SOPAC Water Resources Unit

Drought Mitigation

Water Demand Management as a Tool to Mitigate Drought Impacts in Rural Water Supply Systems

REPORT OF VISIT TO KADAVU

14 September - 17 September 1999

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1: Introduction

As part of the field work for the Small Scale Wastewater Treatment Project (SSWWTP) funded by NZODA in early 1999, the villages Tiliva and Lagalevu in Kadavu, Fiji Islands, were visited (SOPAC LR 106, 1999). Though work, then, concentrated on sanitation problems, it became obvious that water supply problems were more important to the villagers and held the highest priority. This was in part the consequence of the 1998 El Niño Southern Oscillation (ENSO) event which dried out all village intakes. Over a period of 3 months villagers were forced to manually fetch water from nearby creeks of dubious water quality.

Following SOPAC standard procedures, the mentioned report was made available to the village and later this year a village delegation visited SOPAC to formally request a follow-up visit to fully assess the extent of their water problems. SOPAC forwarded the request to all relevant Fijian Government authorities to obtain official approval to undertake the assessment which was granted in August 1999.

All necessary amendments to the system as well as possible system connection have already been outlined and explained to the villagers. This report solely summarises the results in a more formal way.

2: Tiliva Village

2.1 Existing Water Supply System

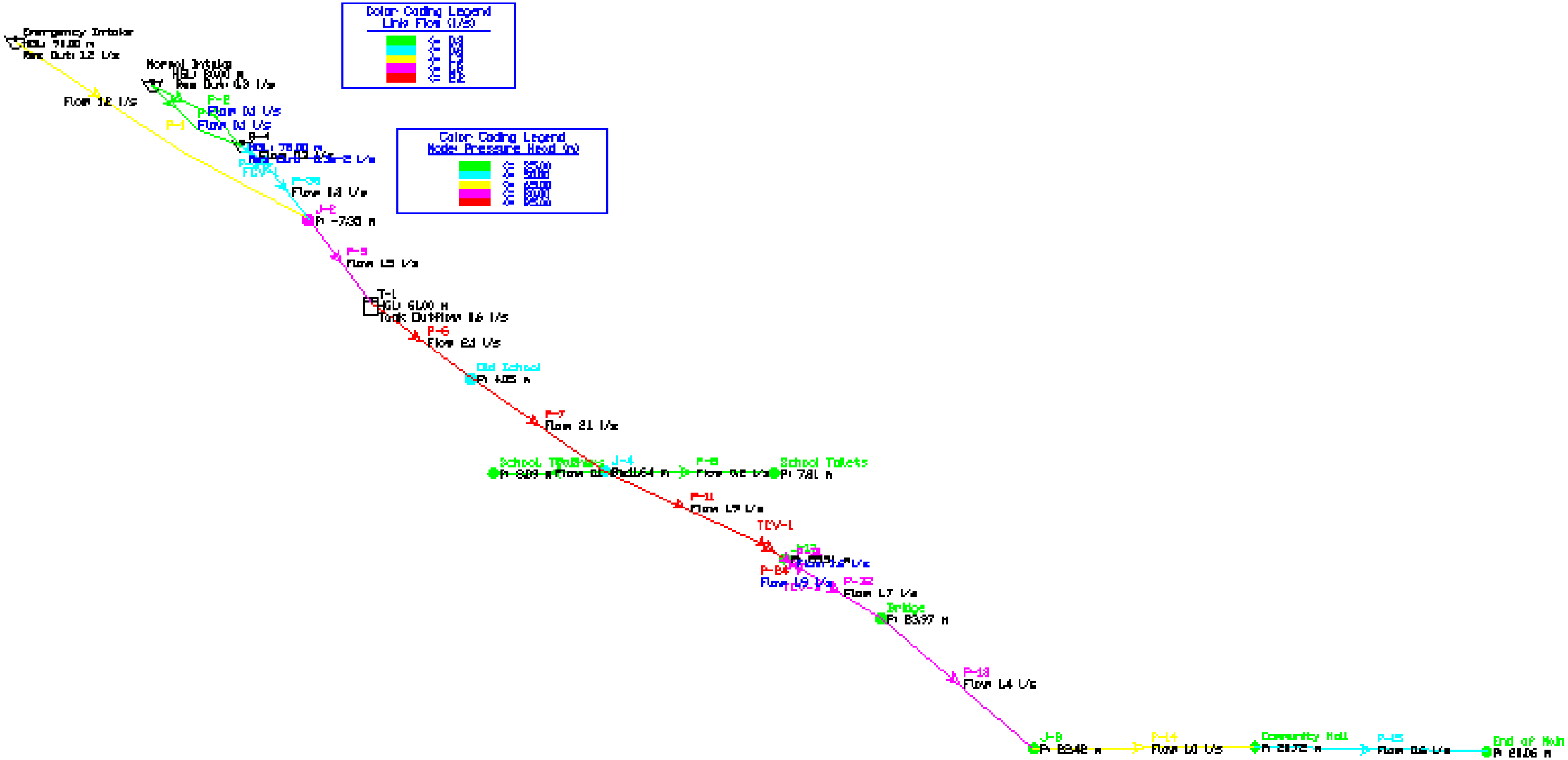
Tiliva Village has a current population of about 300 with approx. 35 houses, a church and a new community hall. Except for the boarding school, teacher housing quarters and 4 outlying settlements, all houses are concentrated on a low-lying nearshore area. The prevailing topography is hilly with a number of creeks originating from springs. It provides ideal conditions for simple gravity water supply systems.

Figure 1: Village of Tiliva, Kadavu

The current water supply system is fed from two springs of the same creek situated approx. 650 meter to 700 meter from the village centre at an elevation of 90 m.a.s.l. (name: **'Emergency intake'**, Figure 2) and 80 m.a.s.l.(name: **'Normal intake'**, Figure 3) . A third intake Figure 4 close by at an elevation of approx. 70 m.a.s.l. has been decommissioned by the villagers after having built the second and the third intake. Since all three intakes rely on the same catchment and creek, it seems very likely that they communicate directly resulting in a decreased flow when the respective upper intake is in use.

Both intakes currently connected are simple dams with an unprotected outlet approx. 30 to 40 cm below the maximum water surface with little protection to avoid surface contamination. The **'Normal intake'** is a moulded concrete box of 2 m x 2 m and two 12.5 mm outlet pipes without any valve while the dam at the **'Emergency intake'** is makeshift with a 25 mm pipe as outlet, again without vale or flushing possibility. Both intakes fed into a 40 PVC pipe main with makeshift connections reducing possible flow rates and pressure within the system.

The 40 mm PVC main feeds into a concrete storage tank with an available storage volume of about 15 m^3. Calculations show that the current system could provide at best approx. 2.1 l/s maximum flow. However, due to the limited storage volume at the tank, the sustainable flow rate under normal (wet conditions) is likely to be in the range of 1.5 l/s. This flow rate would provide a maximum available volume of about 130 m^3 per day or about 430 l per capita and day (l/c/d). But again, since storage is inadequate only a fraction of this amount is available to the community for consumption.



Emergency Intake
Normal Intake
Color Coding Legend
Link Flow (l/s)
Color Coding Legend
Node: Pressure Head (m)
J-2
P-5
T-1
P-6
Old School
P-7
School Toilets
P-11
TCV-1
Bridge
P-13
J-9
P-14
Community Hall
P-15
End of Main

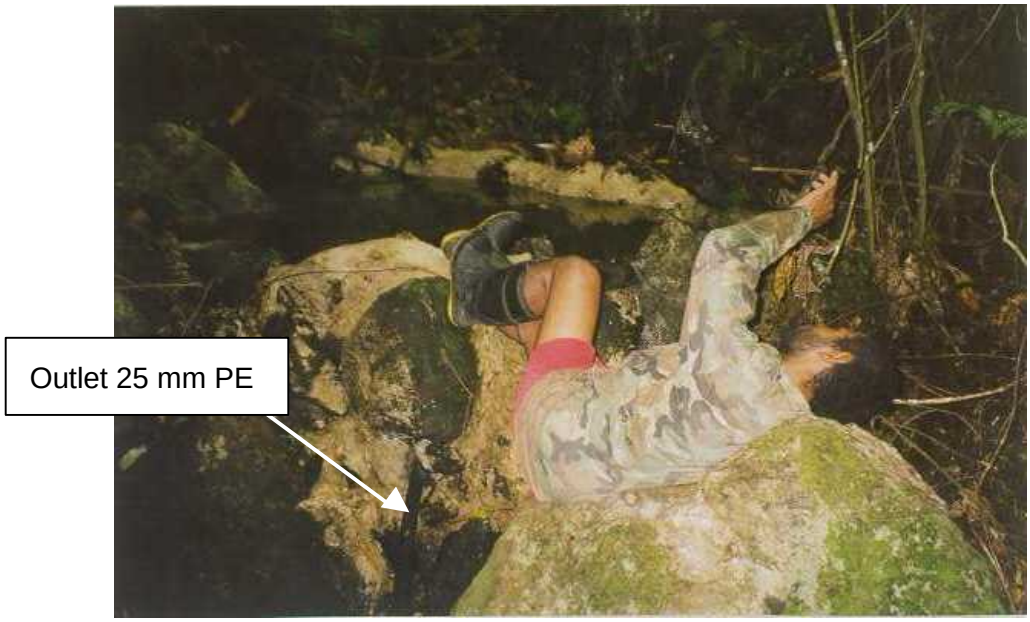


Figure 2: 'Emergency Intake' with exhausted villager

Figure 3: 'Normal Intake' built by the community

Figure 4: Decommissioned intake built by PWD

2.2 Problems

Both intakes experience problems with the outlets either due to siltation in the dam, disconnection of the outlet pipe or regular clogging from leaves. The general condition they are in are poor though normal compared to other village systems.

Both outlets perform badly frequently restricting the availability of water to the village.

Inadequate pipe connection and lack of proper connections leasing to water and pressure losses.

Excessive water consumption through careless behaviour.

Water leakage through running water taps and malfunctioning water flush toilets.

Insufficient storage capacity restricts water consumption even under normal (wet) conditions.

According to the villagers the creek tends to run dry during the prolonged absence of rainfall as for example in 1998 and during previous ENSO events.

2.3 Recommendations

1. The outlet at the 'Normal Intake' should be replaced by a small concrete chamber out of which water will be drawn from a 40 mm PVC pipe. Figure 5 shows the proposed design.

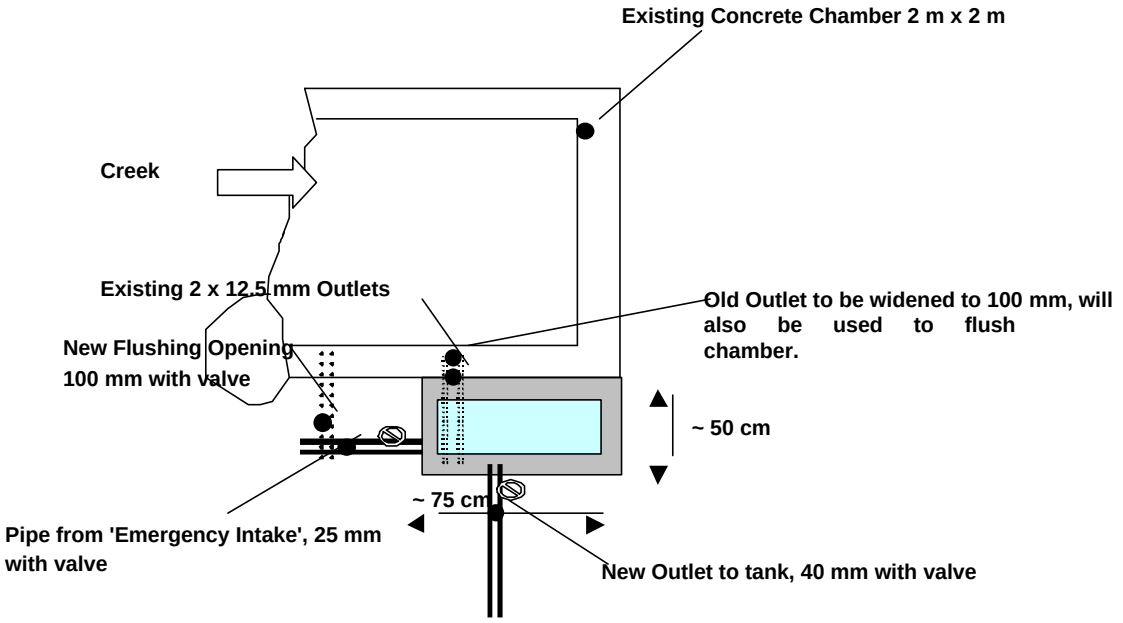


Figure 5: Suggested rehabilitation of the existing intake

2. The 'Emergency Intake' should be decommissioned. Since it is the same creek that both intakes use it is unlikely that both intakes supply significantly more water than the 'Normal Intake' alone. If there is reluctance to shut down the intake it should be connected into the newly built chamber at the 'Normal intake' as shown in Figure 5.

3. To improve the water supply and enhance drought preparedness a new source should be connected to the system. During the field trip a source that according to the villagers 'never dried up' could be identified. Figure 6 shows the proposed source. Figure 7 to Figure 9 show the proposed system extension.

Figure 6: Proposed new spring after investigative excavations (estimated yield ~ 1.5 l/s)

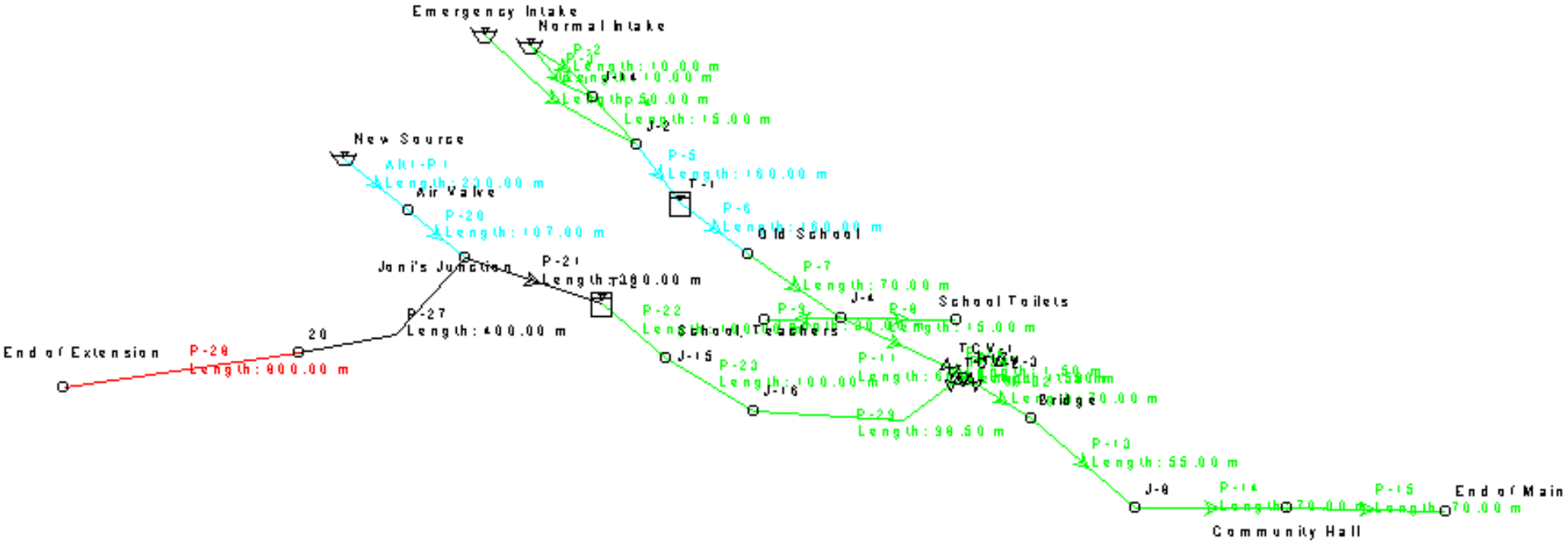


Figure 7: Proposed system extension with approximate pipe length

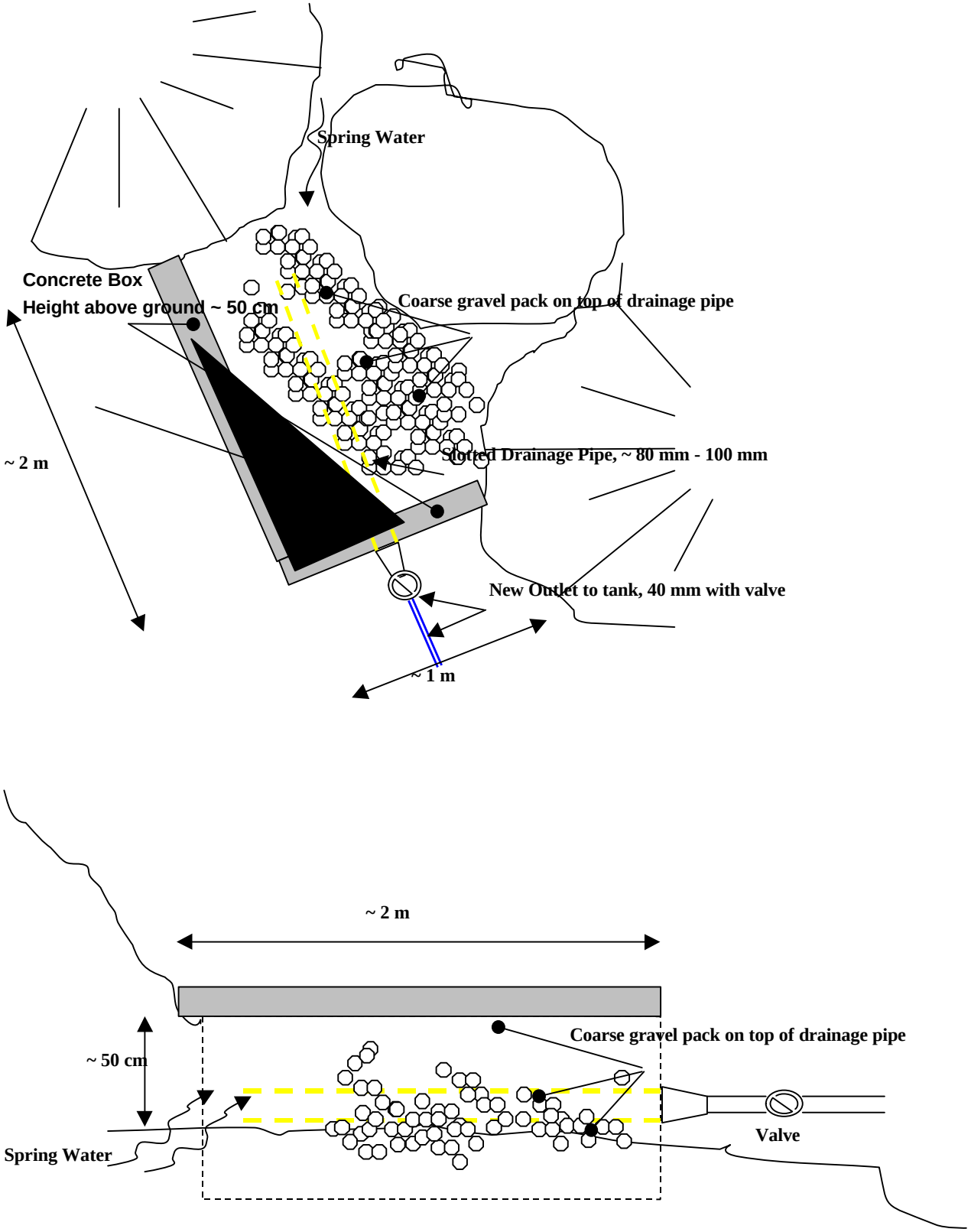


Figure 8: Plan View and Section of proposed spring development

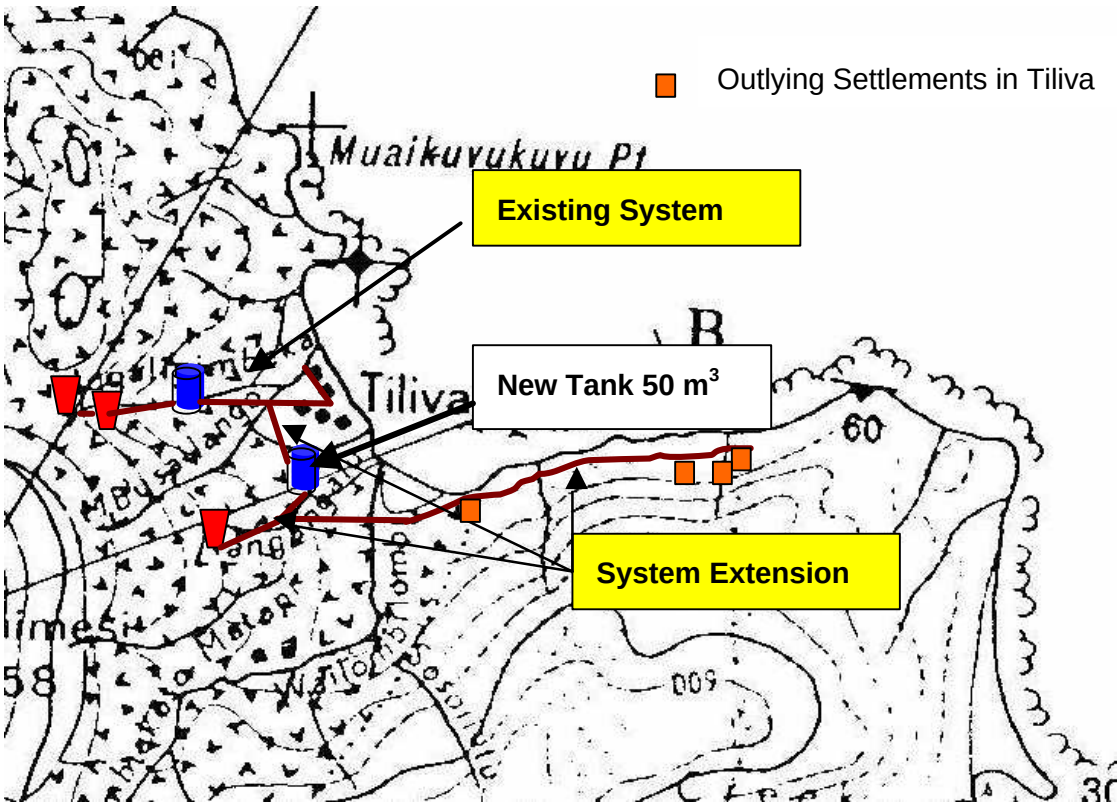


Figure 9: Schematic outline of the existing water supply system and the proposed extension

The extension consists of the source development, a 600 m long main (40 mm, PE pipe) and a new 50 m^3 storage tank. Further 1200 m 40 mm PE pipe are necessary to supply water to the outlying settlements as shown in Figure 9. (Hydraulic analysis of the suggested extension shows that additional 1.5 l/s can be provided to the existing water supply system.

The following table shows estimated material necessary

Item	Quantity	Unit	Price per Unit	Price
System Extension				
40 mm PE pipe	1800	m		
Cement	700	kg		
Plywood	5	m^2		
Air Valve	1	-		
Gate Valves (40 mm)	6	-		
Gravel	1.5	m^3		
Drain Pipe 80 mm	2	m		
Appropriate fittings for all connection, valves				

3: Lagalevu Village

3.1 Existing water Supply System

The Lagalevu water supply system provides approx. 60 people with water. It consists of two intakes about 400 m land inwards from the shoreline out of which only one, the lower one, is currently connected. Figure outlines the scheme

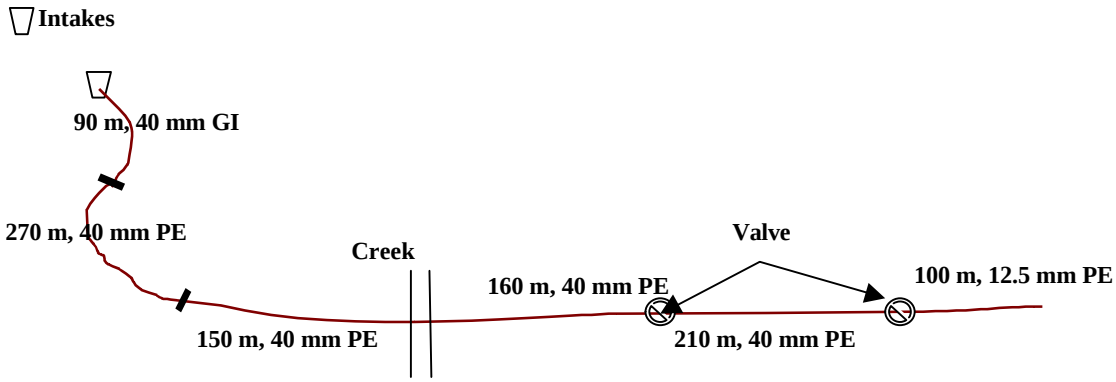


Figure 10: Schematic outline of the Lagalevu water supply system

3.2 Problems

In general the system does not provide water to all settlements. The problems lies in the insufficient amount of water the connected intake is able to supply and presumably particularly high head losses in the galvanised iron pipe as well as excessive (considering the amount of water available) water consumption (leakage, water wastage). Additionally the source is at an elevation of about 20 to 25 m.a.s.l. only already severely restricting possible flows (and pressure).

Hydraulic calculations show that the maximum flow that could be provided under ideal conditions (proper connection, no incrustations, new pipes) is about 1 l/s (86.4 m^3/day). Assuming that real conditions limit the available flow to 50 % of the theoretical flow the system could still provide ~ 44 m^3/day or 440 l/c/d. Since it is believed that the flow currently available is lower, calculations suggest that the source is not able to provide even a sustainable flow rate of ~ 0.5 l/s.

From what could be observed during the field trip the main reason for the perceived water problems of the more outlying settlements is that settlements closer to the source withdraw to much water and apparently often simply waste it through leaking flush toilets, showers, taps etc..

3.3 Recommendations

1. The currently disconnected intake should be reconnected to the system.

2. The GI pipe needs to be replaced.

3. A community meeting should be held explaining water wastage problems and the consequences for other households situated further away from the source or main pipe.

4. It seems to be the most economical option for those settlements experiencing water problems to distribute washers, accessories and taps to other villagers to reduce water wastage and leakage.

Figure 11 shows the proposed rehabilitation of the Lagalevu intake system.

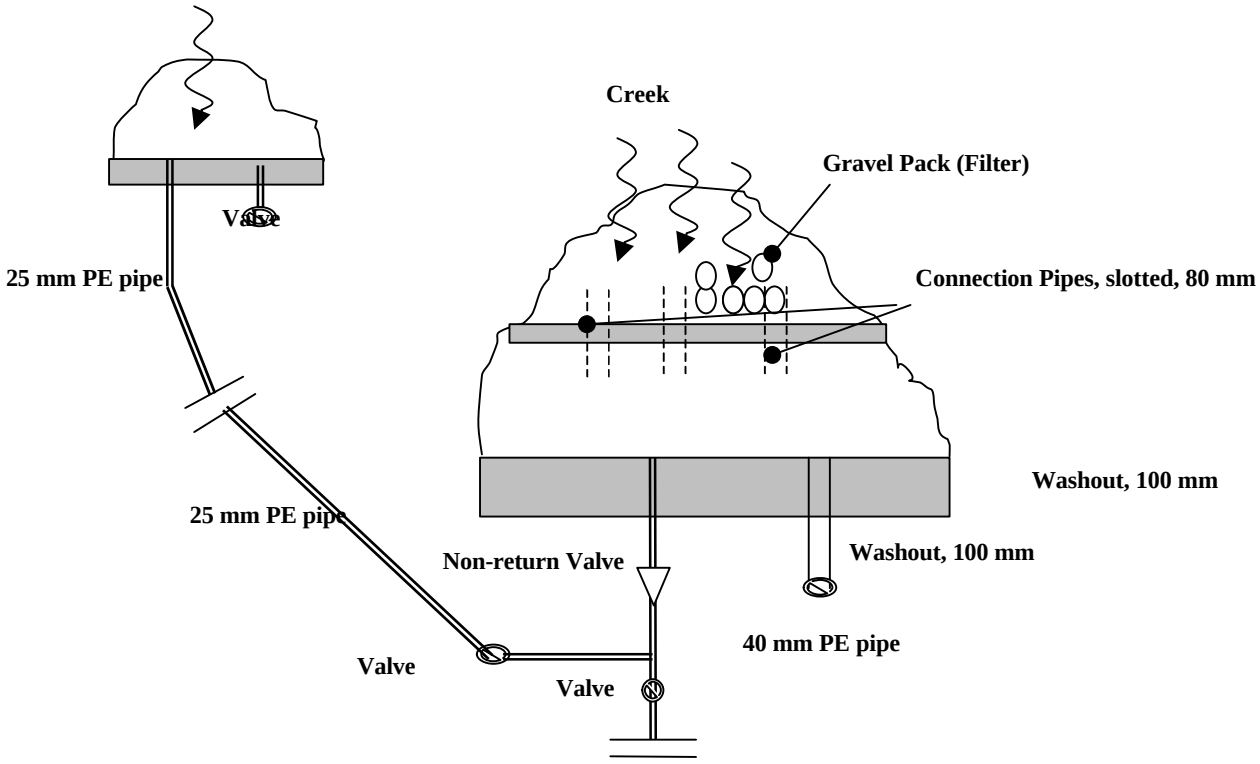


Figure 11: Proposed rehabilitation of the Lagalevu water intakes