INSTITUTE OF APPLIED SCIENCES

THE UNIVERSITY OF THE SOUTH PACIFIC

BASELINE ECOLOGICAL, WATER QUALITY AND AQUATIC FAUNAL STUDIES OF THE WAIDINA RIVER AT THE NAQALI BRIDGE AND WITHIN A SECTION OF WAINIVAKATASI CREEK NEAR NAQALI DISTRICT SCHOOL

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A Report Prepared for Sinclair Knight Merz, EIA Consultants

By

Bale Tamata
Alison Haynes
Batiri Thaman

November 2000

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Institute of Applied Sciences
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November, 2000

Bale Tamata, Manager Environment Unit, IAS, USP
Alison Haynes, IAS, USP
Batiri Thaman, Technician Environment Unit, IAS

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EXECUTIVE SUMMARY

The Institute of Applied Sciences of the University of the South Pacific was commissioned by Sinclair Knight Merz to conduct a baseline assessment of the general physical and ecological characteristics of the surface waters in the vicinity of the area likely to be impacted on by the road upgrading and bridge reconstruction activities near Naqali village, Naitasiri.

The baseline study was conducted along the Waidina River near the Naqali Bridge and within Wainivakatasi Creek near Naqali District School, approximately 2 kilometers from Naqali. Apart from water quality studies, diversity and abundance of the aquatic fauna were also assessed.

A total of five sampling sites were chosen, three within the Waidina River and two in Wainivakatasi creek. Within the Waidina River one site was upstream from the bridge, one at the bridge, and one downstream from the Naqali bridge. Within the small creek one site was upstream and one downstream from the bridge.

The water quality in the Waidina River at the Naqali Bridge and in Wainivakatasi Creek near Naqali District School during the study was generally good, satisfying the Fiji Guidelines for fresh water Class 2. Class 2 fresh waters refers to freshwater which must be protected for the purpose of sustaining important aquatic ecosystems (Fiji Draft Sustainable Development Bill 1996). The road upgrading project may cause some changes in water quality, in particular the turbidity and sediment loading. However, the impacts are temporary and the current generally good status of water quality can be expected, given time, after the construction work on the Naqali bridge and the smaller bridge near Naqali District School is completed.

Invertebrates were generally lacking. The lack of insect larvae is due to two factors: 1. Insect larvae tend to settle and adhere to larger stones and boulders that are not easily dislodged by the current and 2. The river and stream had been in flood during the four weeks previous to sampling and large quantities of mud had been deposited on and between the stones. Crustacea, prawns, shrimps and crabs were the most abundant invertebrates. Seven of the eight species of invertebrates found in the river and stream are used as food by the nearby villages i.e. crabs, prawns, shrimps and the gastropod *Neritina pulligera.*

The Waidina River is an important source of fish food species for the Naqali villagers. The more common fish species caught with hand lines, nets, and spears include the **bau** (Eleotridae) and **vo loa** (*Ophiocara aporos*). Eels, prawns, and crabs are also fished/caught for domestic consumption.

Key informants in the community consultation included the Turaga ni Yavusa, Turaga ni Koro (Ratu Senirusi), the wife of the Turaga ni Yavusa and other women actively involved in fishing. According to the older members of the community, the activities at the Namosi copper mine caused a decline in fish abundance and diversity in the Waidina River, which drains the Namosi highlands in the interior of Viti Levu.

The aquatic fauna, which is rather impoverished at present, will be partially inaccessible to the villagers during the period of construction. However, the project is not expected to cause irreversible changes in the species diversity and abundance.

After all, the river and its fauna are frequently subjected to flooding and sediment loading under normal conditions.

BASELINE ECOLOGICAL, WATER QUALITY AND AQUATIC FAUNAL STUDIES OF THE WAIDINA RIVER AT THE NAQALI BRIDGE AND WITHIN A SECTION OF WAINIVAKATASI CREEK NEAR NAQALI DISTRICT SCHOOL

By
The Institute of Applied Sciences
University of the South Pacific

1.0 INTRODUCTION

The Institute of Applied Sciences of the University of the South Pacific was commissioned by Sinclair Knight Merz to conduct an assessment of the existing water quality and the aquatic fauna within the Waidina River at Naqali Bridge and within Wainivakatasi Creek near Naqali District School. Upgrading of the road and reconstruction of the existing bridges over these two water bodies are being planned and are likely to affect the water quality and life forms within. This assessment is necessary to establish baseline information prior to the disturbance. Aspects assessed included:

- The general status of existing water quality
- Aquatic invertebrate fauna
- Fisheries resources within the creek and Nadi River
- Human use of the creeks and river

The EIA study was conducted by a team from the USP and was conducted over two days. The first day (September 20th) was taken up with traditional "sevusevu" and community consultations. The high water levels in the river prevented any field work. The USP team presented their 'sevusevu' to the 'Turaga ni Yavusa' (traditional head) and the 'Turaga ni Koro' to seek permission to conduct the survey in the area. This custom is significant in any project. After the 'sevusevu' the elderly men present were interviewed (recorded) on their observations of changes in the aquatic fauna abundance and diversity over time. Heavy rain and flooding at the Naqali Bridge delayed the continuation of the study until November.

On the second day, 13th November, the field work was carried out. The field work was conducted over during the hot and wet season for the Fiji Islands. The water quality and aquatic fauna study were conducted simultaneously at three locations along Waidina River and two within Wainivakatasi Creek on November 13th, 2000. The weather was cloudy and overcast during the fieldwork.

The results of this baseline study will serve as benchmark for assessing any impact on these two water bodies that may result from the road upgrading and bridge reconstruction activities being planned.

2.0 SAMPLING LOCATIONS

A total of five sampling sites were chosen, three within the Waidina River and two within Wainivakatasi creek (Appendix 1). Location details of the sampling sites are

presented in Table 1. Photographs showing the general environment at various sites are appended (Appendix 2).

Table 1. Description of Sampling Sites

Site	Location	GPS
1	Approximately 300 meters upstream from Naqali Bridge	17°57.43S 178°23.15E
2	At Naqali bridge	17°57.36S 178°23.32E
3	Approximately 400 meters downstream from Naqali Bridge.	17°57.25S 178°23.63E
4	15 meters downstream from small bridge over Wainivakatasi Creek	17°58.23S 178°23.69E
5	10 meters upstream from small bridge over Wainivakatasi Creek	17°58.24S 178°23.66E

Site 1

Site 1 was within the Waidina River, upstream from Naqali Bridge near a small exposed beach. The area is often used by the women from Naqali village for washing and bathing, as well as fishing. Surrounding topography was flood plains and vegetation was mainly secondary vegetation including paragrass and guava trees. Terrestrial fauna present included insects, mongoose, and snakes. Creek flow was moderate. Medium to fine gravel dominated the river bed. River width was around 30 m and maximum depth 2 m. No signs of any aquatic flora was observed.

Site 2

Site 2 was within the Waidina River on the upstream side of Naqali Bridge. It was situated near a small beach on the inner section of a meander. The area is used by the villagers for washing, fishing, and swimming. The surrounding vegetation again consisted of guavas. Frogs were also present. Creek flow was very slow resulting tin the river bed material being predominately fine mud and silt. River width at sampling area was about 25 m and depth was around 5 m. Again no algae was observed.

Site 3

Site 3 was within the Waidina River downstream from Naqali bridge. Surrounding vegetation included guavas, sedges, and African tulips. River depth was around 2 m, river width 20 m and flow moderate. Sand and gravel substrate dominated the creek bed. No filamentous algae was observed.

Site 4

Site 4 was located in Wainivakatasi creek. The creek had a small vehicle bridge crossing it, but the actual creek was about 5 m below the bridge and bank. This site was approximately 15 m downstream from the bridge and is used for fishing for prawns. African tulip trees, grasses, and ferns were present on the banks of the creek. Creek width was 5 m at the most and maximum depth 30 cm. Creek bed material was made up of small to medium sized pebbles and filamentous green algae was observed on pebbles.

Site 5

Site 5 was again within Wainivakatasi creek about 10 m upstream from the small bridge. The site is used for fishing for prawns and fish. In fact, the women fish along

the entire creek. Surrounding vegetation consisted of guava trees, sedges, and paragrass. Creek width was 2 to 5 m and maximum depth in pools was 1 m. Creek flow was slower than at Site 4. The creek bed was dominated by small to medium sized pebbles. Filamentous green algae was again observed on stones.

3.0 WATER QUALITY

3.1 Methodology

Water quality was assessed at the five sampling locations described above on Monday November 13th, 2000. At each site, water temperature, pH, dissolved oxygen, conductivity, and salinity were measured using a Horiba U-10 Water Multimeter. Measurements were taken just below the surface (about 30 cm depth). The Multimeter was calibrated in the lab prior to fieldwork. Water clarity was measured using a Secchi disc. Results are tabulated in Table 2 below.

Water samples were collected at each site and analysed at the Institute of Applied Sciences laboratory for Total Suspended Solids and Total Dissolved Solids.

3.2 Results

3.2.1 Physico-chemical parameters

Table 2. On-site Water Quality Results for Five Sampling Sites, 13 November, 2000

Parameter	Site 1	Site 2	Site 3	Site 4	Site 5	Fiji Guidelines *
Temperature (°C)	25.7	26.2	26.4	25.6	25.3	Natural +/- 0.9°C
pH	7.4	7.4	7.5	7.9	7.8	6.5 – 8.5
Conductivity (mS/cm)	0.079	0.079	0.078	0.103	0.104	0.05 – 1.5 (potable in USA) **
Dissolved O_2 (mg/L)	8.23	8.06	8.18	8.90	8.60	5 or greater
Salinity (ppt)	0	0	0	0	0	0 (freshwater)
Clarity (m)	~1.5 m	~1 m	>1.5 m	0.3 m (bottom)	0.3-0.5 m (bottom)	>1.2 m

* Fiji Draft Sustainable Development Bill – specific criteria for Class 2 (Freshwater) waters

** APHA. AWWA. WEF (1992)

The parameters measured on site were very similar for those sites within the Waidina River and those in Wainivakatasi creek. There were slight differences though between the two water bodies, for example temperature was slightly lower in the small creek and conductivity higher.

3.2.2 Total Suspended Solids

Table 3. Results of Total Suspended Solids Analysis

Site	TSS (mg/L)	TDS (mg/L)	Total (TSS + TDS) (mg/L)
1	4	47	51
2	3.5	62	65.5
3	5.5	72	77.5
4	2.5	82	84.5
5	2	74	76
ESCAP Guidelines			Up to 500 mg/L*

* ESCAP (1994) - For sustenance of aquatic life in freshwater

3.3 Discussion

Generally speaking the water quality in the Waidina River in Naqali, and in the Wainivakatasi Creek near Naqali District School is in satisfactory condition. All of the physico-chemical parameters satisfy the Guidelines for freshwater bodies as stipulated in the Fiji Draft Sustainable Development Bill (1996) and the ESCAP "Guidelines on Monitoring Methodologies for Water, Air, and Toxic Chemicals/Hazardous Wastes" (1994). Sampling was conducted on a fine day following several days of dry weather. The results for Total Suspended Solids (TSS), possibly Total Dissolved Solids (TDS) and clarity would have been very different if the survey was conducted following rain in the area or in the Namosi Highlands. In fact this survey was delayed for weeks because of the rain in the Namosi area causing flooding of the Waidina River at the Naqali Bridge.

It is to be expected that the road upgrading works and the translocation of the Naqali Bridge will cause some changes, particularly in the turbidity, flow velocity, and the sediment loading of the Waidina River near the Naqali Bridge and of Wainivakatasi Creek near Naqali District School. These changes may in turn affect the fish, prawns, eels, and other life forms in the water for the duration of the works. However, given time, the water quality and the diversity and abundance of aquatic fauna should be re-established in the river and creek.

4.0 THE INVERTEBRATE FAUNA IN THE WAIDINA RIVER AND IN A WAINIVAKATASI CREEK AT NAQALI.

Alison Haynes PhD, CBiol, MIBiol

4.1 Introduction

The Public Works Department, Fiji, propose, as they upgrade the Sawani-Serea road, to build two new bridges at Naqali, one over the Waidina river and one over a small creek near the Naqali District School. The villagers of Naqali village catch fish,

prawns and gastropods from both river and creek. As far as is known no previous studies of the river or creek have been undertaken in this region.

4.2 Methodology

4.2.1 Sampling sites

Sampling was carried out on 13 November 2000. Five sites were sampled, three in the Waidina river (sites 1-3) and two in the creek (4-5) (Appendix 1). The invertebrate study was conducted at the same time as water velocity, water quality readings and water samples were taken and women villagers caught fish and prawns.

4.2.2 Sampling methods

At each site it was necessary to sample 30 stones (6 – 8 cm diameter) as all stones at the sampling sites were small. Large stones and boulders were absent. Stones were selected at random along a 10 m stretch of stream. Each stone was moved into a 1 mm mesh net held just downstream from the stone. The invertebrates adhering to the stones were washed into the net. The contents of the net were identified and counted.

Village women caught fish and prawns with hand nets in deeper parts of the river/stream at each site.

The current velocity, where the invertebrates were sampled from stones, was found by using a current stick.

4.3 Results

4.3.1 Invertebrate abundance

Table 4. lists the invertebrate species and their abundance on 30 stones (bold type) and those caught by villagers in nets (in brackets). Insect larvae were found at one site only. These were the caddisfly larvae and pupae of the net building *Abacaria fijiana.* The freshwater crab *Varuna litterata* and the atyid shrimps *Caridina* sp. were found most frequently - each was present at four of the five sites. The gastropod *Neritina pulligera*, the black atyid shrimp *Atyoida* sp. and the palaemonid prawns *Macrobrachium equidens* and *Palaemon* sp. were present at two sites. Atyid shrimps were the most abundant invertebrates.

4.3.2 Water velocity

Both the river and stream had low current velocity, it varied from 0 – 44 cm s^{-1}. (Table 5)

Table 4. Invertebrates present at 5 sites in the Waidina river and Wainivakatasi creek at Naqali on 13 November 2000. Numbers in bold print are invertebrates found on 30 stones and numbers in brackets are invertebrates caught in nets.

Invertebrates	Sampling Sites				
	1	2	3	4	5
INSECTA					
Trichoptera (caddis fly larvae & pupae)					
Abacaria fijiana (net caddis)	**8**	-	-	-	-
CRUSTACEA					
Varuna litterata (crab) (5)	**1**	-	**1**	**1**	
Palaemonidae (prawns)					
Macrobrachium lar (1)	-	-	-	-	
Macrobrachium equidens	(2)	-	-	(2)	-
Palaemon sp, (8) Atyidae (shrimps)	-	-	-	(15)	
Caridina sp. small	**1**	-	**21**	**2**	**1**
Atyoida sp. black (9)	-	-	-	**2** (2)	
MOLLUSCA					
Gastropoda (snails)					
Neritina pulligera	(1)	(2)	-	-	-
NUMBER OF SPECIES	5	1	2	5	5
NUMBER OF INDIVIDUALS	13	2	22	24	24

Table 5. The water depth, water velocity, nature of the substrate and flora at sampling stations in the Waidina river and in Wainivakatasi creek at Naqali. P = present

	Sampling Sites				
	1	2	3	4	5
Water depth (cm)	30	30+	18	20	10
Current velocity (cm s^{-1})	44	0-10	40	32	38
Substrate	small stones & mud	mud & sand	small stones & mud	small stones & mud	small stones & mud
FLORA					
Spirogyra sp. Short filaments with mud on stones	P	-	P	P	P

4.4 Discussion

The lack of insect larvae is due to two factors: 1. Insect larvae tend to settle and adhere to larger stones and boulders that are not easily dislodged by the current. 2. The river and stream had been in flood during the four weeks previous to sampling and large quantities of mud had been deposited on and between the stones.

Crustacea, prawns, shrimps and crabs were the most abundant invertebrates; all of which are collector or gatherer feeders. Grazers, such as insect larvae and gastropods are few but their numbers are likely to increase after a long spell of fine weather after the mud has been washed away.

Seven of the eight species of invertebrates found in the river and stream are used as food by the nearby villages i.e. crabs, prawns, shrimps and the gastropod *Neritina pulligera.*

5.0 THE VERTEBRATE FAUNA

5.1 Introduction

This study is concerned with the fish and vertebrate stock diversity and abundance in Waidina River near Naqali Bridge and within Wainivakatasi creek near Naqali District School.

The road upgrading works and bridge reconstruction may have an impact on freshwater ecosystems nearby either through direct destruction or due to siltation and increased turbidity as a result of erosion of silt during the upgrading activities. Community interviews with villagers from Naqali village indicates that the villagers are regular fishers of these two water bodies, utilising an important source of protein in the creek's fish and vertebrate stocks.

5.2 Methodology

The aquatic fauna study was carried out on the 13th of November, 2000 simultaneously with the water quality study. There were 3 sites in the Waidina River and 2 sites in Wainivakatasi creek.

At each site women from Naqali village, around 5 at each site, assisted in the catching of freshwater fauna. The gear used to catch the aquatic fauna included: hand nets, fine mesh scoops, and hands. Some young men also assisted using masks and snorkels and catching fish with spears. At each site organisms were identified, counted, and measured. Those that were not identified were preserved for later identification. Fishing time was also recorded.

Johnson Seeto of the Marine Studies Programme at USP identified the aquatic fauna from specimens collected at various sites.

5.3 Results

Table 6 lists the name and number of each species (and lengths for some species) caught at each site during this study and Table 7 shows species diversity and abundance of the aquatic fauna.

Table 6. Aquatic Fauna Caught in Waidina River and a Wainivakatasi Creek

Site	Species Found			Length (cm)
	Common Name	Scientific Name	Fijian Name	
1	Prawn	*Macrobrachium equidens* (2)	moci	7 5.5
	Fish	*Poecilia mexicana* (1)	tiatia	2
		Ophiocara aporos (3)	vo loa	17 18 21
		Eleotridae (1)	bau	15
		Ctenogobius sp. (1)	vo seu	11
	Crab	*Varuna litterata* (1)	taimami	1
	Gastropod	*Neritina pulligera* (1)	sici	large
Total	7 species 10 individuals			
2	Fish	*Ophiocara aporos* (1)	Vo loa	20
		Eleotridae (1)	Bau	25
	Gastropod	*Neritina pulligera* (2)	sici	
Total	3 species 4 individuals			
3	Eel (wormlike)		bonu	42
	Crab	*Varuna litterata* (1)	taimami	2.5
	Fish	*Ophiocara aporos* (1)	vo loa	22
		Poecilia mexicana	tiatia	numerous (small)
Total	4 species 4 individuals			
4	Shrimps	*Caridina* sp. (2)	Moci	1-4
		Palaemon sp. (15)		small
		Atyidae *Atyoida* (4)	Ura ivi	
	Prawns	*Macrobrachium equidens* (2)	ura	3 8
	Fish	*Poecilia mexicana*	Tiatia	numerous
		Ophiocara aporos (1)	Vo loa	23
	Crab	*Varuna litterata* (1)	taimami	2
Total	6 species 26 individuals			

Table 6. continued

Site	Species Found			Length (cm)
5	Crabs	*Varuna litterata* (5)	taimami	2 2 1 1 3
	Prawn	*Macrobrachium lar* (1)	Ura	10
	Shrimp	*Caridina* sp. (1) *Atyoida* (9) *Palemon* sp. (8)	Ura Ura ivi	numerous
	Fish	*Poecilia mexicana* (27) *Ophiocara aporos* (1) *Gambusia affinis* (6)	Tiatia Vo loa Kete leka	2 6-8
Total	7 species 58 individuals			

Table 7. Aquatic Fauna Species Diversity and Abundance

Site No.	No. Species	No. individuals	Fishing Time (minutes)	CPUE (No./ hr) *
1	7	10	35	17.24
2	3	4	15	16
3	4	4	20	12.01
4	6	26	20	78
5	7	58	25	139.42
TOTAL		102	115 minutes (1 hour 55 minutes)	48.81(ave)

* This is CPUE for five women fishing at the same time

Crustaceans (prawns, crabs) were found throughout the study area except for Site 2, but were more abundant and larger in the sheltered creek as compared to the river. The most commonly found was the crab *Varuna litterata* and the shrimps *Caridina* sp. At least one species of eel was found. The gastropod *Neritina pulligera* was the only mollusc collected.

Fish were present at all sites. Particularly common was the larger **vo loa** (*Ophiocara aporos*) and the small **tiatia** (*Poecilia mexicana*). The most abundant species were the **tiatia** (*P. mexicana*) and the **vo loa** (*O. aporos*) found. These two species were found throughout the two water bodies.

Species diversity and abundance was highest at site 5. This is reflected in the CPUE at that site. At the five sites sampled, there was a total of 12 species consisting of about 102 individuals which were captured in 1 hour 55 minutes of fishing time.

5.4 Discussion

The main threats to the abundance and diversity of the aquatic fauna in the Waidina River and Wainivakatasi Creek are increased sediment loading, siltation, and burial of the habitats for the fauna. This is a common threat in the Waidina River which has its origin in the Namosi highlands, a relatively wet region of Viti Levu.

Most freshwater species (Jungle Perch, goby, prawn, eel) migrate downstream to lay their eggs in the estuary or mangrove region. The young, often in larval stage migrate back upstream. This reproductive behaviour is an important aspect to consider in the event of disturbance or change in any region of a stream or river.

Most Fijian freshwater fish are of little commercial importance. Gobies feed on insect larvae and algae and do not have any natural predators, therefore are able to reach a large size. The main predators in the creek and river system appear to be eels. Adult eels breed at sea and larval development occurs at sea.

The Atyid shrimps are not commercially important but provide food for fish and other invertebrates therefore play an important role in the food chain. They are the main part of the diet for predators such as fish (Jungle Perch) and eels. Freshwater prawns also feed on detritus in addition to insects, insect larvae, algae, seeds, small molluscs and fish flesh. Freshwater crabs have a similar diet to that of the prawns.

The species of commercial importance in these water bodies are the prawns. In Fiji, *Macrobrachium* spp. (freshwater prawns) are known as "Ura" and according to Shokita et al (1984) are found along the length of most freshwater streams ie. lower, middle and upper reaches. The fishery for this resource in some rivers and creeks has declined significantly due to silting and man-made changes. *Macrobrachium lar* is believed to make up the bulk of the prawn commercial catch and therefore is considered to be the most important species. The average price has risen gradually from $2.20 per kg in 1977 to $5.50 per kg in 1985 to around $13.50 per kg in 1998. (Fiji Fisheries Division Annual Reports 1977, 1985, 1997).

It is important that the water quality of these water bodies are maintained because the local population depends on these resources to a certain extent. The Waidina River near Naqali is used by villagers from Naqali village for domestic purposes such as bathing and washing as well as for fishing. Men use spears and snorkel and masks for catching fish while the women use hand lines to catch fish such as **vo loa** and grass carp. Women also use hand-held nets for catching shrimps ("moci") along the river banks. The Wainivakatasi Creek is fished by the women for prawns and eels.

6.0 COMMUNITY CONSULTATION

6.1 Methodology

To determine human utilization of the Waidina River and Wainivakatasi Creek in the areas near the bridges, a discussion was held with the Turaga ni Koro, Ratu Senirusi, the Turaga ni Yavusa (traditional head) and other men from Naqali Village on Wednesday 20 September 2000. Another interview was conducted with the women helpers on Monday 14 November 2000. The discussions and interviews were recorded on tape for inclusion in the report.

6.2 Results

Both the men and women interviewed acknowledged the immense value of the Waidina River to the Naqali villagers. The river is utilised for washing of clothes, other domestic needs as well as for bathing and swimming. With isolation from the urban centers and the sea, the river is the main source of protein in the diet of the people, and fishing is therefore a major activity in the river. Major species caught include prawns **ura** (*Macrobrachium equidens*), small crab **taimami** (*Varuna litterata*), eels **duna** (*Anguilla megastoma*) and **bonu** , shrimps (*Caridina* sp.) and a variety of fish; **vo loa** (*Ophiocara aporos*), **bau** (Eleotridae). Methods of fishing used include use of hand nets (**lawa**), hand lines, spears, or the hands.

While flooding is fairly common, the women usually catch more fish when the water level is higher than normal. It may take as little as two or three days for the water to clear after a flood when the current is fast, otherwise it may take up to five days if the flow is slow. Fortunately, the Naqali villagers always find fish in the river, even after extensive flooding. This confirms the fact that the species found in this area have adapted to the river condition over time. It can be expected that after the physical disturbance to the river and creek, the fish will still be around. This assumption can only be confirmed by a monitoring programme for the post-construction period.

7.0 CONCLUSIONS

The baseline study of the water quality and aquatic fauna diversity and abundance, conducted on 13th November 2000 revealed the following:

- Physico-chemical status of the Waidina River and Wainivakatasi Creek near Naqali are satisfactory according to the recommended guidelines (Fiji Draft Sustainable Development Bill, 1996)
- Siltation of the river and creek is a common phenomenon, due to frequent flooding and heavy rain in the Namosi highlands.
- Crustaceans such as prawns, shrimps, and crabs were the most abundant invertebrates. Eel and fish are also caught for domestic consumption.

In conclusion, although the construction work on the Naqali Bridge and smaller bridge may cause changes in water quality in the Waidina River and Wainvakatasi creek and in turn have an impact on the aquatic fauna, the current status of the water and aquatic fauna abundance and diversity should return, given time, after the completion of construction works.

However, it is recommended that measures should be taken to reduce as much as possible the siltation of these two water bodies that may result from the bridge reconstruction activities.

8.0 REFERENCES

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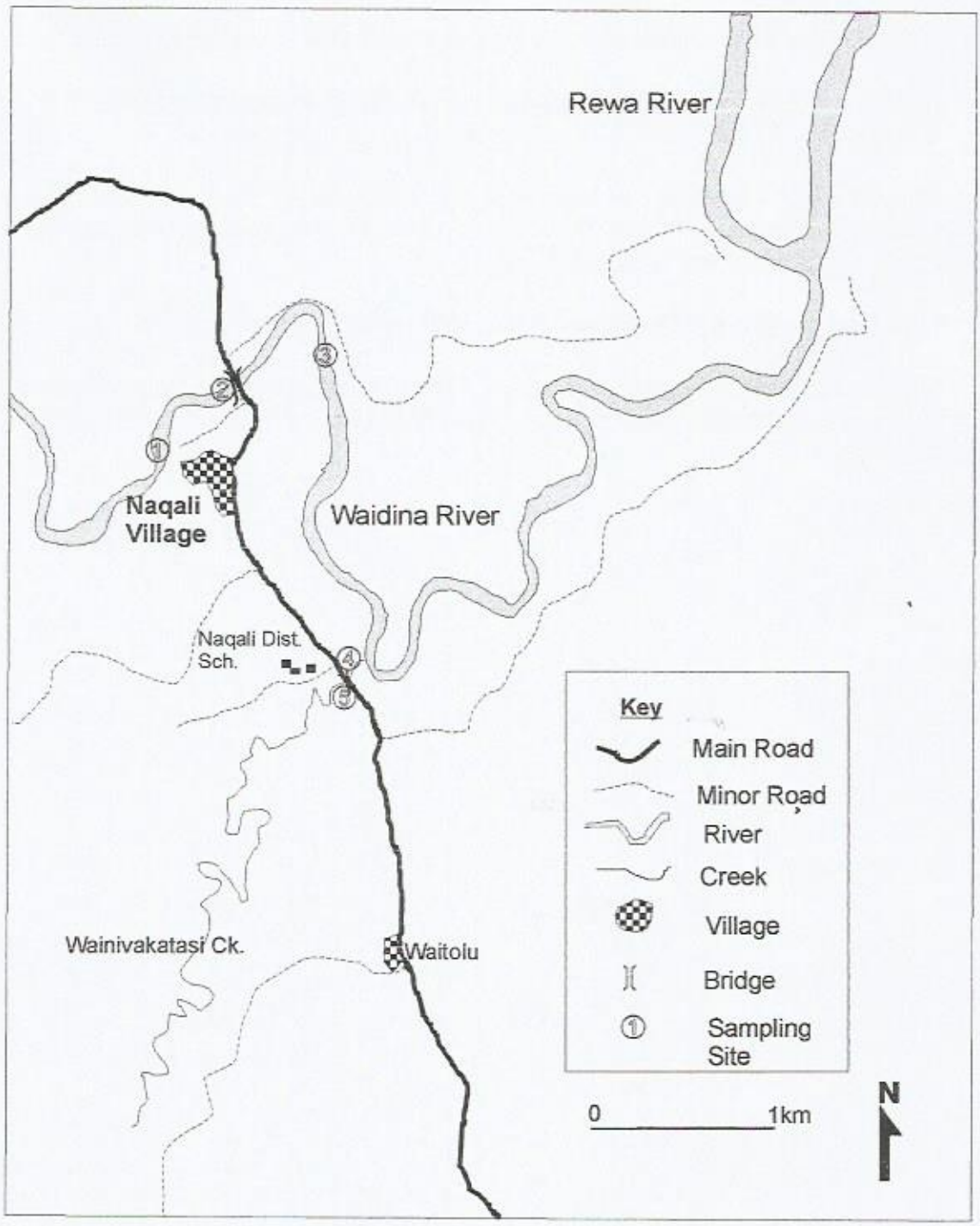
APPENDIX 1. Location of Sampling Sites along the Waidina River and Wainivakatasi Creek



APPENDIX 2. PHOTOS OF SAMPLING SITES AND AQUATIC FAUNA FOUND

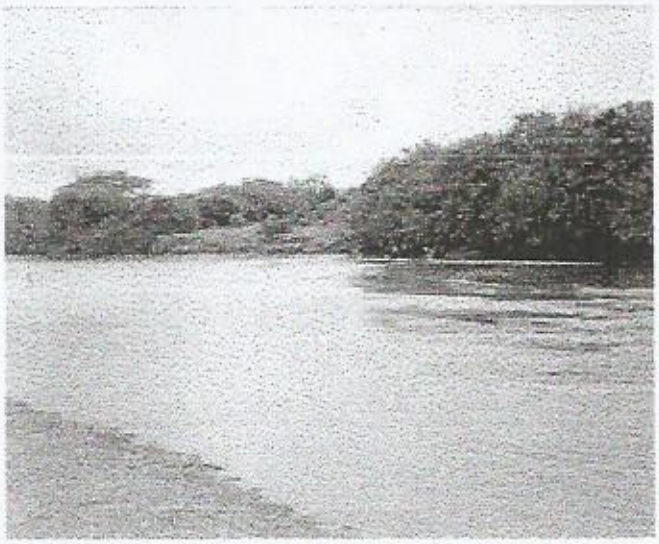


Figure 1. Site 1 located within the Waidina River, upstream from Naqali Bridge

Figure 2. Site 2 located within the Waidina River, at the Naqali Bridge

Figure 3. Site 3 located within the Waidina River, downstream from Naqali Bridge

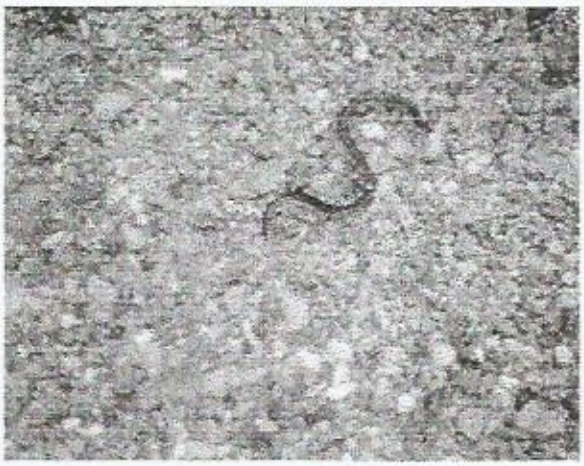


Figure 4. **Bonu,** or worm-like eel caught at Site 3.

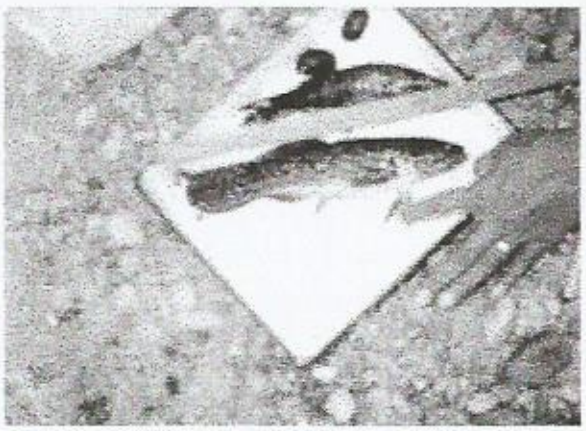


Figure 5. **Bau** (Family Eleotridae) caught at Site 2.

APPENDIX 3. LIST OF FAUNA FOUND

Scientific Name	Common Name	Fijian Name
INSECTS		
Trichoptera	Caddis fly larvae & pupae	
Abacaria fijiana	net caddis	
CRUSTACEA		
Atyidae (shrimps)		
Atyoida sp.		
Caridina sp.		
Grapsidae (crab)		
Varuna litterata	crab	taimami
Palaemonidae (prawns)		
Macrobrachium equidens		ura
Macrobrachium lar	Freshwater Prawn	ura
Palaemon sp.		
MOLLUSCA		
Gastropoda (snails)		
Neritidae		
Neritina pulligera		sici
FISH		
Eleotridae		bau
Ophiocara aporos	goby	vo loa
Poeciliidae		
Gambusia affinis		keteleka
Poecilia mexicana		tiatia
EELS		
Anguillidae		bonu