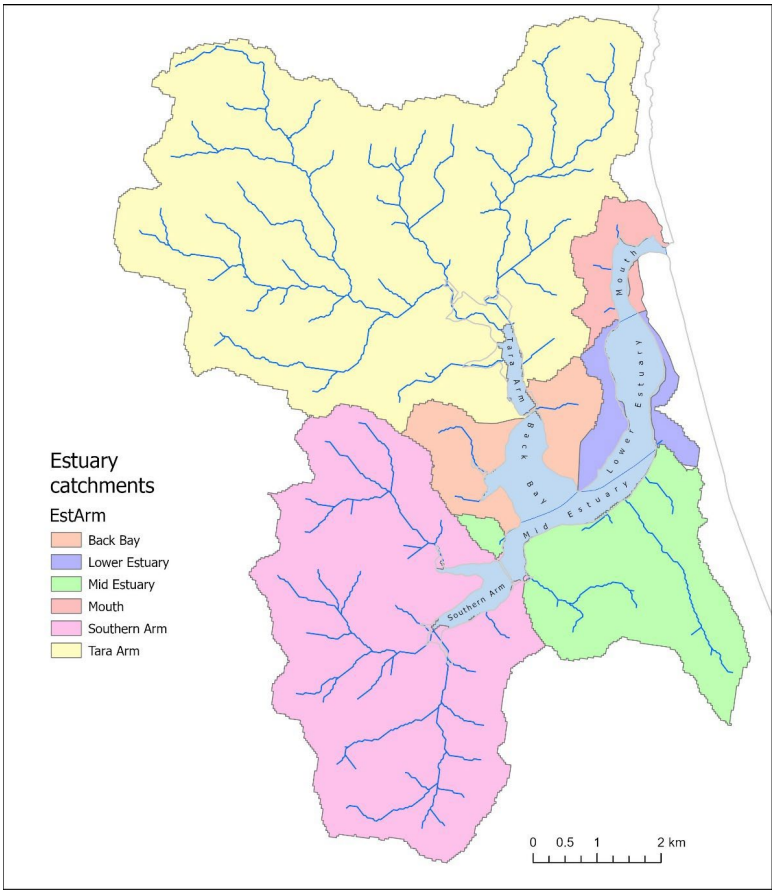
Mangawhai catchment land use and contaminant loadings and estuary impacts[1]
Summary

Purpose and approach

Mangawhai Matters commissioned NIWA to estimate the nutrient and sediment loads delivered to the Mangawhai Harbour given the topography, geology, soils, and land use in the catchment.



As a screening study it identifies areas at risk or "hot spots" contributing nutrients (nitrogen, phosphorous) or sediment to the harbour and the possible impacts of a more volatile climate on them. It applies scientifically sound models to local conditions by sub-catchment and harbour compartment (as mapped) to identify the current potential for eutrophication of the water column and sedimentation of the estuary floor.

Loadings are estimated under current and under changing climatic conditions, the latter according to Shared Socio-economic Pathways (SSP). These internationally developed scenarios are endorsed by the Ministry for the Environment for addressing the possible impacts of increasing temperatures.

This note reports the principal findings and offers conclusions relevant to the long-term health of the harbour.

Findings

Nutrient Load

Current and predicted **phosphorus** loads are not expected to be sufficient to have a eutrophication effect in what is a well-flushed harbour. The predicted nitrogen loading is also low, with a favourable A grading denoting a low likelihood of macroalgae growth. A B-grading for phytoplankton, means limited risk of de-oxygenation or light reduction in the water column.

If treated wastewater were to be disposed of by drip irrigation to the Mangawhai golf course[2] (one option suggested to cope with projected growth in demand) about 1,200 kg N/year would

---

1 S Elliot A Semadeni-Davies and D Plew (October 2024), *Mangawhai catchment contaminant loading and estuary preliminary impacts* Climate, Freshwater, & Ocean Science, NIWA Report to Mangawhai Matters Inc.

2 Current disposal is to land in the Hakaru sub-catchment of the Kaipara Harbour

be added to the wetland and thence the Tara arm, primarily in winter. This amounts to less than 2.7% additional loading.

Further urbanisation and large-lot residential development are the most likely land use changes. They would generate much the same (or lower) nutrient loads than the pastoral farming that they would largely displace. Significant additional areas of nutrient-intensive horticulture (e.g., market gardens or avocadoes orchards) could increase the risk, but are unlikely to do be developed because of the limited suitable land in the catchment.

Overall, the risk of eutrophication is low because of the small size and physical character of the catchment and estuary.[3]

Sediment Load

The sediment yield is predicted to be moderate to low. This also reflects the physical character of the catchment. Steep areas in the Brynderwyn hills comprise mostly bush covered greywacke with a low erosion risk. Most slopes under pasture are below the 24° threshold for landslides associated with the local geology. Aerial imagery confirms negligible land movement following Cyclone Gabrielle and the subsequent torrential rainstorm in February 2023.

An estimated current average of 42.7 t/km^2/year is consistent with measured yields in comparable catchments in Auckland. There is, nevertheless, variation in predicted sediment yields within the catchment, with up to 250-450 t/km^2/year in small areas of steeper pasture, and down to 10 t/km^2/year in flat areas.

Sediment Deposition

If the current sediment load were spread evenly over the non-channel parts of the harbour the estimated average deposition rate would be around 0.59 mm/year. However, because yields vary between sub-catchments and because silt is transported by water movement between compartments, deposition depths vary locally. While the Southern arm is estimated to account for 44% of the sediment load and the Tara 49%, much of this is expected to be deposited in Back Bay. Consequently, the estimated deposition rate is highest there, at about 1.2mm/year, compared with 0.84mm/yr in the Tara arm, 0.56mm/yr mid-estuary, and 0.48mm/yr in the Southern arm. [4]

These are currently below the 2mm/year threshold beyond which there is a risk of ecological impacts. However, the predicted increase in temperatures with future climatic conditions will increase the risk. A high temperature scenario (3° change), for example, would see storm inputs lift deposition at Back Bay to 1.97mm/yr.

Urbanisation is a land use change that can also increase the risk of sedimentation. To explore this, the study assumes that consented and currently proposed areas for urbanisation (capacity for around 2,300 more dwellings) are developed at an even pace over ten years. The estimated contribution to average sedimentation rates from the hydrological adjustment from the primary and secondary earthworks required is just 2.5% over the non-channel area of the harbour.

However, if urbanisation accelerates, the larger area of earthworks in any one year would lift deposition. Doubling the rate of development as a high example would double the sedimentation associated with urban earthworks, leading to around a 5.4% increase in Back

---

3 The catchment is just over 70km^2

4 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.

Bay. If this more intensive development coincided with a large storm, there could be a pulse of sediment to the bay. For example, a 30-year storm event could lift sedimentation by a factor of three. If runoff controls are ineffective under these conditions, there could be a 6-fold increase in earthworks-related sediment yield. It is estimated that this would increase in sedimentation in Back Bay by 32% when compared with long-term average loads with no earthworks.

A further risk which was not addressed in the study, is accumulation of fine sediment where there was previously sand, resulting in expanded muddiness, with significant ecological implications.

Conclusions

A small and largely stable catchment means the risk of pollution and eutrophication from current and anticipated land uses and a changing climatic is modest. The flushing capacity of the harbour means the risk of significant deterioration in water quality is low. Equally, as far as the study has been able to estimate, rates of erosion and levels of deposition do not pose an immediate threat to the health of the harbour. These results also suggest that any increase in the risk will be modest with foreseeable temperature increases.

However, these findings do not eliminate the uncertainty associated with climate volatility, particularly with respect to sedimentation. For this reason, the staging of development would ideally be spread out to reduce the risks of excessive sedimentation from earthworks.

In addition, estimates in the study assume that high quality erosion controls are implemented and vulnerable areas protected during development. Poorly controlled earthworks can release much greater amounts of sediment than well-controlled ones, so it is important that best practice is mandated and enforced throughout the development process, and that maintenance and management controls are sustained.

Further Work

The modelling undertaken could not account for the possible resuspension, transport, and redeposition of fine silts which may well concentrate sediment in specific areas of the harbour with potentially significant local ecological effects. Increasing temperatures and more frequent storms increase this prospect. Back Bay is at the greatest risk given the potential for sediment surges with continuing urban development in the Southern and Tara arms.

Additional measuring and modelling of processes within the estuary are required to plug this gap. They could also align an understanding of the movement of fine silts with the dynamics of sand deposited off the spit in the mid- and lower harbour where there is ongoing shoal expansion. However, the hydro-dynamic modelling required for this is complex, resource demanding, and still subject to the uncertainties around climate change effects.

A less expensive approach to understanding the movement of sediments within the harbour may be to undertake an ecological baseline study identifying areas sensitive to contaminants (in terms of nutrient loadings), and prone to sedimentation. Those areas can then be monitored by means of periodic and, if required, post-event surveys for fine sediment buildup and contaminants. At the least, the evidence in this study calls for baseline measurements of sediment in the Mid Estuary, Back Bay, Tara, and Southern compartments.

Phil McDermott,
Mangawhai Matters
December 2024