Mapping Mangawhai Spit[1]

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Mangawhai Matters Inc

1. Auckland University (2024) “Topographic mapping of Mangawhai sand spit and development of a draft framework for monitoring future changes” Professor Mark Dickson, Assoc. Prof. Murray Ford, Dr Emma Ryan

1 Study Aims

- Hume Report (2023) identified threats to the spit:
    - Wind deflation
    - Erosion of the harbour coast
    - Erosion of the open coast
    - Inundation by the sea
    - Breaching may result from combined ocean side and harbour-side over-wash

- Topographic Mapping by Auckland University (2024)* commissioned to:
    - Provide mapping of spit morphology and evidence of impacts of storm events and SLR
    - Identify areas of vulnerability
    - Provide a capacity to generate computer maps of alternative outcomes
    - Provide a framework for future monitoring

* Auckland University (2024) “Topographic mapping of Mangawhai sand spit and development of a draft framework for monitoring future changes” Professor Mark Dickson,, Assoc. Prof. Murray Ford, Dr Emma Ryan for the Mangawhai Harbour Restoration Society.

2 Main results

- Confirms loss of significant volume of sand from the spit
- •Identifies potential for shoal to cause erosion of spit harbour shore
- •Confirms risks from eastern, ocean-side shore
- •Identifies risk of inundation from northern tip of spit
- •Confirms potential for inundation and breach
- •Identifies where its important to focus mitigation efforts

3 Method

- Map spit from 2018 LIDAR aerial imagery (NRC)
- Undertake and map a 2024 high resolution drone LIDAR survey
- Compare 2018 and 2024 spit outline, topography, and volume
- Identify potential water flow paths
- Model inundation under different storm conditions and sea levels
- Test an alternative, cost-effective method for mapping the spit.
- Assess monitoring options
- Generate user friendly GIS maps of outcomes

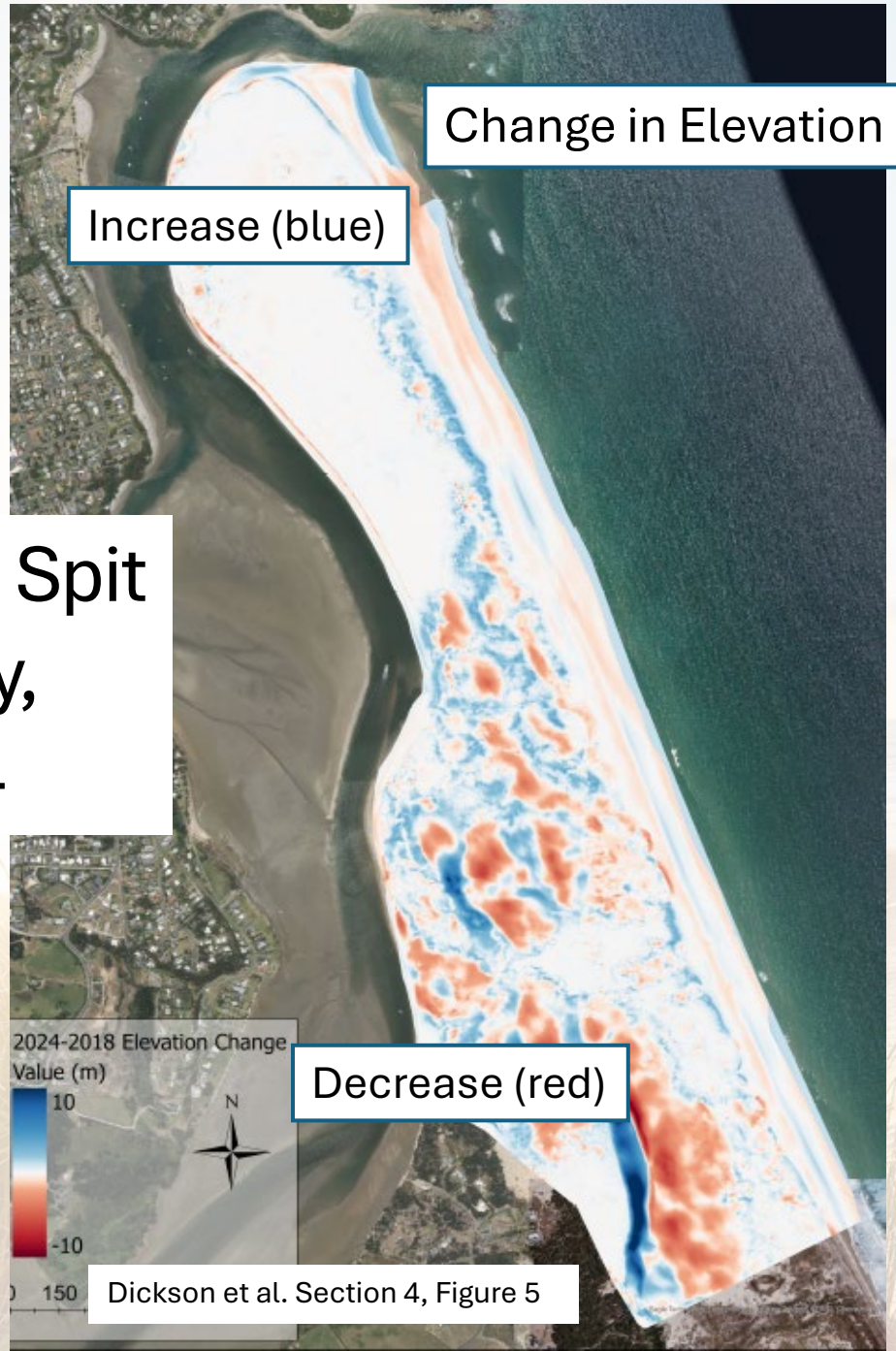
4 Findings – Spit Morphology

- Changes from 2018 to 2024:
  - The low-lying interior has not changed appreciably
  - Erosion of ocean shore from westward dune movement
  - Big dune has moved west 10-25m and decreased in elevation
  - Harbourside erosion up to 15m in places

  - The result:

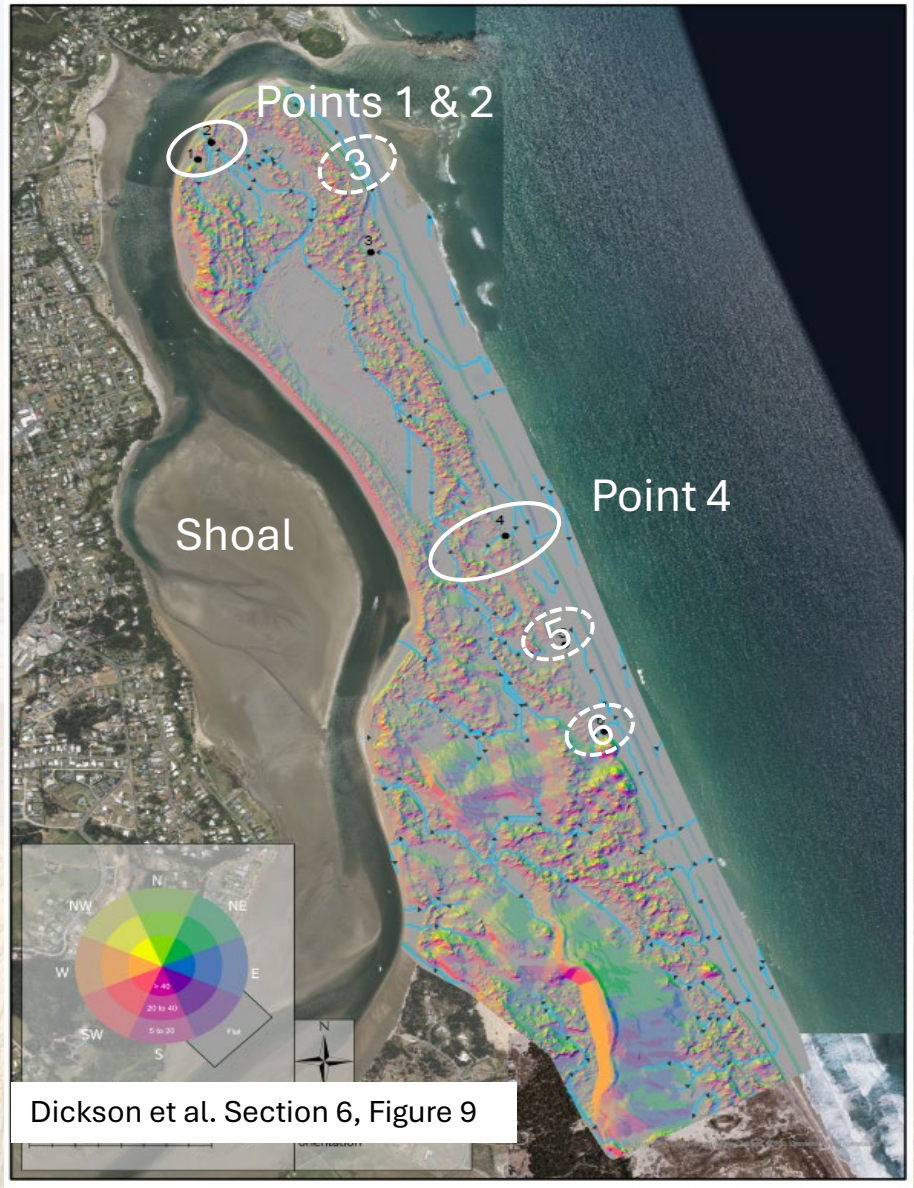
    a six year net loss of around 264,700m^3 of sand after replenishment by dredging (c.1.8% of total volume)

5 Changes in Spit Morphology, 2018-2024



6 Areas of Vulnerability

- Water flow pathways defined by low points and slope
- Shoal expansion will increase these vulnerabilities
- Spit today is wider than 1978
- Dredging and replenishment has reduced vulnerability to recent storms



Dickson et al. Section 6, Figure 9

7 Low Points, Pathways, & Areas at Risk

- Greatest potential for breaching Point 4 where spit is narrowest
- Northen part of spit (points 1 and 2) are vulnerable
- Northern portion of spit – site of previous breach – at significant risk

8 Potential for Inundation

Bathtub modelling – floods areas of the spit based on slopes and elevation

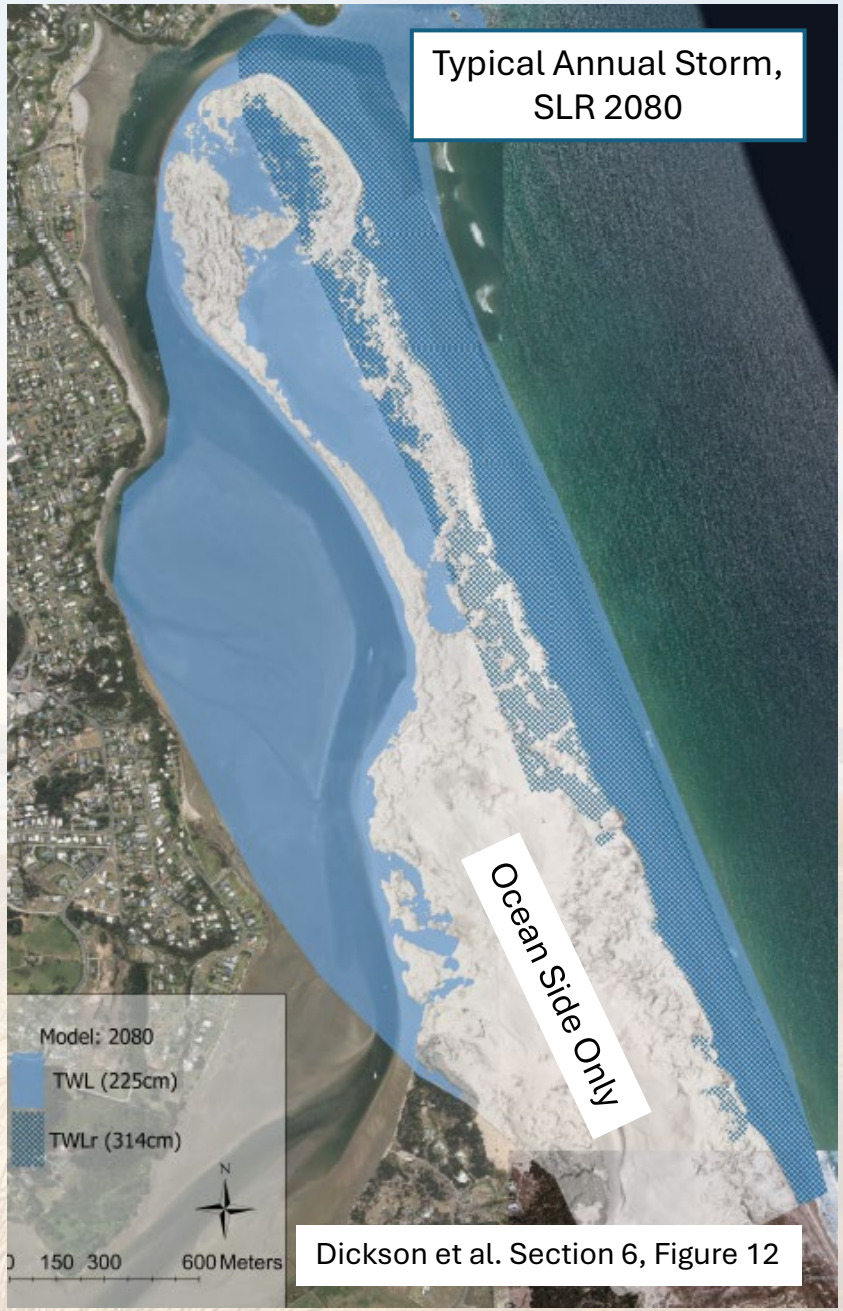
Based on current spit morphology, two sets of flooding scenarios:

Sea Level Rise: Typical annual storm unlikely to inundate the interior with SLR projections to 2040 but likely to do so by 2080.

Extreme storms: 1% Annual Return Interval conditions (cf 1978) see large portions of the spit inundated and breaching a prospect.

9 Impact of Sea Level Rise, 2040, 2080

Dickson et al. Section 6, Figure 11



Dickson et al. Section 6, Figure 12

10 What will determine if breaching occurs?

- Condition of the spit:
  - Erosional state of the ocean beach;
  - Height and continuity of coastal dunes;
  - Height & continuity of harbour shore dunes & bund
  - Eastern extent of harbour shoal
  - Shoal and shoreline interaction in the north
  - Location of low points and pathways

Mangawhai aerial viewer

- Nature of climate event:
  - Duration and frequency of storms
  - Elevation of harbour waters -catchment run-off, storm surge, tide state
  - Elevation of ocean waters – storm surge, storm tide, wave runup and setup

- Sea Level
  - Seasonal, decadal (El Niño and La Niña), and long term (climate change) variations

Inundation from the Ocean, 2005

12 Impact of Severe Weather Events & SLR, 2040

Based on Dickson et al. Section 7, Figure 13

Based on Dickson et al. Section 7, Figure 14

13 Our Conclusions

- The report shows
  - Loss of significant sand from the spit
  - Potential for shoal to erode harbour shore
  - Impact of erosion from eastern, ocean-side shore
  - Risk of inundation from northern tip of spit
- It identifies paths and low points to focus mitigation efforts
- It confirms prospect of another breach within 50 years is high
- Our conclusions
  - Bund wall has been effective in limiting damage from recent storm activity
  - Possibility of a breach within 15 years justifies increasingly active management of the harbour and spit
  - Active management calls for reviewing options and ongoing monitoring of the spit shorelines, topography, and volume

14 Critical Actions (DOC/MHRS/NRC)

- Manage the harbour Continue dredging
  - Prioritise dredging efforts on shoals to direct flow away from:
    (1) the middle estuary and
    (2) the northern tip of spit
- Manage the spit
  - Maintain harbour-side sand replenishment
  - Prioritise sand replenishment on low spots of oceanside dunes
  - Maintain fencing and planting to limit sand loss
- Address land use issues that exacerbate storm runoff, sedimentation, and elevated harbour water levels

15 A Framework for Monitoring

- Annual mapping of ocean coast and harbour shoreline and shoals using:
  - Free aerial imagery and/or ground surveys; or
  - LIDAR imagery and professional interpretation,
- Community/MHRS observation and photographic record of vulnerable areas
- Monitor and map sand placement
- Regular (4-5 yearly) drone LIDAR surveys of spit topography and volume to compare Digital Elevation Models
- One-off LIDAR surveys following extreme events

16. Next Steps – Sustainable Mangawhai Project

- Stage 2A – Complete physical risk assessment
  - Review & refine catchment inundation prospects and outcomes (Tonkin & Taylor)
  - Identify and document existing harbour and spit habitats (NIWA Proposal)
  - Prepare storm-based scenarios covering events, probabilities, and physical outcomes (workshop)
- Stage 2 B – Impact assessment
  - Environmental assessment – marine, terrestrial, and avian biodiversity
  - Cultural assessment – impact on waahi tapu, taonga, heritage
  - Economic assessment – impact on property, visitor business, public assets