



BASELINE TRACE METAL LEVELS  
IN THE LOWER TEIDAMU RIVER  
AND ESTUARY

INR TECHNICAL REPORT NO 87/1

INSTITUTE OF NATURAL RESOURCES  
THE UNIVERSITY OF THE SOUTH PACIFIC

# REPORT

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UNIVERSITY OF THE SOUTH PACIFIC  
INSTITUTE OF NATURAL RESOURCES

ENVIRONMENTAL STUDIES REPORT NO. 37

BASELINE TRACE METAL LEVELS IN THE LOWER  
TEIDAMU RIVER AND ESTUARY

J.E. Brodie and P. Gangaiya

March 1987

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INTRODUCTION

The Tropik Wood timber and chipmill is situated on the ridge between the Teidamu and Vitogo river valley (Figure 1). Any effluent which accidentally escaped the plant effluent containment system would flow into tributaries of the Teidamu River and hence into the river. A small baseline study of water, sediment and shellfish quality in the Vitogo River and estuary has already been published (Gangaiya, Brodie and Morrison, 1986). The present study examines similar quality parameters in the lower Teidamu River and estuary as per the proposal submitted to Forestry Development Services on 20 June, 1986 (Appendix 1).

Sampling Sites and Times

The study involved collection of water samples from three river sites and shellfish samples from one estuary site (Figure 1). Three sampling periods were involved - 13 August, 1986, 24 October, 1986 and 8 January, 1987. Water and shellfish samples were collected at low tide. Site 1 was situated above the point where any effluent from the mill would reach the river, while sites 2 and 3 were downstream of the possible entry point. Site 3 had tidal and saline effects from the estuary. Site 4 was the shellfish collection site near where the river flows out through the mangroves onto the coastal mudflat.

Parameters Measured

Arsenic, copper and chromium were chosen for analysis as these three metals are present in the wood treatment chemical (CCA) used at the mill. Other parameters are general water quality indicators.

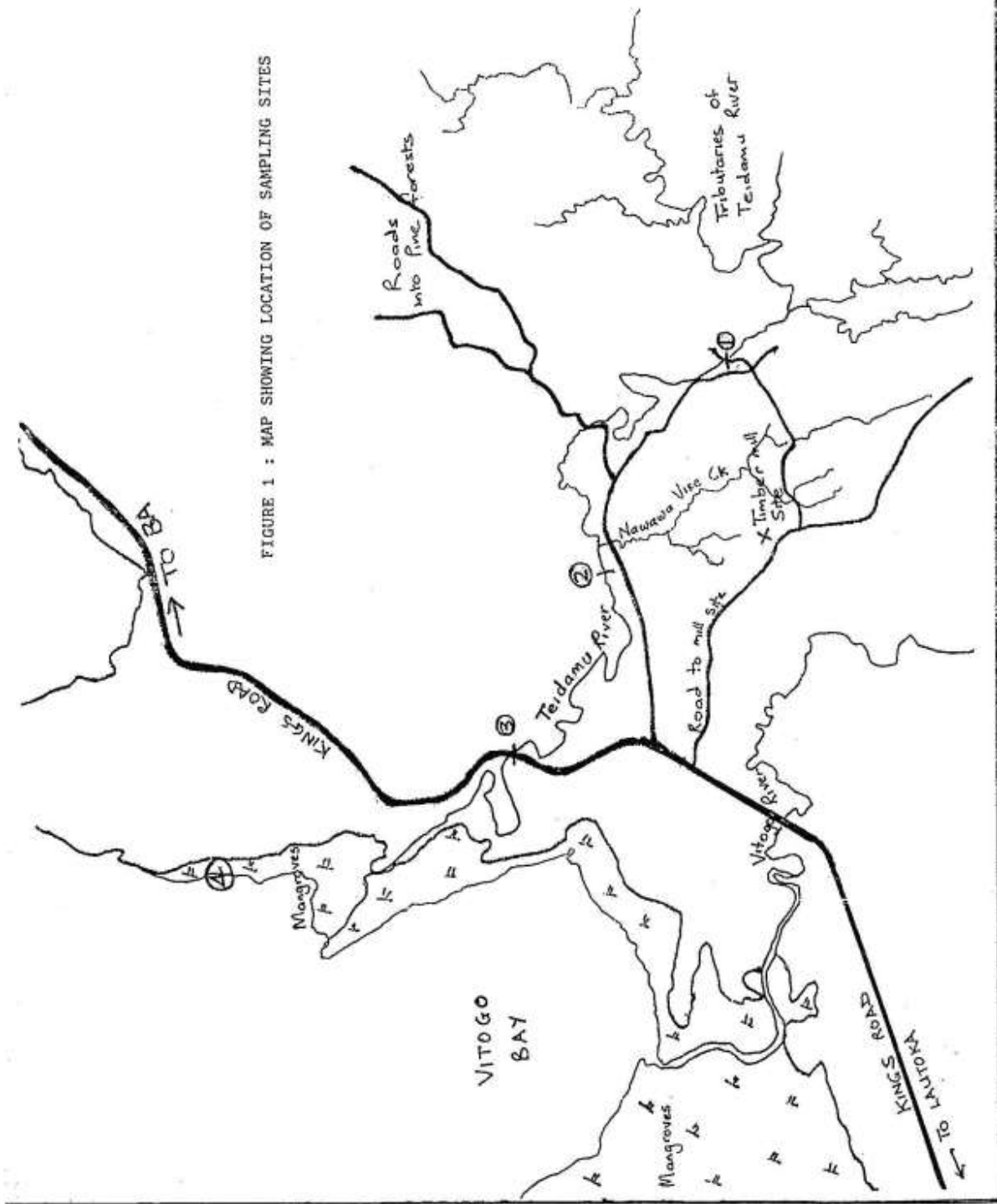


FIGURE 1 : MAP SHOWING LOCATION OF SAMPLING SITES

### Methods

Water samples for arsenic, chromium and copper were preserved by acid addition. No preservatives were used for the samples collected to be analysed for the other parameters but analysis was completed within 48 hours of collection.

Measurement of copper and chromium in the water samples involved extraction/concentration using APDC/MIBK followed by flame Atomic Absorption Spectroscopy (AAS) (APHA, 1980). Arsenic was measured by hydride generation and analysis by AAS in a heated quartz tube (APHA, 1981). The shellfish were digested in a pressure bomb with nitric acid followed by analysis of copper and chromium using flame AAS and arsenic using hydride generation. Methods for the other parameters in water samples followed the American Public Health Association procedures (APHA, 1980).

### Results

The results are shown in Tables 1, 2 and 3. Please note that in the result sheet submitted as a progress report for the January, 1987 sampling trip the headings of Sites 1 and 3 were exchanged. The results in Table 3 of this report show the correct headings.

The results represent a baseline position only and only brief comments will be made on the levels measured. The general water quality parameters are as one might expect with varying results at Site 3 due to tidal influence. Levels of the metals copper, chromium and arsenic are also low in both water and shellfish and are very similar to those found on the Vitogo mudflats (Gangaiya, Brodie and Morrison, 1986). The levels are comparable to those found in uncontaminated shellfish in other tropical and sub-tropical areas of the world.

TABLE 1  
RESULTS OF ANALYSES OF SAMPLES  
COLLECTED ON 12 & 13/8/86

		Water Samples		
		Site 1	Site 2	Site 3
Conductivity	mS/cm	0.099	0.117	8.86
Turbidity	NTU	0	16	20
Total nitrogen	mg/l	4.0	4.0	5.0
Ammonia	µg/l	20	40	100
Nitrite	µg/l	<10	<10	<10
Nitrate	µg/l	70	60	<10
Sulphate	mg/l	4	4	130
Total Phosphorus	µg/l	150	70	70
Phosphate	µg/l	310	250	250
Total Iron	mg/l	<0.2	<0.2	<0.2
Total Manganese	mg/l	0.5	0.5	0.8
Chloride	mg/l	<10	39	1270
Silica	mg/l	27	42	20
Sodium	mg/l	10	9.8	680
Potassium	mg/l	2.9	2.4	84
Calcium	mg/l	10	9.0	50
Magnesium	mg/l	0.3	0.3	119
Arsenic	µg/l	<1	<1	<1
Chromium	µg/l	<2	<2	<2
Copper	µg/l	<5	<5	<5
Oil	mg/l	16	5.4	1.6

SHELLFISH SAMPLE (*Grafarium tumidum*)

Site 4

Arsenic	2.9 mg/kg of wet weight
Chromium	0.75 " " " "
Copper	1.4 " " " "

TABLE 2  
RESULTS OF ANALYSES OF SAMPLES  
COLLECTED ON 24/20/86

		Water Samples		
		Site 1	Site 2	Site 3
Conductivity	mS/cm	0.090	0.111	1.34
Turbidity	NTU	8	12	10
Total Nitrogen	mg/l	2.3	1.6	10.0
Ammonia	µg/l	<20	<20	<20
Nitrate	µg/l	30	60	10
Total Phosphorus	µg/l	160	100	50
Phosphate	µg/l	490	306	150
Arsenic	µg/l	<1	<1	<1
Chromium	µg/l	<2	<2	<2
Copper	µg/l	<5	<5	<5
Oil	mg/l	5.6	2.0	2.0

SHELLFISH SAMPLE (*Grafarium tumidum*)

	Site 4
Arsenic	1.4 mg/kg wet weight
Chromium	0.30 " " "
Copper	2.4 " " "



TABLE 3

RESULTS OF ANALYSES OF SAMPLES  
COLLECTED IN EARLY JANUARY

		Site 1	Site 2	Site 3
Conductivity	mS/cm	0.019	0.135	22.3
Total Nitrogen	mg/l	1.6	3.1	2.8
Ammonia	µg/l	25	150	60
Nitrate	µg/l	56	112	56
Total Phosphorus	µg/l	180	66	123
Phosphate	µg/l	650	306	356
Arsenic	µg/l	<1	<1	<1
Chromium	µg/l	<2	<2	<2
Copper	µg/l	<5	<5	<5
Oil	mg/l	2.9	2.8	3.5

SHELLFISH SAMPLES

SITE 4

	<u>Graffarium tumidum</u>	<u>Crasostrea mordax</u>
Arsenic mg/kg of wet weight	2.4	1.7
Copper mg/kg of wet weight	2.3	2.5
Chromium mg/kg of wet weight	0.3	0.5

References

American Public Health Association/American Water Works Association/Water Pollution Control Association, 1980. Standard Methods for the Examination of Water and Wastewater, ISBN : 0-87553-091-5.

Gangaiya, P., Brodie, J.E. and Morrison, R.J., 1986. Initial Report on the Quality of the Vitogo River and associated environment before construction of an Integrated Sawmill/Chipmill Complex at Drasa, Western Viti Levu, Fiji. INR Technical Report No. 86/5.

## FORESTRY DEVELOPMENT SERVICES LTD.

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FACSIMILE. 60368  
TELEX: FJ5342

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23rd May 1986

Senior Research Fellow  
Institute Of Natural Resources  
University Of The South Pacific  
PO Box 1168  
SOVA

ATTENTION: Jon E. Brodie

Dear Mr Brodie

### FIJI FORESTRY PROJECT

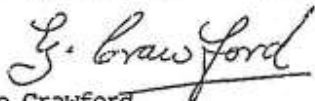
We wish to refer to the meeting held at the Project Office in Drasa on Wednesday 14th May 1986 and in particular to the conversation you had with the writer relating to a survey of the Teidamu River.

We would be interested in you conducting such a survey on our behalf, to provide the base data from which future references can be made.

Would you be kind enough to advise us that you would be willing to conduct a survey of this nature, what the cost of this would be and when could it be performed.

Your early reply would be appreciated.

Yours sincerely  
FORESTRY DEVELOPMENT SERVICES LTD



George Crawford  
PROJECT MANAGER

C.T: Bill Maund  
Gordon Gresham



# The University of the South Pacific

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INSTITUTE OF NATURAL RESOURCES

Our Ref:

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Telephone: 313900.  
Cables: University Suva. Telex: FJ2276.

11 August 1986

Mr G Crawford  
Project Manager  
Forestry Development  
Services Ltd  
P O Box 4607  
LAUTOKA

Dear Mr Crawford

BASELINE STUDY OF THE TEIDAMU RIVER

Thank you for accepting our proposal for the baseline study of the Teidamu River.

We will be making our first sampling visit later this week and will forward to you a report of the visit as soon it is ready.

Regards

Yours sincerely

Philomena Gangaiya  
for DIRECTOR

**FORESTRY DEVELOPMENT SERVICES LTD.**

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14th July 1986

The Director  
Institute Of Natural Resources  
University Of The South Pacific  
PO Box 1168  
SUVA

RE: Baseline Study Of The Teidamu River


Dear Sirs

We accept your proposal for the above study as outlined in your letter dated 20th June 86 and the attached 2 pages proposed.

We undertake to pay the total cost of \$2529.00 upon completion of the outlined works and receipt of your final report, however, we request a brief progress report from yourselves after each visit.

Please take the necessary steps to commence this study.

Your faithfully  
FORESTRY DEVELOPMENT SERVICES LTD

*for*   
George Crawford  
PROJECT MANAGER  
GC/em

INSTITUTE OF NATURAL RESOURCES

20th June 1986

Mr C Crawford  
Project Manager  
Forestry Development Service Ltd  
P O Box 4607  
LAUTOKA

Dear Mr Crawford

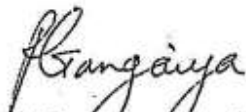
PROPOSAL FOR A BASELINE STUDY OF THE TEIDAMU RIVER

We acknowledge receipt of your letter dated 23rd May 1986 in which you requested our Institute to carry out a baseline survey of the Teidamu river.

We are submitting proposal for monitoring the quality of the river water and shellfish in the area. Details and associated costs are outlined in the enclosed proposal.

If you wish to discuss any aspect of the proposal further please do not hesitate to contact us.

Yours sincerely



Philomena Gangaiya (Miss)  
for DIRECTOR

ENCL

## PROPOSAL FOR A BASELINE STUDY OF THE TEIDAMU RIVER

(Prepared for Forestry Development Services Ltd)

by  
Institute of Natural Resources  
USP

### 1. BACKGROUND

The Teidamu river is one of the major freshwater inputs into Vitogo Bay. The Nawawa Vise creek which is a tributary of the Teidamu river will receive the stormwater drainage of the sawmill/chipmill being constructed by Forestry Development Services Ltd at Drasa. The Institute of Natural Resources, USP has been asked to submit a proposal for a baseline survey of the Teidamu river.

### 2. OBJECTIVE OF STUDY

To generate baseline data on the quality of the Teidamu river water.

### 3. WORKPROGRAM

Three sampling visits (August and October, 1986 and January 1987) to the Teidamu area are proposed. During each visit 3 water samples (sampled from appropriate sites on the Teidamu river) and 1 shellfish sample (at the mouth of the river) will be collected.

### 4. ANALYSIS AND ASSOCIATED COSTS

The following analyses will be performed on samples collected during each sampling visit.

#### 4.1 Water samples

Nutrients (nitrate, ammonia, phosphate, total nitrogen and total phosphorus) at a total cost of \$30.00 per sample.

Turbidity and conductivity at a cost of \$6.00 per sample.

Heavy metals (arsenic, chromium and copper) and oil at a cost of \$35.00 per sample.

#### 4.2 Shellfish

Heavy metals (arsenic, chromium and copper) at a cost of \$35.00 per sample.

In addition to the above, water samples would be analysed once only during the sampling period for other parameters (calcium, magnesium, sodium and potassium; iron and manganese; chloride, sulphate and silica) . Cost will be \$35.00 per sample.

#### 5. OUTPUT

Report describing the water quality of the study area.

#### 6. TOTAL COSTS

		Cost per trip	Cost over sampling period
Water analysis	Nutrients	3 x \$30 = \$ 90	3 x \$ 90 = \$ 270
	Turbidity & cond.	3 x \$ 6 = \$ 18	3 x \$ 18 = \$ 54
	Heavy metals and oil	3 x \$35 = \$105	3 x \$105 = \$ 315
	Other parameters	3 x \$35 = \$105	1 x \$105 = \$ 105
Shellfish analysis	Heavy metals	3 x \$35 = \$ 35	3 x \$ 35 = \$ 105
Staff time	1 graduate 1 technician for 2 days per trip		3 x \$360 = \$1080
Transport	Use of INR car	\$120	3 x \$120 = \$ 360
Accommodation & food		\$ 80	3 x \$ 80 = \$ 240
<u>TOTAL</u>			<u>\$2529</u>

The costs of senior staff time used for supervision of analysis, interpretation of data for reports etc. would be borne by INR.