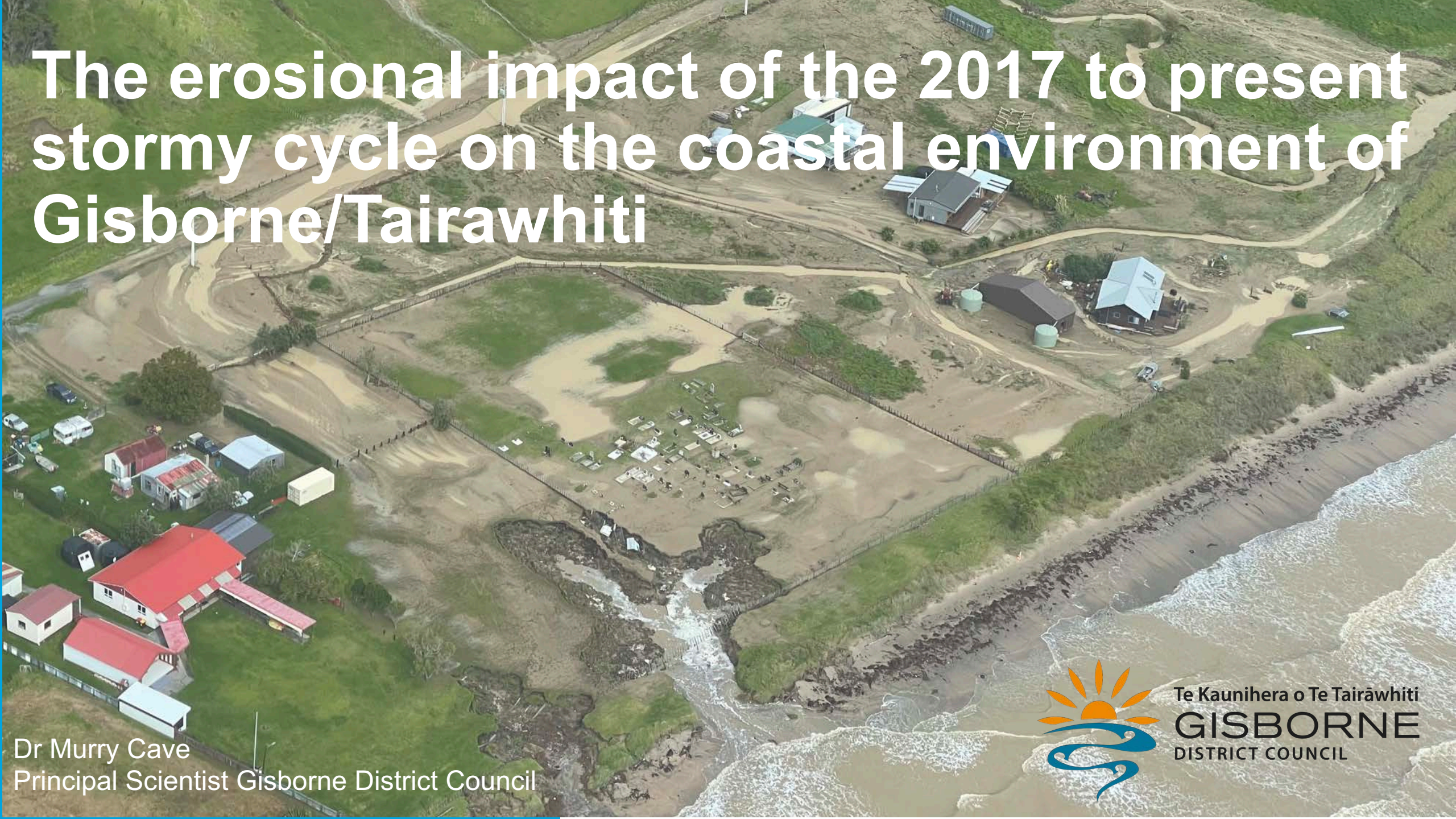
The erosional impact of the 2017 to present stormy cycle on the coastal environment of Gisborne/Tairawhiti



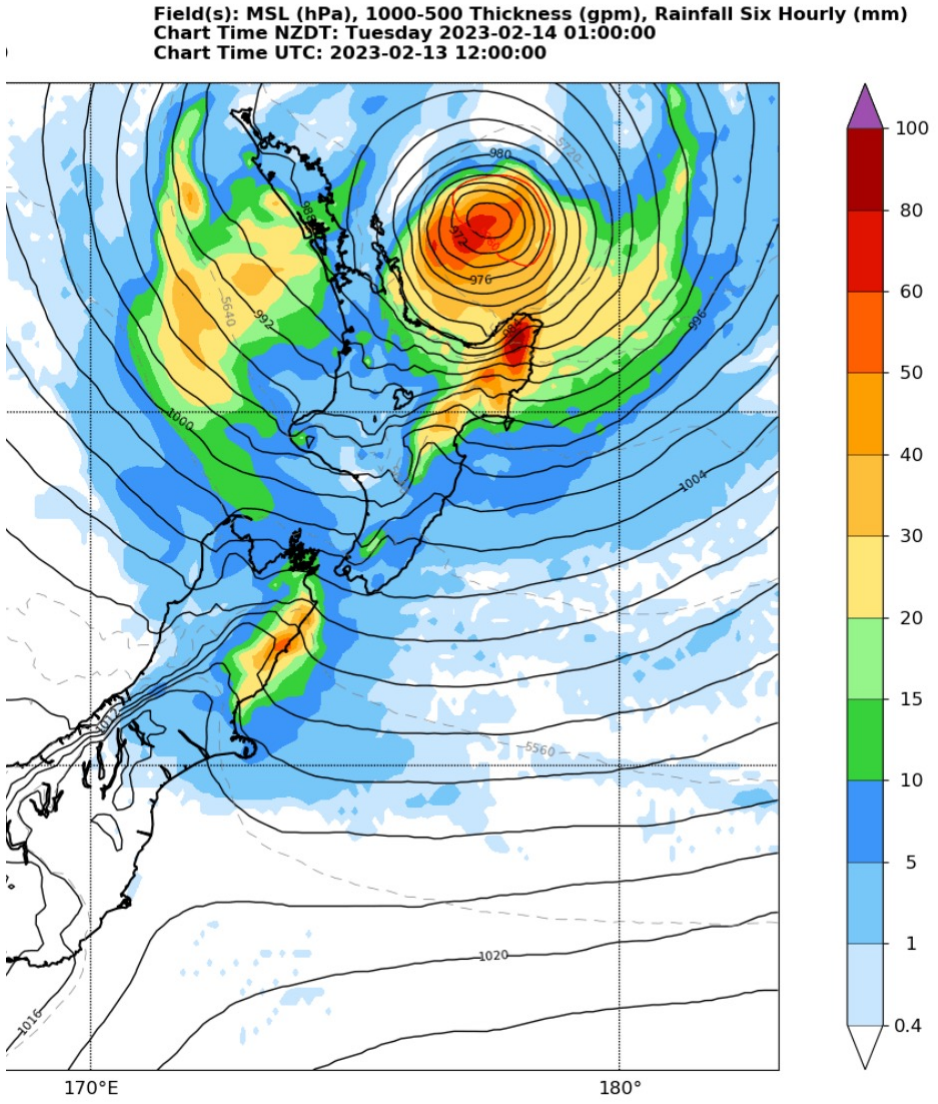
Dr Murry Cave
Principal Scientist Gisborne District Council

Te Kaunihera o Te Tairāwhiti
GISBORNE
DISTRICT COUNCIL

In 2023 multiple severe storms particularly Cyclones Hale & Gabrielle resulted in significant damage and a long recovery to rebuilt resilience

March 1988	**TC Bola Very Severe** lead to landuse change Pasture>Pine
	Post Bola Period of stable weather
April 2017	**TC Cook Severe** Uawa, Tokomaru, Waipaoa
June 2018	**Very Severe** Uawa (4-5th) 11th-12th Waipaoa
Nov. 2021	**Gisborne Very Severe** flooding and landslides
March 2022	**Regional Very Severe** Tokomaru & Anaura Bay

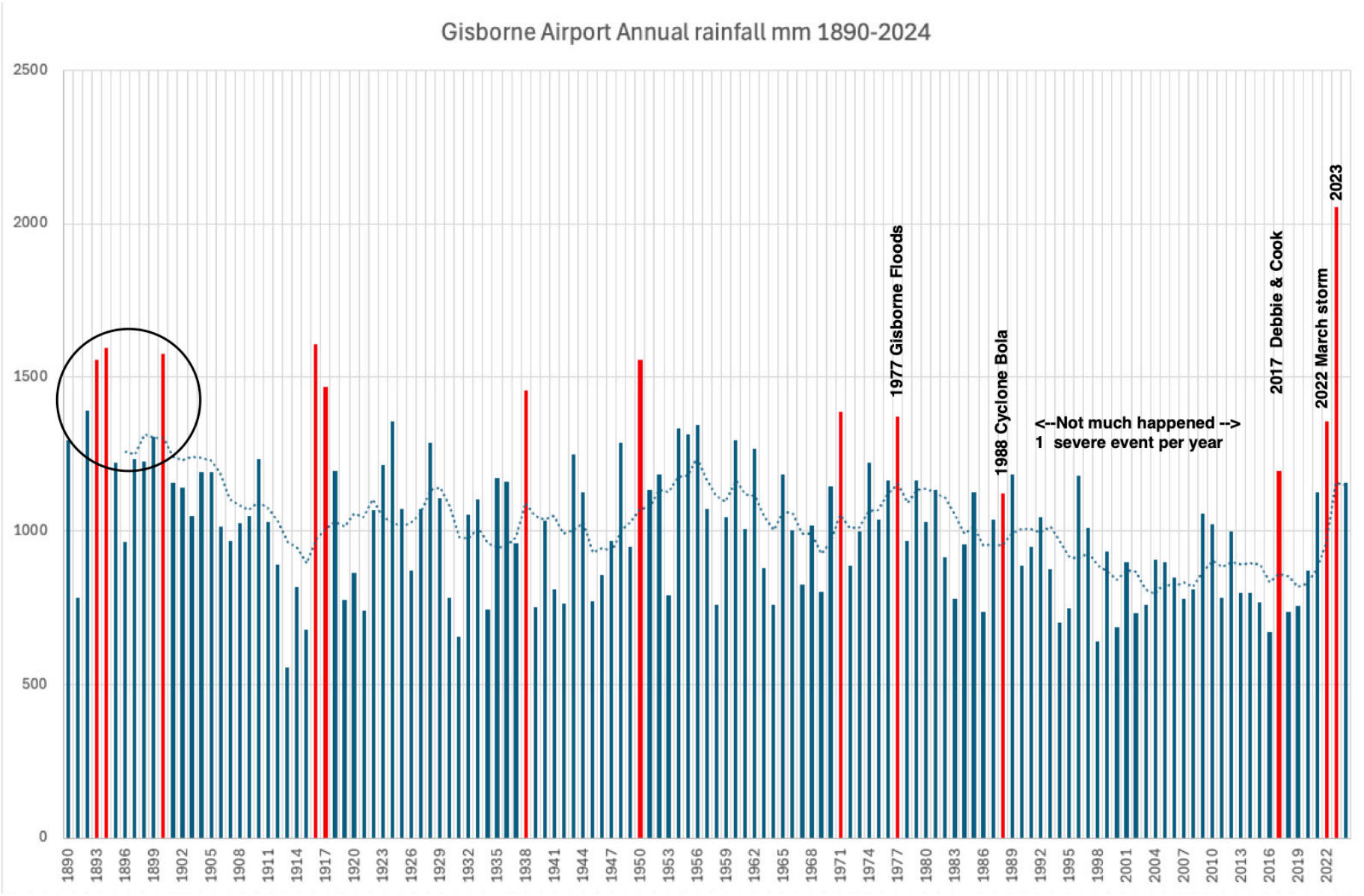
1. Jan 2023 8th	**Revive festival Storm** City short duration high intensity
2. Jan 2023 11-13th	**Ex TC Hale Very Severe**
3. Feb 2023 11th-13th	**Ex TC Gabrielle Very Severe**
4. Feb 2023 27-28th	**Son of Gabrielle** City short duration high intensity +regional
5. June 2023 26th	**Regional Very Severe**
6. September 2023 26th	**Regional South** Severe. Tiniroto Landslide Dam
7. October 2023 30-31st	**Ex TC Lola. Severe**. Tolaga North
8. November 2023 26th	**Regional Very Severe**
June 2024	**Regional Severe**



Maximum daily rainfalls in Gabrielle (594mm). Less than the 990mm in March 2022

But some context Annual rainfall @ Gisborne 1890-2024

- 2024 annual rainfall twice the annual average
- not that much happened in real terms between Bola in 1988 and Cyclone Cook in 2017
- some other “not much happened” cycles but not as sustained as post-Bola
- Obviously a bit damp in the 1890s
- Annual rainfall can mask major events ie Bola or November 21 (next slide)



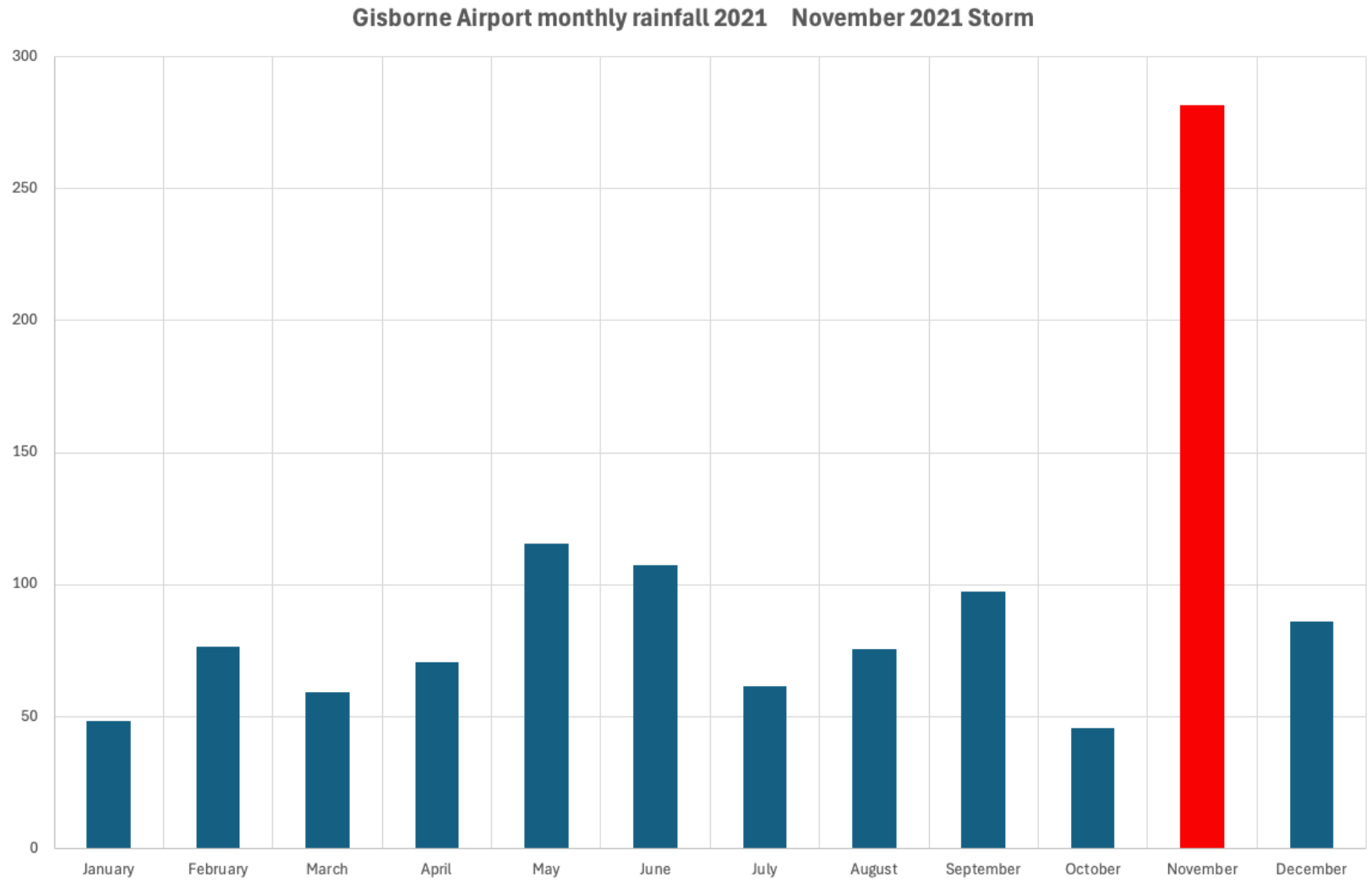
Context # 2 2021 a normal year with only 1 severe storm..but

25% of the years rainfall fell in 1 month

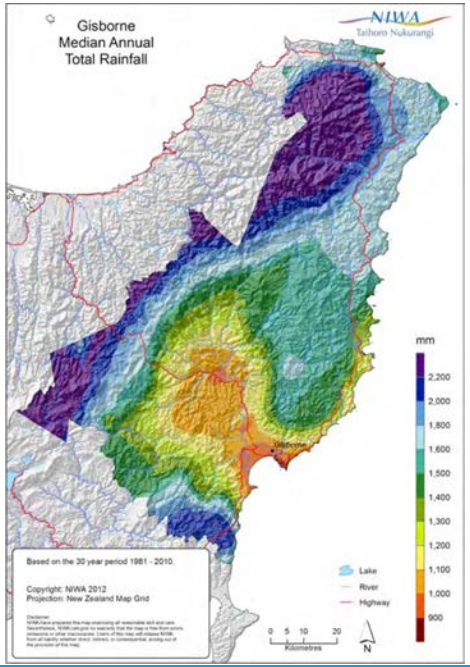
November rainfall (281.8mm) was 370% of the normal monthly average. (75mm)

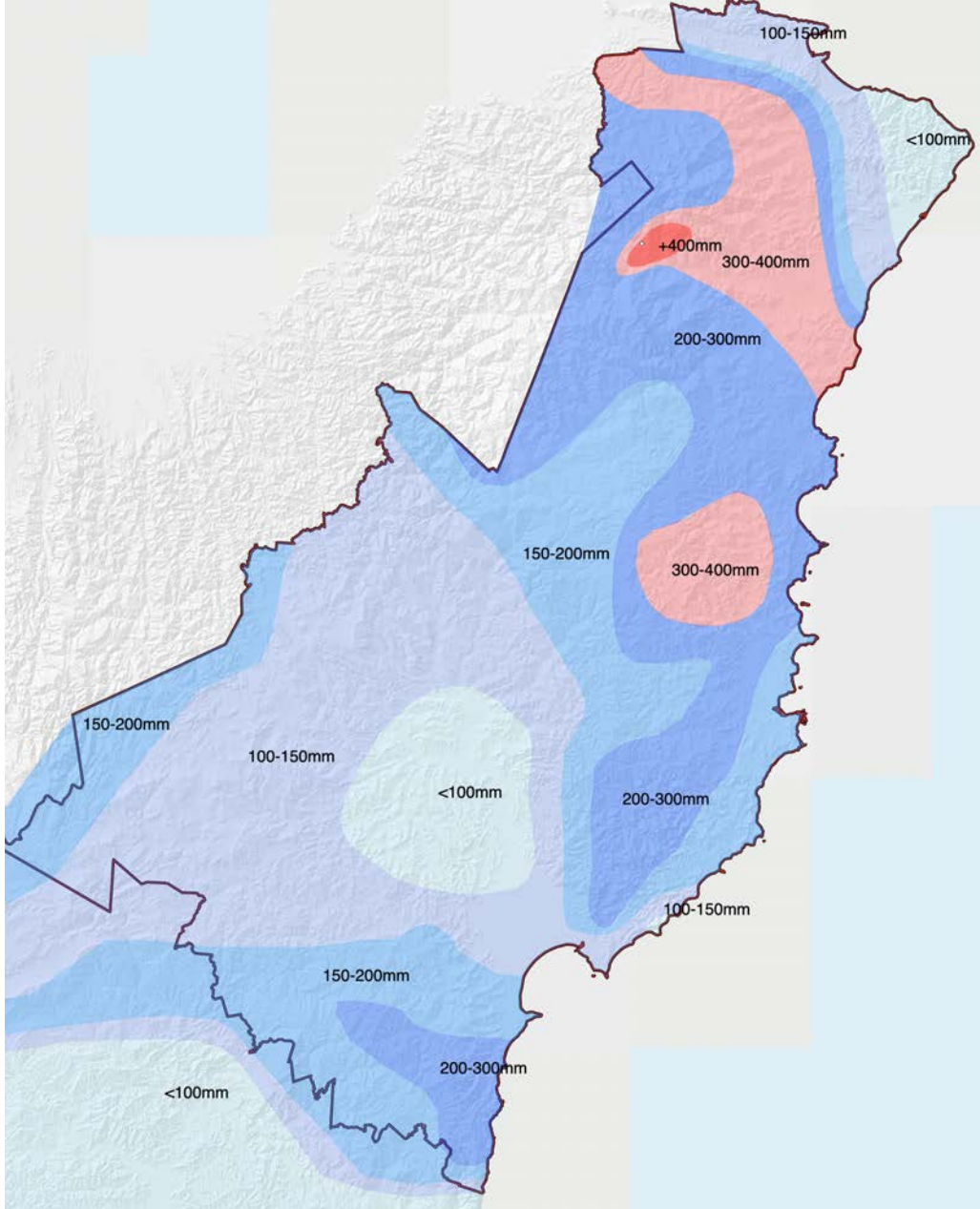
Intensity of the rainfall an important factor Kaiti 117mm in 12 hours 140mm in 24 hours

Extensive landslide damage to dwellings in Gisborne City

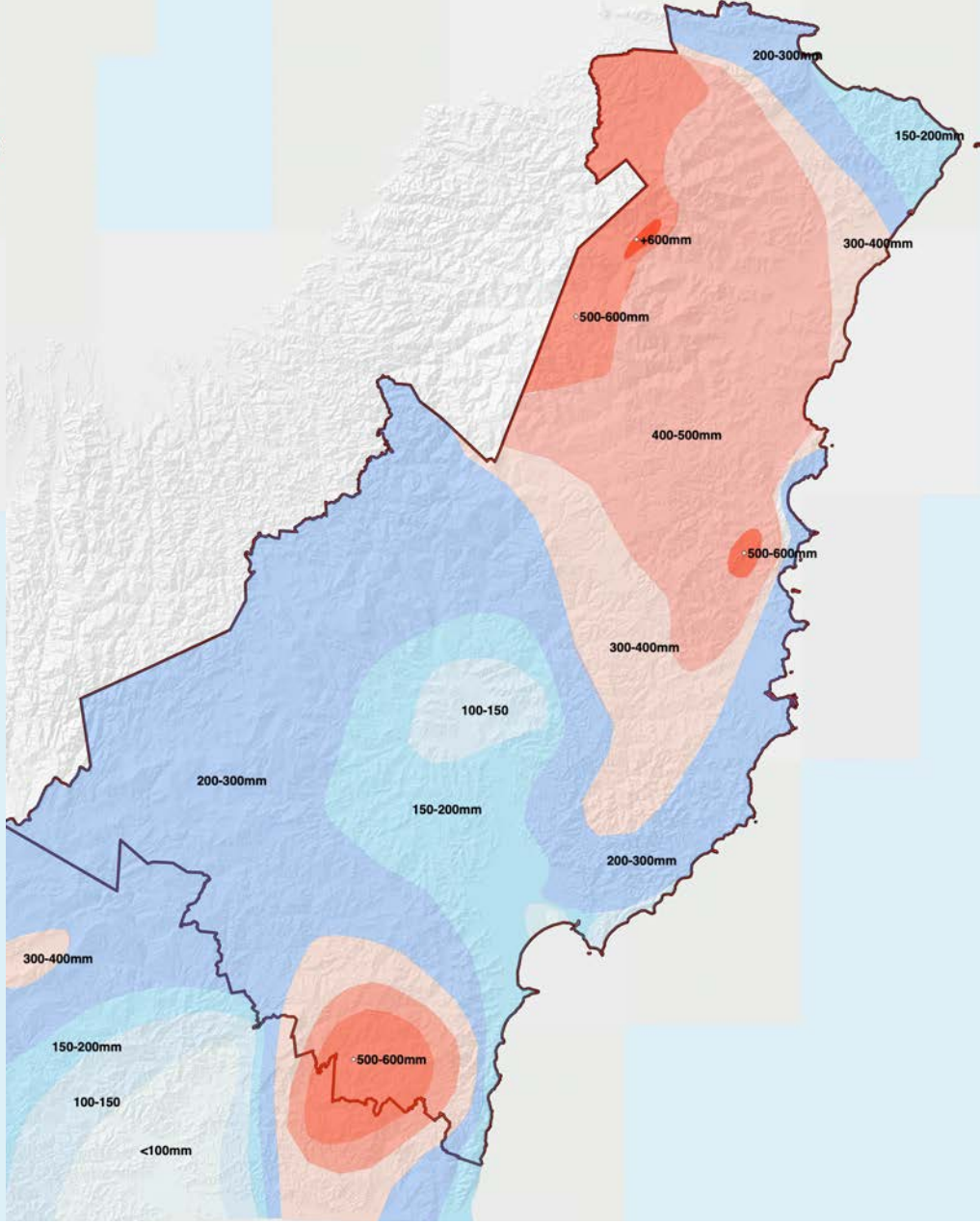


Cyclones Hale and Gabrielle were very different storms but rainfall distribution consistent with long term average





Cyclone Hale January 2023



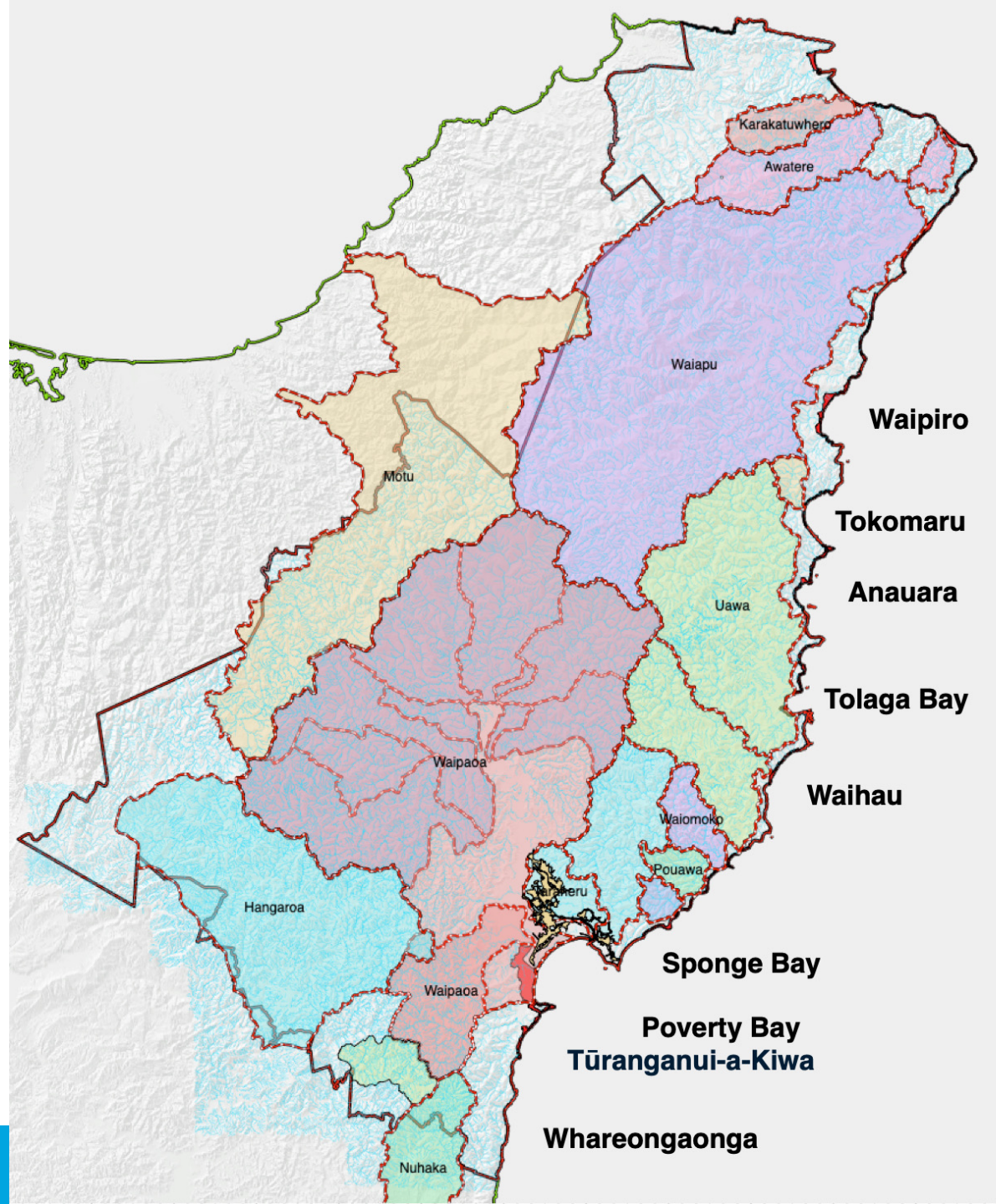
Cyclone Gabrielle February 2023

Its part of an integrated system

Our beaches response to storm events is driven by a range of factors;

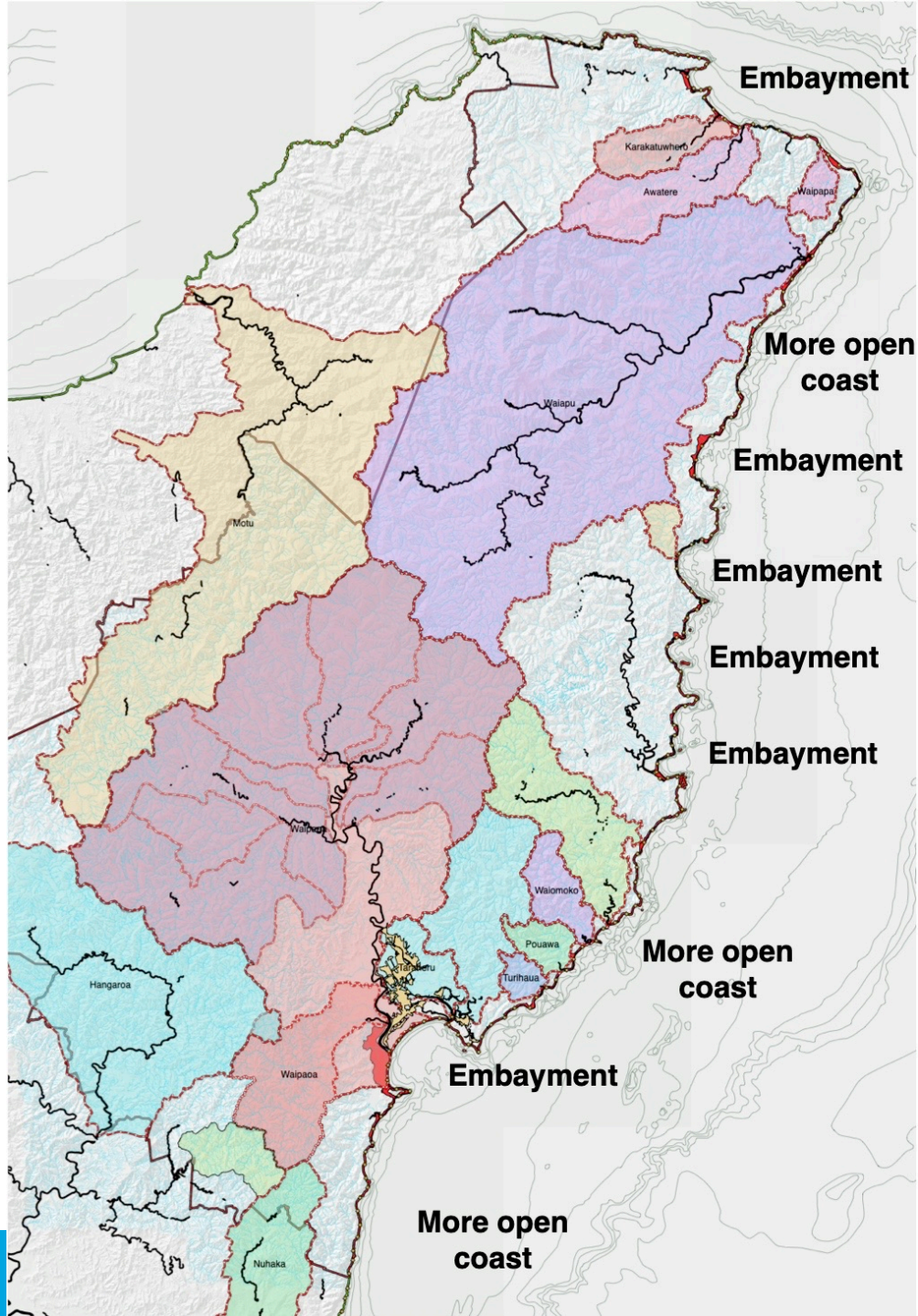
- **Sediment supply,**
- **Long shore drift patterns (north to south)**
- **High seas wave run up & storm surge**
- **Human interventions at various scales,**
- **Bathymetry**
- **Wind (perhaps)**
- **Geology and vertical land movt (uplift in the north, subsidence in the south, neutral in areas)**
- **Geomorphic setting**

I may get around to talk about some of the locations shown.



Drivers of coastal behaviour

- Dominated by large rivers with high sediment yields
  - Sediment flux from young weak rocks & older highly fractured basement
  - Not just present day landuse but post glacial through to human colonisation
  - Local variations from river dominated through to coastal erosion dominated
- A mix of more open coast and embayments
  - Are these embayments really closed systems or is sediment being lost?



Open Coast Line

Whareongaonga Landslide

November 2021

March 2022

Embayed Coast Line

Anaura Bay Urupa March 2022 storm

This is coastal

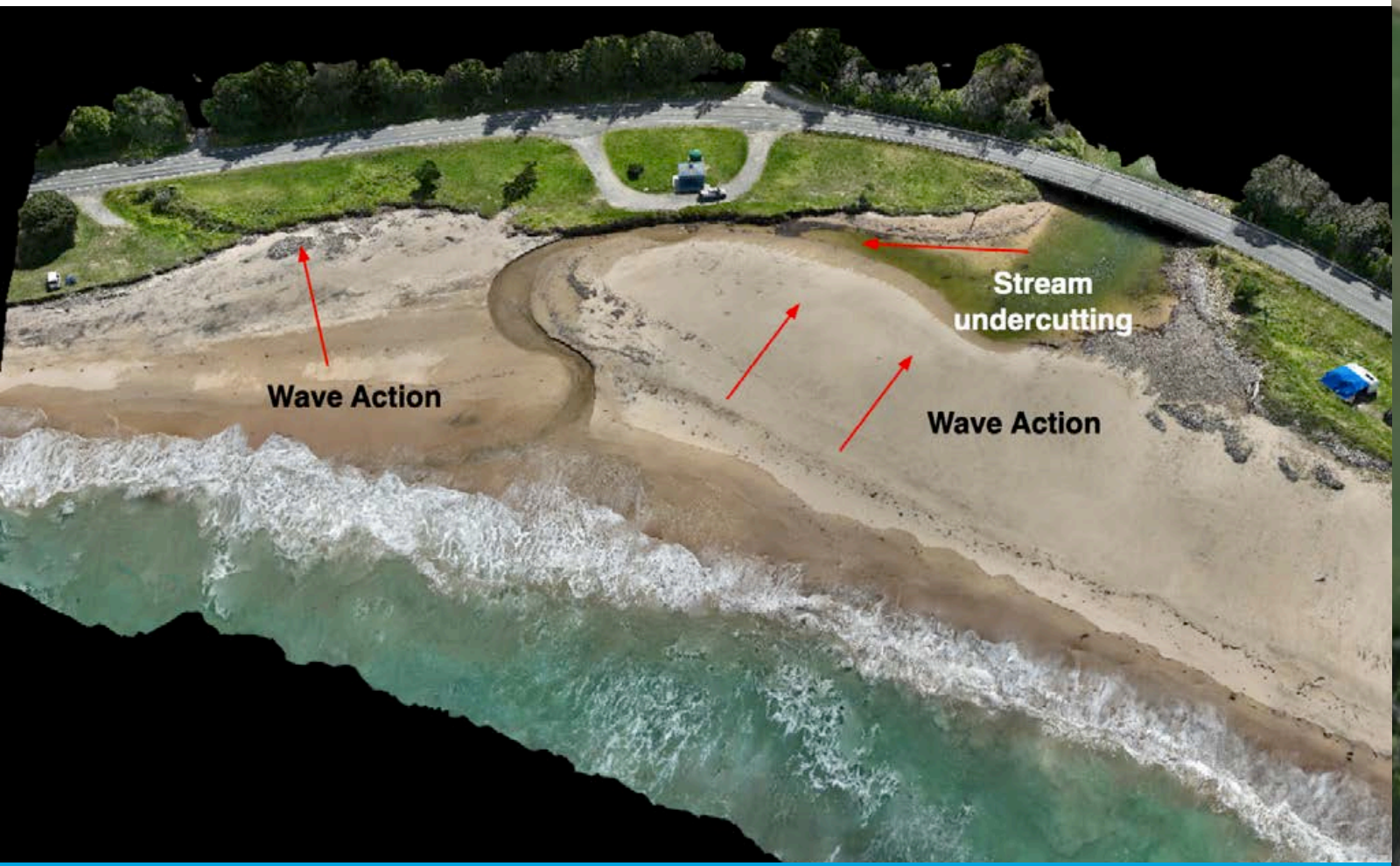
But not the result of storm surge or wave action from high seas.

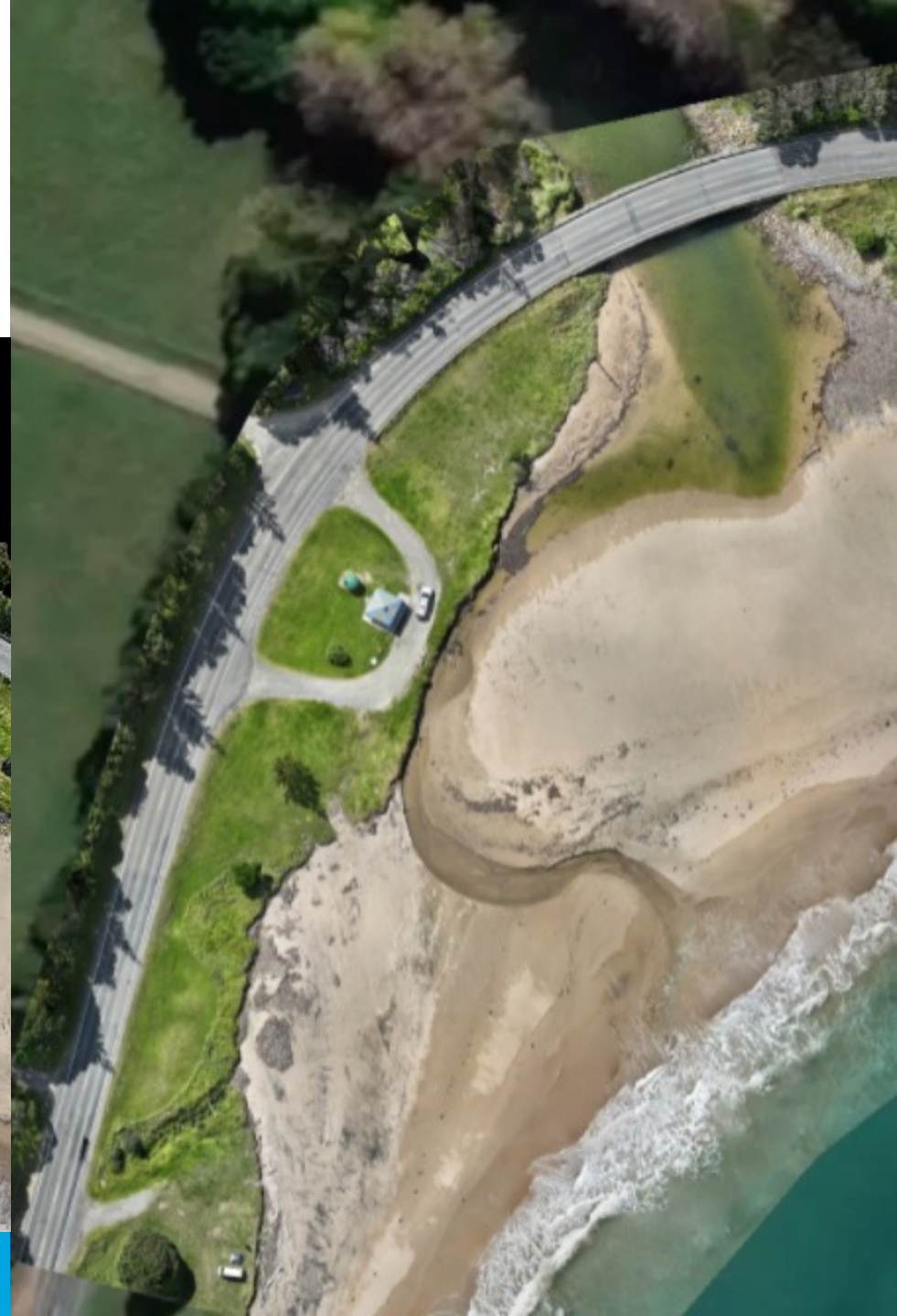
The dune is intact except at the breach point and there's no overall retreat.

High rain at the coast caused a normally small stream to badly flood

Turihaua embayment. Summer camping area and toilets erosion

Area subject to long term erosion. Hard revetments to protect highway both north and south. Wave dominated pushing stream against bank. Retreat best option





Tokomaru Bay

Mangahauini River mouth

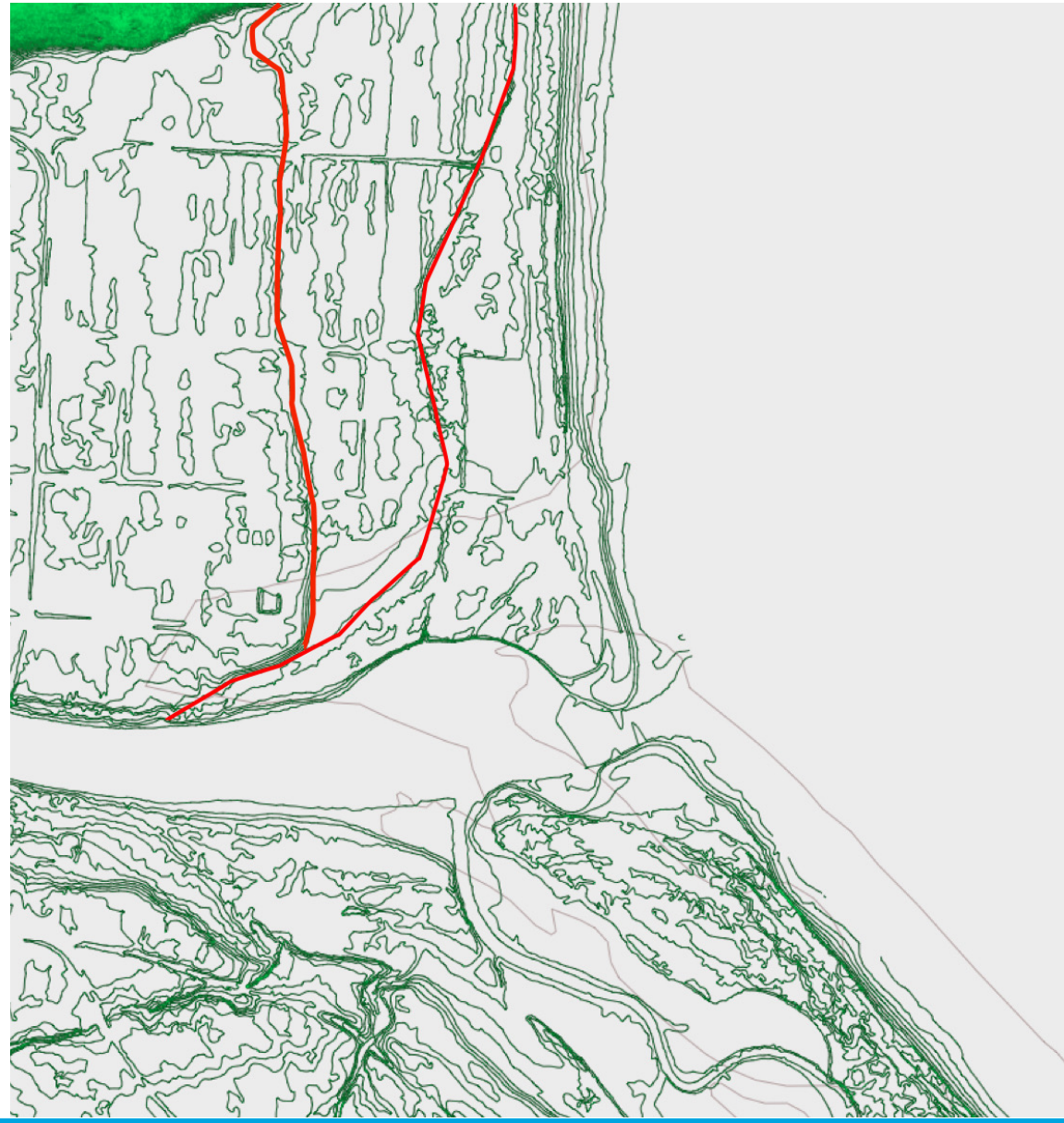
Significant erosion event October 2019
Manhagauini River has a long-term sinistral skew
Wave dominated with skew driven by wave direction and northward longshore drift.
High riverine sediment load from 2023 storms

Sponge Bay Entirely wave action

Tolaga Bay

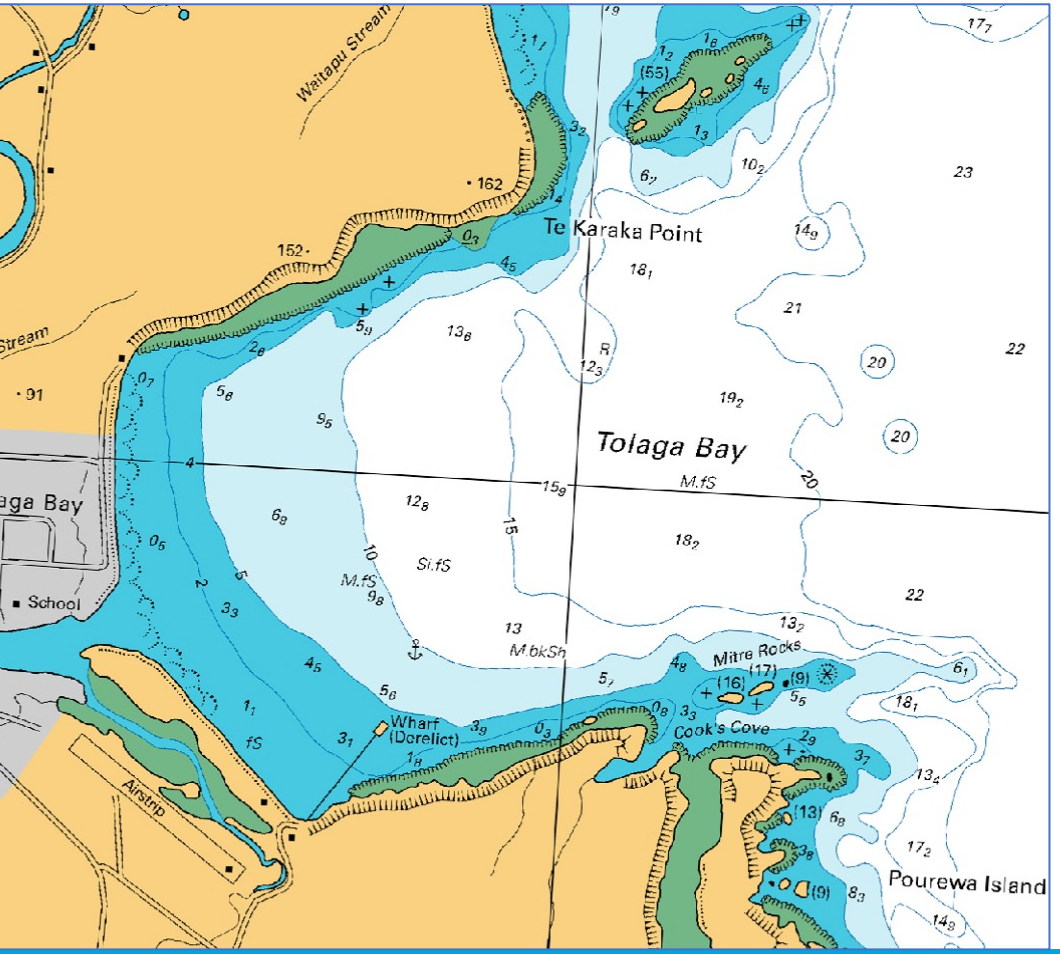
Long term seaward accretion- Short term retreat

2018 LiDAR obvious long term seaward accretion



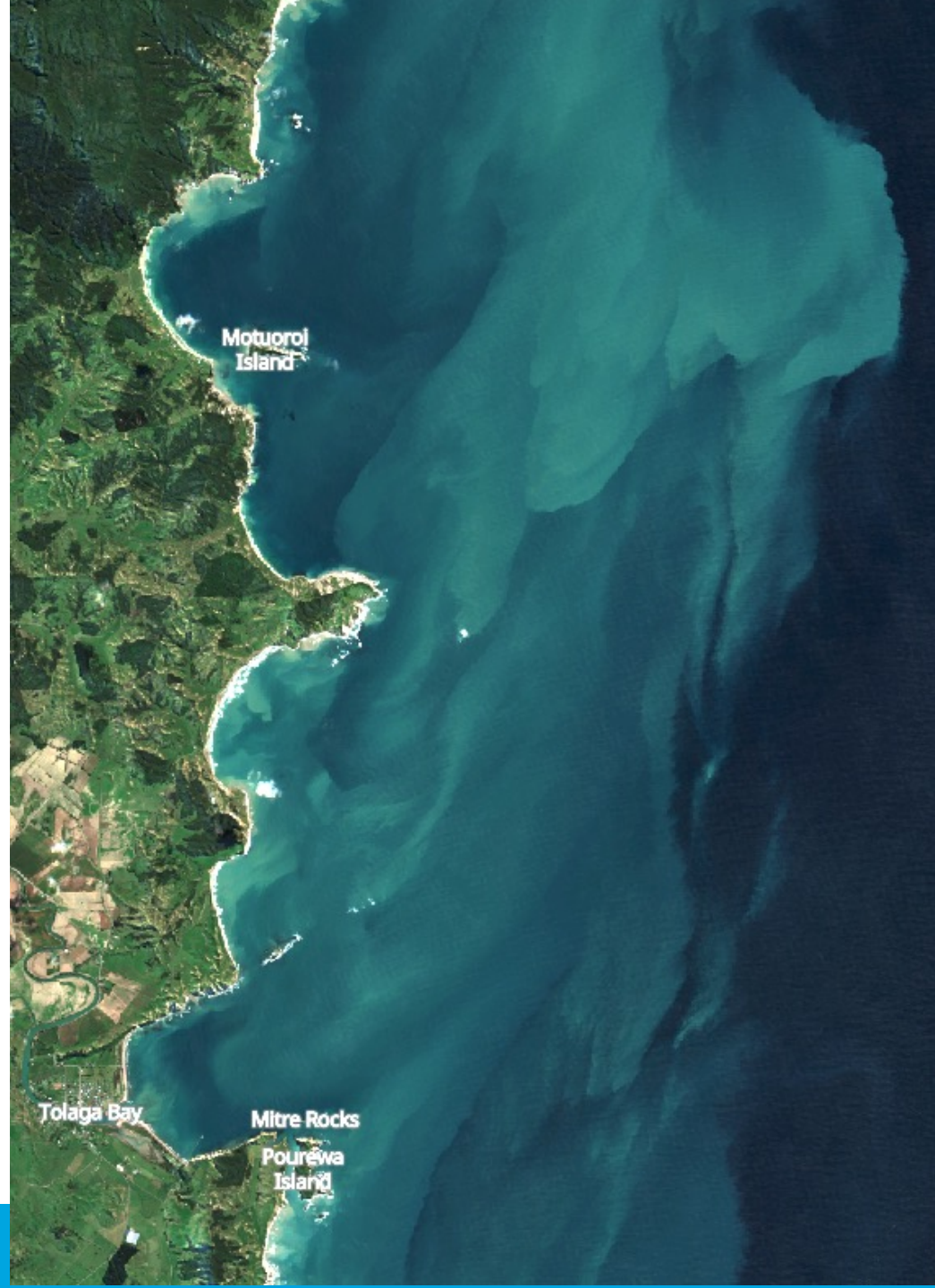
An embayment
but is it a closed system?

A low gradient sea floor reaching 20m 3.8 km out & no feeder channels to transport baseload sediment



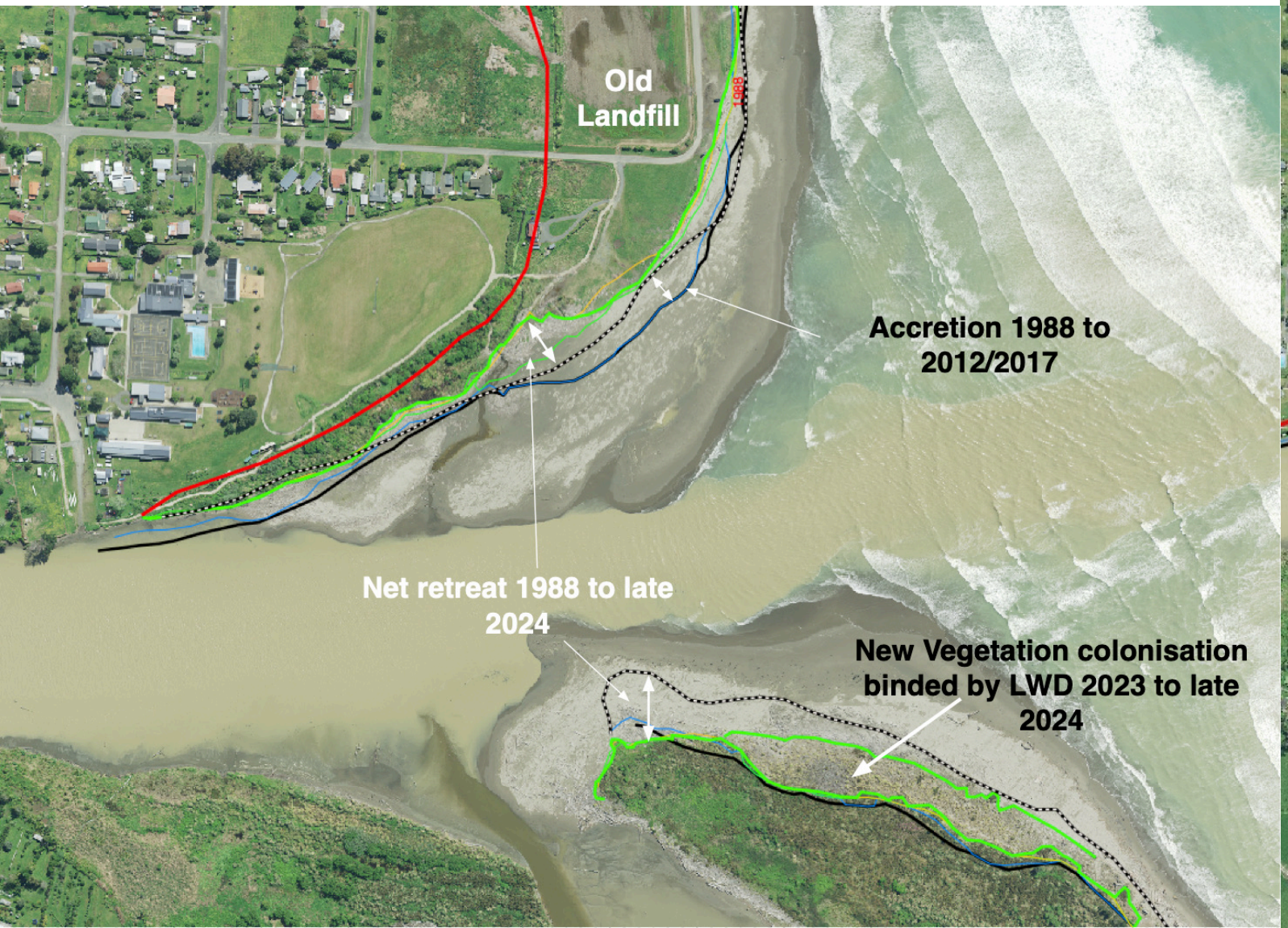
Post Gabrielle 23.03.2023 Suspended sediment plume extends north to beyond Kaiaua Bay.

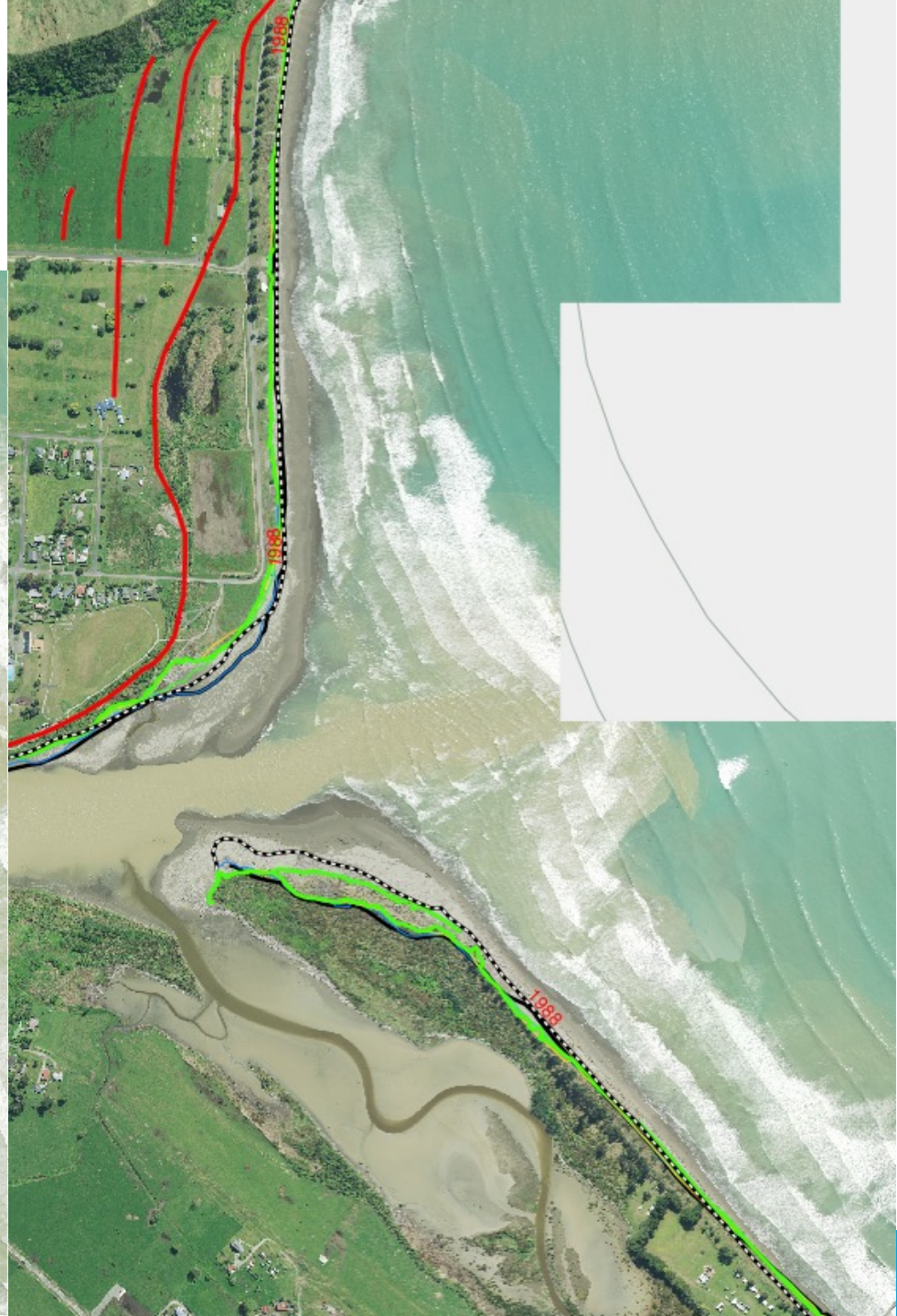
Modelling of LWD sources also indicates that many of our so-called closed systems are in fact at least partially open.
Ocean current north to south, longshore drift South to north.



Tolaga Beach recent changes

Localised net retreat since 1988 ~ Threat to old landfill
What has happened to all of the sediment from the recent storms?





Tolaga Bay Wave action is clearly a key driver


22 May 2021

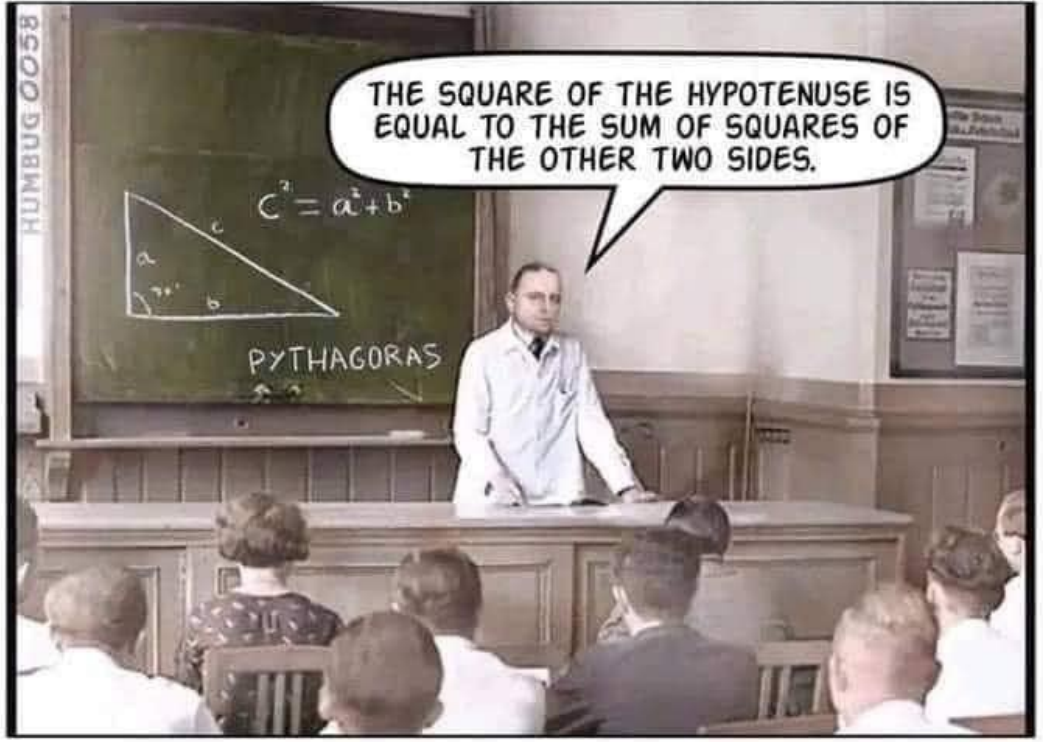
Some solutions or at least buying time for culturally significant locations ~ Whangara Marae/Anaura/Tolaga

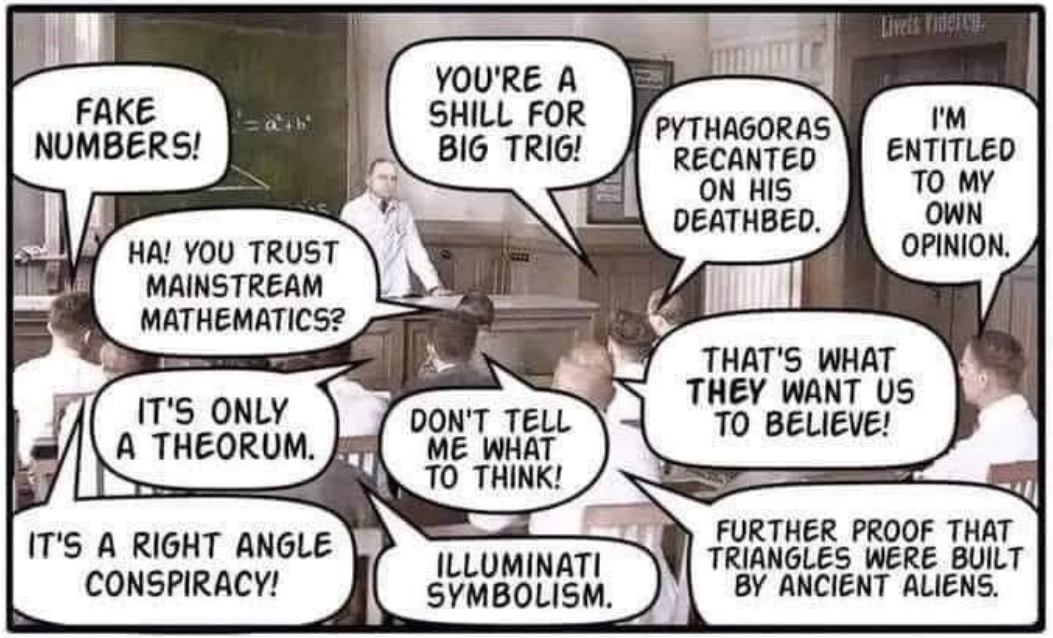
Concrete blocks haven't worked so LWD reinforced push up trial

Coir matting laid down
Logs bundled & tied and then wrapped in the coir matting
Concrete blocks removed from beach & used to hold top of matting
Sand push up over logs placed on outside of bundles

Managed retreat of Council assets

Thank you


HUMBUG 0058
THE SQUARE OF THE HYPOTENUSE IS EQUAL TO THE SUM OF SQUARES OF THE OTHER TWO SIDES.
$c^2 = a^2 + b^2$
PYTHAGORAS


FAKE NUMBERS!
YOU'RE A SHILL FOR BIG TRIG!
PYTHAGORAS RECANTED ON HIS DEATHBED.
I'M ENTITLED TO MY OWN OPINION.
HA! YOU TRUST MAINSTREAM MATHEMATICS?
IT'S ONLY A THEORUM.
DON'T TELL ME WHAT TO THINK!
THAT'S WHAT THEY WANT US TO BELIEVE!
IT'S A RIGHT ANGLE CONSPIRACY!
ILLUMINATI SYMBOLISM.
FURTHER PROOF THAT TRIANGLES WERE BUILT BY ANCIENT ALIENS.