JAPAN INTERNATIONAL COOPERATION AGENCY(JICA)

MUNICIPAL WATER SUPPLY PUBLIC CORPORATION(EMPAGUA)
THE REPUBLIC OF GUATEMALA

THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA

FINAL REPORT

VOLUME IX
DATA BOOK

AUGUST 1996

NIHON SUIDO CONSULTANTS CO.,LTD.
PACIFIC CONSULTANTS INTERNATIONAL

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LIST OF REPORTS

DATA BOOK DA

SURVEY ON EXISTING SMALL-SCALE SEWAGE TREATMENT PLANTS

DATABOOK DA
SURVEY ON SMALL-SCALE SEWAGE TREATMENT PLANTS
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DA 1 Outline of Existing Treatment Plants

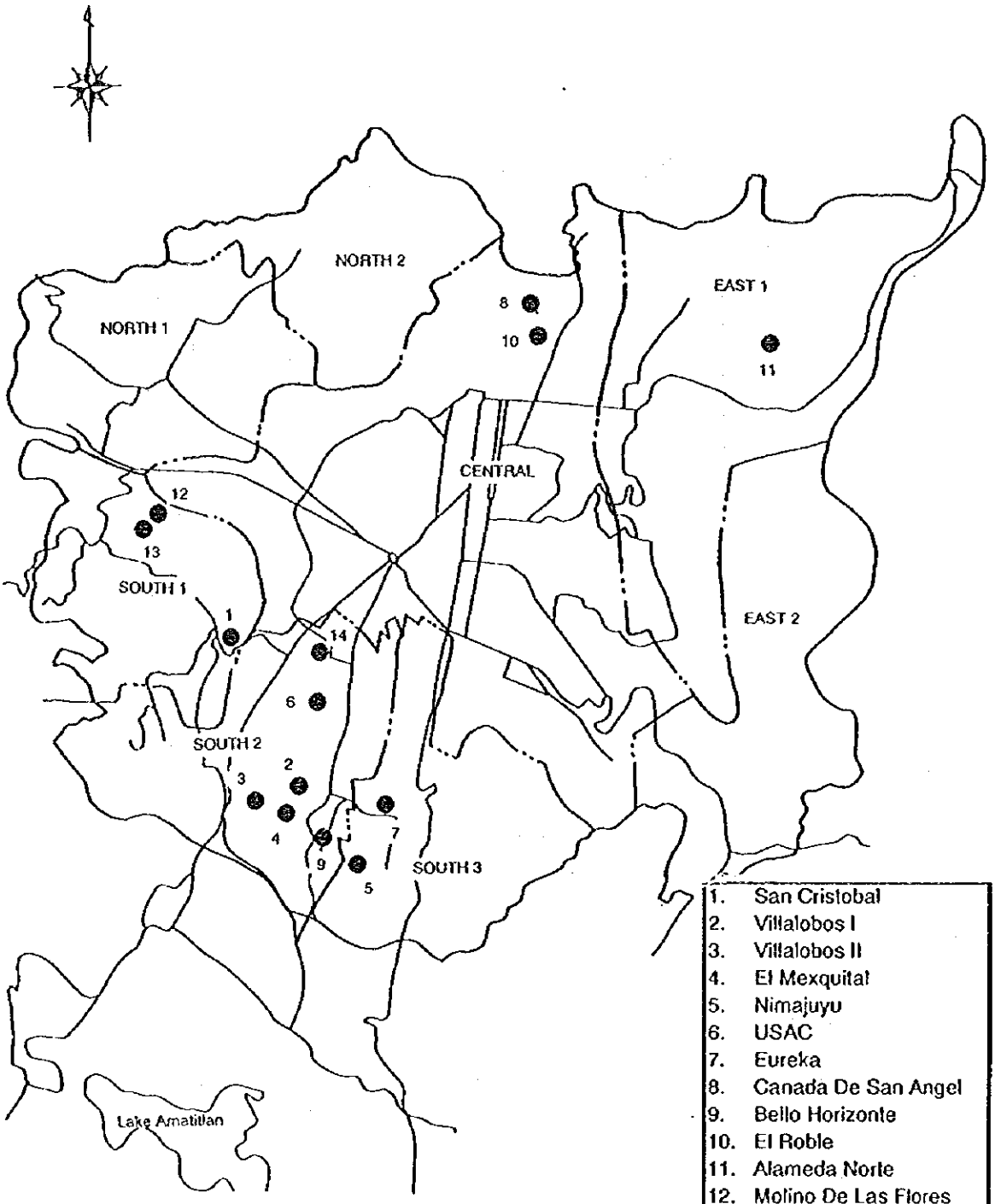
DA 1 Outline of Existing Treatment Plants (1/2)

No.	Name	Adress	Owner	Institution Reseponible For O/M	Treatment Process
1	San Cristobal	Boulevard a Balcones de San Cristobal, entrada planta a Orillas Rio El Campanero	DEINCO	DEINCO	Oxidation ditch --> Sedimentation --> Infiltration well --> Sludge Drying beds
2	Villalobos I	Entrada por la 6ta. ave y 12 calle zona 12 Col. Villalobos I	DAHVI	DAHVI	Sedimentation --> Trickling filters I, II, III --> Final clarifier --> Digester --> Sludge Drying beds
3	Villalobos II	1a. avenida y 54 calle final, zona 12 Colonia Villalobos II	DAHVI	DAHVI	Sedimentation --> Trickling filters I, II, --> Final clarifier --> Digester --> Sludge Drying beds
4	El Mezquital	Entrada por la 1a. calle y 6ta. avenida final zona 12, El Mezquital	DAHVI	DAHVI	Sedimentation --> Trickling filters I, II, III --> Final clarifier --> Digester --> Sludge Drying beds
5	Nimajuyu	Entrada a un costado de el modulo No. 15-B, Col. Nimajuyu zona 21	DAHVI	DAHVI	Imhoff tank --> Trickling filters I, II, --> Secondary Sedimentation tank --> Sludge Drying beds
6	USAC	Ciudad Universitaria zona 12 Guatemala	USAC	USAC	Sedimentation --> Trickling filters I, II, III --> Final clarifier --> Digester --> Sludge Drying beds
7	Eureka	Boulevard Justo Rufino Barrios y 35 calle atras C. Comercial Eureka, zona 12	PRIVATE	PRIVATE	Sedimentation (Dortmund) --> Trickling filter --> Final Clarifier --> Sludge drying beds
8	Canadas de San Angel	Residenciales Canadas de San Angel, Carretera a Chinautla Kilometro 4.5	IHNSA	IHNSA	Imhoff --> Sedimentation --> Sludge Drying bed Drainage channel
9	Bello Horizonte	Carretera a San Miguel Petapa zona 21, a un costado de Fabrica Lacatex	DAHVI	DAHVI	Imhoff --> Trickin filters I, II --> Final Clearifier --> --> Sludge drying beds
10	El Roble	Residenciales El Roble Carretera a Chinautla Kilometro 4.0	IHNSA	IHNSA	Imhoff tanks --> Infiltration wells --> Sludge drying beds
11	Alameda Norte	Colonia Alameda Norte Zona 18, Guatemala	Municipalidad de Guatemala	ARMSA	Biodigester --> Infiltration wells --> Sludge drying beds
12	Molino de las Flores	48 avenida 'A' y 34 calle 'A' zona 11 Colonia Molino de las Flores	Municipalidad de Mixco	Municipalidad de Mixco	Septic tank --> Ground infiltration wells
13	Lomas de Portugal	3a. avenida final Colonia Lomas de Portugal Zona 11 Guatemala	Municipalidad de Mixco	Municipalidad de Mixco	Septic Tank
14	El Carmen				

DA 1 Outline of Existing Treatment Plants (2/2)

No.	Name	Year of Commencement Operations	Flowrate (M3/DAY)	Design Population	Sewered Area	Rehabilitation Costs
1	San Cristobal	1976	2100	10000	200	Q.974,727.00 $.174,100.00
2	Villalobos I	1985	1884	26000	40.9	Q.1,114,522.50 $.199,100.00
3	Villalobos II	1985	1812	25000	46.8	Q.1,220,115.00 $.217,900.00
4	El Mezquital	1980	1332	25000	46.9	Q.738,231.00 $.131,900.00
5	Nimajuyu	1981	1152	10650	25.5	Q.98,475.00 $.17,600.00
6	USAC	1991	1580	18000	122.8	Q.521,430.00 $.93,200.00
7	Eureka	1991	180	1800	3.3	Q.89,505.00 $.16,000.00
8	Canadas de San Angel	EX	540	3155	3.7	Q.192,075.00 $.34,300.00
9	Bello Horizonte	1987	780	8500	12.7	Q.696,832.50 $.124,500.00
10	El Roble	1990	100	1400	4.2	Q.120,315.00 $.21,500.00
11	Alameda Norte	1984	212	500	1.2	ARMSA BID
12	Molino de las Flores	1973	600	3000	192	Q.130,650.00 $.23,400.00
13	Lomas de Portugal	1970	144	700	16.2	Q.638,722.50 $.114,100.00
14	El Carmen				1.5	

Fig. DA - 1



THE REPUBLIC OF GUATEMALA GUATEMALA MUNICIPAL WATER SUPPLY PUBLIC CORPORATION (EMPAGUA)	THE STUDY ON THE IMPROVEMENT OF WASTEWATER MANAGEMENT IN THE GUATEMALA METROPOLITAN AREA JAPAN INTERNATIONAL COOPERATION AGENCY	TITLE

DA 2 Cost Estimates for Rehabilitation of Each Existing Treatment Plants

DA 2 Cost Estimates for Rehabilitation of Each Existing Treatment Plants

SUREVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMMENT PLANT
SURVEY DATE: JUNE 1995

PROYECT: SAN CRISTOBAL
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST Q.
1	Plastering	mt²	90.00	564.00	50,760.00
2	Concrete Pipe (18")	mt²	125.00	20.00	2,500.00
3	Covers (1.0*1.0*0.08)	U.	500.00	4.00	2,000.00
4	Counterdrain	m.l	150.00	120.00	18,000.00
5	Side walks and stairs	m.l	80.00	160.00	12,800.00
6	Access road	m.l	1800.00	200.00	360,000.00
7	Components cleaning	U.	5000.00	3.00	15,000.00
8	Electrical equipment	global	35000.00	1.00	35,000.00
9	Paint for Metalic structures	galons	200.00	5.00	1,000.00
10	Covers (0.8*0.8*0.08)	U.	500.00	4.00	2,000.00
11	Door control Room (2.0*1.0)	U.	800.00	1.00	800.00
	SUB-TOTAL DIRECT COST				499,860.00
	General Contingencies 30%	global			149,958.00
	TOTAL DIRECT COST				649,818.00
	ADMINISTRATION 20%				129,963.60
	PROFIT 20%				129,963.60
	TAX 10%				64,981.80
	TOTAL COST OF REHABILITATION				Q974,727.00
					$174.100.00

PROYECT: VILLALOBOS I
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	Perimeter fence	m.l	300.00	400.00	120,000.00
2	Valves (2" Hg)	U.	200.00	84.00	16,800.00
3	Covers (1.0*1.0*0.08)	U.	500.00	1.00	500.00
4	Counterdrain cleaning	m.l	10.00	200.00	2,000.00
5	Access road	m.l	1800.00	150.00	270,000.00
6	Sludge Pipes	m.l	125.00	50.00	6,250.00
7	Structure cleaning	U.	5000.00	3.00	15,000.00
8	Pipes	ml	250.00	504.00	126,000.00
9	Cleaning of acces road	m.l	100.00	150.00	15,000.00
	SUB-TOTAL DIRECT COST				571,550.00
	General Contingencies 30%	global			171,465.00
	TOTAL DIRECT COST				743,015.00
	ADMINISTRATION 20%				148,603.00
	PROFIT 20%				148,603.00
	TAX 10%				74,301.50
	TOTAL COST OF REHABILITATION				Q1,114,522.50
					$199,100.00

PROYECT: VILLALOBOS II
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	Income grill	U.	100.00	1.00	100.00
2	Paint for Metalic structures	galons	200.00	5.00	1,000.00
3	General fences	m.l	300.00	600.00	180,000.00
4	Counterdrain	m.l	150.00	200.00	30,000.00
5	Side walks and stairs	m.l	80.00	120.00	9,600.00
6	Units cleaning	U.	5000.00	6.00	30,000.00
7	Volcanic gravel for filters	global	500.00	750.00	375,000.00
	SUB-TOTAL DIRECT COST				625,700.00
	General Contingencies 30%	global			187,710.00
	TOTAL DIRECT COST				813,410.00
	ADMINISTRATION 20%				162,682.00
	PROFIT 20%				162,682.00
	TAX 10%				81,341.00
	TOTAL COST OF REHABILITATION				Q1,220,115.00
					$217,900.00

PROYECT: MEZQUITAL
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	Plastering	mt²	90.00	1430.00	128,700.00
2	Pannels	mt²	112.00	27.50	3,080.00
3	Sludge Pipes 6"	m.l	45.00	18.00	810.00
4	Flow Pipes HG,2"	mt	250.00	174.00	43,500.00
5	Values HG, 2"	U.	200.00	29.00	5,800.00
6	Counter Drain Cleaning	mt	10.00	220.00	2,200.00
7	General Fence	mt	300.00	420.00	126,000.00
8	Backfilling (Earth)	global	105.00	90.00	9,450.00
9	Protecting Wall	mt²	112.00	45.00	5,040.00
10	Basements	global	30000.00	1.00	30,000.00
11	Side-Walks and Stairs	mt	80.00	150.00	12,000.00
12	Watter Caps	U.	3000.00	4.00	12,000.00
	SUB-TOTAL DIRECT COST				378,580.00
	General Contingencies 30%	global			113,574.00
	TOTAL DIRECT COST				492,154.00
	ADMINISTRATION 20%				98,430.80
	PROFIT 20%				98,430.80
	TAX 10%				49,215.40
	TOTAL COST OF REHABILITATION				Q738,231.00
					$131,900.00

PROYECT: NIMAJUYU
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	Counterdrains	mt	150.00	60.00	9,000.00
2	Anticorrosive Paint	Gal.	200.00	5.00	1,000.00
3	Cleaning of Counterd	mt	10.00	50.00	500.00
4	Unit cleaning	U.	5000.00	8.00	40,000.00
	SUB-TOTAL DIRECT COST				50,500.00
	General Contingencies 30%	global			15,150.00
	TOTAL DIRECT COST				65,650.00
	ADMINISTRATION 20%				13,130.00
	PROFIT 20%				13,130.00
	TAX 10%				6,565.00
	TOTAL COST OF REHABILITATION				Q98,475.00
					$17,600.00

PROYECT: USAC
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	Plastering	mt²	90.00	10.00	900.00
2	Clean Trickling Filters	Global	5000.00	3.00	15,000.00
3	Metalic Pipes 2" H.G.	mt	250.00	482.00	120,500.00
4	Boxes and Cover Cleaning	Global	500.00	10.00	5,000.00
5	General Fences	mt	300.00	420.00	126,000.00
	SUB-TOTAL DIRECT COST				267,400.00
	General Contingencies 30%	global			80,220.00
	TOTAL DIRECT COST				347,620.00
	ADMINISTRATION 20%				69,524.00
	PROFIT 20%				69,524.00
	TAX 10%				34,762.00
	TOTAL COST OF REHABILITATION				Q521,430.00
					$93,200.00

PROYECT: EUREKA - MORSE
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	Maintenance Structues in General	Global	20000.00	1.00	20,000.00
2	Construct Cover	U.	500.00	6.00	3,000.00
3	Counterdrain	mt	150.00	94.00	14,100.00
4	Sidewalks and Stairs	mt	80.00	110.00	8,800.00
	SUB-TOTAL DIRECT COST				45,900.00
	General Contingencies 30%	global			13,770.00
	TOTAL DIRECT COST				59,670.00
	ADMINISTRATION 20%				11,934.00
	PROFIT 20%				11,934.00
	TAX 10%				5,967.00
	TOTAL COST OF REHABILITATION				Q89,505.00
					$16,000.00

PROYECT: CAÑADAS DE SAN ANGEL
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	Sludge Extraction	ml^2	300.00	30.00	9,000.00
2	Intercomunication Sidewalks an steirs	ml^2	80.00	150.00	12,000.00
4	Counterdrain	m.l	150.00	150.00	22,500.00
5	General Fence	ml	300.00	150.00	45,000.00
6	Unit cleaning	U.	5000.00	2.00	10,000.00
	SUB-TOTAL DIRECT COST				98,500.00
	General Contingencies 30%	global			29,550.00
	TOTAL DIRECT COST				128,050.00
	ADMINISTRATION 20%				25,610.00
	PROFIT 20%				25,610.00
	TAX 10%				12,805.00
	TOTAL COST OF REHABILITATION				Q192,075.00
					$34,300.00

PROYECT: BELLO HORIZONTE
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	Repair the floor of Sludge Driying bed	ml^2	150.00	135.00	20,250.00
2	Metalic Pipes	m.l	250.00	290.00	72,500.00
3	Gate Values	m.l	200.00	48.00	9,600.00
4	Counterdrain	m.l	150.00	100.00	15,000.00
5	General Fence	m.l	300.00	800.00	240,000.00
	SUB-TOTAL DIRECT COST				357,350.00
	General Contingencies 30%	global			107,205.00
	TOTAL DIRECT COST				464,555.00
	ADMINISTRATION 20%				92,911.00
	PROFIT 20%				92,911.00
	TAX 10%				46,455.50
	TOTAL COST OF REHABILITATION				Q696,832.50
					$124,500.00

PROYECT: EL ROBLE
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	Plastering, walks of the inhoff tanks.	mt²	90.00	80.00	7,200.00
2	Replace Covers	U.	500.00	10.00	5,000.00
3	Counterdrains	mt	150.00	30.00	4,500.00
4	General fence	mt	300.00	100.00	30,000.00
5	General Cleaning	Global	5000.00	3.00	15,000.00
	SUB-TOTAL DIRECT COST				61,700.00
	General Contingencies 30%	global			18,510.00
	TOTAL DIRECT COST				80,210.00
	ADMINISTRATION 20%				16,042.00
	PROFIT 20%				16,042.00
	TAX 10%				8,021.00
	TOTAL COST OF REHABILITATION				**Q120,315.00**
					$21,500.00

PROYECT: MOLINO DE LAS FLORES
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	General Chec	Global	15000.00	1.00	15,000.00
2	Cover of infiltration wells	U.	500.00	2.00	1,000.00
3	Counterdrain	mt	150.00	20.00	3,000.00
4	General fence	mt	300.00	160.00	48,000.00
	SUB-TOTAL DIRECT COST				67,000.00
	General Contingencies 30%	global			20,100.00
	TOTAL DIRECT COST				87,100.00
	ADMINISTRATION 20%				17,420.00
	PROFIT 20%				17,420.00
	TAX 10%				8,710.00
	TOTAL COST OF REHABILITATION				**Q130,650.00**
					$23,400.00

PROYECT: LOMAS DE PORTUGAL.
ESTIMATION OF REHABILITATION COSTS

No.	ITEM	UNIT	UNIT COST	QUANTITY	TOTAL COST
1	Rebuild septic tank	Global	600.00	48.00	28,800.00
2	Concrete Pipe (18")	mt	125.00	50.00	6,250.00
3	Counterdrain	mt	150.00	20.00	3,000.00
4	General acces routes	mt	1800.00	150.00	270,000.00
5	General Fence	mt	300.00	60.00	18,000.00
6	Covers	U.	500.00	3.00	1,500.00
	SUB-TOTAL DIRECT COST				327,550.00
	General Contingencies 30%	global			98,265.00
	TOTAL DIRECT COST				425,815.00
	ADMINISTRATION 20%				85,163.00
	PROFIT 20%				85,163.00
	TAX 10%				42,581.50
	TOTAL COST OF REHABILITATION				**Q638,722.50**
					$114,100.00

DA 3 Reports of Each Existing Treatment Plants

SAN CRISTOBAL

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANT
DATE: JUNE 1,995

1. GENERAL ASPECTS

1.1 Plant name
WASTE-WATER TREATMENT PLANT, SAN CRISTOBAL

1.2 LOCALIZATION
GRANJAS SAN CRISTOBAL.BOULEVAR PINARES, zone 8 de MIXCO
SAN CRISTOBAL.

2. GENERAL INFORMATION

2.1 OWNER
DEINCO (PRIVATE CONTRUCTOR)

2.2 GOVERMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND/OR
MONITORING.
DEINCO

2.3 CONTRUCTIONS COSTS

2.4 YEAR OF COMENCEMT OPERATIONS
1976

2.5 TREATMENT CAPACITY
87.5 M3/HOUR = 2.100 M3/DAY
With the following components and volumes
-Oxidation lagoon: 2142 m3
-Digestor: 392 m3
-Drying sludge bed: 125 m3

2.6 TREATMENT PROCESS
-Oxidation lagoon
-Sedimentation tank
-Sludge drying beds

2.7 OPERATING CONDITIONS
The plant began operating aproximately in 1,976 with an electromechanic device with motor and paddles wich worked at 50 % capacity because of diferent problems generated by its electro-mechanic components.

2.8 INTITUTION RESPONSIBLE FOR OPERATION AND MAINTENANCE
DEINCO, S.A.

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
Part of San Cristobal Neighborhood

3.2 SEWERED AREA
200 hectares (estimated)

3.3 DESIGN POPULATION
10.000 habitants; based in calculations in annex # 3

3.4 FLOW RATE DESIGN
87.5 m3/hour; based in calculations in annex # 3)

3.5 QUALITY OF THE INFLUENT
Characteristics of wastewater of a neighborhood of medium - income.

3.6 QUALITY OF THE EFFLUENT
The funtioning of the plant is irregular, therefore it is not posible to guaranty the efficiency of the treatment.

3.7 SCHEMATIC DIAGRAM OF OPERATIONS FLOW
See annex # 1 # 2

3.8 DESIGN DETAILS
See annex # 1 and # 2

- Oxidation lagoon
  lenght: 69.00 m
  width: 22.22 m
  depth: 1.50 m
  depth of the perimetral wall and central at the water level: 0.95 m.
  Components: 2 machine boxes of 1.30 x 1.20 m with 3 paddle modules of 25" diameter.

- Sedimentation Tank
  major diameter: 12.70 m
  minor diameter: 0.30 m
  depth: 3.50 m

- Drying sludge beds
  length: 22.50 m
  width: 19.50 m
  depth of silt at the floor level: 0.45 m

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATORS
one

4.2 NAME OF THE OPERATOR
Nobody has being especificaly asigned by DEINCO, S.A.

4.3 SLUDGE REMOVAL
Suspended

4.4 EFFICIENCY OF TREATMENT
Because the electromechanic sistem presents problems in the equipment, the functioning is estimated at 50 % of the operating time. This determines a low eficiency in the treatment.

5. RESEARCH CONCLUSIONS

5.1 STRUCTURAL STATE
Good general conditions

5.2 PIPES STATE
From oxidation-lagoon to Sedimentation tank and sludge drying beds in good conditions.
The inlet pipe present 3 broken sections on the bridge over the EL CAMPANERO river.

5.3 GATE VALVES FOR OPERATIONAL CONTROL
One valve of 6"of HF is in bad operational conditions.

5.4 BOXES AND COVERS
Box cover for valve box is broken
Box covers for initial boxes of the plant are needed

5.5 COUNTERDRAIN
Existing only in the oxidation lagoon area.

5.6 INTERCOMUNICATION SIDE-WALKS AND STAIRS
Not defined

5.7 GENERAL ACCESS ROAD
In bad conditions.

5.8 GENERAL FENCE
Not existing

5.9 ELECTRO-MECHANICAL INSTALATIONS
There are a small control room, with the following components

BETWEEN OXIDATION LAGOON AND SEDIMENTATION TANK
ELECTRO-MOTOR
HP 1.5
HZ. 50
VOLTS 208
AMP 7.0

FOR SLUDGE REMOVAL IN SEDIMENTATION TANK
FUTO MOTOR
HP 2.0
HZ 50
VOLTS 220
AMP 6.02

FOR PALETS OF OXIDATION LAGOON
TOMPTON PARKINSON
HP 20
VOLT 220

FOR AIR COMPRESSOR
LINCOLN MOTOR
HP 9
VOLTS 208-220/440
RPM 1436
AMP 15-15/7.5

ESPECIFICATIONS AND SWITCHS ON CONTROL ROOM
MAIN SWITCH
CATALOG A86344, SERIE A-1
VOLT 575 AC
AMP 200
HP 50 FOR 575 AC VOLT

SWITCH FOR OXIDATION LAGOON
ELECTRICAL APARATUS COMPANY

SWITCH FOR RECYCLING WHEEL
ELECTRICAL APARATUS COMPANY
No. 1779738
HP 1.0
TYPE 121 WATTS
VOLTS 220
HZ 60
PH 3.0

SWITCH FOR AIR COMPRESSOR
GENERAL ELECTRIC
MODEL-300 LINE CONTROL
CATALOG No. GD3215N
HP MAX 7.5
VOLTS 240
AMP 30

All the electrical components and it's conections doesn't have any maintenance.

6. RECOMENDATIONS

6.1 STRUCTURES
It is neccesary mke works of plastering in the external and internal walls of the oxidarion lagoon in proximately distance of 188 mts, and 1.5 mts of high.

6.2 METALICAL STRUCTURES
The bridges and covers have corrosion, it is necessary paint all these componenets.

6.3 PIPES
Necessary change of 20 mts. of concrete pipe (18")

6.4 BOXES AND COVERS
Necessary construc covers as follow:
- 4 covers of 1.0 x 1.0 x 0.08 mts.
- 4 covers of 0.8 x 0.8 x 0.08 mts

6.5 COUNTERDRAINS
Necessary construction of 120 mts of counterdrains from the oxidation lagoon to sedimentation tank and sludge drying.
beds.

6.6 INTERCONEXIONS SIDE-WALKS AND STAIRS
Necessary contruction of 160 mts of side-walks and stairs between the components.

6.7 GENERAL ACCESS ROAD
Necessary rebuilt of 200 x 5 mts off-road to provide a good access to treatment area.

6.8 COMPONENTS CLEANING
Each unit of the waste-water treatment system shoul be perfectly cleaned.

6.9 CONTROL ROOM

It is necessary the instalation of a metalic door for the control room with dimensions as follow: 2.00 x 1.00 M and check full electrical conections betwen the switches.

6.10 ELECTRICAL EQUIPMENT

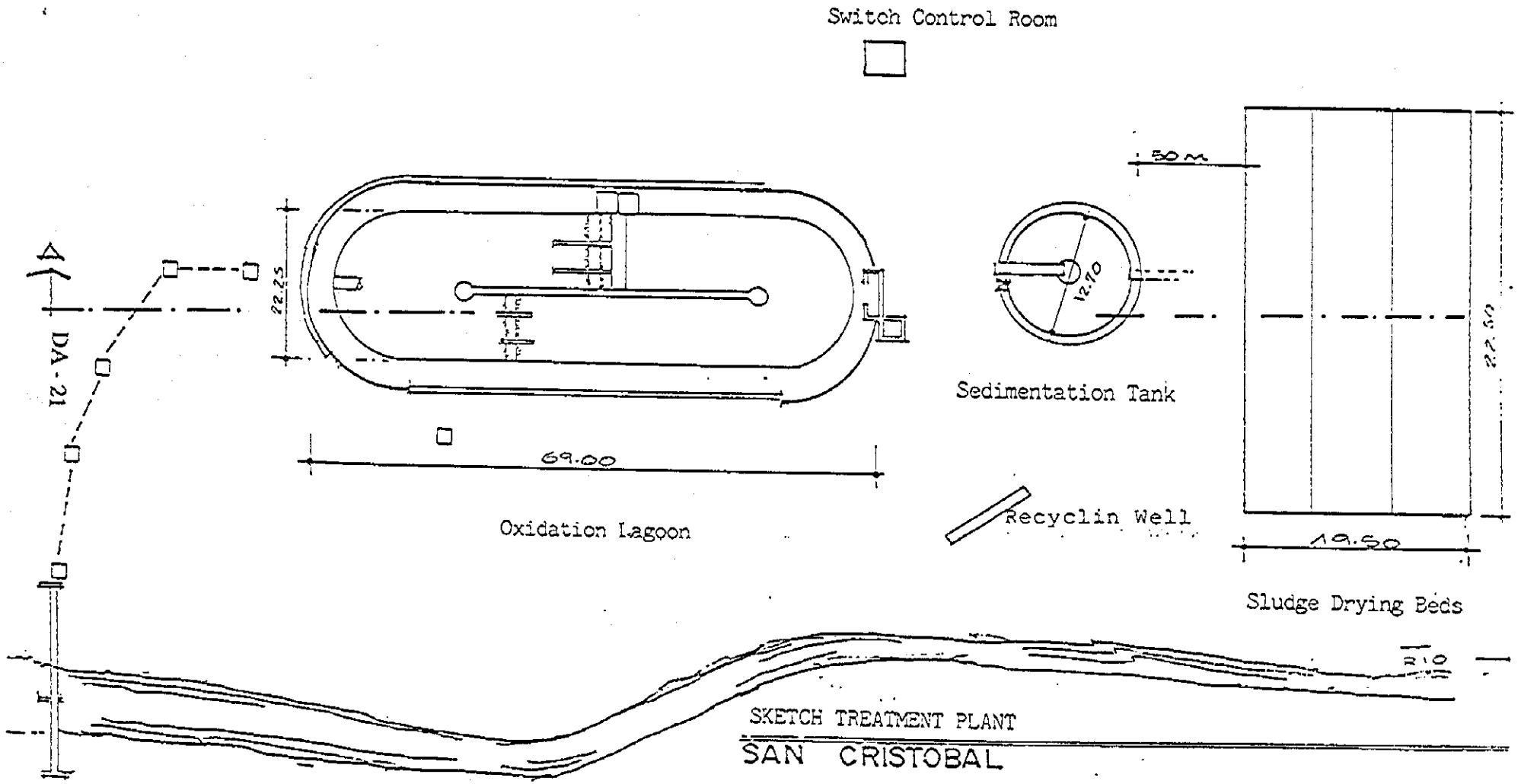
All the electrical motors who provide funcionality to the plant should be replaced, because they already have enough life time service. There are some evidence, that the motors have to be repaired continuosly during the normal operation of the plant.

7.0 FINAL OBSERVATIONS

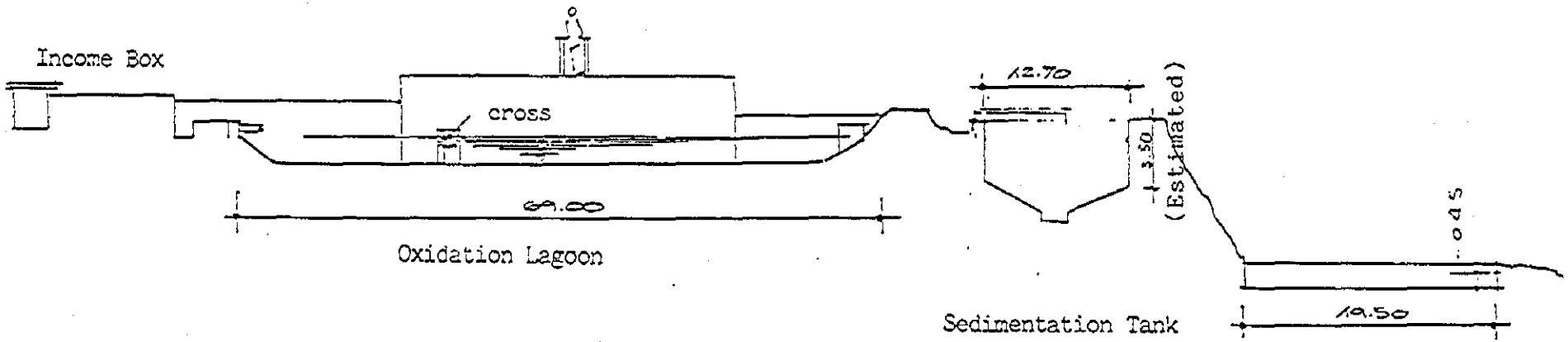
7.1 Because of the three broken sections of the inlet pipe, it is estimate thay only the 50% of the flow goes to the treatment area, and the rest goes directly to El Campanero River.

8.0 FEASIBILITY OF REHABILITATION

8.1 The treatment plant presents general good condition of operational state. It´s posible to rehabilitate under the conditions mentioned on item No.6, cost of these rehabilitation are estimated in an amount of Q. 974,727.00 equal to $.174,100.00


Switch Control Room
DA-21
22.25
69.00
Oxidation Lagoon
12.70
Sedimentation Tank
Recyclin Well
19.50
22.50
Sludge Drying Beds
R10
SKETCH TREATMENT PLANT
SAN CRISTOBAL

DA - 22



HYDRAULIC SKETCH

SIN ESCALA

SAN CRISTOBAL

ANNEX No. 3
WASTEWATER TREATMENT PLANT
SAN CRISTOBAL

		QUANTITY	UNIT	REMARKS
1	SEDIMENTATION TANK			
	1.1 Superficial Area			
	1.2 Volume			
	1.3 Flowrate (R.T.)			
	1.4 Flowrate			
	1.5 Flowrate (M.D.F.)			
	1.6 Flowrate			
	1.7 Population			
	Wastewater volume			
	90 L/H/D			
2	DIGESTER			
	2.1 Volume	392	M3	
	2.2 Volume	392,000	L	
	2.3 Population (30 L/H/D)	9,800	H	
3	SLUDGE DRYING BEDS			
	3.1 Total Area	418	M2	
	3.2 Per Capita Area	0.0304	M2	
	3.3 Population	10,718	H	
4	SUMMARY			
	4.1 Design Flow	87.50	M3/HORA	
	4.2 Population			
	- Primary Sedimentation Tank			
	- Digester	9,800	H	
	- Sludge Drying Beds	10,718	H	
	DESIGN POPULATION	10,000	H	

VILLALOBOS I

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY OF EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANTS
DATE: JUNE 1,995

1. GENERAL ASPECTS

1.1 NAME
WASTEWATER TREATMENT PLANT, VILLALOBOS I

1.2 LOCALIZATION
ASENTAMIENTO VILLALOBOS 1, jurisdiction of VILLA NUEVA

2. GENERAL INFORMATION

2.1 OWNER
BANCO NACIONAL DE LA VIVIENDA BANVI.
actualy the owner is DIRECCION DE ASENTAMIENTOS HUMANOS Y VIVIENDA DAHVI.

2.2 GOVERMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND/OR MONITORING.
Municipality of Guatemala city.

2.3 CONSTRUCTION COST

2.4 YEAR OF COMMENCEMENT OPERATIONS
1985

2.5 TREATMENT CAPACITY
78.5 M3/HOUR = 1,884 M3/DAY
with the following components and volumes
-sedimentation: 313 m3
-digester: 1297 m3
-sludg drying bed: 324 m3

2.6 TREATMENT PROCESS
- flow collector box
- grit chamber
- primary sedimentation tank
- trickling filter phase I
  phase II
  phase III
- secundary sedimentation tank
- digester
- sludge drying beds

2.7 OPERATING CONDITIONS
Good

2.8 INSTITUTION RESPONSIBLE FOR THE OPERATION AND MAINTENANCE
DIRECCION GENERAL DE ASENTAMIENTOS HUMANOS, DHAVI

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
ASENTAMIENTO VILLALOBOS 1

3.2 SEWERED AREA
40.9 hectares (estimation based on data of annex # 3)

3.3 DESIGN POPULATION
28,000 habitants (estimation based on data of annex # 3)

3.4 FLOW RATE DESIGN
78.5 m3/hour (estimation based on data of annex # 3)

3.5 QUALITY OF THE INFLUENT
Normal characteristics of domestic wastewater flow, whit some solid undone like plastic and paper.

3.6 QUALITY OF THE EFFLUENT
60% of efective treatment

3.7 SCHEMATIC DIAGRAM OF OPERATION FLOW
see annex # 1 # 2

3.8 DESIGN DETAILS
see annexed # 1 and # 2

- regulator volume-flow box
  - length: 1.00 m
  - wide: 0.40 m
  - high: 0.40 m

- Grit chamber
  - length: 4.60 m
  - wide: 0.40 m
  - high: 0.80 m

- Primary sedimentation tank
  - major diameter: 11.50 m
  - minor diameter: 0.30 m
  - depth: 9.83 n
  - inlet pipe: pvc 6", 160 psi
  - outlet pipe: pvc 6", 160 psi

- Trickling filters
  it has 3 phase of filters, with the next dimentions:

length:	15.80 m
wide:	8.00 m
depth:	4.00 m

The *granulometry (soil particle size) for the filtrating beds was determinated only for the surface beds.
surface bed: 3"

- secundary sedimentation tank

major diameter:	11.50 m
minor diameter:	0.30 m
depth:	9.63 m
inlet pipe:	pvc 6" 160 psi
outlet pipe:	pvc 6" 160 psi

- digester

major diameter:	18.05 m
minor diameter:	0.30 m
depth:	15.30 m

- Sludge drying bed
  it has 12 drying yards

length:	15.00 m
wide:	6.00 m
high:	0.20 m

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATORS
one

4.2 NAME OF OPERATOR
Erculano Colmenar Estrada

4.3 SLUDGE REMOVAL
primary sedimentation tank: daily
secundary sedimentation tank: daily
digestor: just when sludge overflow capacity

4.4 EFFICIENCY OF TREATMENT
it is estimated that only 60 % of the water is treated, because the distribution flow pipes on trickling filters are damage.

5. CONCLUSIONS OF THE INVESTIGATION

5.1 STRUCTURAL CONDITIONS
Good general conditions

5.2 PIPES STATE
Pipes on Trickling filters are with corrosion.

5.3 GATE VALVES FOR CONTROL OPERATIONAL
Valves on trickling filter with corrosion, 84 valves.

5.4 BOXES AND COVER
The cover of the first box for sludge removal is broken, this is causing an overflow during the removal of sludge from the primary sedimentation tank.

5.5 COUNTERDRAINS
70 % of the perimetral counterdrains are covered with soil and grass.

5.6 INTERCOMUNICATION SIDE-WALKS AND STAIRS
In general good conditions, only need a cleaning by the responsible person.

5.7 GENERAL ACCESS ROADS
There are two diferent access roads, one is for the upper part of the plant: in good conditions, and the second one is for the lower part of the plant in the Sludge drying beds area: who are covered with grass, and other materials.

5.8 SLUDGE DRYING BEDS
There are not in use, because the interconection pipe from digester to sludge drying beds are blocked. The watchman use the yards for agricultural purpose.

6. RECOMENDATIONS

6.1 STRUCTURES
It is necesary to provide adecuated maintenance to the estructures, the structures are in good shape but they need periodical maintenance.

6.2 PIPES
It is necesary to change 84 pipes of 2" HG, and repair connection in firts box for removal sludge.

6.3 GATE VALVES
It is necesary to change HG 2" 84 valves in trickling filters, wich the screw-thread have corrosion.

6.4 BOXES AND COVERS
It is necesary to construct new covers for the first sludge removal box, to provide a good sanitary seal, same as the inlet digester box.

6.5 COUNTERDRAIN
It is necessary provide continuos cleaning for a good rain water sewered.

6.6 GENERAL FENCE
It is necesary provide a perimeter fence to the plant area, because the posibility of invaders and also to avoid garbage dump in the area. The perimetral fence wall most
be long of 400 mts. with gate.

6.7 SLUDGE DRYING BEDS
It´s necessary change the interconection pipe between the digester and the sludge drying beds.

6.8 GENERAL ACCESS ROAD
It´s necessary seed grass in the occidental slape of the acces and avoid land-slide failure over the counterdrains.
It´s necessary the cleaning of 150 mts of the access road.

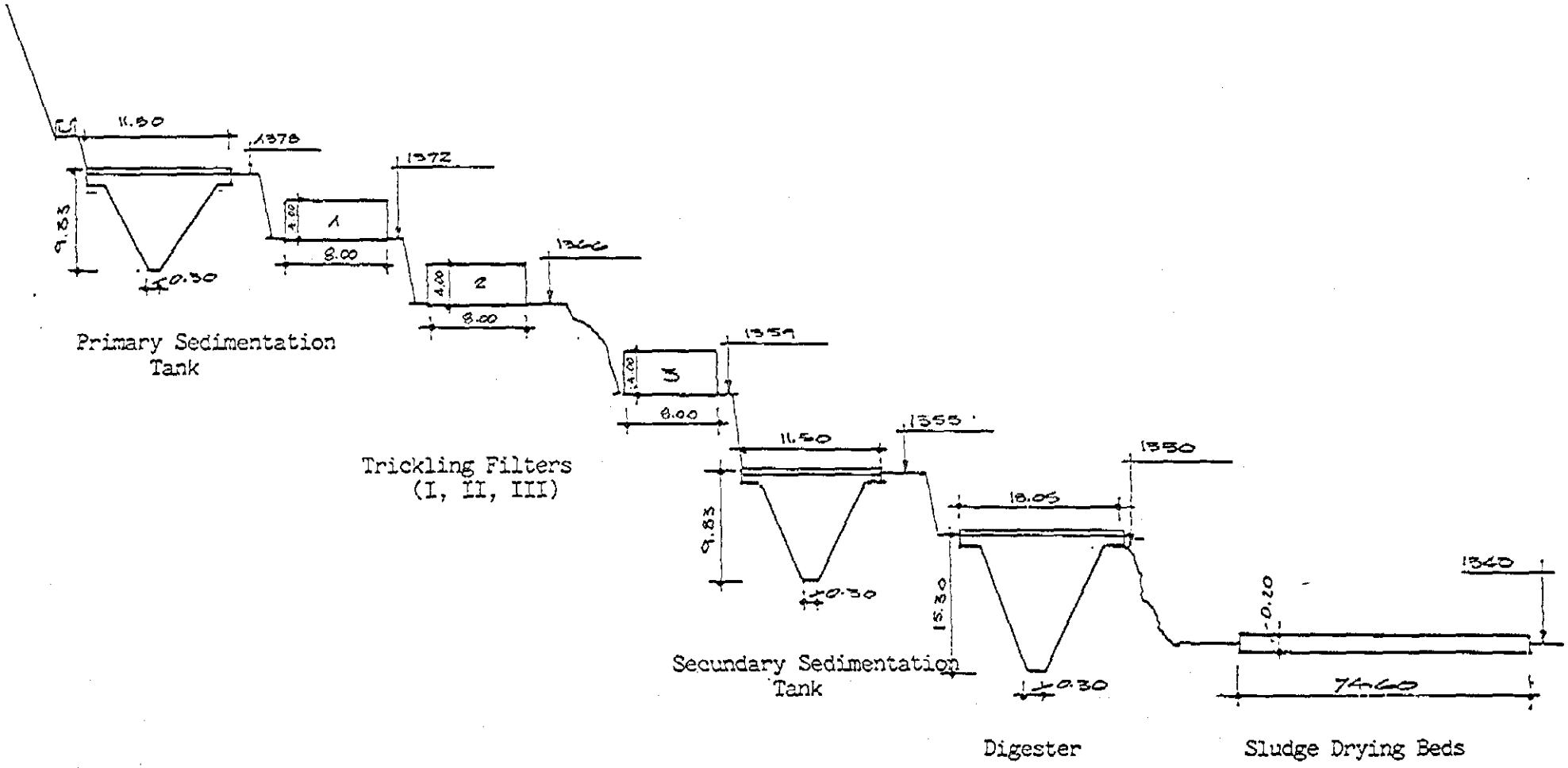
7. FINAL CONSIDERATIONS

7.1 QUALIFIED SUPERVISION
It is convenient to designate a certified person to supervise the operation and maintenance of the plan.

7.2 EQUIPMENT AND CUALIFICATIONS
It is necesary provide to the people in charge of maintenance the necesary tools and adequate equipment for their job. It is necesary to train them for the tasks that they are responsable for.

8. FEASEABILITY OF REHABILITATION AND/OR MAINTENANCE

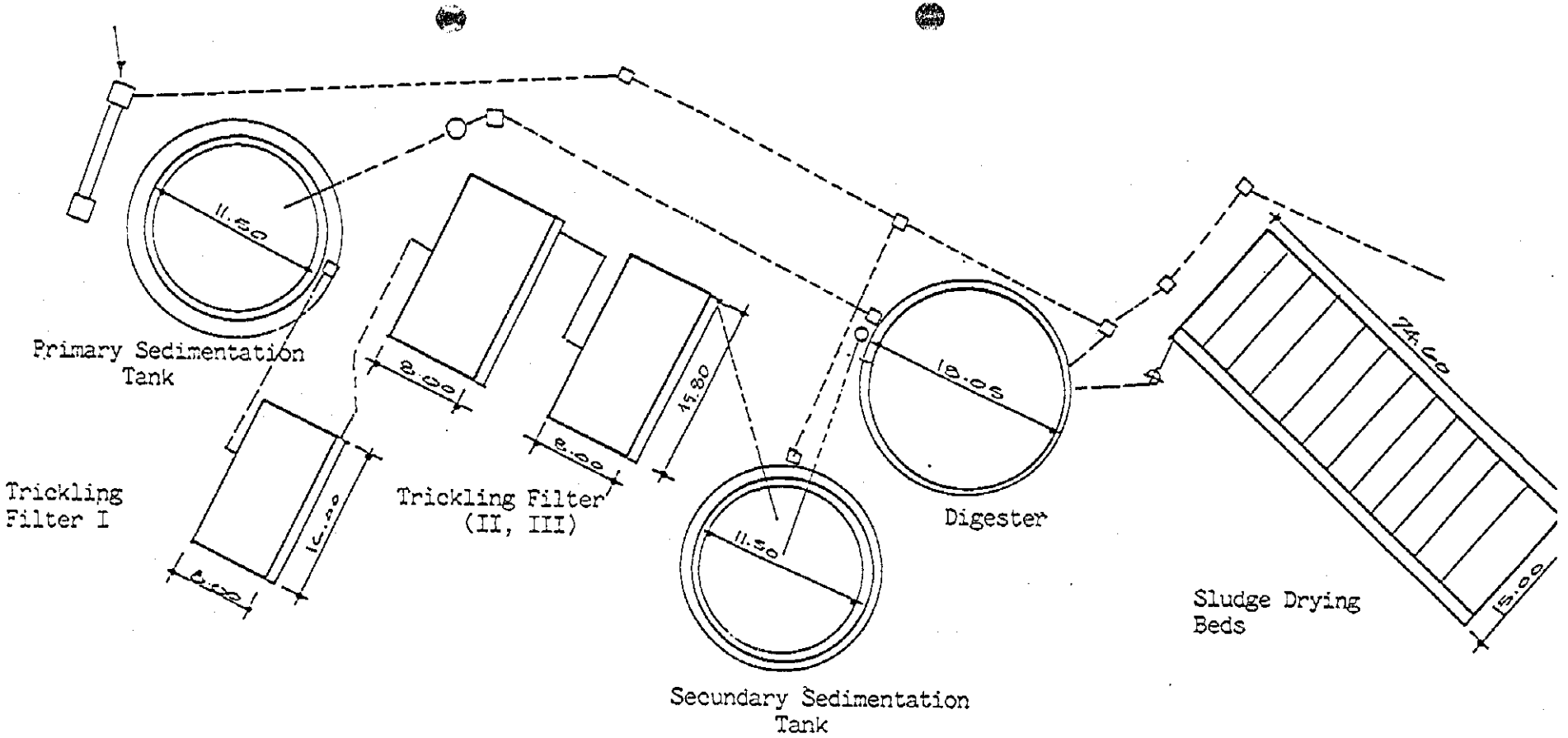
8.1 The plant presents regular conditions for operation; it is posible to fully operate it under the conditions especified in item 6, ascending the estimated cost to Q.1,114,522.50 equal to US$.199,100.00.



HYDRAULIC SKETCH

VILLA LOBOS I

DA - 30



Sketch Treatment Plant SIN ESCALA

VILLA LOBOS I

ANNEX No. 3
WASTEWATER TREATMENT PLANT
VILLALOBOS I

		QUANTITY	UNIT	REMARKS
1	SEDIMENTATION TANK			
	1.1 Superficial Area	104	M2	
	1.2 Volume	313	M3	
	1.3 Flowrate (R.T.)	157	M3/HOUR	
	1.4 Flowrate	3,768,000	L/DAY	
	1.5 Flowrate (M.D.F.)	78.50	M3/HOUR	
	1.6 Flowrate	1,884,000	L/DAY	
	1.7 Population			
	Wastewater volume population			
	90 L/H/D	21,000	H	
2	DIGESTER			
	2.1 Volume	1,297	M3	
	2.2 Volume	1,297,000	L	
	2.3 Population (30 L/H/D)	43,233	H	
3	SLUDGE DRYING BEDS			
	3.1 Total Area	1,080	M2	
	3.2 Per Capita Area	0.0590	M2	
	3.3 Population	18,305	H	
4	SUMMARY			
	4.1 Design Flow	78.50	M3/HOUR	
	4.2 Population			
	- Primary Sedimentation Tank	21,000		
	- Digester	43,233	H	
	- Sludge Drying Beds	18,305	H	
	DESIGN POPULATION	28,000	H	

VILLALOBOS II

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANTS
DATE SURVEY: JUNE 1995

1. GENERAL ASPECTS

1.1 NAME
WASTEWATER TREATMENT PLANT, VILLALOBOS II

1.2 LOCALIZATION
Asentamiento Villalobos II, Zone 12, Guatemala
Jurisdiction of VILLA NUEVA municipium.

2. GENERAL INFORMATION

2.1 OWNER
BANCO NACIONAL DE LA VIVIENDA BANVI.
Actualy the owner is the Dirección de Asentamientos Humanos y Vivienda, DAHVI

2.2 GOVERNMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND/OR MONITORING.
Banco Nacional de la Vivienda, BANVI

2.3 CONSTRUCTION COSTS

2.4 YEAR OF COMMENCEMENT OF OPERATION
1985

2.5 TREATMENT CAPACITY
75.5 M3/HOUR = 1,812 M3/DAY
With the following components and volumes

-Primary sedimentation tank:	301 m3
-Trickling phase I, II	
-Secundary sedimentation tank	301 m3
-digester:	1297 m3
-sludge drying bed:	151 m3

2.6 TREATMENT PROCESS
- Box collector, grit chamber, small grill
- Primary sadimentation tank (Imhoff tank)
- Trickling filter phase I and II
- Secundary sadimentation tank (Imhoff tank)
- digester
- drying sludge bed

2.7 OPERATION CONDITION
The plant never was setting operate properly. At the incoming of the wastewater to the plant, through a by pase is derived to a ravine in the surroundings.

2.8 INSTITUTION RESPONSIBLE FOR THE OPERATION AND MAINTENANCE.
Dirección de Asentamientos Humanos y Vivienda, DAHVI.

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
ASENTAMIENTO VILLALOBOS II

3.2 SEWERED AREA
46.8 HA (estimation based on data of annex # 3)

3.3 DESIGN POPULATION
25.000 inhabitants (estimation based on data of Annex # 3)

3.4 DESIGN FLOW RATE
75.5 M3/HOUR

3.5 INFLUENT QUALITY
The normal characteristics of the domestic wastewater of people of low income.

3.6 EFFLUENT QUALITY
The plant is not in operation, because the flow is been desviated through a by-pass to a surface drainage.

3.7 SCHEMATIC DIAGRAM OF OPERATIONS FLOW
See annex # 1 # 2

3.8 DESIGN DETAILS
See annexed # 1 and # 2

- Grit chamber
  length: 7.50 m
  width: 2.40 m
  high: 0.95 m - 1.80 m
  components: gate, grill

- Primary sedimentation tank
  major diameter: 11.53 m
  minor diameter: 0.30 m
  depth: 8.97 m
  inferior camera high: 1.85 m
  channel collector: width 0.40, high 0.40
  inlet pipe: pvc 6", 160 psi
  outlet pipe: pvc 6", 160 psi

- Secundary sedimentation tank
  The same dimension of the primary sedimentation tank

- Trickling filter
  It has two filters phases, with the next dimentiones:
  length: 17.30 m
  width: 8.20 m
  depth: 3.12 m

  each filter have two modules of:
  length: 8.20
  width: 8.20

  The granulometry for the trickling filters is:
  primary phase:
  top bed: 4" - 6"
  middle bed: 3" - 4"
  bottom bed: 2" - 3"

- Digester
  major diameter: 18.05 m
  minor diameter: 0.60 m
  depth: 15.30 m
  pipe arise from sedimentation tank: PVC 6" 160 psi
  Sludge removal pipe: PVC 6" 160 psi

- Drying sludge bed
  It has 1 drying sludge bed in circular form,
  superficial area: 603 m2
  high: 0.25 m

4. OPERATION AND MANTENAINCE

4.1 NUMBER OF OPERATORS
one

4.2 NAME OF THE OPERATOR
Juan Vicente Calderon

4.3 SLUDGE REMOVAL
There is not operation neither maintenance.

4.4 EFFICIENCY OF TREATMENT
The treatment plant since its construction never has been in operation. (The reason is unknown)

5. CONCLUSIONS OF THE RESEARCH

5.1 SHAPE OF THE STRUCTURES
The structures is in good conditions

5.2 SHAPE OF THE PIPES
Good conditions

5.3 GATE VALVES FOR OPERATIONS CONTROL
In good shape. The plant never was in operation

5.4 BOXES AND COVERS FOR VALVES PROTECTION
In good conditions

5.5 COUNTERDRAIN
It is not defined

5.6 INTERCOMUNICATION SIDEWALKS AND STAIRS
It is necessary to give a mantenaince

5.7 GENERAL ROADS OF ACCESS
The treatment plant is beside a peatonal street

5.8 GENERAL
It is necesary to provide a total fences, around the treatment plant

6. RECOMENDATIONS

6.1 STRUCTURES
It is necesary incoming grill.

6.2 PIPES
It is necesary to operate the treatment plant to determinated it shape. Some plants are missins on the digester pipe.

6.3 GATE VALVES
Same as above.

6.4 BOXES AND COVER
It is necesary to paint the covers of box valves with a anticorrosive paint.

6.5 COUNTERDAIN
It is necesary to designe and built an efficient system of counterdrain in a length of 200 m.

6.6 GENERAL FENCE
It is necesary sorround with the perimeter fence all the area of treatment plant witl length of 600 m, and 200, 2" HG. posts.

6.7 CLEANING
It is necesary to provide cleaning all the units.

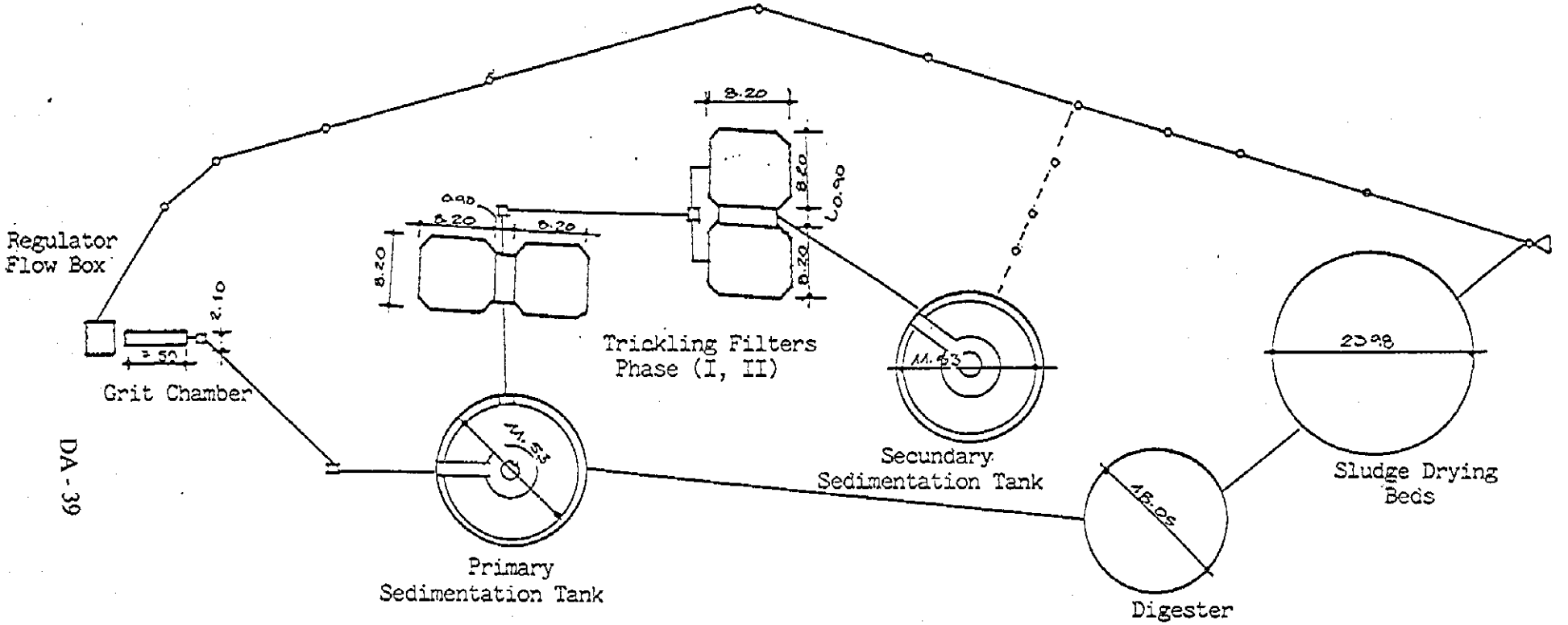
6.8 TRICKLING FILTER.
It is necesary to provide all soil gravel filter medium to a volcanic gravel filtermedia.

6.9 SIDEWALKS EN STAIRS
It is necessary to provide anticorrosive paint to the metal dover of box valve.

7. FEASEABILITY OF REHABILITATION AND/OR MANTENAINCE

7.1 It is necesary to provide an adequated maintenance for the best operation of the plant.

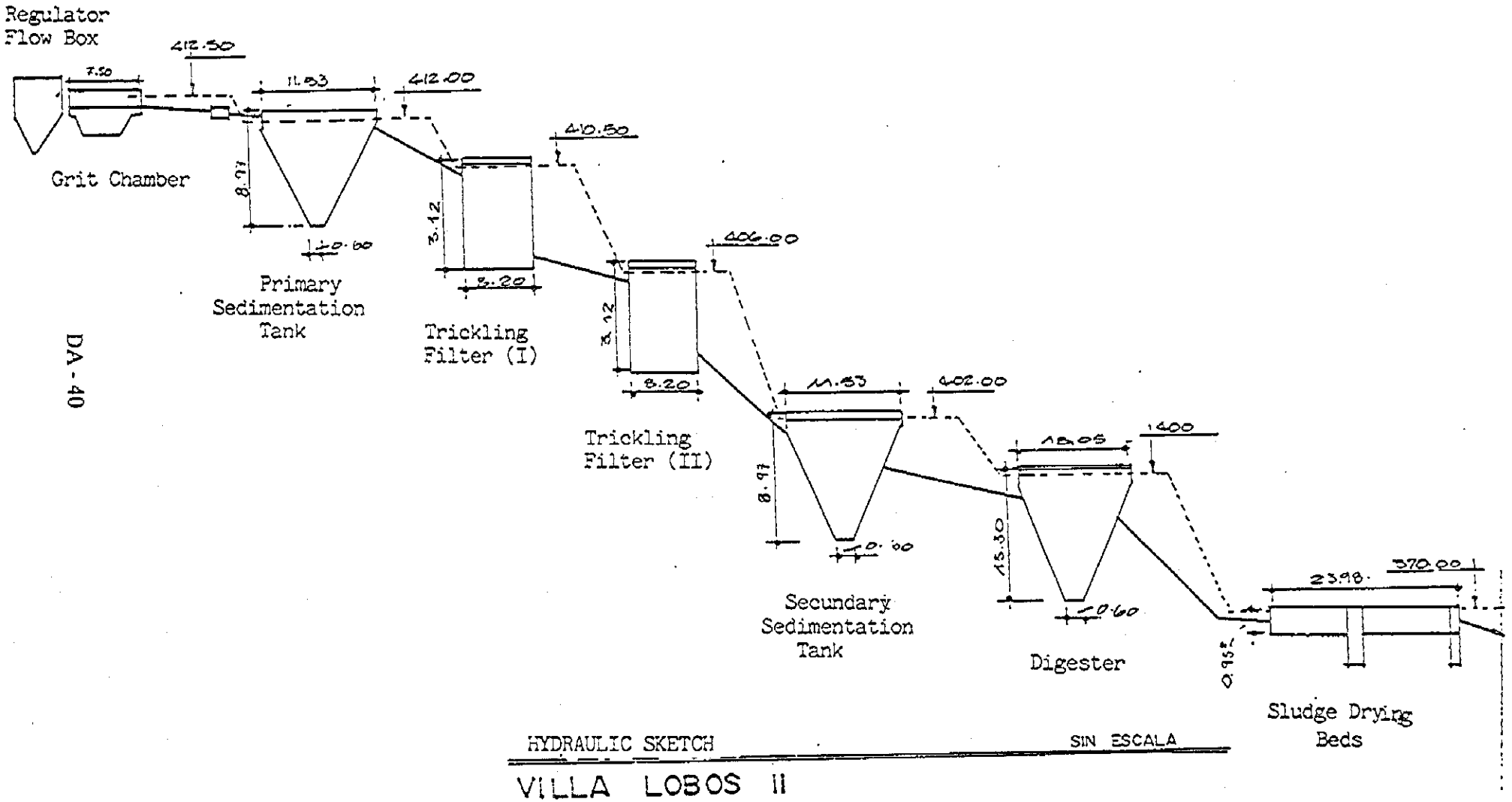
7.2 It is necesary relize the investments indicated in item # 6. total estimated costs are 0.1,220,115.00 equal to U.S $ 217,900.00



DA - 39

SKETCH TREATMENT PLANT — SIN ESCALA

VILLA LOBOS II


Regulator
Flow Box
412.50
7.50
11.53
412.00
Grit Chamber
8.97
0.60
Primary
Sedimentation
Tank
410.50
3.12
5.20
Trickling
Filter (I)
406.00
3.12
5.20
Trickling
Filter (II)
11.53
402.00
8.97
0.60
Secundary
Sedimentation
Tank
15.05
400
15.30
0.60
Digester
23.98
370.00
0.95
Sludge Drying
Beds
DA - 40
HYDRAULIC SKETCH
SIN ESCALA
VILLA LOBOS II

ANNEX No. 3
WASTEWATER TREATMENT PLANT
VILLALOBOS II

		QUANTITY	UNIT	REMARKS
1	SEDIMENTATION TANK			
	1.1 Superficial Area	111.00	M2	
	1.2 Volume	301.00	M3	
	1.3 Flowrate (R.T.)	151.00	M3/HORA	
	1.4 Flowrate	3,617,789.00	L/DIA	
	1.5 Flowrate (M.D.F.)	75.50	M3/HORA	
	1.6 Flowrate	1,812,000.00	L/D	
	1.7 Population			
	Wastewater volume population			
	90 L/H/D	20,133.00	H	
2	DIGESTER			
	2.1 Volume	1,297.00	M3	
	2.2 Volume	1,297,134.00	L	
	2.3 Population (30 L/H/D)	43,238.00	H	
3	SLUDGE DRYING BEDS			
	3.1 Total Area	432.00	M2	
	3.2 Per Capita Area	0.04	M2	
	3.3 Population	11,077.00	H	
4	SUMMARY			
	4.1 Design Flow	75.50	M3/HORA	
	4.2 Population			
	- Primary Sedimentation Tank	20,133.00	H	
	- Digester	43,238.00	H	
	- Sludge Drying Beds	11,077.00	H	
	DESIGN POPULATION	25,000.00	H	

EL MEXQUITAL

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANT
DATE: JUNE 1,995

1. GENERAL ASPECTS

1.1 NAME
WASTEWATER TREATMENT PLANT, EL MEXQUITAL

1.2 LOCALIZATION
ASENTAMIENTO EL MEXQUITAL, zone 12, jurisdiction of VILLA NUEVA

2. GENERAL INFORMATION

2.1 OWNER
BANCO NACIONAL DE LA VIVIENDA BANVI.
actually the responsible institution is DAHVI,
Direccion de Asentamientos Humanos y Vivienda.

2.2 GOVERMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND/OR MONITORING.
BANCO NACIONAL DE LA VIVIENDA BANVI.
DAHVI

2.3 CONSTRUCTION COSTS

2.4 BEGINNING YEAR OF OPERATIONS
1980

2.5 TREATMENT CAPACITY
55.50 M3/HOUR = 1,332 M3
With the follows volumes:
- sedimentation tank: 223 m3
- digester: 1007 m3
- Sludge drying beds: 328 m3

2.6 TREATMENT PROCESS
- flow regulator box
- grit chamber
- primary sedimentation tank
- trickling filters I, II, III.
- secundary sedimentation tank
- digester
- Sludge drying beds

2.7 OPERATION CONDITION
The plant is not working

2.8 INSTITUTION RESPONSIBLE FOR THE OPERATION AND MAINTENANCE.
DIRECCION DE ASENTAMIENTOS HUMANOS Y VIVIENDA
DAHVI

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
Colonia "EL MEXTITAL" ZONA 12.

3.2 SEWEGE AREA
46.9 hectares(estimation based in data of annex # 3)

3.3 DESIGN POPULATION
25,000 habitants, (estimation based in data of annex # 3)

3.4 FLOW DESIGN VOLUME
55.5 m3/hour

3.5 QUALITY OF THE INFLUENT
Normal characteristics of domestic wastewater flow of people of low-income.

3.6 QUALITY OF THE EFFLUENT
The plant is not working.

3.7 SCHEMATIC DIAGRAM OF OPERATION FLOWw
see annex # 1 # 2.

3.8 DESIGN DETAILS
see annexed # 1 and # 2
- flow regulator box
  long: 1.20 m
  wide: 1.00 m
  depth: 0.20 m
- primary sedimentation tank
  major diameter: 10.00 m
  minor diameter: 0.30 m
  depth: 9.10 m
  inlet pipe: pvc 6", 160 psi
  outlet pipe: pvc 6", 160 psi

- trickling filter
  it has 3 filters phases, with the next dimentions:
  lenght: 15.80 m
  wide: 6.20 m
  depth: 3.95 m
  the granulometric size was possible to determinate only for the upper part of the filters.
  top bed: 3"

- Secundary sedimentation tank
  - major diameter: 10.00 m
  - minor diameter: 0.30 m
  - depth: 9.10 m
  - inlet pipe: pvc 6", 160 psi
  - outlet pipe: pvc 6", 160 psi

- Digester
  - major diameter: 16.58 m
  - minor diameter: 0.30 m
  - depth 14.00 m

- Sludge drying beds
  - 10 drying bed
  - lenght: 33.80 m
  - wide: 30.80 m
  - high: 0.20 m

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATORS
1

4.2 NAME OF THE OPERATOR
Manuel de Jesus Marco Paidales

4.3 SLUDGE REMOVAL
without operation and maintenance

4.4 TREATMENT EFFICIENCY
without operation

5. RESEARCH CONCLUSIONS

5.1 STRUCTURAL STATE
The two sedimentation tanks has damage in the internal walls, reason for the filtration out of the flow.
The bridges over the structures (sedimentation tanks), have corrossion.

5.2 STATE OF PIPES
There is corrosion in the distribution pipes of the trickling filters.

5.3 FLOODGATE VALVES FOR OPERATIONS CONTROL
There is corrosion on the valves of the distribution flow on trickling filters.

5.4 COUNTERDRAIN
Some of the counterdrain are covered by soil.

5.5 INTERCOMUNICATION SIDE-WALKS AND STAIRS
Good general conditions, but it has to be cleaned of grass and soil.

5.6 GENERAL ACCESS ROAD
The main road entrance to the plant, has been blocked by
a mechanical garage, who said that he has permission of the authorities to be there.

5.7 SLUDGE DRYING BEDS
The half part of the original drying beds, has been disappear, because it has contac with the river, and this one has drainaged the basement of the beds.

6. RECOMMENDATIONS

6.1 STRUCTURES
Sedimentation tank: it is necessary plastering on the inside of the sedimentation tanks (impermeabilization), and the pannel of the central module of the tank has to be replaced (5.00 x 5.50 mts), the pipes for the sludge removal has to be replaced (3 pipes and 1 TEE of 6" diameter).

6.2 PIPES
It is necessary the change of distribution flow pipes (2" diameter) on trickling filters as follow:
-10 pipes on Filter I
-12 pipes on Filter II
-07 pipes on Filter III

6.3 GATE VALVES
It is necessary the change of gate valves, same diameter and quantity as item 6.2).

6.4 COUNTERDRAIN
Necessary a full periodical cleaning of the counterdrains.

6.6 GENERAL FENCE
The sedimentations tanks has a peripherical fence, with some damages, but it is necessary make a general fence of 420 Mts distance.

6.7 SLUDGE DRYING BEDS
Necessary to make backfilling under the sludge drying beds, in order to provided a good basement for the beds, and it has to built a wall of 15 mts lenght x 3 mts high x 2 mts of basement to protect the structures.

6.8 BASEMENTS
Necessary make a good basements for the admision manifould on tricklingh filters.

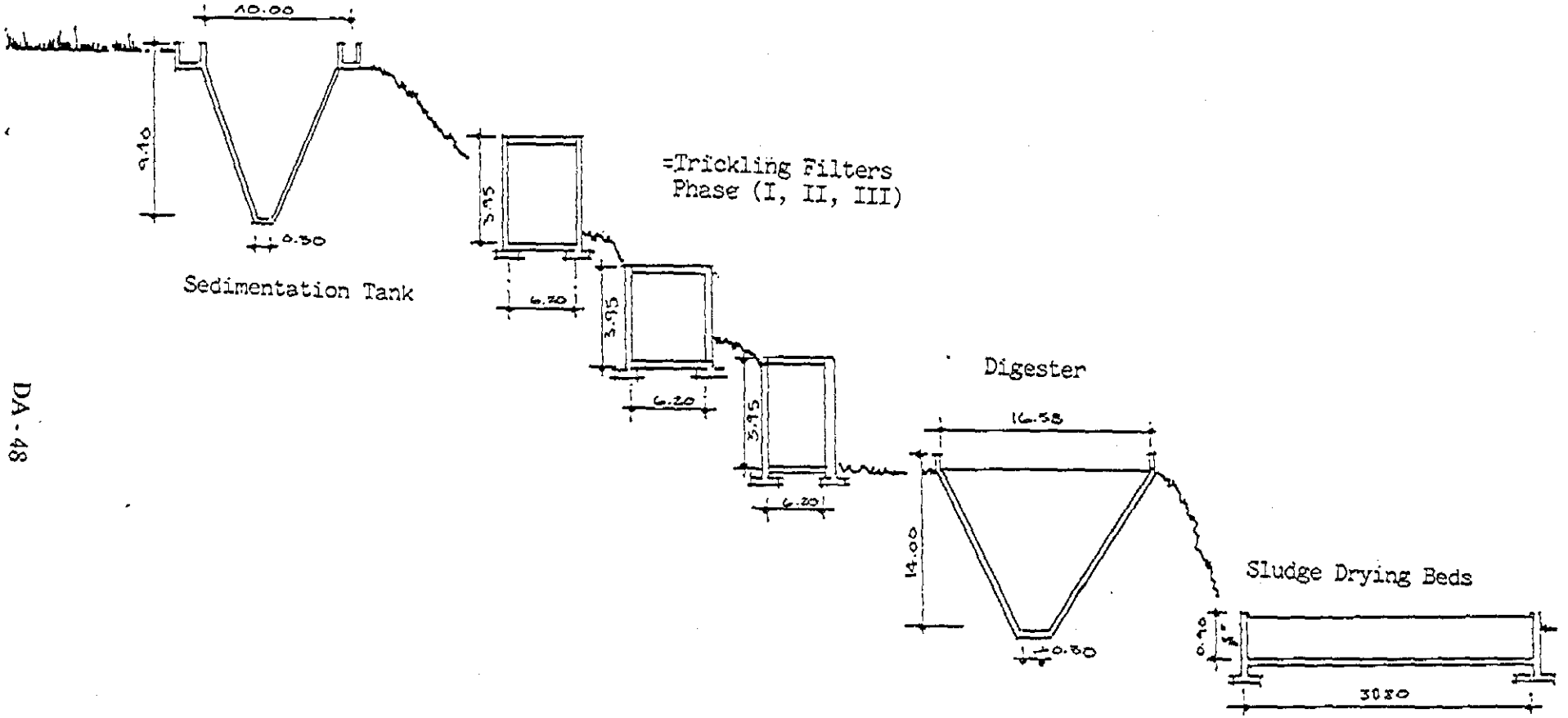
6.9 INTERCOMUNICATIONS SIDE-WALKS AND STAIRS
Necessary construct a 150 mts of side-walks and stairs between the components of the treatment plant.

6.10 WATER CAPS
Necessary the installation of 4 caps for the adecuate cleaning of each components.

6.11 PROTECTION WALL
Necessary make a protection wall on the upper part of the Drying beds, to avoid damage to that structures.

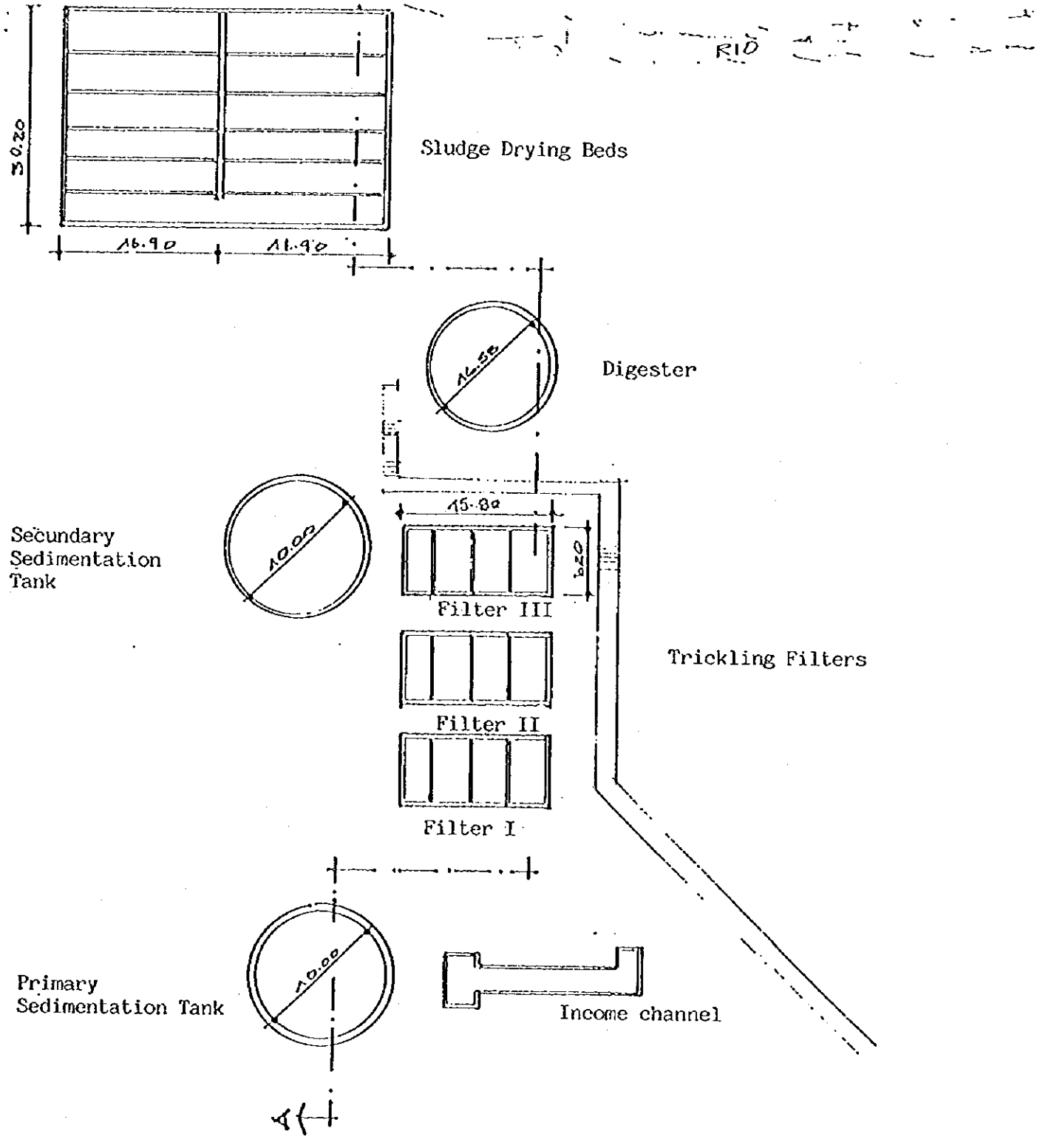
8. FEASIBILITY OF REHABILITATION AND/OR MAINTENANCE

8.1 The plant presents general good conditions for rehabilitation, under the conditions especified on item 6, with an amount of Q.738,231.00 equal to $.131,900.00



HYDRAULIC SKETCH (Section A-A) SIN ESCALA

EL MEXQUITAL



SKETCH TREATMENT PLANT SIN ESCALA

EL MEXQUITAL

ANNEX No. 3
WASTEWATER TREATMENT PLANT
MEXQUITAL

		QUANTITY	UNIT	REMARKS
1	SEDIMENTATION TANK			
	1.1 Superficial Area	79	M2	
	1.2 Volume	223	M3	
	1.3 Flowrate (R.T.)	111	M3/HORA	
	1.4 Flowrate	2,664,000	L/DIA	
	1.5 Flowrate (M.D.F.)	55.50	M3/HORA	
	1.6 Flowrate	1,332,000	L/D	
	1.7 Population			
	Wastewater volume population			
	90 L/H/D	15,000	H	
2	DIGESTER			
	2.1 Volume	1,007	M3	
	2.2 Volume	1,007,000	L	
	2.3 Population (30 L/H/D)	33.567	H	
3	SLUDGE DRYING BEDS			
	3.1 Total Area	1,014	M2	
	3.2 Per Capita Area	0.0390	M2	
	3.3 Population	26,000	H	
4	SUMMARY			
	4.1 Design Flow	55.50	M3/HORA	
	4.2 Population			
	- Primary Sedimentation Tank	15,000		
	- Digester	33,567	H	
	- Sludge Drying Beds	26,000	H	
	DESIGN POPULATION	25,000	H	

NIMAJUYU

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE SEWAGE TREATMENT PLANTS
DATE SURVEY: JUNE 1995

1. GENERAL ASPECTS

1.1 NAME
Wastewater Treatment Plant, NIMAJUYU

1.2 LOCALIZATION
Colony Nimajuyu, zone 21, Guatemala.

2. GENERAL INFORMATION

2.1 OWNER
Banco Nacional de la Vivienda
Actualy the proprietor is DIRECCION DE ASENTAMIENTOS HUMANOS Y VIVIENDA.
VIVIENDA, DAHVI

2.2 GOVERNMENTAL AUTHORITY RESPONSIBLE FOR APPROVAL AND/OR MONITORING.
BANCO NACIONAL DE LA VIVIENDA, BABVI.

2.3 CONSTRUCTION COUST

2.4 YEAR OF COMMENCEMENT OF OPERATION
1981

2.5 TREATMENT CAPACITY
48 M3/HOUR = 1,152 M3/DAY

2.6 TREATMENT PROCESS
- Aproximation canal
- Grease box trap
- Primary sedimentation tank (2 units)
- trickling filter (4 units)
- Primary drying bed
- Secundary sedimentation tank
- Final drying bed

2.7 OPERATION CONDITIONS
The plant is in good operation conditions.

2.8 INSTITUTION RESPONSIBLE FOR THE OPERATION AND MAINTENANCE.
Banco Nacional de la Vivienda.(BANVI)

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
Nimajuyu Condomine, zone 12.

3.2 SEWERED AREA
25.5 HA

3.3 DESIGN POPULATION
10,650 habitants

3.4 DESIGN FLOWRATED
48 M3/HOUR

3.5 INFLUENT QUALITY
Normal characteristics in domestic waste water in a neighborhood of medium income

3.6 EFFLUENT QUALITY
30 % of normal efective treatment

3.7 SCHEMATIC DIAGRAM OF OPERATIONS FLOW
See annex # 1 # 2

3.8 DESIGN DETAILS
See annex # 1 and # 2

- Entrance chanel
  length: 25.00 m
  width: 0.40 m
  depth: 0.40

- Grease tramp box
  length: 1.50 m
  width: 1.50 m
  depth: 2.00 m

- Primary sedimentation tank (2 units)
  lenght: 12.00 m
  width: 6.40 m
  depth: 5.00 m

- Trickling filter (4 units)
  length: 18.90 m
  width: 8.00 m
  depth: 5.00 m

- Primary drying bed
  length: 13.50 m
  width: 9.30 m
  depth: 0.60 m
  surfase area: 125.55 m2
  volume: 75.33 m3

- Secundary sedimentation tank
  length: 5.00 m
  width: 5.00 m
  depth: 2.00 m

- Final drying sludge bed
  length: 13.50 m
  width: 9.30 m
  depth: 0.60 m

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATORS
One, and adition one guard

4.2 NAME OF THE OPERATOR

4.3 SLUDGE REMOVAL
Primary sedimentation tank: 2 times/week
Sludge disposal: manual hauling

4.4 EFFICIENCY OF TREATMENT
It is estimated that only 30 % of the water is treated because of the bad conditions of the trIckling filters do to the lack of operation of the distribution pipe.

5. CONCLUSIONS OF THE RESEARCH

5.1 CONDITION OF THE STRUCTURES
Good general conditions

5.2 WELLS COVER AND BOX
Good shape

5.3 COUNTERDRAIN
Cleaning is necesary.

5.4 INTERCOMUNICATION SIDEWALKS AND STAIRS
They are well defined

5.5 GENERAL ACCES ROAD
In good condition

5.7 PIPES
The pipes of the trickling filters works at 30 % capacity. It is necesary to rehabilitation to acquire full capacity.

5.8 GENERAL FENCE
There is, but in regular conditions

6. RECOMENDATIONS

6.1 STRUCTURES
Good conditions

6.2 COVERS
Good conditions

6.3 COUNTERDRAIN
Existing some sector but it is necesary to define other in an aproximately length of 60 M

6.4 METAL STRUCTURES AND BRIDGES
It is necesary to protect whit anticorrosive paint to the structures of the sedimentation tank

6.5 CLEANING
It is necesary cleaning all units of the plant and existing counterdrain, in 50 m length

7. FINAL CONSIDERATIONS

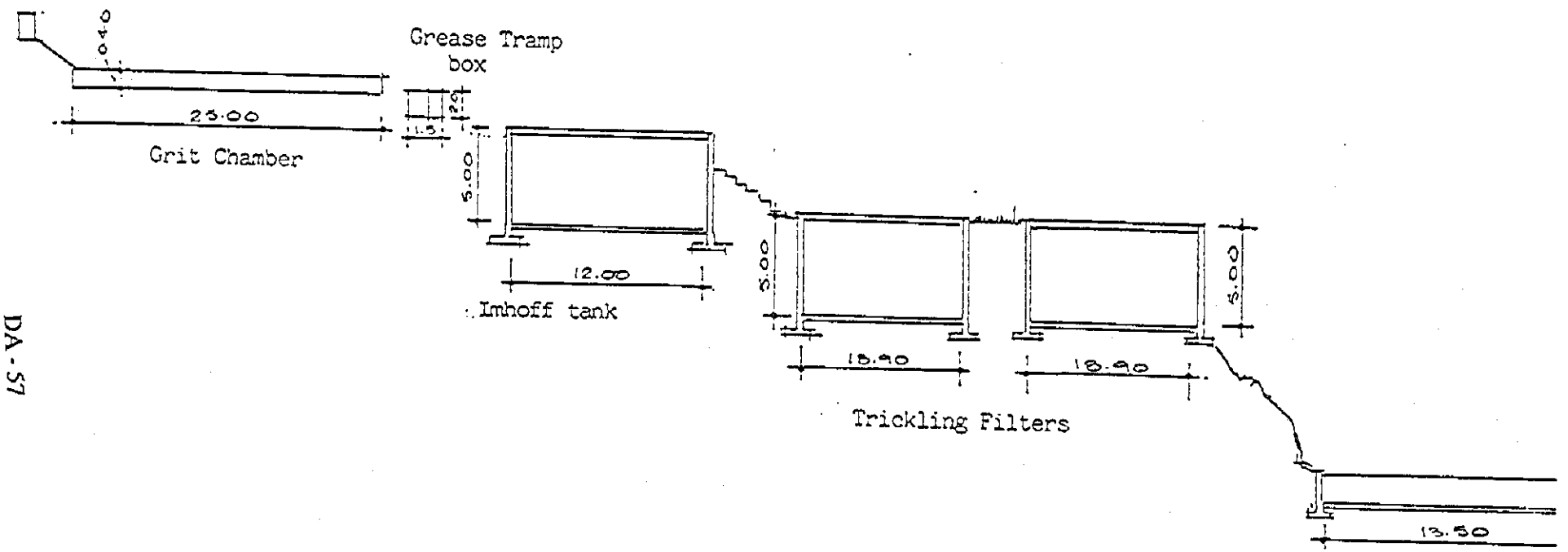
7.1 The capacity of the trickling filter is 30 %, do to the lacking of maintenance and available resources (ecomical)

7.2 The authorities commissioned to operated and maintenance not to give technic assistance at the mantenaince problems.

8. FEASEABILITY OF REHABILITATION AND/OR MAINTENANCE

8.1 The plant is in good conditions to rehabilitation with a small investments and decision to put in operation.

8.2 It is necesary to invest Q. 98,475.00 or US$ 17,600.00 as indicated in item # 6.

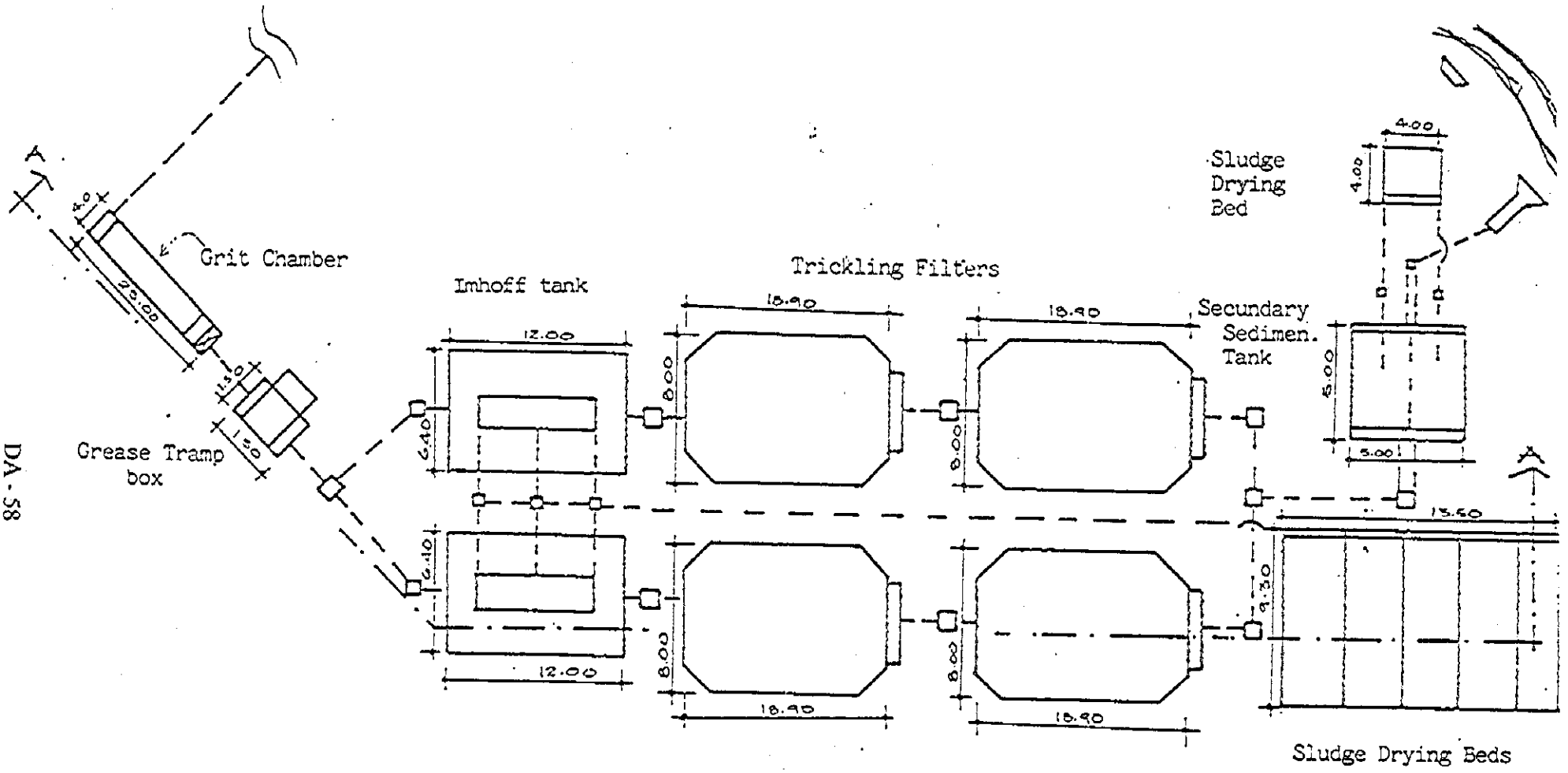


HYDRAULIC SKETCH (Section A-A)

SIN ESCALA

NIMAJUYU

DA - 57



SKETCH TREATMENT PLANT

SIN ESCALA

"NIMAJUYU"

DA - 58

ANNEX No. 3
WASTEWATER TREATMENT PLANT
NIMAJUYU

		QUANTITY	UNIT	REMARKS
1	SEDIMENTATION TANK			
	1.1 Superficial Area	76.80	M2	
	1.2 Volume	192.00	M3	
	1.3 Flowrate (R.T.)	96.00	M3/HORA	
	1.4 Flowrate	2,304,000.00	L/D	
	1.5 Flowrate (M.D.F.)	48.00	M3/HORA	
	1.6 Flowrate	1,152,000.00	L/D	
	1.7 Population			
	Wastewater volume			
	90 L/H/D	12,800.00	H	
2	DIGESTER			
	2.1 Volume			
	2.2 Volume			
	2.3 Population (30 L/H/D)			
3	SLUDGE DRYING BEDS			
	3.1 Total Area	337.50	M2	(estimado)
	3.2 Per Capita Area	0.04	M2	
	3.3 Population	6,500.00	H	
4	SUMMARY			
	4.1 Design Flow	48.00	M3/HORA	
	4.2 Population			
	- Primary Sedimentation Tank	12,800.00	H	
	- Digester	0.00	H	
	- Sludge Drying Beds	8,500.00	H	
	DESIGN POPULATION	10,650.00	H	

UNIVERSIDAD DE SAN CARLOS

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANTS
DATE SURVEY: JUNE 1995

1. GENERAL ASPECTS

1.1 NAME
Wastewater Treatment Plant, "Universidad de San Carlos"

1.2 LOCATION
University City, zone 12, Guatemala.

2. GENERAL INFORMATION

2.1 OWNER
San Carlos University of Guatemala.

2.2 GOVERNMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND/OR MONITORING
Mantenaince Division, San Carlos University

2.3 CONSTRUCTIONS COSTS
Q 650,136.35

2.4 YEAR OF COMMENCEMENT OF OPERATION
1991

2.5 TREATMENT CAPACITY
70 M3/HOUR = 1,680 M3/DAY
With the next components and volumes:

- Primary sedimentation tank	279 m3
- Secundary sedimentation tank	279 m3
- Digester	938 m3
- Sludge drying bed	100 m3

2.6 TREATMENT PROCESS

- Primary sedimentation tank
- Trikling filters (I - II - III)
- Secundary sedimentation tank
- Digester
- Sludge drying bed

2.7 OPERATION CONDITIONS
Good

2.8 INSTITUTION RESPONSIBLE FOR OPERATION AND MANTENAINCE
Mantenaince Division, San Carlos University, and
Regional School of Sanitary Engineering

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
University City.

3.2 SEWERED AREA
122.8 HA (estimated)

3.3 POPULATION DESIGN
18,000 habitant (estimation based on data of annex # 3)

3.4 DESIGN FLOWRATE
70 M3/HOUR

3.5 QUALITY OF THE INFLUENT
Normal characteristics of wastewater in a study center.

3.6 QUALITY OF THE EFFLUENT
Estimated to be a 50% of treatment, because there is not operatation and mantenaince.

3.7 SCHEMATIC DIAGRAM OF OPERATION FLOWRATE
See annex # 1 # 2

3.8 DESIGN DETAILS
- GRIT CHAMBER

length:	9.00 m
width	0.80 m
high:	0.80 m

Components: Grill, metalic gate

- Primary sedimentation tank

major diameter:	10.00 m
minor diameter:	0.50 m
depth:	9.30 m
Canal collector:	0.40 diameter
Inlet pipe:	PVC 8", 160 psi
Outlet pipe	PVC 6", 160 psi

- Trickling filter
It is has 3 filter fases, with dimentions:

length:	16.20 m
width:	6.60 m
depth:	4.00 m

Each filter have four divisions:
length: 6.60 m
width: 3.80 m
depth: 4.00 m

The granulometry of the filtrating material is:
First filter fase: 3.5"
Second filter fase: 3.0"
Third filter fase: 2.5"

- Secondary sedimentation tank: equal dimensions of primary sedimentation tank.

- Digester
Major diameter: 17.00 m
Minor diameter: 0.50 m
Depth: 14.00 m
Inlet pipe from the sedimentation tank PVC 6" 160 psi Oulet pipe of sludge removal, PVC 8", 160 PSI

- SLUDGE DRYING BED

It has two sludge drying bed
Superficial area: 336.00 m2

length: 2.50 m
width: 2.00 m

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATORS
One

4.2 NAME OF OPERATOR
Celestino Mejia

4.3 SLUDGE REMOVAL
Primary sedimentation tank: every day
Secundary sedimentation tank: every day
Sludge removal: manual carrying

4.4 TREATMENT EFFICIENCY
In general, it is estimated a good efficiency of treatment plant, still without an adequate mantenaince.

5. RESEARCH CONCLUSIONS

5.1 STATE OF STRUCTURES
Generally good conditions.
There are problems with external plastering.

5.2 PIPES
Trickling filters:
Module I: Corrosion in 28 metalic pipes 2"
Module II: Corrosion in 26 metalic pipes 2"
Module III: Corrosion in 19 metalic pipes 2"

5.3 GATE VALVES FOR OPERATIONAL CONTROL
Trickling filters I, II, III
63 gates valves in bad condition

5.4 BOXES AND COVERS FOR VALVES PROTECTION
In good conditions

5.5 COUNTERDRAIN
They have not cleaning and mantenaince

5.6 INTERCOMUNICATION SIDEWALK AND STAIRS
They have faulties and cleaning

5.7 GENERAL ACCES ROAD
Good conditions

6. RECOMMENDATIONS

6.1 STRUCTURES
It is necessary to plaster external walls of the trickling filters. Estimated area of plastering: 10 M2

6.2 PIPES
It is necessary to clean the trickling filters, to eliminate the growing grass inside.

6.3 GATE VALVES
It is necessary to change 73 metalic pipes 2", 6.60 M lenght.

6.4 BOXES AND COVERS
It is necessary cleaning and cut the surrounding grass.

6.5 COUNTERDRAIN
It is necessary frequently cleaning.

6.6 GENERAL FENCES
It is convenient general fences surroundign all the treatment plant. Lenght 420 ML

7. FINAL CONSIDERATIONS

7.1 The last cleaning of the sedimentation tanks was made in November 1994.

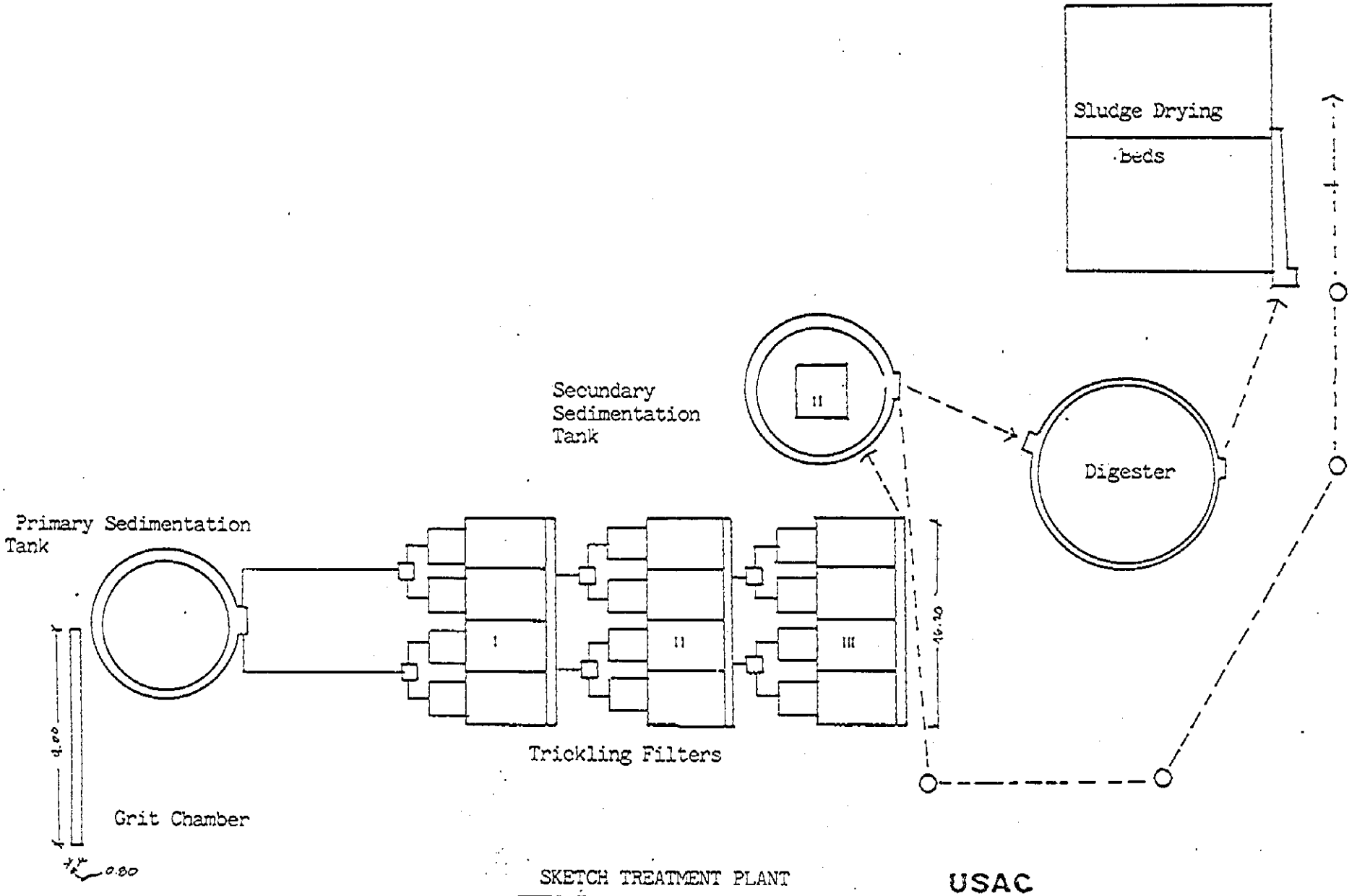
7.2 It is necessary to change the pipes of the trickling filters, to provide an adequate operation.

7.3 It is necessary a Sanitary Engineer, for to give the instructions and advisoring, to obtain a good operation and mantenaince of the treatment plant.

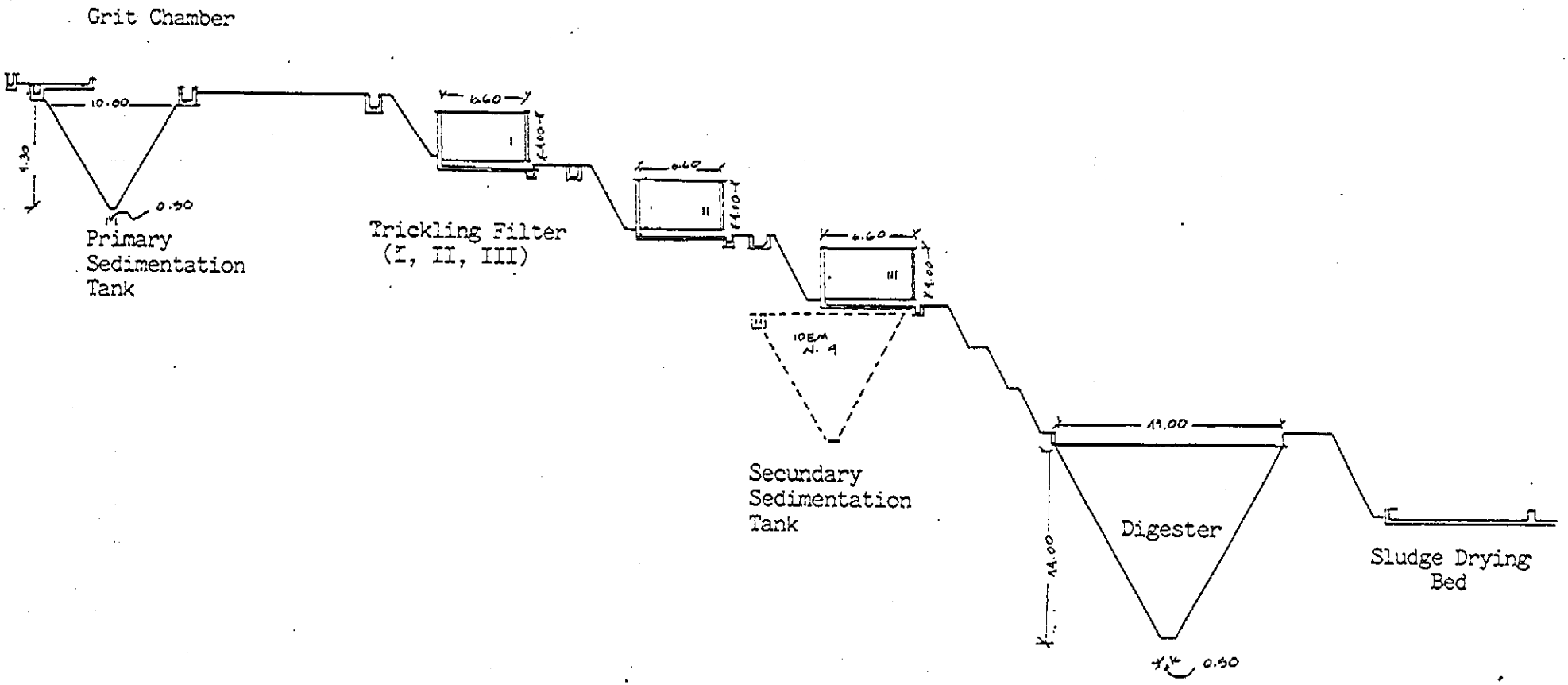
8. FEASIBILITY OF REHABILITATION AND/OR MANTENAINCE

8.1 It is necessary to provide an adequate mantenaince to achieve a good efficiency of the treatment plant.

8.2 It is necessary to invest Q. 521,430.00 equal to US$. 93,200.00 like is annoted in item No. 6.



SKETCH TREATMENT PLANT USAC



HYDRAULIC SKETCH

USAC

DA-67

ANNEX No. 3
WASTEWATER TREATMENT PLANT
UNIVERSITY OF SAN CARLOS

		QUANTITY	UNIT	REMARKS
1	SEDIMENTATION TANK			
	1.1 Superficial Area	79	M2	
	1.2 Volume	279	M3	
	1.3 Flowrate (R.T.)	140	M3/HORA	
	1.4 Flowrate	3,360,000	L/DIA	
	1.5 Flowrate (M.D.F.)	70.00	M3/HORA	
	1.6 Flowrate	1,680,000	L/D	
	1.7 Population			
	Wastewater volume population			
	90 L/H/D	16,000	H	
2	DIGESTER			
	2.1 Volume	938	M3	
	2.2 Volume	938,000	L	
	2.3 Population (30 L/H/D)	31,260	H	
3	SLUDGE DRYING BEDS			
	3.1 Total Area	336	M2	
	3.2 Per Capita Area	0.3042	M2	
	3.3 Population	8,000	H	
4	SUMMARY			
	4.1 Design Flow	70.00	M3/HORA	
	4.2 Population			
	- Primary Sedimentation Tank	16,000		
	- Digester	31,260	H	
	- Sludge Drying Beds	8,000	H	
	DESIGN POPULATION	18,000	H	

L= LITERS

EUREKA - MORSE

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANTS
DATE SURVEY: JUNE 1995

1. GENERAL ASPECTS

1.1 NAME
WASTEWATER TRATMENT PLANT
EUREKA-MORSE.

1.2 LOCALIZATION
Justo Rufino Barrios Boulevard, zone 21

2. GENERAL INFORMATION

2.1 OWNER
CONSULTA, S.A

2.2 GOVERNMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND/OR MONITORING
Municipality of Guatemala.

2.3 CONSTRUCTION COSTS

2.4 BEGINNING YEAR OF OPERATIONS
1984

2.5 TREATMENT CAPACITY
7.50 M3/HOUR = 180 M3/DAY

2.6 TREATMENT PROCESS
- Sedimentation tank (dortmund)
- Trickling filter
- Final Clarifier
- Sludge drying bed

2.7 OPERATION CONDITION
The plant is in experimental phase of rehabilitate and test, under control of CONSULTA, S.A.

2.8 INSTITUTION RESPONSIBLE FOR THE OPERATION AND MAINTENANCE.
CONSULTA, S.A.

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
Eureka-Morse Colony, zone 12, Guatemala.

3.2 SEWERED AREA
3.3 HA (estimated)

3.3 DESIGN POPULATION
1,800 inhabitants, estimate based calculus of annex # 3.

3.4 DESIGN FLOWRATE
7.5 m3/hour

3.5 INFLUENT QUALITY
Normal characteristics of domestics wastewater in a neighborhood of medium income

3.6 EFFLUENT QUALITY
It is a plant in experimental initial phase. Without operation

3.7 SCHEMATIC DIAGRAM OF OPERATIONS FLOW
See annex # 1 # 2

3.8 DESIGN DETAILS
See annexed # 1 and # 2

- Sedimentation tank - Dortmund
  - length: 6.70 m
  - width: 6.70 m
  - depth: 7.15 m

- Trickling filter
  - length: 7.50 m
  - width: 7.50
  - depth: 2.25 m

- Final Clarifier
  - length: 5.30 m
  - width: 4.35 m
  - depth: 2.73 m

- Sludge Drying bed
  - length: 12.00 m
  - width: 7.00 m
  - high: 3.00 m

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATORS
CONSULTA S.A has not designated person.

4.2 NAME OF THE OPERATOR

4.3 SLUDGE REMOVAL
Without operation.

4.4 TREATMENT EFFICIENCY
None. (without operation)

5. RESEARCH CONCLUSIONS

5.1 STATE OF THE STRUCTURES
Generally good conditions.

5.2 PIPES CONDITIONS
In good condition, but without operation

5.3 BOXES AND COVER FOR VALVES PROTECTION
Meets in good condition, but doesn't rely on his respective lids.

5.5 COUNTERDRAIN
Doesn't exist.

5.6 INTERCOMUNICATION SIDEWALKS AND STAIRS
Doesn't exist.

5.7 GENERAL ACCES ROUTES.
In good condition.

5.8 PERIMETRAL FENSE
Exists prefabricated wall at every perimeter of the treatment plant.

6. RECOMMENDATIONS

6.1 STRUCTURES
Providing actions of maintenance to the structures in general.

6.4 BOXES AND COVER
It is necessary to costruct covers, in order to assure the adequate control of flow.

6.5 COUNTERDRAIN
It is necessary counterdain construction, in order to avoid filtrations pluvials in the reactors.

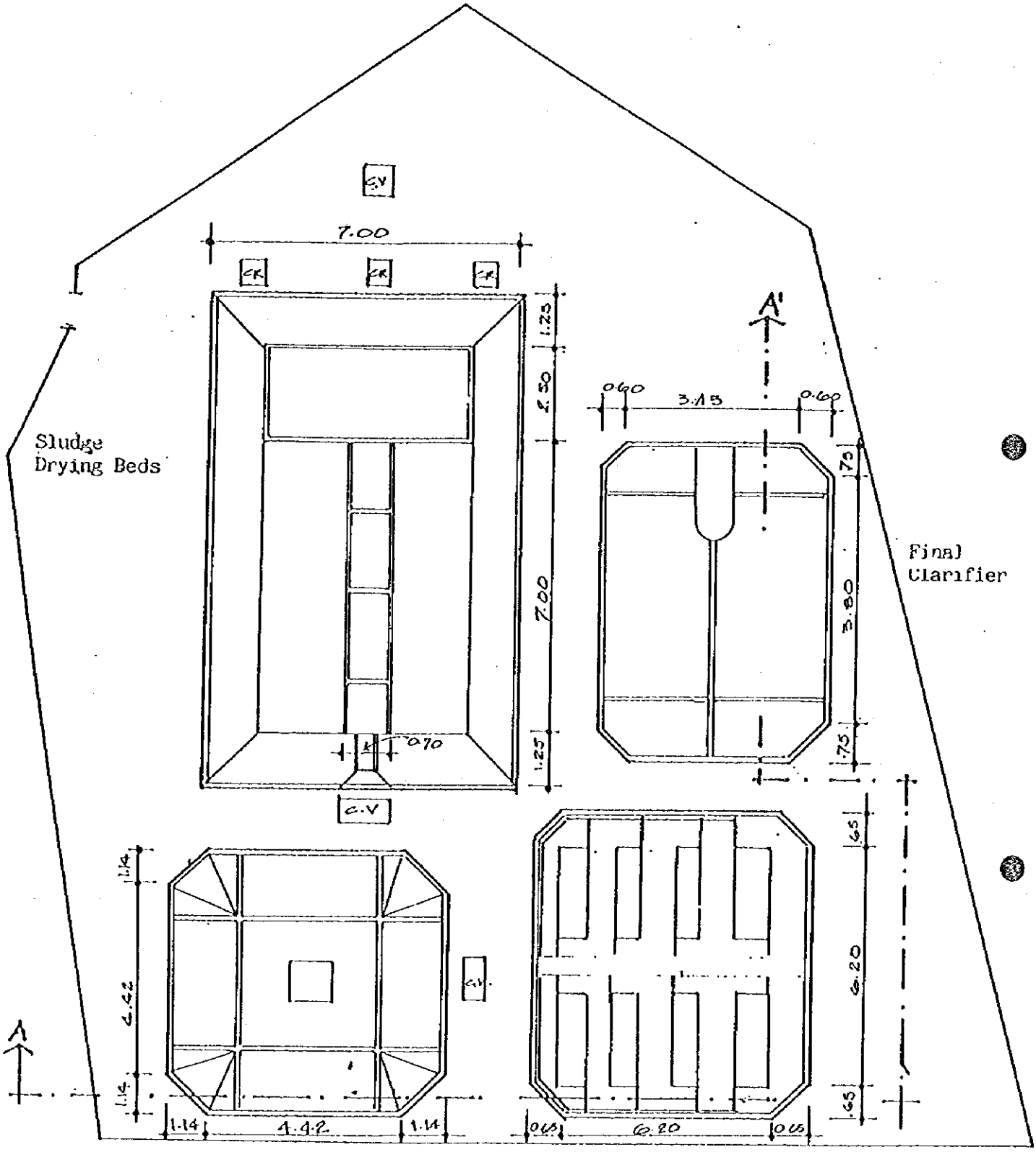
6.6 INTERCOMUNICATION SIDE-WALKS AND STAIRS
Necessary construct all the sidewalks intercomunication roads and the corresponding brakes in order to save the gradients.

7. FEASIBILITY OF REHABILITATION AND/OR MAINTENANCE

7.1 The Plant meets now in a experimental rehabilitation phase, per party of the company CONSULTA S.A., for that which is not possible accomplish an evaluation properly this.

8. FEASILITY OF REAHABILITATION

8.1 The plant is in conditions of rehabilitation, is necessary accomplish the investments annotated in the item #. 6, whose esteemed total cost, ascends to Q. 89,505.00 equal to US$.16,000.00.

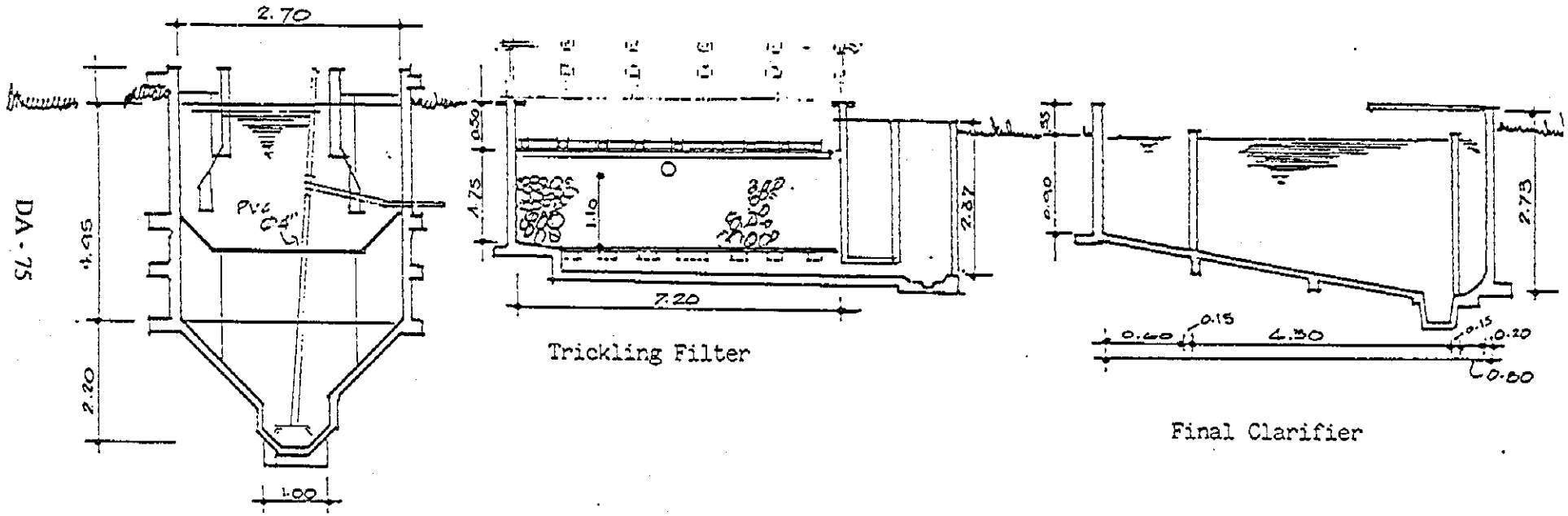


Sedimentation Tank
Dortmund

Trickling Filter

Sketch Treatment Plant SIN ESCALA

EUREKA - MORSE



Sedimentation Tank
Dortmund

Trickling Filter

Final Clarifier

HYDRAULIC SKETCH SIN ESCALA

EUREKA - MORSE

ANNEX No. 3
WASTEWATER TREATMENT PLANT
EUREKA

		QUANTITY	UNIT	REMARKS
1	SEDIMENTATION TANK			
	1.1 Superficial Area		M2	
	1.2 Volume	30	M3	(ESTIMADO)
	1.3 Flowrate (R.T.)	15	M3/HORA	
	1.4 Flowrate	360,000	L/DIA	
	1.5 Flowrate (M.D.F.)	7.50	M3/HORA	
	1.6 Flowrate	180,000	L/D	
	1.7 Population			
	Wastewater volume			
	90 L/H/D	2,000	H	
2	DIGESTER			
	2.1 Volume	64	M3	
	2.2 Volume	64,000	L	
	2.3 Population (30 L/H/D)	1,280	H	
3	SLUDGE DRYING BEDS			
	3.1 Total Area	88	M2	
	3.2 Per Capita Area	0.0420	M2	
	3.3 Population	2,095	H	
4	SUMMARY			
	4.1 Design Flow	7.50	M3/HORA	
	4.2 Population			
	- Primary Sedimentation Tank	2,000		
	- Digester	1,280	H	
	- Sludge Drying Beds	2,095	H	
	DESIGN POPULATION	1,800	H	

CAÑADA DE SAN ANGEL

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL- SCALE
SEWAGE TREATMENT PLANTS
DATE SURVEY: JUNE 1,995

1. GENERAL ASPECTS

1.1 NAME
WASTEWATER TREATMENT PLANT CANADAS DE SAN ANGEL

1.2 LOCALIZATION
Kilometer 4.5, Chinautla road, zone 6, Guatemala

2. GENERAL INFORMATION

2.1 OWNER
INHSA

2.2 GOVERMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND/OR MONITORING.
Municipality of Guatemala.

2.3 CONSTRUCTION COSTS

2.4 YEAR OF COMMENCEMENT OPERATIONS
1984

2.5 TREATMENT CAPACITY
22.50 M3/HOUR = 540 M3/DAY
with the next components and volumes:

- imhoff tank:	90	m3 (estimated)
- Sedimentation tank	100	m3 (estimated)
- sludge bed:	32	m3

2.6 TREATMENT PROCESS
- grit chamber
- imhoff tank
- sedimentation tank
- discharge channel
- sludge drying bed

2.7 OPERATION CONDITION
Good

2.8 INSTITUTION RESPONSIBLE FOR THE OPERATION AND MAINTENANCE.
Neighborhood commitee pay maintenance

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
Cañadas de San Angel y La Floresta

3.2 SEWED AREA
3.7 hectares, estimate based in annex # 3

3.3 DESIGN POPULATION
3,115 habitants, estimate based in annex # 3

3.4 FLOWRATE DESIGN VOLUME
22.50 m3/day

3.5 INFLUENT QUALITY.
normal characteristics of a domestic wastewater of medium-high income.

3.6 EFFLUENT QUALITY
Estimated to be a 30% of treatment

3.7 SCHEMATIC FLOW DIAGRAM.
see annex # 1 # 2

3.8 DESIGN DETAILS
see annexed # 1 and # 2
- grit chamber
length: 2.50 m
width: 1.50 m
depth. 0.50 m
components: gate, grill

- Inhoff tank
length: 13.60 m
wide: 3.30 m
depth. 4.25 m

- Sedimentation tank
major diameter: 8.00 m
minor diameter: 0.30 m
depth: 6.05 m

- sludge drying bed
  4 sludge drying bed with the next dimensions:
  length: 16.00 m
  wide: 6.60 m
  high: 0.30 m

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATIORS
one

4.2 NAME OF THE OPERATOR
Hector Peña

4.3 SLUDGE REMOVAL
every 2 days

4.4 TREATMENT EFFICIENCY
it is estimated a 40 % with the actual operating condi tions

5. RESEARCH CONCLUSIONS

5.1 STATE OF THE STRUCTURES
Generally good conditions.

5.2 STATE OF THE PIPES
In good state

5.3 GATE VALVES FOR OPERATIONS CONTROL
In good state

5.4 BOXES AND COVER TO PROTECT THE VALVES
In good state.

5.5 COUNTERDRAIN
Not defined.

5.6 INTERCOMUNICATION SIDEWALKS AND STAIRS
Doesn't exist.

5.7 GENERAL ACCES ROUTES.
In good condition.

5.8 SLUDGE DRYING BEDS
In generally good state.

6. RECOMMENDATIONS

6.1 STRUCTURES

Make a total flow and sludge extraction to examinate the sedimentation tank bottom.

6.2 INTERCOMUNICATION SIDEWALKS AND STAIRS

It is necesary construction roads and stairs from the primary sedimentation tank to the secundary sedimentation tank and to the sludge drying beds, aproximately 150 m.

6.3 COUNTERDRAIN

It is necesary to construct couterdrain in 150 m, to the treatment area.

6.4 GENERAL FENCE

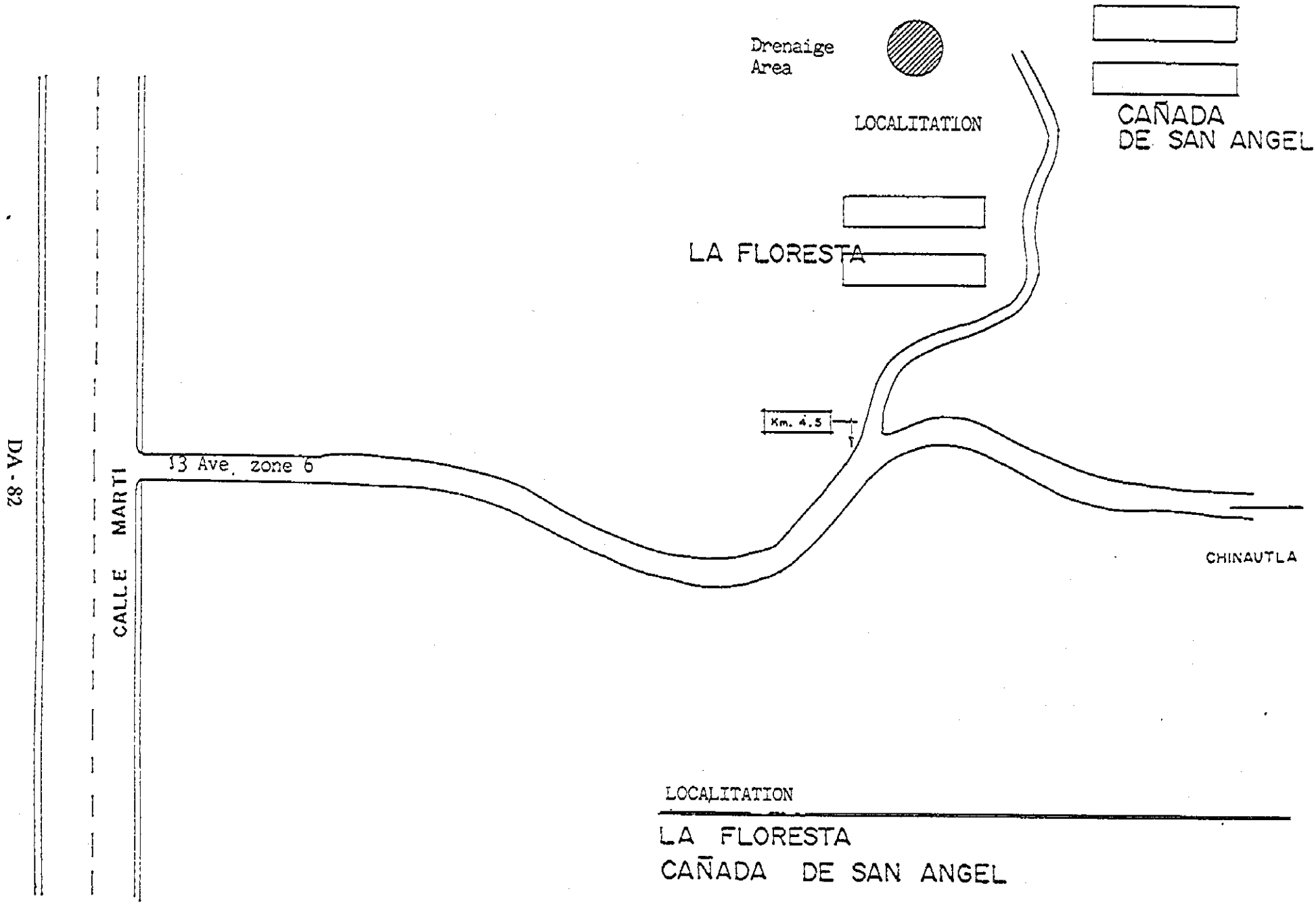
It's necesary surround the two sedimentation tank, in aproximately distance of 150 m.

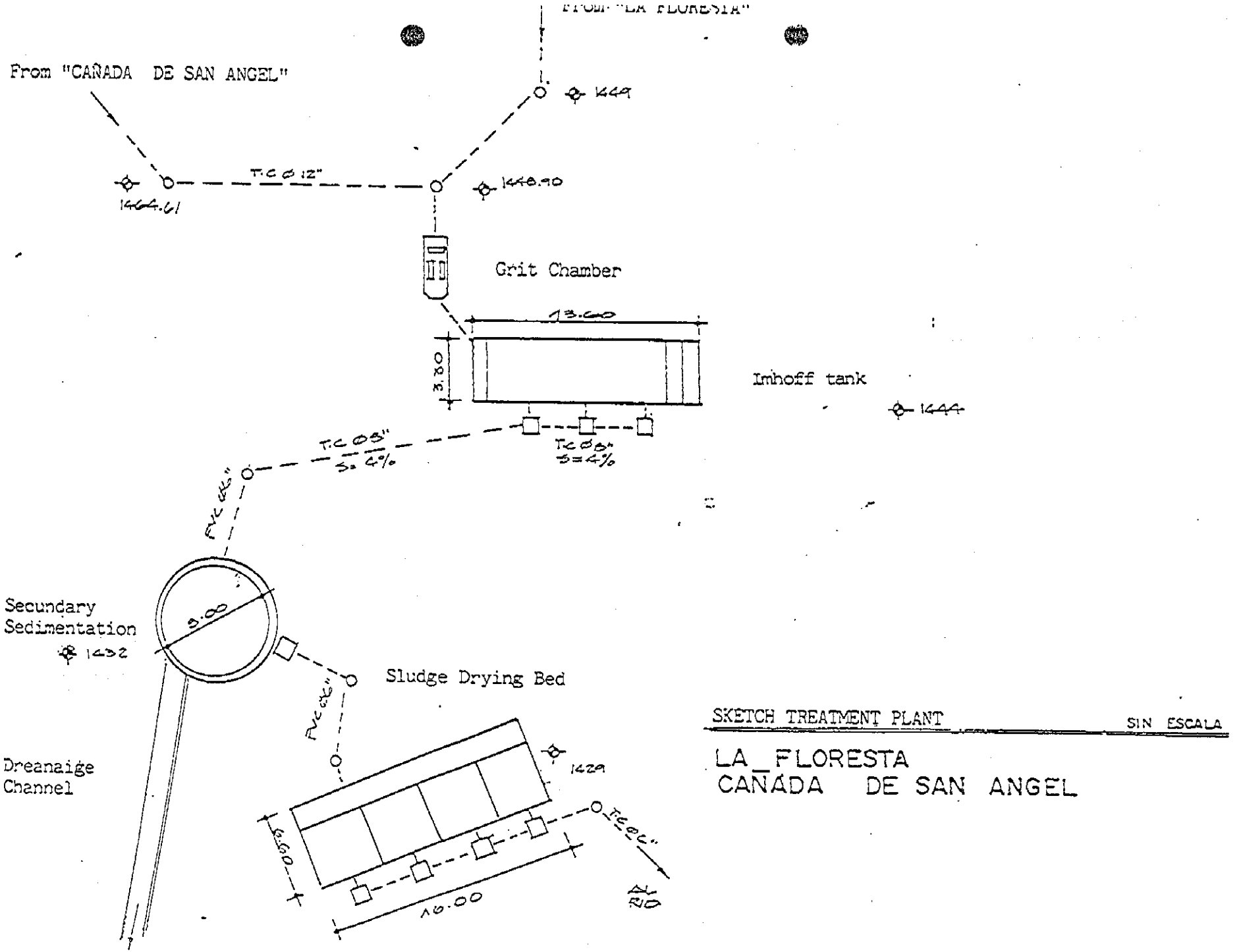
7. FINAL CONSIDERATIONS

7.1 The original desig, contemplate two modules of primary sedimentation tanks, but only one was constructed, Its highly recomended the contruction of the other Sedimentation Tank, to provide an efficiently water treatment.

8. FEASIBILITY OF REHABILITATION AND/OR MAINTENANCE

8.1 The waste-water treatment Plant present good general conditions for rehabilitation, under the conditions especificated on item No. 6, total estimated cost for this rehabilitations are Q.192,075.00 equal to $.34,300.00


Drenaige
Area
LOCALITATION
CAÑADA
DE SAN ANGEL
LA FLORESTA
Km. 4.5
13 Ave. zone 6
CALLE MARTI
DA - 82
CHINAUTLA
LOCALITATION
LA FLORESTA
CAÑADA DE SAN ANGEL



SKETCH TREATMENT PLANT — SIN ESCALA

LA FLORESTA
CAÑADA DE SAN ANGEL

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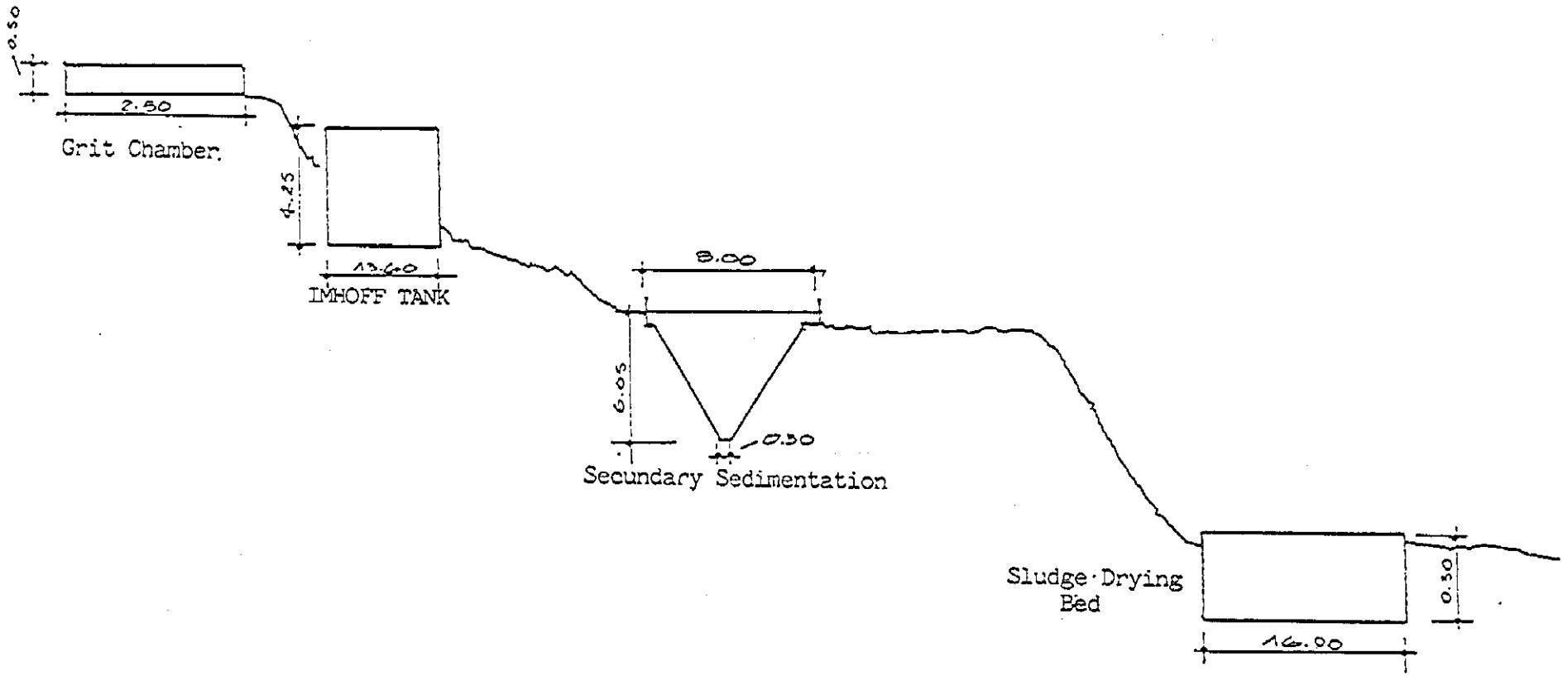
DA - 84



HYDRAULIC SKETCH

SIN ESCALA

LA FLORESTA
CAÑADA DE SAN ANGEL

ANNEX No. 3
WASTEWATER TREATMENT PLANT
CANADA DE SAN ANGEL

		QUANTITY	UNIT	REMARKS
1	SEDIMENTATION TANK			
	1.1 Superficial Area	45	M2	
	1.2 Volume	90	M3	(ESTIMADO)
	1.3 Flowrate (R.T.)	45	M3/HORA	
	1.4 Flowrate	1,080,000	L/DIA	
	1.5 Flowrate (M.D.F.)	22.50	M3/HORA	
	1.6 Flowrate	540,000	L/D	
	1.7 Population			
	Wastewater volume			
	140 L/H/D	3,857	H	
2	DIGESTER			
	2.1 Volume	100	M3	(ESTIMADO)
	2.2 Volume	100,000	L	
	2.3 Population (30 L/H/D)	2,000	H	
3	SLUDGE DRYING BEDS			
	3.1 Total Area	106	M2	
	3.2 Per Capita Area	0.0304	M2	
	3.3 Population	3,487	H	
4	SUMMARY			
	4.1 Design Flow	22.50	M3/HORA	
	4.2 Population			
	- Primary Sedimentation Tank	3,857		
	- Digester	2,000	H	
	- Sludge Drying Beds	3,487	H	
	DESIGN POPULATION	3,115	H	

BELLO HORIZONTE

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMEN PLANT
DATE: JUNE 1,995

1. GENERAL ASPECTS

1.1 NAME
INTEGRAL SAWAGE TREATMENT PLANT, BELLO HORIZONTE

1.2 LOCALIZATION
Road to San Miguel Petapa, Ciudad Real, zone 21 Guatemala.

2. GENERAL INFORMATION

2.1 OWNER
BANCO NACIONAL DE LA VIVIENDA, BANVI.
actualy the propietor is the Direccion de Asentamientos Humanos y Vivienda, DAHVI

2.2 GOVERNMENT AUTHORITY FOR RESPONSIBLE FOR APPROVAL AND/OR MONITORING.
Banco Nacional de La Vivienda. BANVI

2.3 CONSTRUCTION COSTS

2.4 YEAR OF COMMENCEMENT OF OPERATION
1987

2.5 TREATMENT CAPACITY
31.69 M3/DAY = 760 M3/DAY
With the next volumes

- Sedimentation tank	126.74 m3
- Trickling filters I, II	
- Digester	238.00 m3
- Sludge Drying beds	129.00 m3

2.6 TREATMENT PROCESS
- Volume flow regulator box
- Grit chamber
- Inhoff Tank
- Trickilng filters, Phase I, Phase II
- Final Sedimentation
- Sludge dryin bed (2 units)

2.7 OPERATION CONDITION
Regulars. The pipes of the tricklig filter are blocked

2.8 INSTITUTION RESPONSIBLE FOR THE OPERATION AND MAINTENANCE.
Initially Banco Nacional De La Vivienda, BANVI
Actually Dirección de Asentamientos Humanos y Vivienda DAHVI.

3. DESIGN DETAILS

3.1 NAME SEWERED AREA
Bello Horizonte Colony, and Fase II Nimajuyu

3.2 SEWERED AREA
12.7 HA. stimated based in annex # 3.

3.3 DESIGN POPULATION
8,800 inhabitants, estimate based in annex # 3.

3.4 DESIGNE FLOWRATE
31.69 m3/hour

3.5 INFLUENT QUALITY
Normal characteristics of wastewater in a localization of medium income

3.6 EFFLUENT QUALITY
Estimated to be a 60% of efficiency treatmnet

3.7 SCHEMATIC DIAGRAM OF OPERATIONS FLOW
see annex # 1 # 2

3.8 DESIGN DETAILS
see annexed # 1 and # 2

- Grit chamber
  length 7.50 m
  width: 2.50 m
  depth: 0.20 m
  component: sludge, small grating

- Inhoff Tank
  length: 12.00 m
  width: 6.40 m
  depth. 7.16 m

- Trickling filter
  It has two phases of filters, the dimensions are:
  length: 8.00 m
  width: 8.00 m
  depth: 2.00 m

the granulometry of the trckling filters, only in the top bed it was determinated for a visual inspection
top bed: 3"

- Secundary sedimentation tank
  length: 7.71 m
  width: 5.48 m
  depth. 4.04 m

- Sludge drying bed, (unit 1)
  diameter: 24.00 m
  depth: 0.60 m

- sludge drying bed, (unit 2)
  length: 14.62 m
  width: 9.38 m
  depth: 0.60 m

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATORS
Three

4.2 NAME OF THE OPERATOR
Jose vargas Osorio, Norberto Coyoy, Catalino Coxola Rosa

4.3 SLUDGE REMOVAL
- primary sedimentation tank: every day
- final sedimentation tank: every day
- disposition sludge metod
  After in dryin yard, to sludge valves

5. RESEARCH CONCLUSIONS

5.1 STATE OF THE STRUCTURES
In generally all in good conditions. Only in the sludge drying bed a sinking in on ceel is observed. Then the treatment process is not doing.

5.2 STATE OF THE PIPES
Corrosion in trickilg filter in metalic pipes 2".

5.3 COUNTERDRAIN
None counterdrain defined

5.4 INTERCOMUNICATION ROUTES AND GRADER
In good conditions.

5.5 GENERAL ACCES ROUTES.
It is next of the route to avenue Petapa near San Miguel Petapa Municipality.

5.8 PERIMETRAL FENCE
It is necesary to surrounding whit fences

5.9 TREATMENT EFFICIENCY
It is estimated 60 % the efficiency of the treatment

6. RECOMMENDATIONS

6.1 STRUCTURES
It is necesary to repair the floor of the sludge drying bed.

6.2 PIPES
It is necesary change 48 metalic pipes of the trickling filter, phase I and phase II

6.3 GATE VALVES
Equal of item 6.2

6.5 COUNTERDRAIN
It is necessary to design an efficient counterdrain system the treatment area, in a lenght estimated of 100 meters.

6.6 GENERAL FENCE
It is necesary to sorround with protected mesh the contour of the tratment plant, in a length of 800 meters, and 400 metals posts

7. RECOMENDATIONS

Talking with the operators of the plant, they express their r in the following form:

7.1 The maintenance Chief is deficient to coordinate the activities

7.2 There is a Sanitary Engineer, but he do not visit the plant.

7.3 The operators don't have tools and minimun equipment

7.4 It is necessary more caps, to facilitate the maintenance and cleaning of the plant.

7.5 Its convenient to built a septic tank for use of the watchman.

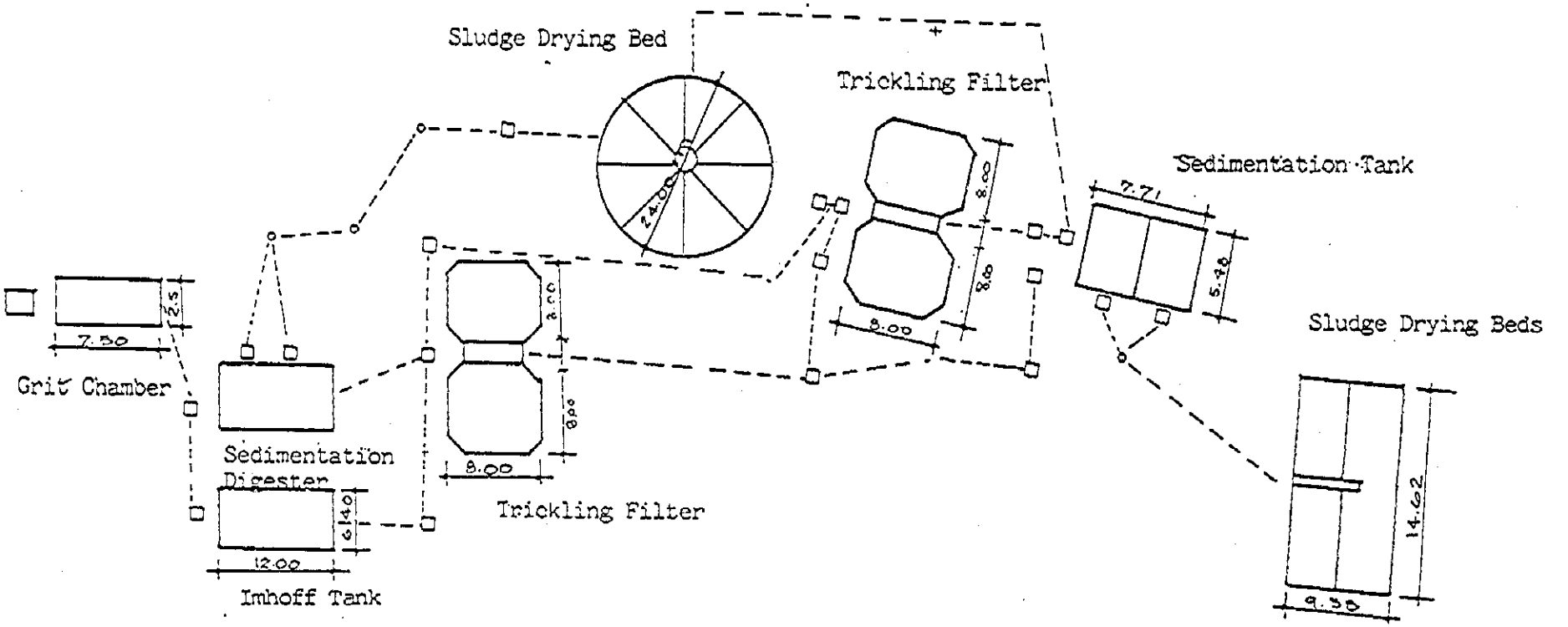
7.6 According with the operators, it is necessary the following.
- Three maintenanceman
- One watchman

7.8 In the grill is trap solid matter. It is necessary to remove them every day.

8. FEASIBILITY OF REHABILITATION AND/OR MAINTENANCE

8.1 It is necesary to provide adequated maintenance to gain the efficient operation of the plant.

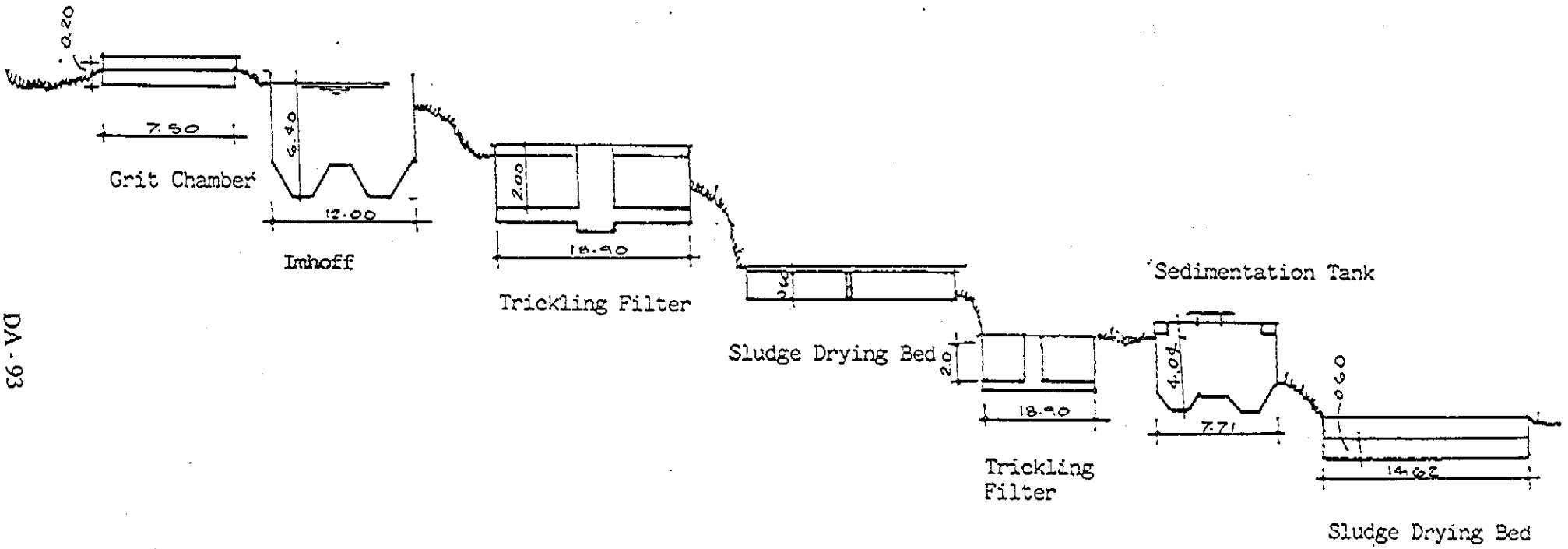
8.2 It is necessary to realize the investments indicated in item # 6. The estimate total cost is Q.696,832.50 equivalent to US $.124,500.00



SKETCH TREATMENT PLANT

SIN ESCALA

BELLO HORIZONTE



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HYDRAULIC SKETCH.

SIN ESCALA

BELLO HORIZONTE

ANNEX No. 3
WASTEWATER TREATMENT PLANT
BELLO HORIZONTE

		QUANTITY	UNIT	REMARKS
1	SEDIMENTATION TANK			
	1.1 Superficial Area	76.60	M2	
	1.2 Volume	126.74	M3	
	1.3 Flowrate (R.T.)	63.37	M3/HORA	
	1.4 Flowrate	1,520,880.00	L/DIA	
	1.5 Flowrate (M.D.F.)	31.69	M3/HORA	
	1.6 Flowrate	760,440.00	L/D	
	1.7 Population			
	Wastewater volume			
	90 L/H/D	8,500.00	H	
2	DIGESTER			
	2.1 Volume	238.00	M3	
	2.2 Volume	238,000.00	L	
	2.3 Population (30 L/H/D)	5,950.00	H	
3	SLUDGE DRYING BEDS			
	3.1 Total Area	423.90	M2	
	3.2 Per Capita Area	0.04	M2	
	3.3 Population	12,146.00	H	
4	SUMMARY			
	4.1 Design Flow	31.69	M3/HORA	
	4.2 Population			
	- Primary Sedimentation Tank	8,500.00	H	
	- Digester	5,950.00	H	
	- Sludge Drying Beds	12,146.00	H	
	DESIGN POPULATION	8,800.00	H	

EL ROBLE

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANTS
DATE SURVEY: JUNE 1995

1. GENERAL ASPECTS

1.1 NAME
Wastewater Treatment Plant, El Roble

1.2 LOCALIZATION
Km. 4.0 on Road to Chinautla

2. GENERAL INFORMATION

2.1 OWNER
INHSA

2.2 GOVERMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND-OR MONITORING.
Municipality of Guatemala.

2.3 CONSTRUCTION COSTS

2.4 YEAR OF COMENCEMENT OPERATION
1990

2.5 TREATMENT CAPACITY
4.12 M3/HOUR = 100 M3/DAY
With the follows volumes:
- Two sedimentation tanks: 74 m3
- Sludge drying bed 23.7 m3

2.6 TREATMENT PROCESS
- Grit Chamber
- Imhoff Tank 2 units
- Sludge drying bed
- Infiltration wells 4 units

2.7 OPERATIONAL CONDITIONS
It is not working

2.8 INSTITUTION RESPONSIBLE FOR THE OPERATION AND MAINTENANCE
INHSA. pay to the operator.

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
Colony El Roble, zone 6, Guatemala

3.2 SEWERED AREA
4.2 HA (estimated based on data of annex # 3)

3.3 DESIGN POPULATION
1,400 habitants, (estimate based on data of annex # 3)

3.4 DESIGN FLOWRATE
4.12 m3/hour

3.5 QUALITY OF THE INFLUENT
Normal characteristics of domestics wastewater of a neighborhood of
medium income

3.6 QUALITY OF THE EFFLUENT
The flow has a by-pass from the grit chamber to the infiltration wells.

3.7 SCHEMATIC DIAGRAM OF OPERATION FLOW
See annex # 1 # 2

3.8 DESIGN DETAILS
See annexed # 1 and # 2

- Grit Chamber
  length: 14.50 m
  wide: 1.07 m
  high: 0.70 m
  components: metalic small grating, sluice

- Imhoff Tank (2 units)
  diameter: 2.95 m
  depth: 3.78 m (# 1)
  depth: 4.83 m (# 2)
  Inlet pipe: concret, diameter 8"
  Outlet pipe: concret, diameter 8"

- Sludge drying bed
  Four sludge drying bed, (irregular measure)
  total superficial area: 54 m2

- Infiltration wells
  4 wells, diameter 80"

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATORS
One

4.2 NAME OF THE OPERATOR
Marcelino Gomez Davila (operator/guard)

4.3 SLUDGE REMOVAL
Grit chamber: two times at week

4.4 TREATMENT EFFICIENCY
None

5. RESEARCH CONCLUSIONS

5.1 STRUCTURAL STATE
General in good conditions.

5.2 COVERS FOR WELLS AND BOXES
Good state but without functioning

5.3 COUNTERDRAIN
Not existing

5.4 INTERCOMUNICATION SIDEWALKS AND STAIRS
Not existing

5.5 GENERAL ACCESS ROAD
Not defined, the access is very hard

5.6 GENERAL FENCE
Not existing

6. RECOMMENDATIONS

6.1 STRUCTURE
Neccesary make works of plastering in walls of Imhoff Tanks.

6.2 BOX COVERS
Neccesary replace covers for flow boxes and valve boxes.

6.3 COUNTERDRAIN
Neccesary to make works for counterdrains in a distance of 30 Meters.

6.4 GENERAL FENCE
Neccesary 100 meters of fence for the treatment area.

6.5 CLEANING COMPONENTS
It is neccesary make a general cleaning of the all componentes of the treatment area.

7. FINAL CONSIDERATIONS

7.1 There are no budget for the operational and maintenance works of the plant.

7.2 The access to the treatment area is so difficult, because the topography of the land.

7.3 The infiltration wells has a lot of grass, and it is imposible to see how much they are destroyed.

8. FEASIBILITY OF REHABILITATION AND/OR MAINTENANCE

8.1 The Treatment Plant has conditions for rehabilitation, if the recommendations of item #6 and #7 are made.

8.2 The investments that should be made has an amount of Q.120,315.00 equal to US$. 21,500.00 as specify in item No. 6

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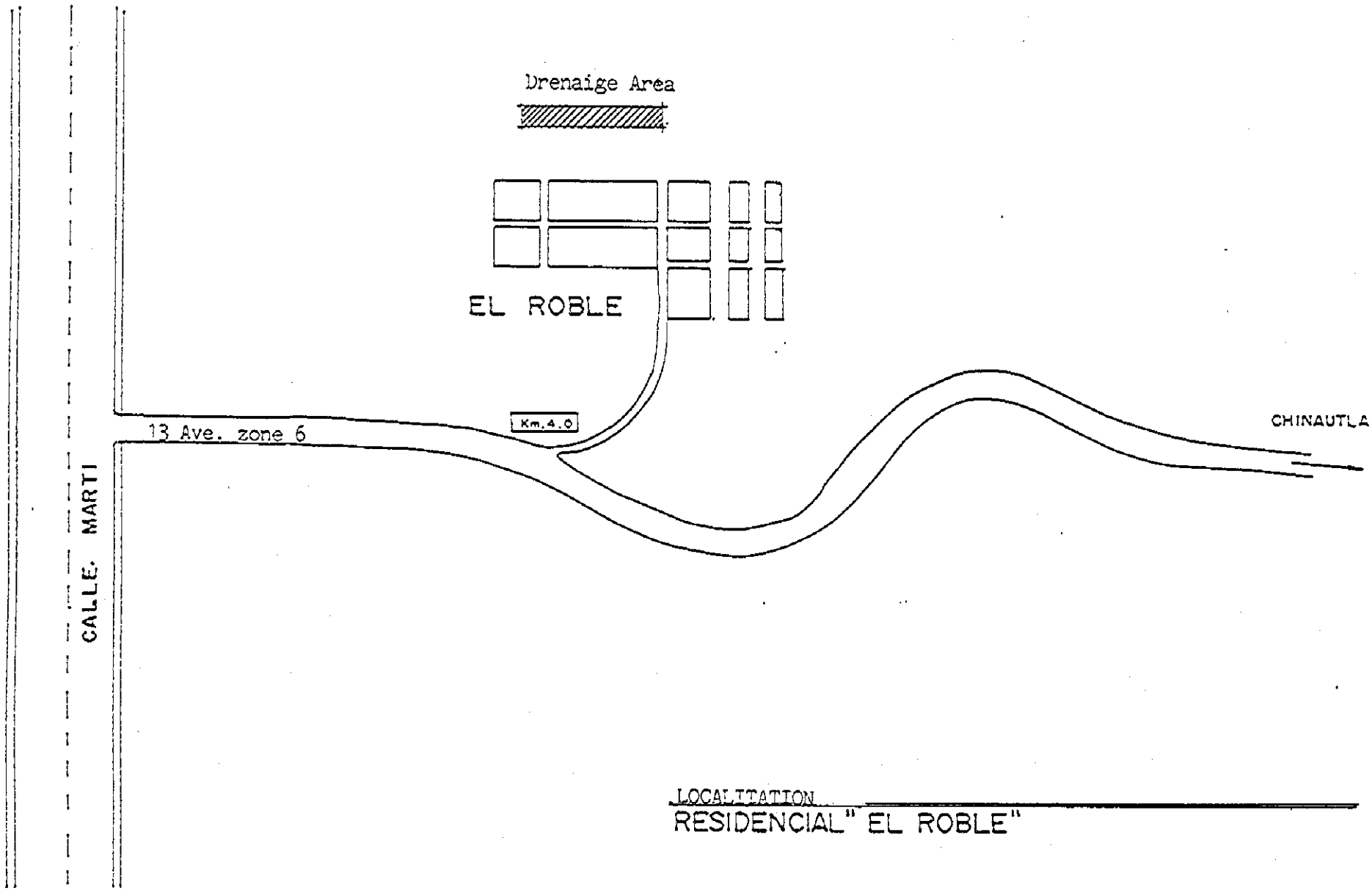
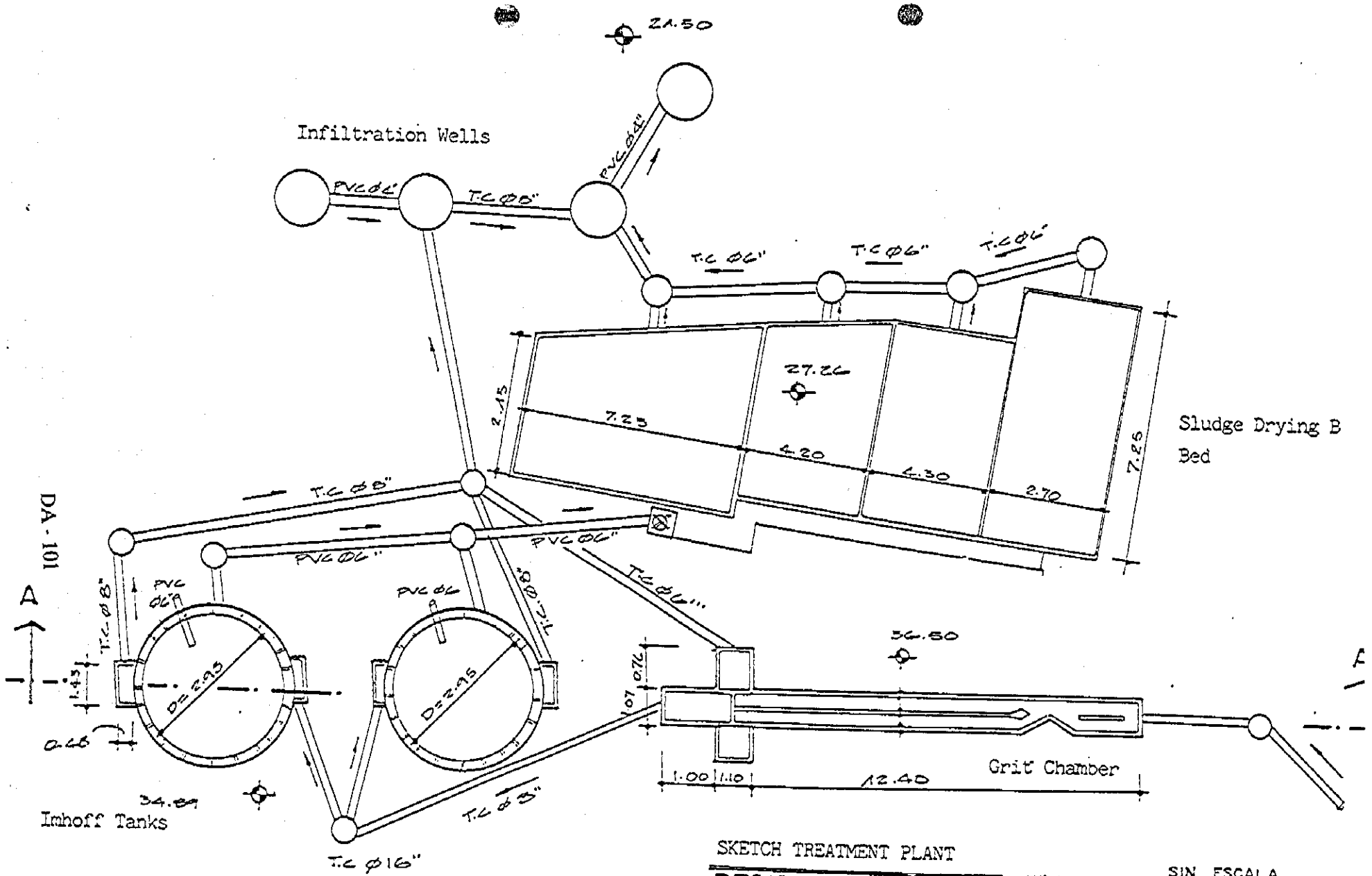


LOCALITATION
RESIDENCIAL" EL ROBLE"



SKETCH TREATMENT PLANT

SIN ESCALA

RESIDENCIAL "EL ROBLE"

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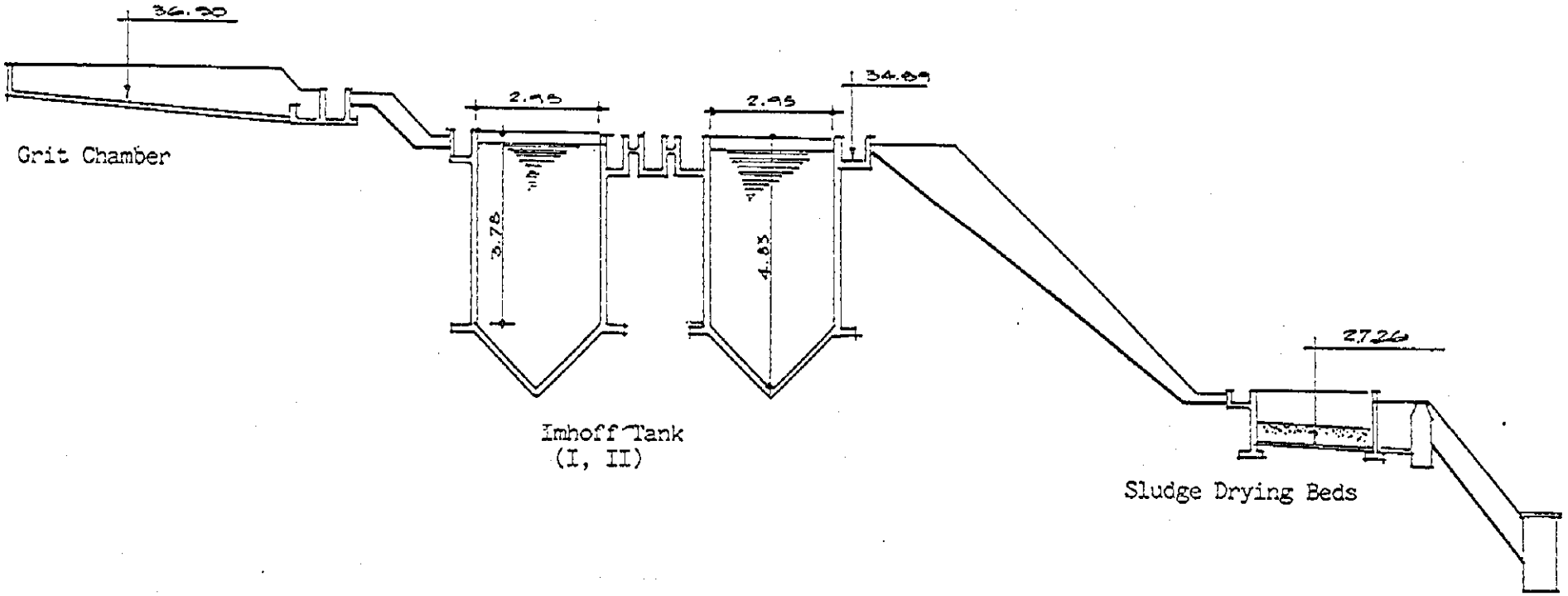


HYDRAULIC SKETCH

SIN ESCALA

RESIDENCIAL "EL ROBLE"

ANNEX No. 3
WASTEWATER TREATMENT PLANT
EL ROBLE

		QUANTITY	UNIT	REMARKS
1	SEDIMENTATION TANK			
	1.1 Superficial Area	6.66	M2	
	1.2 Volume	8.24	M3	
	1.3 Flowrate (R.T.)	8.24	M3/HORA	
	1.4 Flowrate	197,760.00	L/DIA	
	1.5 Flowrate (M.D.F.)	4.12	M3/HORA	
	1.6 Flowrate	98,880.00	L/D	
	1.7 Population			
	Wastewater volume			
	140 L/H/D	700	H	

2	DIGESTER			
	2.1 Volume	74.00	M3	
	2.2 Volume	74,000.00	L	
	2.3 Population (30 L/H/D)	1,480	H	

3	SLUDGE DRYING BEDS			
	3.1 Total Area	79.00	M2	
	3.2 Per Capita Area	0.04	M2/H	
	3.3 Population	2,026	H	

4	SUMMARY			
	4.1 Design Flow	8.24	M3/HORA	
	4.2 Population			
	- Primary Sedimentation Tank	700	H	
	- Digester	1,480	H	
	- Sludge Drying Beds	2,026	H	
	DESIGN POPULATION	1,400	H	

" ALAMEDA NORTE "

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE SEWAGE TREATMENT PLANTS
DATE: JUNE 1995

1. GENERAL ASPECTS

1.1 NAME
Waste Solids and Wastewater Integral Treatment Plant, "Alameda Norte"

1.2 LOCATION
Colony Alameda Norte, Zone 18, Guatemala City

2. GENERAL INFORMATION

2.1 OWNER
Municipality of Guatemala
Lessee: Asociación para la Recuperación, Manejo y Saneamieto Ambiental, ARMSA.
Society for Recuperation, Management and Enviromental Sanitation

2.2 ACTUAL STATE

In the years 1982 - 1985 it was created the Enviroment
Program of the Guatemala Municipality.
As result it was introducted a "pilot project" with the follow componentes:
- Solid Waste: Compostage room, recycling materials
- Nivelation, cleaning and a part of instalation for wastewater treatmen plant:
To excavate for "sedimentation-digester tank" and stabilization lagoon.
This was the first phase.

This actual state has:

- SEDIMENTATION AND DIGESTER TANK
It is an anaerobic biodigester

* YEAR OF COMMENCEMENT OF OPERATION
1984

* TREATMENT CAPACITY
213 M3/DAY

* TREATMENT PROCESS
Anaerobic biodigester with upflow, plus sludge drying bed.

* OPERATION CONDITION
Regular. At this time there was not made an evaluation

* INSTITUTION RESPONSIBLE FOR OPERATION AND MANTENAINCE
Asociación para la Recuperación, Manejo y Saneamiento
Ambiental, ARMSA

DESIGN DETAILS

* NAME OF SEWERED AREA
Colony Alameda Norte, Zone 18, Guatemala City

* SEWERED AREA
1.2 HA

* DESIGN POPULATION
500 habitants

* DESIGN FLOWRATE
8.8 M3/HOUR = 212 M3/DAY

* QUALITY INFLUENT
Is the caracteristic of domestic wastewater in a neighborhood of low-income

* QUALITY EFFLUENT
Estimated to be a 60% eficciency of the actual process.
This no means the wastewater has a 60% treatment.

* DESIGN DETAILS

Biodigester:	
Geometry	
Mayor Diameter	4.30 M
Minus diameter	
Depth	2.10 M
Components:	
Gas collector bell, pipes for sludge removal	
Sludge Drying Bed	
Length	3.50 M
Width	2.50 M
Depth	0.65 M

Infiltration well	
Diameter	1.50 M
Depth	10.00 M

3. OPERATION AND MANTENAINCE

3.1 NUMBER OF OPERATORS

None

3.2 OPERATOR'S NAME

In this experimental Phase, the responsible is Engineer Erick Escobar.
There is an operator named Sr. Sebastián Lemus

3.3 SLUDGE REMOVAL

From Anaerobic digester: At this moment there are not sludge removal actions.

4. FUTURE PROJECT

Is in process of program in its differents aspects. All the activity is conducted by ARMSA and the responsible is Engineer Erick Escobar.
The cost of construction was estimated in U.S.$100,00.00
The process programmed is:
- Anaerobic biodigester
- Sludge drying bed
- Three anaeorobic stabilization ponds

Frecuency of sludge removal: every two days Gas estimated production: 80 M3/DAY

The actual study is conducted by the supervision of DANIDA, Agency of development of Finlandia. There are negotiation with the DIB

5. RESEARCH CONCLUSIONS

5.1 STATE OF THE STRUCTURES

Generally good conditions.

5.2 STATE OF THE PIPES

Drainage pipes of the biodigestor toward lagoons of oxidation ponds is obstructed by solid paste.

5.3 GATE VALVES FOR OPERATION CONTROL

There is a valve for sludge removal from the biodigestor.

5.4 BOXES AND COVERS
In good state.

5.5 COUNTERDRAIN
Not defined.

5.6 INTERCOMUNICATION SIDEWALKS AND STAIRS
The evaluated phase (biodigestor) in good conditions.

5.7 GENERAL ACCES ROUTES
In good condition.

5.8 SLUDGE DRYING BED
In generally good state, but without working because there is a by-pass in the biodigestor.

6. RECOMMENDATIONS

6.1 STRUCTURES
Existing construction in good state, needing preventive maintenance.

6.2 PIPES
In good state, need cleaning to eliminate the obstruction.

6.3 GATES VALVES
In good state.

6.4 BOXES AND COVERS
In good state.

6.5 COUNTERDRAIN
It is necessary to design an efficient counterdrain system the treatment area, in a length estimated of 100 meters.

6.6 PERIMETER FENCE
It is necessary to complete 30 M contiguous to the access street.

7. FEASIBILITY OF REHABILITATION AND/OR MAINTENANCE

7.1 The plant is in generally good operating conditions and maintenance, their rehabilitation is feasible under the conditions specifying in item 6.

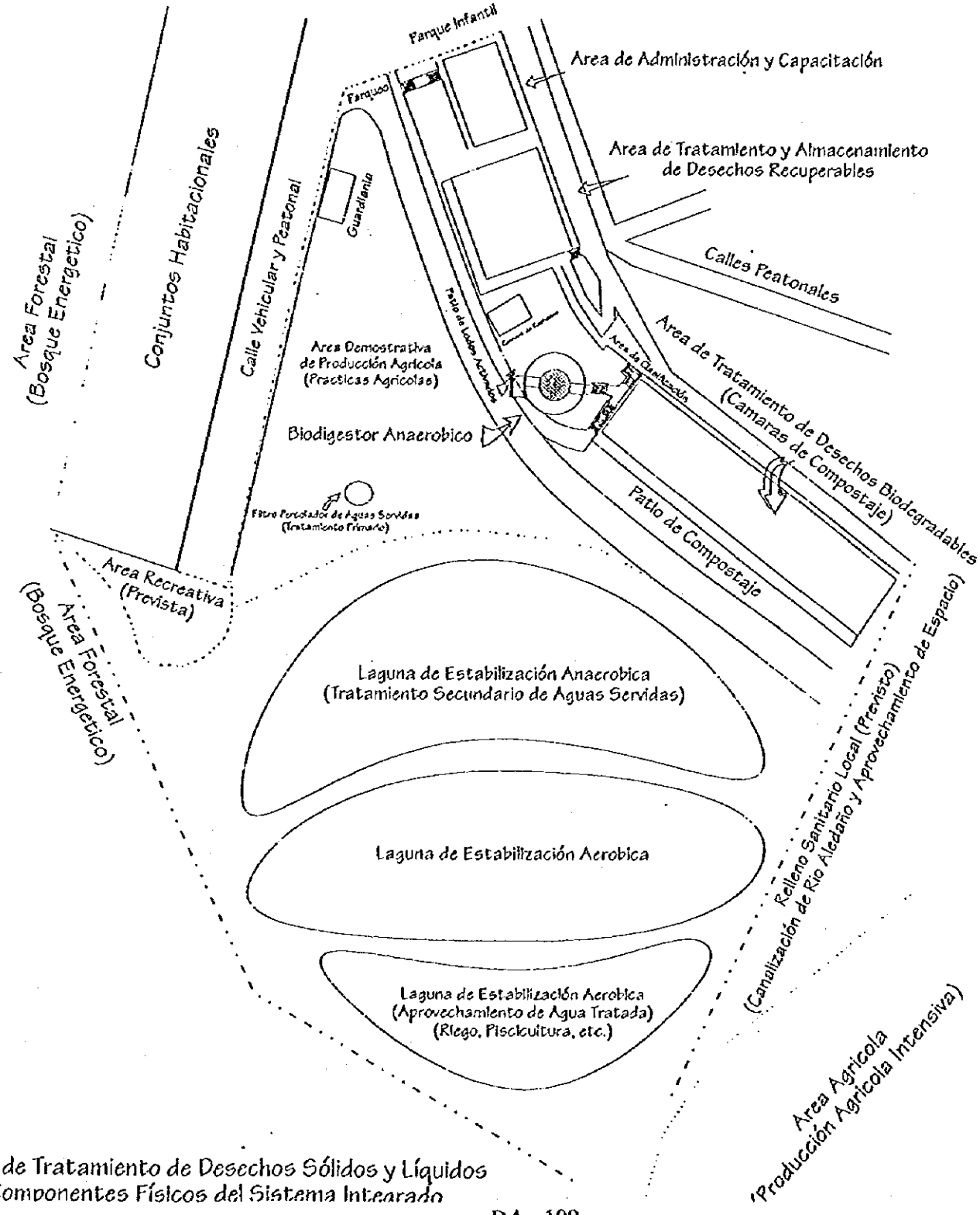
Costs are not introduced, as is being operated by
ARMSA, SANEAMIENTO INTEGRADO ALTERNATIVO ALAMEDA NORTE.

ASOCIACION PARA LA RECUPERACION, MANEJO Y SANEAMIENTO AMBIENTAL

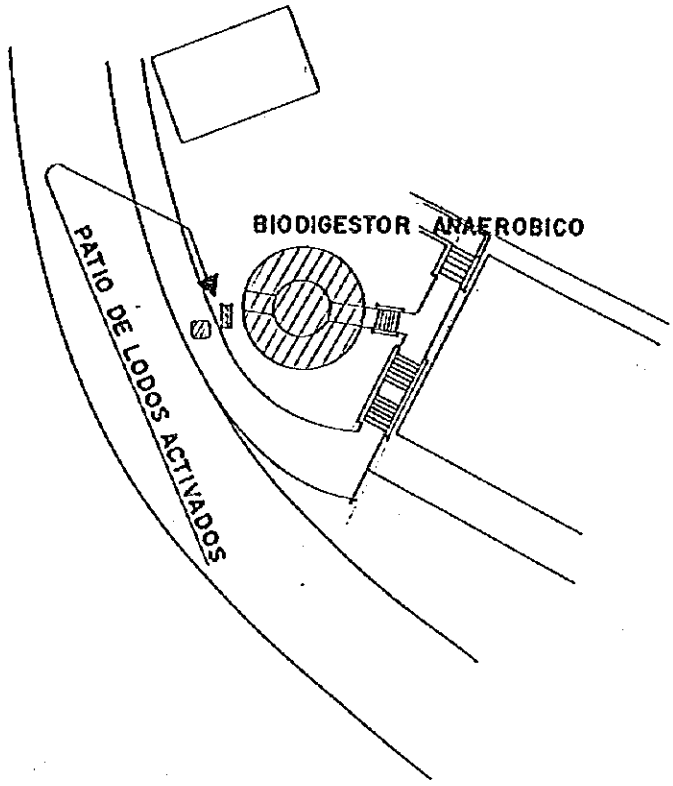
ARMSA

SISTEMA INTEGRADO ALTERNATIVO ALAMEDA NORTE

DIAGRAMA 1: Disposición de Areas a Nivel de Diseño



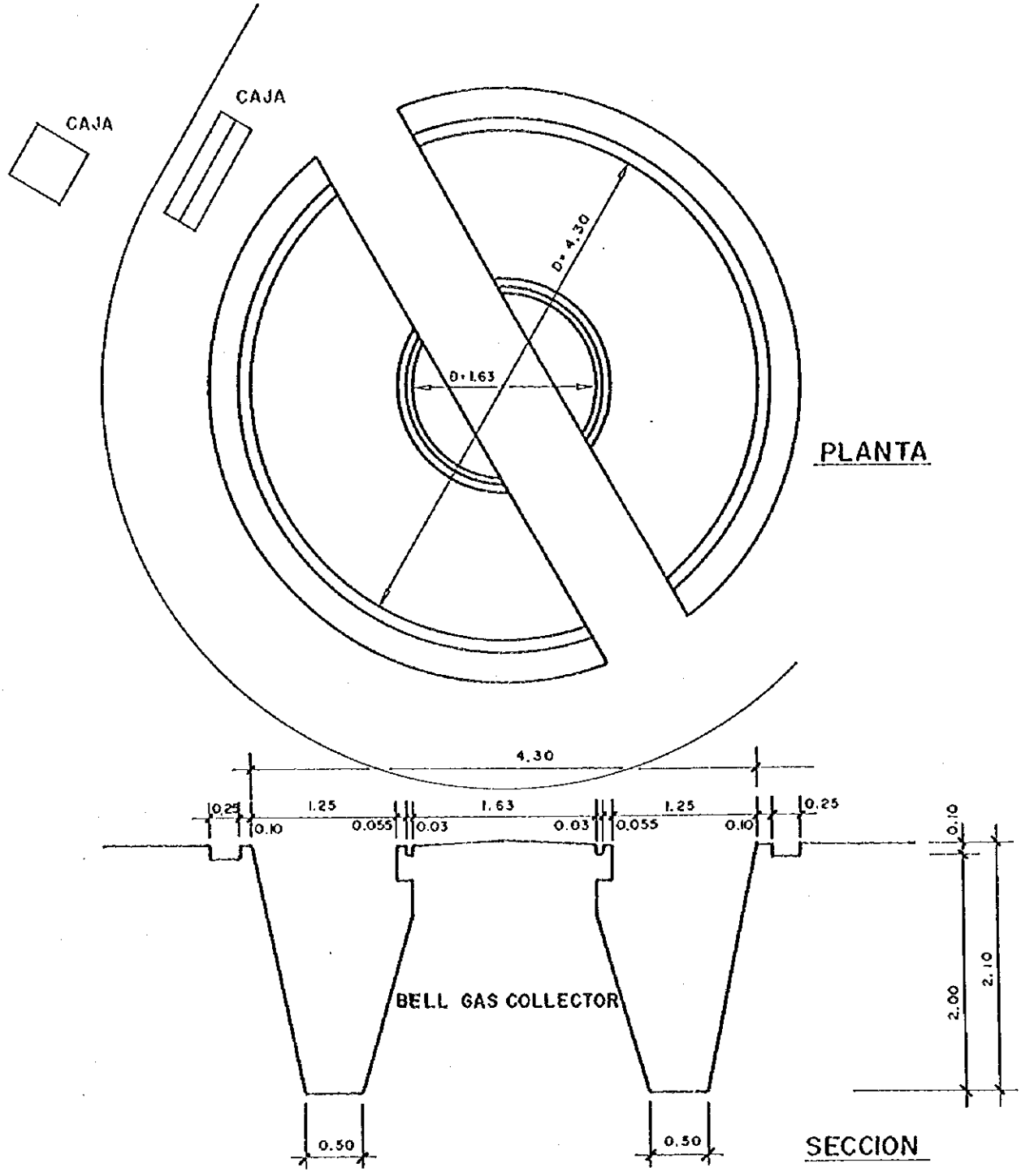
Planta de Tratamiento de Desechos Sólidos y Líquidos y Componentes Físicos del Sistema Integrado



FILTRO PERCOLADOR
DE AGUAS SERVIDAS

TRATAMIENTO PRIMARIO

INDICA EXISTENTE



SKETCH

PLANTA: BIODIGESTOR ANAEROBICO COLONIA "ALAMEDA NORTE"

MOLINO DE LAS FLORES

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN THE
GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANT
DATE: JUNE 1,995

1. GENERAL ASPECTS

1.1 NAME
TREATMENT PLANT MOLINO DE LAS FLORES

1.2 LOCALIZATION
48 Av. A and 34 st. colony MOLINO DE LAS FLORES, zone 11.

2. GENERAL INFORMATION

2.1 OWNER
Municipality of Mixco.

2.2 GOBERMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND/OR MONITORING.
Municipality of Mixco.

2.3 CONSTRUCTION COSTS

2.4 YEAR OF COMMENCEMT OPERATIONS
1,973

2.5 TREATMENT CAPACITY
25 M3/HOUR = 600 M3/DAY
With the following components and volumes
-Septic tank: 596 m3

2.6 TREATMENT PROCESS
- flow box collector
- septic tank
- 11 infiltration wells

2.7 OPERATIONAL CONDITION
Regular

2.8 INSTITUTION RESPONSIBLE FOR THE OPERATION AND MAINTENANCE.
Municipality of Mixco

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
MOLINO DE LAS FLORES colony. zone 11, Guatemala.

3.2 SEWERED AREA
192 HA

3.3 DESIGN POPULATION
3000 habitants (1006 houses, information of the municipality of Mixco)

3.4 FLOWRATE DESIGN
25 M3

3.5 QUALITY OF THE INFLUENT
Normal characteristics of wastewater flow, for a colony of people of medium incom.

3.6 QUALITY OF THE EFFLUENT
Effluent final with a 50% of treatment

3.7 SCHEMATIC DIAGRAM OF OPERATION FLOW
Seeing annex # 1 # 2

3.8 DESIGN DETAILS
Seeing annexed # 1 and # 2

- septic tank
  - long: 14.80 m
  - wide: 11.50 m
  - depth : 4.00 m

- absortion well
  - diameter: 1.00 m
  - depth: 15.00 m

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATOR
There is not operator designated.

4.2 NAME OF THE OPERATOR

4.3 SLUDGE REMOVAL
Once every 6 months cleaning of septic tank and wells

4.4 EFFICIENCY OF TREATMENT
Estimated a 50% treatment because only the half of the wells are working.

5. CONCLUSIONS OF THE INVESTIGATION

5.1 STRUCTURAL STATE
The septic tank is in good structural conditions of operation, it has 4 boxes of distribution flow of 1.00 m x 1.00 m, and then to 11 wells of infiltration (two of them without cover), the tank has 3 air pipes and one is completely locked.

5.2 STATE OF PIPES
The pipes from the septic tank to the infiltration wells could not be chequed, because they are underground.

5.3 VALVES GATE FOR OPERATIONAL CONTROL
not exist valves.

5.4 BOXES AND COVER FOR PROTECTION
Two covers of infiltration well are needed

5.5 COUNTERDRAIN
Not existing.

5.6 INTERCOMUNICATION SIDE-WALKS AND STAIRS
Not existing

5.7 GENERAL ACCESS ROADS
The septic tank is approximately to 8 meters of gradient in relationship with the height of the 48 avenue and 34 street. any class of road definite access doesn't exist, to exception a trail pedestrian.

6. RECOMMENDATIONS

6.1 STRUCTURES
Necessary to check the exactly location of the all well, to put all of them in operational state.

6.2 PIPES
Necessary make excavation in the all area to check all the pipes from the septic tank to the infiltration wells.

6.3 VALVES GATES
Not existing

6.4 BOXES AND COVERS
Necessary replace two covers of infiltration wells.

6.5 COUNTERDRAIN
Necessary construct counterdrains in a distance of 20 mts. around the septic tank.

6.6 GENERAL FENCE
Necessary contruct a general fence in aproximately 160 lineal meters.

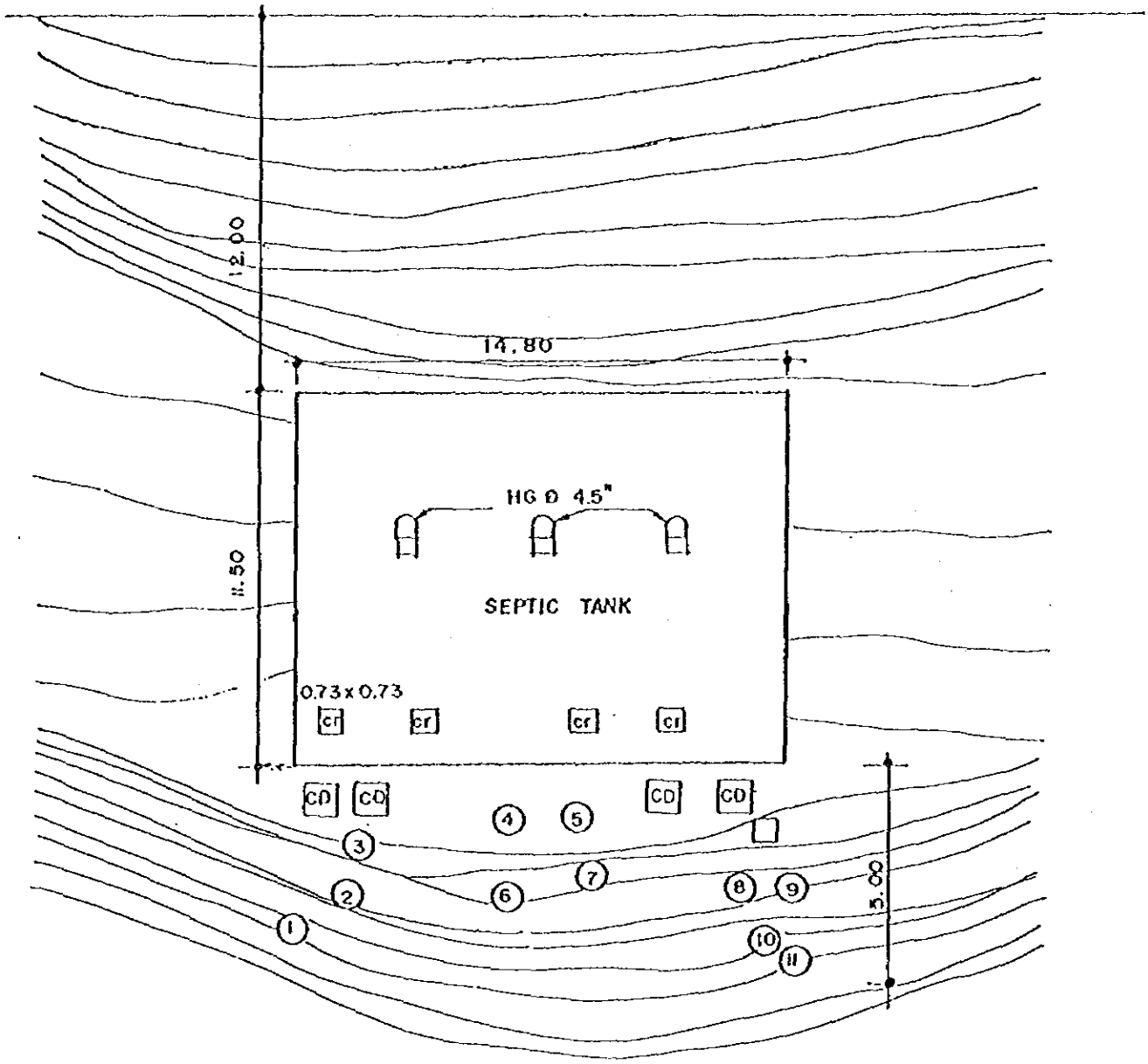
7. FINAL OBSERVATIONS

7.1 QUALIFIED SUPERVISION
It's convenient designate one person who take the permanent maintenance for the septic tank and infiltration wells.

8. FEASEABIBLITY OF REHABILITATION AND/OR MAINTENANCE

8.1 The treatment plant presents a general good conditions for rehabilitation, acording to the observations made in item 6, estimating cost of this rehabilitation are Q. 130,650.00 equivalent to US$.23,400.00.

48 Ave. A and 34 St. A

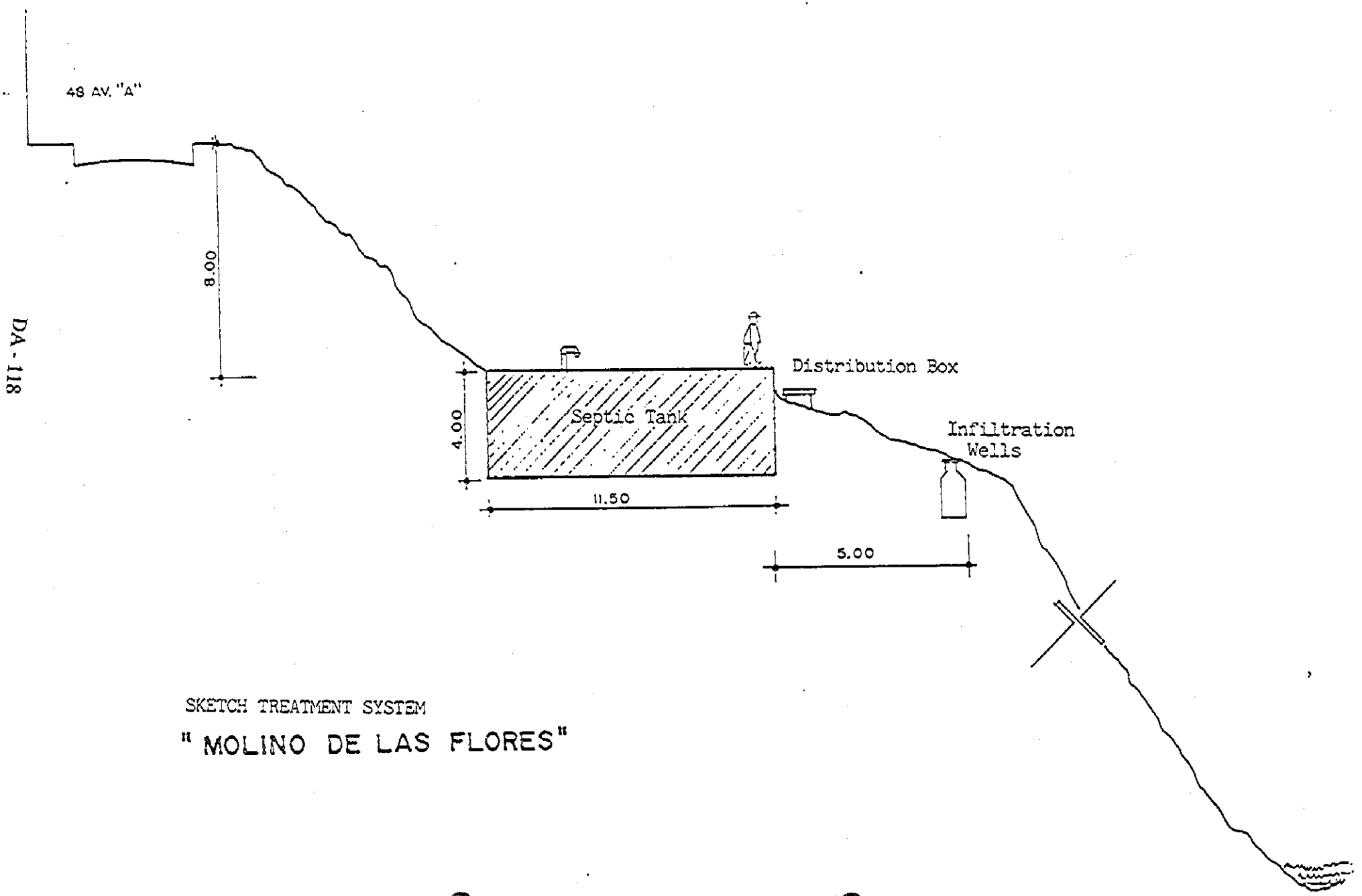


SKETCH TREATMENT SYSTEM

SCALE 1/200

"MOLINO DE LAS FLORES"

DA - 117



SKETCH TREATMENT SYSTEM

" MOLINO DE LAS FLORES"

ANNEX No. 3
WASTEWATER TREATMENT
MOLINO DE LAS FLORES

SEPTIC TANK	QUANTIT	UNIT
Volume	596	M3
Flowrate estimation for		
retention time of		
24 hours	25	M3/Hours

POPULATION DESIGN ESTIMATIO	2837	H
Duty water supply 150 l/h/d		
Q wastewater: 105 l/h/d		
Maximum Factor day: 2		

RESUMEN		
Estimate population	3000	H
Estimation flowrate	25	M3/Hours

LOMAS DE PORTUGAL

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN THE
GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANT
DATE: JUNE 1,995

1. GENERAL ASPECTS

1.1 NAME
WASTEWATER TREATMENT, LOMAS DE PORTUGAL

1.2 LOCALIZATION
Colonia LOMAS DE PORTUGAL, ZONA 11

2. GENERAL INFORMATION

2.1 OWNER
Municipality of Mixco.

2.2 GOBERMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND/OR MONITORING.
Municipality of Mixco.

2.3 CONSTRUCTION COSTS

2.4 YEAR OF COMMENCENT OPERATIONS
1,970

2.5 TREATMENT CAPACITY
6 M3/HOUR = 144 M3/DAY
With the following components and volumes
-Septic tank: 144 M3

2.6 TREATMENT PROCESS
- General collector
- Final outlet to Molino River

2.7 OPERATIONAL CONDITION
Not operating

2.8 INSTITUTION RESPONSIBLE FOR THE OPERATION AND MAINTENANCE.
Municipality of Mixco

3. DESIGN DETAILS

3.1 NAME OF SEWERED AREA
LOMAS DE PORTUGAL

3.2 SEWERED AREA
16.24 HA.

3.3 DESIGN POPULATION
700 habitants

3.4 FLOWRATE DESIGN
6 M3/HOUR

3.5 QUALITY OF THE INFLUENT
Normal characteristics of wastewater flow, for a colony of people of medium incom.

3.6 QUALITY OF THE EFFLUENT
The septic tank is not operating

3.7 SCHEMATIC DIAGRAM OF OPERATION FLOW
Seeing annex # 1 # 2

3.8 DESIGN DETAILS
Seeing annexed # 1 and # 2
- septic tank
lenght: 12.00 m
width: 4.00 m
depth : 3.50 m

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATOR
None

4.2 NAME OF THE OPERATOR

4.3 SLUDGE REMOVAL

4.4 EFFICIENCY OF TREATMENT
The septic tank is not working.

5. CONCLUSIONS OF THE INVESTIGATION

5.1 STRUCTURAL STATE
Itis neccesaryrebuiltcoversandwalls oftheseptic tank.

5.2 STATE OF PIPES
The outlet pipes are broken.

5.3 BOXES AND COVERS
It has full damage.

5.4 COUNTERDRAIN
Not existing.

5.5 GENERAL ACCESS ROADS
Not defined

6. RECOMMENDATIONS

6.1 STRUCTURES
Necessary to rebuil septic tank

6.2 PIPES
Necessary replace 20 meters of concrete pipes of 18"

6.3 COUNTERDRAIN
Necessary to construct 20 mts. around the septic tank.

6.4 INTERCOMUNICATION SIDE-WALKS AND STAIRS
Necessary to contruct 40 m. of side-walks.

6.5 GENERAL ACCESS ROUTES
Necessary to contruc 150 meters.

6.6 GENERAL FENCE
Necessary fence in a lenght of 60 meters.

7. FINAL OBSERVATIONS

7.1 The septic tank has 8 years without function, and it has a lot of soils and stones inside. It shoul be cleaned

7.2 The actual discharge of the wastewater of the neighborhood, is going directly to the Molino River.

7.3 The size of the septic tank is to small for the amount of houses and people in Lomas de Portugal.

7.4 It was possible to obtain actual data on the Municipality of Mixco as follow:

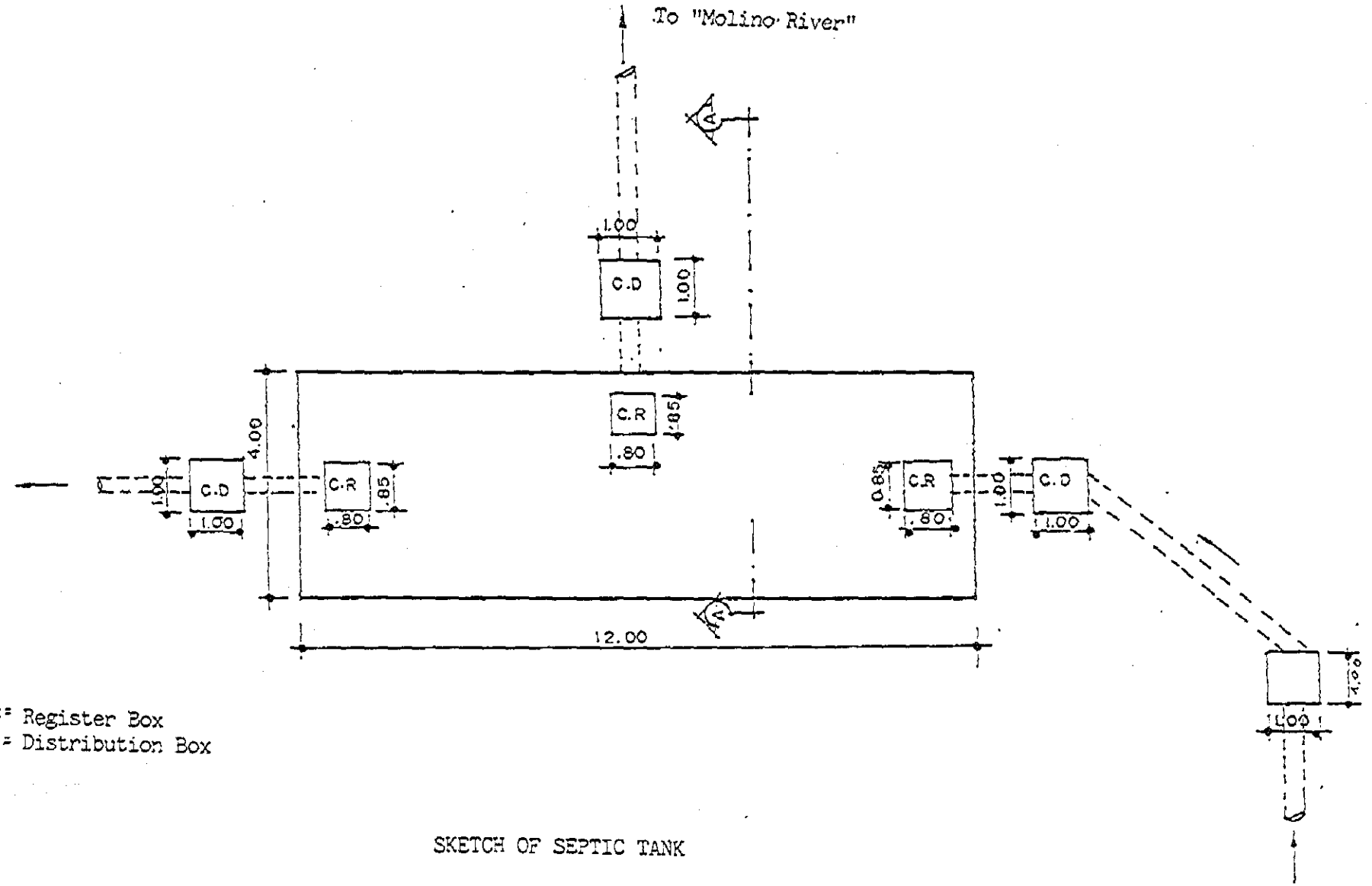
Number of houses:	1,014
Lots Area	232 M2
Colony total area	584,703 M2
Water connections	650
Dotation	200 L/H/D
Source	5 wells

8. FEASEABIBLITY OF REHABILITATION AND/OR MAINTENANCE

8.1 The size of the septic tank, could not serve to the actual number of habitants in good way. It is recommended to build another treatment system.

8.2 The estimating cost of this rehabilitation is 0. 638,722.50 equal to US$.114,100.00

DA - 125



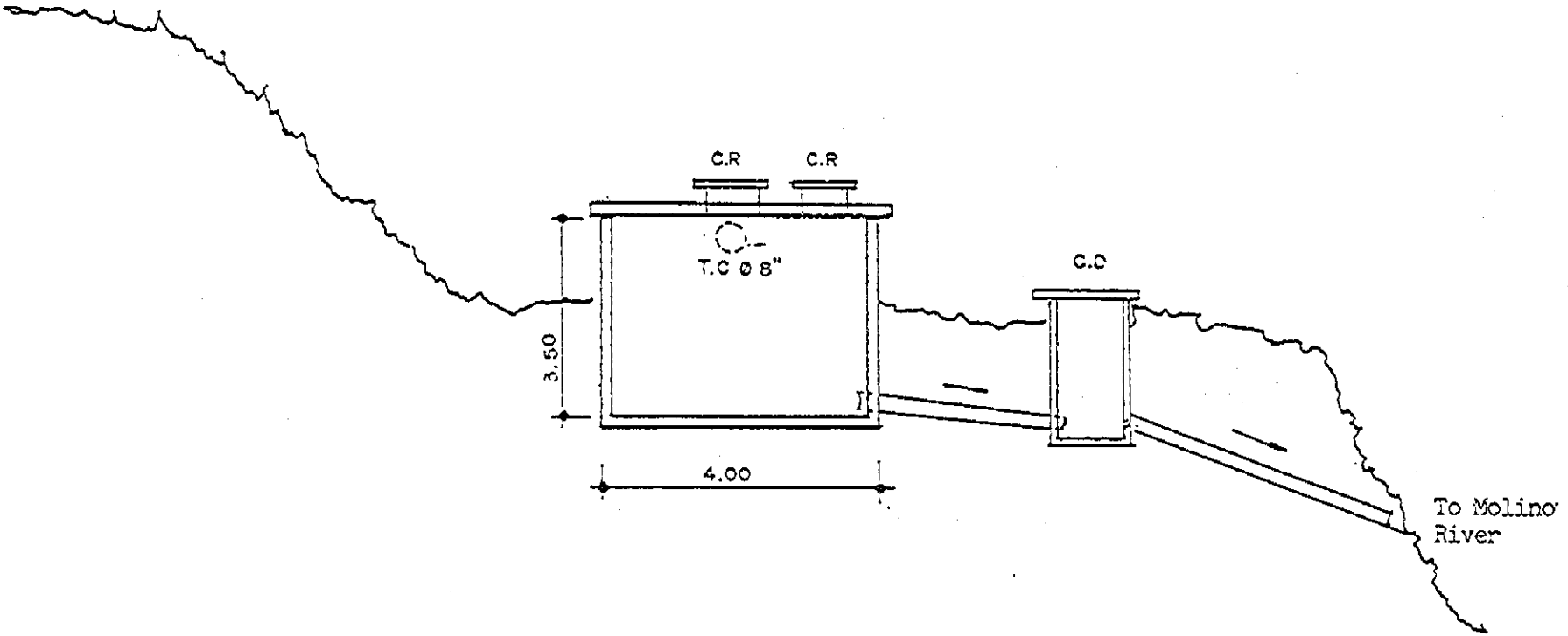
C.R= Register Box
CD= Distribution Box

SKETCH OF SEPTIC TANK

"LOMAS DE PORTUGAL"

ESC. 1:100

DA - 126



SKETCH TREATMENT PLANT (Section A-A)

"LOMAS DE PORTUGAL"

ESC . 1:100

ANNEX No. 3
WASTEWATER TREATMENT
LOMAS DE PORTUGAL

	QUANTIT	UNIY
SEPTIC TANK		
Volume	144	M3
Estimation flowrate for		
retention time of		
24 hours	6	M3/Hours

DESIGN POPULATION ESTIMATIO	686	H
Dotacion 150 l/h/d		
Q wastewater: 105 l/h/d		
Maximum Factor day: 2		

SUMMARY		
Estimate population	700	H
Estimate flowrate	6	M3/Hours

EL CARMEN

THE STUDY ON THE IMPROVEMENT OF
WASTEWATER MANAGEMENT IN
THE GUATEMALA METROPOLITAN AREA

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANTS
DATE SURVEY: JUNE 1,995

1. GENERAL ASPECTS

1.1 NAME
EL CARMEN

1.2 LOCALIZATION
2a. Ave and 36 St. Colony El Carmen, zone 12

2. GENERAL INFORMATION

2.1 NAME

2.2 GOVERMENT AUTHORITY RESPONSIBLE FOR APPROVAL AND OR MAINTENANCE

2.3 CONTRUCTION COSTS

2.4 YEAR OF COMMENCEMENT OPERATIONS

2.5 TREATMENT CAPACITY

2.6 TREATENT PROCESS

2.7 OPERATING CONDITIONS

2.8 INSTITUTION RESPONSIBLE FOR OPERATION AND MAINTENANCE

3. DESIGN DETAILS

3.1 NAME OF SEWEGE AREA
Colony El Carmen

3.2 SEWERED AREA
1.5 hectares (estimated)

3.3 DESIGN POPULATION

3.4 FLOW RATE DESIGN

3.5 QUALITY OF THE INFLUENT

3.6 QUALITY OF THE EFFLUENT

3.7 SCHEMATIC DIARGRAM OF OPERARION FLOW

3.8 DESIGN DETAILS

4. OPERATION AND MAINTENANCE

4.1 NUMBER OF OPERATORS

4.2 NAME OF OPERATOR

4.3 SLUDGE REMOVAL

4.4 TREATMENT EFFICIENCY

5. RESEARCH CONCLUSIONS

5.1 In 1,957, the area that actualy is knowed as COLONIA EL CARMEN was a cow farm, where the principal objetive was the production o dairy products, after a few year, in 1961 the area was sold for a recidential area, but the city limits was to far from that zone. Reason because they dont have any design for adecuate wastewater management.

When the Guatemala city start to grow, and the city limits go far to Colonia El Carmen, the municipality department of waste-water made a regulation law who said, that every house in colonia El Carmen should have a septic tank of 24.5 mts minimum deep.

With the new contructions that apperar in the last years, some owners have been conected their sewer channels to the public storm water pipes, creating problems on the final box located on 2a. avenue and 36 street an then 200 mts down in a grill.

These persons told us that they do not have space for septic tanks in their houses, reason because they decide to discharge on the storm water pipes.

6. RECOMMENDATIONS

6.1 It is necessary to make a completely design of sewer for the Colonia El Carmen. Some houses are starting to built another septik tank because they have already full the firts one.

DA 4 Estimation of Capacity

DA 4-1 Estimates of Served Area
DA 4-2 Typical Calculations to Determine Capacity of Existing Treatment Plant

DA 4 - 1 Estimates of Served Area

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANTS

TREATMEN PLANT NAME	No. PERS/FAMILY	LOT SIZE (M2) M2	GREEN AREA FACTOR	AREA (HA)
SAN CRISTOBAL	5	25 X 25	1.6	200
VILLALOBOS I	6	12 X6	1.25	40.9
VILLALOBOS II	6	12X6	1.3	46.8
EL MEZQUITAL		12X6	1.3	48.9
NIMAJUYU	6	12X8	1.25	25.5
USAC	5	UNIVERSITY DATA		122.8
EUREKA	5	12X6	1.3	3.3
CANADAS DE SAN ANGEL	5	HORIZONTAL	1.25	3.7
BELLO HORIZONTE	5	12X6	1.2	12.7
EL ROBLE		12X10	1.25	4.2
ALAMEDA NORTE		ARMSA DATA		1.2
MOLINO DE LAS FLORES		MIXCO DATA		192
LOMAS DE PORTUGAL		MIXCO DATA		16.2
EL CARMEN				

DA 4 - 2 Typical Calculations to Determine Capacity of Treatment Plant

SURVEY ON EXISTING SMALL-SCALE
SEWAGE TREATMENT PLANTS
DATE: JUNE 1991

1. INTRODUCTION

It was necessary to calculate some data like:
- Design Flowrate
- Design Population
- Area sewered

This data, it was necessary to calculate, due to not be available memorial technical or other documents with the required information.

2. PROCESS TO CALCULATE

SEDIMENTATION TANK

a. From geometry: --> SUPERFICIAL AREA (M2)
b. From geometry: --> VOLUME (M3)
   For this item, is considered the type of reactor (like Imhof Tank)
c. From "time retention" and considering TR = 2
   VOL/TR --> FLOWRATE (M3/HOUR)
d. From "Day Max Factor" and using
   FDM = 2 --> FLOWRATE (M3/H)
e. With "use water/day"
   DOTACION [100, 250] L/H/DAY, and a factor por wastewater
   FACTOR = 0.7 --> POPULATION

FACTORS SUMMARY:
1. Retention Time: 2
2. Day Max Fac: 2
3. Dotation: [100 - 250] L/H/DAY
   Used in calculations: 128 L/H/DAY

DIGESTER

a. From geometry --> VOLUME (M3)
c. Converting to liter --> VOLUME (LITERS)
d. Using range
[30, 50] L/H/DAY
VOL/RANGE --> POPULATION

NOTE:
Used in calculations: 30 L/H/DAY

SLUDGE DRYING BED

a. From geometry --> TOTAL AREA (M2)
b. From "Area for
8 annual discharges and
sludge high = [0.25, 0.30] --> AREA PER CAPITA (M2)
c. a/c --> POPULATION

NOTE:
Used in calculations:
High of Sludge drying bed: 0.30
Area for 8 annual discharges
calculated with the expression:

$$\frac{0.260/1000 \times 365}{8 \times 0.30}$$

2. RESULTS SELECTED

DESIGN FLOWRATE — USE VOLUME/RETENTION TIME
DESIGN POPULATION — USE THE AVERAGE [SED POP + DIG POP + SLUDGE POP]/3

DATA BOOK DB

AGRICULTURAL SURVEY

DATA BOOK DB
AGRICULTURAL SURVEY
TABLE OF CONTENTS

ANNEXES

THE STUDY ON THE IMPROVEMENT
WASTEWATER MANAGEMENT IN
THE GUATEMALAN METROPOLITAN AREA

1. INTRODUCTION

On December 1994, was agreed between the Guatemala Government, representing by the Empresa Municipal de Agua de la Ciudad de Guatemala, EMPAGUA and the International Cooperation Agency of Japan, JICA, to realize "The Study on The Improvement of Wastewater Management in the Metropolitan Area of Guatemala"

To achieve this study it was required to carry out a AGRICULTURAL SURVEY

PALA reviewed the technics aspects of the Study proposed, confirmed its participation, establishing the initials mechanisms of the job.

On the 7th of April of 1995, the Japanese Mission had its first interview with the Engineer Hector Paiz Castillo, General Manager of PALA and the 10th of April was realized the official presentation of the members of the guatemalan counterpart personnel.

In order to achieve the goal mentioned, from the beginning was defined the technics and procedures that will conducted along the activities for the preliminary Studies of the Work.

2. SCOPE OF WORKS

The Scope of work, the definition of the geographic study and the actions properly mentioned, were defined, basically on Document dated 2 May 1995.

The work activities established were:

- To identify the types of fertilizer and pesticides used in the study area and their estimated use.

- To identify ten farms in the northern part and southern part of the Study area.This activity were done jointly with Dr. S. Kugaprasathan. Annex 2.

- To conduct a questionnaire survey for hearing on use fertilizer and pesticides in those farms in order to get information about:
  - Amount or fertilizer/pesticide used.
  - Period of application
  - Method of application

- To prepare a report of the results of questionnaire survey.

3. OBJECTIVES OF THE INVESTIGATION

In general, the objectives of the investigation, are marked within the following aspects:

a. To formulate a Master Plan for the improvement of the manage of the Wastewater, contributing in this way to raise the sanitary level and the environmental conditions in the Metropolitan Area of Guatemala to the year 2015.

b. To conduct a feasibility study about the priority project selected in the master plan.

c. To transfer technology in planning skill to the guatemalan counterpart personnel through the study

4. AREA OF STUDY

For the realization of the investigation, the Guatemalan Government and the Japan International Cooperation Agency "JICA" on December 1994, defined the geographic area for the development of the study.

4.1 METROPOLITAN AND THE INFLUENCE AREA

It was defined as the area of the study of Guatemala City properly mentioned and the part of the municipiums that surrounded the Guatemala municipium, they are: Chinautla, Mixco, Villa Nueva, Villa Canales, San Miguel Petapa, Santa Catarina Pinula and San Pedro Ayampuc.

4.2 GEOGRAPHIC LOCALIZATION

The area of study mentioned, it shows as follows in the Annex 2

The addresses of each Farm are shown in Graphic No. 2

5. METHODOLOGY OF WORK

5.1 SELECTION AND PERSONNEL TRAINING

For the accomplishing the activity, it was necessary to select the suitable personnel to accomplish with the acquired engagements. The selection of personnel was realized through two levels of responsibility:

COORDINATION

The responsibility of the coordination, was delegated in the Eng.. Jose Gilberto González de León, graduated in Civil Engineering of the San Carlos University, with post-grade in Sanitary Engineering, in the Regional School of Sanitary Engineering.

WORK OF FIELD AND PERSONNEL SELECTION

For this activity, the responsibility of the Coordinator is less, it was proceeded to the searching and selection of personnel sampling and the field work according of the action.

The criteria utilized for the selection, considered the importance of the study, were among others:

- Level of university education
- Vocation of field work
- High spirit of cooperation
- Capacity of work under conditions of high effort
- Spirit of responsibility
- Ability to communicate in English Language

The personnel selected was:
- Eng. José Díaz (Enviroment Specialist)
- María Elena de Diéguez.
- Edgar Mijangos.

It was necessary realized a series of actions previous to the field activities like give information about the activity to develop and transfer the general information, making emphasis in aspects as:

* Object of the Study
* Responsibility and necessary professionalism
* Necessity of obtain of field reliable data

5.2 FIELD ACTIVITIES

5.2.1 IDENTIFICATION OF THE FARMS

It was necessary to identify all types of farms located in the State of Guatemalan. The information was selected basically from several resources:

- Dirección General de Servicios Agrícolas, DIGESA
  (Agricultural Services General Direction)
- Unidad Sectorial Planificación de la Agricultura, USPADA.
  (Sectorial Unit Agriculture Planning)
- Facultad de Agronomía, Universidad de San Carlos, USAC
- Gremial de Exportadores de Productos No Tradicionales.
  (Products non traditionalize Exporter Society)
- Asociación Nacional del Cafe, ANACAFE
  (Coffee National Society)

5.2.2 CLASSIFYING THE INDUSTRIES

After the selection of the Farms the following was to classify them as:

- Coffee
- Sugar-cane
- Corn
- Beans
- Flowers
- Fruits
- Green peas
- Legumes

The type of Farms are showed in GRAPHIC No. 3

5.2.3 SELECTING THE FARMS

The next steep was necessary to select ten Farms for conduct the agricultural survey. This acctivity was carry out jointly with Dr. S. Kugaprasathan. But, because of the difficulty to obtain free data from the Farms, it was necessary to select and list more farms than ten, to be sure to fill the questionnaire for the expected industries.

5.2.4 CONDUCTING THE QUESTIONNAIRE

Once the Farms was selected, the next action was to visit the Farms and fill the questionnaire.

In this activity, same as the Industrial survey, was found many troubles, do to the hostility industry's managers, usually they hesitate and refused to give information for several reasons.
At the end it was possible to full-fill sixteen questionnaires with the available information.

5.3 TABULATION RESULTS (Farms general description)

5.3 1 ACCESS AND ADDRESS

The Farms were located in or near of the study area, using as a basic criteria that the searching location can make some influence, of the surface drainaje that goes to the Amatitlan Lake. This information is shown in GRAPHIC No. 2

5.3 2 GENERAL TOPICS

In this item was considered the use and soil property, as well the different kind of seeding of the Farm. The state is shown in GRAPHIC No. 3

5.3.3 AGRONOMICAL TOPICS

This item provide us the ubication and cultivated area and the annual production of each type of seeding. This information was provided by the farm's owners. The information is shown in GRAPHIC No.4

5.3.4 AGROCHEMICAL USE

The agriculture land needs in general the agrochemical products. Specially the land needs fertilizers and biocides to provide efficiency in agronomical practics. The information is shown in GRAPHIC No. 5 and GRAPHIC No. 6

5.4 SURVEY RESULTS

In the Annex No. 1 it is possible to see, the questionnaires with the available information.

6. GENERAL STATISTICS ON AGRONOMICAL TOPICS

In this item, it is possible to see different tables which shows some data about the Theme:

- Estimated area of production. See GRAPHIC No. 7 (Data in Ha)
- Estimated area of production. See GRAPHIC No. 8. (Data in Metric Ton.)
- Legumes, fruits and flowers production (1989/1990). See GRAPHIC No. 9. (Global data)
- Legumes, fruits and flowers production (1989). See GRAPHIC No. 10 (Data in qq)
- Legumes, fruits and flowers production (1989). See GRAPHIC No. 11 (Data in area)
- Legumes, fruits and flowers production (1989). See GRAPHIC No. 12 (Data in qq/Mz)
- Legumes production (1989). See GRAPHIC No. 13. (Data in Area/Mz)
- Legumes production (1989) See GRAPHIC No. 14 (Data in qq)
- Legumes, fruits aznd flowers (1989). See GRAPHIC No. 15 (Income sales)
- Seeding areas on non tradiotionals products. See GRAPHIC No. 16 (Data in area/Mz)
- Use of soil for seeding legumes, fruits and flowers in the Metropolitan Region. See GRAPHIC No. 17

7. CONCLUSIONS AND RECOMENDATIONS

7.1 The survey on Fertilizer/Pesticide use in Agriculture, is an important activity, because from the knowledge of the relative data, it is possible to obta in general inmformation tha contributes to an integral view of the agricultural effluents in the Guatemalan Metropolitan Area.

7.2 The knowledge of the results on the analysis of agricultural effluents, can help to plan the future actions in the enviroment field.

7.3 The results can help to different guatemalan institutions related with the enviroment field.

7.4 The results, permitts to make adequate laws, that contributes to the upgrading of sanitary and enviroment conditions.

GRAPHIC No. 2
ACCES AND LOCALIZATION

No.	NOMBRE DE LA FINCA	ACCESO	DIRECCION
1	San Agustin Las Minas	Km. 13.5 Ruta a Villa Canales	Villa Canales, Guatemala
2	Mayacrop	Km. 25 Hacia Relleno Lago Amatitlan	Villa Canales, Guatemala
3	Ingenio Santa Teresa	Villa Canales, Guatemala	Villa Canales, Guatemala
4	Moran	Km. 22 Entrado a Villa Canales	Villa Canales, Guatemala
5	Las Brisas	Km. 18 a San Juan Sacatepequez	Mixco, Guatemala
6	Los Guajes	Km. 23 Ruta a el Salvador	Fraijanes, Guatemala
7	El Socorro	Km. 23.5 Ruta a el Salvador	Fraijanes, Guatemala
8	Chestnut Hill S.A.	Km. 24 Ruta a el Salvador	Fraijanes, Guatemala
9	Avicola Campo Nuevo	Ruta Aldea Los Ocotes	Zona 17, Guatemala
10	Monterrey	Ruta Aldea Los Ocotes	Zona 17, Guatemala
11	El Sintul	Aldea Los Ocotes	Zona 17, Guatemala
12	Caserio Los Angeles	Cruce a Los Ocotes y Las Canoitas	Zona 17, Guatemala
13	Rancho Dulce	Entrada a Colonia El Rosario	Zona 18, Guatemala
14	Mariana	Ruta Entre Residenciales Catalina y San Miguel Petapa (Aldea El Frutal)	Villa Nueva, Guatemala
15	Aldea Cebadilla Grande	Zona 17, Guatemala	Zona 17, Guatemala
16	Aldea Las Canoitas	Zona 17, Guatemala	Zona 17, Guatemala
17	Lotific. Valles de San Cristobal	Camino a El Campanero	Mixco, Guatemala

GRAPHIC No. 3
PROPERTY AND KIND OF CROP

No.	NAME	PROPERTY		MAIN AGRICULTURE CULTIVES
		OWNER	RENTING	
1	San Agustin Las Minas	X		Cafe, Sabila, Leard Life y Mora.
2	Mayacrop		X	Flores, Geranios y Chinas.
3	Ingenio Santa Teresa	X		Cana.
4	Moran	X		Cafe.
5	Las Brisas		X	Arbeja China.
6	Los Guajes	X		Semillas Para Pastura.
7	El Socorro	X		Maiz y Cafe.
8	Chestaut Hill S.A.		X	Fresas.
9	Avicola Campo Nuevo	X		Maiz, Frijol, Guisquil, Naranjo y Tomate.
10	Monterrey	X		Cafe, Maiz y Frijol.
11	El Sintul	X		Guisquil, Maiz y Frijol.
12	Caserio Los Angeles	X		Guisquil y Maiz.
13	Rancho Dulce	X		Cafe.
14	Mariana	X		Mora, Frambuesa y Verduras.
15	Aldea Cebadilla Grande	X		Maiz.
16	Aldea Las Canoitas	X		Maiz.
17	Lotific. Valles de San Cristobal	X		Maiz.

GRAPHIC No. 4

TOTAL AREA CROP

No.	NAME	TOTAL AREA	AREA EACH CROP	PRODUTION ESTIMATION ANUAL EACH CROP
1	San Agustin Las Minas	1263.52 Ha.	Cafe - 293.45 Ha. Sabila - 13.98 Ha. Leard Life - 6.99 Ha. Mora - 10.48 Ha.	Cafe- 10,000 qq. oro No proporcionaron datos. No proporcionaron datos. No proporcionaron datos.
2	Mayacrop	34.94 Ha.	Flores - 34.94 Ha.	No proporcionaron datos.
3	Ingenio Santa Teresa	489.10 Ha.	Cana - 419.22 Ha.	Cana - 60,000 Ton.
4	Moran	139.74 Ha.	Cafe - 104.81 Ha.	Cafe- 3,270 qq. pergamino
5	Las Brisas	6.99 Ha.	Arbeja Chino - 2.79 Ha.	No proporcionaron datos.
6	Los Guajes	180.51 Ha.	Pasto - 67.07 Ha.	No proporcionaron datos.
7	El Socorro	225.63 Ha.	Maiz - 10.48 Ha. Cafe. - 13.97 Ha.	Maiz - 675 qq. Cafe. - 1,200 qq.
8	Chestnut Hill S.A.	67.07 Ha.	Fresas - 42.17 Ha.	No proporcionaron datos.
9	Avicola Campo Nuevo	315.88 Ha.	Maiz - 69.87 Ha. Frijol - 69.87 Ha. Guisquil - 27.95 Ha. Naranja - 12.58 Ha. Tomate - 2.10 Ha.	Maiz - 3,000 qq. Frijol - 2,000 qq. Guisquil - 8,000 qq. Naranja - 150,000 Unidades. Tomate - 1,000 Cajas.

GRAPHIC No. 4

HOJA. No. 2/2

TOTAL AREA EACH CULTIVE

No.	NAME	TOTAL AREA	AREA EACH CROP	PRODUTION ESTIMATION ANUAL EACH CROP
10	Monterrey	361.00 Ha.	Cafe = 16.76 Ha. Maiz = 15.36 Ha. Frijol = 15.36 Ha.	Cafe = 600 qq. Maduro. Maiz = 880 qq. Frijol = 550 qq.
11	El Siatul	90.25 Ha.	Guisquil = 22.35 Ha. Maiz = 44.70 Ha. Frijol = 44.70 Ha.	Guisquil = 8,000 qq. Maiz = 2,560 qq. Frijol = 1,920 qq.
12	Caserio Los Angeles	6.28 Ha.	Guisquil = 2.10 Ha. Maiz = 2.79 Ha.	Guisquil = 225 qq. Maiz = 200 qq.
13	Rancho Dulce	225.13 Ha.	Cafe = 81.05 Ha.	Cafe = 6,270 qq. Pergamino.
14	Mariana	34.94 Ha.	Mora = 4.20 Ha. Frambuesa = 4.20 Ha. Verduras = 8.40 Ha.	No proporcionaron datos. No proporcionaron datos. No proporcionaron datos.
15	Aldea Caballo Grande	69.88 Ha.	Maiz = 41.92 Ha.	Maiz = 2,400 qq.
16	Aldea Las Canoitas	69.88 Ha.	Maiz = 34.94 Ha.	Maiz = 2,000 qq.
17	Lotific. Valles de San Cristobal	2.80 Ha.	Maiz = 2.80 Ha.	Maiz = 140 qq.

GRAPHIC No 5
BIOCIDES

HOJA 1/2

No.	NAME	CROP	KIND OF BIOCIDES	* QUANTITY CRAP	APLICATION TECNIC	APLICATION PERIOD
1	San Agustin Las Minas	Cafe.	ALTO, CARBENDACIN, PACONIL, SENLATE, METAXISTO, THIODAN, TEXIC, FURADAN, TERBUFOS Y FETRILON COMBI.	Conforme la necesidad, se aplican los Biocidas. La produccion de Cafe se exporta a Europa. no dieron datos produccion	Manual y Mecanico	Variable segun Muestreo.
2	Mayacrop	Flores.	DESISTOL, COUNTER, MOCAP, THIODAN, ALTO 100, VONDOSED Y PROGO 500.	72 qq., 72qq. y 72 qq. 1/2 Lts./Mz., 250cc./Mz. 3 Lbs./aZ. Y 1 Lts./aZ. (Por cada aplicacion)	Fumigacion y Goteo.	2 por Ano Conforme Muestreo Plagas.
3	Ingenio Santa Teresa	Cana.	TERBOFOS, AEROFOS, LORBAN, BELPAR, CARMEX, 2-4D Y RANDON	60 qq., 60 qq. y 60 qq. 100 Gal de cada uno.	Manual y Mecanico Manual y Bomba.	1 por Ano 1 por Ano
4	Moran	Cafe.	THIODAN	72 Galones. (Por cada aplicacion)	Manual y Bomba.	2 por Ano
5	Las Brisas	Arbeja China.	THIODAN, MALATHION, CHAMPION, FERBAM Y DIAZINON.	32 Lts., 5 Lts., 32 Lts. 5 Lts. y 10 Lts. (Por cada aplicacion)	Aspercion y Goteo.	3 por Ano
6	Los Guajes	Pasto.	NO USAN BIOCIDAS.			
7	El Socorro	Maiz. Cafe.	VOLATON y MALATHION THIODAN	30 qq. y 30 Lts. 20 Lts.	Manual Manual y Bomba.	1 por Ano 2 por Ano
8	Chestnut Hill S.A.	Fresas.	CAPTAN Y PENOKIL.	2.5 qq. y 1.35 qq.	Manual y Goteo.	12 Vez al Ano (2 por mes)

GRAPHIC No 5
BIOCIDES

No.	NAME	CROP	KIND OF BIOCIDES	QUANTITY CRAP	APLICATION TECNIC	APLICATION PERIOD
9	Avicola Campo Nuevo	Maiz. Frijol. Guisquil. Naranja. Tomate.	COUNTER. COUNTER. TAMARON TAMARON TAMARON, METASYSTOX Y COMPASAL	1200 Lbs. 1200 Lbs. 500 Lts. 126 Lts. 15 Lts., 27 Lts. y 150 Lts	Fumigando Fumigando Fumigando Fumigando Fumigando	1 por Ano 1 por Ano 6 por Ano 1 por Ano 3 por Ano
10	Monterrey	Cafe. Maiz. Frijol.	THIODAN AEROFOS Y COUNTER. AEROFOS Y COUNTER.	24 Litros. 66 Lbs. y 66 Lbs. 66 Lbs. y 66 Lbs.	Fumigando Manual Manual	1 por Ano 1 por Ano 1 por Ano
11	El Sintul	Guisquil. Maiz. Frijol.	TAMARON Y CIDIAL NO UTILIZAN NO UTILIZAN	64 Lts. y 64 Lts.	Fumigacion	1 Vez al Ano
12	Caserio Los Angeles	Guisquil. Maiz.	TAMARON Y FOLIDOL NO UTILIZAN	54 Lts. y 54 Lts.	Fumigacion	1 Vez al Ano
13	Rancho Dulce	Cafe.	ZINC, BORO Y COBRE NEMACUR Y CAPTAFOL.	1485 Lts,183 Lbs,279 Lbs Conforme Muestreo.	Manual y Bombeo Manual y Bomba.	1 Vez al Ano
14	Meriana	Mora Y Frambue. Verduras.	TRISEL 20, GRAMOXONE, DIVERINO Y CARVENDACIN. AFALON Y VOLATON GRANULADO.	16 qq., 24 Lts., 2 qq., 288 Lts. 25 Lbs. y 24 Lbs.	Manual, Goteo y Aspersion. Goteo y Aspersion	cada 2 dias por cultivo y por cosecha
15	Aldea Cebadilla Grande	Maiz.	COUNTER	4 qq.	Manual	1 Vez al Ano
16	Aldea Las Canoitas	Maiz.	VOLATON Y COUNTER	6 qq. y 3 qq.	Manual	1 Vez al Ano
17	Lotific. Valles de San C	Maiz.	VOLATON GRANULADO	60 Lbs.	Manual	1 Vez al Ano

GRAPHIC No. 6
FERTILIZERS

HOJA 1/2

No.	NAME	CROP	BIOCIDES KINDS	QUANTITY CROP	APLICATION METHOD	APLICATION PERIOD
1	San Agustin Las Minas	Cafe.	UREA.	2.520 qq.	Manual y Mecanico	1 por ano
			BASF.	2.520 qq.	Manual y Mecanico	1 por ano
			NITROFOSCA.	2.520 qq.	Manual y Mecanico	1 por ano
2	Mayacrop	Flores.	UREA.	160 qq. / ano	Manual y Goteo.	Cada 48 Horas
			NITRATO DE CALCIO	160 qq./ ano	Manual y Goteo.	Cada 48 Horas
			NUTREX 20-20-0	160 qq. / ano	Manual y Goteo.	Cada 48 Horas
3	Ingenio Santa Teresa	Cana.	UREA.	1.800 qq.	Manual y Mecanico	2 por ano
			SULFATO DE AMONIO	1.200 qq.	Manual y Mecanico	2 por ano
4	Moran	Cafe.	UREA	1.000 qq.	Manual y Mecanico	1 por ano
			COMPLETO	700 qq.	Manual y Mecanico	1 por ano
5	Las Brisas	Arbeja China.	FUERTE ORGANICO	288 qq.	Manual y Goteo.	1 por ano
			CAL	288 qq.	Manual y Goteo.	1 por ano
			10-28-0	144 qq.	Manual y Goteo.	1 por ano
6	Los Guajes	Pasto.	TRIPLE 20	960 qq.	Manual y Mecanico	1 por ano
7	El Socorro	Maiz.	UREA.	230 qq.	Manual	1 por ano
		Cafe.	TRIPLE 20	100 qq.	Manual	1 por ano
8	Chestnut Hill S.A.	Fresas.	UREA.	720 qq.	Manual y Goteo.	Mensual
			NITRATO DE POTASIO	720 qq.	Manual y Goteo.	Mensual
9	Avicola Campo Nuevo	Maiz.	SULFATO DE AMONIO	300 qq.	Manual y Mecanico	1 por ano
		Frijol.	SULFATO DE AMONIO	300 qq.	Manual y Mecanico	1 por ano
		Guisquil.	GALL. SULFAMO. UREA Y 20.	100. 1200. 1390 y 1.800 qq.	Manual y Mecanico	2 por ano
		Naranja.	TRIPLE 15	90 qq.	Manual y Mecanico	1 por ano
		Tomate.	TRIPLE 15 Y UREA	18 qq. y 16 qq.	Manual y Goteo.	3 por ano

GRAPHIC No. 6
FERTILIZERS

No.	NAME	CROP	BIOCIDES KINDS	QUANTITY CROP	APLICATION METHOD	APLICATION PERIOD
10	Monterrey	Cafe.	UREA Y 20-20-0	100 qq. y 100 qq.	Manual	1 por ano
		Maiz.	TRIPLE 15 Y SULFAMO	70 qq. y 70 qq.	Manual	2 por ano
		Frijol.	TRIPLE 15 Y SULFAMO	70 qq. y 70 qq.	Manual	2 por ano
11	El Sintul	Guisquil.	UREA Y SULFAMO	208 qq. y 192 qq.	Manual	6 por Ano
		Maiz.	UREA Y GALLINAZA	96 qq. y 960 qq.	Manual	1 por Ano
		Frijol.	UREA Y GALLINAZA	96 qq. y 960 qq.	Manual	1 por Ano
12	Caserio Los Angeles	Guisquil.	UREA Y TRIPLE 15	12 qq. Y 12 qq.	Manual	6 por Ano
		Maiz.	SULFAMO Y GALLINAZA	24 qq. y 24 qq.	Manual	1 por Ano
13	Rancho Dulce	Cafe.	UREA Y CAL DOLOMATICA	314 qq. y 600 qq.	Manual	2 y 1 por Ano
14	Mariana	Mora Y Frambue.	MURPOT. UREA. 10 Y GALL.	1200, 700, 1440 y 1600 qq.	Manual y Goteo.	En Invierno
			MAP, NITCAL. Y NITPOT.	6, 88, y 88 qq.	Manual y Goteo.	En Verano
		Verduras.	10-50-0. Y UREA.	40 qq. y 20 qq.	Aspersion	Todo el Ano
15	Aldea Cebadilla Grande	Maiz.	SULFAMO Y GALLINAZA	240 qq. y 300 qq.	Manual	1 por Ano
16	Aldea Las Canoitas	Maiz.	SULFAMO,TRIP15 Y GALL.	200, 200 Y 200 qq.	Manual	1 por Ano
17	Lotific. Valles de San (	Maiz.	TRIPLE 15	20 qq.	Manual	1 por Ano

ABREVIATURAS: GALL. = GALLINAZA, SULFAMO. = SULFATO DE AMONIO, 20. = 20-20-0, MURPOT. = MURIATO DE POTACIO, NITCAL. = NITRATO DE CALCIO, NITPOT. = NITRATO DE POTACIO Y TRIP 15. = TRIPLE 15.

GRAPHIC No. 7

ESTIMATED AREA OF PRODUCTION IN HA.

Surface (thousand HA)

DEPARTAMENTO	1992/1993	1993/1994	1994/1995
TOTALES	18.76	17.89	17.56
MAIZ	16.83	16.23	15.54
ARROZ	0.00	0.00	0.00
FRIJOL	1.93	1.66	2.02
SORGO	0.00	0.00	0.00
TRIGO	0.00	0.00	0.00

FUENTE: ELABORACION USPADA EN BASE A DATOS
DE INDECA Y EL BANCO DE GUATEMALA

GRAPHIC No. 8

ESTIMATED AREA OF PRODUCTION IN HA.

Production (thousand metric tons)

DEPARTAMENTO	1992/1993	1993/1994	1994/1995
TOTALES	30.85	29.11	28.20
MAIZ	29.31	27.77	26.66
ARROZ	0.00	0.00	0.00
FRIJOL	1.54	1.34	1.54
SORGO	0.00	0.00	0.00
TRIGO	0.00	0.00	0.00

FUENTE: ELABORACION USPADA EN BASE A DATOS
DE INDECA Y EL BANCO DE GUATEMALA

GRAPHIC No. 9

LEGUMES, FRUITS AND FLOWERS PRODUCTION

YEAR 1989/1990
GLOBAL QUANTITY

CONCEPTO	GUATEMALA PRODUCCION EN QUINTALES
HORTALIZAS	23,998.00
LEGUMBRES	26,650.00
SUBTOTAL	50,648.00
FRUTAS	16,480.00
FLORES /1	528,000.00

1/= CIFRAS EN UNIDADES DE PRODUCTO

FUENTE: BANCA CENTRAL, Diagnostico y Perspectiva de la Produccion, de Productos Agricolas no Tradicionales, 1990, Banco de Guatemala.

GRAPHIC No. 10

LEGUMES, FRUITS AND FLOWERS PRODUCTION
YEAR 1989
AMOUNT IN QUINTALES EACH PROYECT

CONCEPTO	GUATEMALA
HORTALIZAS	23,998.00
BROCOLI	14,598.00
COLIFLOR	0.00
MINIVEGETALES	0.00
APIO	0.00
LECHUGA	7,500.00
PAPA (semilla)	1,500.00
ESPINACA	0.00
COL DE BRUCELAS	0.00
REPOLLO	400.00
REMOLACHA	0.00
LEGUMBRES	26,650.00
ARVEJA CHINA	21,850.00
ARVEJA DULCE	4,800.00
EJOTE FRANCES	0.00
FRUTAS	16,480.00
FRESAS	16,480.00
FRAMBUESAS	0.00
MORA	0.00
FLORES	528,000.00
ROSAS	528,000.00
CLAVELES	0.00

a/= NO INCLUYE PRODUCCION DE PLANTACIONES EN ENSAYO
b/= CIFRAS EN UNIDADES DE PRODUCTO
FUENTE: BANCA CENTRAL, Diagnostico y Perspectiva de la Produccion, de Productos Agricolas no Tradicionales, 1990, Banco de Guatemala.

GRAPHIC No. 11

LEGUMES, FRUITS AND FLOWERS PRODUCTION

YEAR 1989

CROP AREA IN MANZANAS

CONCEPTO	GUATEMALA
TOTAL	577.50
HORTALIZAS	118.50
BROCOLI	81.00
COLIFLOR	0.00
MINIVEGETALES	0.00
APIO	0.00
LECHUGA	30.00
PAPA (semilla)	5.00
ESPINACA	0.00
COL DE BRUCELAS	0.00
REPOLLO	2.50
REMOLACHA	0.00
LEGUMBRES	278.00
ARVEJA CHINA	230.00
ARVEJA DULCE	48.00
EJOTE FRANCES	0.00
FRUTAS	170.00
FRESAS	103.00
FRAMBUESAS	0.00
MORA a/	67.00
FLORES	11.00
ROSAS	11.00
CLAVELES	0.00

a/= DE ESTA AREA DE CULTIVO NO SE REPORTO PRODUCCION, DEBIDO A QUE LAS PLANTACIONES ESTABAN EN FASE DE ENSAYO.

FUENTE: BANCA CENTRAL, Diagnostico y Perspectiva de la Produccion, de Productos Agricolas no Tradicionales, 1990, Banco de Guatemala.

GRAPHIC No. 12

LEGUMES, FRUITS AND FLOWERS PRODUCTION
YEAR 1989
QUINTALES EACH MANZANA

CONCEPTO	GUATEMALA
HORTALIZAS	
BROCOLI	180.00
COLIFLOR	165.00
MINIVEGETALES	0.00
APIO	0.00
LECHUGA	250.00
PAPA (semilla)	300.00
ESPINACA	0.00
COL DE BRUCELAS	0.00
REPOLLO	160.00
REMOLACHA	0.00
LEGUMBRES	
ARVEJA CHINA	95.00
ARVEJA DULCE	100.00
EJOTE FRANCES	0.00
FRUTAS	
FRESAS	160.00
FRAMBUESAS	0.00
MORA	0.00
FLORES	
ROSAS 1/	48,000.00
CLAVELES	0.00

1/= EN UNIDADES
FUENTE: BANCA CENTRAL, Diagnostico y Perspectiva de la Produccion, de Productos Agricolas no Tradicionales. 1990. Banco de Guatemala.

GRAPHIC No. 13

LEGUMES PRODUCTION
YEAR 1989
PROAC AREA IN MANZANA

CONCEPTO	GUATEMALA
TOTAL	601.89
HORTALIZAS	212.82
BROCOLI	167.78
COLIFLOR	5.42
MINIVEGETALES	0.00
APIO	0.00
LECHUGA	31.47
PAPA (semilla)	5.00
ESPINACA	0.00
COL DE BRUCELAS	0.00
REPOLLO	3.15
REMOLACHA	0.00
LEGUMBRES	389.07
ARVEJA CHINA	230.00
ARVEJA DULCE	159.07
EJOTE FRANCES	0.00

FUENTE: BANCA CENTRAL, Diagnostico y Perspectiva de la Produccion, de Productos Agricolas no Tradicionales, 1990, Banco de Guatemala.

GRAPHIC No. 14

LEGUMES PRODUCTION
YEAR 1989
IN QUINTALES

CONCEPTO	GUATEMALA
TOTAL	157,445.60
HORTALIZAS	81,931.60
BROCOLI	60,400.00
COLIFLOR	1,788.60
MINIVEGETALES	0.00
APIO	0.00
LECHUGA	15,735.00
PAPA (semilla)	3,000.00
ESPINACA	0.00
COL DE BRUCELAS	0.00
REPOLLO	1,008.00
REMOLACHA	0.00
LEGUMBRES	75,514.00
ARVEJA CHINA	43,700.00
ARVEJA DULCE	31,814.00
EJOTE FRANCES	0.00

FUENTE: BANCA CENTRAL, Diagnostico y Perspectiva de l Produccion, de Productos Agricolas no Tradicionales, 1990, Banco de Guatemala.

GRAPHIC No. 15

LEGUMES, FRUITS AND FLOWERS
YEAR 1989

GUATEMALA

CONCEPTO	COSTO PRODUCCION	INGRESO POR VENTA: RENDIMIENTO EN QUINTALES	INGRESO POR VENTA: PRECIO UNITARIO	INGRESO POR VENTA: TOTAL NETO	INGRESO NETO	RENTABILIDAD
ESPINACA	0.00	0.00	0.00	0.00	0.00	0.00
BROCOLI	3,600.00	180.00	28.00	5,040.00	1,440.00	40.00
REMOLACHA	0.00	0.00	0.00	0.00	0.00	0.00
ARBEJA CHINA	6,840.00	95.00	85.00	9,025.00	2,185.00	31.94
APIO	0.00	0.00	0.00	0.00	0.00	0.00
ARBEJA DULCE	5,100.00	100.00	65.00	6,500.00	1,400.00	27.45
MINI VEGETALES	0.00	0.00	0.00	0.00	0.00	0.00
EJOTE FRANCES	0.00	0.00	0.00	0.00	0.00	0.00
COL DE BRUCELAS	0.00	0.00	0.00	0.00	0.00	0.00
LECHUGA	3,625.00	250.00	19.00	4,750.00	1,125.00	31.03
COLIFLOR	2,557.50	165.00	24.00	3,960.00	1,402.50	54.84
PAPA (semilla)	16,500.00	300.00	80.00	24,000.00	7,500.00	45.45
REPOLLO	2,080.00	160.00	17.62	2,819.20	739.20	35.54
FRESAS	5,576.00	164.00	48.00	7,544.00	1,968.00	35.29
FRAMBUESAS	0.00	0.00	0.00	0.00	0.00	0.00
ROSAS	8,280.00	48,000.00	0.20	9,600.00	4,380.00	81.82
CLAVELES	0.00	0.00	0.00	0.00	0.00	0.00

a/- NO INCLUYE PRODUCCION DE PLANTACIONES EN ENSAYO
b/- CIFRAS EN UNIDADES DE PRODUCTO

FUENTE: BANCA CENTRAL, Diagnostico y Perspectiva de la Produccion, de Productos Agricolas no Tradicionales, 1990, Banco de Guatemala.

GRAPHIC No. 16

SEEDING AREAS ON NON TRADITIONALS PRODUCTS
IN MANZANAS
GUATEMALA

CONCEPTO	CENSO 1979	ENCUESTA 1990
TOTAL	1,424	783
ESPINACA	0	0
BROCOLI	0	168
REMOLACHA	12	0
ARBEJA CHINA	0	230
ARBEJA DULCE	15	159
APIO	0	0
MINI VEGETALES	0	0
EJOTE FRANCES	0	0
COL DE BRUCELAS	0	0
LECHUGA	22	32
COLIFLOR	13	5
PAPA (semilla)	909	5
REPOLLO	95	3
HABA	2	0
ZANAHORIAS	14	0
TOMATE	189	0
FRIJOL	40	0
FLORES	113	11
FRUTA	0	170

a/= EN ESTE CASO SE TOMO COMO BASE LA INFORMACION DE LAS PLANTAS PROCESADORAS EXCEPTO PARA LAS AREAS DE FLORES Y FRUTAS. QUE CORRESPONDEN A INFORMACION DE LOS PRODUCTORES.

FUENTE: III Censo Nacional Agropecuario, 1979.
Direccion General de estadistica, y encuesta directa

GRAPHIC No. 17

USE OF SOIL FOR SEEDING LEGUMES,
FRUITS AND FLOWERS IN THE METROPOLITAN AREA

GUATEMALA DEPARTAMENT

MUNICIPIO	TOTAL	AREA EN MZ. SEGUN OPCION		CARACTERISTICAS				
		I	II	RANGO ALTITU		PENDIEN	BIOCLIMA	TIPO DE SUELO
TOTAL	32.190	3.190	29.000					
PALENCIA		-	1.015	1.500	2.400	05-12	Bosque Humedo Bajo Subtropical.	Profundos, textura mediana , bien drenados, color pardo o cafe.
		-	4.060	1.500	2.400	00-05	Bosque Humedo Bajo Subtropical.	Profundos, textura mediana , bien drenados, color pardo o cafe.
		-	1.160	1.500	2.400	05-12	Bosque Humedo Bajo Subtropical.	Profundos, textura mediana , bien drenados, color pardo o cafe.
SAN PEDRO		2.175	-	1.500	2.400	00-05	Bosque Humedo Bajo Subtropical.	Moderadamente profundos, textual mediana,moderadamente drenados.
SACATEPEQUEZ		1.015	-	1.500	2.400	00-05	Bosque Humedo Bajo Subtropical.	Profundos, textura mediana , bien drenados, color pardo o cafe.
		-	7.830	1.500	2.400	00-05	Bosque Humedo Bajo Subtropical.	Profundos, textura mediana , bien drenados, color pardo o cafe.
		-	5.655	1.500	2.400	00-05	Bosque Humedo Bajo Subtropical.	Moderadamente profundos, textual mediana,moderadamente drenados.
FRAIJANES		-	6.525	1.500	2.400	05-12	Bosque Humedo Bajo Subtropical.	Profundos, textura mediana , bien drenados, color pardo o cafe.
		-	2.755	800	1600	12-32	Bosque muy humedo Subtropical	Profundos, textura mediana , bien drenados, color pardo o cafe.

FUENTE: Secretaria General del Consejo de Planificacion Economica y Banco de Guatemala.