

WHERE THE SEA MEETS THE SAND
CARING FOR MANGWHAI AND ITS HARBOUR
The Sustainable Mangawhai Project
Stage Two Report



Mangawhai Matters Inc
September 2025

Protecting our Environment, Sustaining our Community

Mangawhai Matters Incorporated is a community group committed to maintaining the qualities of the Mangawhai. The Sustainable Mangawhai Project aims to assess the physical risks to the harbour and distal spit and the consequences for the environment and community of any damage to them as the probability of global warming increases. The objective is to provide an authoritative information base to encourage the community and agencies responsible to cooperate in the preparation and implementation of harbour management and food hazard reduction policies and guidelines.

Where the Sea Meets the Sand: Caring for Mangawhai and its Harbour

The Sustainable Management Project
Stage Two Report:
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Contents

PREFACE

1.	INTRODUCTION	1
1.1.	Stage One – Setting the Scene	1
1.2.	Stage Two – Identifying the Issues	1
2.	The Contribution of the Catchment	3
2.1.	Nutrient load	3
2.2.	Sedimentation	4
2.3.	Land use impacts	4
2.4.	Conclusions	4
3.	The Changing Face and Fortune of Mangawhai Spit	6
3.1.	The Study	6
3.2.	Recent Changes in Spit Morphology	6
3.3.	The Risk of Inundation and Breaching	7
3.4.	Conclusions	7
4.	The Inundation Outlook	8
4.1.	Introduction	8
4.2.	The Storms	8
4.3.	Modelling the Possibilities	8
5.	Where to From Here?	12
5.1.	A Call to Action	12
5.2.	Adaptive Planning for Sustainability	12
5.3.	Assessing the Options: A Policy Toolbox	13
5.4.	Conclusion	13

Tables

Table 1	Global Development Scenarios - Shared Socioeconomic Pathways	9
Table 2	Coastal Inundation Levels by Storm Intensity and Warming Scenario	9

Figures

Figure 1	Estuary Catchments and Runoff Receiving Arms	3
Figure 2	After the Storm - Sediment Load, Tara Arm-Back Bay, 2025	5
Figure 3	Pre-Breach Narrowing of the Spit Neck, 1976	6
Figure 4	Mapping Inundation	10
Figure 5	Vulnerability of the Spit	11

PREFACE

Mangawhai lives by its harbour. The harbour shapes the environment and defines the community. Unfortunately, it is under threat from volatile and sometimes extreme weather conditions. This in turn threatens the wellbeing of its residents, its biodiversity, and its cultural heritage. It would also lower the recreational benefits provided to thousands of visitors each year and, consequently, undermine a large part of the local economy.

Stage Two of the Sustainable Mangawhai Project focuses on the physical challenges future storms might pose. It comprises three studies, summarised in this report.

A team from Auckland University identified areas of the spit, the harbour's key defensive mechanism, at risk of erosion, flooding, or breaching. We are pleased to say that Mangawhai Harbour Restoration Society, working with the Department of Conservation, is already refining and extending its spit conservation and recovery works in response.

Based on catchment geology, topography, and land use, Dr Sandy Elliot of NIWA (Earth Sciences New Zealand) modelled possible pollution from runoff, finding that it is not a significant problem given the small size and composition of the catchment.

Silting of the harbour is not currently an issue, either. However, more volatile weather could see increased deposition leading to damaging sedimentation in parts of the harbour, with Back Bay most obviously at risk. The report also identifies risks around open earthworks and recommends limiting the amount in the catchment at anyone time. In addition, Mangawhai Matters recommends that the local and regional councils implement and enforce best-practice stormwater controls and management, particularly for exposed earthworks.

Third, with the help of Tonkin and Taylor, coastal engineers, we considered the prospect of coastal inundation from intensive storms over the next 50 years. The scientific evidence and the recent record confirm that we can expect storms of growing greater potentially giving rise to widespread flooding. This prospect, coupled with sea level rise, threatens public and private assets, community welfare, ecosystems, and the economy. In the light of these findings, it is time to act.

To this end, we are recommending that Northland Regional Council, Kaipara District Council, the Department of Conservation, and mana whenua collaborate to develop and implement a long-term plan to safeguard the harbour, its environment, and the ecological, cultural, and community values it embodies. Mangawhai Matters will continue to promote the community's interests in such an initiative.

Investing in mitigation through such an initiative now will cost far less than the impact of a major storm event later. Building resilience will preserve Mangawhai's attractive natural environment and its appeal for residents and visitors.

The reports summarised here are available on our website, www.mangawhaimatters.com.

We thank all who donated to make this work possible and the experts who contributed.

Doug Lloyd
Chair, Mangawhai Matters Incorporated
September 2025

1. INTRODUCTION

This section recaps Stage One and introduces the studies commissioned for Stage Two of the Sustainable Mangawhai Project. It provides links to the underlying reports in the footnotes.

Mangawhai Harbour and its barrier spit support biodiversity, recreation, economic activity, and cultural, community, and personal well-being. The Sustainable Mangawhai Project aims to provide evidence supporting measures to counter or mitigate threats to these services from a more volatile climate and ongoing development.

Stage One surveyed coastal and harbour processes, identifying issues affecting the integrity of the harbour and its protective barrier spit. For Stage Two, Mangawhai Matters commissioned experts to bring their knowledge and skills to the key threats identified. The aim is to inform policies to protect from or mitigate the impacts of intensive storms and storm tides.

This report summarises their findings and proposes developing and implementing a plan to lower the risk of coastal inundation and sedimentation from storms over the next 50 years.

1.1. Stage One – Setting the Scene

Based on a survey of processes affecting the harbour and coast, oceanographer Dr Terry Hume identified the following threats:¹

- A **breach of the sandspit** would have a highly disruptive impact on the harbour, particularly if it interacted with other threats.
- **Coastal inundation** would have serious, if localised, impacts on infrastructure, property, and wildlife habitats.
- Inappropriate land use and poor stormwater management could lead to a loss of **water quality**.
- **Mangrove forest** expansion is a risk that is contained by current management provisions.
- The capacity of **causeways**, culverts, and bridges to cope with higher storm tides and intensive run-off events needs to be determined.
- **Recreational use** poses very little risk to the state of the spit or harbour.

Based on these findings, three more detailed reports were commissioned in Stage Two to focus on the impact of storms on the morphology and integrity of the spit; nutrient and sediment deposition in the harbour; and the prospects for coastal inundation.

1.2. Stage Two – Identifying the Issues

The reports are available on the Mangawhai Matters website. They are summarised in the following sections, with links to them provided in the footnotes.

A report by Dr Sandy Elliot of NIWA/Earth Sciences NZ² modelling nutrient and sediment deposition from the catchment is summarised in Section 2. While the risks of harbour pollution

¹ Terry Hume, (2023) Mangawhai Harbour and Spit: Coastal physical processes and management, Report for Mangawhai Matters Incorporated. Link [here](#).

² Sandy Elliot, A Semadeni-Davies, David Plew (November 2024) Mangawhai *catchment contaminant loading and estuary impacts*, National Institute of Water and Soil. Report prepared for Mangawhai Matters Inc. Link [here](#). Summary report is [here](#).
The Mangawhai Harbour Contaminant Loading Web map can be accessed [here](#).

and sedimentation appear low, even with high intensity storms, maintaining best practice standards of stormwater management is required to sustain the harbour in its current condition.

The Auckland University Coastal Mapping team surveyed of spit morphology, as summarised in Section 3 below.³ The study analysed changes, and identified areas currently vulnerable to the impact of storm tides.

Mangawhai Harbour Restoration Society commissioned a follow-up analysis to pinpoint areas of the spit at greatest risk and the how they might be remedied by sand placement at vulnerable points.⁴ It is now acting on the results of that study alongside the Department of Conservation.

The risk of coastal inundation under more volatile weather conditions was assessed through reference to ex-tropical cyclones and summarised in Section 4⁵. The analysis is based on a web-based tool for mapping coastal inundation at Mangawhai⁶ developed by Tonkin and Taylor which, in turn, builds on projections of underlying coastal hazards that company undertook for Northland Regional Council⁷.

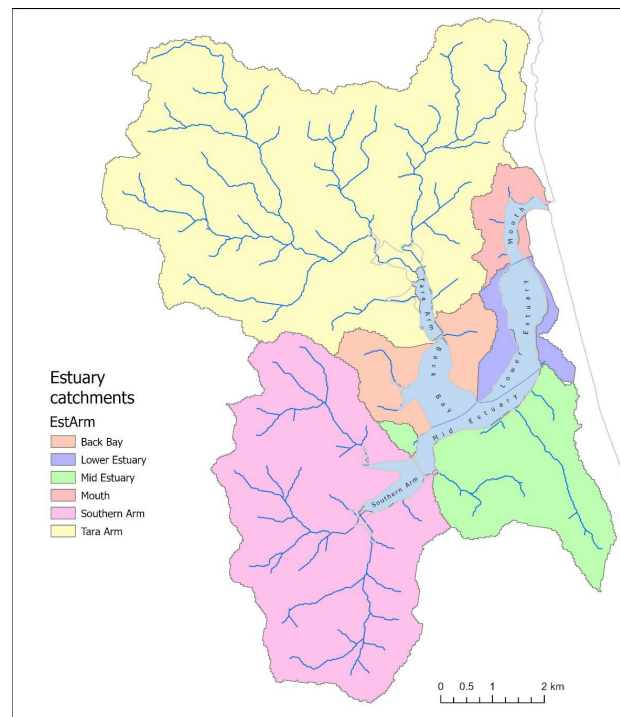
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- 3 Professor Mark Dickson, Assoc. Prof. Murray Ford, Dr Emma Ryan, Auckland University (2024) *Topographic mapping of Mangawhai sand spit and development of a draft framework for monitoring future changes* Report prepared for Mangawhai Matters Inc. Link [here](#). Summary report is [here](#). Presentation is [here](#).
 - 4 Dickson M (2025) Topographic mapping of Mangawhai sand spit – identifying low points in the foredune, University of Auckland, Mangawhai Harbour Restoration Society. Link [here](#).
 - 5 McDermott P (2025) The Coastal Inundation Risks Facing Mangawhai, Mangawhai Matters, Link [here](#) and, the short version - Wet Feet: the Coastal Inundation Risk Facing Mangawhai Link [here](#). Summary report [here](#)
 - 6 Tonkin and Taylor Ltd (2025) *Mangawhai Matters coastal inundation guidance* Report to Mangawhai Matters Inc..
 - 7 Tonkin and Taylor Ltd (2021) *Coastal Flood Hazard Assessment for Northland Region 2019-2020*, Report to Northland Regional Council.

2. The Contribution of the Catchment

This section describes a study predicting the nutrient and sediment yield under current and potential future rainfall conditions, and the resulting sediment deposition in the harbour.

The nutrient loads delivered by runoff into the Mangawhai Harbour and associated eutrophication, E-coli, and sedimentation risks were estimated based on the topography, geology, soils, and land use in the catchment.⁸ Loadings were estimated for current and changing conditions. The sub-catchments and receiving waters used are shown in Figure 1.

Figure 1 Estuary Catchments and Runoff Receiving Arms



2.1. Nutrient load

Current and predicted phosphorus loads are unlikely to cause eutrophication in what is a well-flushed harbour. Similarly, predicted nitrogen loading is also low, with a favourable A grading denoting low likelihood of macroalgae growth. A B-grading for phytoplankton means limited risk of de-oxygenation or light reduction in the water column.

The risk of eutrophication is low because of the small size (just over 70km²) and the physical character of the catchment and estuary. Further urbanisation and large-lot residential development are unlikely to generate nutrient loads greater than the pastoral farming they would largely displace. And there is not enough suitable land for any conversion to horticulture that might take place to significantly increase the risk of contamination.

⁸ Sandy Elliot, A Semandeni-Davies, David Plew (November 2024) Mangawhai catchment contaminant loading and estuary impacts, National Institute of Water and Soil. Report prepared for Mangawhai Matters Inc.

2.2.Sedimentation

The sediment yield is predicted to be moderate to low, again reflecting the physical character of the catchment. Steep Brynderwyn hill areas comprise mostly bush covered greywacke with low erosion risk. Most slopes under pasture are below the local 24° threshold for landslides. Negligible land movement was evident following Cyclone Gabrielle and subsequent torrential rainstorm in February 2023.

The estimated average sediment load (42.7t/km²/year) is consistent with comparable catchments in Auckland. There is some variation in predicted yields, with up to 250-450t/km²/year in small areas of steeper pasture, and down to 10t/km²/year in flat areas.

If the current load was spread evenly over the non-channel harbour floor, the average deposition rate would be around 0.59 mm/year, well below the 2mm/year threshold at which local ecology is under threat. However, yields vary between sub-catchments and silt is transported by currents between harbour compartments, so that sediment depths will vary within the harbour.

The southern arm accounts for around 44% of the sediment load and the northern arm (Tara) 49%. Much of the load from both arms is likely to be deposited in Back Bay where the estimated deposition is 1.2mm/yr compared with 0.84mm/yr in the Tara arm, 0.56mm/yr mid-estuary, and 0.48mm/yr in the Southern arm.⁹

Future climatic conditions could increase the threat of damaging sedimentation. Under a high temperature climate scenario (a 3°C change) storm inputs could lift deposition at Back Bay to 1.97mm/yr. Extended or frequent storms could also see depths exceed the critical threshold for periods of time in some places.

2.3.Land use impacts

Urbanisation is the main land use change that could lift the risk of sedimentation. The estimated contribution from the primary and secondary earthworks associated with recent rates of development would be just 2.5% over the non-channel area of the harbour.

However, if urbanisation accelerates, a larger area of earthworks would lift deposition. Even under current conditions, doubling the rate of development would double associated sedimentation, leading to around a 5.4% increase in Back Bay. If this more intensive development coincided with a large storm, there could be a significant pulse of sediment.

A 30-year storm could lift sedimentation by a factor of three. If runoff controls are ineffective, this could result in a 6-fold increase in earthworks-related yield. This would lift sedimentation in Back Bay by around a third compared with the long-term average without earthworks. Fine primarily clay silts could replace sand with mud, with significant ecological implications.

2.4.Conclusions

Nutrient deposition, rates of erosion, and sedimentation do not pose immediate threats to the harbour. However, the modelling does not account for the potential concentrations of silts from

⁹ Based on an assumed high deposition rate, not allowing for the impact of resuspension, flocculation, currents, and wind waves on redeposition, which may increase or lower local silt depths.

resuspension, transport, and redeposition which could lead to significant local ecological effects. Increasing temperatures and more frequent storms increase this prospect, with Back Bay at the greatest risk.

Climate volatility and the fact that estimates of erosion from urban development assumed best practice stormwater management suggest that staging of development may be required to reduce the risks from earthworks sedimentation. It also requires high standards of erosion control to be mandated and enforced, with vulnerable areas protected during development.

Finally, the prospect that sediment will concentrate in parts of the harbour calls for baseline measurement and subsequent monitoring in the Mid Estuary, Back Bay, Tara, and Southern compartments to ensure that thresholds of ecological vulnerability are not being exceeded.

Figure 2 After the Storm - Sediment Load, Tara Arm-Back Bay, 2025



3. The Changing Face and Fortune of Mangawhai Spit

Mapping Mangawhai spit - its volume, topography, and shape -and modelling the impact of storms on it identifies areas vulnerable to penetration and flooding by sea water and provides a framework for managing and monitoring the threats it faces.

3.1.The Study

A high-resolution survey¹⁰ of the Mangawhai Spit was used to develop digital models of spit elevation and volume. The results were compared with a 2018 survey to trace recent changes, showing places where the coastal dunes have retreated or been deflated, leaving the spit vulnerable to penetration by high seas, and internal flow paths leading to internal flooding.

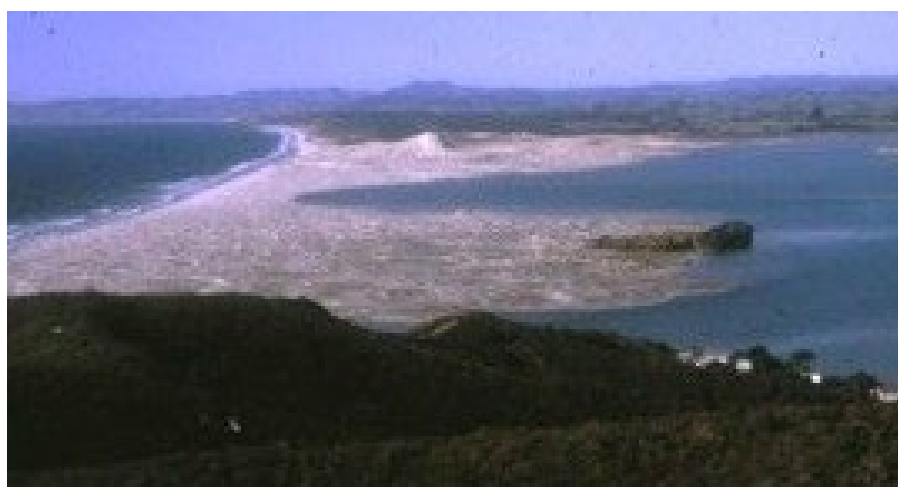
3.2.Recent Changes in Spit Morphology

There was a net loss of sand from the spit of around 260,000 m³ between 2018 and 2024¹¹, or about 1.8% of total spit volume. If lost evenly, it would lower the spit by around 8 cm. However, this is less important than where on the spit sand has been lost and where it has increased.

The low-lying interior did not change much. Some ocean-facing dunes in the north increased in elevation, although at the cost of the adjoining ocean beach and foredune. The resulting east to west movement was even more pronounced in the south, where dunes moved between 10m and 25m. This may reflect a longer-term westward shift with one study suggesting that it has been taking place for centuries. Another estimated that the ocean-facing coast of the spit has been retreating at about 1.4 m/year over six decades.

Harbour-facing dunes have been moving in the opposite direction – eastward. Among other things, this has seen a narrowing of the spit neck that protects the lower and mid harbour. Narrowing is a function of the position of the harbour channel and shoal. It was evident prior to the 1978 storm which breached the spit (Figure 3). Such long-term shifts will increase the risk of another breach if storm-driven over-wash from the ocean side meets elevated harbour waters.

Figure 3 Pre-Breach Narrowing of the Spit Neck, 1976



¹⁰ LIDAR - Light Detecting and Ranging aerial imagery

¹¹ Net of sand returned by wave action from the sea and dredging and placing sand from the mid-harbour channel and returning it to the spit.

It is important to maintain dunes heights on the eastern side and interior of the spit, impeding over wash from the ocean, and on the western coast to avoid flooding from the harbour.

3.3. The Risk of Inundation and Breaching

While the spit is unlikely to be breached by a typical annual storm, it is a real possibility in more intensive storms. The mapping identified two low points on the north of the spit in then lower harbour and four on the coast, all vulnerable to penetration by high seas. It also identified two critical flow paths, one which would see saltwater flood the dune lake and the other almost connecting the ocean side to the harbour side of the spit. The latter raises the prospect of another breach in a sufficiently severe storm. To date, the restoration of the western bund wall has avoided a repeat breach.

At the extreme, a one in 100-year storm would see inundation of over 4m overtopping the dunes in many places, making a breach highly likely. Even a storm like the 1978 one would probably over-wash several ocean-side locations and inundate inland areas, despite the spit being significantly wider than it was then (see Section 4.3, below). With the prospect of increasing storm tide elevations, maintaining if not extending the bund wall and shifting sand on the dune to impede the flow paths will be critical to preserving the integrity of the spit

There are caveats around these conclusions, though. For example, the modelling assumes that the water surface remains elevated for long enough to inundate the spit and that an increase in spit elevation in the interim could reduce a storm's destructive impact. While ongoing sand loss makes this unlikely, the planned movement of sand from high to low points could achieve the same result, eliminating vulnerable points on the coast, and blocking the pathways through which over-wash can flood the interior.

3.4. Conclusions

One outcome of the mapping and modelling has been the initiative by the Mangawhai Harbour Restoration Society supported by the Department of Conservation to shift sand on the spit to build up the low points. The findings also reinforce the importance of continuing to dredge the harbour channel to return wind-blown sand to the spit and strengthen the harbourside dunes and fencing and planting on the spit to promote dune growth and stability.

An important outcome of the Auckland University Study is the development of an information base which can be updated to identify and respond to the areas in which the spit is most vulnerable. Another important outcome is the ability to track the effectiveness of programme of spit conservation and restoration and modify it as necessary.

4. The Inundation Outlook

The third report examined the likelihood of and consequences of increased storm activity. The findings indicate a strong probability that more severe cyclonic storms in the future will see an increase in coastal inundation, extending further than in the past and reaching greater depths.

4.1. Introduction

The third report explores the prospect of more intensive storms and their potential to inundate the coast. Assessment of their flooding potential is based on a visualisation tool developed by Tonkin and Taylor for MMI¹². This builds on an earlier regional flood hazard assessment for Northland Regional Council.¹³ It enables coastal inundation around Mangawhai Harbour to be mapped in some detail under different storm and sea level rise scenarios.

4.2. The Storms

The focus is on the storms that most threaten Northland. These are tropical cyclones originating mainly in the Solomon and Coral seas northwest of New Zealand during summer and autumn. They track southeast, many passing either west or north and east of Northland. The latter are the most likely to affect Mangawhai. While they are generally degraded into tropical storms by the time they reach the Northland coast, they still bring strong winds and heavy rain.

Modelling of storm activity in the southwest Pacific region indicates that, while there may be slightly fewer in the future, cyclones will be more intense and migrate further south. This is confirmed by analysis of 75 ex-tropical storms passing the Northland coast from 1956 to 2025. In the first 34 years three out of 41 were classified as major (hurricane categories 3, 4, or 5), all three between 1975 and 1988. Over the next 35 years, to 2024, seventeen out of 34 cyclones were classified as major.

Given the prospect of increasingly severe storms for the foreseeable future, this report focuses on the medium term, through to 2080, on the grounds that responding to risks apparent over the medium term is a prerequisite to managing longer term threats.

4.3. Modelling the Possibilities

A series of scenarios combining sea level rise and storm conditions was adopted to demonstrate the inundation threats posed by more intensive storm activity. Three of the five Shared Socioeconomic Pathways employed globally to account for possible sea level rise were used (Table 1): SSP2–4.5 represents the current consensus that warming could cease mid-century; SSP3–7.0 is consistent with the growing prospect of a breakdown of world trade and continued warming, and SSP5–8.5 which is an outlier that sees no slowdown in warming. Fossil Fuelled Development is considered a prospect if major economies pursue policies of re-industrialisation based on continuing dependence on fossil fuels (Table 1).

¹² Tonkin+Taylor (2025) *Mangawhai Matters Coastal Inundation Guidance* Report to Mangawhai Matters Inc, Link here. Inundation Visualisation Report, Link here.

¹³ Tonkin and Taylor Ltd (2021) *Coastal Flood Hazard Assessment for Northland Region 2019-2020*, Report to Northland Regional Council

Table 1 Global Development Scenarios - Shared Socioeconomic Pathways

SSP Scenario	Socioeconomic Setting	Positive Radiative Forcing, 2100	Consequences
SSP1: Sustainability (Green Growth)	Cooperation, renewable energy adoption, and environmental preservation.	~1.9 W/m ²	Warming limited to 1.5°C, reduced extreme weather risks.
SSP2: Middle of the Road	Moderate development and transition to renewables.	~4.5 W/m ²	Warming stabilizes at 2.5–3.0°C, moderate risks remain.
SSP3: Regional Rivalry (Fragmentation)	Limited collaboration on greenhouse gas reduction, continued fossil fuel reliance.	~7.0 W/m ²	Warming > 3.5°C, severe climate impacts like droughts and biodiversity loss.
SSP4: Inequality (A Divided World)	Uneven development between rich and poor regions.	~6.0 W/m ²	Warming at 3.0–3.5°C, unequal impacts, vulnerable communities facing worst outcomes.
SSP5: Fossil-Fuelled Development (Conventional Growth)	Maintaining a fossil-fuel based mode of production and distribution Economic growth driven by fossil fuels.	~8.5 W/m ²	Warming exceeds 4.0°C, catastrophic impacts extreme heat, sea-level rise, unliveable regions.

Three storm intensities were adopted, with their characteristics based on frequency of occurrence, the most intensive storms being the least frequent:

- A 5-year annual return interval (ARI) storm, or 18% chance of occurring in any one year (Annual Exceedance Probability, AEP);
- A 20-year ARI storm, 4.9% AEP;
- A 50-year ARI storm, or 2% AEP.

The effect of long-term rise in sea level is simply to raise the base from which storms impact and consequently increase the area they might flood. Combining the sea level rise projections with the different storm intensities generates nine scenarios, each of which was projected through to 2080 based on the resulting storm tides and base sea level associated with each global socio-economic pathway (Table 2).

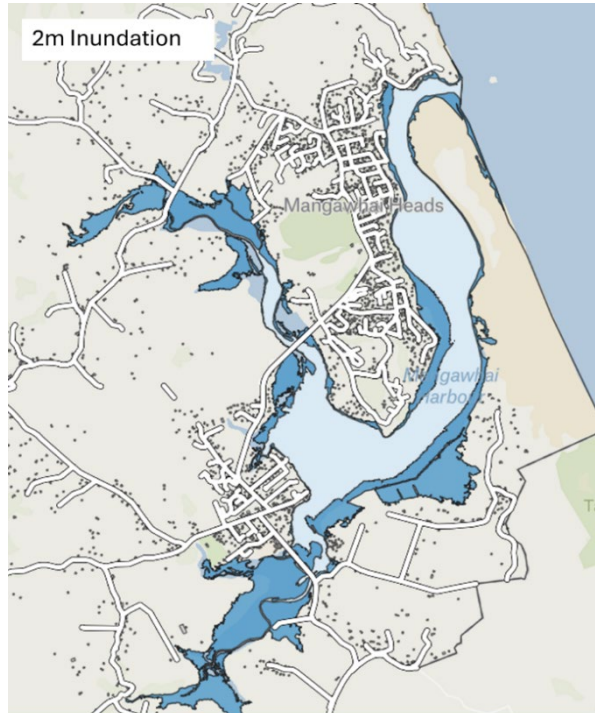
Over the fifteen years to 2040 all scenarios project around 2m of inundation (light grey, Table 2), a figure not dissimilar to the 1978 breach storm and Gabrielle in 2023. Anything more intensive than 20-year ARI storm, however, is likely to exceed those flood levels within this period. Increasing sea temperatures make this even more likely through their impact on storm intensity.

Table 2 Coastal Inundation Levels by Storm Intensity and Warming Scenario

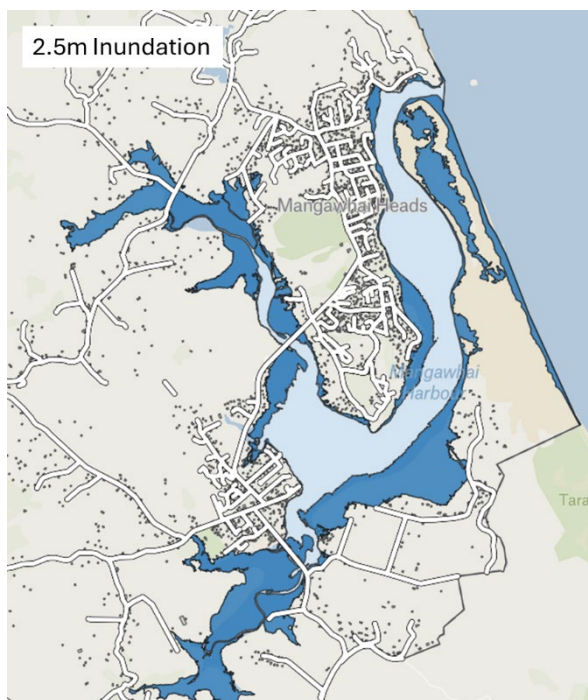
		Harbour Inundation (metres)			
Scenario		2030	2040	2060	2080
Storm Frequency (Intensity)	SSP2-4.5	Business as Usual			
	5-Year ARI	1.7	1.9	2.0	2.2
	20-Year ARI	1.9	2.0	2.2	2.4
	50-Year ARI	2.1	2.2	2.4	2.6
	SSP3-7.0	Regional Rivalry			
	5-Year ARI	1.7	1.8	2.0	2.3
	20-Year ARI	1.9	2.0	2.2	2.5
	50-Year ARI	2.1	2.2	2.4	2.7
	SSP5-8.5	Fossil-Fuelled Development			
	5-Year ARI	1.7	1.8	2.1	2.3
	20-Year ARI	1.9	2.0	2.3	2.5
	50-Year ARI	2.1	2.2	2.5	2.7

The extent of potential inundation under the different storm scenarios highlighted in grey is illustrated in following maps.

Figure 4 Mapping Inundation



Although much of Mangawhai sits above four metres, at 2m (light grey, Table 2) there is significant inundation on the harbour margins in the mid and upper harbour. This includes coastal reserves and esplanades, and some areas of harbourside residential development.

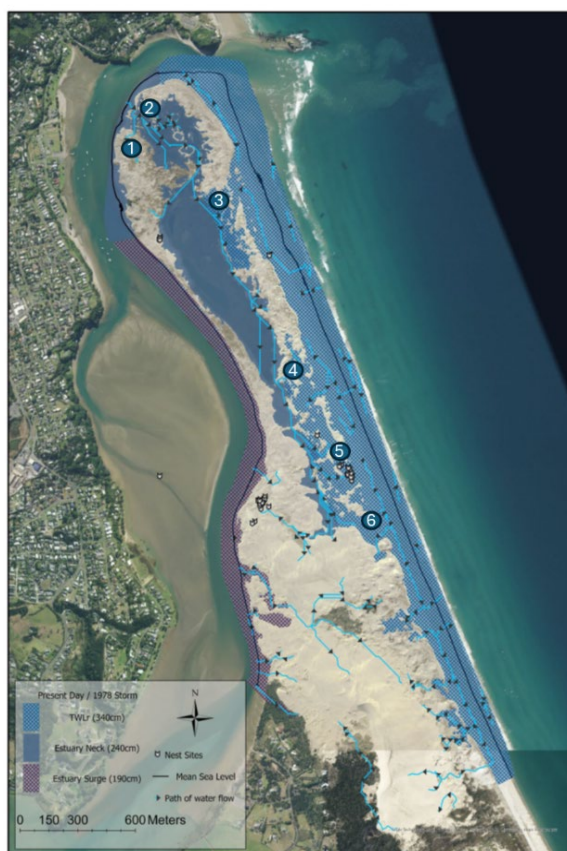


As storm tide water levels rise to 2.5m (dark grey, Table 2), impacts will be more widespread and severe. Roads like Lincoln Street and Cove Road become flooded, more developed areas are affected and the level of flooding close to the harbour edge is likely to be significantly deeper. Critical infrastructure, including stormwater and wastewater systems, are at risk.

The degradation or breaching of the spit at 2.5m would open the northern and middle reaches of the harbour to increased flooding and associated erosion, exposing them further to the impact of storm tides and wave energy.

At 3m inundation, a possibility by the turn of the century, the spatial extent of flooding may not expand greatly but flood waters would be deeper. The spit would be overwhelmed, altering the form and function of the harbour with infrastructure and harbour-side assets likely to suffer severe damage.

Figure 5 Vulnerability of the Spit



Based on the Auckland University modelling, storms delivering inundation of around 2.5m, would see the ocean side of the spit over-topped by pushing seawater along low pathways into the spit. (The numbered localities are points currently vulnerable to penetration by the sea).

Although to date the harbourside bund wall and increased spit width have protected the spit from a repeat of the 1978 breach, more frequent and intense storms could overpower current defences by 2060.

Spit degradation at the level illustrated would impact the wildlife reserve, potentially destroying roosting and nesting areas. The likely level of erosion and spit degradation under these circumstances also raises the risk of a breach in succeeding storms and reduces protection of harbourside development.



5. Where to From Here?

5.1.A Call to Action

The findings of the studies summarised here call for early action.

The science and the record together point to the high probability of increasing storm intensity compounded over time by sea level rise. Shifting geopolitical conditions raise the prospect that a change in global development towards increased regional rivalry will increase the probability of 2.5m storm tides within 50 years (and 3m by the turn of the century).

The modelling used to evaluate inundation prospects took account of storm surge, wave setup, and freshwater retention using evidence from past storms. The resulting assumptions are likely to be conservative given the more extreme wind and rain conditions anticipated in the future.

Furthermore, the modelling treats storms as discrete events acting on current landforms and spit topography. In practice, the cumulative effect of successive storms would be to increase vulnerability to erosion, progressively eroding the protective barrier role of the spit.

Finally, the scenarios do not provide for freshwater flooding from major storms other than through elevating harbour water levels. Direct flooding by runoff will compound inundation from the sea in low lying areas.

5.2.Adaptive Planning for Sustainability

The direct interests of the community in the spit, the coastline, and the harbour were canvassed in Stage One of this report and, indeed, are the reason for the Sustainable Mangawhai Project. The evidence brought together on behalf of the community is sufficiently strong to justify the preparation of an adaptive plan to mitigate and manage the consequences of the inundation expected from more intensive storms.¹⁴

An adaptive plan requires selection of the most effective measures for responding to the threats identified, their costs, implementation timelines, and responsible parties. It involves identifying a plausible adaptation pathway and establishing a monitoring framework to determine when to implement different measures. It is proposed that responsibility for such a plan is shared among those parties with a common interest in preserving the integrity of the harbour and spit.

To this end, we recommend the establishment of an inter-agency groups to take responsibility for preparing and implementing such a plan.

Kaipara District and Northland Regional councils both have statutory and substantive interests in sustaining the integrity of the spit and harbour. Given the threats to the Mangawhai Wildlife Reserve, the Department of Conservation has a strong stake in the preservation of the distal spit and the productivity of the harbour. Mana whenua (Te Uri o Hau) has a longstanding interest. Among other things, the Mangawhai Coast was an important source of kai moana. The spit still displays evidence of regular and extensive summer occupation in the form of substantial middens dating back some 400 years.¹⁵

¹⁴ A detailed framework for adaptive planning for coastal hazards is set out in the MfE 2024 guidelines.

¹⁵ N. J. Enright & M. J. Anderson (1988) "Recent evolution of the Mangawhai Spit dunefield" *Journal of the Royal Society of New Zealand*, 18:4, 359

5.3. Assessing the Options: A Policy Toolbox

This section describes some of the measures relevant to the threats identified in Mangawhai, grouped into regulatory, soft engineering, hard engineering, and infrastructure measures. It is proposed that these be canvassed for adoption in a plan for Mangawhai.

Regulatory Measures

Regulatory measures aim to reduce exposure to inundation impacts through zoning and land use and development standards. They include restricting development in high-risk areas, managing stormwater runoff, development and building standards in medium-risk areas, and encouraging or facilitating the relocation of vulnerable buildings.

Soft Engineering Measures

Soft engineering works with natural systems to create barriers or buffers against flooding. They include protecting the spit through sand dredging, building, and maintaining dunes, and beach restoration. They may include extending wetlands to detain floodwaters. While cost-effective and ecologically beneficial, they require ongoing maintenance. Such measures are likely to provide only partial protection in severe storms and in some instances may be associated with hard engineering measures.

Hard Engineering Measures

Hard engineering solutions, such as groynes and seawalls, offer quick and targeted protection for developed areas. However, they are expensive, may disrupt ecosystems, and require ongoing maintenance. Their long-term effectiveness depends on design quality and integration with local landforms.

Infrastructure Measures

Infrastructure measures include ensuring stormwater systems are fit for purposes as storm intensity and that other infrastructure is resilient under flood conditions. This is likely to mean upgrading existing facilities, applying heightened standards to new infrastructure, and reviewing lifeline services to ensure that they can withstand coastal flooding and recover quickly from major disruption.

Monitoring Indicators

Monitoring should be directed towards identifying signs of increased or shifting risk. Indicators may include, globally, trends in oceanic warming and the amplitude and return time of El Niño-ENSO conditions; regionally, changes in the frequency and intensity of severe storms in the Southwest Pacific; and, locally, changes in the morphology of the spit and ocean and harbourside dunes and beaches. It also means identifying the consequences of storm events as they occur.

5.4. Conclusion

The Sustainable Mangawhai Project points to likely coastal inundation with major impacts on property and infrastructure, and the undermining of the services which the harbour and spit currently provide to the community and the environment. The increased probability of more serious coastal inundation than experienced in the past and the scale of damage that could result justifies an early commitment by the responsible agencies to planning to mitigate and manage the effects.