

Appendix 1

Single Site Reports

Part 4

Hibiscus Coast

Explanatory notes

This appendix provides a summary of the sediment chemistry and particle size distribution data for each monitoring site. The appendix has been divided according to “Marine Reporting Areas” (MRAs):

- Part 1: Central Waitemata Harbour
- Part 2: Upper Waitemata Harbour
- Part 3: East Coast Bays
- Part 4: Hibiscus Coast
- Part 5: Tamaki Estuary
- Part 6: Tamaki Strait
- Part 7: Manukau Harbour

The summaries are given as “Single Site Reports” (SSRs), in which the key physical and chemistry data are provided in 2 pages:

1. The first page provides a brief description of the site: its location; classification in terms of sediment and contaminant transport/accumulation – “Settling Zone” (SZ) or “Outer Zone” (OZ), as described in ARC Technical Publication TP 170 (ARC 2002); key physical characteristics; notable features and relevant monitoring information (e.g. location of nearby sites).
2. The second page gives a summary of the sediment contaminant and sediment texture data: results from each year of monitoring for Cu, Pb, Zn, “high molecular weight” PAH (HWP AH), total organic carbon (TOC), and “mud content” (defined below). The contaminant results have been compared with sediment quality guidelines (the ARC “Environmental Response Criteria”, ERC). Indicative trends over time (see below), and a brief interpretative summary on key features of the data, have also been given.

Plots and summary statistics include all data reported to end of 2010, unless otherwise stated (e.g. occasional clear outlier removed before plotting & analysis). Where replicate analyses have been performed, data have been summarised as medians.

Trend data given in the SSRs have been determined by linear regression. The trend plots have been fitted with a quadratic curve “line of best fit” as an aid for visually assessing the nature of changes over time in the data series. Trend indicators, using “arrow” symbols, have been used to show the magnitude and direction of trends. No statistical significance associated with these trends is given (this is discussed in detail in the body of the Status and Trends Report). The trend indicators should be interpreted as follows:

- $<\pm 1\%$ per annum change probably indicates no (or very little) trend;
- $\pm 1\text{--}2\%$ per annum indicates a small, or emerging, trend. Changes of this magnitude could be largely associated with analytical and/or sampling variation, so trends in this range may not have any “real world” significance; and
- $>\pm 2\%$ indicates a stronger trend, equivalent to $> \pm 20\%$ per decade, which is probably worth investigating further to better understand possible causes.

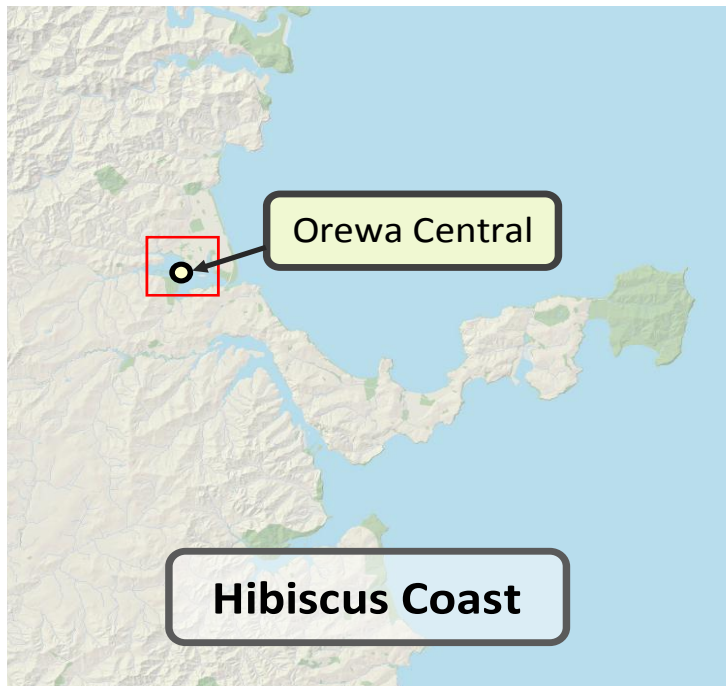
Mud content is given as the % of the $<500\ \mu\text{m}$ fraction of the sediment that is $<63\ \mu\text{m}$. Where this has been determined by more than one method in any year, the average of the values has been used.

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1.1 Orewa Central

Site	Type	Description & Notes
Orewa Central	Sandy OZ	
Reporting Area	Land Use	Site is located in the middle reach of the Orewa estuary. The sediment here is firm sand. The catchment is established urban, with on-going development.
Hibiscus Coast	Urban	

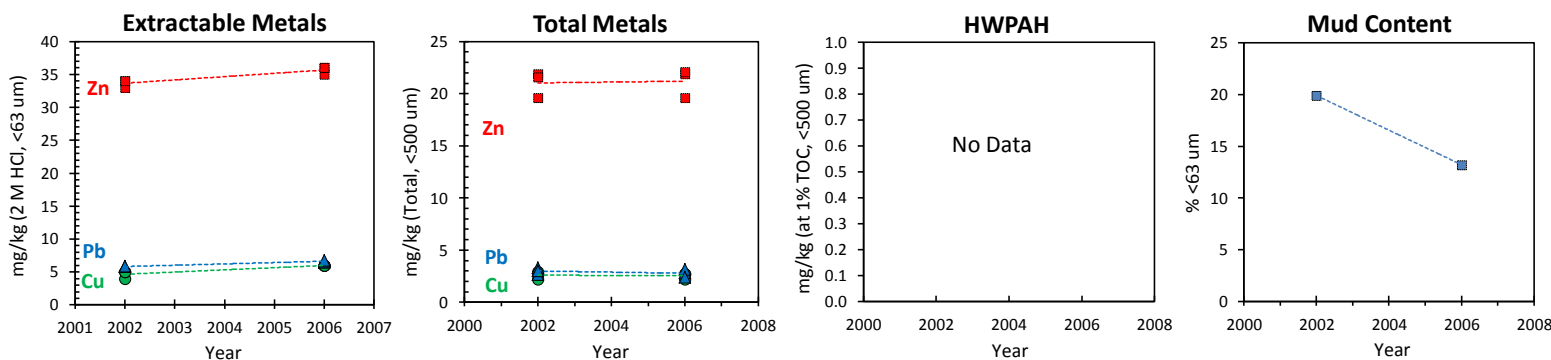


Additional Notes

Sewage oxidation ponds being decommissioned and southern catchment undergoing extensive urban development (not shown on 2006 aerial shown above).

Site	Description	ERC Status	Trends & Comments
Orewa Central	Sandy OZ site. Urban developing catchment.	<div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">PAH</div> </div>	2 years of monitoring only. No trends can therefore be assessed. 2002 & 2006 results similar. Current contaminant status ERC-Green.
Reporting Area			
Hibiscus Coast			

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

Year	Mud Content % <63 µm	Organic Carbon TOC (% <500 µm)	Extractable Metals (mg/kg, <63 µm)			Total Metals (mg/kg, <500 µm)			HWPAH (mg/kg, <500 µm)	
			Cu	Pb	Zn	Cu	Pb	Zn	mg/kg	at 1% TOC
2002	19.9	no data	5.0	5.8	34	2.7	3.0	22	no data	no data
2006	13.2	no data	6.0	6.6	36	2.7	2.8	22	no data	no data
Median	16.6	no data	5.5	6.2	35	2.7	2.9	22	no data	no data
Trend (absolute units per year)	-1.7	no value	0.3	0.2	0.5	0.0	-0.1	0.0	no value	no value
Trend (% of median per year)	↓ -10.1	no value	↑ 6.1	↑ 3.2	↗ 1.4	→ -0.6	↘ -1.9	→ 0.2	no value	no value

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66	Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7	Cu >34 Pb >50 Zn >150 PAH >1.7
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ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction data

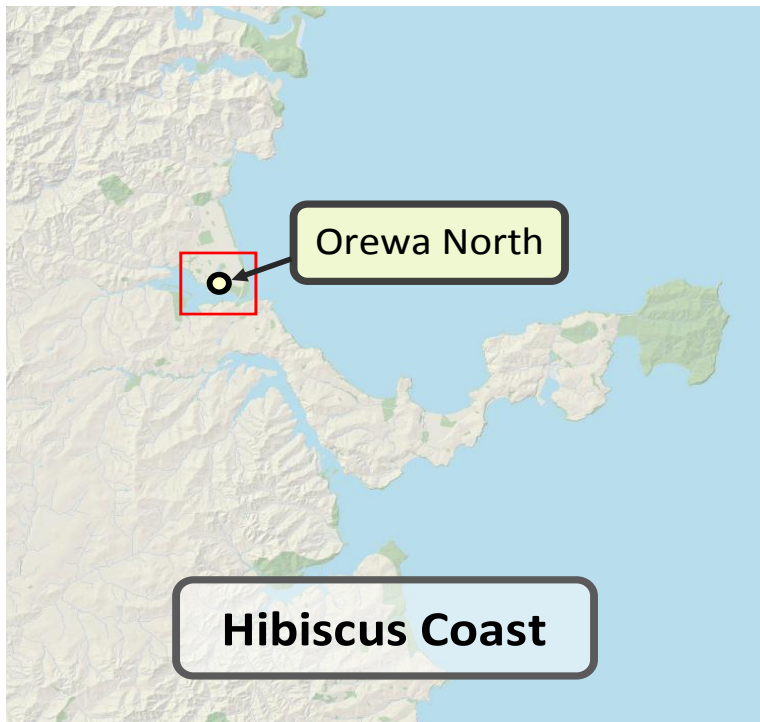
Trend Indicators

⇒ < ±1%
↔ ±1 - 2%
↕ > ±2%

Average annual rate of change, as % of median per year

1.2 Orewa North

Site	Type	Description & Notes
Orewa North	Muddy sand OZ	
Reporting Area	Land Use	Site is located at the mouth of the northern arm of Orewa estuary. The sediment here is muddy sand. Texture is muddier further up the arm, which is now almost totally infilled with mangroves. The catchment is established urban (Orewa township).
Hibiscus Coast	Urban	

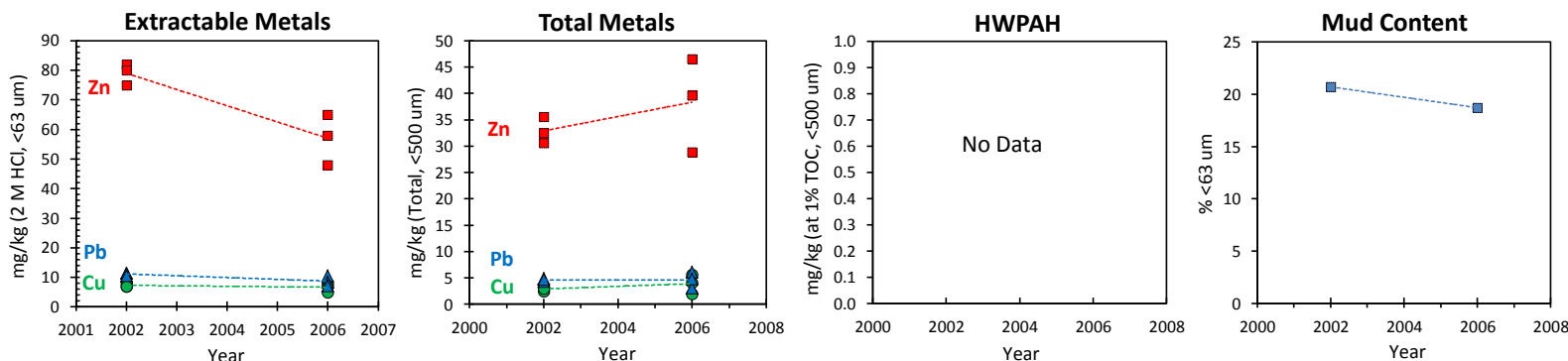


Additional Notes

Site first sampled in 2002, from a site approximately 50 m further up the northern estuary arm from the 2006 site (shown above). Sewage oxidation ponds being decommissioned and southern catchment undergoing extensive urban development (not shown on 2006 aerial shown above).

Site	Description	ERC Status	Trends & Comments
Orewa North	Muddy sand OZ site at confluence of northern arm & main estuary body. Urban catchment.	<div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid black; padding: 2px; margin: 2px;">PAH</div> </div>	2 years of monitoring only. No trends can therefore be assessed. 2002& 2006 results similar. Current contaminant status ERC-Green. 2006 monitoring site small & of low quality, sited at confluence of northern arm & main body (SZ/OZ boundary?).
Reporting Area			
Hibiscus Coast			

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

Year	Mud Content % <63 μm	Organic Carbon TOC (% <500 μm)	Extractable Metals (mg/kg, <63 μm)			Total Metals (mg/kg, <500 μm)			HWPAH (mg/kg, <500 μm)	
			Cu	Pb	Zn	Cu	Pb	Zn	mg/kg	at 1% TOC
2002	20.7	no data	7.0	11.4	80	3.0	4.7	33	no data	no data
2006	18.7	no data	7.0	8.4	58	4.1	4.8	40	no data	no data
Median	19.7	no data	7.0	10.6	70	3.1	4.8	34	no data	no data
Trend (absolute units per year)	-0.5	no value	-0.2	-0.6	-5.5	0.3	0.0	1.4	no value	no value
Trend (% of median per year)	↓ -2.5	no value	↓ -2.4	↓ -5.7	↓ -7.9	↑ 8.1	→ 0.0	↑ 4.0	no value	no value

Environmental Response Criteria (ERC)

- Cu <19 Pb <30 Zn <124 PAH <0.66
- Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7
- Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 μm and <500 μm fraction data. Settling Zones - the <500 μm fraction data

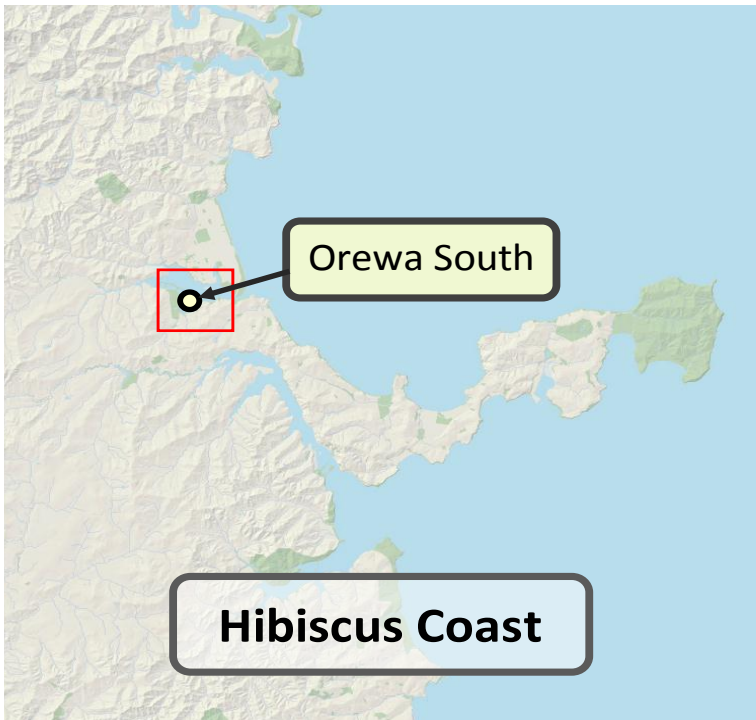
Trend Indicators

- ⇒ < ±1%
- ↔ ±1 - 2%
- ↑↓ > ±2%

Average annual rate of change, as % of median per year

1.3 Orewa South

Site	Type	Description & Notes
Orewa South	Sandy mud OZ	
Reporting Area	Land Use	Site is located at the mouth of the southern arm of Orewa estuary. The sediment here is sticky sandy mud. The southern side of the estuary catchment is undergoing extensive urban development (not shown on aerial photo below).
Hibiscus Coast	Urban	

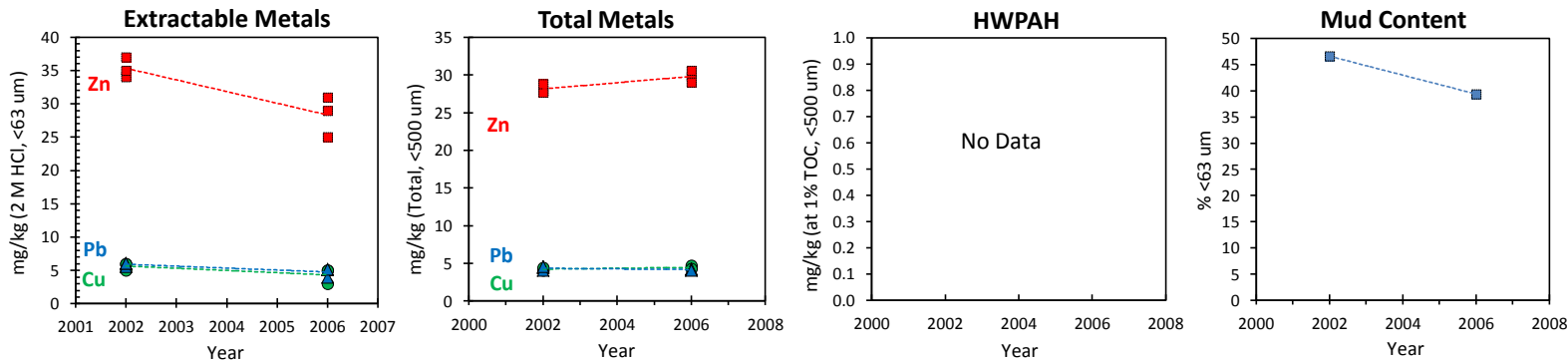


Additional Notes

Sewage oxidation ponds being decommissioned and southern catchment undergoing extensive urban development (not shown on 2006 aerial shown above).

Site	Description	ERC Status	Trends & Comments
Orewa South	Sandy mud SZ site just inside southern arm. Rural/urban developing catchment.	<div style="display: flex; flex-wrap: wrap;"> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Cu</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Pb</div> <div style="border: 1px solid green; padding: 2px; margin: 2px;">Zn</div> <div style="border: 1px solid yellow; padding: 2px; margin: 2px;">PAH</div> </div>	2 years of monitoring only. No trends can therefore be assessed. 2002 & 2006 results similar. Current contaminant status ERC-Green.
Reporting Area			
Hibiscus Coast			

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

Year	Mud Content % <63 µm	Organic Carbon TOC (% <500 µm)	Extractable Metals (mg/kg, <63 µm)			Total Metals (mg/kg, <500 µm)			HWPAAH (mg/kg, <500 µm)	
			Cu	Pb	Zn	Cu	Pb	Zn	mg/kg	at 1% TOC
2002	46.6	no data	6.0	6.1	35	4.2	4.4	28	no data	no data
2006	39.4	no data	5.0	5.1	29	4.4	4.1	30	no data	no data
Median	43.0	no data	5.0	5.4	33	4.4	4.2	29	no data	no data
Trend (absolute units per year)	-1.8	no value	-0.3	-0.3	-1.8	0.1	0.0	0.4	no value	no value
Trend (% of median per year)	↓ -4.2	no value	↓ -6.7	↓ -5.4	↓ -5.4	↗ 1.3	↘ -1.0	↗ 1.4	no value	no value

Environmental Response Criteria (ERC)

Cu <19 Pb <30 Zn <124 PAH <0.66
Cu 19–34 Pb 30–50 Zn 124–150 PAH 0.66–1.7
Cu >34 Pb >50 Zn >150 PAH >1.7

ERC: For Outer Zones - the greater of the <63 µm and <500 µm fraction data. Settling Zones - the <500 µm fraction data

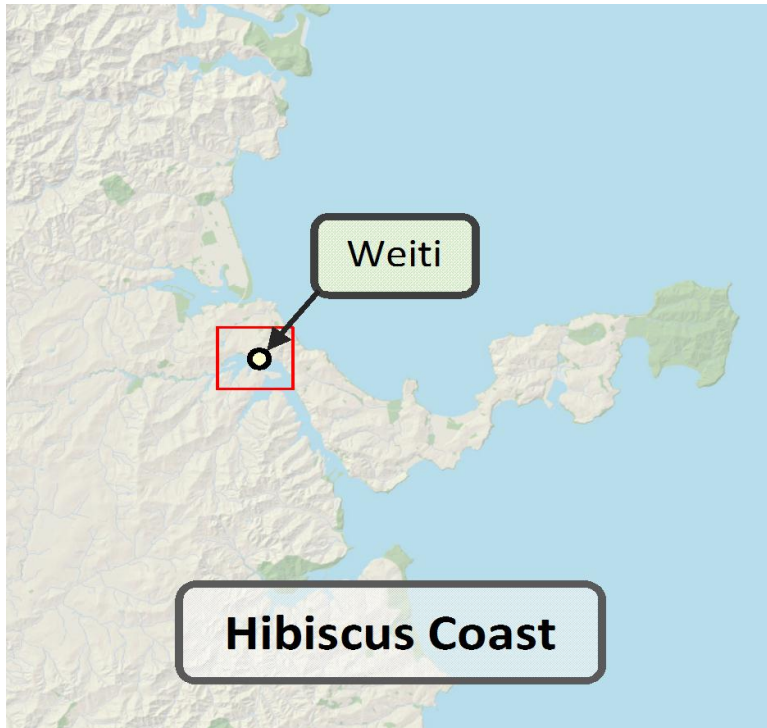
Trend Indicators

↔ < ±1%
↔ ↗ ↘ ±1 - 2%
↕ > ±2%

Average annual rate of change, as % of median per year

1.4 Weiti (SoE)

Site	Type	Description & Notes
Weiti River	Muddy SZ	
Reporting Area	Land Use	Site is located in the upper reaches of the Weiti River estuary. The sediment here is soft mud. The catchment is undergoing development with growth in Silverdale.
Hibiscus Coast	Developing urban	

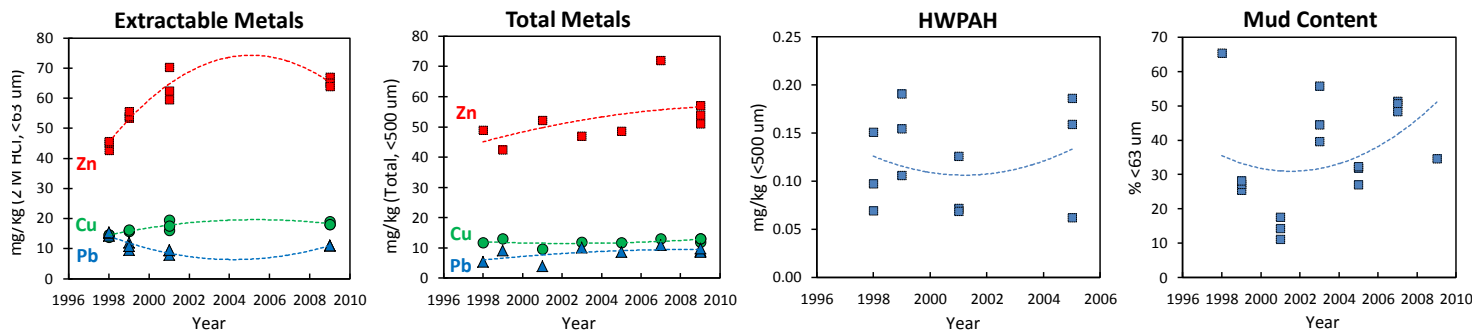


Additional Notes

Monitoring site appears to be subjected to erosion - visually heterogeneous & "lumpy". This may contribute to variable chemistry & textural data from this site?

Site	Description	ERC Status	Trends & Comments
Weiti River (SoE) Reporting Area East Coast Bays	Muddy SZ site. Urbanising catchment.	Cu Pb Zn PAH	11 year monitoring period. Extractable metals' data for 2003-2007 considered unreliable, therefore not shown. Assess metals' trends from Total Metals. Current contaminant status - ERC Green. Zn unusually high in 2007? Variable mud content & chemistry data.

Changes in sediment chemistry over monitoring period. "Line of best fit" (quadratic smoothing) shown.



Annual median concentrations & indicative trends (by linear regression). Colours refer to ERC (see footnotes).

Year	Mud Content % <math><63 \mu\text{m}</math>	Organic Carbon TOC (% <math><500 \mu\text{m}</math>)	Extractable Metals (mg/kg, <math><63 \mu\text{m}</math>)			Total Metals (mg/kg, <math><500 \mu\text{m}</math>)			HWPAH (mg/kg, <math><500 \mu\text{m}</math>)	
			Cu	Pb	Zn	Cu	Pb	Zn	mg/kg	at 1% TOC
1998	65.4	no data	14.6	15.0	45	11.8	5.4	49	0.097	no data
1999	27.1	no data	16.0	10.8	54	13.0	9.2	43	0.155	no data
2001	14.4	no data	17.6	9.4	62	9.7	3.9	52	0.072	no data
2003	44.5	1.04	no data	no data	no data	12.0	10.1	47	no data	no data
2005	31.9	0.92	no data	no data	no data	11.8	8.7	49	0.159	0.196
2007	50.6	1.30	no data	no data	no data	13.0	11.0	72	no data	no data
2009	34.7	no data	18.0	11.0	65	13.0	9.0	54	no data	no data
Median	32.4	1.04	16.2	11.0	58	12.0	9.0	51	0.116	0.196
Trend (absolute units per year)	1.2	0.05	0.3	-0.2	1.5	0.1	0.3	1.0	0.002	no value
Trend (% of median per year)	↑ 3.8	↑ 4.5	↗ 1.8	↘ -1.5	↗ 2.5	→ 0.8	↑ 3.3	↗ 2.0	↗ 1.3	no value

Environmental Response Criteria (ERC)	Trend Indicators
Cu <math><19</math> Pb <math><30</math> Zn <math><124</math> PAH <math><0.66</math> Cu 19-34 Pb 30-50 Zn 124-150 PAH 0.66-1.7 Cu >34 Pb >50 Zn >150 PAH >1.7	⇐ $\pm 1\%$ ↗ ↘ $\pm 1 - 2\%$ ⇕ >math>\pm 2\%</math> Average annual rate of change, as % of median per year
ERC: For Outer Zones - the greater of the <math><63 \mu\text{m}</math> and <math><500 \mu\text{m}</math> fraction data. Settling Zones - the <math><500 \mu\text{m}</math> fraction data	