

should be shifted from DLPM.

3.3 Opening of New Landfill Site at Las Guacamayas

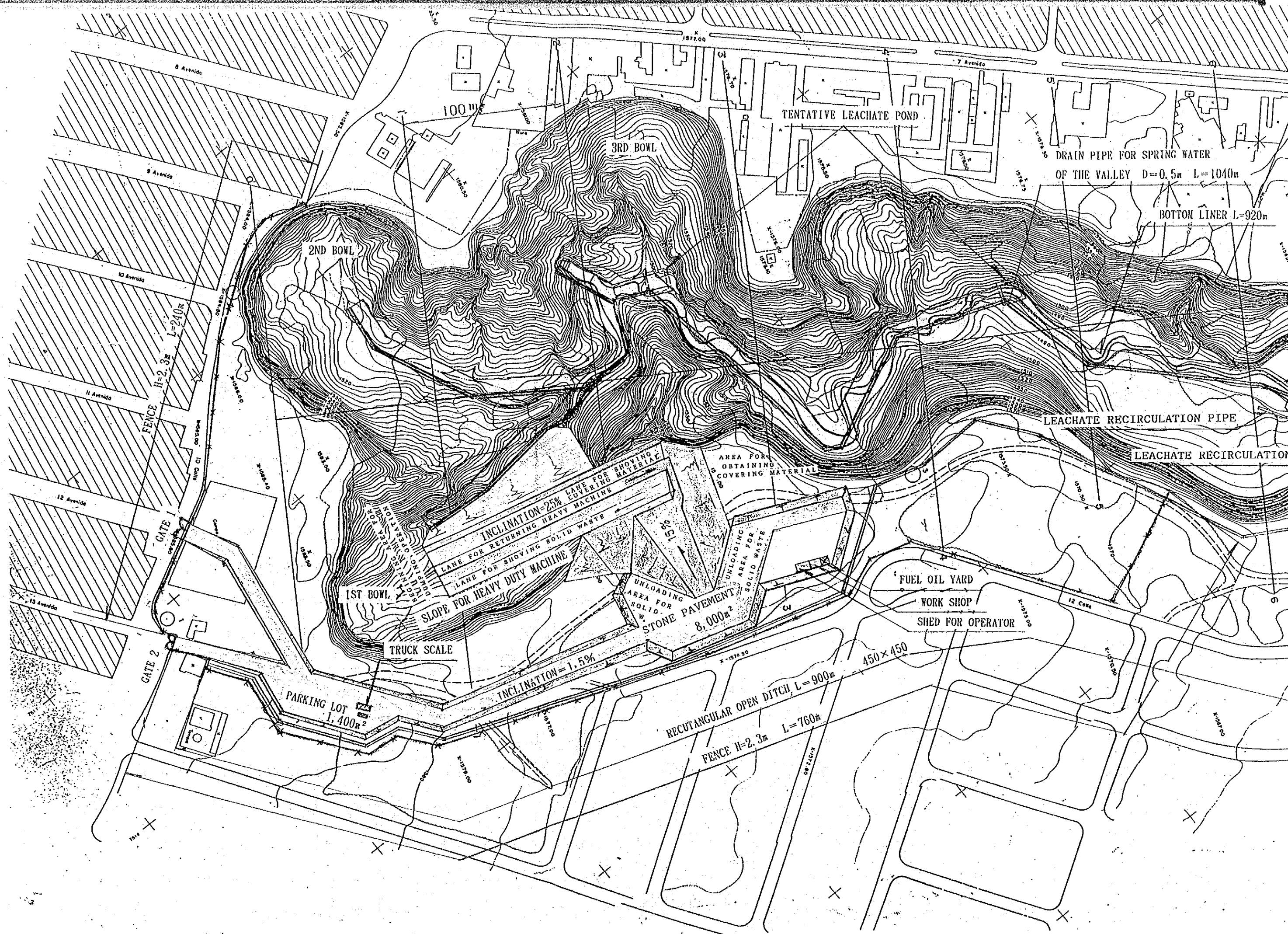
3.3.1 Selection of Suitable Landfill Method for the Las Guacamayas

Down slope method was also selected for Las Guacamayas as same as El Trebol.

Conceptual plan of the landfill method of Las Guacamayas is shown in the Fig. III-3.3-1 - Fig. III-3.3-8.

Table III-3.3-1 Evaluation of Three Landfill Methods of "Las Guacamayas"

		No. 1	No. 2	No. 3
		Truck access to bottom method	Multi platform method	Down slope method
Transportation	Unloading	Basically, trucks have access to the bottom step-by-step for unloading	Always unloading at the top level ground. Bulldozers push the waste to the bottom platform-by-platform.	Always unloading at the top level ground. Push waste to bottom sliding on slope by bulldozers
	Difficulty	Aged trucks have difficulty to ascend to the bottom for unloading	No problem	No problem
	Efficiency	Not good	Good	Good
Land-filling	Need to push waste to the bottom	Not necessary	Necessary	Necessary
	Soil for covering	Direct transport by trucks	Pushed platform-by-platform using bulldozers	Push down on slope by bulldozers
	Operation	Easy	Easy	Easy
	Covering work	Easy	Not easy	Somewhat difficult
Equipment required	Soil transport	By specific truck	By bulldozers	By bulldozers
Costs	Number of personnel	A few	Many	Many
Operational conditions	Investment cost	Yes for specific trucks	For bulldozers	For bulldozers
	Time to start up	A long time	Not so long	1 year
	Preparation work	A long time is required	Not so long	About 1 year



THE DRAWING
OF FACILITY DEPLOYMENT

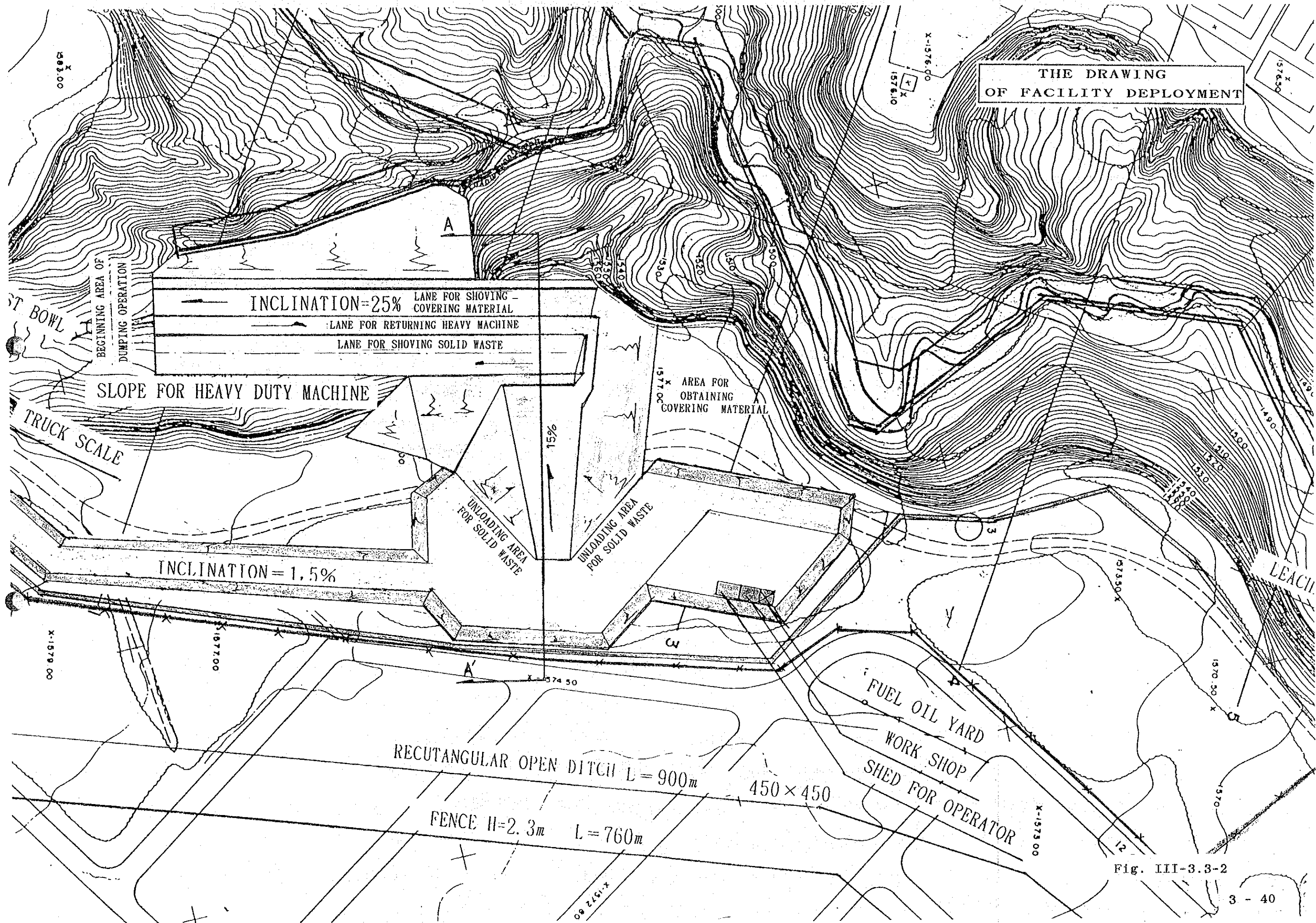


Fig. III-3.3-2

A - A' SECTION

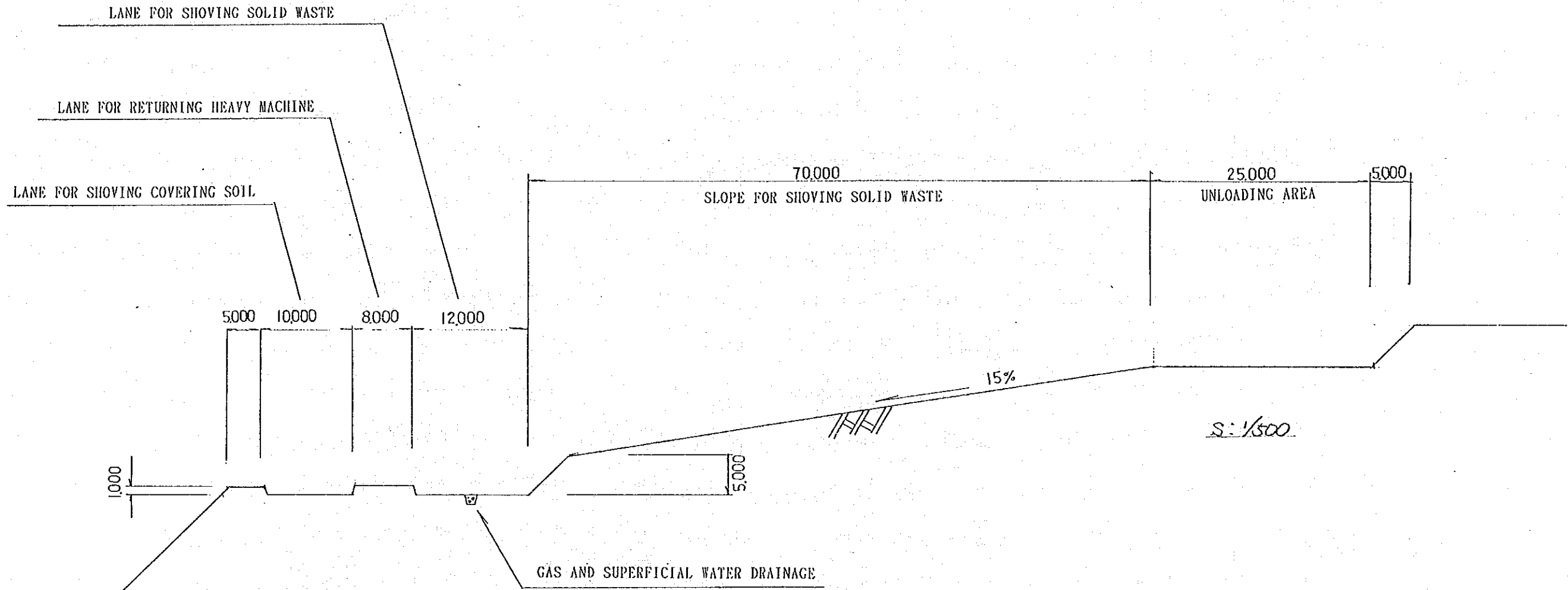


Fig. III-3.3-3

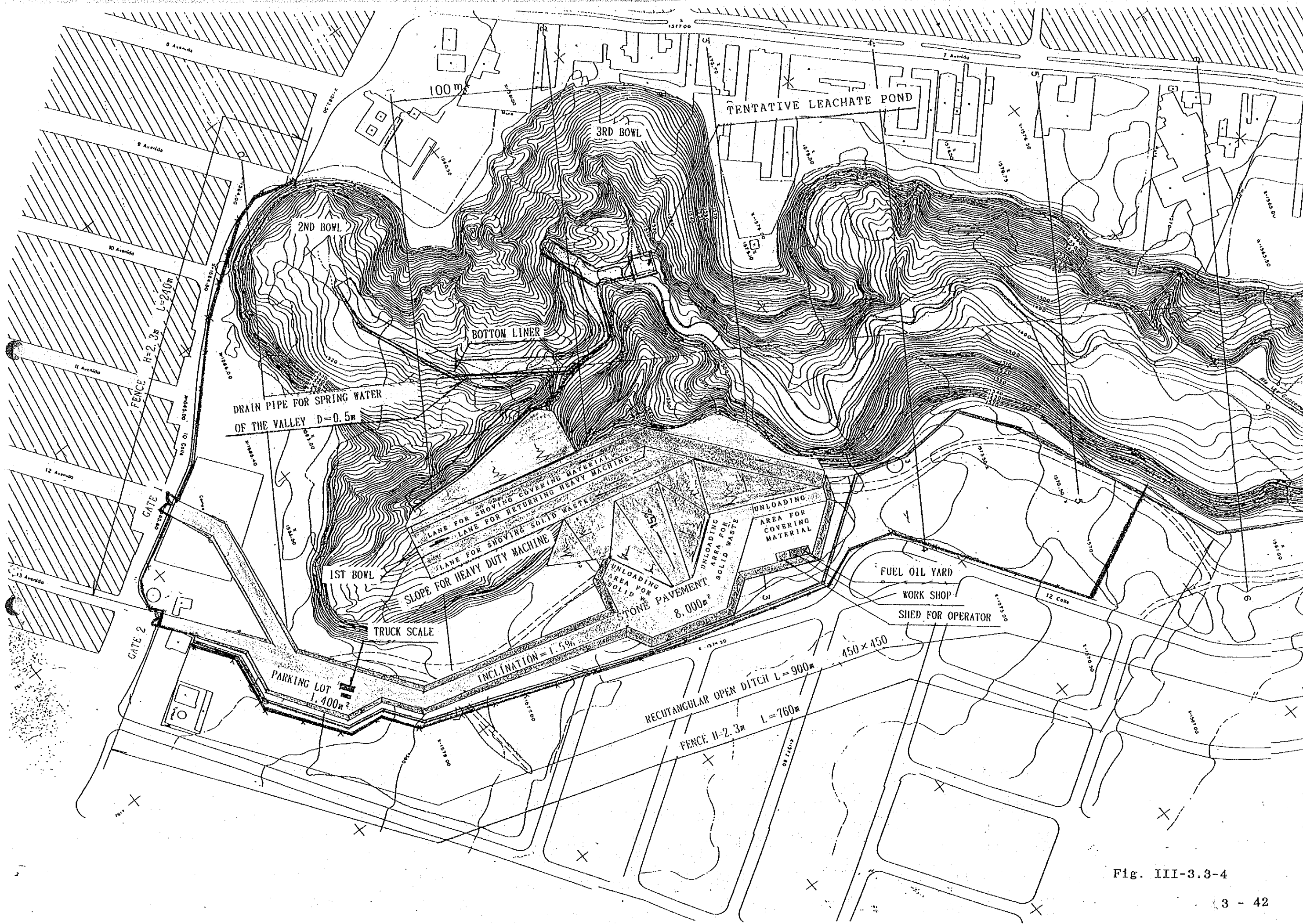


Fig. III-3.3-4

1590

1580

1580

1575

TOTAL CAPACITY: 4,898,000m³
USAGE PERIOD: 16.3 YEARS

1571

1566

1561

1556

1551

1546

1570

1560

1550

1540

1530

1520

1510

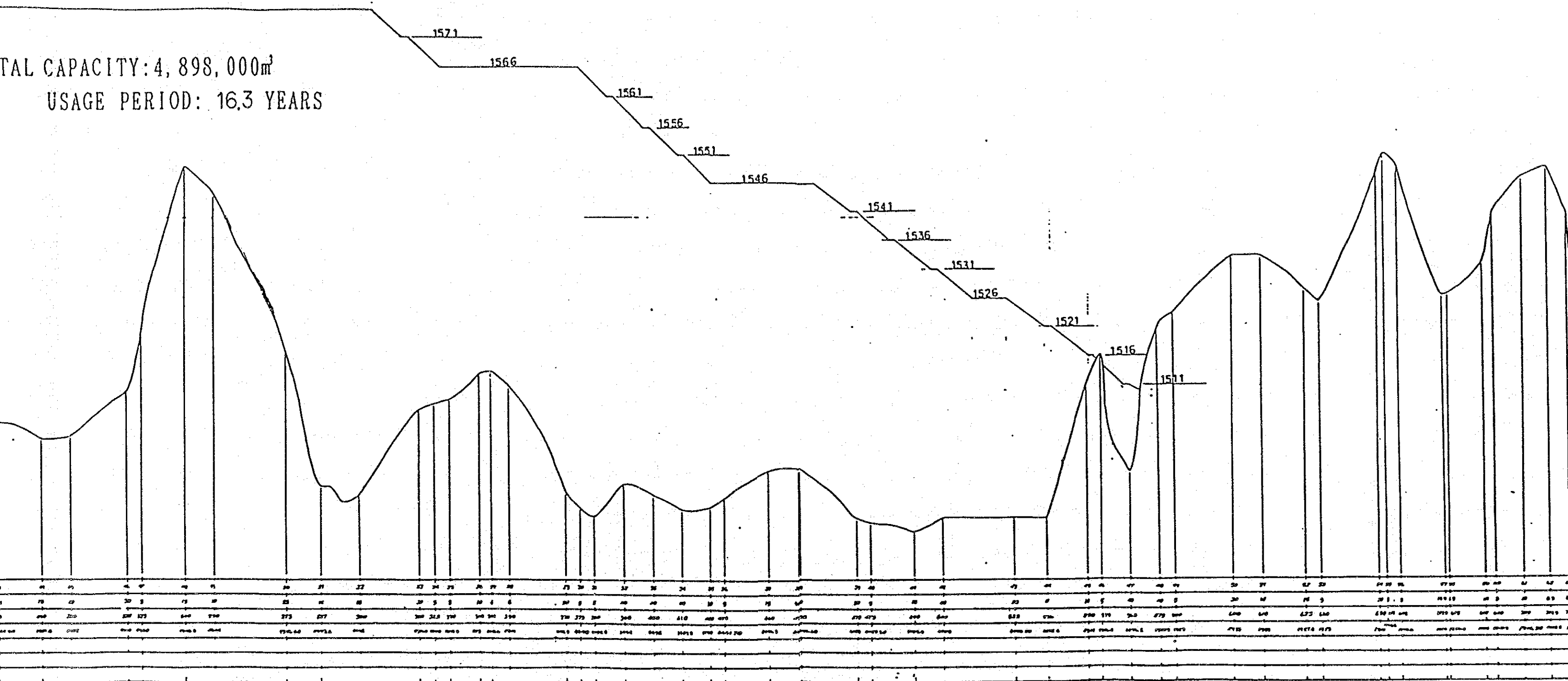
1500

1490

1480

ESTACION No.	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	
DISTANCIA	0	20	40	60	80	100	120	140	160	180	200	220	240	260	280	300	320	340	360	380	400	420	440	460	480	500	520	540	560	580	600	620	640	660	680	700	720	740	760	780	800	
ALT. ACTUAL	1585	1580	1575	1570	1565	1560	1555	1550	1545	1540	1535	1530	1525	1520	1515	1510	1505	1500	1495	1490	1485	1480	1475	1470	1465	1460	1455	1450	1445	1440	1435	1430	1425	1420	1415	1410	1405	1400	1395	1390	1385	1380
ELEV. ACTUAL	1585	1580	1575	1570	1565	1560	1555	1550	1545	1540	1535	1530	1525	1520	1515	1510	1505	1500	1495	1490	1485	1480	1475	1470	1465	1460	1455	1450	1445	1440	1435	1430	1425	1420	1415	1410	1405	1400	1395	1390	1385	1380
ELEV. DISEÑO	1585	1580	1575	1570	1565	1560	1555	1550	1545	1540	1535	1530	1525	1520	1515	1510	1505	1500	1495	1490	1485	1480	1475	1470	1465	1460	1455	1450	1445	1440	1435	1430	1425	1420	1415	1410	1405	1400	1395	1390	1385	1380

TOTAL CAPACITY: 4,898,000m³
 USAGE PERIOD: 16.3 YEARS



Guacamayas Longitudinal View

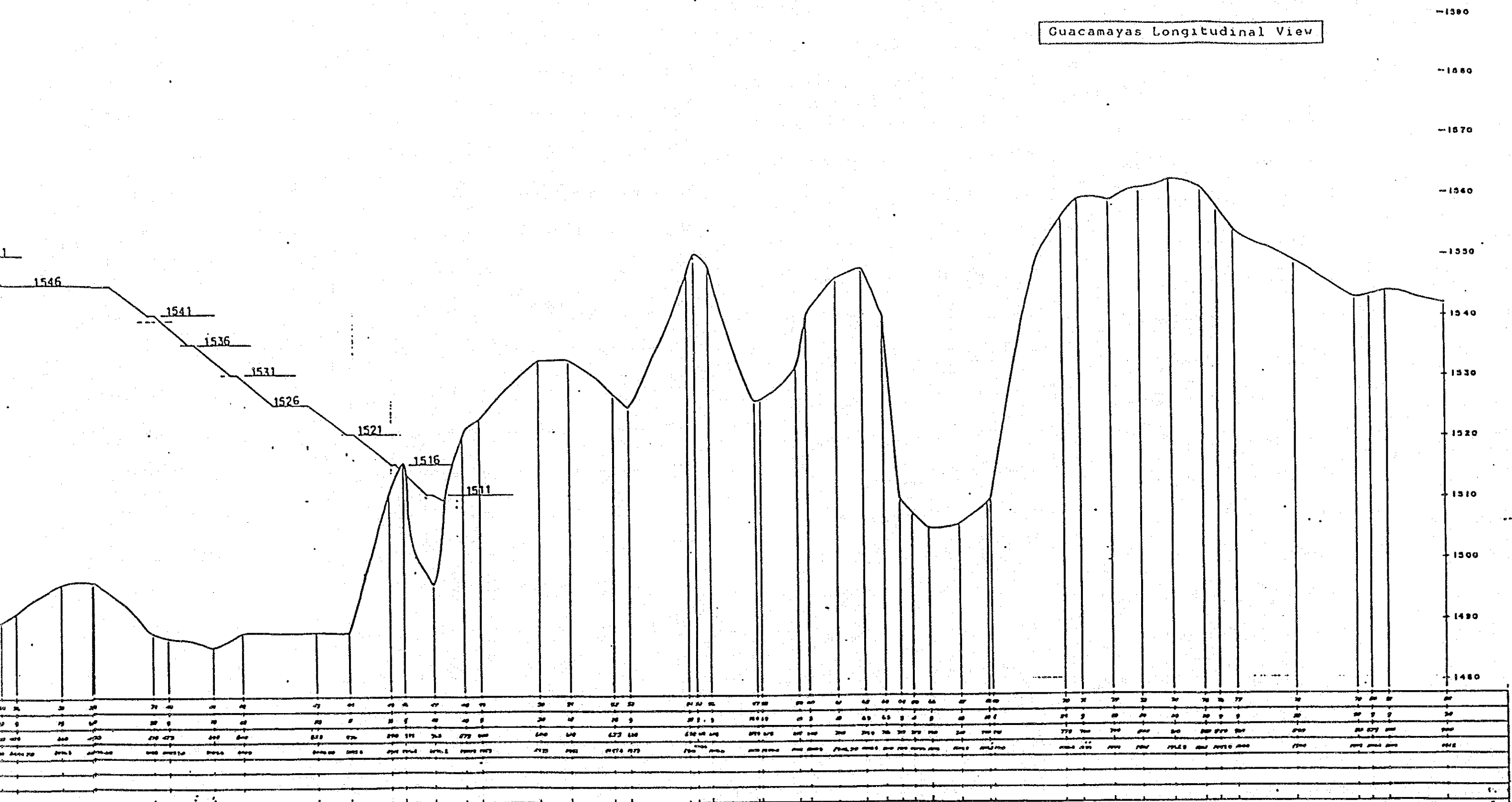


Fig. III-3.3-5

SOLID WASTE MANAGEMENT
 IN GUATEMALA
 "LAS GUACAMAYAS"
 LONGITUDINAL PROFILE
 HORIZONTAL SCALE 1:2000
 VERTICAL SCALE 1:1000
 DONE BY TELECTO GENERAL DIR. S. VARGAS
 DATE: JANUARY, 1991 JICA

MANEJO DE DESECHOS SOLIDOS
 EN GUATEMALA
 LAS GUACAMAYAS
 PERFIL LONGITUDINAL
 ESCALA H 1:2000
 ESCALA V 1:1000
 ELABORADO POR TELECTO S.A. DISEÑADO POR ING. S. VARGAS
 FECHA: ENERO 1991 JICA

Completed Plane
View of Guacamayas
New Sanitary Landfill Site

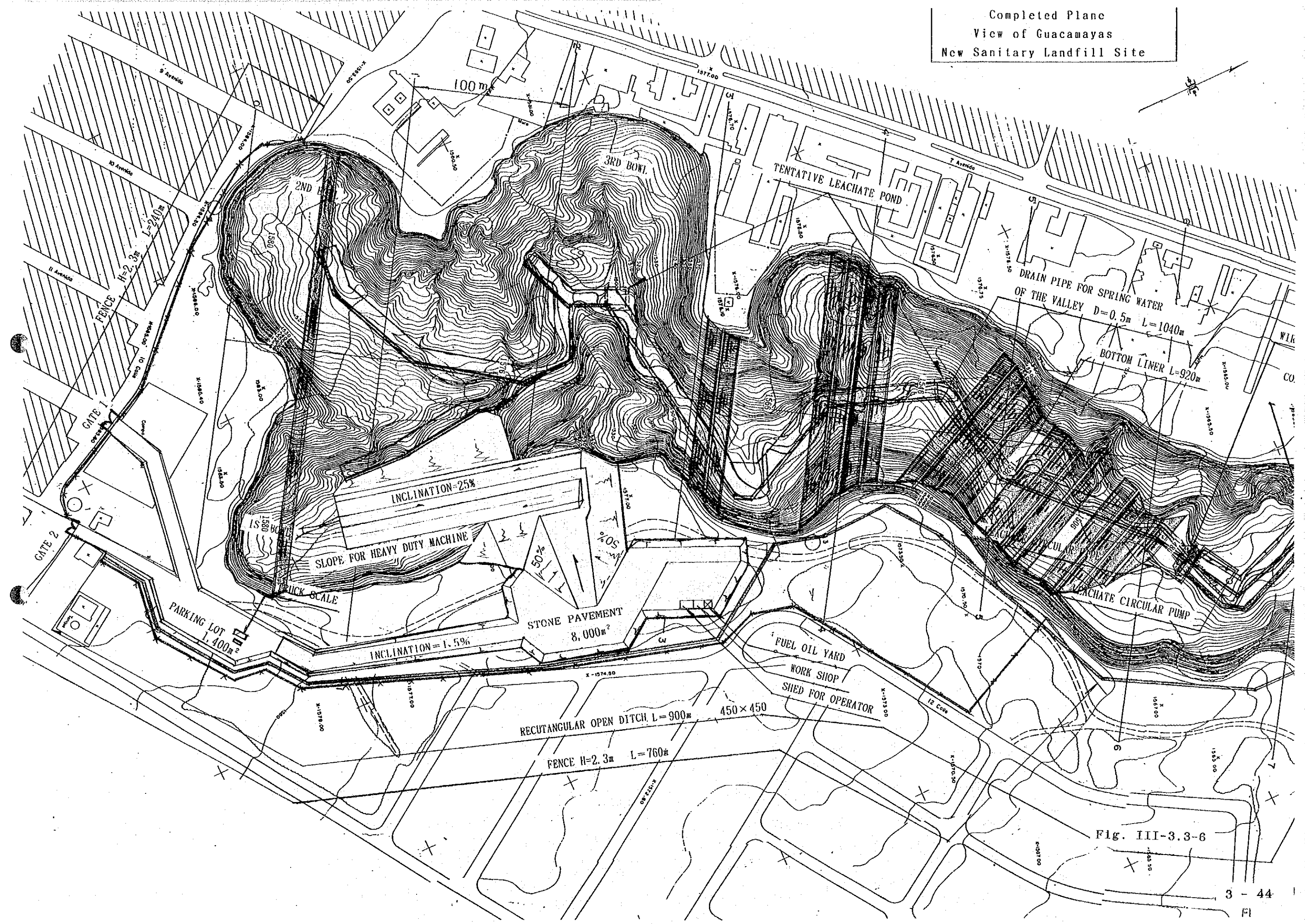


Fig. III-3.3-6

STRUCTURE OF THE STANDARD CROSS SECTION OF
LEACHATE COLLECTION DITCH AT THE BOTTOM OF LAS GUACAMAYAS

UNIT-M

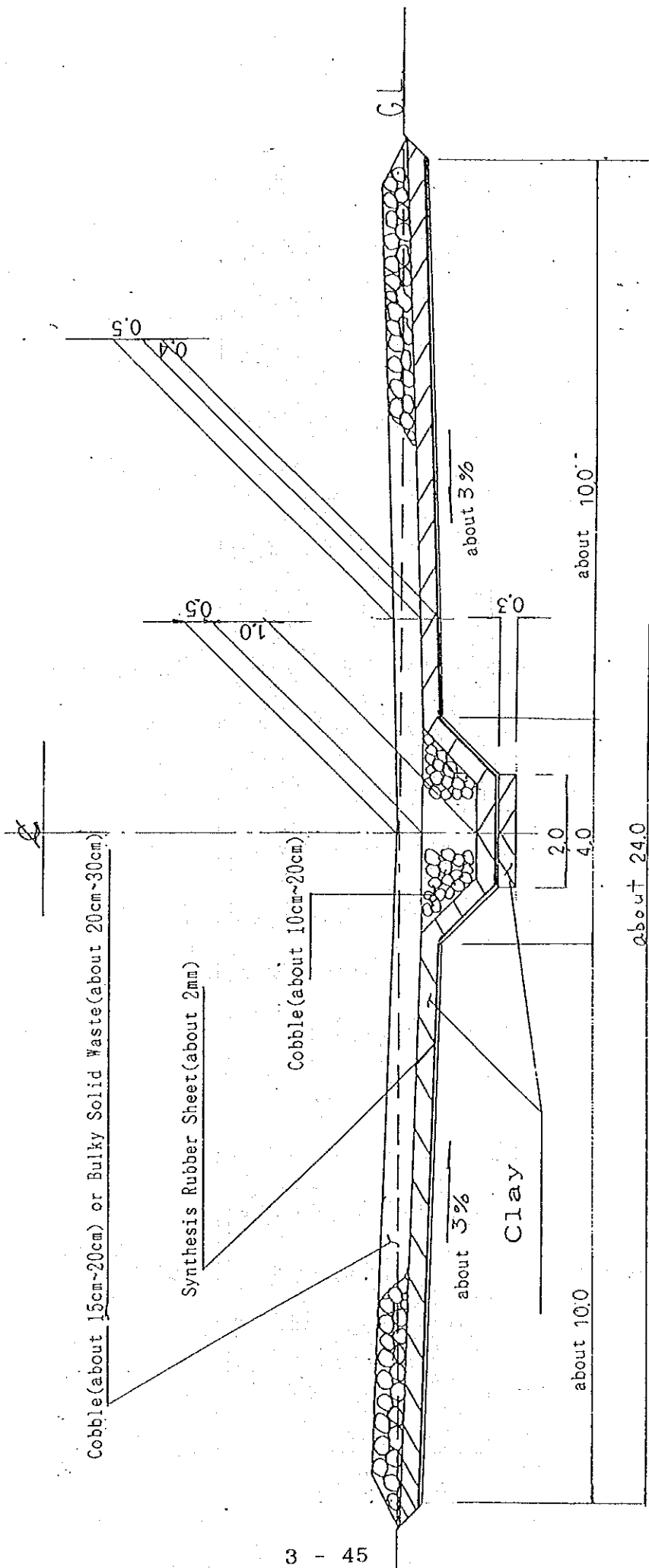
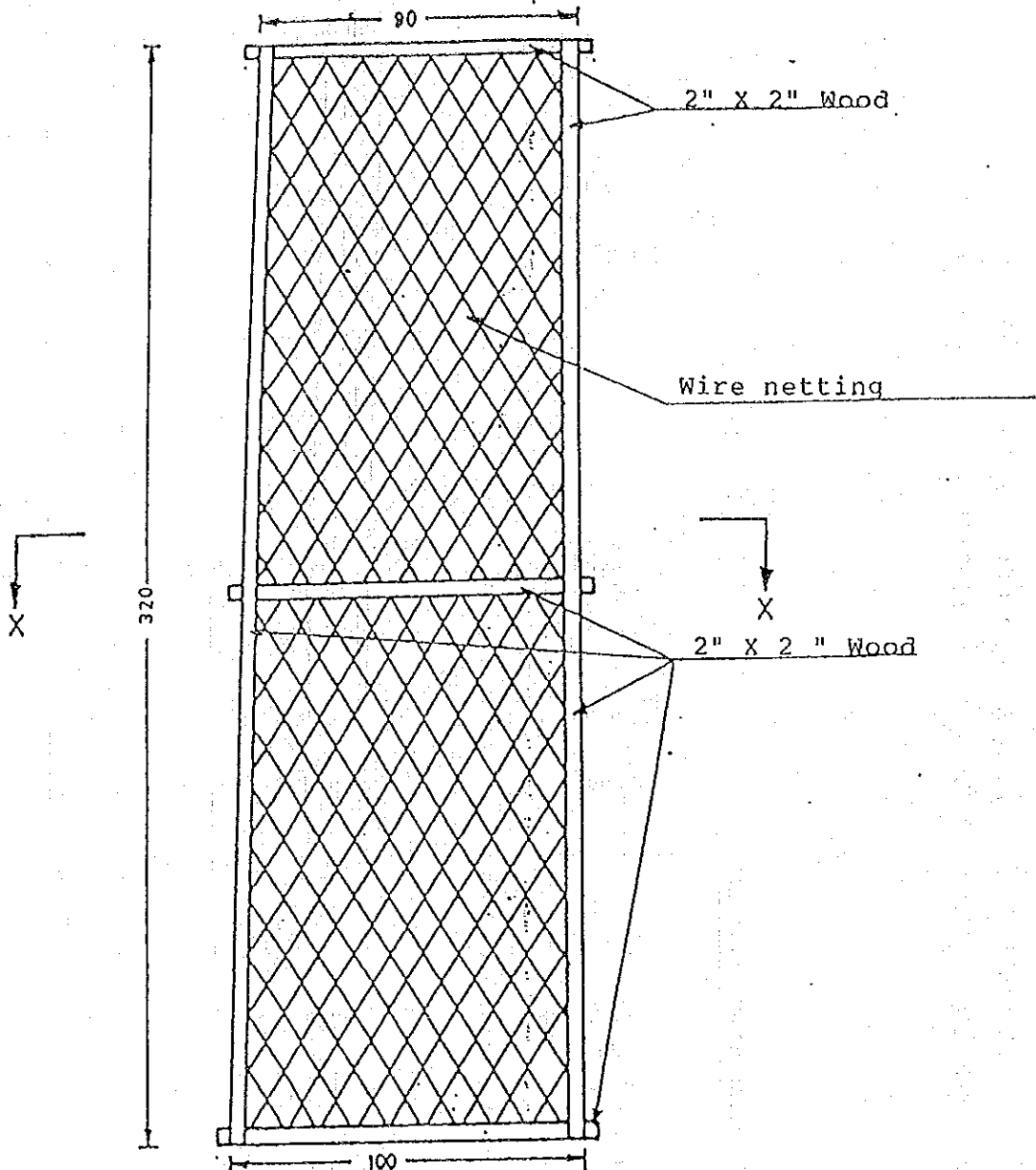


Fig. III-3.3-7

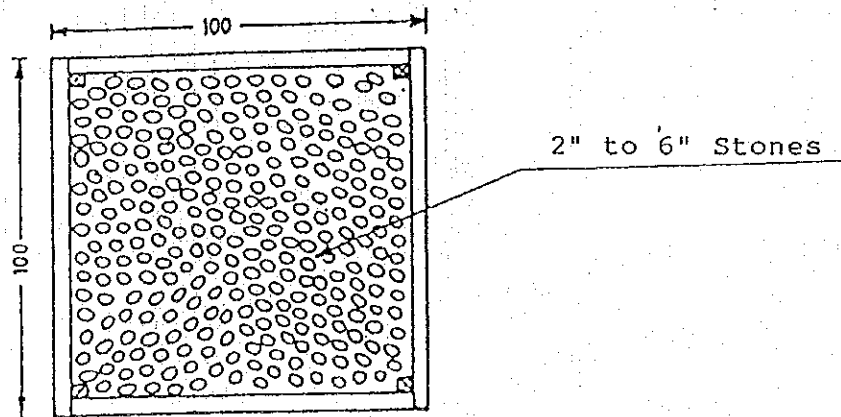
S: 1/100

BIO GAS EXHAUSTING DUCT

Escale 1:20



ELEVATION



SECTION X-X

Fig. III-3.3-8

3.3.2 Construction of Sanitary Landfill at Las Guacamayas

- (1) The most basic concept and basis for construction of sanitary landfill at Las Guacamayas

The slope with about 35 m width will be constructed with the natural soil.

Basically the waste and covering materials will be transported sliding on each specified lane which is constructed on the slope divided into three lanes, between them 2 m width partition zone consisting of cobble stones is provided for gas exhausting and leachate draining.

- BOD of leachate: 5,000 mg/l
- Quantity of leachate: 785 m³/day

- (2) Construction planning

- 1) Construction of internal access roads and slope

- a. Internal access road (including small branch roads)

The main road along the new fence will be paved with stone.

- Width of the road: 10 m
- Length of the road: about 310 m
- Thickness of stone pavement: 0.3 m

- b. Slope

Slope will be constructed for transportation of waste and covering materials

- Width of the slope: 35 m
- Length of the slope: about 200 m
- Material: Soil

c. Ground preparation

Existing top level ground where the collection vehicle will unload the waste will be prepared. It is necessary to level the ground.

- Ground area: about 18,000 m²

2) Drainage of rain water

The rain water on the top level ground and places nearby has to be collected and led to the outside of landfill site in order to minimize the quantity of leachate.

- Maximum rainfall rate: 74.8 mm/hr
- Area subject to collection: 130,000 m²
- Design of drainage system: Open ditch
- Size of ditch 450 mm x 450 mm
- Material of ditch Concrete
- Length of total ditch about 900m

3) Administration facility

To implement the sanitary landfilling method, the following facilities are indispensable from the administrative view points.

a. Fence

Concrete made fence will be constructed with 2 gates to control the public from entering.

- Size of fence: 10 cm thickness x 2.3 m height
- Material: Reinforced concrete
- Length of fence: about 1000 m
- Size of gate: 2.3 m height x 6 m width
- Material of gate: Mild steel made

b. Workshop

A workshop will be constructed for maintenance of bulldozers and backhoes, etc. Maintenance tools and equipment have to be bought.

- Size of shop: 50 m²
- Material: Steel columns with roof

c. Oil tank yard

The oil tank yard will be constructed to locate the fuel oil containers

- Size of yard: 15 m²

d. Parking lot

The parking lot will be constructed for city government owned vehicles and others.

- Size of parking lot = 1400 m²

e. Operator's shed

The shed will be constructed for operators resting and other purposes.

- Size of shed = 30 m²
- Material = Steel and slate roof

4) Dam construction

This will consist of concrete and wire-mat dams to form a leachate reserving pond.

Beside the pond, a pump house and its foundation will be constructed.

- Structure of concrete dam: Gravity dam
- Size of dam: 4.0 m height x 20 m length
 - Width at top: 0.5 m
 - Width at bottom: 3.7 m
- Structure of wire-mat dam
- Size of dam: 2.0 m height x 20 m length
 - Width at top: 1.0 m
 - Width at bottom: 14 m
- Materials of wire-mat dam: Wire-net and cobble stones

5) Leachate pond

- Volume of pond: about 1000 m³
- Number of concrete foundation: 1
- Number of pump house: 1
- Size of pump house: 12 m²
- Material of pump house: Steel construction with slate

6) Leachate collection ditches (to be constructed by 3 stages)

- Standard width = 24 m and total length about 920 m

(3) Equipment planning

To implement the sanitary landfill the following equipments have to be provided.

1) Bulldozers

Waste and cover soil have to be pushed down on the slope by bulldozers from the top level ground to the gully bottom.

- Number of bulldozers: 6 (six)
- Type of bulldozers: High sprocket type for soft ground
- Capacity: 230 HP

2) Back hoe loaders

This loader will be mostly used for on-site excavation and transportation of the natural soil.

- Number: 2 (two)
- Type: Wheel loader type
- Capacity: 150 HP, 0.6 m³

3) Submerged pumps

The pump will be used for leachate recirculation from the pond.

- Number: 2
- Type: Submerged type
- Capacity: 30 m³/hr x 5.5 kW

4) Aerator

The aerator will be used for leachate aeration in the tentatively made small pond.

- Number: 1
- Type: Portable type
- Capacity: 3.7 kW

5) Truck scale

This scale will be used for weighing of solid waste transported to the site, and the data will be automatically processed by a computer.

- Number: 1
- Type: Multi load-cell type with computer data processor
- Capacity: 30 tons

3.3.3 Cost Estimation and Its Basis

(1) Construction cost

1) Ground preparation Q150,000

2) Access road (Slope structure) Q2,805,000

Slope for hauling solid waste

W = 35 m, L = 200 m

3) Drainage system

a. Concrete ditch 450 mm x 450 mm Q270,000

L = 900 m

b. Drain pipe at the bottom of gully Q208,000

D = 50 m L = 1040 m

c. Concrete box Q16,000

Sub total Q494,000

4) Administrative facility

a. Fence	H = 2.3 m	L = 1000 m	Q70,000	
b. Parking lot	1400 m ²		Q70,000	
c. Fuel oil yard	15 m ²		Q30,000	
d. Work shop	50 m ²		Q50,800	
e. Shep for operator	30 m ²		Q62,700	
f. Gate	H = 2.3 m	W = 10 m	2 gates	Q4,000

Sub total Q287,500

5) Dam construction

- Concrete gravity dam H = 40 m, Q49,000
L = 20 m

- Wire-mat dam Q750,000

Sub total Q799,000

Approx. Q800,000

6) Leachate pond

Side wall Q535,200

Clay layer 500 m² Q40,000

Electric facilities Q130,000

Pump Submerged 0.5 m³/min. 2 pumps Q210,000

Head 20 m

Pump house Q14,770

Sub total Q930,000

7) Construction of leachate collection ditch

a. Cobble 2,000 + 11,000 = 13,100 m³

b. Synthetic rubber sheet 2.0 m/m, 22800 m²

c. Clay layer 9100 m³

Sub total Q2,863,000

(2) Equipment cost

1) Bulldozers Q8,022,000

Capacity: 230 HP

Type: High sprocket type for soft ground

Number of bulldozer: 6 (six)

2) Backhoe loader Q1,785,000

Capacity: 0.6 m³

Type: Wheel loader type

Number of loader: 2

3) Submerged pump Q210,000

Capacity: 15 kW x 30 m

Type: Submerged type

Number of pump: 2

4) Aerator Q10,000

Capacity: 3.7 kW

Type: Portable type

Number of aerator: 2

5) Truck scale Q400,000

Capacity: 30 tons

Type: Multi-load-cell type with computer data processor

Number of scale: 1

(3) Operational cost

1) Fuel

For bulldozers

$$5.8 \text{ gallons/bulldozer} \times 6 \times 6 \text{ hrs} = 210$$

For back hoe

$$1.6 \text{ gallons/back hoe} \times 2 \times 6 \text{ hrs} = 20$$

$$\text{Total} \quad \quad \quad 230 \text{ gallons/day}$$

$$230 \text{ gallons} \times 313 \text{ days} = 71,990 \text{ gallons/year}$$

$$\text{Fuel cost } 71,990 \times Q6.3/\text{gallon} = Q453,540/\text{year}$$

2) Maintenance

Unit maintenance cost for bulldozer

$$Q42/\text{hr} \times 6 \times 6 = Q1,512/\text{day}$$

$$Q3/\text{hr} \times 2 \times 6 = Q36/\text{day}$$

$$\text{Total} \quad Q1,548/\text{day}$$

$$1,548 \times 313 \text{ days} = Q484,500/\text{year}$$

3) Electric power $Q46,300/\text{year}$

4) Personnel cost $8 \times Q600/\text{day} = Q4,800/\text{day}$

$$4,800 \times 313 \text{ days} = Q484,500/\text{year}$$

5) Covering material

$$50,200 \text{ m}^3 \times Q28/\text{m}^3 = Q1,405,300/\text{year}$$

6) Bio-gas exhausting ducts

$$Q64,000/8 \text{ years}$$

3.4 Final Disposal in the Isolated Areas

The isolated areas (IA) are defined as areas topographically separated from the other residential areas by the surrounding gullies. The disposal method proposed for these areas will be self disposal as it is being performed now. In further future after the year 2000, it would be recommended to be transformed into the mini-scale landfill basically, in accordance with the topographical conditions of the area in question. However, it must be a controlled landfill at least.

3.5 Final Disposal at Marginal Areas

Before considering the final disposal in these areas, geographical meaning of the marginal areas in the metropolitan area of Guatemala City should be recognized.

It does not necessarily mean that the areas are geographically separated from the surrounding areas like isolated areas. It can be said that these areas are rather socially separated from the surrounding areas.

In this sense, self disposal methods like the ones for isolated areas should be taken into account for the marginal areas in future.

On the other hand, it is obviously true that the ordinary public collection services to such areas have to be considered as much as possible.

In this case self disposal methods would be understood as mini-landfills carried out in a controlled manner at least.

4. Institutional Aspects

4.1 Proposed Organizational Structure

As has already been indicated, the recommended alternative is to organize, from 1992, a Public Cleansing Department (DLP), a municipal department which would be responsible for handling solid waste in Guatemala City and, in addition, for coordinating with the municipalities involved, the handling of solid waste in the Metropolitan Area.

4.1.1 General

The proposed organizational structure is shown in the Organization Chart provided in Fig. III-4.1-1. The selection of this alternative will promote greater prospects for the improvement of solid waste management given that the following criteria has been considered:

- (1) Includes the formal and coordinated participation of private collectors in the public cleansing system, thereby avoiding social conflicts.
- (2) Incorporates the planning and evaluation system, which is indispensable for making decisions within the DLP.
- (3) Permanently and continuously promotes community education and participation to support solid waste management. At the same time DLP will reinforce the process of supervision and the fulfillment of corresponding laws and regulations.

- (4) Improve the operating efficiency of the municipal public cleansing service without increasing personnel, except for key positions and, at the same time, avoid social problems by avoiding dismissals or reduction of personnel. The proposed organizational structure also includes the instruction and training of human resources.

Alternative organization chart which is transitory during improvement of "El Trebol" landfill site is shown in Fig. III-4.1-2.

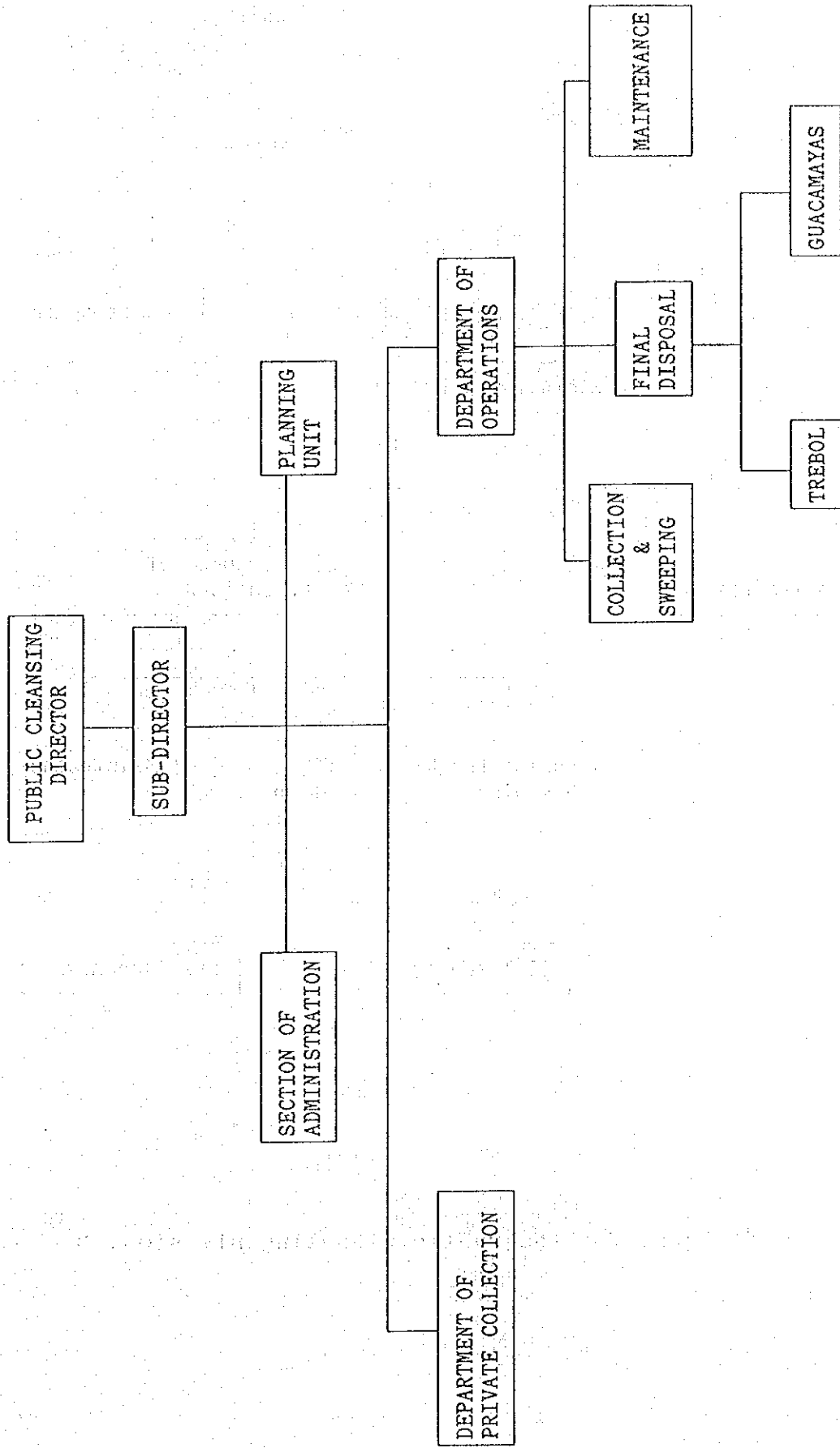


Fig. III-4.1-1 ORGANIZATIONAL CHART FOR DIRECTION OF PUBLIC CLEANSING, DLP

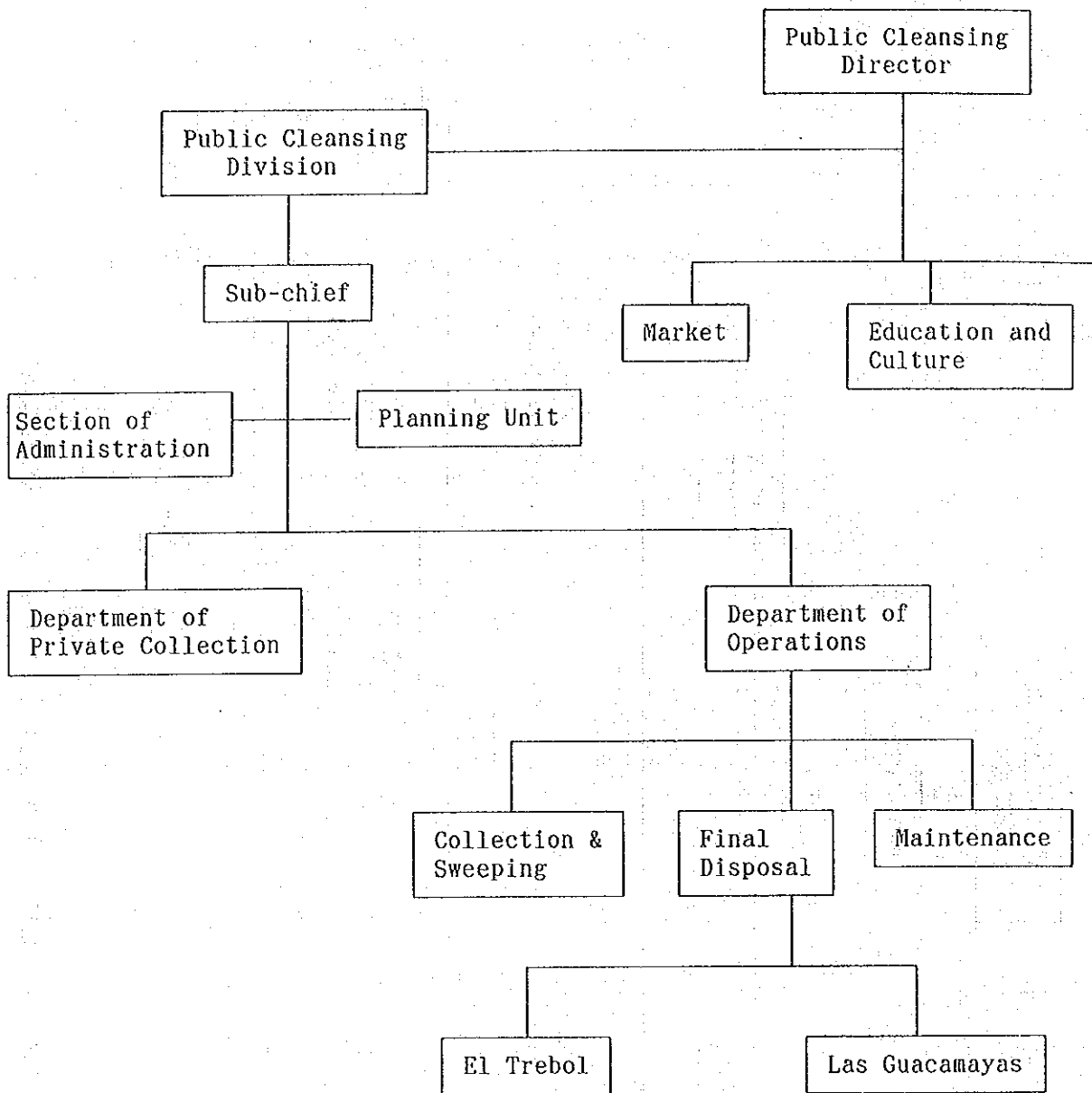


Fig. III-4.1-2 Chart for the Public Cleansing Division, DLP

4.1.2 Organizational System

The new proposed organizational structure of the DLP has a Management which includes the Submanagement, the Planning and Evaluation Unit, two Departments, Private Collection and Operations, and one Administrative Support Section.

(1) Management of DLP

The Management and Submanagement of DLP plans, organizes, directs, coordinates, controls and operates the supply of public cleansing services in Guatemala City, efficiently administering operations for the benefit of the public. Public cleansing service is understood to be that including sweeping of the streets and public areas, collection, transport, treatment and the final disposal of solid waste.

Personnel: 4

(2) Planning and Evaluation Unit

Functions:

- Prepare short-, medium- and long-term plans.
- Evaluate the costs and overall efficiency of all DLP operations.
- Prepare and implement a corresponding budget program.
- Collect and process all DLP statistical information.
- Establish a data-processing system, which permits the DLP's decision-making based on the information.
- Maintain control of all scheduled activities, verifying the overall performance, the causes of any variations and the corrective measures to be applied.
- Prepare and conduct the instruction and training programs for DLP personnel.

- Prepare any necessary projects for the improvement, updating and expansion of legal regulations and standards relevant to solid waste management.
- Promote mass education and community participation through a video program, public sanitation campaigns, recovery and recycling programs and programs teaching the correct use of containers in different areas. Carry out these activities within different population sectors, such as outlying areas, markets, isolated area, schools, private collectors, and the DLP itself.
- Register public complaints and direct these to the corresponding department for attention.

Personnel: 5

(3) Private Collection Department

Functions:

- Strengthen the dual-collection system
- Supervise and control private collection
- Coordinate with private collectors to provide better quality service while increasing coverage.
- Study and organize the collection zones for the purpose of granting them as concession.
- Establish the necessary conditions and procedures prior to granting concessions.
- Assign and contract concessions
- Promote private collectors through technical consultation, training courses, and the surveillance of illegal and clandestine competition.
- Supervise the fulfillment of contracts and cancel and/or penalize in case of nonfulfillment or violations.
- Confirm that all the domestic solid waste generated within the concession zones is being collected by the private collector commissioned to provide the service.

Personnel: 9

(4) Operation Department

Includes the elements, resources and activities carried out to administer the preparation and execution of collection, sweeping, storage, transportation, treatment and final disposal of solid waste projects directly or through contracting, as well as the operation and maintenance of any equipment or installations intended to provide public cleansing services.

The Operations Department includes three sections:

- Collection and sweeping
- Final disposal ("El Trebol" controlled landfill and the future "Las Guacamayas" sanitary landfill)
- Maintenance

Personnel: 659

(5) Administration section

This is a section which supports management in the administration of human, physical and financial resources.

Functions:

- Execution of the budget
- Administration of supplies
- Inventory control
- Control of personnel
- Annual medical examination of workers
- Administration of equipment and machinery

Personnel: 7

4.1.3 Evaluation

The feasibility of the project and the attainment of the goals proposed in the main plan will depend, to a great extent, on the institutional and organizational establishment proposed.

(1) Organizational feasibility

1) The purpose of the organizational system is to realistically respond to the objectives and goals proposed in the project:

- Improve operational efficiency to satisfy the collection demand in outlying areas and reduce the problem highlighted by 500 open garbage dumps.
- Improve present sanitary conditions at the "El Trebol" landfill.
- Obtain the formal participation of private collectors

2) To make this organization effective, realistic measures and practices are proposed:

- Incorporate a Planning and Evaluation System to aid in the decision-making process.
 - Promote community education and participation
 - Initiate a preventive maintenance program for the equipment.
 - Establish a permanent training program for personnel
 - Gradually increase the financial resources of the public cleansing service to face the higher costs which any improvement of services will entail.
- Once again it should be stated that there will be

no increase of personnel and that the only additional resources will be exclusively for operating costs.

- 3) The new public cleansing service will not take high profile within the Municipality. What is important is the internal reorganization of this department, as well as the institutional, political and, particularly, financial support provided by the municipal corporation.

(2) Evaluation indicators

The main indicators to be evaluated are the following:

- 1) Solid waste generation: Kg/working day
- 2) Coverage: Percentage of the population served with collection relative to the total population.
- 3) Productivity: Number of residents served per DLP employee.
- 4) Quality: Percentage of the number of satisfied users surveyed relative to the total number of users surveyed.
- 5) Costs:
 - Manual and mechanical sweeping (\$/ton swept)
 - Collection (\$/ton collected)
 - Final disposal (\$/ton filled)
- 6) Operation:
 - Number of open garbage dumps, evaluated every 3 months
 - Tons of garbage collected per month

- Tons of garbage disposed of at "El Trebol" and "Las Guacamayas" per month.
- 7) Truck scale performance: Number of weighings per day
- 8) Frequency of claims or complaints: Total number per month/population served.
- 9) Personnel:
 - Rotation: Percentage of the number of retirees per year relative to the total number of employees.
 - Absenteeism: Percentage of days of absence relative to the total number of workdays for all personnel
- 10) Private collectors:
 - Registration of private collectors
 - Tons collected per day
 - Quality: Percentage of the number of satisfied users surveyed relative to the total number of users surveyed.

4.2 Concession to Private Collectors

4.2.1 Dual Operating System for Private Collection

The dual collection system, municipal and private, as has already been indicated, is one that is proposed in the main plan and that will operate during the decade.

Once the above decision has been made, two possibilities will have to be defined:

- (1) Continue operating with the current private collectors,
or
- (2) Contract with one or several new private companies
which will be established specifically to provide this
service.

After a simple analysis, JST concluded that for economic, financial, social, political and operational reasons, the first alternative, (1) Continue operating with the current private collectors," that is, the Association, Cooperative and Independents was the most recommendable.

4.2.2 Formalization with Private Collectors

The next step was to define the formalization procedure of the collection operation in the light of the special characteristics of the groups and persons engaged in this work.

- (1) Formalize the process through the concession of zones, or
- (2) Continue operations in the same way as in the present.

These two paths were carefully analyzed, and an intermediate procedure was recommended, that is, the method of concession zones, however, this is to be done on a gradual basis and for the time being operations would continue as in the present manner in zones not yet granted as concessions. The schedule for the granting of concessions is shown in the chart below, which indicates that up to 1995, concessions would be granted for 11 of the 20 zones in Guatemala City.

<u>Year</u>	<u>Concession Zones</u>
1992	1
1993	3
1994	3
1995	4

The analysis and evaluation of the procedure, operation and development of the zone concessions in 1992 will be of great importance to make corresponding adjustments in the process. This study will be carried out by the DLP.

4.2.3 Criteria for the Identification of Zones to be Granted Gradually as Concessions

The criteria for determining the priority of the zones to be granted as concessions is:

- (1) The type of area established in the collection plan. ECA is preferred.
- (2) The number of open garbage dumps within the zone. Zones with more open dumps are preferred.
- (3) The financial return expected in the zone based on the following premises:
 - Average truck capacity: 15 m³
 - Volume occupied by load in each truck: 70%
 - Standby trucks: 20% additional, since old vehicles are involved.
 - Number of trips to the landfill: Average, 1.2 per truck per working day.
 - Average rates: Q.12, high level; Q.7, intermediate level; Q. 1.00, low level
 Zones with high financial return are preferred.
- (4) The possibility of conflict among private collectors. Zones with smaller conflict possibility are preferred.

4.2.4 Concession Procedures

The procedures were studied for the granting of concessions. They include;

- (1) Zoning
- (2) Conditions for the concessions
- (3) Criteria for the awarding of concessions
- (4) Contracting of concessions

(1) Zoning

- 1) Maintain the jurisdiction of the present 22 zones of Guatemala City.
- 2) Concessions may be granted in 20 of the 22 zones, either totally or partially during the decade. Zones 24 and 25 are excluded because they are rural areas. However, the zones corresponding to the municipalities of Mixco, Villa Nueva, Chinautla and Villa Canales should also be included.
- 3) The zone corresponding to Santa Catarina Pinula will be treated as an isolated area, where a specific approach will be taken.
- 4) The City of Mixco, with its large population, may be subdivided into as many as three zones for concession purposes.
- 5) In addition, alternatively, considering that Zones 7 and 18 have also dense populations, it is recommendable that they also be subdivided into two subzones each (7A and 7B; 18A and 18B).
- 6) In summary, taking into consideration the above, the zoning for concession purposes will include:

20 zones in Guatemala City, three in Mixco, and one each in Chinautla, Villa Nueva and Villa Canales, bringing the total to 26 zones.

7) However, the above zoning is a proposal, which should be adjusted in practice to account for local conditions and characteristics, as well as any jurisdictional, topographic and access problems which may arise. Thus, for example, the following cases may arise, among others:

- a. Zones which will be granted partially
- b. Special areas, within zones, which may need to be handled independently.
- c. Isolated areas which may be granted as concessions to private collectors.
- d. Sectors of a zone which for topographical reasons or due to easy access, may be concessioned in contiguous zones, even if they lie within the jurisdiction of another municipality.

8) Consequently, the approach to zoning cannot be rigid, and special cases should be treated and resolved by the DLP's Private Collection Department, with the support of this department's Planning Unit. The solution of intermunicipal jurisdictional questions should have the support of the Metropolitan Solid Waste Committee (CMDS), whose establishment has been proposed in this study.

9) Table III-4.2-1 presents an example showing possible concession areas, the design population in the year 1995, the estimated amount of garbage generated in each zone in 1995, the required load capacity to collect all the garbage generated each working day in areas where collection is easy. Naturally, this

example would represent the alternative of the maximum concession.

- 10) Tables III-4.2-2 and III-4.2-3 present financial simulations for the formalization of concessions in the zones during the decade. It is expected that already existing vehicles of private collectors will be used for the most part. Twenty percent of the additional capacity has been considered as reserve (given the age of these trucks). The composition ratios for high-, medium- and low-income level, obtained by the first field study are used and collection fees are simulated for each level in Cases A and B:

	Case A	Case B
Hi-income	Q 10/month	Q 10/month
Medium-income	Q 6/month	Q 7/month
Low-income	Q 1/month	Q 1/month

(2) Conditions for the concessions

1) General conditions

- a. In accordance with Article 31 of the Municipal Code, the Municipal Public Services are rendered directly by the departments or through granted concessions.
- b. The Municipality has the authority to grant concessions for the rendering of public services exclusively within its jurisdiction to individuals or companies, through a public law contract with a determined duration, in which the nature and conditions of the service and guarantees of the operation are established (Art. 32, Municipal Code).
- c. The Municipality will establish the contributions and rates arising from the

contract which the receiver of the concession will derive (Art. 32, Municipal Code).

- d. The Public Cleansing Department (DLP) regulates and controls all matters related to private solid waste collection, and the Municipal Council grants concessions to applicants who fulfill all the necessary requirements.
- e. Private collectors may act as individual companies, cooperatives or as any other legal entity which is not a foreign consortium.
- f. The assignment of concessions assumes a process of negotiations between the Municipality and the applicants, since the variables involved do not permit rigid rules or guidelines.
- g. After negotiations, and the granting of the concession by the Municipality, the corresponding administrative contract or open contract will be signed.
- h. The Municipality will update the Register of Private Collectors, and registration in this Municipal Register will be an indispensable requirement for any applicant desiring a concession.
- i. Experience as a private collector will be indispensable for applying for a concession. Such experience will be verified and certified by the Public Cleansing Department.
- j. Only private collectors who have worked continuously as such prior to December 31, 1990 will be allowed to register in the Municipal Register.

TABLE III-4.2-1 ZONES TO BE CONCEDED FOR PRIVATE COLLECTORS
AND COLLECTION CAPACITY OF EACH ZONE

Zones	(1) Population 1995 (1000)	(2) Population collected by private collectors (1000)	(2) % -- (1)	Collection Amount (m ³ -Dia Lab)
Guatemala Z 1	46.20	46.20	100	156.40
Guatemala Z 2	27.80	27.80	100	94.10
Guatemala Z 3	48.40	48.40	100	163.90
Guatemala Z 4	4.10	4.10	100	13.80
Guatemala Z 5	84.60	84.60	100	286.70
Guatemala Z 6	94.40	94.40	100	319.90
Guatemala Z 7	204.80	204.80	100	693.70
Guatemala Z 8	19.90	19.90	100	67.20
Guatemala Z 9	3.50	3.50	100	11.80
Guatemala Z 10	14.80	14.80	100	50.30
Guatemala Z 11	75.20	75.20	100	254.70
Guatemala Z 12	55.60	55.60	100	188.50
Guatemala Z 13	39.90	39.90	100	135.30
Guatemala Z 14	28.90	28.90	100	98.00
Guatemala Z 15	28.70	28.70	100	97.20
Guatemala Z 16	23.00	12.30	53	41.70
Guatemala Z 17	30.60	19.50	64	66.00
Guatemala Z 18	246.70	142.90	60	484.00
Guatemala Z 19	38.50	20.30	53	68.60
Guatemala Z 21	74.80	54.40	73	184.50
Guatemala Z 24	9.90	-----	---	-----
Guatemala Z 25	8.30	-----	---	-----
Mixco	424.20	151.60	36	513.60
Villa Nueva	62.50	-----	---	-----
Villa Canales	28.30	-----	---	-----
Sta. C. Pinula	22.30	-----	---	-----
Chinautla	43.30	43.30	100	146.70
Total:	1789.30	1221.10		4136.00

Note: Waste generation per capita-working day: 0,6775 kg
Density: 0.2 kg/l

TABLE III-4.2-2 FINANCIAL EXERCISE FOR PRIVATE COLLECTION BY CONCESSIONS
(CASE A)

NOMBRE DE RECOLECCION LA ZONA	(m ³ /dl)	NUMERO DE CAMIONES	COMP. DE INGRESOS			TARIFA PROMEDIO	TASA DE UTILIDAD
			A	M	B		
ZONA 1	156.4	13	5	57	38	4.32	19.09
ZONA 2	94.1	8	0	72	28	4.63	22.61
ZONA 3	163.9	13	0	62	38	4.13	19.04
ZONA 4	13.8	2	0	92	8	5.63	-8.30
ZONA 5	286.7	22	0	48	52	3.38	4.26
ZONA 6	319.9	25	0	52	48	3.63	9.23
ZONA 7	693.7	53	0	72	28	4.63	30.45
ZONA 8	67.2	6	0	52	48	3.63	-3.65
ZONA 9	11.8	2	65	35	0	8.60	17.23
ZONA 10	50.3	4	85	15	0	9.40	64.36
ZONA 11	254.7	20	10	90	0	6.40	48.33
ZONA 12	188.5	15	25	62	13	6.38	47.43
ZONA 13	135.3	11	30	52	18	6.32	45.88
ZONA 14	98.0	8	84	13	3	9.27	62.93
ZONA 15	97.2	8	79	13	8	8.82	60.74
ZONA 16	41.7	4	0	52	48	3.63	-11.38
ZONA 17	66.0	6	0	62	38	4.13	7.22
ZONA 18	484.0	37	0	57	43	3.88	16.94
ZONA 19	68.6	6	0	52	48	3.63	-1.54
ZONA 21	184.5	15	0	72	28	4.63	25.98
ZONA 24	0.0	1	0	52	48	0.00	0.00
ZONA 25	0.0	1	0	52	48	0.00	0.00
Mixco	513.6	40	5	38	57	3.32	1.38
Villa N	0.0	1	0	52	48	0.00	0.00
Villa C	0.0	1	0	52	48	0.00	0.00
SC. Pinu	0.0	1	0	77	23	0.00	0.00
Chinaut	146.7	12	0	43	57	3.13	-10.19

FOOTNOTE:

1. COLLECTION

(1) COLLECTION VEHICLE

CAPACITY 15.0 m³

LOAD FACTOR 70.0 %

RESERVE 20.0 %

(2) NUMBER OF TRIPS 1.5 /wd

(3) NUMBER OF HELPERS 4.0 persons/vehicle

(4) DENSITY .20

2. FINANCE

(1) TARIFF

HIGH INCOME 10.0 Q/month, house

MIDDLE INCOME 6.0 Q/month, house

LOW INCOME 1.0 Q/month, house

(2) PERSONNEL COST

OWNER 600.0 Q/month, person

HELPER 250.0 Q/month, person

(3) FUEL & MAINTEN. COST 500.0 Q/month, vehicle

(4) OTHER COST (2) * 10.0 %

Table III-4.2-3 FINANCIAL EXERCISE FOR PRIVATE COLLECTION BY CONCESSIONS
(CASE B)

NOMBRE DE RECOLECCION LA ZONA	(m ³ /dl)	NUMERO DE CAMIONES	COMP. DE INGRESOS			TARIFA PROMEDIO	TASA DE UTILIDAD
			A	M	B		
ZONA 1	156.4	13	5	57	38	5.00	30.01
ZONA 2	94.1	8	0	72	28	5.35	33.09
ZONA 3	163.9	13	0	62	38	4.75	29.70
ZONA 4	13.8	2	0	92	8	6.55	7.00
ZONA 5	286.7	22	0	48	52	3.85	16.07
ZONA 6	319.9	25	0	52	48	4.15	20.71
ZONA 7	693.7	53	0	72	28	5.35	39.87
ZONA 8	67.2	6	0	52	48	4.15	9.46
ZONA 9	11.8	2	65	35	0	10.25	30.56
ZONA 10	50.3	4	85	15	0	11.25	70.22
ZONA 11	254.7	20	10	90	0	7.50	55.91
ZONA 12	188.5	15	25	62	13	7.50	55.31
ZONA 13	135.3	11	30	52	18	4.15	2.71
ZONA 14	98.0	8	84	13	3	11.10	69.03
ZONA 15	97.2	8	79	13	8	10.55	67.16
ZONA 16	41.7	4	0	52	48	4.15	2.71
ZONA 17	66.0	6	0	62	38	4.75	19.43
ZONA 18	484.0	37	0	57	43	4.45	27.67
ZONA 19	68.6	6	0	52	48	4.15	11.31
ZONA 21	184.5	15	0	72	28	5.35	36.01
ZONA 24	0.0	1	0	52	48	0.00	0.00
ZONA 25	0.0	1	0	52	48	0.00	0.00
Mixco	513.6	40	5	38	57	3.80	13.71
Villa N	0.0	1	0	52	48	0.00	0.00
Villa C	0.0	1	0	52	48	0.00	0.00
SC. Pinu	0.0	1	0	77	23	0.00	0.00
Chinaut	146.7	12	0	43	57	3.55	3.00

FOOTNOTE:

1. COLLECTION

(1) COLLECTION VEHICLE

CAPACITY

15.0 m³

LOAD FACTOR

70.0 %

RESERVE

20.0 %

(2) NUMBER OF TRIPS

1.5 /wd

(3) NUMBER OF HELPERS

4.0 persons/vehicle

(4) DENSITY

.20

2. FINANCE

(1) TARIFF

HIGH INCOME

10.0 Q/month, house

MIDDLE INCOME

7.0 Q/month, house

LOW INCOME

1.0 Q/month, house

(2) PERSONNEL COST

OWNER

600.0 Q/month, person

HELPER

250.0 Q/month, person

(3) FUEL & MAINT. COST

500.0 Q/month, vehicle

(4) OTHER COST (2) *

10.0 %

- k. Private collectors who have obtained a concession will not be allowed to apply for any new zone, prior to at least December 31, 1995.

2) Nature of the service

- a. The service which will be provided in the concession areas will exclusively entail the collection of solid waste generated within the concession zone.
- b. The private collector must collect all domestic solid waste generated within the zone, employing the procedures, routes, frequencies, schedules and specifications that have been approved by the municipalities.
- c. They may also collect solid waste of a commercial origin, as well as solid waste originating from small industries within the zone. The private collectors will not, however, be permitted to do so outside their zones.
- d. Commercial companies that have their own collection services should request the corresponding authorization from the DLP to continue their operations.
- e. It shall be strictly prohibited for the private collector of any zone to collect or transport hazardous waste.
- f. Solid waste generated at public institutions (schools, public offices, etc.), will be collected by the Municipal Service. However, they will have the option of using private collector services, by being charged the average rate for domestic services.

3) Service Conditions

- a. The DLP will clearly define the concession zone and its location.
- b. The private collector must express acceptance of the municipal ordinances and regulations which regulate this service.
- c. The private collector must agree to provide collection services in accordance with DLP's technical specifications, including frequencies, schedules, collection methods and route diagram.
- d. The private collector must expressly agree to collect all the garbage generated within the concession zone.
- e. Prior to implementation the DLP must grant its permission for the implementation of any new collection methods or procedures, proposed by the private collector.
- f. The maximum rate to be charged to low-income residents within the zone, and the type of collection service to be provided must be defined.
- g. The maximum rate to be charged to domestic service users within the zone and the service characteristics which will be provided (door-to-door collection, house-to-house collection, multifamily container collection, etc.) must be defined.
- h. The scale of rates which will be collected from commercial users with an indication of the service characteristics which will be provided must be defined in the concession agreements.
- i. The private collector must give all the guarantees required by the Municipality to permanently ensure the number of daily vehicles, and to correctly fulfill the service demand. In addition, standby vehicles should

be permanently available to guarantee the continuity of the collection service.

- j. The number, characteristics, registration and identification of the vehicles, including any standby vehicles, should be established in detail, in the concession agreement. These vehicles should be intended exclusively for collection services within the concession zone. Consequently, the use of these vehicles in zones other than the concession zone will be strictly prohibited. Violators will be penalized and a recurrence may be grounds for a cancellation of the concession.
- k. The design population for the calculation of the load capacity of the collector vehicles in the concession zones will be five (5) years, which represents the term of the concession.
- l. The number of standby vehicles will be defined by the Municipality in accordance with the number of the years of use of the vehicles proposed for service by the private collector. In every case, the minimum standby will account for 10% of the total number of vehicles.
- m. The private collector will be obliged to replace any vehicle or vehicles of the service fleet or standby vehicle which, due to obsolescence or disrepair, breaks down during the concession period.
- n. The private collector will be obliged to transport the solid waste collected, exclusively and in its entirety to the sanitary landfills operated by the Municipality. Violators will be penalized and a repeat violation may be grounds for a cancellation of the concession.
- o. All the vehicles used by the private collector should have the appropriate systems, either automatic or adapted, for a quick unloading of

the vehicles into the landfills. Unloading time should not exceed seven minutes.

- p. In the awarding of concessions from January 1, 1996, vehicles manufactured prior to 1980 will not be acceptable.
- q. Any modification in the rates charged to users must previously be approved by the Municipality. The nonfulfillment of this requirement will be grounds for cancellation of this concession.
- r. The private collector and the collector's personnel may carry out the separation and recovery of materials contained within the garbage collected, for purposes of recycling, provided that sanitary and safety regulations are observed.

4) Other concession conditions

- a. The private collector must keep accounting records in accordance with the law, thereby making verification by the Internal Revenue Service possible, whenever the Municipality wishes to determine the financial condition of the company (Municipal Code, Art. 33, b.).
- b. The private collector must agree to make available to the Municipality all accounting books and documents and to provide any necessary information, in the case of an audit of services (Municipal Code, Art. 33, c.).
- c. The duration period of the concession in each of the concession zones will be five (5) years. Applications for an extension for a similar period must be submitted within the last three (3) months of the initial period.
- d. The private collector will be obliged to fulfill all technical requirements regarding the inspection of the vehicles and equipment,

and the operation of services defined by the Municipality, as well as the payment of rates and fees stipulated by the Municipal Corporation.

- e. However, the Municipality may consider releasing or reducing the rate charged to collectors for unloading solid waste in the sanitary landfills.

5) Audit of accounts or cancellation of the concession

- a. An audit of the accounts of a concession may be carried out for reasons stipulated in Article 34 of the Municipal Code.
- b. A private collection concession may be canceled under any of the following circumstances:
 - When it is detrimental to the Municipality's interests.
 - When regulations of a general or local nature related to public health and hygiene are violated.

In either of these cases, there will be no recourse to administrative legal procedures (Municipal Code, Art. 35).

6) Prohibitions and penalties

- a. Persons who fall under any of the circumstances indicated in Article 48 of Decree No. 35-80 are prohibited from applying for collection concessions.
- b. Any nonfulfillment or violation of the contract will be punished, in accordance with the seriousness of the violation, with fines which may amount up to 10% of the monthly income for the payment of rates in the concession zone. Recurrence of the violation may be grounds for the cancellation of the concession.

(3) Criteria for the awarding of concessions

The basic criteria will be the following:

- 1) Exclusively award to existing private collectors, registered with the Municipality, because they have experience.
- 2) The awarding will occur through negotiations between the Municipality and the private collector, which should be based on the guidelines and conditions proposed in this document.
- 3) The plan proposed by the private collector to collect all the solid waste in a concession zone.
- 4) The tariff plan and structure proposed by the private collector.
- 5) The plan and method proposed by the private collector for collection in poor and low-income areas, and the maximum rate which can be charged.
- 6) The guarantees which the private collector offers to ensure a permanent basis for the number of vehicles claimed for the service, including standby vehicles.
- 7) The organizational and financial plan proposed by the private collector, to modernize and make his company more efficient.

(4) The contracting of concessions

The concession agreement for a zone for private-collection service will be prepared by the Municipal Legal Department.

4.2.5 Supervision and Control of Concessions

The operation and functioning of private collection within the concession areas will be monitored, supervised and controlled by the DLP's Private Collection Department. The basic matters which will be supervised daily will include the following:

- (1) The total collection of waste generated in the zone.
- (2) Controls to ensure that the vehicles of the commercial companies have the appropriate DLP authorization to transport solid waste.
- (3) Prohibition of the transportation of hazardous wastes by private company vehicles.
- (4) Supervision regarding the maximum rate charged to users of the service.
- (5) Supervision of vehicles operating exclusively in the concession zone.
- (6) Control of solid waste dumping in clandestine garbage dumps.
- (7) Control of collectors operating in zones other than their own concession zone.

5. Financial Aspect

5.1 Project Costs

The project costs estimated in the feasibility study are shown in Table III-5.1-1 (capital costs) and Table III-5.1-2 (additional operation costs), from 1991 to 1995.

According to the tables, the total capital costs are Q 28,121 million and the total additional operation costs are 14,873 million summed from 1992 to 1995. In the Table III-5.1-1, the purchase cost of collection vehicles and bulldozers, Q 9,203 million, appears in 1995, but this cost is ignored because the return on cost will be generated after 1995.

Table III-5.1-1 Capital Costs

(1,000Q, 1991 price)

	1991	1992	1993	1994	1995	Total
Collection						
Compactor Truck		4,950			(5,225)	(10,175)
Open Truck		700			(350)	(1,050)
Facilities		100				100
- TOTAL -		5,750			(5,575)	(11,325)
Final Disposal						
- Trebol -						
Landfill		7,073			(2,674)	(9,747)
Facilities		919			(0)	919
Equipment		6,154			(2,674)	(8,828)
Leachate Treat		0				0
Facilities		0				0
Equipment		0				0
Sub-Total		7,073			(2,674)	(9,747)
- Guacamayas -						
Landfill		14,344				14,344
Facilities		3,737				3,737
Equipment		10,607				10,607
Leachate Treat		954			(954)	(1,908)
Facilities		954			(954)	(1,908)
Equipment		0			(0)	(0)
Sub-Total		15,298			(954)	(16,252)
- TOTAL -		22,371			(3,628)	(25,999)
Grand Total		28,121			(9,203)	(37,324)

Table III-5.1-2 Additional Operation Cost

(1,000Q, 1991 price)

	1991	1992	1993	1994	1995	Total
Personnel						
Director	-	42	42	42	42	168
Sanitary Engineer	-	32	32	32	32	128
Total	-	74	74	74	74	296
Collection						
Fuel, Maintenance & Repair	-	420	420	420	205	1,465
Final Disposal						
- Trebol -						
Fuel, Maintenance, Power	-	1,675	1,675	1,675	2,179	7,204
Soil	-	650	650	650	650	2,600
Personnel	-	36	36	36	50	158
Sub-Total	-	2,361	2,361	2,361	2,879	9,962
- Guacamayas -						
Fuel, Maintenance, Power	-	-	992	992	992	2,976
Soil	-	-	0	0	0	0
Personnel	-	-	58	58	58	174
Sub-Total	-	-	1,050	1,050	1,050	3,150
- TOTAL -	-	3,361	3,411	3,411	3,929	13,112
Grand Total	-	2,855	3,905	3,905	4,208	14,873

5.2 Necessary Budget

The financial situation required by solid waste activities in future is studied based on the project costs and revenues, in view of the cash flow analysis.

First, the debt service payments, including repayment of principal and interest payments, are calculated, using the capital costs under the following conditions:

Repayment period	10 years
Grace period	0 years
Interest rate	4%/year
Straight line method applied	
(Refer to Table III-5.2-1)	

Next, additional expenditures for SWM are defined as the additional operation costs plus the debt service payments.

The result of cash flow analysis for SWM is shown in Figure III-5.2-1. This figure indicates that the increase of budget for SWM will be necessary to improve sanitary and environmental situation in Guatemala City.

Table III-5.2-1 Debt Service Payments

(1,000Q, 1991 price)

	1991	1992	1993	1994	1995
Capital Costs		28,121			(9,203)
Borrowing Money (Loans)		28,121			(9,203)
Debt Service Payment					
Repayment of Principal			2,812	2,812	2,812
Interest Payment			1,125	1,013	900
- Total -			3,937	3,825	3,712

Note: Borrowing Conditions

Repayment Period 10 years

Grace Period 0 years

Interest Rate 4%/year

Straight Line Method applied

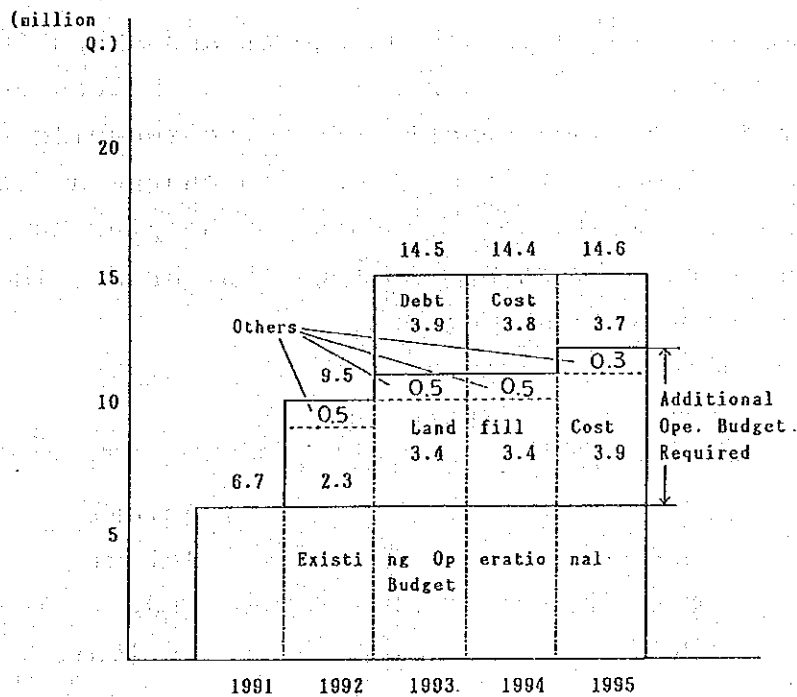


Fig. III-5.2-1 Transition of necessary budget (interest rate of 4%)

5.3 New Revenue Source

According to the result of 5.2, it is clear that the more budget will be necessary for the Municipality to improve present environmental conditions. Therefore the Municipality is requested to take the financial countermeasure.

Presently DLPM is giving the following services:

- a. Sweeping services on the streets
- b. Cleansing services on the markets
- c. Final disposal on landfill site
- d. Collection service in marginal areas

Since some people obtain the benefits from above services, the Municipality can consider to charge some fee to them. The tentative survey results on the fee of each service (a-c) are as follows:

(1) Fee for street sweeping service

Commercial facilities, such as stores and shops facing a paved street, and residents living in the center of the city can get some benefits from the sweeping service. Although it is difficult to charge a fee on them, this fee would be necessary for helping the financial condition on SWM in the study area. The sweeping costs were as follows:

	Value (Q.1000)	Share in DLPM (%)	
1988	1330	33	} Actual
1989	1550	37	} Actual
1990	1800	34	Budget
1991	2200*	34	Estimate

$$* (5.114 + 1412) \times 34\% = 2218.84$$

It is assumed here that one half (Q1.1 million) will be borne by the Municipality while the remaining one half will be charged to commercial facilities and residents.

- a. Q. 1,100,000 would be charged to the Municipality.
- b. Q. 1,100,000 would be charged to the people obtaining benefits from it furthermore.

Q. 1,100,000 x 1/3 -- Commercial facilities

Q. 1,100,000 x 2/3 -- Residents

Number of commercial facilities are assumed to be about 5,000 based on the member list of "Camara de Comercio 1990" that shows about 1600 registered. So the fee would be Q.6/store, month. The number of houses located along the paved street with sweeping services with a middle or higher income is assumed to be about 100,000. Then Q7/house year would be charged. These fees seem to be a light burden for them.

Next, the possible fee collection methods are mentioned. There are several methods to be considered as follows:

- a. To increase the existing property tax rate for the people obtaining benefits
- b. To add these fees to the existing property tax rate for the people.

Since these fees belong to "Impuesto" a kind of tax, approval of Congress is necessary to change the existing property tax rate.

(2) Fee for cleaning service in markets

The Municipality is presently charging "Piso de Plaza" to all tenants in markets. If the Municipality increase this fee, the following income will be obtained:

a. Increase 20% of the rate of this fee

b. In 1991, this fee is supposed to be as follows:

1987	3,903	(1000Q.)	} Actual
1988	4,451	"	} Actual
1989	5,278	"	} Actual
..	..		
1991	7,100	"	} Estimate

Therefore, $Q. 7,100,000 \times 20\% = Q. 1,420,000$ can be expected as the new income in 1991. Also the approval by Congress is requested to increase this rate.

(3) Fee for final disposal (tipping fee)

Landfilling in El Trebol site has been free so far, but money will be needed for improving the situation to a controlled landfill and for opening a new site. Actually, much of commercial and construction waste has been dumped at Trebol site.

The composition of final disposal is:

Private collectors	438 ton/wd
Municipality	240 ton/wd
Commercial and industrial waste	106 ton/wd
Construction waste	426 ton/wd
Total	1,210 ton/wd

(at Trebol site in 1991)

If a tariff of 1Q/ton for solid waste by private collectors and 10Q/ton for commercial and industrial waste, and 33% of construction waste, is approved, Q.910,416 would be produced annually, as new income in 1991.

$$438 \times 312 \times 1 + (106+426/3) \times 312 \times 10 = 910,416$$

The tariff of 1Q/ton is equal to charging 1Q for 13 houses per month. But this tariff had better be free for some years, because of expansion of gradual concession. Also, 2/3 of construction waste would be used as cover material. As such its dumping should be free. Then, the law enforcement to regulate clandestine open dumpings in gullies would be needed parallel to establishing this tariff.

Also, approval of this fee by Congress would be obviously needed, as this fee belongs to "arbitrio". The collection of this fee would be done at the landfill site using the truck scale.

(4) Boleto de ornato

This tax depends on the income of the working population and it is paid at the working place. This tax has been as follows:

1987	1,680	(1000Q.)	} Actual
1988	2,101	(")	} Actual
1989	2,318	(")	} Actual
...	...		
1991	3,200	(")	} Estimate

Then if a 30% increase of the "Boleto de Ornato" (working tax) would be approved, the new income resource would be estimated to be about Q.1,000,000. Municipalities are now processing to increase this

"Boleto de Ornato" and expecting that it will be approved by Congress immediately.

As a result, about Q4.7 million per year can be expected as new income resources for DLPM as follows:

Road sweeping fee:	Q1,100,000
Market cleansing fee:	Q1,420,000
Final disposal fee:	Q910,000
Boleto de ornato:	Q1,000,000
Total	Q4,430,000

On the other hand, the DLPM's additional budget required is estimated below:

	Debt service	Operating cost	Total
1992	0	2.8	2.8
1993	3.9	3.9	7.8
1994	3.8	3.9	7.7
1995	3.7	4.2	7.9

(Unit: million Q)

Accordingly, it is clear that the additional operating costs can be fully recovered by the new income resources. Furthermore, if a foreign donation applied on procurement of the equipments, such as vehicles and bulldozers, etc., is assumed, the debt cost will reduce from Q3.9 to Q1.0 million:

	Equipments	Others	Total
1992	16,660	5,711	22,371

(Unit: 1000Q)

$$3.9 \times 5.711/22,371 = 1.0$$

Besides, it is possible to obtain a financial support from the Central Government for the other capital costs, in order to reduce the debt service further. Therefore, under

the conditions that DLPM's budget can be increased through the new income resources, a foreign donation can be requested to procure the machines and equipments and the Government financial support can be obtained, the plans for improving SWM can be feasible from the financial point of view.

6. Evaluation of the Feasibility

6.1 Socio-Economic Aspect

- (1) Effective application of the existing municipal labor force

To improve the present situation of solid waste management, some experts and workers will be necessary. However, personnel from other municipal sections can be transferred to the SWM section without the need to hire new employees. Therefore, the size of the labor force employed by the Municipality will be maintained and labor costs will not increase.

- (2) Improvement of private collection management

One reason behind introducing the concession collection method is to reduce excessive competition among private collectors in the concession areas and stabilize their businesses. In other words, an adequate collection fee will be applied fairly in each concession area. Therefore, improvements in private services via the replacement of collection vehicles will be expected by 1995.

- (3) Repercussions of the estimated capital costs

Estimated capital costs will mainly result from the purchase of collection vehicles, and the improvement and construction of landfill sites. Although the costs for purchasing vehicles will be paid to foreign countries, construction costs will be consumed almost entirely in Guatemala. However, the economic repercussions will not be expected to be so great since only a small amount of money is related to landfilling and since the industrial structure of Guatemala is not properly integrated.

(4) Environmental and sanitary improvements

According to the premises of the project's main plan, a great improvement in sanitary and environmental conditions is expected since clandestine open dumping will decrease, the efficient collection of garbage will be implemented in marginal areas, and the sanitary conditions of residents will also be substantially improved.

(5) Cost-benefit analysis

Targets of the Study are as follows:

- a. Expansion of collection service
- b. Realization of or transition to a sanitary landfill
- c. Strengthening of institution and organization in solid waste management

As a result, the following benefits will be expected:

- a. Extreme reduction of clandestine open dumpings
- b. Realization of sanitary environment both in residential areas and landfill sites
- c. Decrease of disease and mortality caused by unsanitary condition.

So above benefits must be quantified, in order to apply the Cost-Benefit Analysis. It is quite difficult, however, to quantify all of the benefits, especially the realization of sanitary environment and the decrease of disease and mortality. Therefore, the C-B analysis for collection of solid waste is attempted here.

The premise for the analysis are mentioned below.

a. Concept

- Collection of solid waste in the peripheral and marginal areas is considered to be a benefit.
- By the reason of long life span of vehicles, the benefits are accounted until year 2000.

b. Costs

- Purchasing costs for collection vehicles
 - 1992: 5,650 (1000Q)
 - 1995: 5,575 (1000Q)
- Additional operating costs
 - 1992 - 1994: 420 (1000Q/year)
 - 1995 - 2000: 205 (1000Q/year)

c. Benefits

- Regarding the collection, a total of 43 municipal vehicles will be replaced for 1995. If these vehicles are not obtained by 1995, the following solid waste amount will not be collected, assuming the loading capacity remains constant (refer to Supporting Report).

1992 - 1994: 415t - 326t = 89t/wd

1995 - 2000: 483t - 326t = 157t/wd

- Furthermore, it is assumed that the loading capacity will decrease by 5% per year due to mechanical failure; therefore, the collection capacity of DLPM in year 2000 will be 63% of the 1991 capacity.

- It is assumed that collection fee is average Q3/month per house. The expected revenue will be:

1992 - 1994: 1,139 - 1,294 (Q1000/year)
 1995 - 2000: 2,433 - 3,349 (Q1000/year)

d. Discount rate

- Two figures are considered.
 8%/year for the municipal collection service.
 20%/year for the private collection service.
- These rates correspond to their capital costs which match the average interest rates of borrowing money from external financial organizations.

The present net values of the costs and benefits using the above rates are shown below (refer to Table III-6.1-1 and 2 in detail):

Net Present Value	Municipal Collection	Private Collection
Benefits (1000Q)	12,456	7,884
Costs (1000Q)	11,164	8,676
Benefits/Costs	1.12	0.91

Note: Price in 1991

This results mean that in peripheral and marginal areas only the municipal collection is profitable. Private collectors will not be able to recover high capital cost imposed on them. Therefore, municipal collection services are indispensable in peripheral and marginal areas.

TABLE III-6.1-1 INVESTMENT EFFICIENCY FOR MUNICIPAL COLLECTION

(Q1000)

YEAR	SW AMNT REMAINED	HOUSE SERVED	REVENUE EXPECTED	-- EXPENDITURE -- CAPITAL	OPERATION	DISCOUNTED CASH IN-FLOW	OUT-FLOW
1991	0	0	0	0	0	0	0
1992	95	31625	1139	5650	420	1055	5620
1993	101	33712	1214	0	420	1041	360
1994	108	35937	1294	0	420	1027	333
1995	203	67578	2433	5575	205	1788	4248
1996	216	72038	2593	0	205	1765	140
1997	230	76793	2765	0	205	1742	129
1998	246	81861	2947	0	205	1720	120
1999	262	87264	3142	0	205	1698	111
2000	279	93024	3349	0	205	1675	103
					NPV	12456	11164

INVESTMENT EFFICIENCY = 1.12

FOOTNOTE:

- 1) UNIT OF SW AMOUNT REMAINED IS ton
- 2) UNIT OF HOUSE SERVED IS house
- 3) DISCOUNT RATE IS 8.00%
- 4) TARIFF 3.00 Q/month, house
- 5) SW GENERATION 0.60 kg/capita
- 6) PEOPLE/HOUSE 5.00 persons
- 7) USING 1991 PRICE

TABLE III-6.1-2 INVESTMENT EFFICIENCY FOR PRIVATE COLLECTION

(Q1000)

YEAR	SW AMNT REMAINED	HOUSE SERVED	REVENUE EXPECTED	-- EXPENDITURE --		DISCOUNTED CASH	
				CAPITAL	OPERATION	IN-FLOW	OUT-FLOW
1991	0	0	0	0	0	0	0
1992	95	31625	1139	5650	420	949	5058
1993	101	33712	1214	0	420	843	292
1994	108	35937	1294	0	420	749	243
1995	203	67578	2433	5575	205	1173	2787
1996	216	72038	2593	0	205	1042	82
1997	230	76793	2765	0	205	926	69
1998	246	81861	2947	0	205	822	57
1999	262	87264	3142	0	205	731	48
2000	279	93024	3349	0	205	649	40
					NPV	7884	8676

INVESTMENT EFFICIENCY = 0.91

FOOTNOTE:

- 1) UNIT OF SW AMOUNT REMAINED IS ton
- 2) UNIT OF HOUSE SERVED IS house
- 3) DISCOUNT RATE IS 20%
- 4) TARIFF 3.00 Q/month, house
- 5) SW GENERATION 0.60 kg/capita
- 6) PEOPLE/HOUSE 5.00 persons
- 7) USING 1991 PRICE