

Salt Ecology Short Report 026. Prepared by Barrie Forrest for Otago Regional Council, March 2023

**OVERVIEW**

Since December 2021, Otago Regional Council has undertaken annual State of the Environment monitoring in Tautuku Estuary to assess trends in the deposition rate, mud content, and oxygenation of intertidal sediments. Sediment monitoring is undertaken at two sites (Fig. 1), with the latest survey carried out on 1 December 2022. Tautuku is of particular interest as a relatively unmodified “reference” estuary.

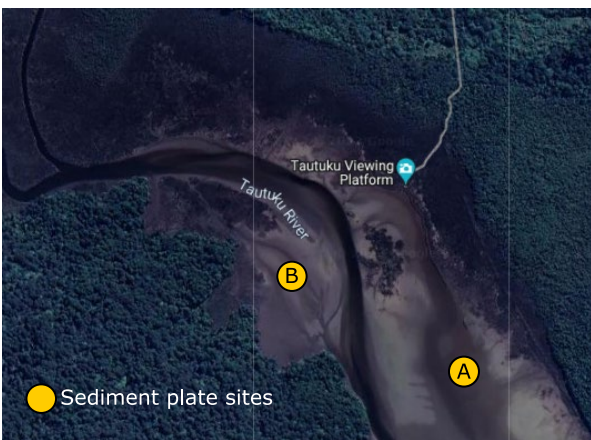


Fig. 1. Location of Tautuku Estuary sites.

**METHODS**

Estuary sedimentation is measured using the ‘sediment plate’ method (e.g. Forrest et al. 2022). The approach involves measuring sediment depth from the sediment surface to the top of each of four buried concrete pavers. Measurements are averaged across each plate (n=3) and used to calculate a mean annual sedimentation rate for each site.

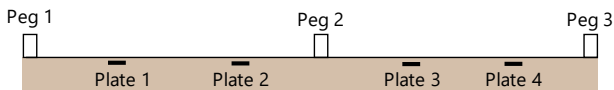


Table 1. Summary of condition ratings for sediment plate monitoring.

Indicator	Unit	Very Good	Good	Fair	Poor
Sedimentation rate <sup>1</sup>	mm/yr	< 0.5	≥0.5 to < 1	≥1 to < 2	≥ 2
Mud content <sup>2</sup>	%	< 5	5 to < 10	10 to < 25	≥ 25
aRPD <sup>3</sup>	mm	≥ 50	20 to < 50	10 to < 20	< 10

Condition ratings derived or modified from: <sup>1</sup>Townsend and Lohrer (2015), <sup>2</sup>Robertson et al. (2016), <sup>3</sup>FGDC (2012).

A composite sample of the surface 20mm of sediment is collected adjacent to the plates and analysed for particle grain size (wet sieve, RJ Hill laboratories), enabling assessment of sediment muddiness.

Sediment oxygenation is visually assessed in the field by measuring the depth at which sediments show a change in colour to grey/black, commonly referred to as the apparent Redox Potential Discontinuity (aRPD). Results for all indicators are compared to condition ratings of ecological state shown in Table 1.

**RESULTS**

Table 2 shows a summary of results and the respective condition ratings where applicable.

Table 2. Indicator summary and condition ratings (no ratings available for gravel and sand). Five years of data are required to establish a meaningful trend in sedimentation rate.

Site	Survey	Sed rate mm/yr	Gravel %	Sand %	Mud %	aRPD mm
A	Dec-2021	na	< 0.1	83.9	16.1	50
	Dec-2022	5.1	< 0.1	79.7	20.3	45
B	Dec-2021	na	0.1	46.4	53.5	20
	Dec-2022	1.4	0.2	51.5	48.3	12

< All values below lab detection limit

**Sedimentation rate**

In the first year of measurement, sediment accrual was rated ‘fair’ at Site B (1.4mm/y), and exceeded the 2mm/yr national guideline value at Site A (5.1mm/yr, a condition rating of ‘poor’). Given that the catchment is largely unmodified and there were no significant rainfall events in the local area in 2022 (ORC & ES Environmental data portals), the sediment deposition observed at Site A is unlikely driven by catchment

sources. It is possible that fine sediments have been released from eroding salt marsh habitat and/or fine sediments have been re-mobilised and deposited from other parts of the estuary. These results represent the first year of data collection and a time series of at least 5 years is required before a meaningful trend can be established.

### Sediment mud content and oxygenation

Sediments at Site A are rated 'fair' in terms of their mud content and are approaching the threshold of concern (Table 1), while sediments at Site B comprise ~50% mud and are rated 'poor'. This situation likely reflects that Site B is located in a depositional area within the mid-upper estuary, while Site A represents the more well-flushed mid-estuary flats.

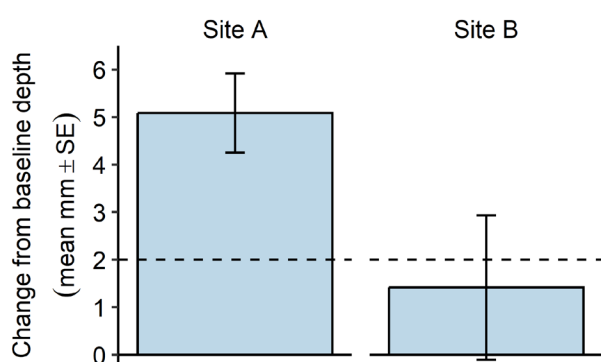


Fig. 2. Change in mean sediment depth over buried plates ( $\pm$ SE) in Dec-2022 relative to the Dec-2021 baseline. The dashed line represents the national guideline value of 2mm/yr.

Sediment oxygenation was generally quite high, although the average aRPD depth was generally shallower (rated 'fair') at Site B than Site A. This result reflects the relatively muddy surface sediment at Site B, which reduces oxygen penetration into the sediment matrix. However, the sediment did not show any of the typical symptoms of strong enrichment (e.g. black colour, strong sulfide odour, extensive cover of opportunistic macroalgae) and burrowing fauna were visible in the sediment samples.



Sediment oxygenation (aRPD transition from brown to dark grey sediment) at Site B in November 2022.



Firm muddy sand sediments at Site A, November 2022

### CONCLUSION

Sedimentation exceeded the national guideline value of 2mm/yr at Site A, but probably as a result of fine sediment re-mobilisation or the release of sediment from eroding salt marsh habitat. A time series of at least 5 years is required before a meaningful sedimentation trend can be established. Whereas Site A has consisted of firm muddy sand over the two surveys to date, Site B is relatively muddy. Given that the catchment is largely unmodified, the muddy sediments at Site B likely reflect the mid-upper estuarine and depositional nature of the site.

### RECOMMENDED MONITORING

Continue annual monitoring of sedimentation rate, sediment grain size and aRPD depth, and include results in a summary report. Comprehensive reporting should be undertaken in 2023/24 as part of the completion of the 'fine scale' ecological and sediment monitoring three-year baseline.

### REFERENCES

- FGDC. 2012. Coastal and Marine Ecological Classification Standard Catalog of Units, Federal Geographic Data Committee FGDC-STD-018-2012. 343p.
- Fine Scale Intertidal Monitoring of Tautuku Estuary. Salt Ecology Report 092, prepared for Otago Regional Council, June 2022. 27p.
- Robertson BM, Stevens L., Robertson BP, et al. 2016. NZ Estuary Trophic Index. Screening Tool 2. Screening Tool 2. Determining Monitoring Indicators and Assessing Estuary Trophic State. Prepared for Envirolink Tools Project: Estuarine Trophic Index MBIE/NiWA Contract No: C01X1420. 68p.
- Townsend M, Lohrer D. 2015. ANZECC Guidance for Estuary Sedimentation. NIWA client report number HAM2015-096, prepared for Ministry for the Environment 45p.