South Pacific Commission

Foundation for the Peoples of the South Pacific

DRAFT SANITATION DEVELOPMENT PROGRAMME

FOR THE VILLAGE OF PORT OLRY, SANTO, NEW HEBRIDES

by

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TABLE OF CONTENTS

II. OBJECTIVES

It was agreed with the head of the Port Olry mission, Father Linossier, and with the Condominium authorities, that the purpose of improving sanitation in the village and mission should be to provide the villagers with decent hygienic conditions, and to improve their standard of living by means of the ensuing changes in their immediate environment.

It is intended, now that piped water is available, to:

- improve the distribution of drinking water;
- build water seal latrines near the houses;
- build a pigsty, and milking shed;
- build a digester producing gas from sewage;
- improve individual rubbish pits.

Details of these projects are given in the following chapter. They are of great importance if, within a year or two, the sanitation programme is to play a significant role in the prevention of disease, while at the same time raising existing standards of comfort in the village.

It should also be noted that, if they are to be fully effective, these measures must be accompanied by others which, though they may be considered a necessary adjunct to the suggestions made here, have not been included in this schedule:

- a plan for alignment of village houses;
- removal of individual roof catchment tanks;
- extension of drinking water connections to some individual houses.

Recommendations along these lines are given in Chapter 6.

III. DEVELOPMENT PLAN

3.1. Drinking Water

Water - plentiful and of good quality, though a little hard - is provided by a 10 m bore. It is transported by a diesel pump to a tank behind the church.

With a capacity of 90 m3, the tank theoretically represents one day's consumption. However, additional water is continuously provided from the roof of the church (approximately 300 m2). Rainfall, combined with the fact that the villagers do not always consume their 150 litres per day, means that the reservoir is filled only twice a week; thus, there is no danger of a water shortage.

The village water supply comprises 10 taps (plus one for the school and another in the mission), making one tap for 60 people, or 10 families. Pressure is satisfactory. However the number of taps will need to be at least doubled, to give one tap for 30 people (5 families).

Further connections will therefore be necessary. With the exception of two public showers, described later, these are not included in this schedule, since they are to be built by the Condominium Mining Department.

The location of the extension taps will be indicated on subsequent, more detailed, plans.

The pipe being of a given diameter, there will be a maximum number of taps, taking account of the coefficient of simultaneity:

$$Qm = \Sigma' q \times k$$

for:

$$k = \frac{1}{\sqrt{x - 1}}$$

Assuming 26 taps, then:

$$K = 0.20.$$

The taps used are standard, with a flow rate of 0.15 l/s, giving an estimated flow of:

$$26 \times 0.15 \times 0.20 = 0.78 \text{ l/s.}$$

Thus, for the first section (PVC - Ø 2"):

$$Qm = 0.78 \qquad V = 0.35 \text{ m/s}$$

Loss of head = j = 0.00344 m/m
i.e., for 150 m, (distance to the first tap) 0.00344 x 150 = 0.52 m.

As the tank is only a few metres above the average ground level in the village, pressure is relatively low. Thus, before fitting a large number of taps, caution dictates that readings be taken to ensure that the hydraulic gradient over the entire span of the distribution network allows for the changes in pipe diameter.

This work will be the responsibility of the SPC Engineer.

In addition, as the drop from the 90 m3 tank to the mission - boarding school - animal-sheds distribution sector is insufficient, it was decided to include an electrip pump (run off the mission generator), and an auxiliary tank at a height of 10 m:

- input from main tank;
- distribution via pipes of appropriate diameter.

The work specifications in the Annex give most of the requisite information. However, no precise estimation of piping diameter has been made, as we have still to be informed of the distribution requirements for the school (number of basins, showers, toilets, etc.).

3.2. Excreta

The construction of water seal latrines will be continued for as long as necessary, and with full participation by the villagers.

Initially, a British public health team will be responsible for training one or two young people from the village in the use of concrete moulds for toilet bowls and slabs. Sites will be determined by the SPC Engineer after consultation with the villagers, who will be responsible for digging the holes and constructing the shelters.

Moulds are to be provided by the British Health Department. The cement required will be purchased out of the US$2,500 made available to the mission by the Foundation for the Peoples of the South Pacific.

Sites will be selected near present or future taps, and in the vicinity of housing. It is intended to build one latrine for each family (average 6 persons).

Each family will be responsible for latrine maintenance.

No definite duration can yet be allotted to the operation, as this will depend essentially upon the number of moulds provided, and the time taken by the villagers to complete the digging work.

3.3. Animal Sheds

It is planned to build, on an appropriate section of land:

- one pigsty (30 to 40 head);
- one milking-shed (4 to 5 dairy cows).

The pigsty will comprise:

- two fattening bays for 12 to 15 pigs = 24/30;
- one fattening bay for 1 boar;
- one combined unit (pregnant sow/sow plus farrow)

Total = four modules.

The entire sty covers approximately 90 m2, including a central corridor (1.23 metres) and outlet drain. Additional space should be kept in reserve in case extensions later become necessary.

Intended for manual milking of 4 cows, the milking-shed is of simple design. It contains a trough and an outlet drain leading to a sump. A small additional room will be required for the storage of canisters, equipment, etc., and for the cleaning of utensils; it must contain a tap.

Total area required: approximately 40 m2.

3.4. Waste Water

This concerns waste water from the boarding school, pigsty, and milking-shed only, estimated at 4.5 m3 per day, as follows:

- 35 litres/day per pig
- 50 litres/day per cow
- 10 litres/day per litre of milk
- 160/180 litres/day per boarder.

Thus, there will be three sources of effluent : the school, the pigsty, and the milking-shed. Each building will have a reception drain leading into a single control drain upstream from the digester.

The digester will be of the model designed by the SPC Waste Digester Specialist: model 100 D/2A, capacity 6 m3, continuous digestion (see plan, Annex 5).

The work specifications (Annex) include a short section on gas production and loss of head.

Effluent from the school will be pre-treated in a septic tank already under construction.

Effluent from the digester not used for garden irrigation and fertilization will be fed into the sea by a pipe calculed to be under water at all times, including ebb tides.

3.5. Household Refuse

The villagers use holes near their houses for disposal purposes. This method would be valid if the rubbish were properly buried; unfortunately it is never fully covered.

Consequently, and in order not to break with the present system, it is intended to provide lids. Holes will first be dug out to standard size (e.g. 1 metre diameter) so as to be fitted with a wood or metal support (e.g. 1.10 metres diameter) bolted or otherwise fixed to the ground; the latter will take a removable cover that may be fastened so as to withstand bad weather, wind in particular.

It should be possible to limit the number of pits to one for several dwellings.

Sites will be determined by the SPC Engineer.

IV. WORK SCHEDULE AND FINANCING

Although the schedule stipulates completion by the end of 1977, an extension into 1978 may be necessary.

April 1977:

- Construction of first latrines;
- Installation of auxiliary tank and pump;
- Siting of pigsty and milking-shed.

July 1977:

- Continuation of latrine construction;
- Construction of pigsty and milking-shed;
- Installation of rubbish pit covers;
- Construction of showers and extension taps.

October 1977:

- Continuation of latrine construction;
- Completion of pigsty and milking-shed;
- Siting and construction of waste digester;
- Continued installation of rubbish pit covers.

This schedule is intended only as an indication. It could be fully respected only if no delay were to occur at any stage.

Funding is provided by a donation from the Foundation for the Peoples of the South Pacific, which has already advanced US$2,500 earmarked specifically for the latrine programme. On receipt of justification in support of expenditure, a further US$13,000 will be made available to the Port Olry mission.

The total cost of the project may exceed US$15,500. It is not yet possible to draw up a full and accurate estimate; this will be done after April 1977.

The rough estimate in the following chapter is intended rather as an indication of the overall limit within which the project should be kept if possible.

V. ROUGH ESTIMATE

No.	Brief description		Quantity	Unit Price $US	Total Price $US
1	Locally cast latrines, bowl, slab, and water trap	U.	100	8	800
2	"Squatter" type tank, capacity 2,650 gallons	U.	1	500	500
3	Tubular steel tank support structure, height approx. 10 m	U.	1	400	400
4	Tank level gauge	U.	1	50	50
5	Provision for PVC piping		-	-	250
6	Modular pigsty (fattening)	m2	90	80	7,200
7	Milking-shed	m2	40	90	3,600
8	Electric pump	U.	1	300	300
9	Brickwork digester	U.	1	1,000	1,000
10	Drains	U.	3	150	450
11	Rubbish pit covers	U.	50	25	1,250
	Provision for miscellaneous and unforeseen expenses : approximately 15%				2,200
			Total :	$US	18,000

VI. ADDITIONAL MEASURES AND CONCLUSION

Although the figures quoted above are only a rough estimate, total expenditure under the sanitation development programme can clearly be limited to a ceiling of $20,000, even if this were to entail reducing quantities, or simplifying certain project components.

The fact remains that for this sum it is possible to achieve a full, basic sanitation programme for the benefit of the community.

Assuming a total of $20,000, total costs will be equivalent to US$ 33.30 per head. For this amount, the villagers are to receive both community and individual facilities.

The villagers themselves are to take an active part in the improvement of their environment. For example, extension waterpipes are to be laid on, but they themselves will adapt them for the purpose required (public showers and latrines, sports grounds, etc.).

Consequently, both community and individual efforts will need to be continued. One of the more evident needs is a plan for the alignment of houses, as the present spacing is far too dense. Since houses in permanent materials are now beginning to appear, it would be advisable to establish simple standards defining, in particular:

- intervals between houses;
- width of streets;
- alignment of buildings along streets.

It is strongly recommended that such a plan be established before any extension is made to public or private water distribution networks.

At the same time, and while the water distribution network is being enlarged, the villagers must be made to understand that rainwater tanks not only have outlived their usefulness, but also, by providing perennial mosquito breeding sites, constitute a hazard.

The extension of water mains to private dwellings is feasible, providing that hydraulic gradients are sufficient. Such extensions could not of course be carried out free of charge; they are, however, advisable as a means of enhancing the standard of living of the inhabitants.

To summarise, this preliminary schedule must be supplemented by the surveys and research mentioned above. The resulting document will serve as a guide to those in charge of construction, and will also be made available to the project sponsors, together with precise estimates or pro forma invoices for all materials to be purchased.

Annex

WORK SPECIFICATIONS

1) Water distribution to the boarding school, pigsty, milking-shed, and mission buildings

School : 80 boarders, with provision for extension to 100.
Showers - wash basins - toilets.
Milking-shed : 4 to 5 dairy cows.
Pigsty : Six 3.90 x 4.60 m-modules (30/40 head).
Mission : 4/5 users, 200 l/day each.

Daily requirements

1.1 School

Shower flow rate : 0.25 l/s.
Shower duration : 2'30".
Shower requirements : 0.25 x 150 x 100 = 3,750 l.
Collective wash basins : 0.05 l/s.
Duration of wash basin use : 5'.
Wash basin requirements : 0.05 x 300 x 100 = 1,500 l.
Toilet requirements : 6 l per flush.
Assuming 3 flushes/child/day
then : 3 x 6 x 100 = 1,800 l.
Total school : 7,050 l.

1.2 Mission

5 x 200 l/day = 1,000 l.

1.3 Pigsty

The amount generally required is 20 l per animal. However, the use of a digester entails a consumption of about 35 l/head. Thus, for 40 head :

35 x 40 = 1,400 l/day.

1.4 Milking-shed

50 l per head must be allowed, plus about 10 litres per litre of milk. Assuming 5 dairy cows producing a daily average of 20 l of milk, then :

cattle requirements :	5 x 50 =	250 l
milking-shed requirements :	20 x 5 x 10 =	1,000 l
Total milking-shed :		1,250 l

Summary of requirements

School :	7,050 l
Mission :	1,000 l
Pigsty :	1,400 l
Milking shed :	1,250 l
Total daily requirements :	10,700 l

1.5 Tank

The capacity of the secondary tank must be at least 12 m3.

The feasibility of installing a tank of this size (full weight over 12 tonnes) on the projecting part of the church roof is open to some doubt.

In addition, pressure would be increased if the tank were raised about 10 metres from the ground. Thus, it would be advisable to build a support structure made of tubular elements, and with a platform on which a "squatter" type tank will be installed.

1.6 Pump

Power :

$$P = \frac{Q \times H}{75 \frac{r^1}{100} \frac{r^2}{100}} = \text{(in HP)}$$

Flow rate Q corresponds to the total tank capacity (12 m3) during the period of operation of the generator (generally 3 or 4 hours in the evening, from 6 to 10 p.m.).

Assuming the pump operates for 1h30' per day, i.e. :

$$Q = \frac{12,000}{5,400} = 2.22 \text{ l/s} \quad \text{(or 8 m3/h).}$$

$$P = \frac{2.22 \times 10}{102 \times \frac{75}{100} \cdot \frac{60}{100}} = 0.48 \text{ KW.}$$

We recommend purchase of an electric pump (Loewe type) of 1.25 KW, 220 V, Δ 50 Hz, 2,900 rpm, weight 35 kg, dimension approximately 0.67 x 0.28 x 0.30, and with the following flow/height ration:

Flow m3/h	2	4	6	8	10	15	20
Height in m.	22	21	20	19	18	15	10

A "Guinard"-type pump, MOA 8-13, of 0.6 KW capacity, may be sufficient:

Flow m3/h

4.50	6.50	8	10	11	12
16	15	14	12	11	9.50

Height in m.

Connecting pipe

The diameter of the connecting pipe (formula D = 1.5 VQ) should be at least 0.07 m (approx. 3").

Gravity-fed distribution

The diameter of the main distribution pipe (servicing the school, mission, pigsty, and milking-shed) will depend essentially upon the degree of simultaneity with which taps, toilets, etc., are operated.

As a rough approximation, a flow slightly slower than the tank filling rate (2.22 l/s), i.e. 1.86 l/s, will require, for a reasonable speed of 0.95 m/s, a pipe with an internal diameter of 50 mm (2"). Loss of head will then be 0.022 mm, giving a perfectly acceptable drop in pressure, over a 50 m length of pipe, of 1.10 m (110 g/cm2).

2) Sewage

Sewage consumed by the digester will comprise:

- Pigsty	:	1,400 l
- Milking-shed	:	1,250 l
- School toilets	:	1,800 l
Total	:	4,450 l/day.

Sewage from the toilets will be pre-treated in a septic tank. It is strongly recommended that waste water from showers, wash basins, laundries, etc. be channelled directly into the sea or a sump.

A 6-m3 brickwork digester, model 100 D/2A, should be sufficient to operate a continuous digestion system, and for the production of locally usable bio-gas.

Gas production

The digester will produce the following average rates of bio-gas:

- Pigs : 0.250 m3/kg/day
- Cattle : 0.045 to 0.095 m3/kg/day
- Humans : 0.095 to 0.125 m3/kg/day

We have restricted input to 35% for humans (the septic tank absorbing 75%), and 50% for cattle, as half the waste matter will be scattered at a distance. Concerning pigs, the figures given allow for 1 boar, 2 sows, and 30 fattening pigs (average 50 kg).

Gross matter kg	D. M.	T. S. 20%	V. S.	Gas m3/day
30 x 0.6 =	18			
2 x 0.9 =	1.8			
1 x 1.3 =	1.3	4.22	3.6	0.900
5 x 1.4 x 0.5 =	3.5	0.70	0.56	0.053
100 x 0.2 x 0.35 =	7	1.40	0.28	0.040
			4.44	0.993

Thus, minimum daily gas production should be 1 m3, i.e. sufficient to run an ordinary burner (hourly consumption : 0.400) for 2 h 30'.

Loss of head is given by the formula :

$$H = 0.84 \frac{Q^2 L}{D^5}$$

H = loss of head in mm of water
Q = consumption in m3/h = 0.400
L = length in metres = 100 m
D = diameter in cm = 1.00 (internal diameter)

H = 13.44 mm.

Such loss of head is negligeable provided internal pipe diameter is at least 1 cm.