3.5 Findings of Alternative Study

(1) Community participation (involvement) for realizing the simple means of graywater management shall be promoted under the initiative of the Municipality of Ujung Pandang (KMUP) and be undertaken on a Kelurahan level. The options of wastewater management shall be implemented in step by step, starting from the five Kelurahans where the social survey has been carried out. In this regard a simple guidance manual is prepared and incorporated in the Annex.

(2) When the overall environmental improvement of the objective area is targeted on a short term basis, the following three (3) project components are recommendable as the cost effective (least cost) project package. These projects would contribute to both the improvement of living environment and water environment of the objective area.

The project components along with the respective direct construction costs are given below. The total cost would be about 15.5 billion Rp.

Project component	Direct construction cost (million Rp.)
Interceptor sewer system for central area (Alternative 3 of Section 3.4)	13,270
Interceptor along Losari beach (Alternative c of Section 3.3)	1,700
Dilution water introduction from Jeneberang river (Section 3.2)	515
Total cost (least cost package)	15,485

The project components delineated above are illustrated in *Fig. 3.7.*

However, if the multipurpose interceptor system for overall protection of Losari beach, including that of coastal erosion mitigation, is used instead of the single purpose system as above, then the total direct construction cost becomes 21.150 billion Rp., an increase of 5.665 billion Rp. (ref. *Fig. 3.6*).

Moreover, in the medium term if the graywater conveyance and treatment system is to replace the dilution water introduction (due to the unavailability of water from Jeneberang river), as the canal water improvement program, then the required additional investment as the direct construction cost would be 3.905 billion Rp.

It is noted that the investment for interceptor sewer system for the central area is of long term, since the project is also the initial stage of conventional sewerage system development as per the Feasibility Study.

Moreover, this interceptor system is financially viable (cost recovery is possible), with a tariff system set within the affordability of beneficiaries, when the wastewater management service is comprised of both interceptor sewerage (graywater management) and desludging of septage (septage/blackwater management).

Table 3.1 Preliminary Evaluation of Strategic Options for Community Participation

	Strategic Option	Scope of Improvement			Community Participation			Installation by Community
		Ditch / drain	Main Drain	Canal / river / sea	Planning	Imple.	O/M	
1	Cleansing of ditches and drains	———	- - -	- - -	○	○	○	○
2	Provision or improvement of ditches and drains	———			○	○	○	○
3	Installation of screens in ditches and drains	———	- - -	- - -	○	○	○	○
4	Provision of household based infiltration trench	———	———	———	○	○	○	○
5	Graywater collection and infiltration using ditches and drains		———	———	△	○	○	△
6	Graywater collection and treatment using ditches and drains		———	———	×	×	△	×
7	Provision of treatment system within canal (*)		———	———	×	×	△	×
8	Introduction of flushing or dilution water from Jeneberang river (*)			———	×	×	△	×
9	Graywater conveyance and treatment system using canal (*)			———	×	×	△	×
10(1)	Interceptor for coastal water protection			———	×	×	△	×
10(2)	Interceptor sewerage system for living environment improvement		———	———	×	×	△	×

(*) : Installation of three (3) gates, one each in Panampu, Jongaya and Sinrijala canal, is required.

○ Easy and recommended for community participation.

△ Fair for community participation including retribution.

× Difficult for community participation.

Table 3.2 Comparative Evaluation of Alternative Canal Water Improvement Programs

	Alternative	Required Facilities	Effect	Term of Construction	Direct Construction Cost (million Rp.)	Advantage	Disadvantage
1	Introduction of dilution water from Jeneberang River	Intake facilities/channel Three(3) Gates in Canal	- Canal water (BOD) improvement - Salinity protection	6 months	Intake facilities : 85 Gate : 430 Total : 515	- Simple and quick for implementation and O/M	- No reduction of pollution load discharge - Requirement of freshwater for dilution (No water after water supply project completion)
2	Provision of treatment within canal (Installation of aerator)	Three (3) Gates Aerator (3.7 kw x 28)	- Canal water treatme - Salinity protection	1 - 2 years	Gate : 430 Aerator : 4,616 Total : 5,046	- Some reduction in pollution load	- Potential noise and foam due to aerator operation - Interference with flood discharge during rainy season - Power requirement of aeration - Inefficient treatment (sludge can not be removed) - Requirement of O/M (operation of aerator may not required in rainy season) - Construction cost is the highest
3	Graywater conveyance and treatment system using canal	Three (3) Gates Modification of canal to double section Treatment plant and Pump facilities (Lembo/ Maccini Sombala)	- Improvement of canal environment - Canal water treatment - Salinity protection	2 - 3 years	Gate : 430 Double section: 1,870 Treatment plant : 949 Pump facilities : 1,086 Total : 4,335	- Reduction of pollution load - Quick wastewater conveyance and ease of canal cleansing (dry season) - Treatment plants have long term use	- Power requirement of pump facilities - Requirement of O/M

Table 3.3 Comparative Evaluation of Alternative Losari Beach Protection Programs

	Alternative	Required Facilities	Effect	Term of Construction	Direct Construction Cost (million Rp.)	Remarks
a	Pipe and Anaerobic Filter Treatment Plant with Influent Pump	Pipe - diameter 200mm x 250m - diameter 300mm x 1250m Treatment Plant (anaerobic filter) - Beach (2900cu.m/day, Anaerobic Filter 20m x 60m) - Taman Safari (1600cu.m/day, Anaerobic Filter 13m x 50m)	Pollution load into the bay is reduced by collection and treatment system	1 year	4,250	- Land acquisition for treatment plant - Requirement of O/M for interceptor collection pipe - Requirement of O/M cost for pump
b	Ditch and Anaerobic Filter Treatment Plant with Influent Pump	Ditch with cover - 200(w) x 300(h)mm x 250m - 300(w) x 300(h)mm x 1250m Treatment Plant (anaerobic filter) - Beach (2900cu.m/day, Anaerobic Filter 20m x 60m) - Taman Safari (1600cu.m/day Anaerobic Filter 13m x 50m)			4,150	- Land acquisition for treatment plant - O/M is most simple among 3 alternatives - Requirement of O/M cost for pump
c	Ditch with Anaerobic Filter	Ditch with anaerobic filter - 3000(w) x 3000(h)mm x 250m (1600cu.m/day) - 3000(w) x 3000(h)mm x 1250m (2900cu.m/day)			1,700	- Requirement of O/M for open ditch with anaerobic filter

Table 3.4: Comparative Marginal Costs by Technical Alternatives (US$ million)

	Intercepter		Septage		Overall	
	Alt - 2	Alt - 3	Alt - 2	Alt - 3	Alt - 2	Alt - 3
Total Investment	8.34	9.36	0.42	0.42	8.8	9.8
Marginal Cost (p.a)	1.04	1.16	0.08	0.08	1.1	1.2

Table 3.5: Beneficiaries, Population, Floor Area and Share by Category

	Household				Business Entity			Public
	R - 1	R - 2	R - 3	Sub-Total	BE - 1	BE - 2	Sub Total	PE
Population	58,950	45,850	26,200	131,000				
Household	10,718	8,336	4,764	23,818				
% share	(45%)	(35%)	(20%)	(100%)				
Floor Area, sq.m					312,884	54,242	367,126	58,115
% share					(50%)	(9%)	(59%)	(41%)

Table 3.6: Share of Cost Allocation by Beneficiary Category

	Households			Business Entity		Public Institute
First-order	0.5			0.3		0.2
Second-order	R - 1	R - 2	R - 3	BE 1	BE - 2	PE
	0.2	0.35	0.45	0.6	0.4	1.0
Cost Share	0.10	0.18	0.23	0.18	0.12	0.20

Table 3.7: Cost Recovery (Indicative Tariff) by Beneficiary Category (Rp./month)

	R - 1	R - 2	R - 3	BE - 1	BE - 2	BE-WA	PE
Households							
Alt - 2	2,154	4,847	10,905				
Interceptor	2,007	4,516	10,160				
Septage	147	331	745				
Alt - 3	2,399	5,398	12,145				
Interceptor	2,234	5,027	11,311				
Septage	165	371	834				
Entities(/sq.m)							
Alt - 2				133	511	190	179
Interceptor				124	476	177	167
Septage				9	35	13	12
Alt - 3				148	569	211	199
Interceptor				138	530	197	186
Septage				10	39	14	13

BE-WA: Average cost share of business entity weighed by floor areas

Table 3.8: Average Household Income/Revenue (Rp.,USD)

	Rp.		USD	
	Year	Month	Year	Month
Household	3,034,000	252,800	1,348	112
Business Entity	118,671,000	9,889,000	52,743	4,395

Table 3.9: Empirical Parameters for Willingness to Pay

	Interceptor	Septage	Overall
WTP (% share of Disposable Income)	1.0	0.75	1.75

Table 3.10: Willingness to Pay by Household Subcategory (Rp./month)

	R - 1	R - 2	R - 3	BE
Overall	2,520	5,320	11,200	173,060
Interceptor	1,440	3,040	6,400	98,890
Septage	1,080	2,280	4,800	74,170

Table 3.11: Budget Allocation by Category in South Sulawesi Province (1989-1993, Rp. Billion)

	1989	1990	1991	1992	1993
Total Provincial Budget	75.3	103.3	130.1	137.6	149.0
Routine	37.8	45.6	53.0	61.5	69.6
Development	37.5	57.7	77.1	76.1	79.4
of which Own Revenue	21.6	31.3	34.4	31.7	31.7

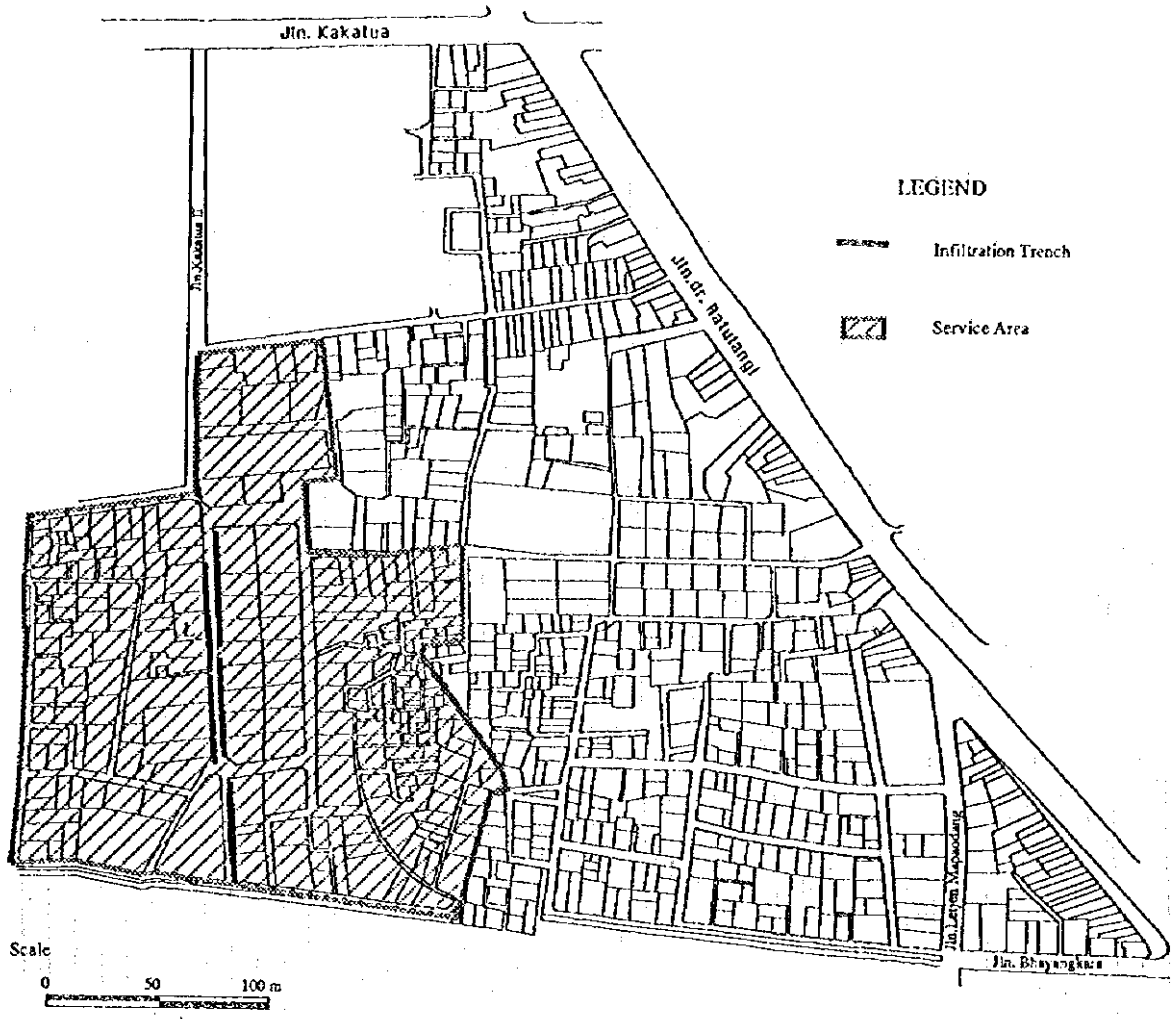
Table 3.12: Financial Position of the City Government-KMUP (1991-1995 Rp. Billion)

	1991	1992	1993	1994	1995
Revenue	38.4	46.7	60.4	66.0	80.9
Expenditure	38.3	46.4	60.4	65.4	80.3
Debt Service	3.5	3.9	3.6	2.4	4.8

FIG. 3.1	Location of Typical Infiltration Trenches - Losari

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

JICA A.D.1994



- About 20% of generated graywater discharge will be infiltrated.
- Total length of the infiltration trench is about 300m in about 4.3ha.

FIG. 3.2 **Location of Typical Infiltration Trenches - Parang**

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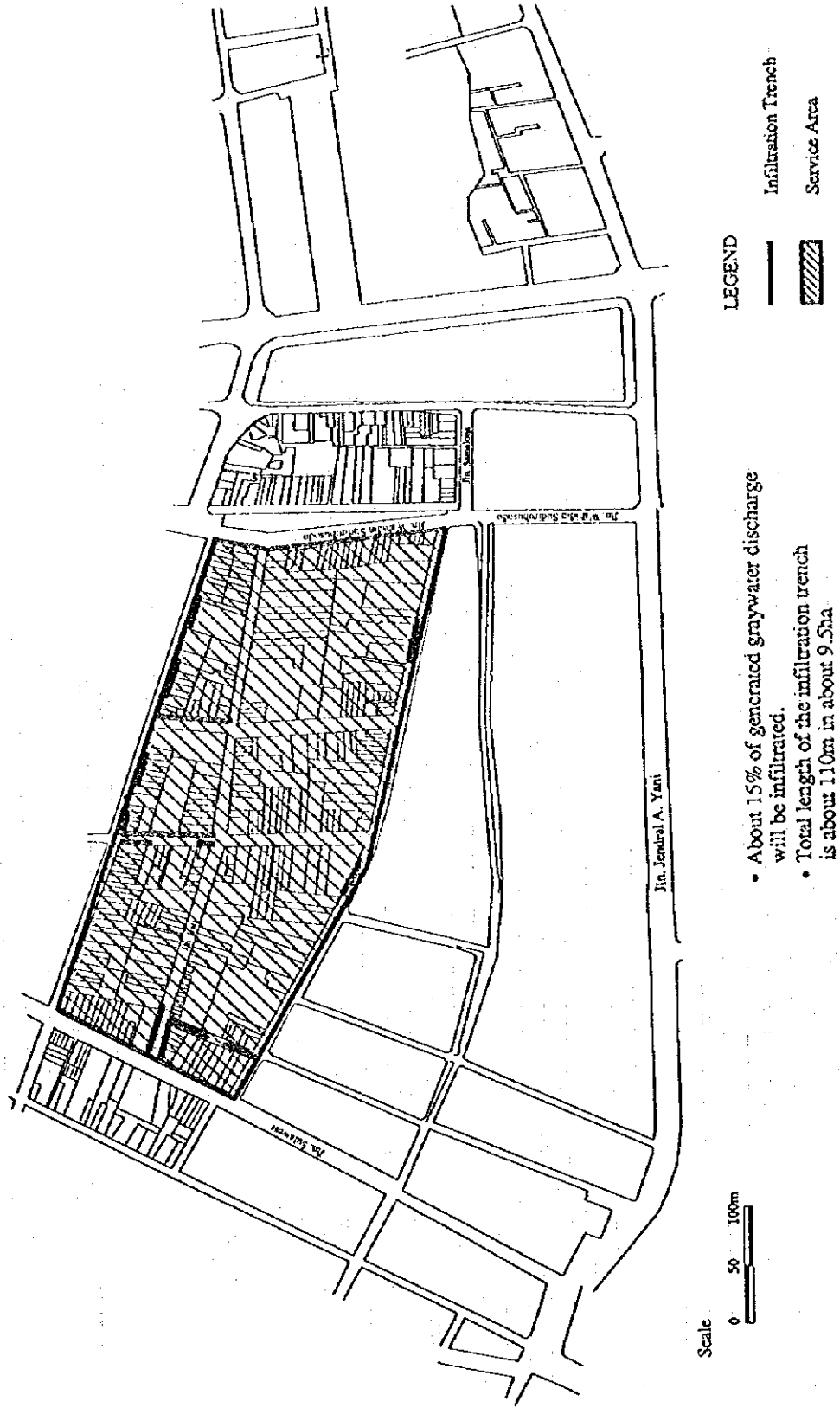

FIG. 3.3	Location of Typical Infiltration Trenches - Pattunuang

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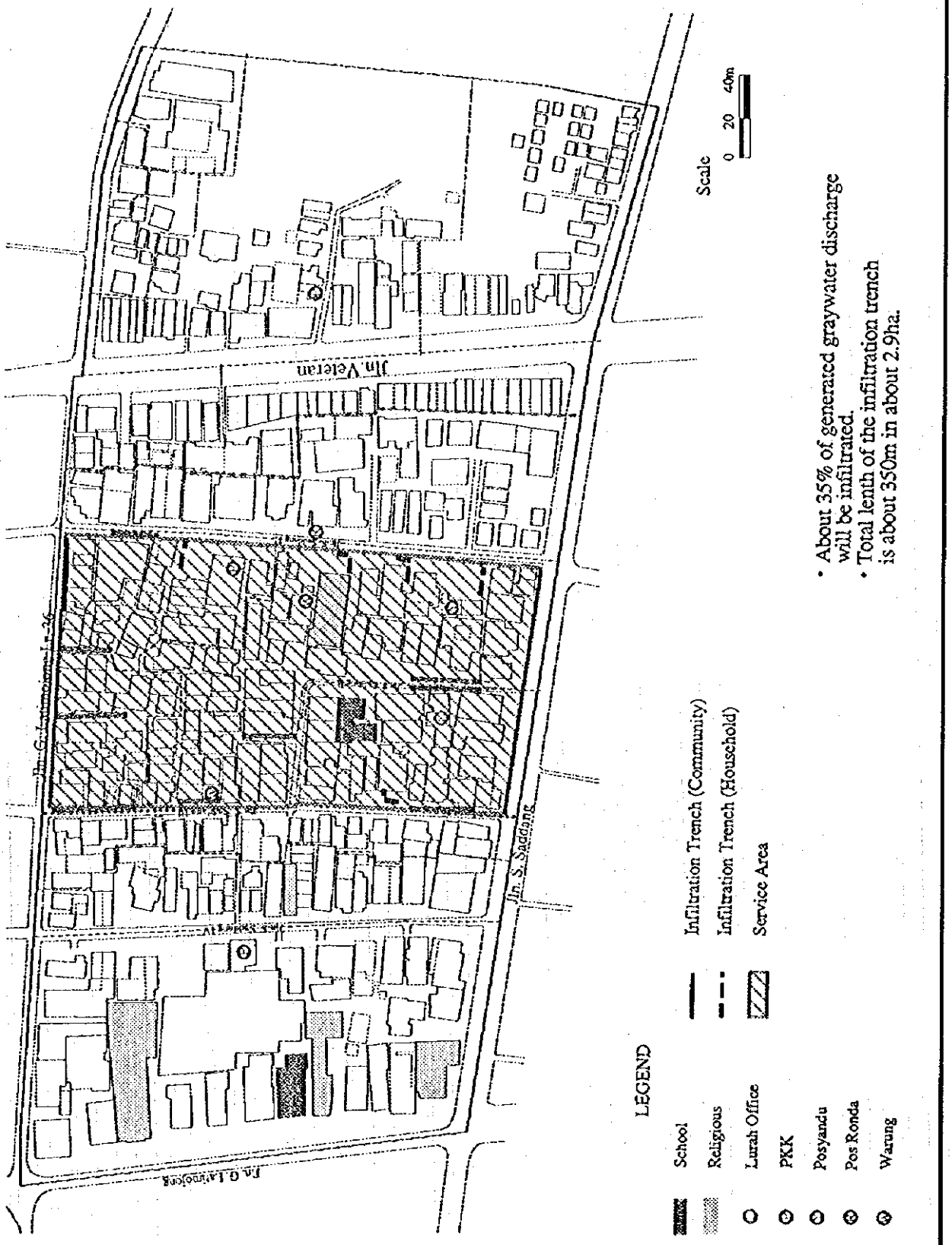

FIG. 3.4 **Location of Typical Infiltration Trenches - Maradekaya Selatan**

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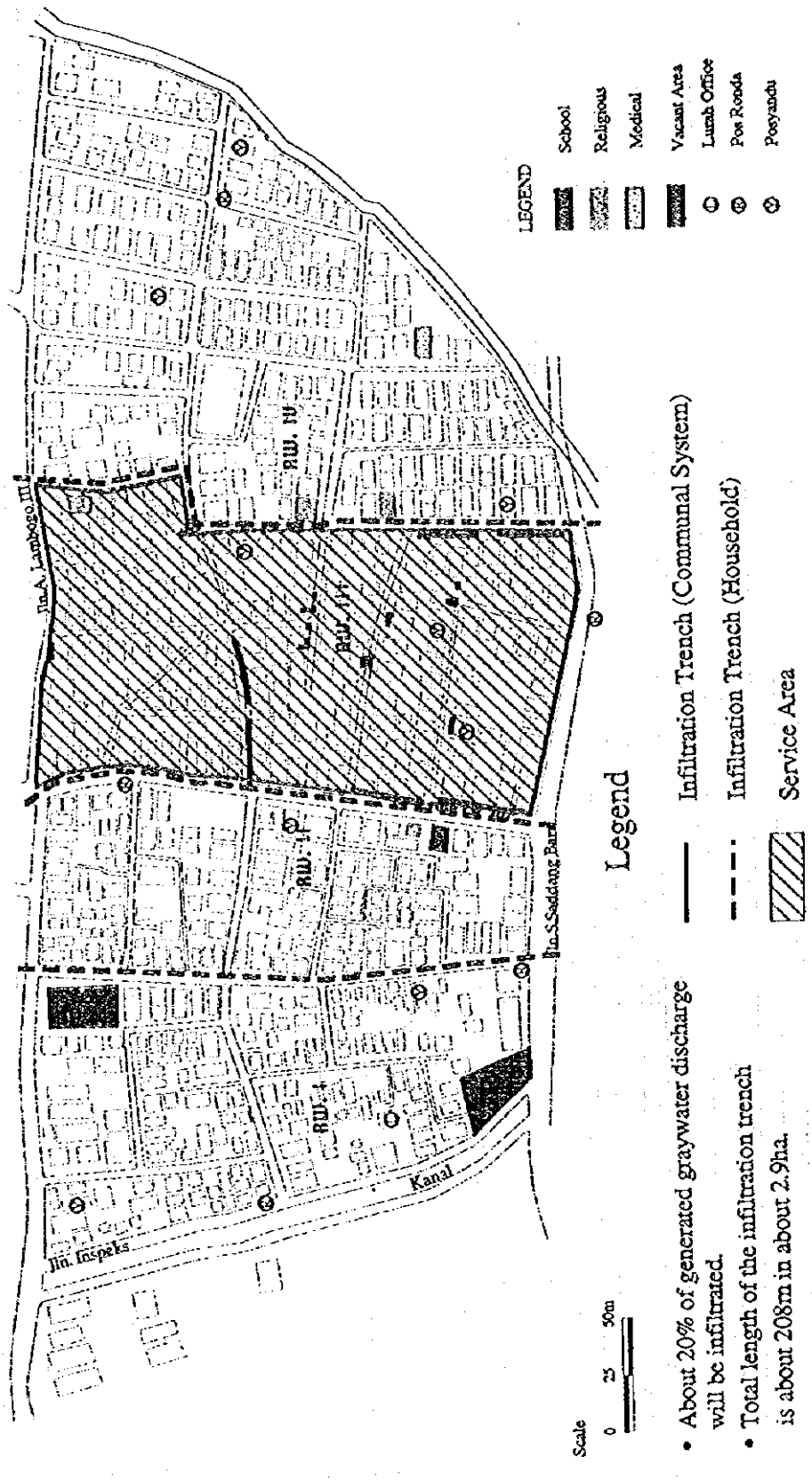

FIG. 3.5	**Location of Typical Infiltration Trenches - Bara - baraya Selatan**

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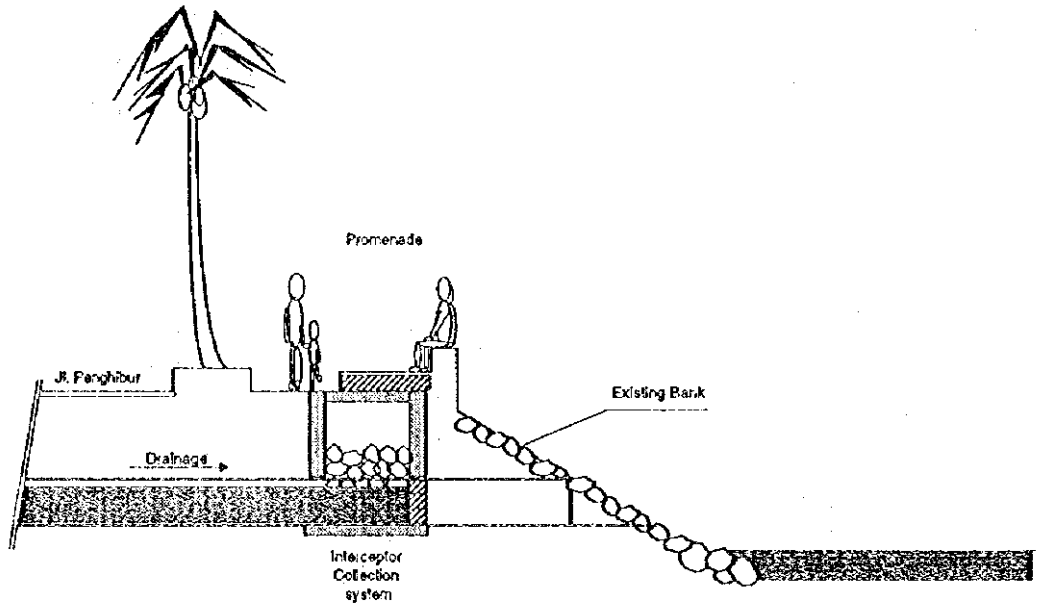
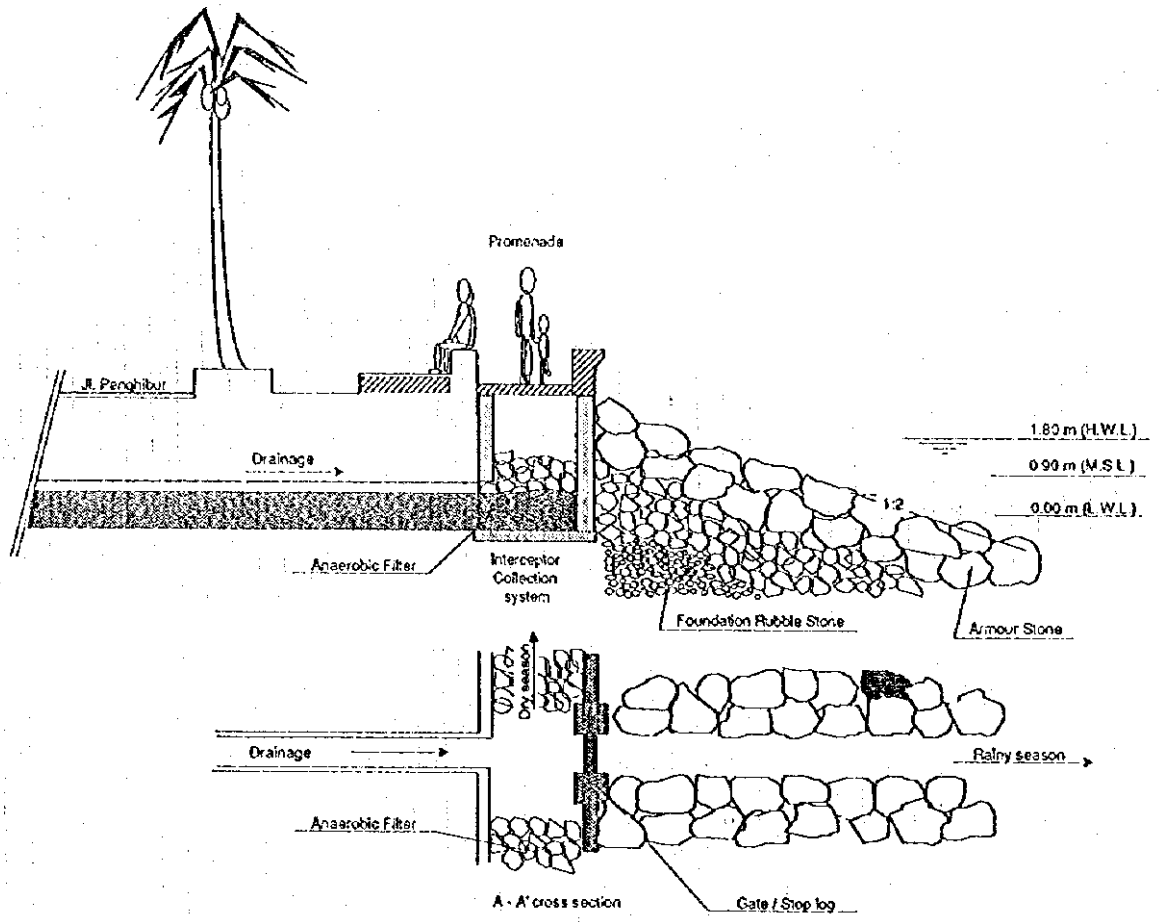


Interceptor with anaerobic filter - Alternative c (single purpose)



Interceptor with anaerobic filter for multipurpose (beach protection)

FIG. 3.6 — **Losari Beach Interceptor with Anaerobic Filter -Single and Multipurpose Systems**

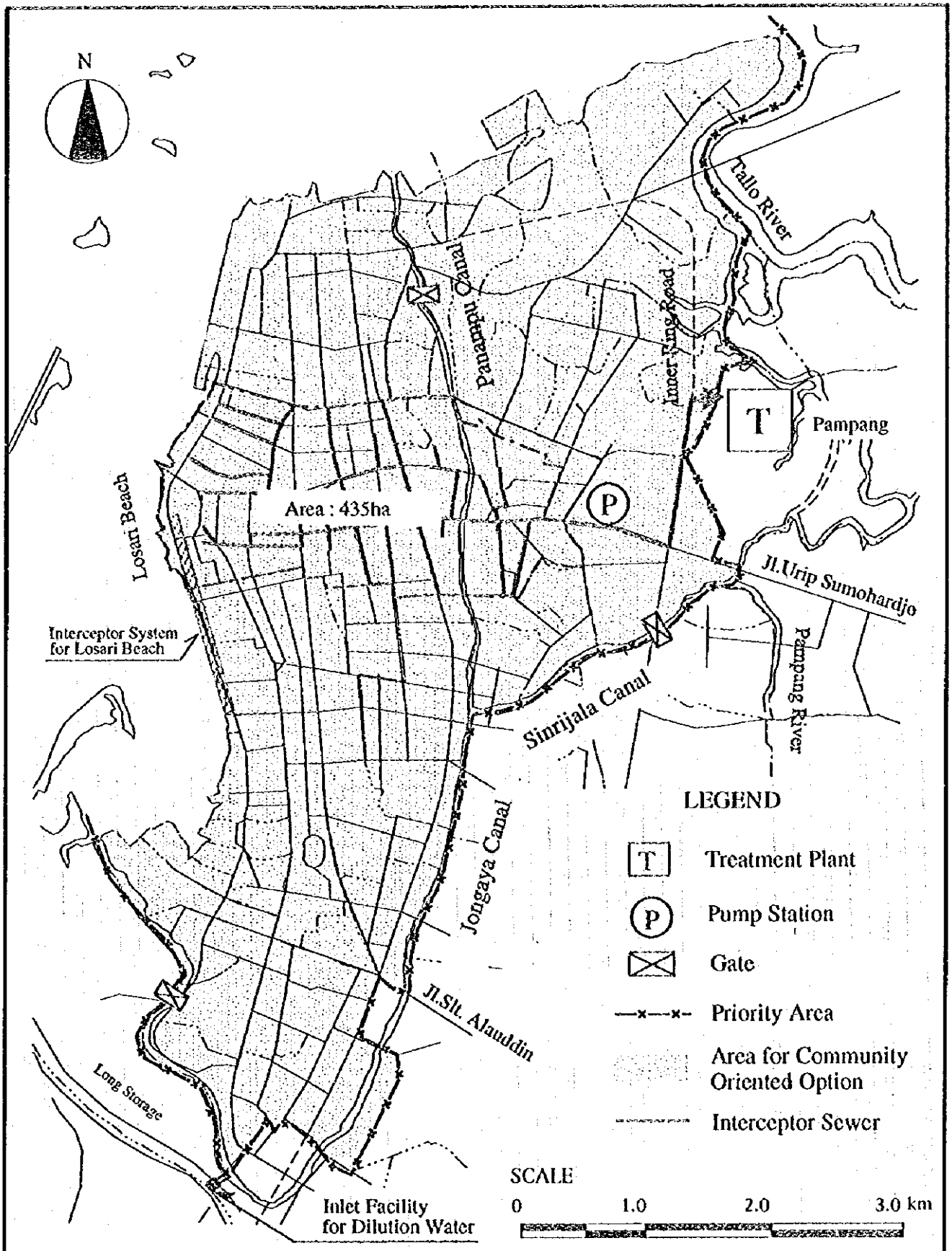


FIG. 3.7	Recommended Project Components

MASTER PLAN AND FEASIBILITY STUDY ON WASTEWATER AND SOLID WASTE MANAGEMENT FOR THE CITY OF UJUNG PANDANG IN THE REPUBLIC OF INDONESIA

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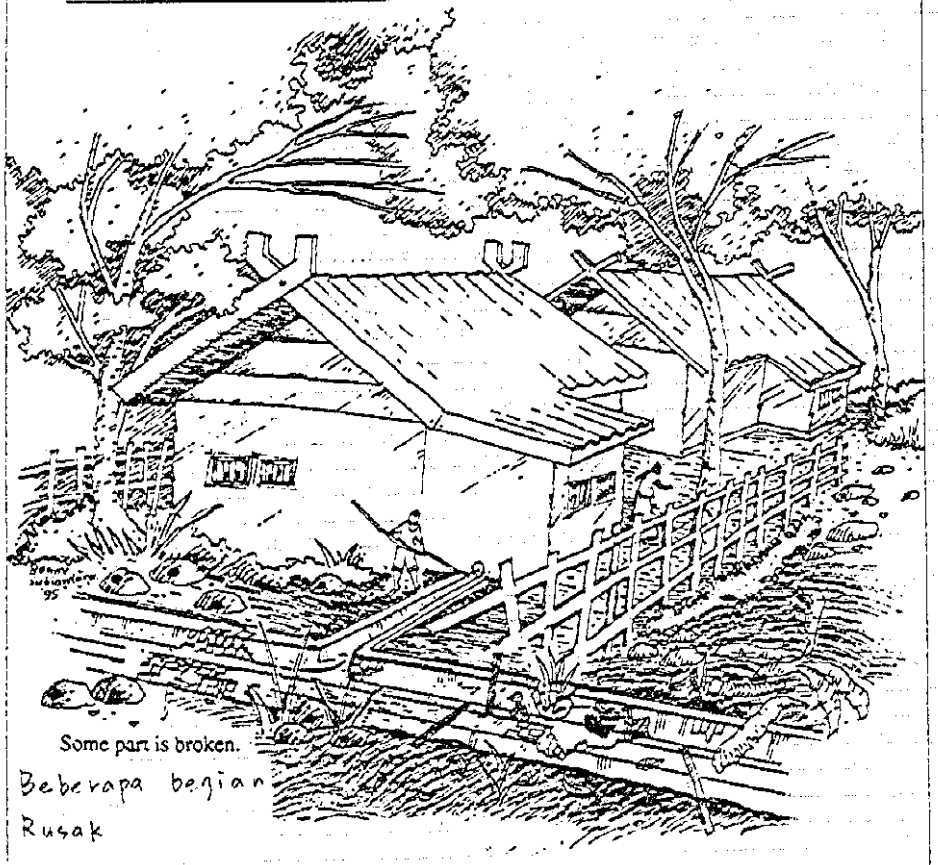
ANNEX

Installation Manual for Screen Petunjuk Instalasi Saringan



Some part is broken.

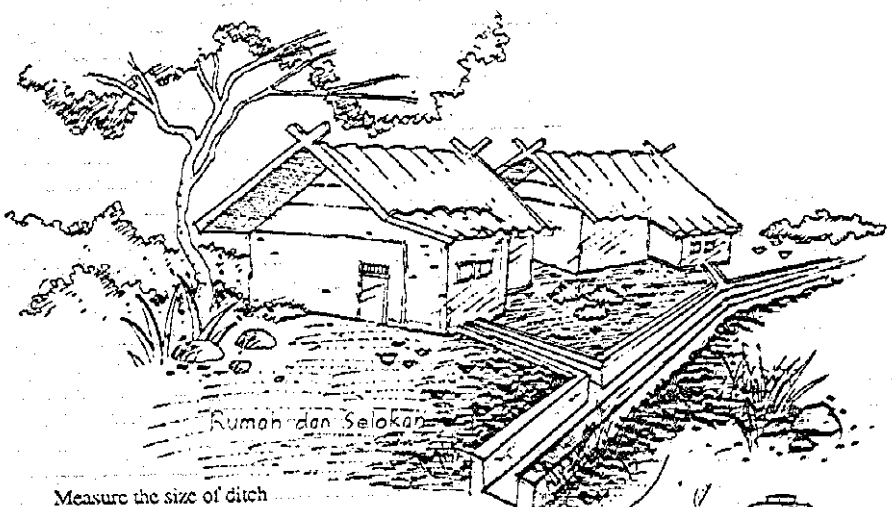
Beberapa bagian Rusak

Solid waste is accumulated at some part of drains.

SAMPAH TERKUMPUL PADA BAGIAN SALURAN

Present condition of ditches

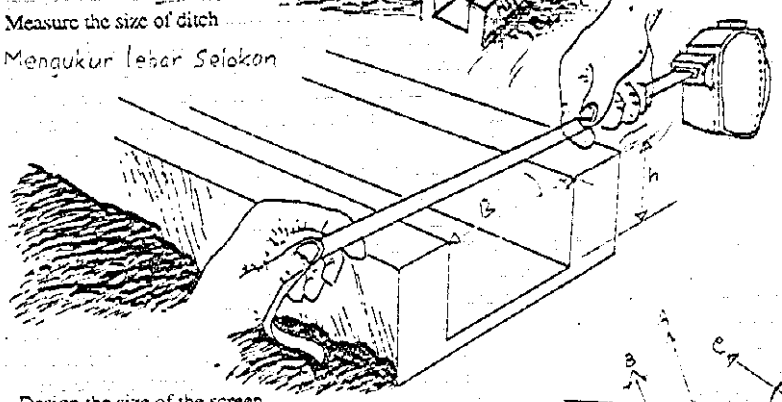
kondisi Selokan Sekarang



Rumah dan Selokan

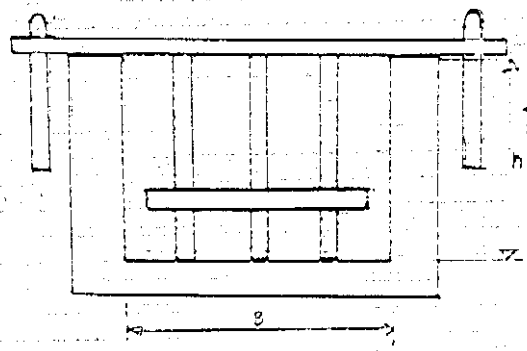
Measure the size of ditch

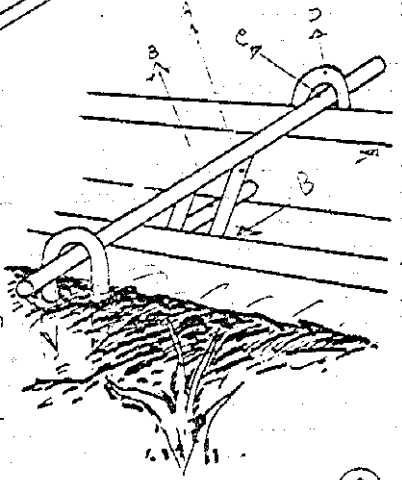
Mengukur lebar Selokan



Design the size of the screen

RENCANA LEBAR SARINGAN

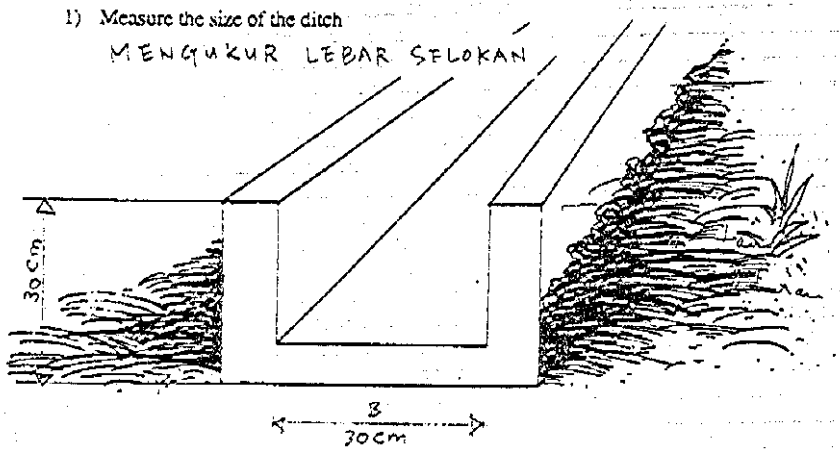




Example of design of the screen Contoh Rencana Saringan

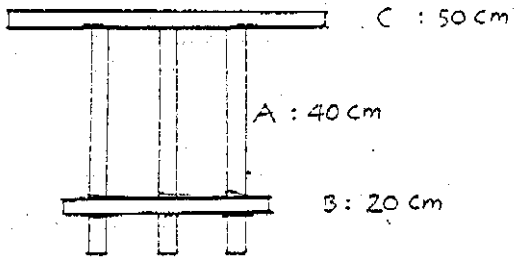
1) Measure the size of the ditch

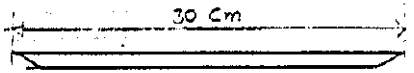
MENGUKUR LEBAR SELOKAN



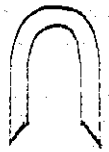
2) Design the dimension of the materials

Rencana Dimensi dari bahan Saringan





Besi Yang akan dilengkungkan bentuk huruf "U" terbalik

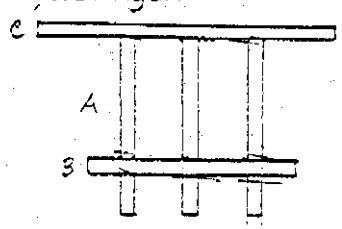


Lengkungan besi yang akan dipakai sebagai kancing.

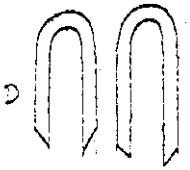
3) Estimate the required length of iron bar

Perkiraan Panjang besi beton : 50+40×3+20+30×2= 2.5 m.
Yang dibutuhkan

Gambar Rencana Saringan



Lengkungan Besi

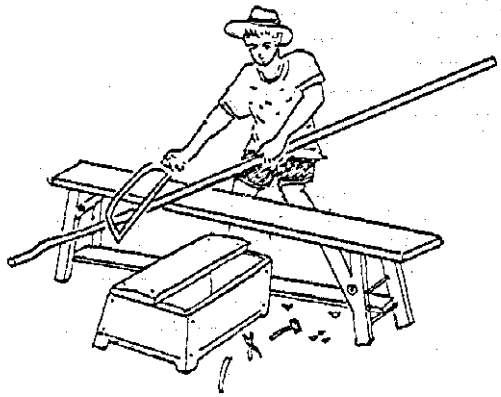


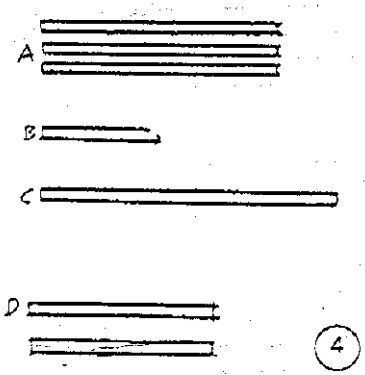
Membeli Besi Beton/Bahan-bahan Di Toko ALAT Bangunan

Purchase the materials

Cut the materials as designed

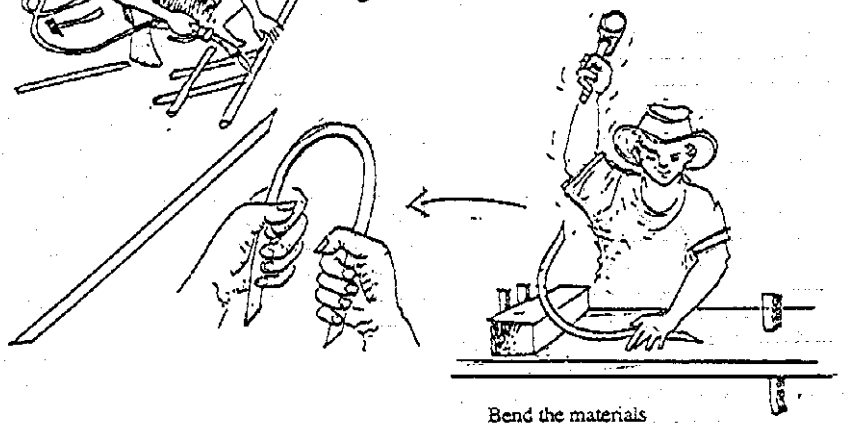
MEMOTONG BESI BERDASARKAN RENCANA



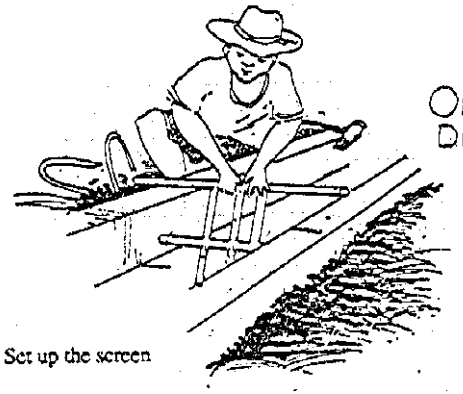


Weld the cut materials

Orang Sedang Mengelas
Besi Yang Sudah
Di potong

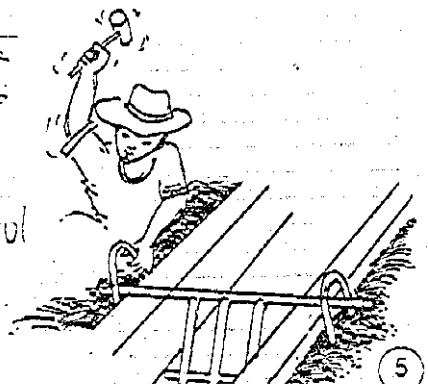


Bend the materials

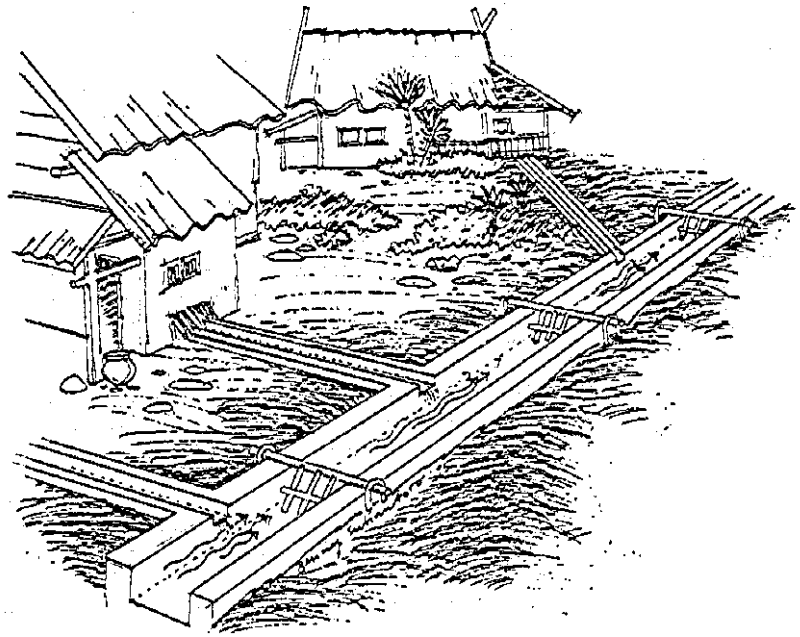


Orang Memasang Saringan
Di Dalam Selokan

Set up the screen

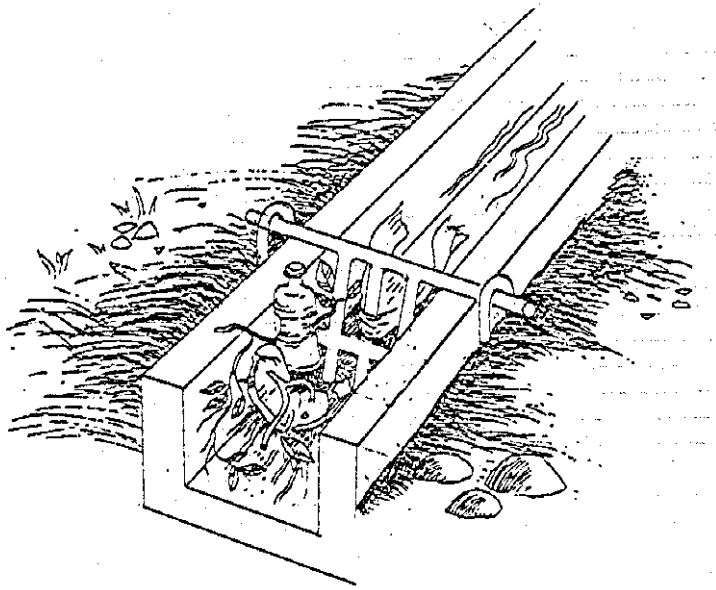


Orang Sedang Memukul
Lengkungan Besi,
Mengancing Saringan.



Gambar Masa Depan

Future figure of drain with screen



Bentuk Saringan yang Sudah Terpasang dapat menghalangi sampah-sampah padat.

Solid waste is trapped by the screen.

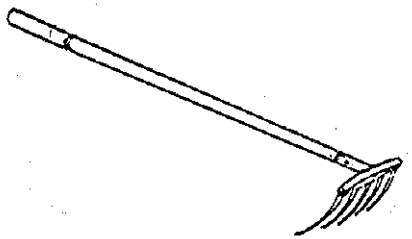
Penggunaan dan Pemeliharaan

Setiap 2 minggu selokan dan saringan dibersihkan dengan menggunakan pengais sampah dan skop.
Jika ada sampah yang besar, harus segera diambil.

The trapped solid waste shall be removed once in every two(2) weeks and disposed for collection by solid waste (garbage) collection agency.

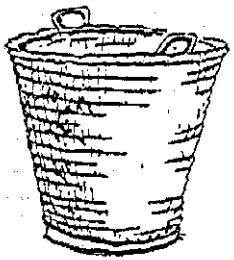
Tools

ALAT - ALAT YANG DIGUNAKAN UNTUK KEBERSIHAN



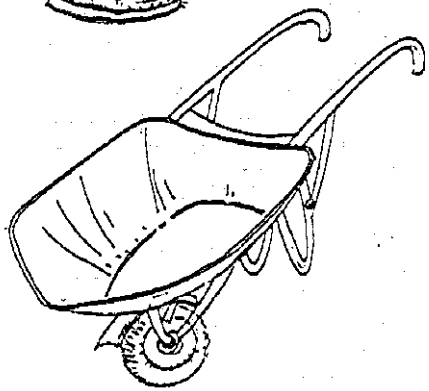
Pick

Pengais Sampah



Keranjang

Bucket

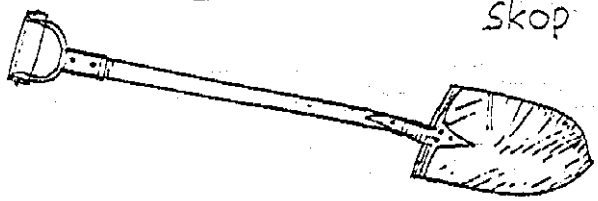


Gerobak dorong

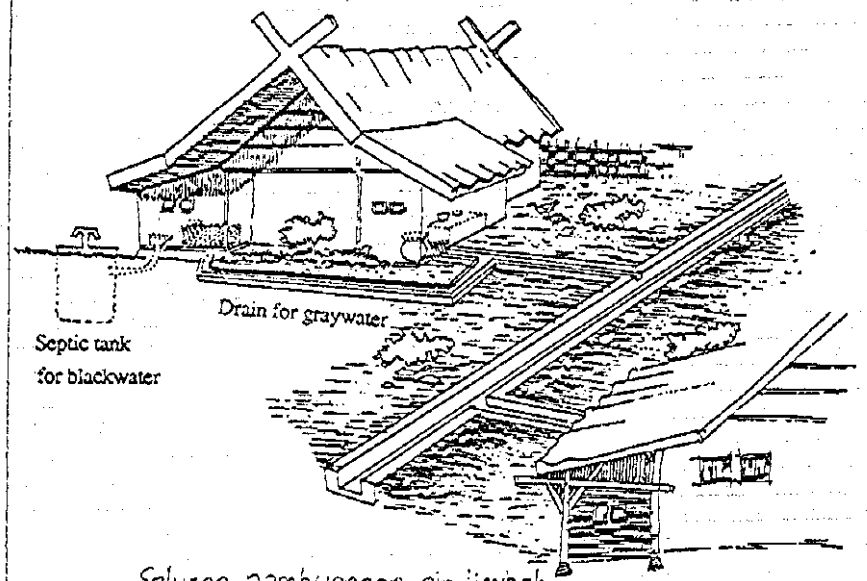
Wheel barrow

Shovel

Skop



PENGOLAHAN LIMBAH CAIR
RUMAH TANGGA



Saluran pembuangan air limbah masing-masing rumah memiliki selokan. Selokan air dalam kondisi sekarang.

Present Condition of Wastewater Discharge in Household

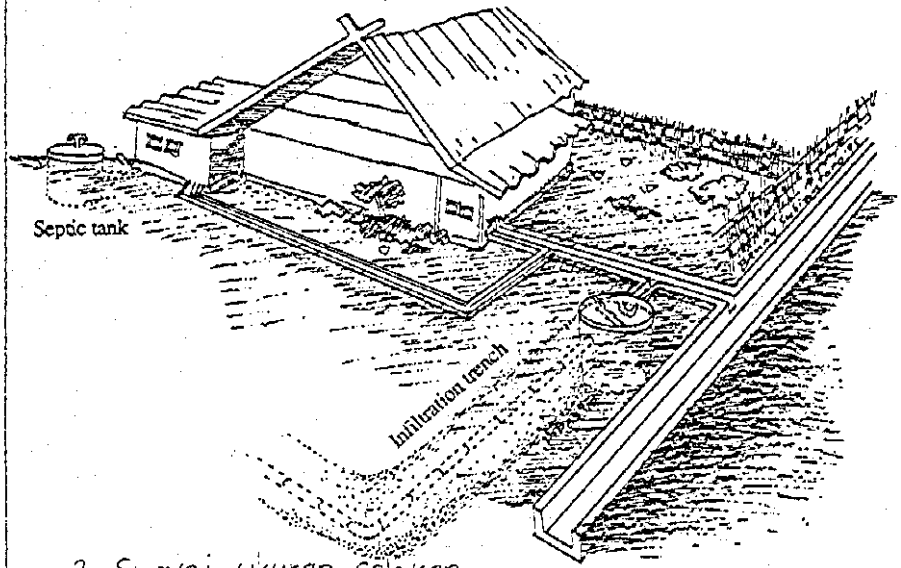
(Blackwater means wastewater from toilet.)
(Graywater means wastewater from other household works of washing, bathing, cooking and laundry)

PERENCANAAN
atau GAMBARAN MASA DEPAN

Surveying Items for the Design

1. Survei tentang air tanah pada musim air panas.
Sistem ini dapat diterapkan di atas tingkatan lebih tinggi dari atas tanah.

1) Survey the groundwater table level in dry season referring well.
The system can be applied up to groundwater table.

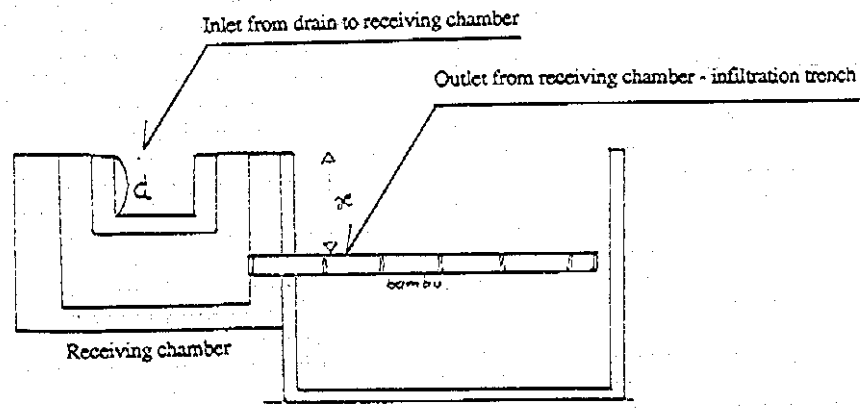


2. Survei ukuran selokan
3. Survei kondisi tanah untuk pemasangan penyaringan dalam tanah
4. Tentukan letak bak air kotor
5. Tentukan letak posisi dan panjang saringan.

2) Survey the size of the present ditch
3) Survey land area for how to install the infiltration trench
4) Design the position of receiving chamber and leaching trench

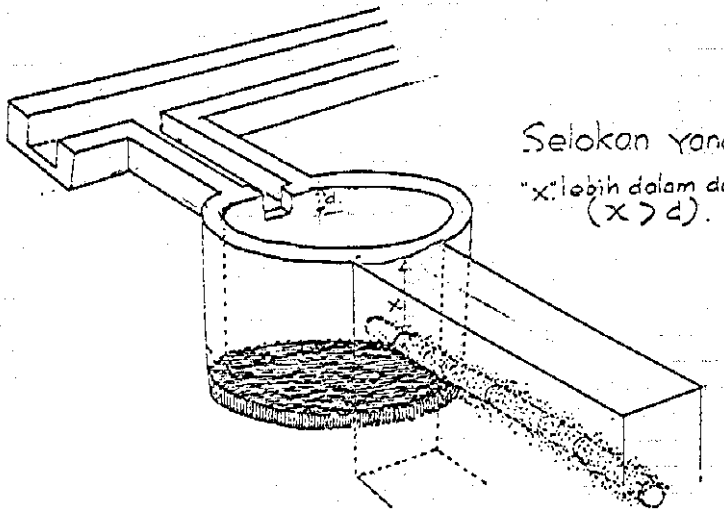
A-7

Height adjustment of inlet and outlet in the receiving chamber



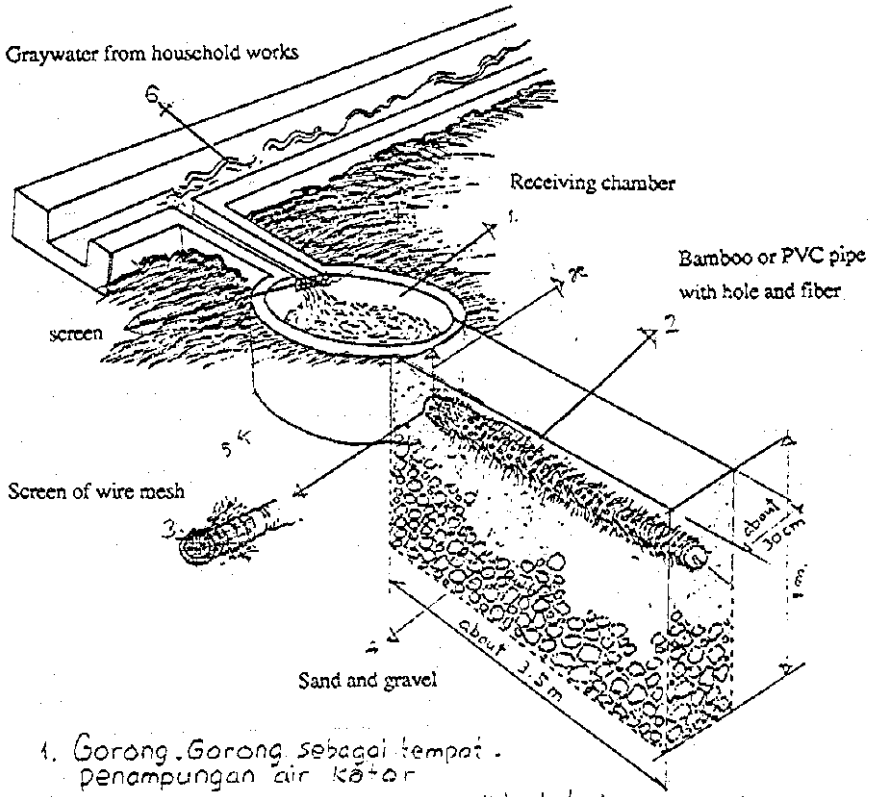
Selokan yang berasal dari sumber rumah. Tangga harus lebih rendah dari pada bambu.

X > d : Design the depth of X. The X shall be deeper than d.
This is to drain wastewater into infiltration trench from drain well.



Selokan yang baru
"x" lebih dalam dari "d"
(x > d).

Formation of the infiltration trench



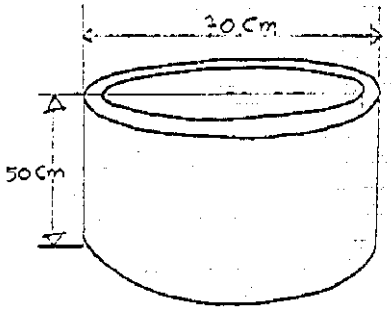
1. Gorong. Gorong sebagai tempat penampungan air kotor
2. Bambu yang di lubangi dan di balut dengan ijuk.
3. Ujung batang bambu di beri kawat saringan
4. Kerikil dan pasir
5. Bak air kotor terbuat dari semen (cor)
6. Air kotor yang berasal dari dapur dan kamar mandi.

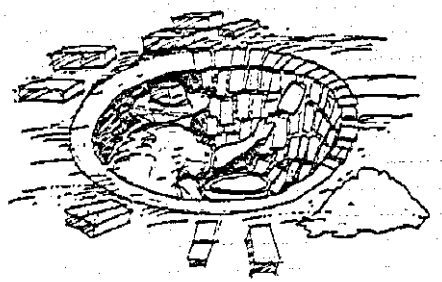
referring to typical figure page 2 - 28.

Materials

BAHAN

1) Concrete pipe or bricks for receiving chamber

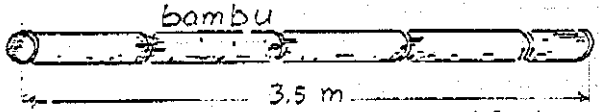




Gorong-gorong atau bak yang dibuat dari bata merah yang di lepa dengan semen. untuk menampung air kotor.

Diameter : 70 Cm
Tinggi : 50 Cm

2) Bamboo or PVC pipe (dia. about 70cm, length about 3.5m)

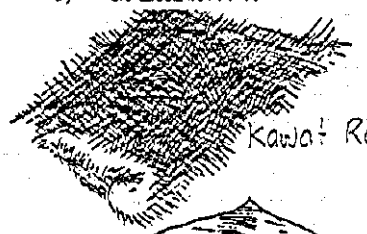


Ø : 75mm

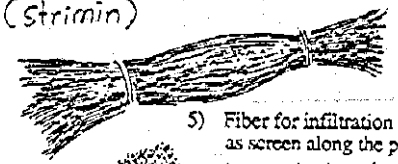
3) Wire mesh for screen at inlet of receiving chamber and infiltration trench

40x40 Cm = Untuk bak air kotor yang berasal dari Selokan Rumah Tangga

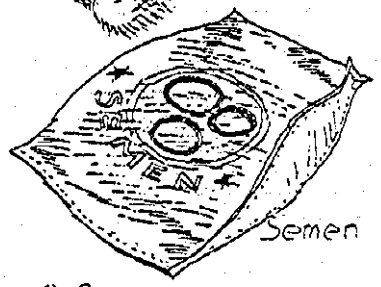
20x20 Cm = Untuk penutup lubang pipa.



Kawat Rang (Strimin)



5) Fiber for infiltration trench as screen along the pipe



Semen

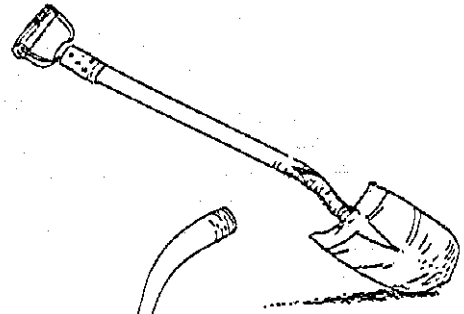
4) Cement

Kerikil dan Pasir

6) Sand and gravel for infiltration trench and plaster with cement

Tools

Alat-Alat Yang Dibutuhkan :



Shovel

Skop

Cangkul

Hoe

Strika plester Lantai / tembok

Sendok semen

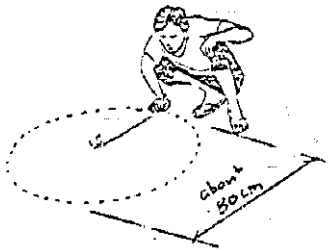
Cement spoon

A-9

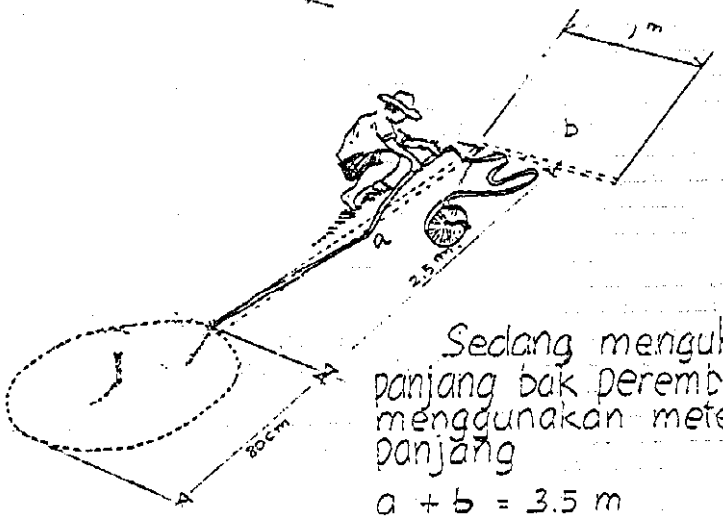
Construction of the infiltration trench at household

KONDISI

Orang sedang menggaris bentuk lingkaran diatas tanah yang telah direncanakan



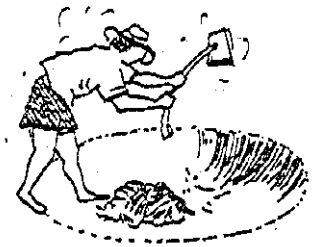
Draw the boundary of the receiving chamber for digging work



Sedang mengukur panjang bak perembesan menggunakan meteran panjang

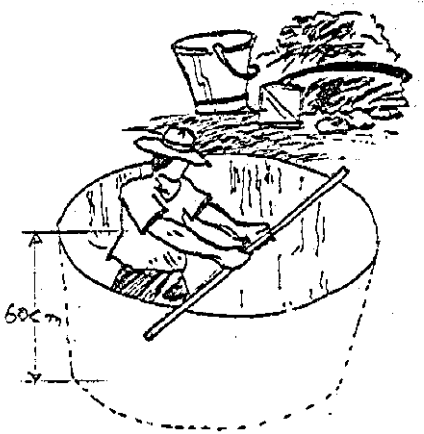
a + b = 3.5 m

Draw the boundary of the infiltration trench.
The length of a + b is about 3.5m or more.



Menggali tanah yang sudah ditentukan

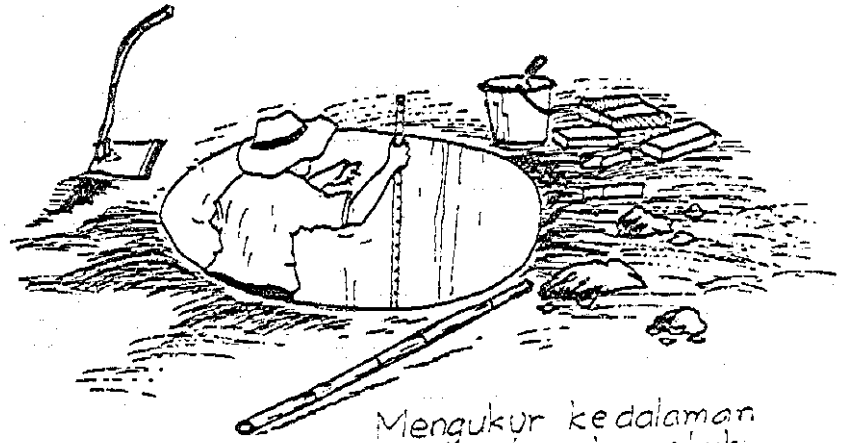
Dig the hole for the receiving chamber



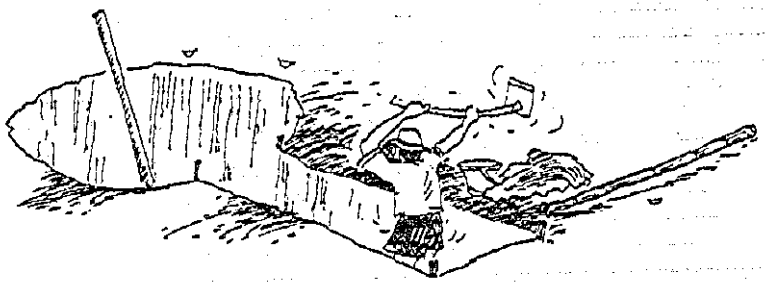
Mengukur lebar dan dalamnya galian

Measure the diameter and the depth for check

Diameter is about 80cm and the depth is about 60cm.



Mengukur kedalaman galian tanah untuk menanam bak paralon (60 cm)



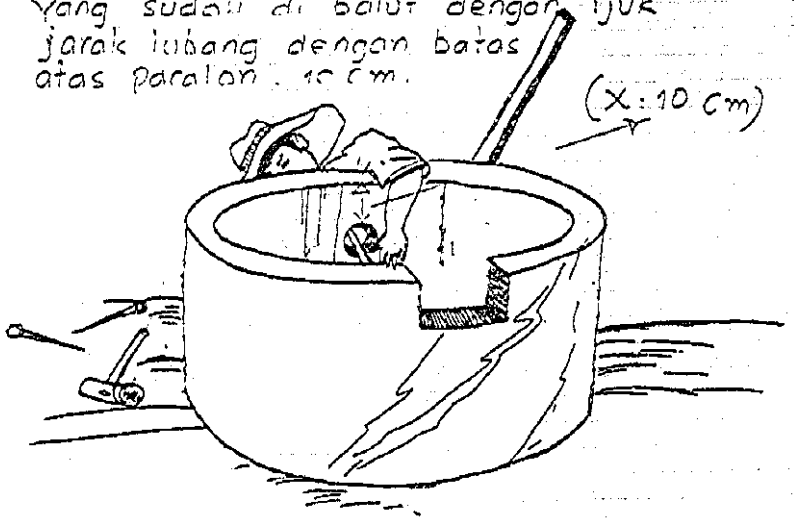
Menggali tanah untuk perembesan

Dig the strip for the infiltration trench

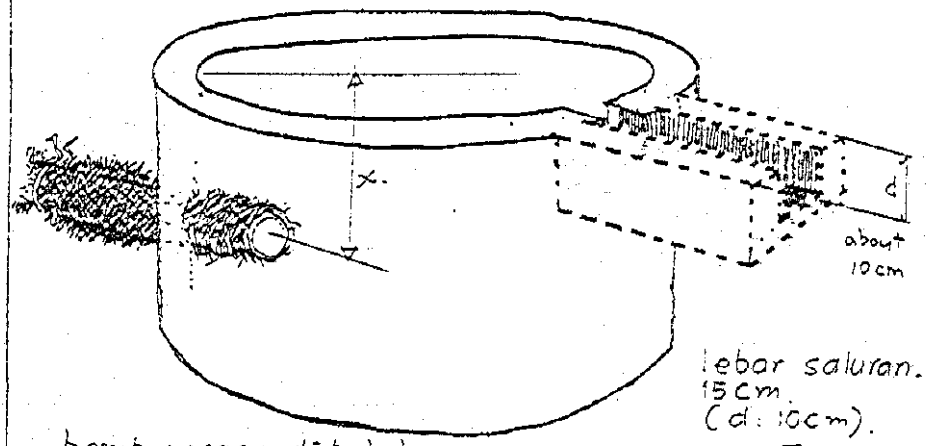
Width is about 30cm and the depth is about 1m.

Make a hole for a pipe of infiltration trench

Membuat lubang untuk saluran bambu yang sudah di balut dengan ijuk jarak lubang dengan batas atas paralon . 10 cm.



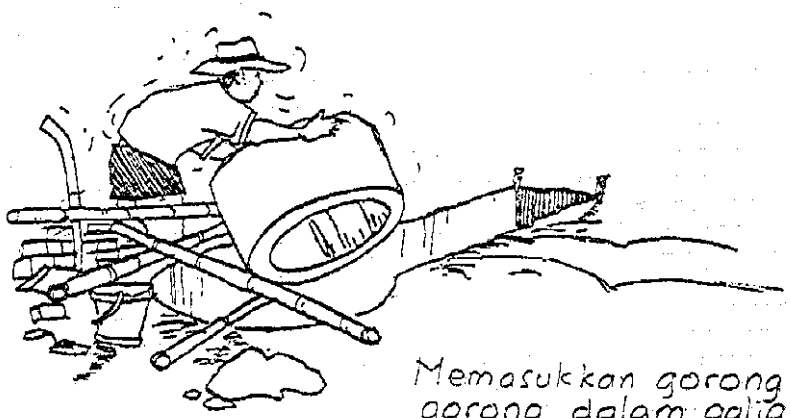
X value shall be designed referring page 3



lebar saluran.
15 cm
(d : 10cm).

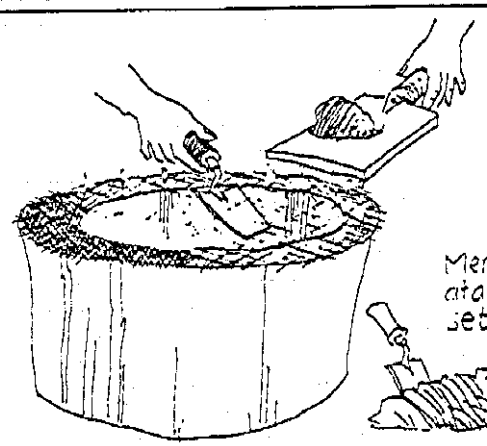
bambu yang di balut dengan ijuk

Saluran air got masuk dalam bak paralon

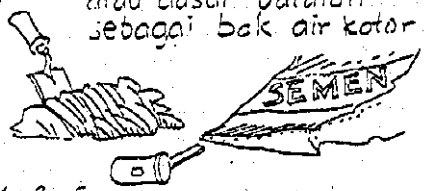


Memasukkan gorong-gorong dalam galian berbentuk lingkaran.

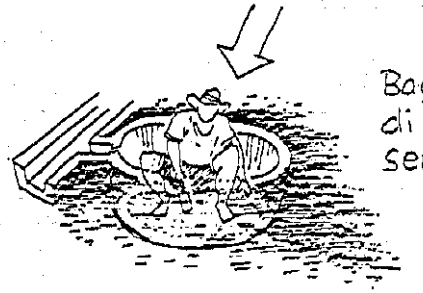
Put the concrete pipe into the hole



Membuat landasan atau dasar paralon sebagai bak air kotor



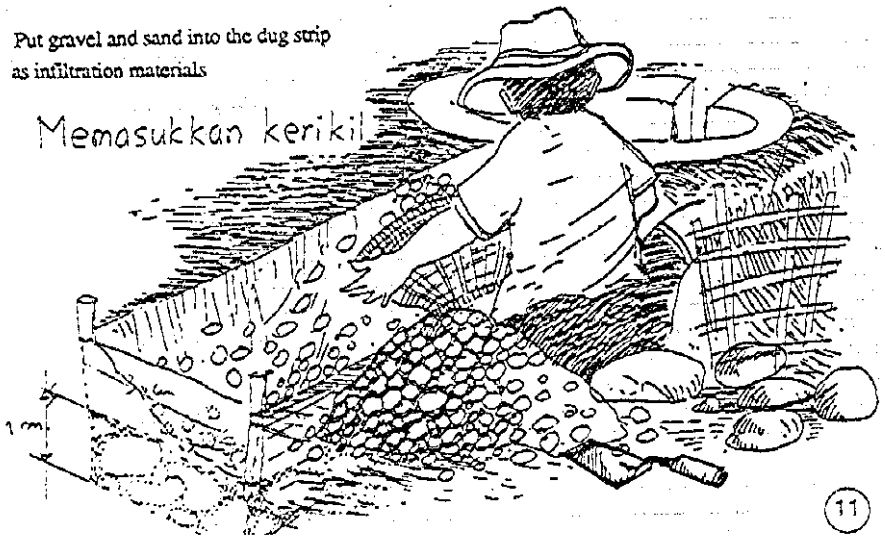
Campuran semen, pasir dan kerikil, ukuran : 1:3:5



Bagian landasan paralon di pelester dengan Campuran semen dan pasir.

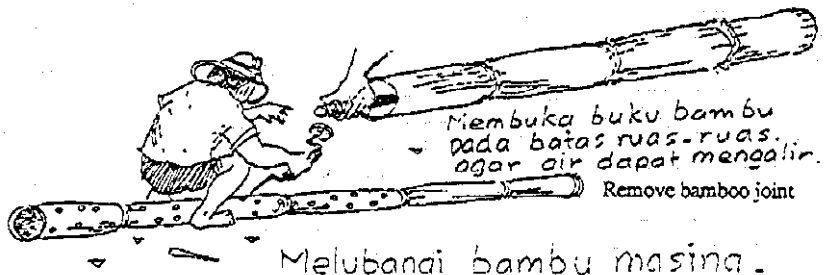
Put gravel and sand into the dug strip as infiltration materials

Memasukkan kerikil



Preparation of the infiltration pipe

MEMPERSIAPKAN BAMBU ATAU PIPA PARALON.



Membuka buku bambu pada batas ruas-ruas, agar air dapat mengalir.

Remove bamboo joint

Melubangi bambu masing-masing berjarak ± 1 cm.

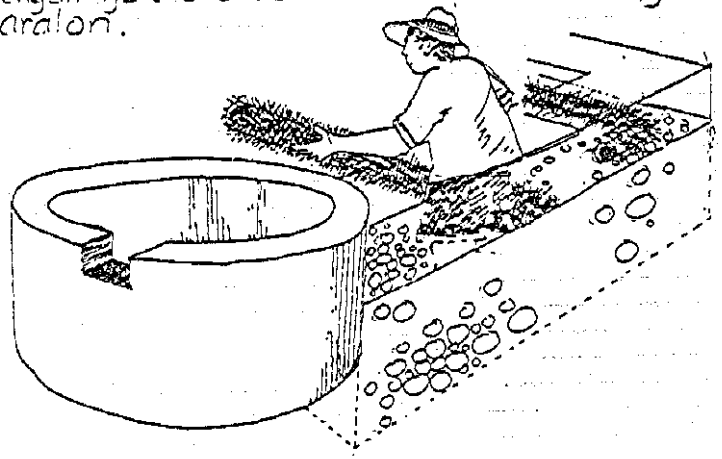
Make holes the diameter is about 1cm with about 5cm interval.

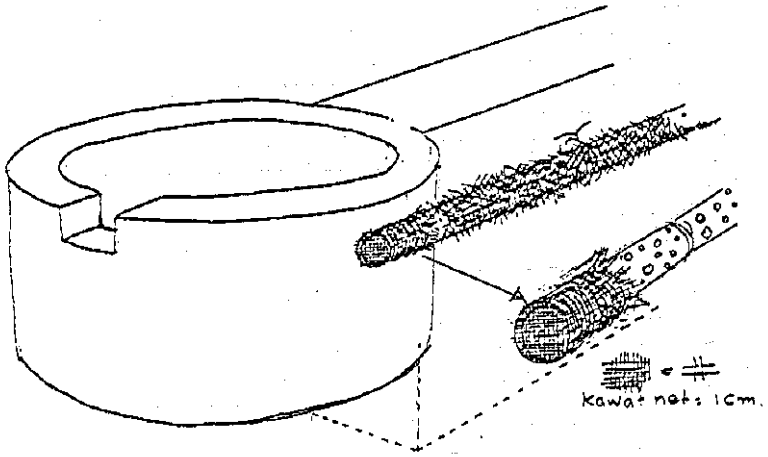
Bambu yang sudah di lubangi di balut dengan ijuk.

Put (palm) fiber around the pipe as screen

Install the pipe into the strip

Memasang pipa/bambu yang sudah di balut dengan ijuk diatas kerikil pada lubang - peralon.



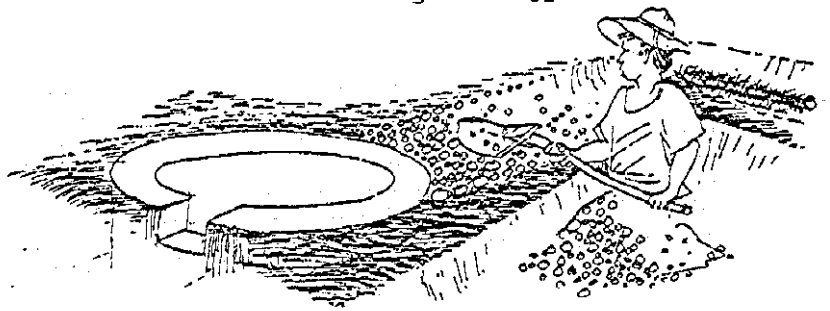


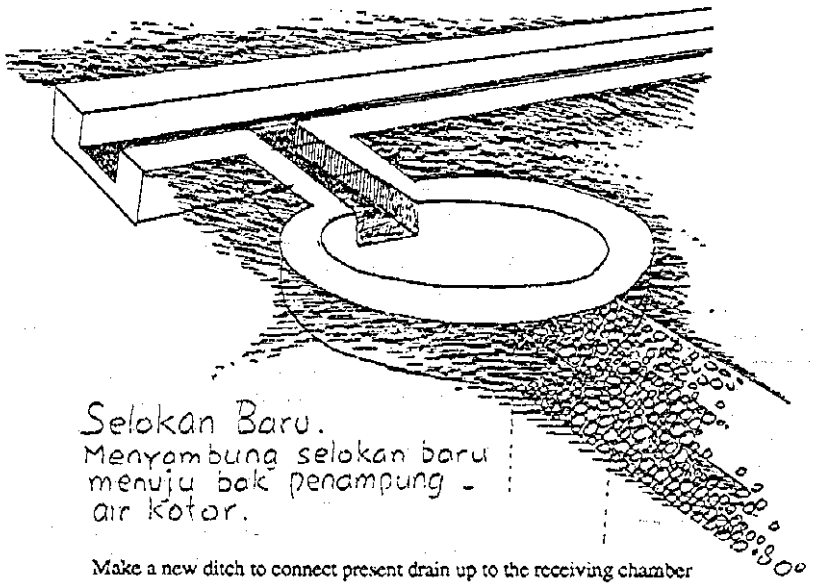
Ujung pipa bambu di tutup dengan kawat - rang (strimin). lebar anyaman 1 cm.

Put wire net at the inlet of the pipe

Cover the remained strip on the pipe with gravel and sand up to ground level

Tutup sisa lubang (di atas bambu) dengan kerikil sedatar dengan tinggi tanah.



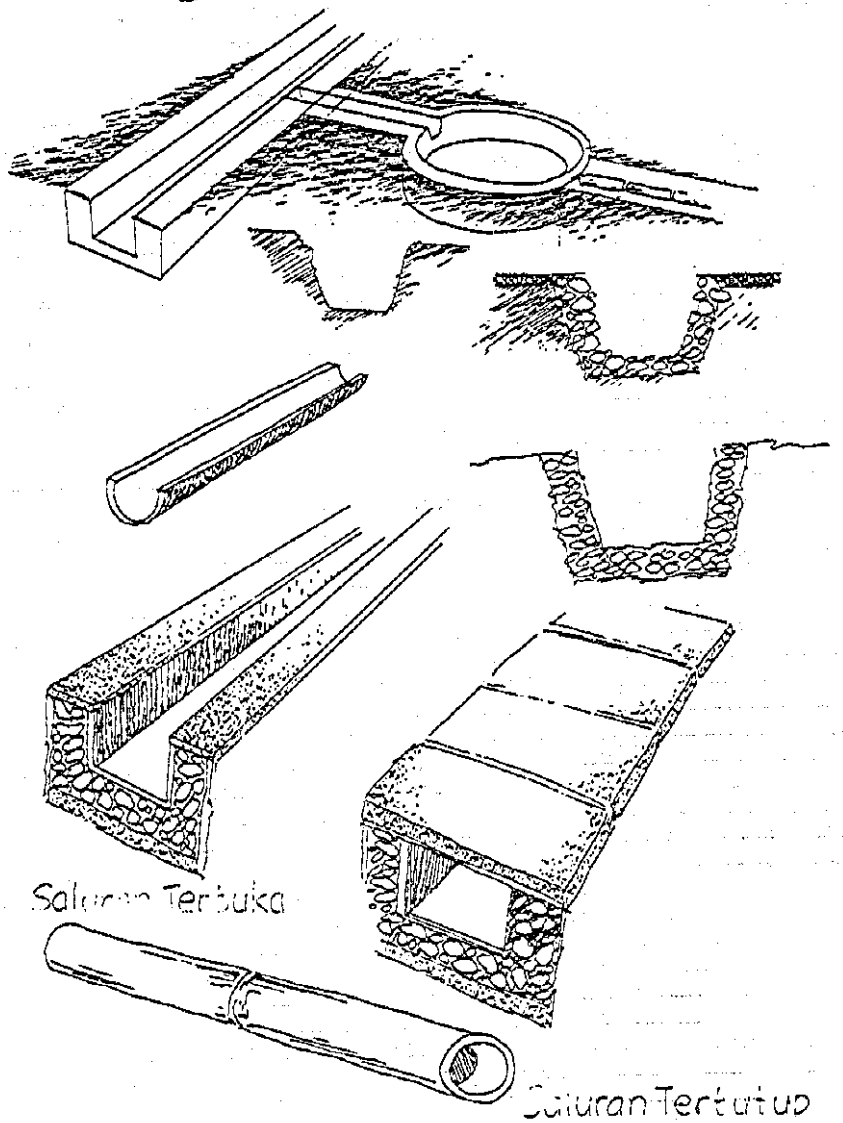


Selokan Baru.
Menyambung selokan baru menuju bak penampung - air kotor.

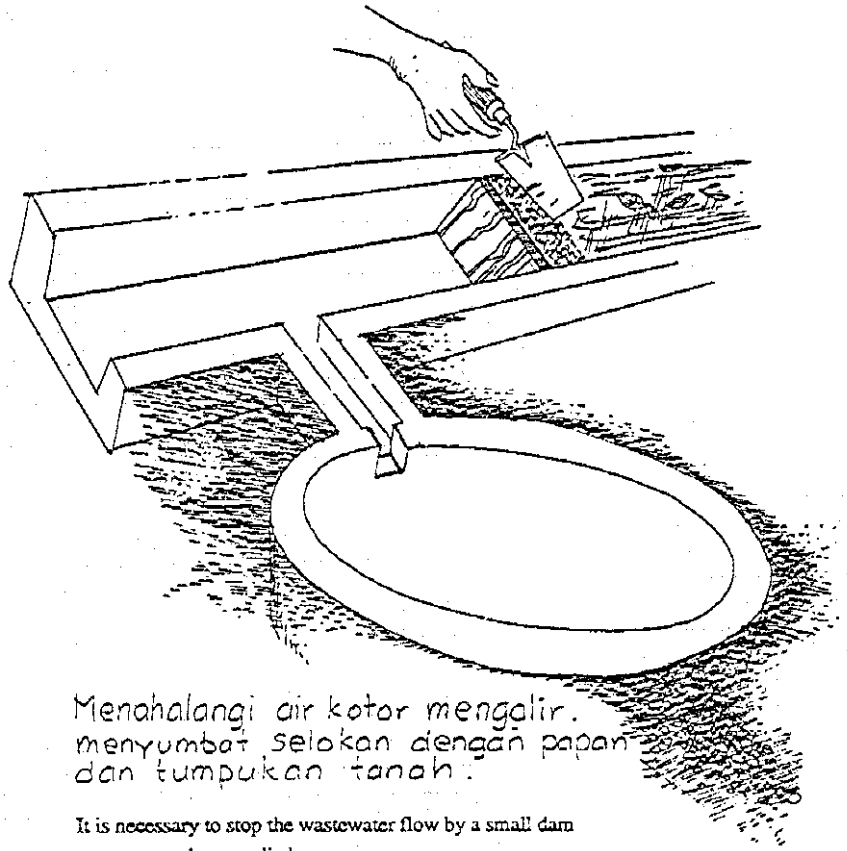
Make a new ditch to connect present drain up to the receiving chamber

Several kinds of ditch for newly constructed ditch

SALURAN PEMBUANGAN AIR HUJAN DAN LIMBAH CAIR.

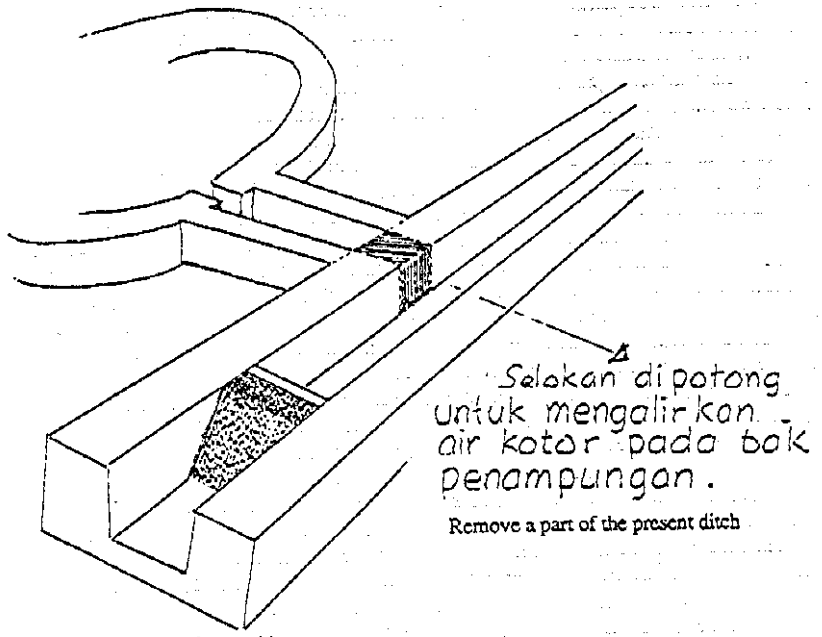


Preparation for new ditch construction



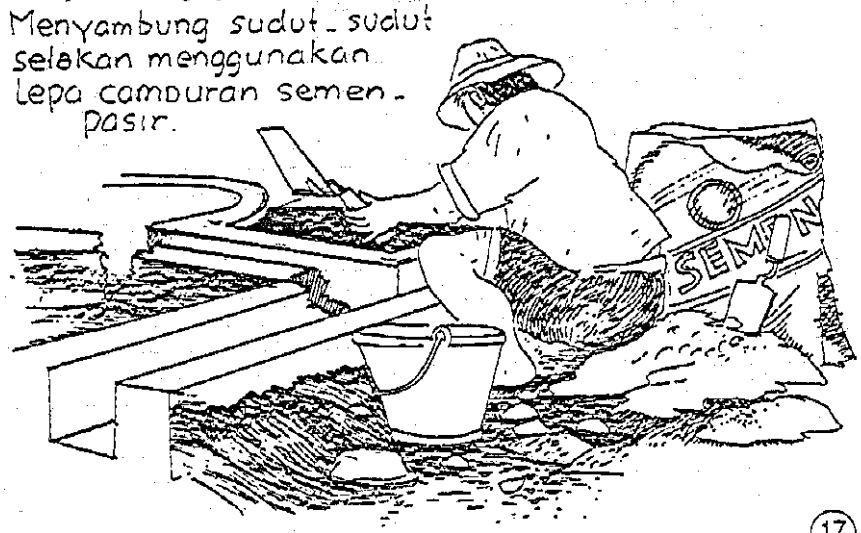
Menahalangi air kotor mengalir.
menyumbat selokan dengan papan dan tumpukan tanah.

It is necessary to stop the wastewater flow by a small dam to construct the new ditch.

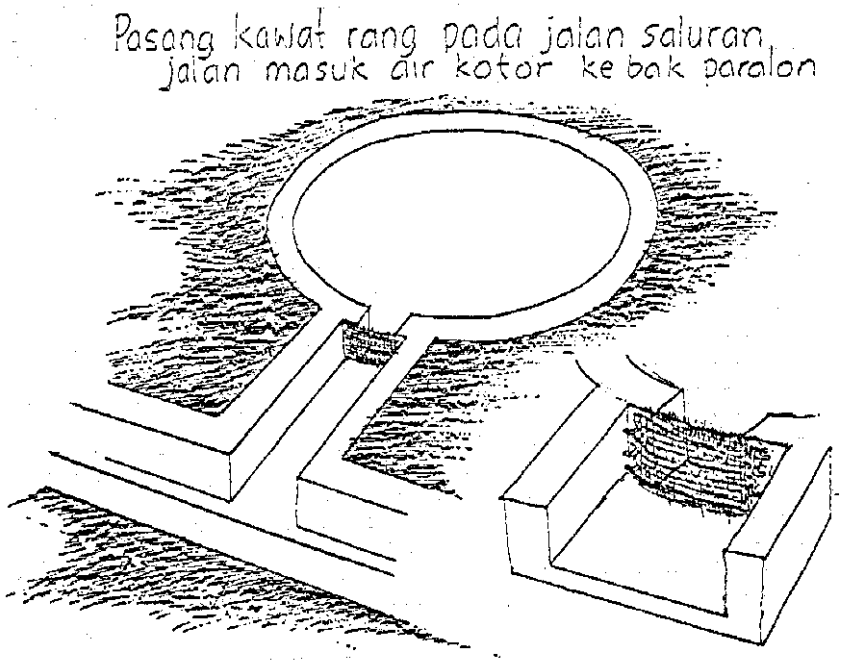


Remove a part of the present ditch

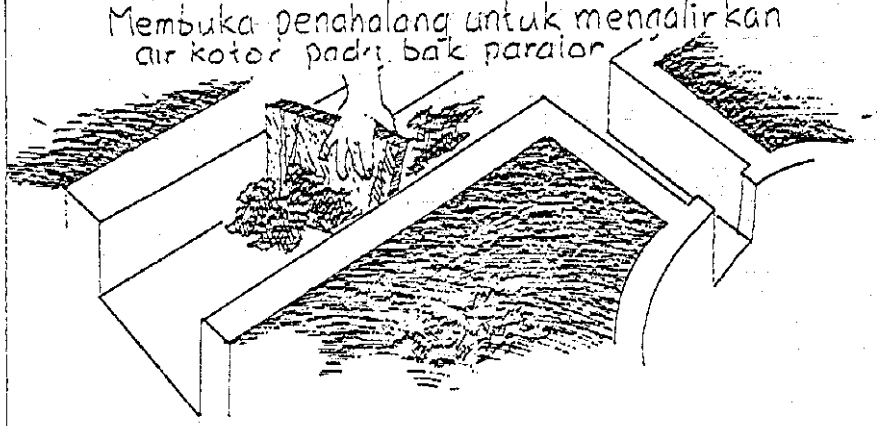
And repair the damaged part with mortar.



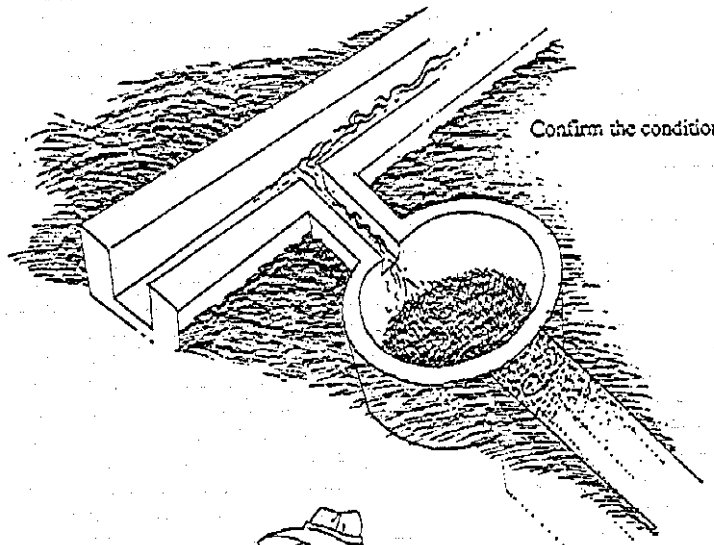
Set up screen with wire net at the inlet of the receiving chamber.



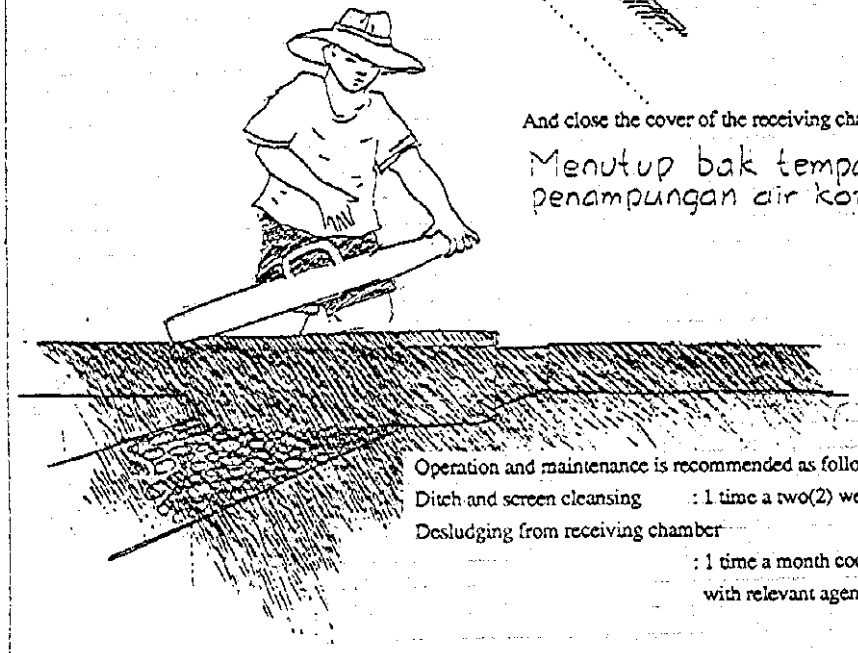
Introduce the wastewater flow removing the small dam



PEMELIHARAAN ALIRAN DAN KONDISI PEREMBESAN



Confirm the condition of wastewater flow



And close the cover of the receiving chamber.

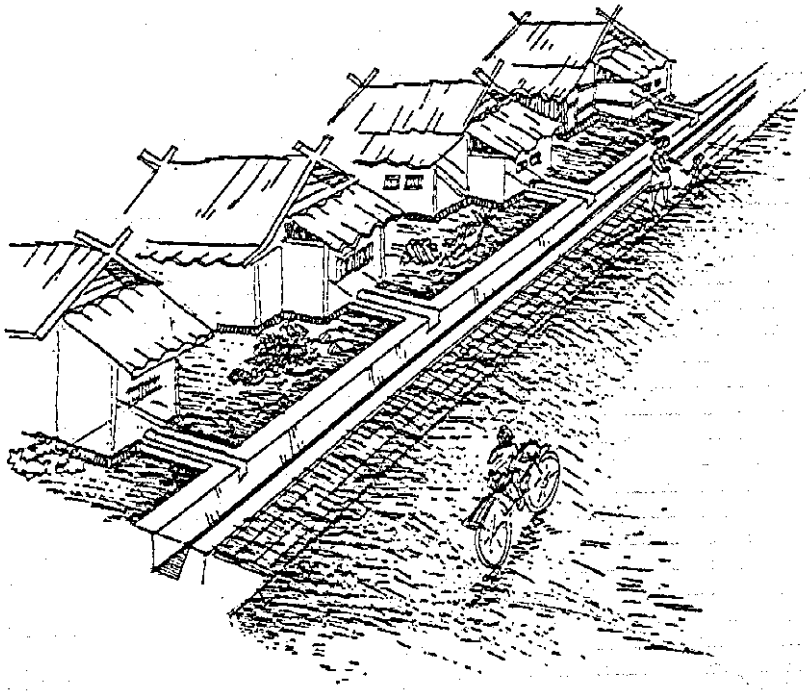
Menutup bak tempat penampungan air kotor

Operation and maintenance is recommended as follows.

Ditch and screen cleansing : 1 time a two(2) weeks

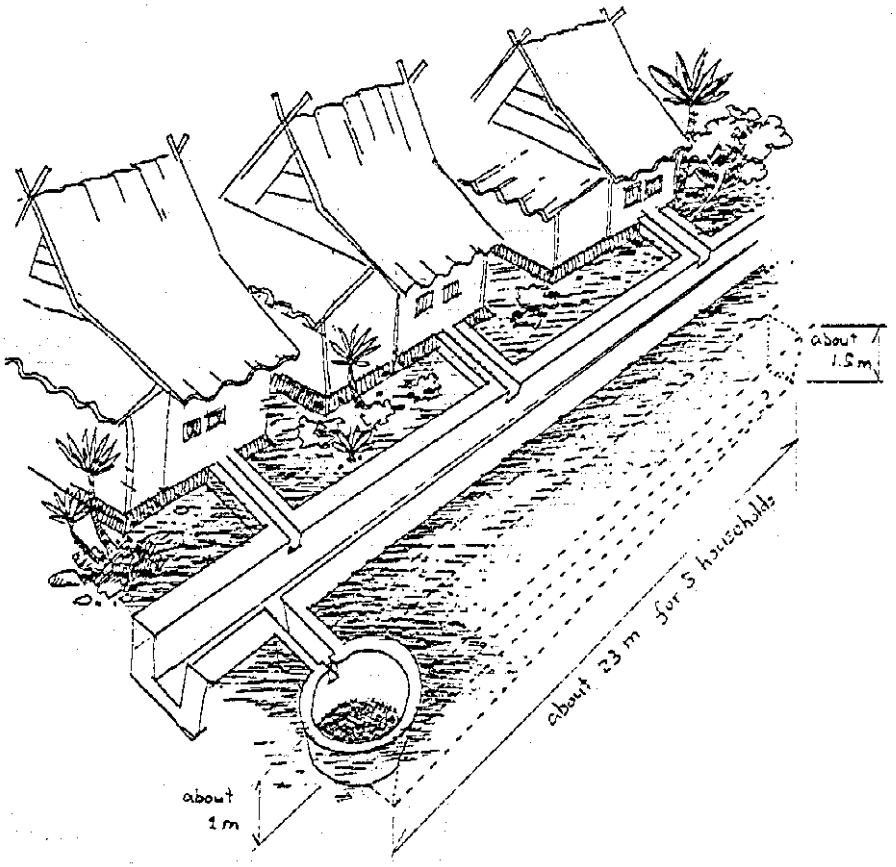
Desludging from receiving chamber : 1 time a month cooperated with relevant agency

Construction Manual for Infiltration Trench of some households



Present condition of wastewater discharge along road

Planning figure for some household with infiltration trench



Construction order is same to the previous infiltration trench for household, but the size is different.

JICA