b. Individual allotment system

The present individual allotment system is regarded as appropriate, because in general the efficiency of the sweeping work by groups of two or three sweepers is worse than individual one. Such being the case, this project assumes that all street sweepers will be given hand carts.

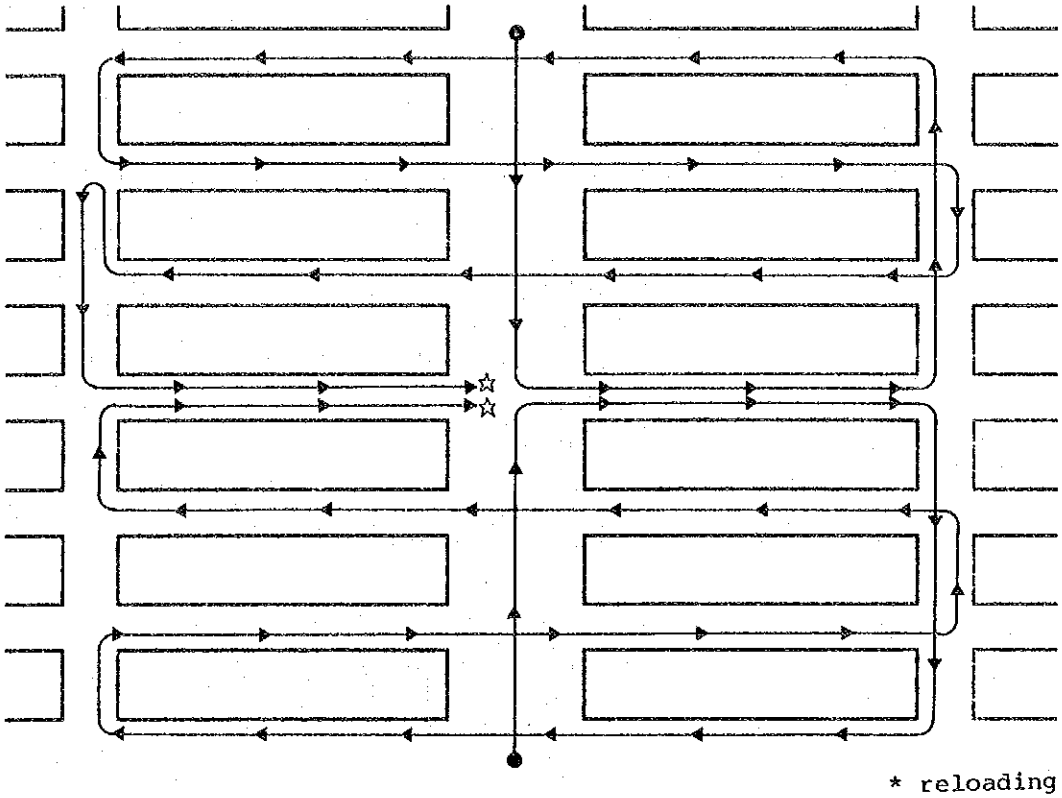
c. Street waste haulage

Street waste collected by the hand carts should be reloaded directly to haulage trucks. In this connection it is decided to adopt the two-barrel type hand cart, with the reasons leading to this decision mentioned later on.

The reloading place and time should be determined, and each sweeper should finish their work within the prescribed time, and should gather at the reloading place.

The haulage trucks should be manned with two workers, who shall take charge of reloading street waste collected by the sweepers to the haulage trucks.

The reloading places should be located taking into considerarion that the largest number of sweepers can finish their work at the reloading place as shown in the Fig. 5-1-17.



* reloading place

Fig. 5-1-17 TYPICAL SWEEPING ROUTE

d. Sweeping zone

Areas to be swept once a week should be divided in six even zones. Areas of twice a week and trice a week frequency should be divided in three and two even zones, respectively.

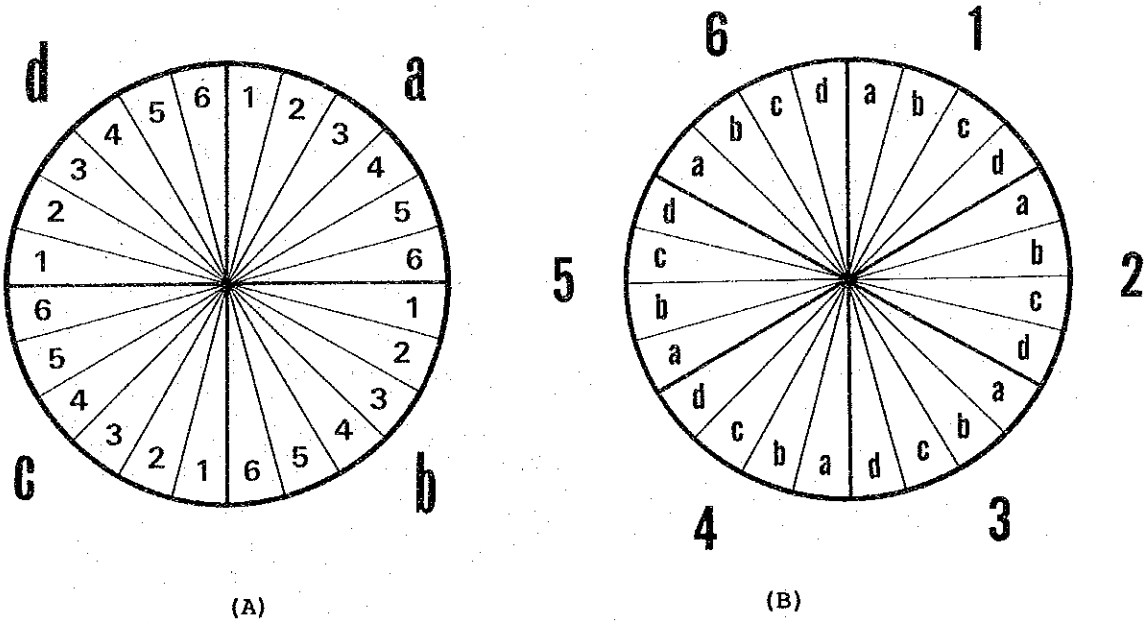


Fig. 5-1-18 METHODS FOR DIVIDING SERVICE AREAS

There are two possible methods for dividing the service area in even zones: (A) to divide the service area in even zones in the first place, followed by the allotment of the individual divided zone to the sweepers, and (B) allotment of the individual sweeping areas to the sweepers and arrangement of the said sweeping areas in even zones. The alternative (A) is adopted in this project in view of its advantages of reloading efficiency. As for the alternative (B), it has advantages regarding the allotment of individual work responsibility to the sweepers and easiness of arrangement of hand carts within the area in question.

(7) Working standard

In principle, the street sweepers shall work eight hours a day, from 6:00 to 14:00, but in reality a period of five actual working hours is regarded as appropriate, because there are many sweepers, including women, who do not have so much physical strength, and a prolonged sweeping work is very hard particularly during the summer season. The results of the experiments carried out in the summer 1985 confirm the appropriateness of these considerations.

On the other hand, when alloting zones to the sweepers, considerable attention should be paid to the fact that the work load differs conspicuously according to the street conditions. For example, in the main street of the City Center it is possible to allot a relatively long length because the amount of street waste is small due to the high frequency of cleaning work, and relatively good pavement condition. On the other hand, in the residential areas the sweeping length should be shorter considering the streets conditions.

Results of the street sweeping experiment carried out in 1985 and the study carried out in 1984 indicate that each sweeper can take charge of the undermentioned distances without strain during the working hours.

- Main street 1,200m
- Other streets 800m

(8) Litter bin

At present there are litter bins installed by the Women's Association along the streets of the commercial areas of the City Center, and it is expected that this service will be maintained also in the future. Waste thrown in these bins should be collected by sweepers.

(9) Equipments and apparatus to be provided

Equipments and apparatus to be used for manual street sweeping consist of brooms, baskets and hand carts. Brooms shall have hard tip because the street paving conditions are not so good, and those being used at present are regarded as appropriate, and should be adopted in this project as well. The tips of the brooms shall be changed thrice a year. As for the baskets, those made locally shall be used also hereafter, and each street sweeper shall be provided with 4 baskets per year.

Following three types of hand carts are being used at present.

- Two barrel hand cart ($0.11m^3$)
- Iron hand cart ($0.3m^3$)
- Wooden hand cart ($1m^3$)

Results of street sweeping experiment indicate that a sweeper can collect, if limited only to street waste, as much as 60kg waste per 800m (4-day interval), and this is just about the amount which can be loaded into a two-barrel hand carts. Incidentally it is expected to be reduced further as a result of the future evolution of the citizenry cooperation in this regard.

Therefore the two-barrel hand carts should be used as a standard cart in this project. In addition, this type is superior regarding the direct reloading into haulage trucks.

On the other hand, it is assumed that the vacuum type mechanical sweepers, which are being introduced at present, will be maintained in trunk roads.

As for the haulage of street waste collected by the sweepers, two-ton trucks shall be used for this purpose.

(10) Depots

At present, each one of the five sub-district areas is provided with the respective depots, and they are located at appropriate places from where sweeper can access on foot to the areas alloted to them. The locations of these depots should remain but the installation of shower rooms and locker rooms should be planned for the convenience of the sweepers.

(11) Introducing non-parking day

Non-parking day with limited area should be introduced once a month in each sweeping zone. Notice boards should be provided in the residential areas, and the non-parking days should be adjusted according to the sweeping frequency.

(12) Penalties

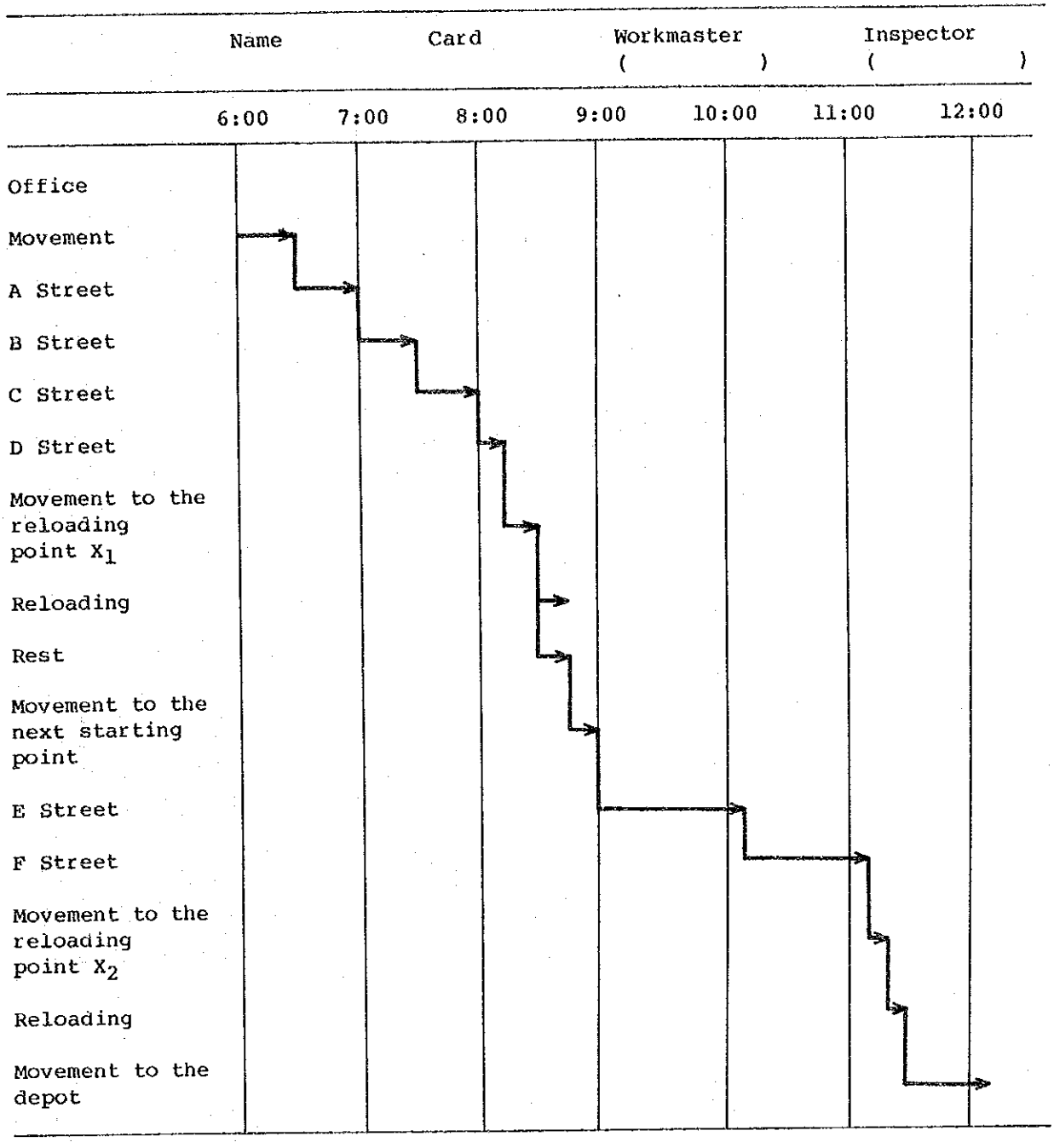
Citizenry consciousness against discharging waste on the streets is indispensable in order to reduce littering on the streets. The penalties (10 LE) applicable to the illegal discharging should be more strictly enforced.

(13) Inspection of street sweeping

Inspections are necessary to improve the work efficiency of the sweepers, and the work schedule for each sweeper should be drawn up as shown in Table 5-1-19, so as to undergo an effective inspection. The inspector can always be acquainted with actual sweeping conditions in conformity with the said schedule.

In addition to the aforementioned control measures, the zone alloted to the sweepers should be changed at regular intervals in order to give even working conditions to each sweeper.

Table 5-1-19 EXAMPLE OF STREET SWEEPING TIME SCHEDULE



3) Required number of manpower and equipments

The results of calculations referring to manpower and hand cart requirement for street sweeping are in the following:

(1) Premises for calculation

Street length by sweeping area and frequency are shown in Table 5-1-20.

Table 5-1-20 STREET LENGTH BY SWEEPING FREQUENCY

(km)

Sub-district	3 times/ day	Twice/ day	Once/ day	3 times/ week	Twice/ week	Once/ week
Attarin	6.7	2.6	54.6	0	7.3	0
Bab Sharki 8th	4.5	8.2	12.4	0	44.8	46.0
Bab Sharki 7th	0	2.3	2.8	0	0	45.1
Ghorbal 6th	0	3.2	3.2	32.5	27.0	0
Moharam Bey 7th	0	7.8	8.2	5.7	52.6	18.5
Total	11.2	24.1	81.2	38.2	131.7	109.6

The shift to the new street sweeping system should be applied in accordance with the staged plan shown in Table 5-1-21, because the improvement plan should be implemented concurrently with the waste collection service improvement.

Table 5-1-21 STAGED PLAN

Preparation	1988 - 1990	1991 - 1995	1996 - 2000
Preparation for the shift to the new system	Switching to the new system mainly in the City Center, such as Attarin Bab Sharki 8th and a part of Bab Sharki 7th	Switching to the new system in the other areas	Total application of the new system

(2) Sweepers and Equipments

The numbers of sweepers and carts to be alloted to the each sweeping area are shown in Table 5-1-22.

Table 5-1-22 SWEEPERS AND CARTS

(person, unit)

	1985 -		1990 -		1995 -		2000 -	
	Sweepers	Carts	Sweepers	Carts	Sweepers	Carts	Sweepers	Carts
Attarin	101	38	110	110	110	110	110	110
Bab Sharki 8th	111	57	81	81	81	81	81	81
Bab Sharki 7th	61	25	40	32	19	19	19	19
Ghorbal 6th	58	11	58	11	35	35	35	35
Moharam Bey 7th	141	46	141	46	59	59	59	59
Total	472	177	430	280	304	304	304	304

The number of haulage trucks for street waste and its purchasing schedule until 2000 are shown in Table 5-1-23.

Table 5-1-23 NUMBER OF HAULAGE TRUCKS AND DRIVER

(unit)

	1990	1995	2000	Total	Remarks
No. of haulage trucks	3	5	5	-	2-ton trucks
Purchasing number	3	5	5	13	
No. of drivers (person)	3(4)	5(6)	5(6)	-	

Note: Figures enclosed within parenthesis indicate number of drivers including those of mechanical sweepers.

Purchasing schedule of cart is shown in Table 5-1-24.

Table 5-1-24 NUMBER OF HAND CARTS

(unit)

	1985	86	87	88	89	90	91	92	93	94
Nos. of Carts	35	35	36	35	36	138	35	36	35	36

	1995	96	97	98	99	2000
Nos. of Carts	162	35	36	35	36	162

As for vacuum-type mechanical sweepers, one unit will be replaced in 1990, 1995 and 2000 respectively.

The numbers of brooms and baskets shall be replaced each year, and their annual requirements are shown in Table 5-1-25.

Table 5-1-25 NUMBER OF BROOM AND BASKET

(set)

Equipment	1990	1995	2000
Broom (Changeable tip type)	1,290	912	912
Basket	1,720	1,216	1,216

5.1.5 Contents of Project for Waste Collection Haulage and Street Sweeping

1) Principal target of the project

Under the project, necessary equipments and facilities shall be procured and constructed for the following programs:

a. Establishment of new waste collection system
b. Construction of transfer station
c. Reorganization of street sweeping system

Together with the above-mentioned programs being performed, the waste collection system shall be changed to a single-shift system and eventually a higher operating rate of collection vehicles shall be achieved through the improvement of vehicle maintenance.

2) Establishment of new waste collection system

The new waste collection system shall be established taking into consideration of characteristics of areas and waste discharge methods.

a. Residential area

Each household uses plastic bags for their waste discharging. All wastes shall be discharged to the designated place (waste station) in a specified time. The waste discharged to the station shall be collected by medium-sized compactor vehicle.

b. City Center

A rule shall be established that waste shall be discharged in a plastic bag at the entrance or the corners of buildings during a specified time. The discharged waste shall be collected by light trucks and the collected waste shall be reloaded into medium-sized compactor vehicles for haulage to the landfill site.

c. Market place

A completely separate waste collection system from common household shall be established for market place and medium-sized compactor vehicles shall be used for waste collection.

d. Special facilities

Special facilities including schools, hospitals and railway stations shall be provided with communal containers and collected by container vehicles.

e. Beach side

Wastes on the beach side shall be collected by special trucks with mounted a crane.

These new waste collection systems will be gradually established in the whole of Middle District and the target year is fixed for respective area, by 1990 for northern area and 1991 through 1995 for southern area basically.

However, in the low income area within the District, the new waste collection system will be realized by the end of this century.

The number and types of equipments and workers needed for these systems are shown in Table 5-1-26 and 5-1-27.

Table 5-1-26 EQUIPMENT NEEDED FOR THE NEW WASTE COLLECTION SYSTEM

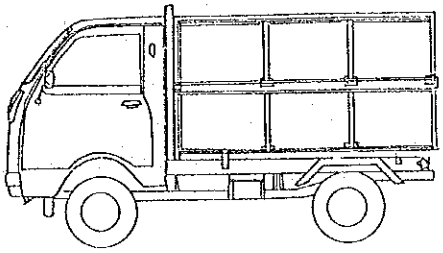
(unit)

	1990	1995	2000
Northern area			
Vehicles			
Compactor-vehicle	16	19	23
Light truck	11	13	15
Container vehicle	2	2	2
Special Truck for beach side	1	1	1
Total	30	35	41
Communal container	40	40	40
Southern area			
Vehicles			
Compactor vehicle	8	29	42
Container vehicle	0	2	2
Total	8	31	44
Communal container	0	55	55

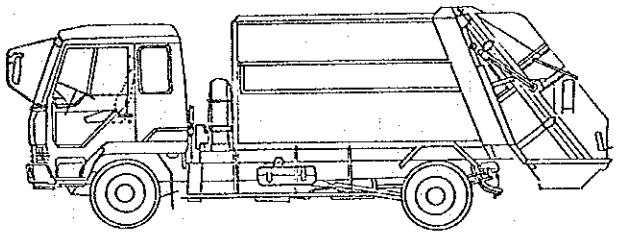
Table 5-1-27 NECESSARY WORKER FOR NEW COLLECTION SYSTEM

(person)

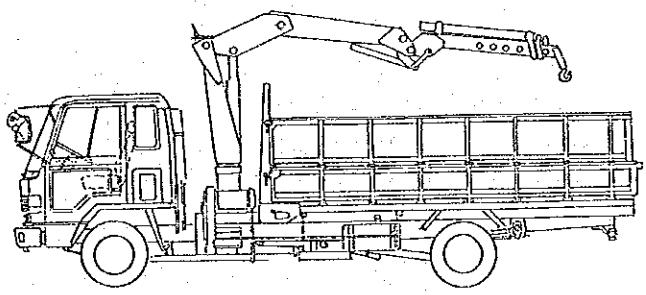
	1990	1995	2000
Northern area			
Driver	29	35	40
Worker	92	107	126
Total	121	140	166
Southern area			
Driver	8	30	45
Worker	32	121	175
Total	40	151	220



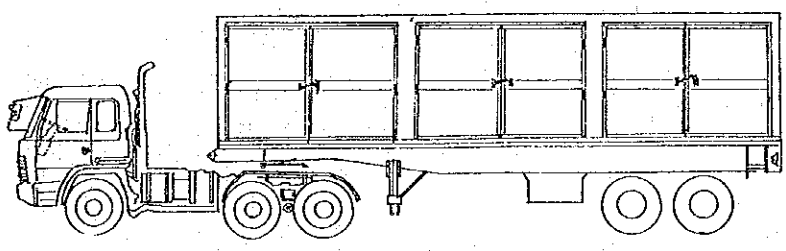
Light Truck



Compactor Vehicle



Special Truck



Truck Tractor/Semitrailers

Fig. 5-1-19 VEHICLES FOR COLLECTION AND HAULAGE

For reference, the number and type of equipments and personnel needed in 1990 and 1995 under the current waste collection system would be as shown in the following Table 5-1-28.

Table 5-1-28 EQUIPMENT AND WORKER REQUIRED UNDER THE CURRENT SYSTEM (SOUTHERN AREA)

(unit)

	1990	1995
Vehicles		
Container vehicle	9	4
Small-sized dump tuck	8	0
Large-sized dump truck	14	0
Total	31	4
Communal container	290	135
Manpower (persons)		
Driver	32	4
Worker	90	129

Since a rather long time is needed for establishing the new system completely, the program shall be divided into two stages and required number of equipments shall be fixed as shown in Table 5-1-29 by the end of each stage.

Table 5-1-29 EQUIPMENT NEEDED FOR NEW COLLECTION SYSTEM

(unit)

	1st stage 1990	2nd stage 1991-2000
Compactor vehicle	24	41
Container vehicle	2	2
Light truck	11	4
Special truck	1	0
Total	38	47
Communal container	40	55

3) Construction of transfer stations

The transfer stations shall be constructed for long haul distance of waste after MBSDS is completed. Facilities, equipments and workers for the transfer station are shown in Table 5-1-30.

Table 5-1-30 OUTLINE OF TRANSFER STATION

Waste amount to be handled (planned)	Normal day	480 tons	5-hour operation
	Non-operation of the compost plant	938 tons	10-hour operation
Area of site		12,000 m^2	
Dumping stage		2 units	(4 vehicles can be handled at once)
Platform		5 m height with area: 1,650 m^2	
Size of hopper		6 m width x 3 m depth	
Truck scale		30t x 2 units	
Storage area		600 m^2	
Trailer parking area		800 m^2	

The number of equipments by type for the transfer station during 1990 - 1994 is shown in Table 5-1-31 and the number of workers is shown in Table 5-1-32.

Table 5-1-31 EQUIPMENTS FOR TRANSFER STATION

(unit)

	1990	1995	2000	
Truck tractor	11	12	12	Diesel-driven, max. output 320 HP
Semitrailer	11	12	12	Loading volume: 60 m^3
Wheel-loader	4	5	5	Backet volume: 2.3 m^3, max. output: 100 HP
Large-sized dump truck	6	7	7	Diesel-driven, loading volume: 8 m^3

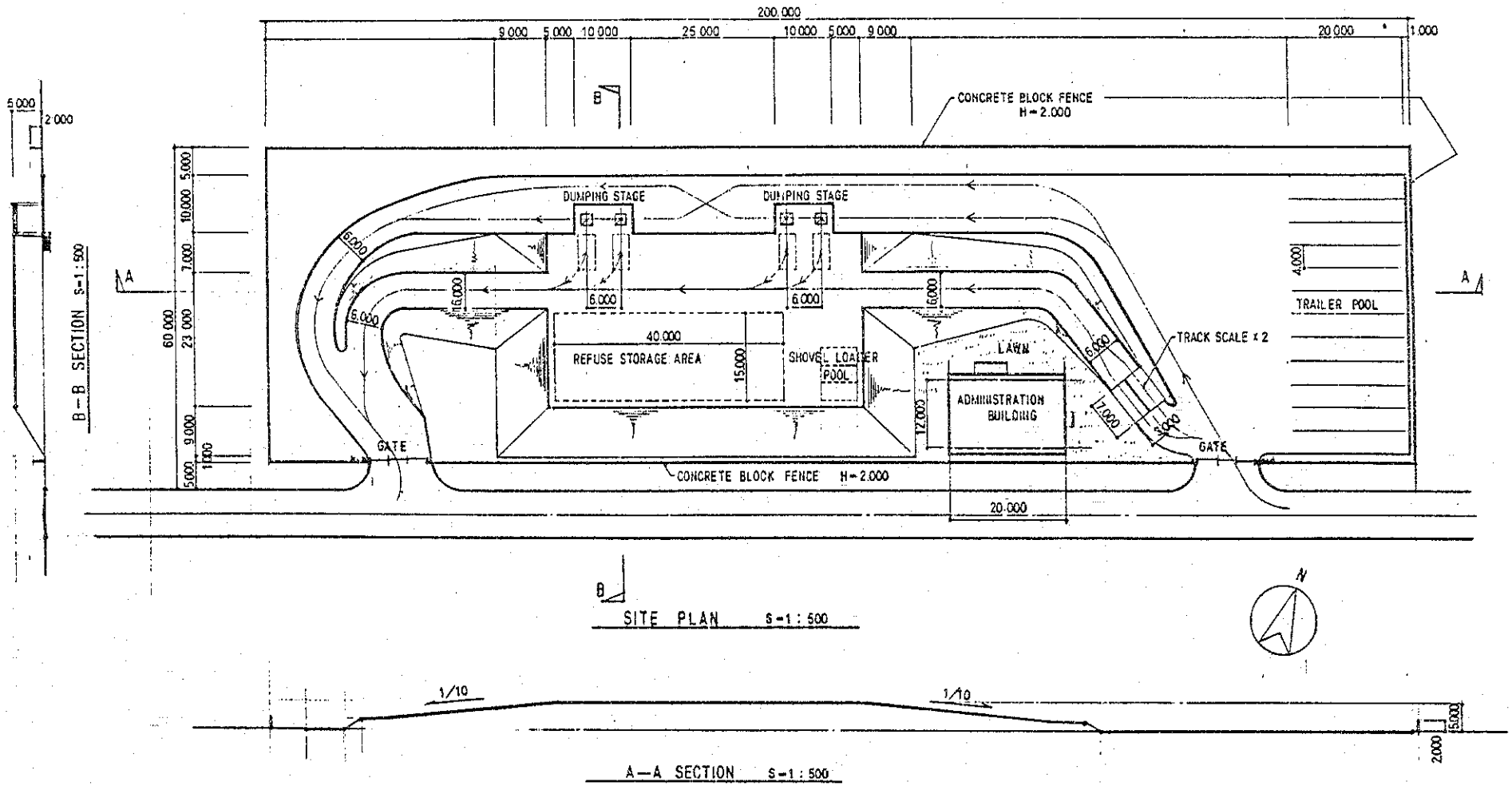


Fig. 5-1-20	TRANSFER STATION PLAN

THE FEASIBILITY STUDY ON REFUSE COLLECTION, TREATMENT AND DISPOSAL IN ALEXANDRIA

Table 5-1-32 WORKERS FOR TRANSFER STATION

(person)

	1990	1995	2000
Managerial staff	2	2	2
Engineer and Technician	3	3	3
Driver	22	24	24
Worker	11	15	15
Office Clerk	5	5	5
Total	43	49	49

The facilities and equipments for transfer stations shall be provided by the end of each stage as shown in Table 5-1-33:

Table 5-1-33 FACILITIES AND EQUIPMENTS FOR TRANSFER STATION

(Unit)

	1st stage 1990	2nd stage 1991-1992
Transfer Station	1	-
Truck tractor	11	1
Semitrailer	11	1
Wheel-loader	4	1
Large-sized dump truck	6	1

4) Reorganization of street sweeping system

The street sweeping system shall be reorganized independently from the waste collection system in the following scheme:

a. For main streets and city center area

Street sweepers shall, one to three times a day, clean the streets using a broom and a 2-barrel type hand cart. The collected waste from the streets shall be reloaded on small-sized dump trucks.

b. For residential area

Street sweepers shall, one to three times a week, clean the street in the same manner as a mentioned above.

The proposed program of street sweeping shall be gradually expanded in parallel with the collection system and shall be completed by the end of 1990 for northern area and from 1991 to 1995 for southern area.

The number of workers and equipments by type for street sweeping are shown in Table 5-1-34 and 5-1-35.

Table 5-1-34 EQUIPMENTS FOR IMPROVEMENT OF STREET SWEEPING SYSTEM

(unit)

	1990	1995	2000
Northern sub-District			
2-barrel hand cart	191	191	191
Small-sized dump truck	3	3	3
Southern sub-District			
2-barrel hand cart	0	113	113
Small-size dump truck	0	2	2

Table 5-1-35 NUMBER OF SWEEPERS AND DRIVERS FOR IMPROVEMENT OF STREET SWEEPING SYSTEM

(person)

	1990	1995	2000
Northern area			
Sweeper	191	191	191
Driver	3	3	3
Southern area			
Sweeper	0	113	113
Driver	0	2	2

For reference, the number of workers and equipments needed for the southern area in 1990 if the new system is not introduced are shown in Table 5-1-36.

Table 5-1-36 WORKERS AND EQUIPMENT NEEDED IN SOURTHERN AREA

	1990	Remark
Southern area		
Hand cart	89 units	
Sweeper	239 persons	
Main road		
Mechanical sweeper	1 unit	Mechanical sweeping will be continued by 2000
Driver	1 person	

Procurement of the equipments will be made in two stages and the required number of equipments as of the end of each stage is shown in Table 5-1-37.

Table 5-1-37 EQUIPMENTS FOR IMPROVEMENT OF STREET SWEEPING SYSTEM

(unit)

	1st Stage - 1990	2nd Stage 1991 - 2000
Hand carts	191	113
Small-size dump trucks	3	2

5.1.6 Organization and Management Plan

1) *Organization*

The project for waste collection haulage and street sweeping indispensably requires strengthening of organizational structure for supporting its effective operation and the result of the project totally depends upon whether or not such organizational strengthening would be achieved.

In this connection, the following program will be proposed for organizational strengthening of the District Cleansing Office of the Cleansing Authority which is in charge of execution of waste collection and street sweeping duties.

The transfer stations contemplated under this project will be controlled directly by Central Office of the Cleansing Authority not by District Cleansing Office.

(1) The Chief of District Cleansing Office shall be given rather expanded powers and have some engineers under his command.
(2) District Garages will be under the control of the Chief of District Cleansing Office.
(3) The administration departments will be under the leadership of the Chief of District Cleansing Office and such departments are shown in Fig. 5-1-21.

The functions to be performed by the departments and sections respectively will be shown in Table 5-1-38.

The organization of District Garage, which is very important for proper maintenance of vehicles, shall be structured as shown in Fig. 5-1-22.

Following points will be considered in structuring District Garage organization:

- Preventive maintenance shall be made once a month for all vehicles at a rate of units per day. In case of 80 units of vehicle and 4 units/d preventive maintenance execution, 20 days per month is necessary. Remaining 5 days will be allocated to preparatory maintenance work.

- The employees in charge of vehicle repair shall be divided into four teams, each consisting of three repair workers.

- Since repair worker is so busy with preventive maintenance of vehicles, lubrication and greasing shall be undertaken by another section.

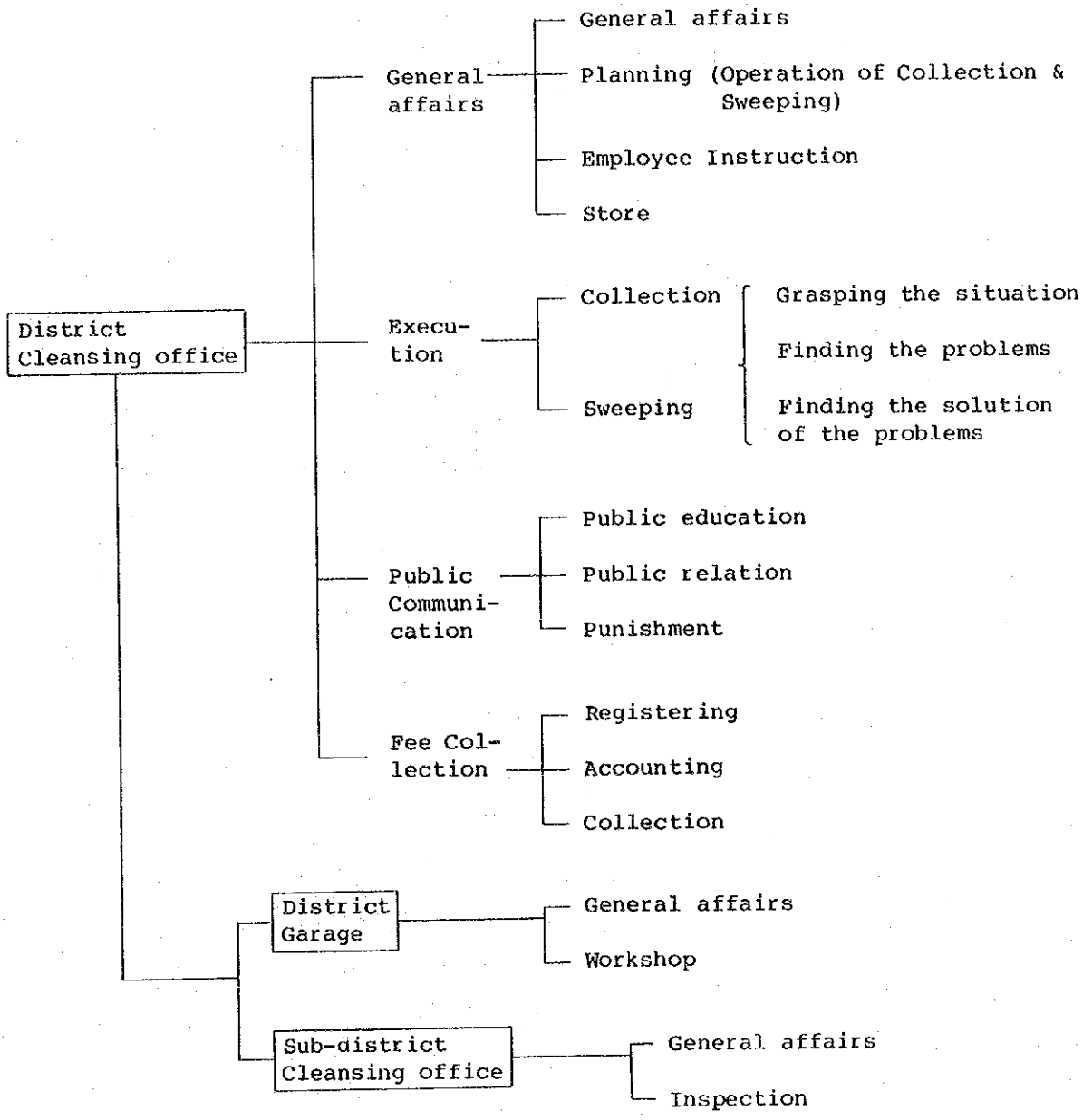


Fig. 5-1-21 THE ORGANIZATIONAL STRUCTURE OF DISTRICT CLEANSING OFFICE

Table 5-1-38 FUNCTION OF EACH SECTION

Department/Section	Function
1. Chief and Assistant Chief	. Overall management of District Cleansing Office . Decision making on important matters
2. General Affairs Dept.	
- General Affairs Section	. Negotiations with outside bodies . Complaint procedure . Confirmation of attendance and non-attendance of employees, approval for leaves . Ceremonial matters of District Cleansing Office
- Planning Section	. Planning for execution of waste collection and street sweeping . Manning of work force . Planning of waste collection zones and passing route of vehicles . Planning of equipment procurement . Evaluation of work effciency . Planning of improvement programs
- Employee Instruction Section	. Instruction and training of employees . On-the-job training
- Store Section	. Storage of materials, equipments, tools and spare parts . Recording of goods' coming and going
3. Execution Dept.	
- Collection Section - Sweeping Section	. Daily confirmation of cleansing . Finding-out problems if any . Taking emergency measures for problems found

Department/Section	Duties
4. Public Communication Dept.	
- Public Education Section	. Preparation of materials for instruction including video tapes . Instructing . Issuing publicity papers . Patrolling . Collection of fine
5. District Garage	
- Chief Engineer	. Evaluation of vehicles' working condition (for decision of disuse) . Mechanical diagnosis of vehicles . Administration . Preparation of historical records of maintenance and troubles of vehicles . Maintenance of vehicles . Repair of troubled and damaged parts of vehicles . Control and management of spare parts . Control and management of fuel
6. Sub-District Cleansing Office	
- General Affairs Section	. Administration
- Inspection Section	. Patrolling . Supervising of waste collection and street sweeping jobs

Note: Fee collection, cleansing of public toilets, beach side, etc. are not mentioned in this table.

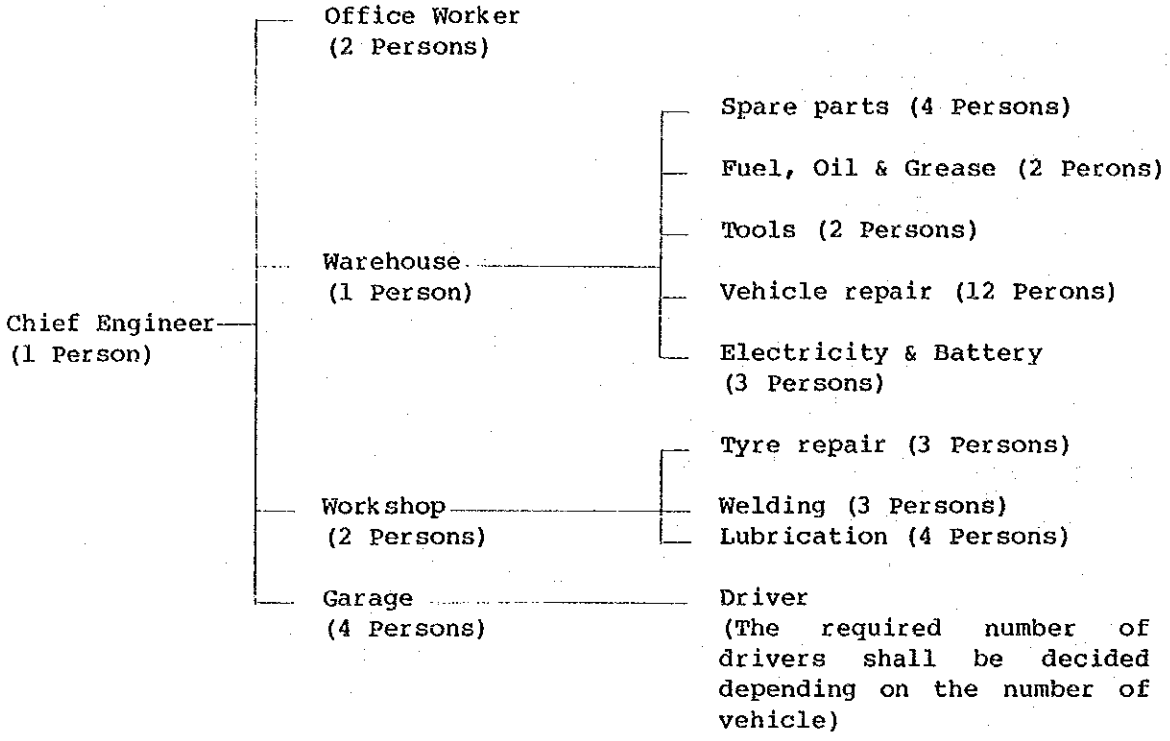


Fig. 5-1-22 ORGANIZATION OF MIDDLE DISTRICT GARAGE

2) Personnel

The personnel needed for waste collection and street sweeping are summerized in Table 5-1-39.

Table 5-1-39 PERSONNEL REQUIRED FOR WASTE COLLECTION AND STREET SWEEPING

(person)

	Drivers	Garage	District Cleansing Office				Total
			Inspec-ter	Work-master	Collection worker	Sweeper	
1985	40	(15)*	12	48	131	570	816
1990	75	20	12	50	214	430	801
1995	75	22	13	52	240	304	706
2000	91	22	14	54	301	304	786

* Figure in parenthesis is not confirmed.

Notes 1: A considerable decrease of workers especially for street sweeping is expected through introducing the new waste collection and street sweeping system in the Middle District by 1995.

2: The office clerks and staff shall be discussed in the Chapter 8, of "Organization and Finance of the Cleansing Authority".

The number of sweepers and collection workers by Sub District Cleansing Office are shown in Table 5-1-40.

Table 5-1-40 NUMBER OF SWEEPERS AND ASSISTANTS BY SUB-DISTRICT CLEANSING OFFICE

(person)

Sub-District Cleansing Off.	1985			1990			1995			2000		
	W	S	T	W	S	T	W	S	T	W	S	T
Attarin	28	101	129	64	110	174	73	110	183	88	110	198
Bab Sharki 8th	25	110	135	28	81	109	34	81	115	38	81	119
Bab Sharki 7th	16	61	77	28	40	68	38	19	57	43	19	62
Ghorbal 6th	20	58	78	16	58	74	18	35	53	19	35	54
Moharam Bey 7th	29	141	170	78	141	219	77	59	136	113	59	172
Total	118	472	600	214	430	644	240	304	544	301	304	605

Note: W - Collection Worker, S - Sweeper, T - Total

3) Maintenance

(1) Recording and analysis of maintenance history

Recording and analysis of maintenance history is always extremely important for proper maintenance of vehicles. Following documentary work should be done at each section.

a. Chief Engineer:
   - Preparation of garage management schedule for the year
   - Summing-up and keeping of monthly reports from each department
   - Preparaton of an annual report regarding the management result

b. Work Shop Chief: to submit its monthly report to Chief Engineer
   - Preparation of monthly maintenance program and monthly follow-up report
   - Preparation and keeping of maintenance history for every unit vehicle owned by District Garage (for grasping the working conditions of vehicles)
   - Preparation and keeping of Maintenance Check List for quick reference of maintenance history
   - Preparation and keeping of report on troubles and damages and repair work done therefor.
   - Summing-up of monthly working reports from Mechanics
   - Checking the stock of spare parts reported by Mechanics and transfer the certified request to Warehouse Chief

c. Mechanics: to submit its report and request to Workshop Chief
   - Preparation of daily working report
   - Checking performed maintenance work using Maintenance Check List and reporting thereof
   - Reporting of the content of repair work for troubles or damages if any
   - Preparation of the request for spare parts, lubricant oil and grease to be supplied and tools to be lent.

d. Warehouse Chief: to submit its monthly report to Chief Engineer
   - Preparation of monthly purchasing schedule for spare parts, lubricant and fuel oil

- Summing-up of consumed quantity and stock of spare parts, lubricant and fuel oil within one month and keeping the data
- Stock-taking for every half or one year and confirmation of actual stock and optimum stock
- Preparation and keeping of a register book for spare parts (The amount of spare parts shall also be written in the register book.)

  Remark: Spare parts enough for three to six months maintenance work will be needed for District Garage.

l. Parts Stock: to submit its report to Warehouse Chief
- Recording of daily coming and going of spare parts and confirmation of the stock
- Confirmation of daily going spare parts and preparation of a request for spare parts to be supplied
- Proper inventory management

f. Fuel Oil and Grease: to submit its report to Warehouse Chief
- Recording of daily coming and going of fuel oil and greases and confirmation of the stock
- Confirmation of monthly consumption of fuel oil and grease and preparation of a request for fuel oil and grease to be supplied
- Proper management of fuel oil and grease consumption by inventory register book

g. Tool Room: to submit its report to Warehouse Chief
- Recording and controlling stock number of all the tools and any damages thereof by tool register book
- Control of tools lending by tool lending book
- Preparation of a request for replacement of damaged tools

h. Garage Chief: to submit its report to Chief Engineer
- Preparation of monthly report on vehicles' working conditions
- Preparation of a request for maintenance and repair of vehicles in trouble or damage, and transfer the request repairs to the Workshop Chief
- Checking and keeping of drivers' daily working and maintenance reports

i. Driver: to submit its report to Garage Chief
   - Preparation of daily working and maintenance reports
   - Reporting the details of any troubles immediately

j. Office Clerk: to submit monthly report to Chief Engineer
   - Administration for Garage management

(2) Standard for parts change

Preventive change of parts is imperative for proper maintenance and safety and a standard for parts change suitable to the vehicles' working conditions in Alexandria shall be established based upon the following maintenance guidance:

a. Parts to be periodically changed within a shorter period of time (every five to thirty days)
   - Filters
     (air filter, lubricant filter, fuel oil filter, cooling water filter, hydraulic filter)

b. Parts to be changed every one year
   - Parts to be easily worn out (tires, v-belts)

c. Parts to be changed every two years
   - Parts for brake system
     (brake lining, head of master cylinder and oil cylinder, dust seal, rubber seal of air brake)
   - Battery and water hose (inspection and change)

d. Parts to be changed every four years
   - Brake system, hydraulic equipment and hose of fuel supply line
   - Main clutch disc.
   - Thorough overhaul and change of internal parts (starter motor, oil meter, water pump, etc.)

e. After 5 year operation, maintenance work will be decided depending upon the working conditions and the expected life of vehicles.

(3) Stock management of spare parts

A proper stock management of spare parts is absolutely necessary for proper maintenance of vehicles. A non-scheduled procurement of spare parts may result in excessive stock for particular parts and adversely affect the total management of Workshop. Therefore, a delivery-upon demand system should be established for spare parts supply based upon the optimum stock and adequate quality control in the following manner.

a. To confirm the optimum stock for the existing vehicles judging from the historical data on the consuming rate of spare parts per vehicle.
b. To control and manage stock by a spare parts register book (notebook type or visible card type)
   Remark: All the parts shall be given code number and name, and purchasing price, purchased amount, as well as stock amount and the price thereof shall be recorded.
c. To carry out stock-taking every half or one year and the data obtained therefrom to be utilized for confirmation of actual stock amount, optimum stock and for planning of parts purchasing.
d. Supplemental spare parts after stock-taking to be done within every half or one year.

(4) Training for maintenance personnel

Following materials shall be prepared for training of maintenance personnel so that their technical knowledge and know-how can be improved:

- program for execution of periodical maintenance
- operation manuals for proper handling of machineries, equipments and tools for the maintenance
- education program for basic maintenance technics and vehicles' mechanics
- data collection at maintenance and repair work and the effective utilization thereof
- check list for vehicles' working conditions for determination of disuse

4) Public communication

Another important aspect for the success of this project is better understanding and cooperation of the citizens.

The main reasons why the great effort exerted in cleansing services by the executive agency has not been satisfactorily rewarded are the weak publicity and nonreliable cleansing services. Therefore, much understanding on cleansing services shall be secured through public communication in addition to establishing a reliable cleansing operation.

The proposed public communication aims primarily at obtaining better understanding and cooperation of citizens on the following points.

- enhancing the effectiveness of waste collection service
- keeping cleanness and healthy conditions on the streets and at the waste discharging stations
- getting rid of people's scorning attitude towards cleansing jobs and cleansing workers
- getting approval of citizens for provision of cleansing facilities
- decreasing waste amount at its generating source by recovery of reusable materials
- reducing unnecessary cost and expenses for cleansing jobs

One of the most important things in performing public communication is that such public communication shall be repeated and implanted in people's mind for their future habit. In this connection, since any effect can not be expected immediatly, all public communication program will be consistently and repeatedly performed.

Followings are the proposed programs for education and enlightenment on cleansing jobs.

(1) Education of citizens

- preparation of materials for instruction book and public health education to primary school pupils

- preparation and distribution to citizens of booklets on cleansing jobs
- preparation of an annual report on cleansing jobs (to be available to people upon demand)
- broadcasting a radio program for enlightenment
- holding meetings for explanation and opinion exchange on cleansing jobs (to be proposed to various society groups)

(2) Guidance to citizens and periodical campaign

- conducting several week-long campaigns for cleansing operation at some model areas in spring and autumn (cooperation of citizens is requested for reducing waste amount, waste discharging manner, keeping cleanness of towns and the stricter order is enforced during the campaign period.)
- preparation of posters, badges, mascot dolls, etc. for the campaign, conducting on-the-street campaign by radio broadcasting and publicity cars and holding town meetings
- clearer indication of waste discharging station and waste discharging procedures by way of panels
- preparation and distribution of leaflets instructing procedures for waste discharging
- periodical patrolling for inspecting waste discharging manner and cleanness of areas, instructing to citizens and stricter watching for violating actions

5) Replacement of Equipment

Equipments for waste collection such as collection vehicles, communal container, hand cart and so on, will be replaced according to their life time. Their number to be replaced are shown in Table 5-1-41.

Table 5-1-41 REPLACEMENT OF EQUIPMENT

(unit)

	1986-1990	1991-1995	1996-2000
Vehicles for waste collection			
Compactor vehicle	0	24	48
Container vehicle	9	6	4
Light trucks	0	11	13
Small-sized dump trucks	8	0	0
Large-sized dump trucks	11	0	0
Special trucks	0	1	1
Total	28	42	66
Equipments for transfer station			
Truck tractors	0	10	12
Trailers	0	10	12
Wheel loaders	0	4	5
Large-sized dump trucks	0	6	7
Equipments for street sweeping			
Small-sized dump trucks	0	3	5
Mechanical sweepers	1	1	1
Hand carts	89	191	304
Communal container	167	40	84

5.1.7 Estimation of the Project Cost

The project cost will be separately estimated for the construction and procurement and for the operation and management of the project. Spare parts for 2-year operation is included within the equipment purchasing cost.

1) Waste collection, haulage and street sweeping

The equipment procurement cost excluding replacement amounts to 4,300,700 LE in total by the target year consisting of 1,687,100 LE for the 1st stage and 2,613,600 LE for the 2nd stage as shown in Table 5-1-42.

Table 5-1-42 EQUIPMENT PROCUREMENT COST FOR WASTE COLLECTION AND STREET SWEEPING

(1,000 LE)

	1st Stage			2nd Stage		
	Foreign	Local	Total	Foreign	Local	Total
Compactor-vehicle	1,152.0	0	1,152.0	1,968.4	0	1,968.4
Light truck	47.0	0	47.0	17.5	0	17.5
Container vehicle	160.0	0	160.0	160.0	0	160.0
Special truck	28.0	0	28.0	0	0	0
Small-sized dump truck	45.0	0	45.0	97.0	0	97.0
Hand cart	0	25.0	25.0	0	16.0	16.0
Communal container	0	10.0	10.0	0	13.8	13.8
Total	1,432.0	35.0	1,467.0	2,242.9	29.8	2,272.7
Spare part	143.2	3.5	146.7	224.3	3.0	227.3
Engineering Service	71.6	1.8	73.4	112.1	1.5	113.6
Grand Total	1,646.8	40.3	1,687.1	2,579.3	34.3	2,613.6

The annual operation cost for waste collection and for street sweeping is expected as shown in Table 5-1-43. The cost per ton of collected waste is 8.1 LE in 1990 and 8.3 LE in 2000 respectively. The total cost per capita is 2.23 LE in 1990 and 2.62 LE in 2000.

Table 5-1-43 ANNUAL PROJECT OPERATION COST FOR WASTE COLLECTION AND STREET SWEEPING

(1000 LE)

	1990	2000	Remarks
Waste collection			
Depreciation	535.0	704.3	5-year depreciaion with 10% residual value
Expenditures for spare parts and repairs	216.2	284.6	
Fuel expense	45.0	58.0	
Personnel expenditures	478.1	642.8	
Total	1,274.3	1,689.7	
Cost per collected per ton (LE/t)	8.1	8.3	
Cost per capita (LE/year)	1.66	2.13	
Street sweeping			
Depreciation	41.0	47.0	
Expenditures for spare parts and repairs	17.6	20.8	
Fuel expense	5.0	6.0	
Expenditures for fittings	11.0	8.0	
Personnel expenditures	369.8	308.8	
Total	444.4	390.6	
Cost per capita (LE/year)	0.57	0.49	

2) Transfer station

The construction and procurement cost for facilities and equipment for the transfer station are shown in Table 5-1-44. The total amount of the project cost is 3,743,500 LE consisting of 3,468,000 LE for the 1st stage and 275,500 LE for the 2nd stage.

Table 5-1-44 CONSTRUCTION AND PROCUREMENT COST FOR TRANSFER STATION

(1000 LE)

	1st Stage			2nd Stage		
	Foreign	Local	Total	Foreign	Local	Total
Facility construction cost						
Building	278.9	653.2	932.1	0.	0	0
Machinery and other outfittings	103.2	18.2	121.4	0	0	0
Engineering Service	26.7	47.0	73.7	0	0	0
Physical Contingency	45.6	62.4	108.0	0	0	0
Total	454.4	780.8	1,235.2	0	0	0
Truck Tractors	797.5	0	797.5	72.5	0	72.5
Semitrailers	638.0	0	638.0	58.0	0	58.0
Wheelloader	290.0	0	290.0	73.1	0	73.1
Large-sized dump trucks	216.0	0	216.0	36.0	0	36.0
Spare parts	194.2	0	194.2	23.9	0	23.9
Engineering Service	97.1	0	97.1	12.0	0	12.0
Total	2,232.8	0	2,232.8	275.5	0	275.5
Grand Total	2,687.2	780.8	3,468.0	275.5	0	275.5

The annual operation cost for transfer station is summerized in Table 5-1-45 and the cost per ton of handled waste amounts to 3.1 LE in 1990 and 2.5 LE in 2000.

Table 5-1-45 ANNUAL PROJECT OPERATION COST FOR TRANSFER STATION

(1000 LE)

	1990	2000
Depreciation		
Building	36.6	36.6
Truck scale and other facilities	9.5	9.5
Vehicles	401.9	451.5
Sub-total	448.0	497.6
Expenditures for spare parts and repairs	178.6	200.6
Fuel expense	39.0	62.0
Personnel expenditures	83.0	93.4
Total	748.6	853.6
Cost per ton of treated waste (LE/year)	3.1	2.5

Note: The transfer station will receive waste from Middle, Gomrok and a part of West Districts.
The total amount of waste received by the transfer station is expected to be 665 t/d in 1990 and 938 t/d in 2000.

5.1.8 Process for Realization of Project

Necessary items to be developed and measures have to be timely taken for successful launching of the improvement project by 1990. Time schedule by necessary item is shown in Fig. 5-1-23.

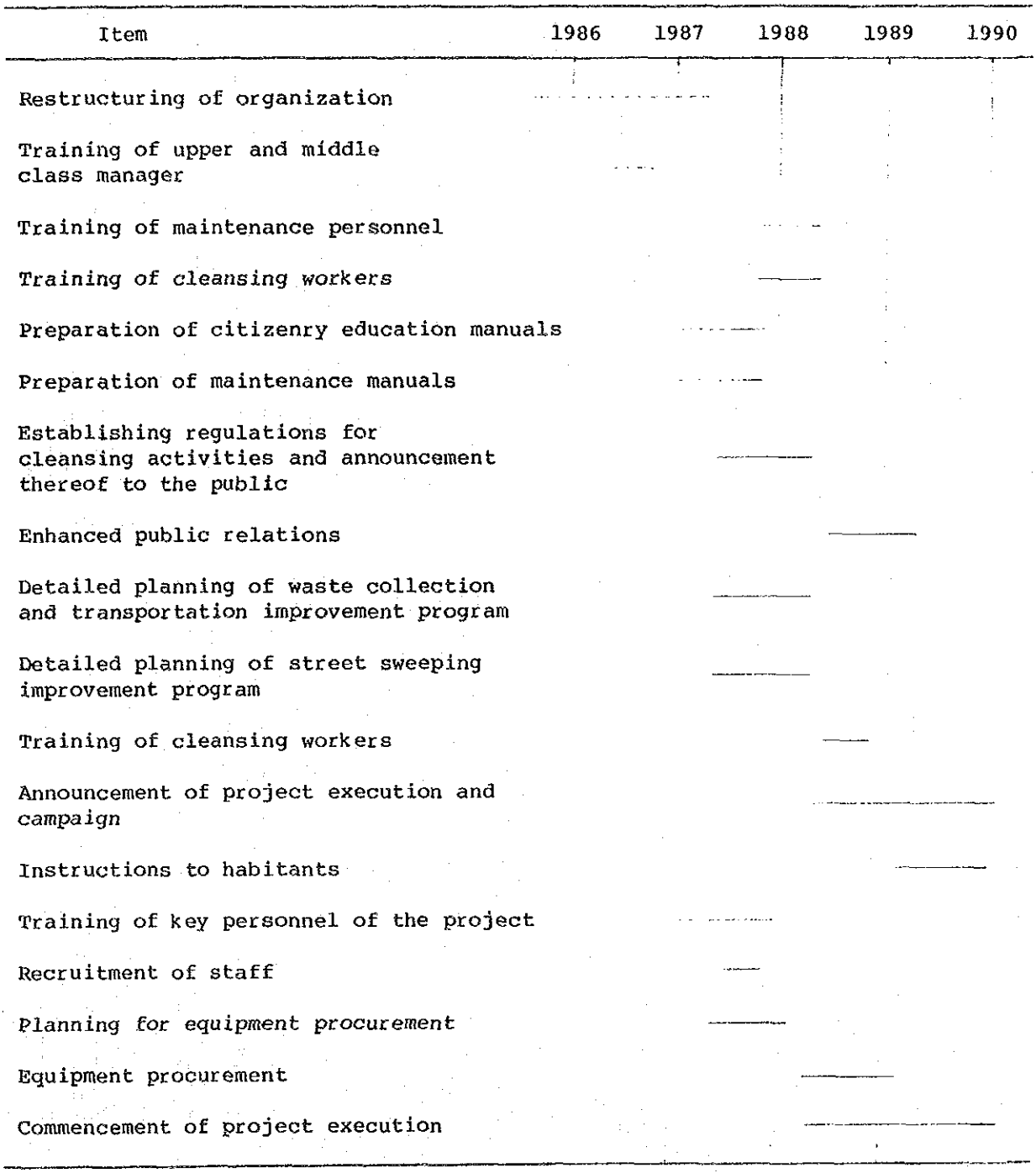


Fig. 5-1-23 SCHEDULE OF THE IMPROVEMENT PROJECT FOR COLLECTION AND STREET SWEEPING IN THE 1ST STAGE

The proposed time schedule for construction of transfer station is shown in Fig. 5-1-24. The location of the final disposal site to be used after 1990 shall be decided for detailed planning of the transfer station project.

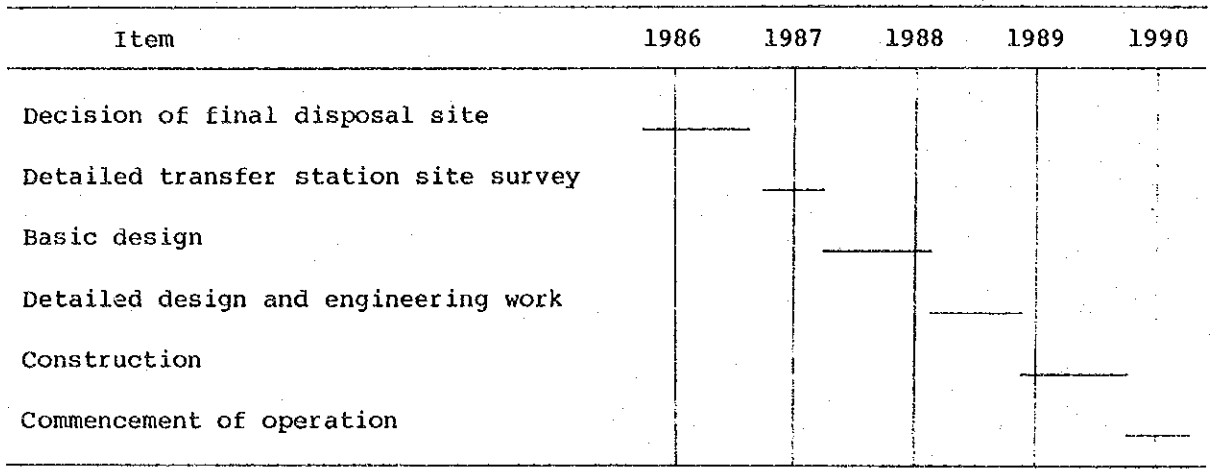


Fig. 5-1-24 CONSTRUCTION SCHEDULE OF TRANSFER STATION

5.2 Moharam Bey Square Disposal Site (MBSDS) Construction Project

5.2.1 Planned Disposal Amount and Landfilling Period

1) Planned service area

For the time being, MBSDS has been selected as a final disposal site. The site is located at the outskirts of the city, at the southern extremity of the Middle District. The site is used for final disposal by landfilling of municipal waste generated in three districts of the city, by taking into consideration of its the location. The planned service area consists of the undermentioned districts.

- Middle District
- Gomrok District
- Part of the West District

2) Estimation of the planned disposal amount

The amounts of waste discharged in 1985 from the three districts above-mentioned are concluded in the section 3.2 of the Master Plan as shown below. In reality, the said amounts are practically the same as actually disposed of by landfilling at present (Refer to section 2.12 of the S.R.).

- Middle District: 396 t/d
- Gomrok District: 196 t/d
- A part of the West District: 86 t/d

The amount of waste discharged from these three districts by the end of 1990, when the new Abis Compost Plant is planned to start its operation, amounts to 1,141,000 t/year. (Refer to S.R. Table 4-2-3 and Section 3.1 or 4.2). The amount of waste generated after 1990 is estimated by taking into consideration the operation of the compost plants with a capacity of 460 t/d.

3) Planned landfilling amount

Assuming for the sake of the formulating of the plan, that the sanitary landfilling at the MBSDS will be started July 1987, the allocation of sanitary landfill site is illustrated in Fig. 5-2-1.

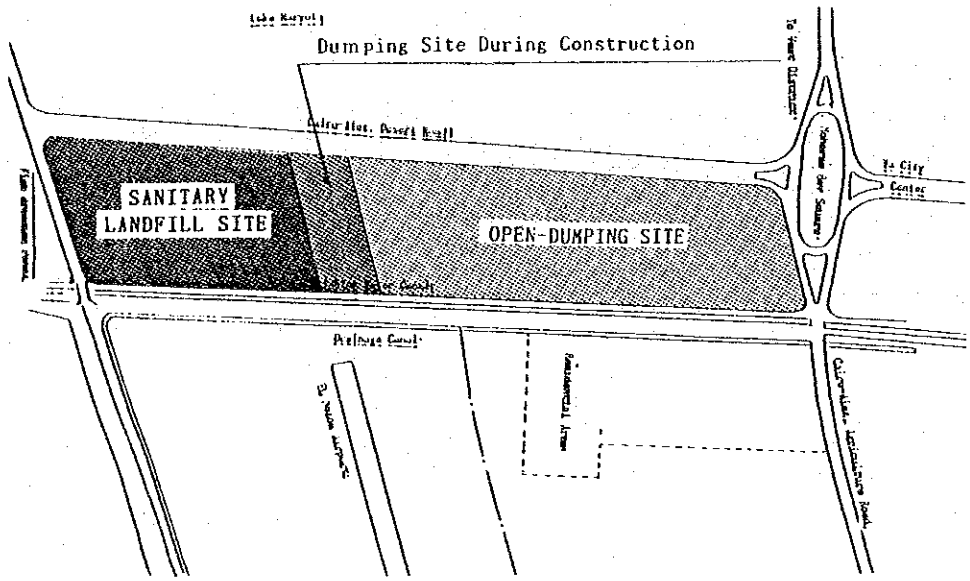


Fig. 5-2-1 LANDFILL SITE IN MBSDS

The remnant landfill capacity of the MBSDS estimated as of August 1985 amounts to 1,617,000 m^3 (Refer to S.R. section 4.2). The said capacity is calculated by assuming a final landfill elevation of GL-1.7 m (1.7 m below the average sea level), taking into consideration a ground settlement of 50 cm and the bottom excavation for securing cover soil. The final disposal site is divided into three parts on the condition of the planned disposal amount and the project implementation schedule. The area to be filled up before the start of the construction, the area to be filled up during the construction and the area of sanitary landfill site are calculated and shown in Table 5-2-1. The calculations are carried out by assuming the following values for the various basic parameters concerned.

- Unit weight of the landfilled municipal waste (collected waste and direct-hauled waste): 0.8 t/m^3 (after compaction)

- Unit weight of compost reject: 0.6 t/m^3 (after compaction)

- Unit weight of cover soil: 1.6 t/m^3 (after compaction)

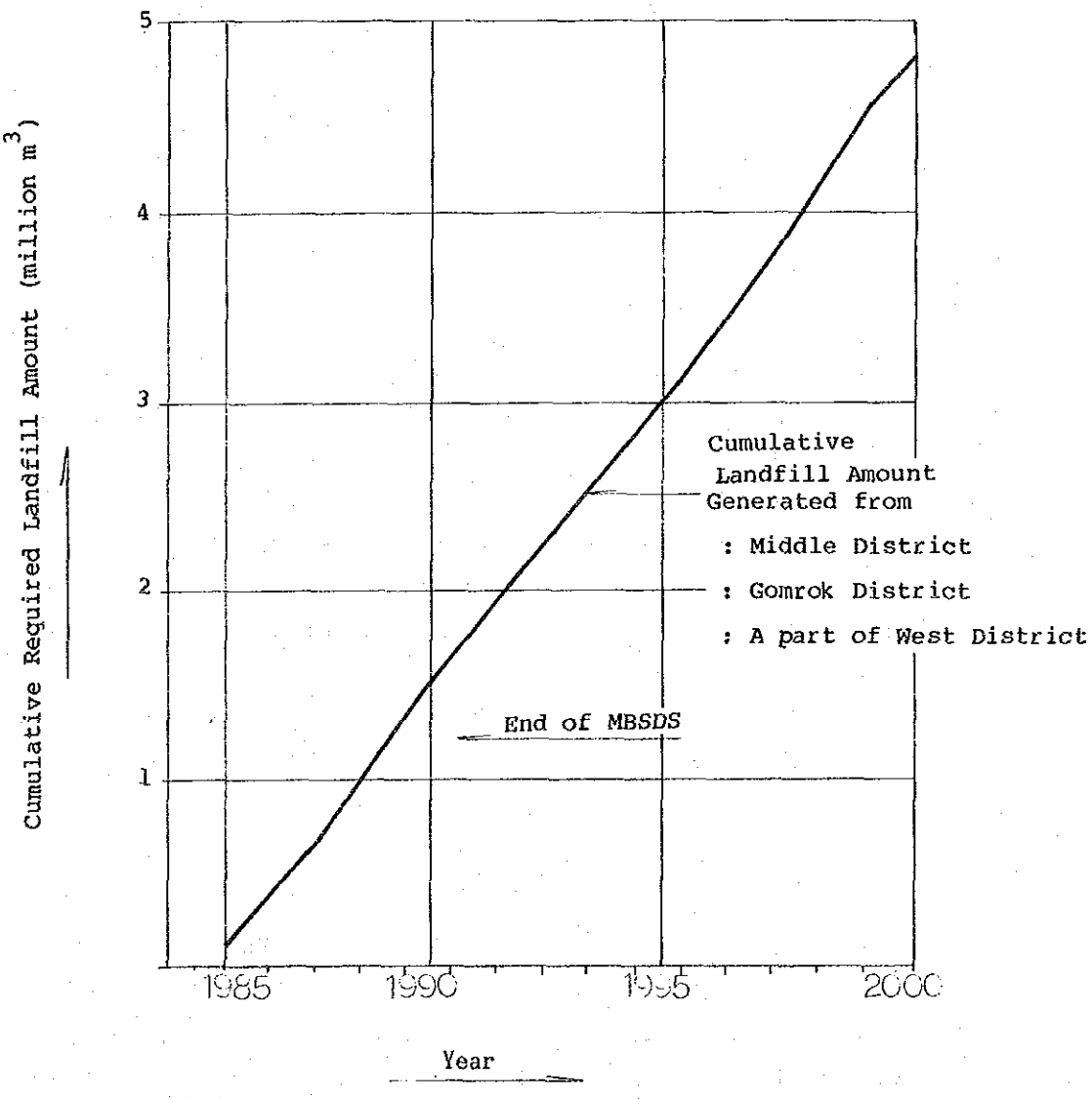


Fig. 5-2-2 CUMULATIVE LANDFILL AMOUNT

Table 5-2-1 LANDFILL PERIOD OF MBSDS

Site	Landfill Area (m^2)	Date of Commence-ment	Date of Completion	Landfill Amount (m^3)	Cumulative Sum (m^3)
Open Dumping Site	90,000 (filled) 223,000 (remained)	Aug., 1985	June, 1987	537,000	537,000
Dumping Site During Con-struction	64,000	July, 1987	Dec., 1987	161,000	699,000
Sanitary Landfill Site	175,000	Jan., 1988	Oct., 1990	918,000	1,617,000
Total	552,000	--	--	1,617,000	--

The cumulative landfill amount until the year 2000 will evolve in the form of the curve shown in Fig. 5-2-2. The landfill capacity of the area in which sanitary landfilling will be carried out is 918,000 m^3, and the period of use will be from January 1988 to October 1990. The cumulative landfill amount until 2000 calculated in section 4.2 of the S.R. and the amounts to 5,010,000 m^3 (Please refer to S.R. section 4.2).

5.2.2 Basic Policy of the Project

1) Problems of the existing MBSDS

The landfill operation carried out at present in the MBSDS has many problems. In particular, its exerts a harmful influence on the surrounding environment, and this problem requires an urgent solution. The main problems occurring in this connection are mentioned in the followings.

- Open dumping with no countermeasures for environmental conservation whatsoever is being carried out.

- The Drinking Water Canal (D.W.C.), which provides 2/3 of potable water for the 3 million people of Alexandria is located nearby. Furthermore, the D.W.C. is an open canal.

- Part of the disposal site lies within the approach zone of the runway of the El Nazha Airport (Alexandria Airport). In addition, the runway meets with the MBSDS at right angles, and their extremities are barely several hundred meters apart.

- The groundwater level at the site is high, and furthermore there is a permeable layer containing much shell fragments down to 3.0 the current ground surface, and this soil composed the bank of the D.W.C.

As can be seen, the use of this disposal site is not desirable from many standpoints, and if possible wastes are preferably disposed of at other sites. In reality however, it is virtually impossible to secure another appropriate disposal site at present, and such being the case there is no choice but continuing to use the present disposal site, by considering proper countermeasures for solving the said problems.

2) *Basic policy of the MBSDS improvement plan*

It is desirable to draw up the plan for improving the MBSDS by examining the following points with sufficient care.

- Prevention of the seeping out of leachate to outside the disposal site
- Prevention of fire
- Prevention of scattering wastes
- Prevention of diffusion of offensive odor
- No waste shall be left uncovered at the end of the day in the disposal site.
- Consideration to the ultimate use of the completed site
- Consideration to the view of the disposal site

The execution of sanitary landfilling becomes the premise for realizing the aforementioned goals. The disposal of waste by sanitary landfilling, basically, consists of the undermentioned operations.

- The waste hauled into the disposal site should be weighed.
- The solid wastes are diposited in a controlled manner in a prepared portion of the site.
- The solid wastes are spread and compacted in thin layers.
- The solid wastes are covered daily or more frequently, if necessary, with a layer of earth.
- The cover material is compacted daily.

5.2.3 Plan for Construction of Facilities

1) Facilities of the final disposal site

The final disposal site consists of the undermentioned facilities, and the construction should be implemented in conformity with an appropriate planning, design and execution scheme.

- Pre-processing facilities
- Facilities for preventing the outflow of waste such as retaining walls and the like
- Seepage control facilities
- Collection and drainage facilities for storm water and the like
- Collection and drainage facilities for leachate and the like
- Leachate treatment facilities
- Facilities for preventing wastes from scattering
- Facilities to cope with gas generated in the disposal site
- Fire prevention and fighting facilities
- Facilities for administration
- Site access roads
- Gates and fences

2) Design of the facilities

Of the previously listed facilities composing the final disposal site, those ones from the 1st to 4th will not be installed in this project, in view of the conditions of the MBSDS.

The facilities to be provided (in this project) are outlined in the followings.

a. Collection and drainage facilities for leachate and the like

These facilities have the function of leachate control facility as well, and their installation consist of laying filters and pipes for collection and drainage of leachate, installing sewage pump, etc. The relevant facilities are outlined in the followings. (Please refer to Drawings of the S.R. for details on these facilities.)

- Filter
  Width 1.0 m, height 4.0 m length 460 m, sand and gravel

- Leachate collection pipe
  Diameter 300 mm, length 450 m, perforated concrete pipe

- Sewage pump
  Diameter 100 mm, discharge rate 0.263 m^3/min, total pump head 33.0 m
  Sewage pump: 2 units

- Collection pit and pump station
  Automatic control equipment (provided with water level gauge for automatic start/stop)

- Leachate pipe
  Diameter 80 mm, length 920 m, steel pipe

- Leachate regulating pond
  Effective capacity 570 m^3
  (To be constructed by excavating the landfill site and lining with cover soil).

b. Leachate treatment facilities

No facility of this kind is planned in particular in this project. However, the leachate regulating pond planned as a part of the leachate control facility mentioned before has oxidation effect and sedimentation effect, contributing for reducing both BOD and COD because it is relatively shallow.

c. Facilities for preventing wastes from scattering

A concrete block masonry fence with 2 m height shall be constructed around the disposal site, with the purpose of preventing the intrusion of animals and functioning as a screen as well.

d. Facilities to cope with gas generated in the disposal site

Gas generated when wastes are piled up by cell type landfilling shall be removed by laying perforated pipes surrounded by gravel. The interval, interspace between adjacent pipes shall be 50 m grid.

e. Fire prevention facilities

Wastes hauled into the disposal site shall be covered with soil on the same day to prevent them from catching fire, and furthermore a motor sprinkler equipped with fire-fighting pump shall be provided so as to cope with any unexpected spontaneous combustion.

f. Facilities for administration

These facilities consist of the truck scale, car wash and office building, and are planned as follows.

- Truck scale

One unit of truck scale of load-cell type, 4-point support, remote digital indication, on-the-ground type with maximum weighing capacity of 30 ton shall be provided.

- Car wash

  The pool-type car wash shall be provided.

- Office building

  The office building comprises the rooms and the facilities required for weighing work, health care of the workers, storing relevant equipments, and the like. This building shall be designed with a total floor area of 180 m^2. For further details, Refer the Drawings of the S.R.

g. Site access road

The site access road shall branch off the Agricultural Road, and shall be constructed in the form of a 8 m-width road with 15 cm-thickness gravel pavement.

3) Layout of the facilities

The layout of the aforementioned facilities should be determined by taking into consideration such factors as the surrounding conditions, traffic flow of the collection vehicles, excavation and temporary storage of the cover soil, etc.

Fig. 5-2-3 shows the layout of the various facilities. Detailed layout of the facilities, cross sections, and other relevant particulars are shown in the Drawings of the S.R.

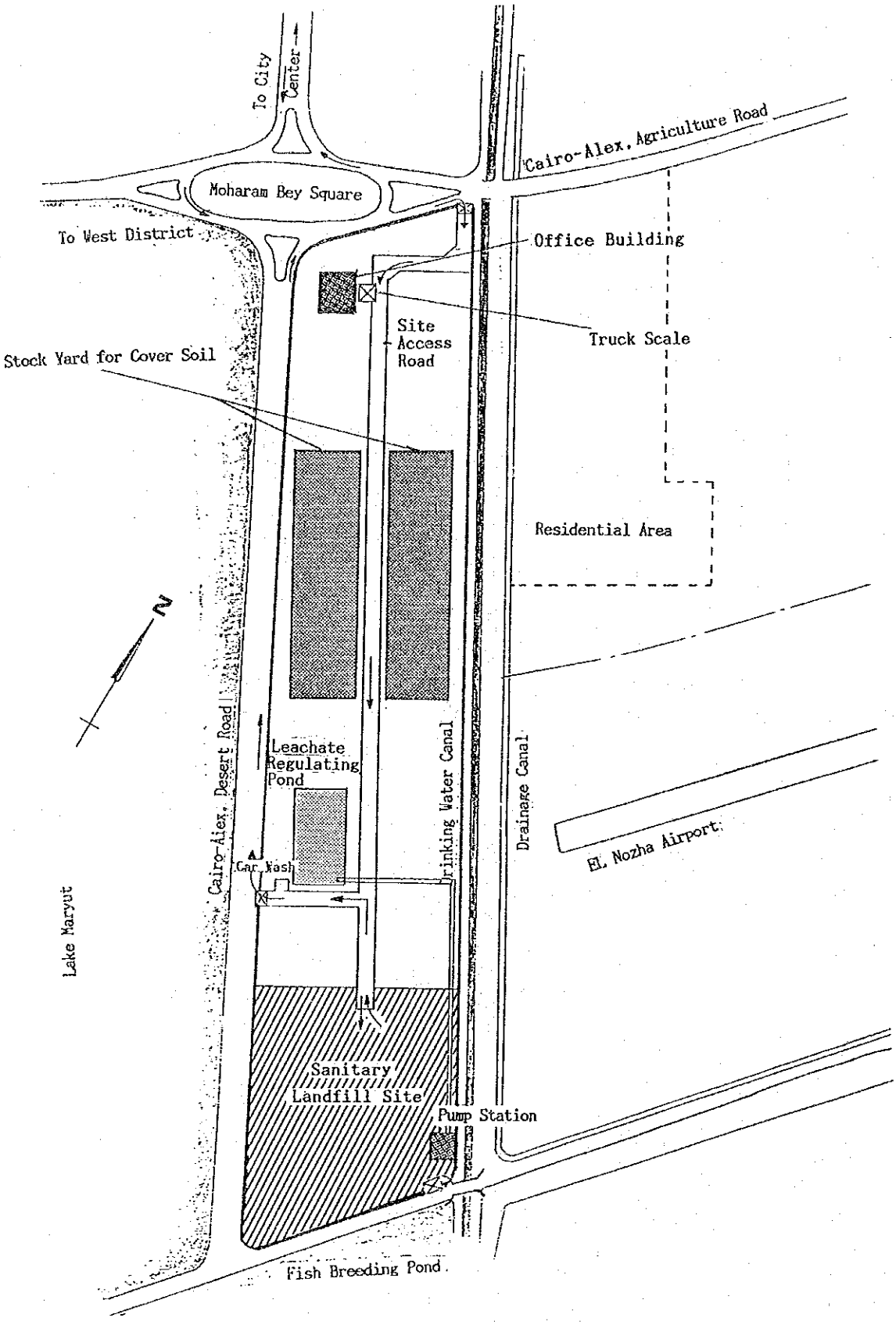


Fig. 5-2-3 LAYOUT OF THE FACILITIES IN MBSDS

5.2.4 Landfilling Plan

1) Landfill method

The landfill method to be used in this project should be the sanitary landfilling. Wastes hauled into the disposal site shall be disposed of on the same day by means of the cell method, with an average total landfill height of 5.9 m divided into 2 layers. The earth cover shall be planned with a thickness of minimum 15 cm for daily cover, 15 cm for intermediate cover and 50 cm for final cover.

Conditions after completed landfilling is shown schematically in the MBSDS cross section of Fig. 5-2-4. Cover soil will be obtained by bottom excavation, and the total volume required from the commencement of the sanitary landfilling to the completion of the landfilling in October 1990 is estimated to be 422,000 m^3. The volume of earth obtained by bottom excavation amounts to (455,000 m^3), by the excavation of average 260 m width and up to -7.1 m depth and therefore the cover soil is self sufficient in this connection.

2) Landfill equipment

Contents of the work to be carried out by the landfill equipment in the disposal site are shown in Table 5-2-2.

Table 5-2-2 CONTENTS OF THE WORKS BY THE LANDFILL EQUIPMENT

Waste Handling	Cover Material Handling	Others
Pushing (moving)	Excavation	Levelling (site access road & unloading site)
Crushing	Loading, Hauling spreading & levelling	Site maintenance
Compaction	Compaction	

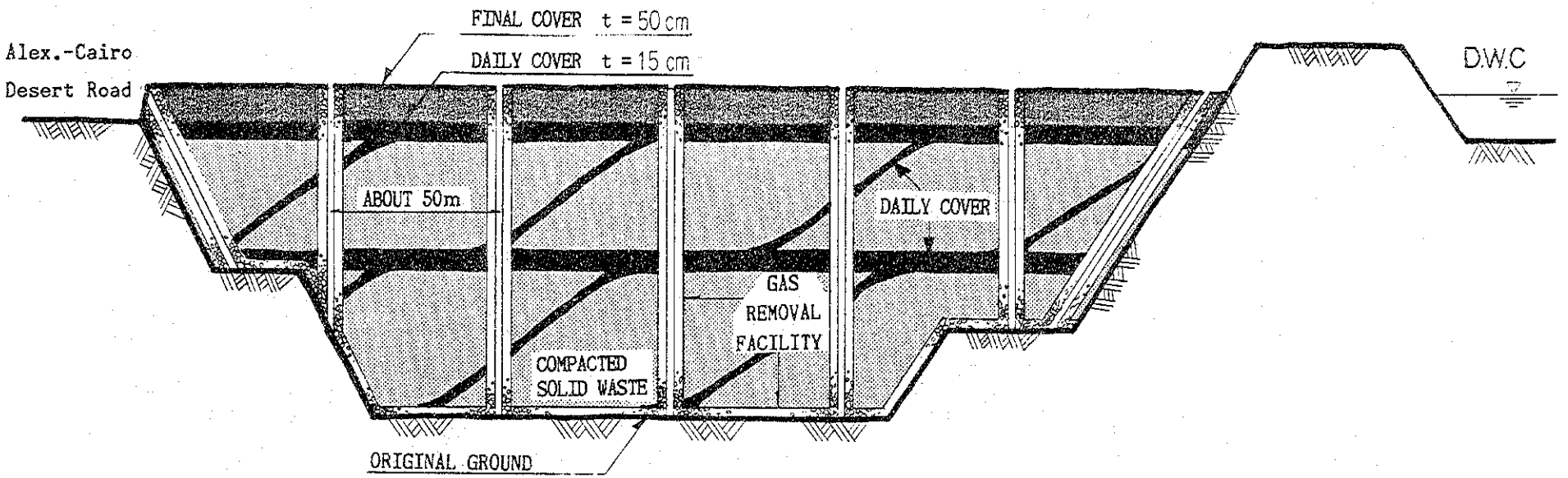


Fig. 5-2-4 MBSDS CROSS SECTION
(Sanitary landfill site)

Landfill equipments necessary for the aforementioned landfill work, calculated by assuming six hours of daily working time considering daily and seasonal fluctuation of haulage, is shown in the followings.

a.	Landfill compactor	20 ton class	2 units
b.	Back-hoe	0.7 m^3 class	1 unit
c.	Dump truck	11 ton class	2 units
d.	Bulldozer (for Swamp use)	14 ton class	1 unit
e.	Motor sprinkler	10 m^3	1 unit

5.2.5 Plan for Environmental Conservation, and for Maintenance and Management of the Disposal Site

1) Environmental conservation plan

The object of environmental conservation shall be realized by providing the various facilities required for this purpose, the correct execution of the landfill operation and the maintenance and management of the disposal site. The environmental conservation should be carried out in conformity with the undermentioned scheme.

a. Countermeasures for coping with the gas generation

Concentration of combustible gas (mainly methane gas) generated within the disposal site should be lowered below the explosion limit by diffusing it into the atmosphere by means of gas removal facilities consisting of porous pipe and gravel.

b. Fire prevention measures

Fire-fighting sand (cover soil will be applied for this purpose) and motor sprinkler with fire-fighting pump will be used to cope with any unexpected fire in the disposal site. Furthermore, daily soil covering will be carried out concurrently so as to prevent fire from occurring.

c. Countermeasures for prevention from the massive generation of rodents and insects and dispersion of offensive odor

Daily soil covering is effective for prevention from breeding of rats, insects and birds, as well as for preventing offensive odor caused by the decomposition of the disposed wastes, but other countermeasures such as sprinkling of insecticides will be considered as occasion demands.

d. Environmental monitoring

Monitoring is required in the water quality and waste quality hauled into. In other words, it is necessary to carry out the periodic inspection of the water quality in the Drinking Water Canal and in the Fish Breeding Pond, and to inquire whether the waste to be disposed of includes unsuitable one, such as noxious materials. At the same time, the disposal site and its surrounding area should be patrolled for elimination of scattered waste, so as to eliminate harmful effect on the surrounding environment.

e. Control of illegal dumping to the site

2) Maintenance and management scheme

The landfill operation at the disposal site will be operated in conformity with the organization chart shown in Fig. 5-2-5. The diposal site shall be staffed with 28 persons.

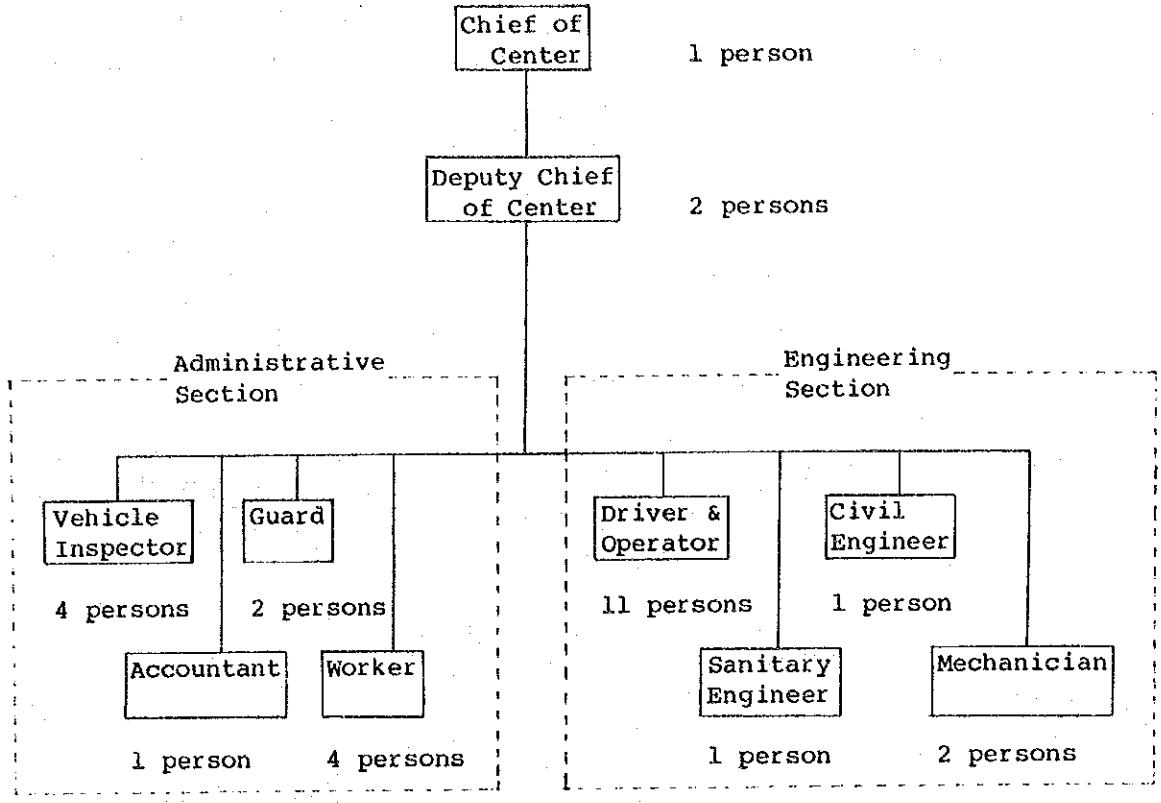


Fig. 5-2-5 MBSDS LANDFILL CENTER ORGANIZATION CHART

Details referring to the items required in the execution of the landfill work, the maintenance and operation of the facilities, such as operation manual, countermeasures to cope with emergency, safety supervision, sanitary control, scavenger control, and maintenance and operation of the facilities composing the site and the landfill equipment, are described in the section 4.2 of the S.R.

5.2.6 Plan for Ultimate Use of the Completed Site

At present, the Planning Department of the Alexandria Governorate has plans for ultimate use of the completed site in the future as an international garden project and a housing complex project for new couples.

However, the studies concerning the said projects are in conceptual stage yet, and there is no detailed plan at all for their implementation. Consequently, the points to be taken into consideration in connection with the utilization of the site are examined in the following points of view, by taking into account the location of the MBSDS and the fact that it is the site for landfill of waste without any treatment.

1) The utilization as an international garden is favorable in view of the characteristics of the landfill site. However, special considerations such as the selection of appropriate species of vegetation taking into account the generation of gas and heat due to the decomposition of organic matters, re-execution of the cover soil suited for plantation, etc., are required in this project.

2) As for the housing complex for new couples, it is not recommendable to construct it soon after completion of the landfill. It is recommendable to wait at least five or six years so as to secure preferable adequate period for the decomposition of organic matters and the stabilization of the ground settlement prior to starting the construction.

3) The disposal site can be used as a car park during the period preceding the construction of the housing complex for new couples. Since the MBSDS is located at the entrance of Alexandria, the flow of private cars from the suburban areas into the center of Alexandria could be restricted by parking them in the MBSDS, and the access to the city center could be met by using mass transportation such as by bus and the like.

4) The construction of sports facilities such as football fields, tennis courts, athletics fields, etc., is recommendable as well. Alexandria is critically short of these kinds of facilities, and if possible they would be opened to the public without any charge, and even when used as fee-charging facilities the charges should be as cheap as possible for the general citizenry to use it frequently.

The aforementioned recommendation are summarized diagramatically in Drawings of the S.R. It is hoped that these recommendations will be helpful to attain the concensus of the various authorities concerned, and to secure the required construction finance.

5.2.7 Estimation of the Project Cost

1) Outline of the construction

The outline of the MBSDS construction work and the required landfill equipment planned in sections 5.2.3, 5.2.4 and 5.2.5, are summarized in Table 5-2-3 and 5-2-4.

Table 5-2-3 MBSDS CONSTRUCTION WORK

Item	Contents	Unit	Quantity
Earth work	Excavation of the site, haulage and storage	m^3	455,000
Site access road	Total width 10 m, gravel pavement (width 8 m, thickness 15 cm)	m	2,060
Leachate control facility	Pump station	Nos.	1
	Leachate pipe	m	920
	Leachate regulating pond	Nos.	1
	Leachate collection pipe	m	450
	Filter	m	460
Office and administration facilities	Building	m^2	180
	Truck scale	Nos.	1
	Car wash	Nos.	1
Fence	Concrete block masonry. height 2 m	m	4,100
Gas removal facilities*	Gravel, perforated PVC pipe	m	6,480

* Although these items should properly be appropriated for O/M expense, they are accounted in property purchasing.

Table 5-2-4 PURCHASE OF LANDFILL EQUIPMENT

Item	Contents	Number
Back-hoe	$0.7m^3$	1
Dump Truck	11 ton	2
Bulldozer (For Swamp)	14 ton	1
Landfill Compactor	20 ton	2
Motor Sprinkler	10 m^3	1

In addition to the aforementioned works, it is desirable to carry out the works mentioned in Table 5-2-5, that consist of the countermeasures against environmental conservation and for utilization of the completed site in which the landfill was carried out without cover soil.

Table 5-2-5 ENVIRONMENTAL CONSERVATION COUNTERMEASURES IN THE COMPLETED SITE

Item	Contents	Unit	Quantity
Final cover in the completed sites	50 cm thickness	m^3	157,000
Leachate control facility	Leachate collection pipe	m	1,250
	Filter	m	1,250
	Excavation	m^3	25,000

2) Estimation of the construction cost

The construction cost is estimated on the basis of the construction commodity prices and unit costs of works. The said data were obtained as a result of a survey covering not only the private sector but also public institution.

Table 5-2-6 CONSTRUCTION COST OF MBSDS

(1000 LE)

Item	Foreign Currency	Local Currency	Total
Earth work	637.0	1,365.0	2,002.0
Site access road	1.5	20.8	22.3
Leachate control facility	27.9	108.3	136.2
Office & inspection facility	59.0	103.0	162.0
Fence	10.3	106.9	117.2
Gas removal facility	2.3	30.8	33.1
Total	738.0	1,734.8	2,472.8

Table 5-2-7 PURCHASE COST OF LANDFILL EQUIPMENT

Items	Type	Unit Price (LE)	Number of Unit	Purchase Price (LE)	Spare Parts cost (LE)
Back-hoe	0.7 m^3	121,000	1	121,000	12,100
Dump Truck	11 ton	51,900	2	103,800	10,380
Bulldozer (for swamp)	14 ton	108,300	1	108,300	10,830
Landfill Compactor	20 ton	284,600	2	569,200	56,920
Motor Sprinkler		121,000	1	121,000	12,100
Total			7	1,023,300	102,330

Table 5-2-8 COST OF ENVIRONMENTAL CONSERVATION COUNTERMEASURES IN THE COMPLETED SITE

(1000 LE)

	Foreign Currency	Local Currency	Total
Final Cover	78.5	172.7	251.2
Leachate Control Facility	53.4	244.7	298.1
Total	131.9	417.4	549.3

3) Calculation of the project cost

The project cost is summarized in Table 5-2-9.

Table 5-2-9 PROJECT COST OF MBSDS

(1000 LE)

	Item	Foreign Currency	Local Currency	Total
(a)	Construction of MBSDS	738	1,735	2,473
(b)	Procurement of Landfill Equipment	1,126	-	1,126
(c)	Engineering Services	160	69	229
(d)	Physical Contingency *1	74	173	247
	Total	2,098	1,977	4,075
(e)	Price Contingency *2	22	162	184

Note: *1 Physical Contingency: 10% of (a)

*2 Price escalation rate per annual:
5% for foreign currency portion, and
18% for local currency portion, of (a)+(c).
Construction period is six months.

4) Operation and maintenance cost

A total of 28 persons will be allotted to the MBSDS. The annual operation and maintenance cost, including the personnel expenditure of the said workers, the depreciation of the facilities and landfilling machinery, etc., is shown in Table 5-2-10. As can be seen, the annual operation and maintenance costs amount to 187,310 LE/year, and the costs including the depreciation cost which amounts to 1,412,970 LE/year.

Table 5-2-10 OPERATION AND MAINTENANCE COST

(LE)

Item	Expenditure
A. Depreciation cost	
Facilities of the disposal site	1,021,000
Landfill machinery	204,660
Sub Total	1,225,660
B. Repair cost	83,490
C. Fuel & lubricant	46,520
D. Power & water	2,500
E. Personnel expenditure	54,800
TOTAL	1,412,970 LE/year
Excluding depreciation cost	187,310 LE/year

5.2.8 Future Plan

1) Next disposal site

The MBSDS, which is the disposal site of the planned service area at present, will terminate its life in October 1990, even if this project would be implemented.

There are two or three sites proposed after the completion of landfilling at MBSDS, but there is no guarantee about their availability. The Master Plan proposes the implementation of sanitary landfilling at two sites, located at the Eastern and Western parts of the Green Belt shown in the Plan 2005, a superior plan of this study. In reality however, availability of these sites for landfill is quite low, because the implementation of the Plan 2005 is behind schedule.

Such being the case, securing the required landfill sites on the Green Belt should be regarded as prime objects, but on the other hand it is necessary to consider other sites as well in case the initially proposed ones are impossible to use.

In this study the Quarry Site, which is the most promising one, is proposed for the place to implement the next waste disposal by landfilling for the planned service area.

2) Quarry Disposal sites

Former quarries of limestone, etc. locate approximately 35 to 40 km away from the center of Alexandria are prospective for disposal site in the future. The outline of the plan drawn up on the conditions described in the S.R. is summarized as follows.

a. Characteristics of the plan

The surrounding conditions of the Quarry Disposal sites are far better compared with the one of the MBSDS. In reality however, the plans for the various quarry sites will conform fundamentally to that of the MBSDS, by assuming that, after 1990 when their use will be started, the development as residential areas would be under way in the surrounding areas. Therefore, these disposal sites shall be operated sanitary landfilling.

The plans for construction of the required facilities, the requirement of landfilling machinery and the manning scheme are outlined in the followings.

- Plan for construction of facilities

  The layout of the facilities and the outline of the landfill plan are shown in the Drawings in S.R. Table 5-2-11 outlines the facilities. As for the construction quantities, it differs considerably depending on the objective site, but the approximate quantities planned for the King Maryut Site, which is regarded as the most prospective one, are shown herein.

Table 5-2-11 CONSTRUCTION OF QUARRY DISPOSAL SITE

Item	Content	Unit	Quantity
Site access road	Gravel pavement (width 8 m, thickness 15 cm)	m	1,000
Office & inspection facilities			
- Building		m^2	180
- Truck Scale	30 ton	unit	1
- Car Wash	Pool type	unit	1
Fence	Concrete block Thickness 20 cm	m	2,000
Gate	Steel fabricante	unit	1
Gas removal facilities	Perforated pipe & gravel	m	5,800

- Landfill equipment plan

  The landfill equipment plan is shown in Table 5-2-12.

Table 5-2-12 LANDFILL EQUIPMENT PLAN

Name	Contents	Quantity (unit)
Back-hoe	0.7 m^3	1
Dump truck	11 ton	2
Bulldozer for swamp	14 ton	1
Landfill compactor	20 ton	2
Motor sprinkler	10 m^3	1

- Manning scheme

  The required manpower is in the followings which is conforming to landfill scheme planned for the Quarry Disposal site.

Chief	1 (person)
Deputy chief	1
Vehicle inspector	4
Accountant	1
Guard	2
Worker	4
Driver & operator	11
Civil engineer	1
Mechanic	2
Sanitary engineer	1
Total	28

b. Project cost

The project cost is calculated by the unit prices as of 1985.
The project cost amount to 1,517,000 LE.

5.3 New Abis Compost Plant Construction Project

5.3.1 The Plant Capacity

Full scale introduction of compost production to the s.w.m. system for Alexandria as described in Chapter 3, will increase financial burden of the s.w.m. and preclude its self-supporting operation. However, compost plants will contribute to reducing the waste amount, neutralizing and stabilizing wastes, and recycling resources. Introduction of the plant facilities is also expected to lead to modernization of the s.w.m. Furthermore, the plant can contribute to agricultural development in Egypt through supply of compost.

Considering both of the financial scale for the s.w.m. in Alexandria and expected contribution to development of farmland in adjacent areas, composting would be the only system that could be introduced as an intermediate treatment system for Alexandria. However, for the moment, the compost plant capacity should not be the whole amount of waste collected but only a part of the amount from financial viewpoint.

For this reason, introduction of compost plants should be inplemented, step by step to prevent a sharp increase in financial burden and its introduction for each stage should be carefully examined regarding financial condition.

Consequently, the construction project for a new compost plant in Alexandria should be undertaken as a pilot plant to expand the scale of compost processing operation in future.

The capacity of the new plant shall be 300 t/d for the reasons cited below.

a. The existing Abis Compost Plant has only one single line with a capacity of 10 t/hr (16 hours operation). For stable processing, it is desirable that two more lines shall be added to total three lines.

b. In compost processing, reusable items are salvaged along with removal of foreign material by hand picking system to be limited to about 10 t/hr in waste amount.

c. For the waste in Alexandria in 2000 estimated at 2,200 t/d, the processing capacity of as much as the aforementioned 300 t/d is at least required for one plant.

5.3.2 Preconditions for the Project

1) Location

A plot of land has already been secured next to the existing Abis Compost Plant as the site for the new compost plant. The site can be reached from the Middle District through Moharam Bey Square, Desert Road and Abis access road. The distance from the Middle District to the site is about 9 km, or about 2 km from the Desert Road.

MBSDS, the present final disposal site, lies halfway between the Middle District and the planned site, is about 4 km from the site. The quarry in Ameriyah, a future landfill site, is situated about 27 km away from the site through Desert Road.

2) Topography and geological condition

As shown in Fig. 5-3-1 the planned site is a narrow strip of land, about 60 m width and 1,500 m long, sandwiched between Lake Maryut and the drainage canal. The site is flat with an elevation difference of only about 1.5 m. However, recessed areas are swamps with thick set bamboo.

Geological conditions are as shown in Fig. 5-3-2 and soft silt stratum cover the surface. Sand stratum appear at a depth of about 22m below the surface. These sand stratum are relatively loose with only about 15 in N value. Since these sand layers are estimated to be rather thick and the compost plant consists of no heavy structure or equipment, the piles shall be driven into this stratum, using them as friction piles, in case pile foundation is applied.

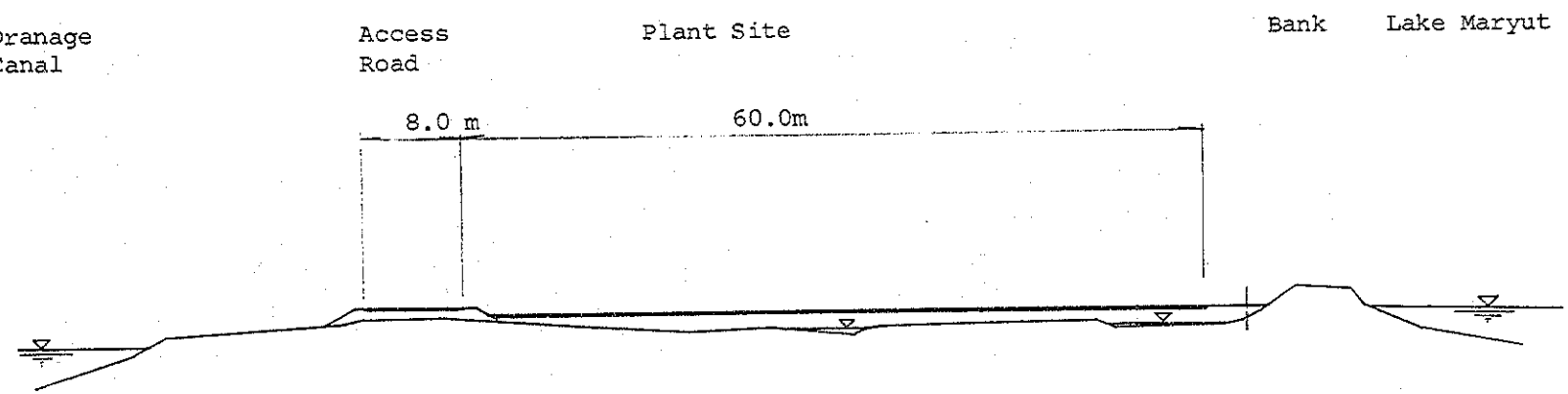


Fig. 5-3-1 CROSS SECTION OF THE PLANT SITE

CONSULTATIVE BUREAU
FOR CIVIL CONSTRUCTIONS

BOREHOLE DATA SHEET

DATE: August, 1985 JOB No.1221 BOREHOLE No.1
JOB : JICA FEASABILITY STUDY TEAM. DEPTH: 27.00 ms.
LOCATION : New Abis Compost Plant Site - Alex. W.L. : 0.50 ms. below G.L.

Description of Strata	Depth meters	Legend	Layer Thick. meters	LL	P.L	Ground Water	Remarks N/30 cms.
Ground level.	0.00						
Brown, medium Clay mixed with shells & crushed shells.	1.00		1.00				
Light grey, very soft Clay mixed with shells & crushed shells.	2.00		1.00				1
Dark grey, soft silty Clay.	4.00		2.00	74.0	29.46		2 3
Brown, sandy Clay containing crushed shells.	5.00		1.00				4
Brown, sandy silty Clay with stone pieces.	6.00		1.00	61.0	27.49		
Brown, clayey Silt.	7.00		1.00				9
Brown, sandy Silt.	9.00		2.00				10 8
Mottled: Brown/grey, medium silty Clay laminated with sand.	11.00		2.00				12
Grey, medium silty Clay.	12.70		1.70	96.0	22.41		13
Light brown, calcareous sandy Silt with small stones.	13.50		0.80				4
Brown, sandy silty Clay cont. calcareous pockets.	14.10		0.60	89.0	30.30		14
Brown, sandy silty Clay.	15.00		0.90				15
Brown, medium silty Clay laminated with sand.	17.00		2.00	88.0	26.39		12
Mottled: Brown/grey, medium silty Clay laminated with sand.	17.50		0.50	86.80	25.44		4
Light grey, calcareous sandy Silt, with small stones.	18.00		0.50	70.0	16.96		5
Light grey, sandy Silt containing calcareous materials.	19.00		1.00				9
Light grey, medium sandy Clay.	20.00		1.00	60.0	27.38		
Light grey, sandy Silt containing calcareous pockets.	21.00		1.00	43.50	19.57		5
Light grey, sandy Clay with small stones.	22.00		1.00				13
Grey, medium silty Clay with small cal. stones.	22.50		0.50				14
Brown, siliceous & calcareous Sands containing calcareous materials.	23.60		1.10				15
Brown, siliceous & cal. Sands, with agg. cont. cal. mat.	24.50		1.00				13
Brown, siliceous & calcareous Sands containing calcareous materials.	25.00		1.40				15
Brown, calcareous & siliceous Sands, with minute calcareous fragments, containing cal. materials.	27.00		1.00				
End of boring.							

Additional Remarks: No Warranty is given that the information shown represents conditions throughout the project site.

Fig 5-3-2 BOREHOLE DATA OF THE PLANT SITE (1)

TEST RESULTS

Depth of Sample	m	3.0 — 4.0	5.0 — 6.0	15.0 — 16.0	
Bulk Density	t/m³	1.44	1.42	1.77	
Dry Density	t/m³	0.87	0.99	1.13	
Water Content	%	65.99	42.08	56.59	
Unconfined Compressive Strength	kg/cm²	0.211	0.222	0.759	
Shear - Cohesion	kg/cm²	—	—	—	
Shear - Angel of Friction		—	—	—	
Specific Gravity		2.80	2.81	2.81	
Consolidation Test		Fig.(8)	—	Fig.(9)	

Depth of Sample	m	22.50 — 23.60	23.50 — 24.50	24.50 — 25.0	25.0 — 27.0
Bulk Density	t/m³	γ_L | γ_D	γ_L | γ_D	γ_L | γ_D	γ_L | γ_D
Dry Density	t/m³	1.33 | 1.54	1.35 | 1.55	1.39 | 1.56	1.33 | 1.59
Water Content	%	—	—	—	—
Unconfined Compressive Strength	kg/cm²	—	—	—	—
Shear - Cohesion	kg/cm²	ϕ_L | ϕ_D	ϕ_L | ϕ_D	ϕ_L | ϕ_D	ϕ_L | ϕ_D
Shear - Angel of Friction		35° 48' | 38° 42'	35° 50' | 38° 00'	34° 24' | 37° 10'	36° 5' | 39° 18'
Specific Gravity		2.68	2.67	2.55	2.52
Consolidation Test		—	—	—	—

Undisturbed Sample ●

Disturbed Sample ■

Sulphate Test SO_3

N — Number of Blows for Standard Penetration Test.

W.L. — Water Level in Borehole.

Fig 5-3-2 BOREHOLE DATA OF THE PLANT SITE (2)

3) The wastes to be treated

Table 5-3-1 shows the amount of wastes generated in Middle, Gomrok and West Districts, which are close to the planned site. As is noted in the table, the estimated total waste amount in 1990 is 843 t/d and that in 2000, 1,062 t/d.

Table 5-3-1 WASTE AMOUNT

(t/d)

District	1984	1990	2000
Middle	389 (18)	433 (18)	550 (18)
Gomrok	192 (0)	215 (0)	276 (0)
West	174 (0)	195 (0)	236 (0)
Total	755 (18)	843 (18)	1,062 (18)

Figures in parenthesis shows amount of vacationer's waste in summer.

The composition of wastes, which is estimated under the Master Plan, is as shown in Table 5-3-2.

Table 5-3-2 WASTE COMPOSITION

(% in wet base)

Classification	1984	1990	2000	Composition Including Vacationer's Waste, in 1984
Garbage/Grass	62	57	51	62
Paper	20	21	23	21
Textile	5	6	6	5
Plastic	6	7	9	6
Metal	3	4	6	3
Glass & Like	2	3	4	2
Others	2	2	1	1
Total	100	100	100	100

Variations in the amount of wastes has been estimated as follows:

a. Seasonal variation

Vacationer's waste amount is estimated of 18 t/d in the Middle District. Other seasonal factors are unknown.

b. Weekly variation

According to the result of survey conducted at Airport Dump Site in September 1984, the peak coefficient (to the average) was 1.07 for Tuesday and the dip one was 0.73 for Friday which is a holiday.

c. Hourly variation

The survey result at Airport Dump Site shows that peak hours in connection with the the waste amount hauled are the two hours from 10:00 - 12:00, and that in each of these two hours 12.7% of the total wastes hauled from 7:00 to 12:00, or about 19% of wastes hauled from 7:00 to 15:00, are converged.

4) Target year

The life expectancy of the compost plant is about 15 years. However, considering the efficiency of the facilities, it is a normal practice to design plant facilities with the life of about 7 to 10 years. For the project, it is assumed that it is planned for the plant to be used for 10 years, and that the plant shall commence its operation from 1990. Then the target year for the planning is 2000.

5) The waste amount and composition to be treated

The annual treatment amount is ordinarily decided based on the plant capacity, annual operation days and operation ratio, taking into consideration the planned collection amount. As this plant capacity is 300 t/d as mentioned before, annual operation days are 300, then yearly treatment amount becomes 90,000 t/year on assuming the plant operation ratio equal to 1.0.

Among the wastes, those suited for the composting are only domestic waste and some of business establishments' wastes (wastes generated at restaurants, etc.) It is therefore desirable that wastes to be treated at the plant are confined as possible to these two types of wastes. However, wastes to be treated in the compost plant shall inevitably include commercial waste and tourist waste under combined collection system, while directly hauled wastes and street waste shall be disposed of at dump sites

6) Type of collection vehicles

Collection vehicles used in Alexandria at present include Truxmore, Leach, Isuzu and Mazda. For improvement in waste collection, these vehicles shall be changed in the future. Planning for the compost plant facilities such as truckscale shall be assumed on the basis of Truxmore usage which is largest vehicle. Specifications of each type of vehicles are shown in Table 5-3-3.

Table 5-3-3 RESULTS OF VEHICLE SCALE SURVEY

	Loading capacity (m^3)	Loading weight (ton)	Density of waste (kg/m^3)	Average loading weight used (ton)
Truxmore*	16.1	6.35	395	6.5
Fiat*	11.2	6.27	560	6.3
Leach*	9.1	4.00	560	4.0
Isuzu	6.0	2.44	407	2.5
Mitsubushi	6.0	2.68	447	2.5
Nissan	4.0	1.62	405	1.2
Daihatsu	3.5	1.17	334	1.2

* Compactor Vehicle

7) Conditions for the plant operation

It is desirable that the compost plant is operated every day because daily waste collection is implemented in Alexandria. However, one more shift of operating personnel have to be provided for daily operation. In view of the present situation that personnels for operation are not available in Alexandria, the plant will be planned to operate for 300 days a year, closing it on Fridays and other national holidays.

Therefore, wastes collected on holidays will be hauled directly to landfill sites. The plant will be operated for 16 hours/d on a 2-shift system.

5.3.3 Basic Study

1) Process flow

To design the process flow for the compost plant in Alexandria, the following four conditions will be taken into consideration:

- To be suited for waste composition.
- To be suited for the climatic condition and the condition of the plant location.
- To be simple and easy for operation and maintenance.
- To be low in its investment cost.

Under these conditions, the process flow shall be the one shown in Fig. 5-3-4, almost the same as the one of the existing Abis Compost Plant.

(1) Reception system

There are two types for reception system, one is pit-and-crane-system and the other is shovel-loader-system with reception stage. For this project, the later one is adopted because the site is geologically week with high ground-water level and the system can be easily controlled and maintained.

(2) Pretreatment system

As pretreatment system for composting, two functions are required, adjustment in particle size and water content and classification of material. Although there are several pretreatment methods, the Selective Pulverizing Classification developed in Japan, is applied for the following reasons:

- Shredding, classification and water conditioning can all be performed as one process unit.

- This pretreatment method offers a much greater shredding ability than Homogenizing Drum. It can also cope with increases in plastic materials and qualitative deterioration in waste with relatively greater adaptability for such changes.

The pretreatment shall include processes for manual sorting to remove foreign materials and recover reusable items. In these processes, paper, glass, textile, plastic and metal will be recovered. Salvage rate is about 7% of the waste amount to be treated in 2000 as shown in Table 5-3-4.

Table 5-3-4 SALVAGE RATE OF THE REUSABLE MATERIAL

(%)

	Salvage rate	1984	1990	2000	Actual salvaged rate in 1985 at Abis Plant
Paper	10	2.00	2.10	2.30	7.5
Textile	4	0.20	0.24	0 24	2.2
Plastic	4	0.24	0.28	0.36	1.2
Metal	50	1.51	2.02	3.02	9.7
Glass	25	0.50	0.75	1.00	7.5
Total		4.45	5.39	6.92	

(3) Fermentation

Fermentation can be made either by windrow system or mechanical system. For the plant of this project, windrow system is applied because this system requires low investment cost and is easy to maintain. The fermentation yard of windrow system can be located outdoors because precipitation in Alexandria is very low, and there are no residences around the site. Raw material for composting can be handled to the fermentation area either by truck or by conveyor. Handling by trucks is more advantageous from the economical viewpoint due to more than 700 m handling distance.

(4) Refining

At present, a portion of the product is sold as coarse compost without processing through refining. In the long term, however, in order to raise the value of compost as fertilizer, it is imperative that quality of compost shall be improved by removing foreign objects as possible. For this reason, the whole amount of compost shall be refined. For this process, vibrating screens shall be used since no particular problems are occuring from the use of a similar system in existing plant.

Packaging of compost is a highly effective means to expand the market. Present sales situation shows that the dealings mainly consist of large transaction contracts. Thus, packaging is considered not required for the moment. Nevertheless, space for packaging operation is secured within the site premises to meet the possible future need for packaging.

(5) Others

For sales, reusable items will be treated as follows:

- Paper, textile and metal will be packed after compaction.

- Plastics will be left in bulk.

And rejects will be disposed of by sanitary landfilling.

2) Material balance

In the compost plant, moisture content will be conditioned by adding water in the pretreatment process. And in fermentation process, organic material in waste is decomposed and the weight of the waste is reduced in this process. Water also evaporates during this process. For these changes, material balance should be studied by taking into account moisture content in each stage. In addition, it should be considered that material balance will vary depending on the characteristics of wastes.

The basic points on material balance are as follows:

(1) Recovery rate for reusable materials

The recovery rate at the existing plant is extremely lower than planned one, as little as about 2%. With improvement in the sorting process as planned for the project, the recovery rate based on the present characteristics of waste will be increased to about 4.5% and up to about 7% in the future. Recovery rate for reusable materials depends on the work level in this process. It is necessary that efforts should be made to improve the labor skill.

(2) Moisture content in the raw materials of the compost should be controlled to about 55%.

(3) The product obtained after fermenting and maturing is reduced to 65% of raw materials in dry basis. And water content is reduced to about 30%.

(4) Foreign objects, in amount, in the fine compost is set at about 2% under the plan. Thus, the recovery rate of the fine compost becomes about 25%.

3) Market for compost

Compost will be sold under seasonal (4 times a year) contract system and delivered in bulk at the plant.

Application of compost as fertilizer greatly varies by season. Climatic conditions in Alexandria allow compost to be stored in a pile in open at farms. Its required space is also relatively small. For these reasons, compost will be marketed on the assumption of the stockpile in farmyard. Consequently, no plan will formulated to stockpile a substantial amount of compost at the plant.

The plant shall meet weekly-level variations in compost demand and shall secure a stockpiling space for about two days' supply. In case of greater variations in demand, such variations will be dealt by adjusting operation of the refining process and controlling the stockpiling, in the fermentation area.

Although an approximately 660 t/d potential demand for compost is expected, difficulty in marketing of compost has been occurring in various countries. The main reason is considered that compost plants are operated by authorities primarily responsible for cleansing operations. It is supposed that executive agency of the cleansing operation does not make efforts to develop compost marketability.

These are the most difficult problems in management of a compost plant. It should be reconsidered that successful operation of the compost plant depends on its marketability. Therefore, following two points should be carefully examined:

a. Requirement on quality of compost

Foreign objects will become a major problem in quality of compost. These objects may increase caused by the deterioration of waste composition. At present, compost is sold with no claims in spite of involving foreign materials such as heavy metal in it. However, foreign objects tend to accumulate in farm soil as compost is repeatedly applied. Therefore, from the long-range standpoint, it is important to produce, from the beginning, compost which contains as few foreign objects as possible.

Contents of foreign objects can be reduced by adding refining processes and qualitative improvement of wastes through separate collection by type of wastes, although such measures reduce compost productivity. This point also has to be studied, along with the demand situation.

b. Compost market development

Since the introduction of a composting plant into the s.w.m system is only possible by securing a stable market for the compost to be produced in terms of both demand and price, it goes without saying that every effort should be made to expand market outlets at all times.

In order to accomplish this goal, it is necessary to coordinate with the relevant institutions on the following matters and thereby enhance consumer confidence in the product.

- Quality assurance
  The product should be periodically analyzed by some authoritative institution such as an university or a research institute affiliated to the Ministry of Agriculture and the consumers should be informed of the results.

- Confirmation of the fertilizing effect
  The cooperation of the agricultural experiment stations or ordinary farms should be solicited in order to confirm the effects of compost in increasing crop yield and in saving irrigation water at pilot farms.

- Fertilizer administration design with the conjunctive use of compost
  Fertilizer administration design with the conjunctive use of compost should be prepared for each crop with due regard to the soil conditions in order that it might serve as a guideline for the consumers in administering fertilizer.

- Product transport and sales
  The transportation and sales routes of the Credit Bank which is an institution affiliated to the Ministry of Agriculture or those of the Agricultural Association which is one of the organizations for communal activities shall be effectively utilized.

Also, as measures for expanding its own sales outlets, every effort should be made to effectively advertize the product, survey consumer needs and improve the forms of selling products (granulated compost, bagged compost) while also endeavoring to assure stable product supply.

4) Sale of reusable materials

Reusable materials, salvaged during the process of waste treatment, shall be sold through dealers in the same manner as the currently operating plant.

The estimated amount, delivery frequency and required storage capacity for each reusable materials are as follows:

Items	Expected quantity (t/d)	Required storage capacity
Paper	6.9	for one day
Textile	0.7	for three-day
Plastic	1.1	for three-day
Metals	9.1	for two-day
Glasse	3.0	for three-day

Depending on the estimated amount of each item, paper shall be delivered daily while metal shall be delivered three times a week and others two times a week.

5) Disposal of rejects

Rejects are separated at the picking line, pulverizing classification system, magnetic separator and vibrating screen of the plant and the estimated amount mounts to 119.4 tons per day in total. The rejects will be disposed of by sanitary landfilling at Quarry Site. A rejects storage space for one day shall be secured in the premises of the plant.

6) Organization

The new Compost plant shall require the following personnel for efficient operation:

- Plant Manager
- Operator
- Laboratory chemist
- Maintenance staff
- Sales personnel
- Clerical staff

The personnel plan of the new Abis Plant shall be worked out taking the existing plant's personnel into full account. Since the sites of both existing and new plant are neighboring, a common operation program can be feasible and among other things, the common sales promotion shall be preferrably set in view of its duty and the nature of the job.

In addition administrative organization shall be established for the common management of the two plants. This organization shall be named 'Compost Center', and its head office shall be located in the site of the new compost plant.

However, due to the characteristic of respective plant, other departments for work site operation shall be separatedly organized to secure an independent operation from each plant.

The organization of the Compost Plant shall, therefore, be formed as shown in Fig. 5-3-3.

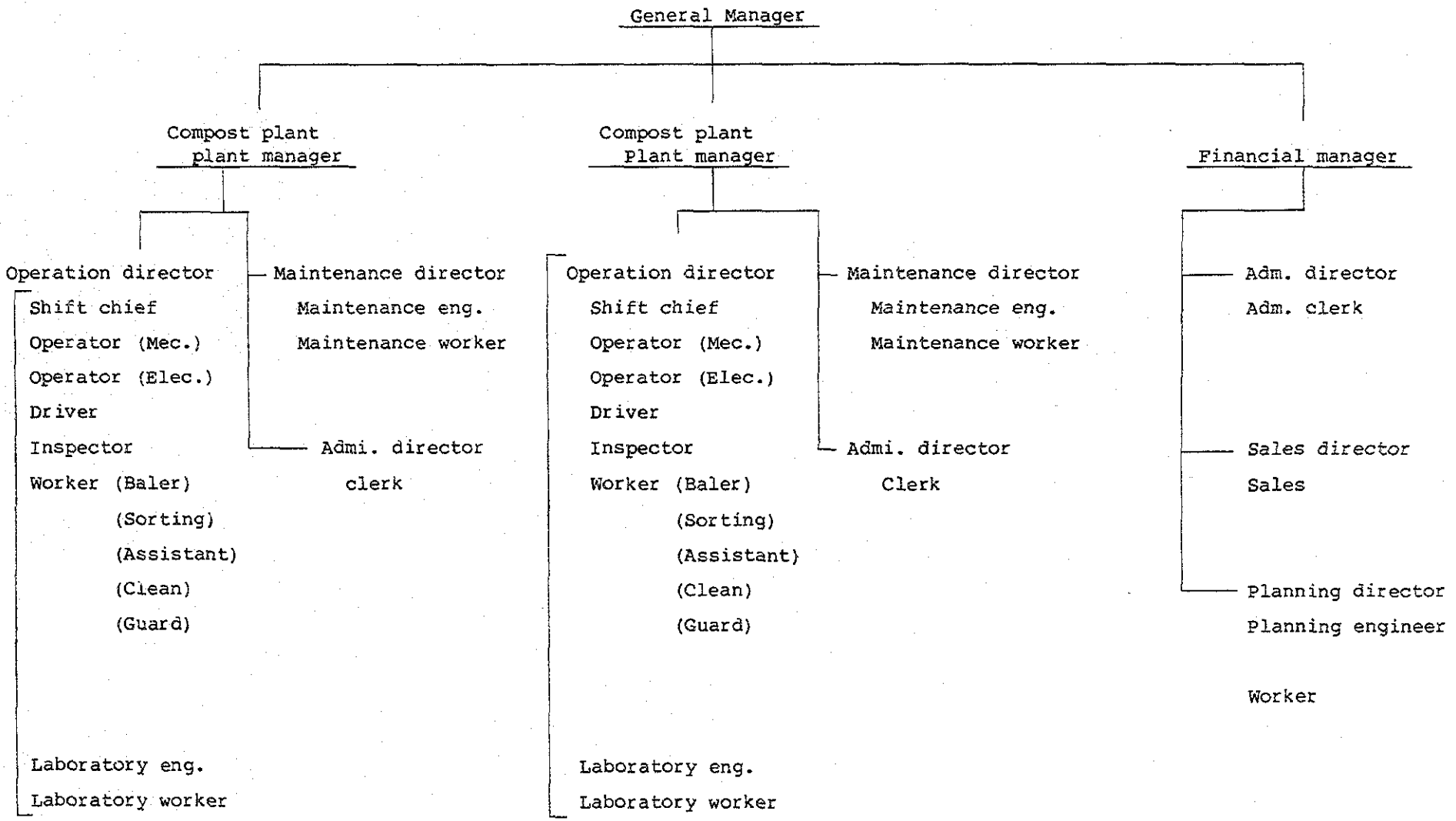


Fig. 5-3-3 ORGANIZATION CHART FOR COMPOST PLANT

5.3.4 Facility Plan

1) Plant capacity and operation plan

The plant capacity and operation plan shall be as underlisted:

- Waste treatment capacity: 300 t/d
- Operation hour: 16 hr/d (waste handling hour: 14 hr/d)
- Operation days: 300 d/year
- Site area: 6 ha.

2) Process flow

Following systems are adopted as major processes of the plant:

- Shovel loader system for waste receiving
- Selective pulverizing system for pretreatment
- Windrow system for fermentation

Manual sorting process and refining process are also incorporated.

The process flow of the new plant is as shown in Fig. 5-3-4.

3) Material balance

The plant is designed to treat 300 t/d of wastes with characteristics as expected in 2000, to produce daily 72.9 t/d of fine compost and to salvage 21 t/d of reusable materials. In addition, rejects of 119.4 t/d is expected to be disposed of.

Daily 115.3 t of water shall be supplied at the pretreatment and fermentation process for moisture content adjustment of raw materials. The detailed material balance is as shown in Fig. 5-3-5.

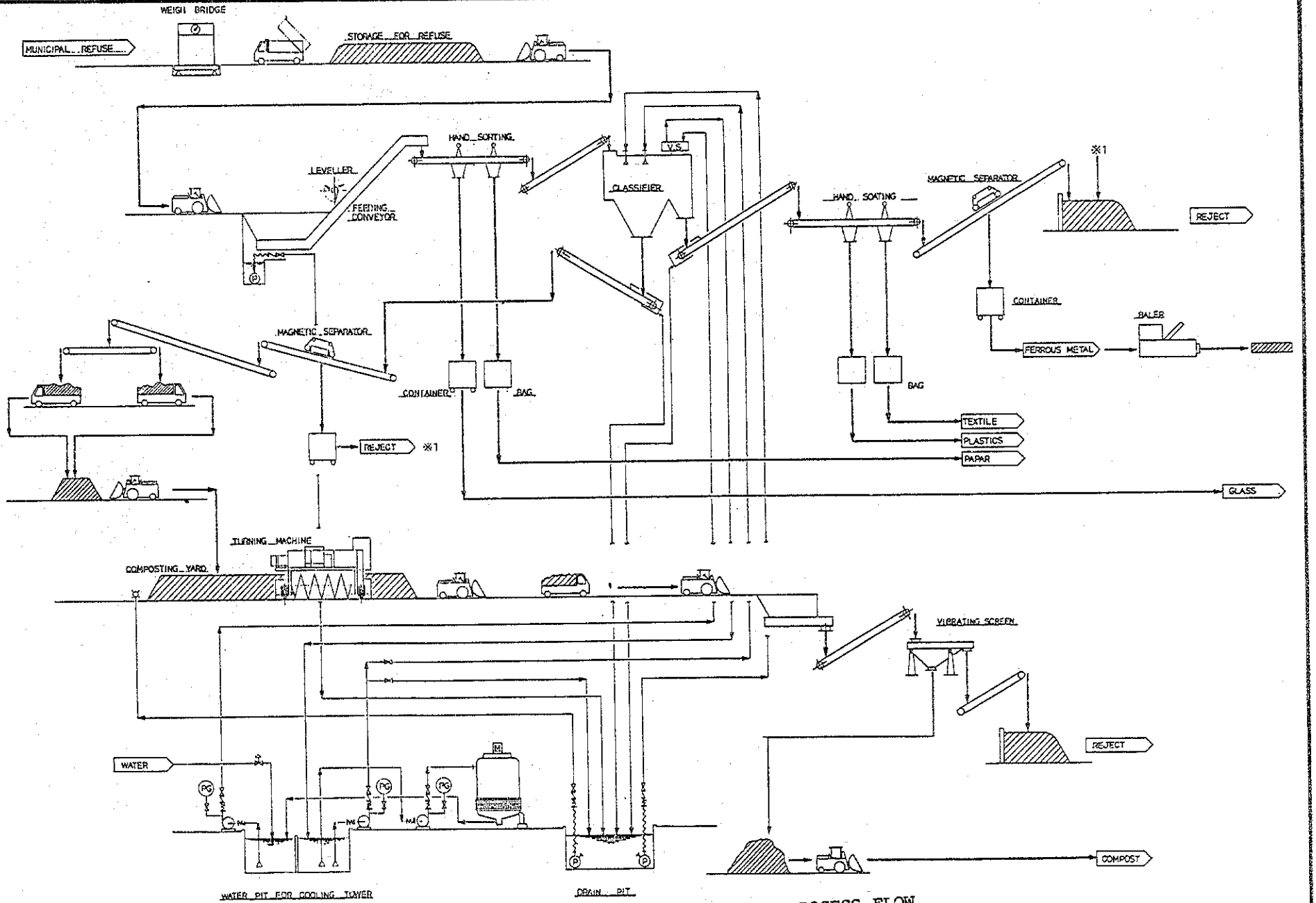


Fig. 5-3-4 PROCESS FLOW

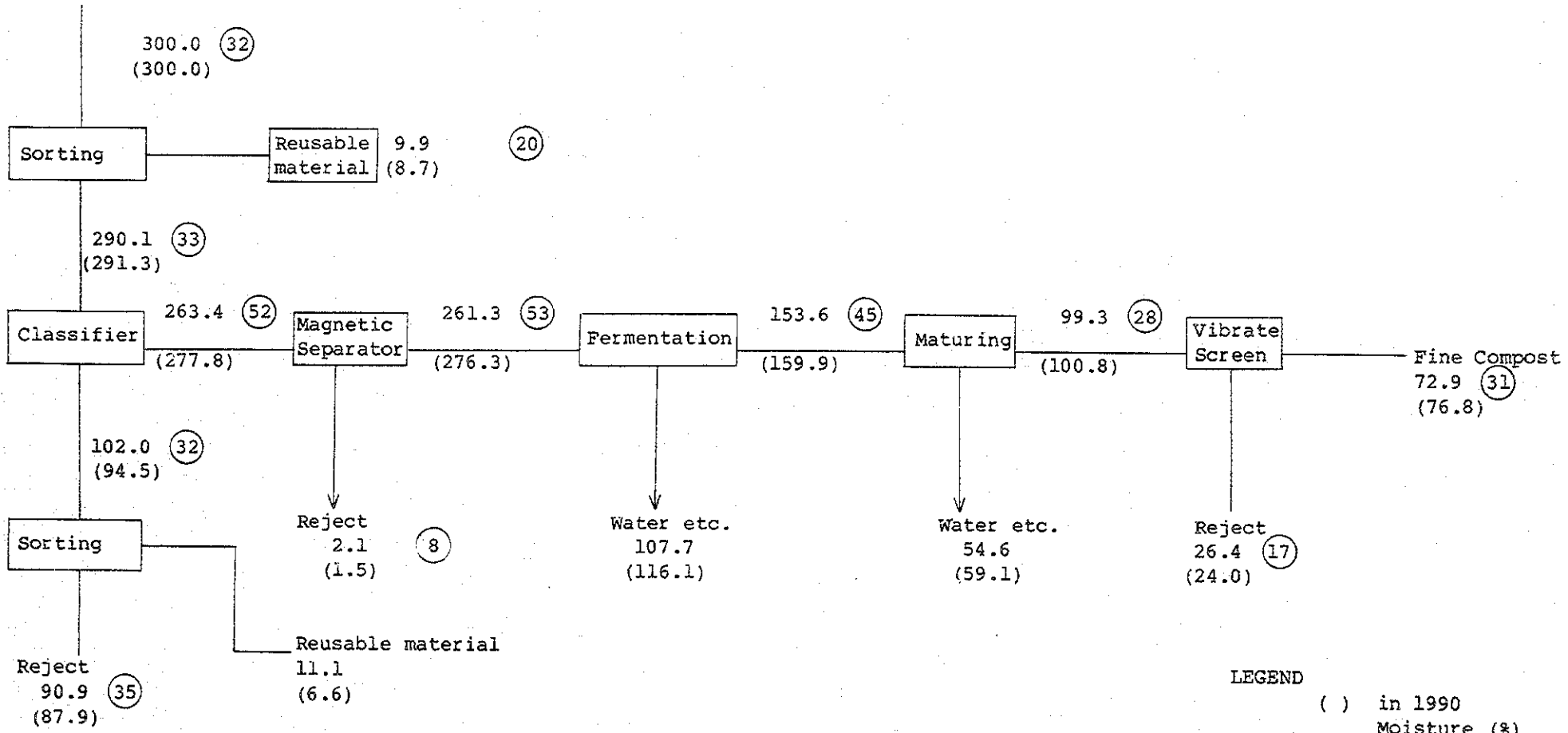


Fig. 5-3-5 MATERIAL BALANCE (in 2000)
(t/d)

4) Plant layout

The layout of the plant shall be formulated to satisfy the following principles:

- to secure the most effective path of vehicles moving line for carrying-in and -out of wastes and products after treatment.

- to centralize facilities to be effectively and economically controlled.

- to make the most of the site area.

The plant layout is heavily restricted by the long and slender shape of the site area and the general plan of the plant is shown in Fig. 5-3-6 and 5-3-7.

5) Machinery and Equipments

The new Abis Compost Plant is provided with following facilities in which machine are listed on Table 5-3-5.

- Waste Reception
- Pretreatment and Picking Line
- Fermentaiton
- Refining
- Standby Generater
- Administration Office

6) Civil work and building plan

(1) Preparation of the site

The access road to the new plant shall be 8 m width and filled up by 1.0 m thick earth on the existing ground, so as to be the same level of the road already constructed in front of the existing Abis Compost Plant.

Although the site level of the new plant should be preferrably equal to that of the new access road, it is planned at 0.5 m lower level from access road surface in order to reduce site reclamation cost. The average filling-up thickness will be 1.0 m.

(2) Foundations of machinery

The selective pulverizing equipment is the only heavy machinery to be installed among various machinery and equipments of the new plant. The foundation of this machine shall be pile foundation and the other foundations shall be spread foundation same as the existing Abis Compost Plant.

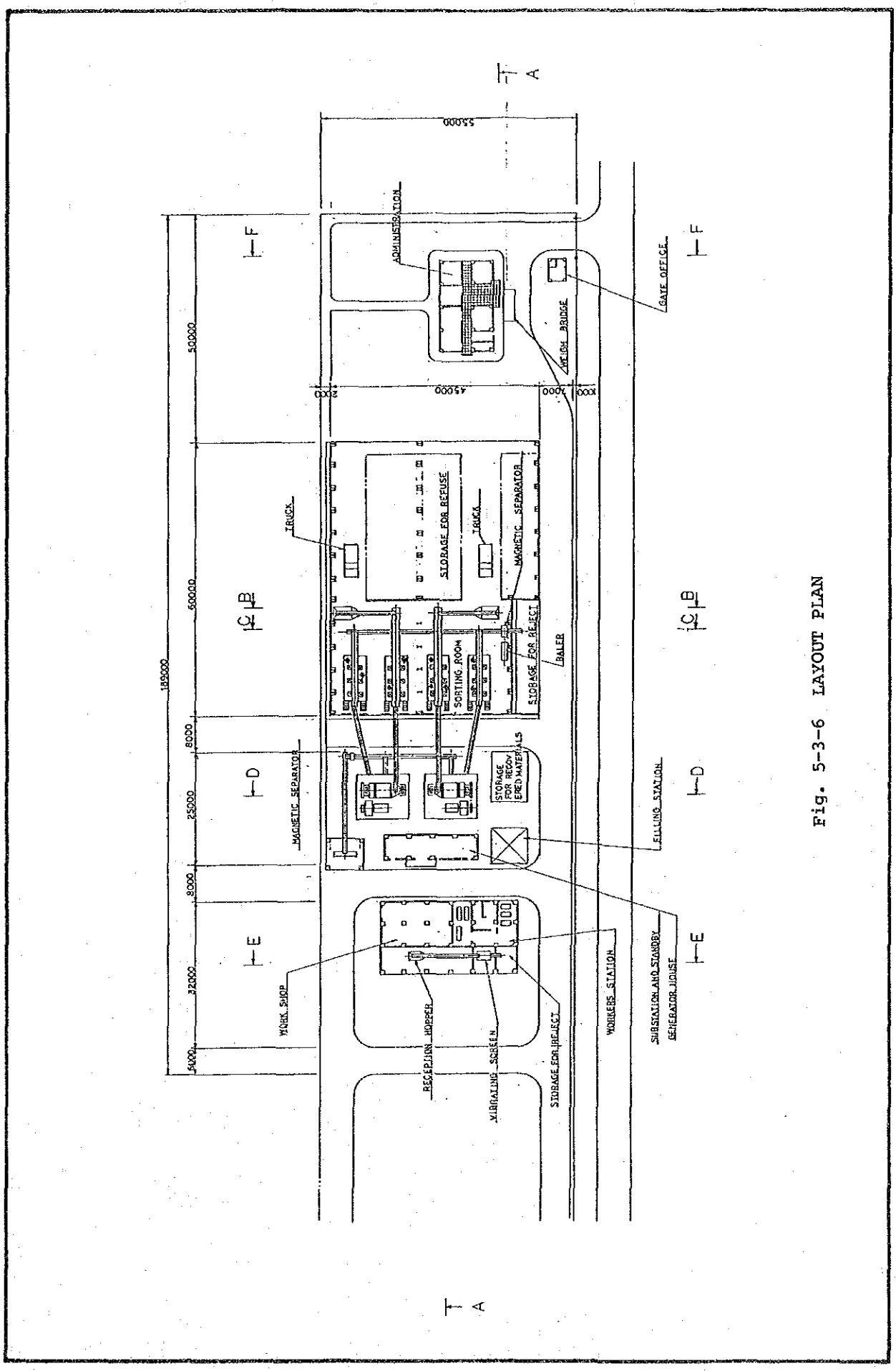
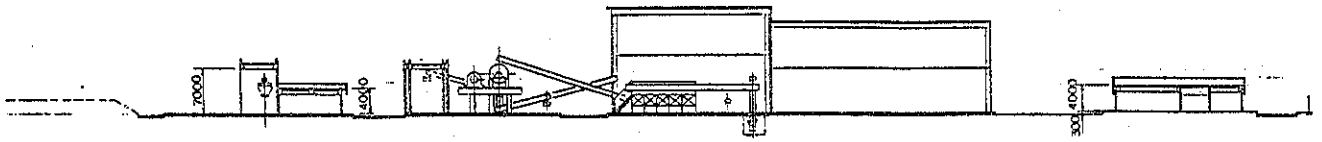
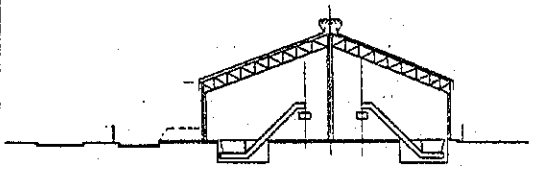


Fig. 5-3-6 LAYOUT PLAN

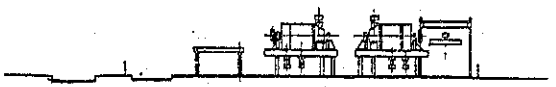


VIEW A - A

VIEW F - F



VIEW B - B



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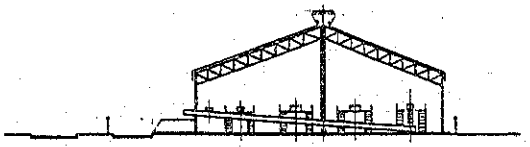

VIEW C - C

VIEW E - E

Fig. 5-3-7 CROSS SECTIONS

Table 5-3-5 PLANT MACHINERY AND EQUIPMENTS

Item	Machine and Specification		Quantity
Waste	Truckscale	30t Multi-load cell type	1 unit
Reception	Storage area		1,500 m^2
	Shovel loader	1.5 m^3	2 unit
	Feeding conveyor	w = 0.75 m	2 set
Pretreatment	Conveyor (1)		2 set
	Pulverizer	ø = 2.4 m	2 set
	Conveyor (2)		2 set
	Conveyor (3)		1 set
	Conveyor (4)		1 set
	Magnetic separator		1 set
Picking	Picking conveyor (1)	w = 1.6 m	2 set
	" (2)	w = 1.0 m	2 set
	Magnetic separator		1 set
	Baler for paper and textile		2 set
	Baler for ferrous material		1 set
	Conveyor		1 set
	Storage for reusable material		204 m^2
	Hand cart		24 unit
Fermentaion	Dump truck	4 t	4 unit
	Turing machine	w = 4.3 m	1 unit
	Fermentation yard		15,000 m^2
Refining	Feeder conveoyor		1 set
	Vibrating screen		1 set
	Shovel loader	1.5 m^3	1 unit
	Conveyor		1 set
	Storage for fine compost		640 m^2
Electricity	Generator	625 KVA	1 set
Disposal	Shovel loader	1.5 m^3	1 unit
	Dump truck	8 t	5 unit
	Storage for rejects		150 m^2
Maintenance	Maintenance shop		150 m^2
Admini-stration	Office		240 m^2
	Gate house		20 m^2
	Restroom		150 m^2
	Car park		450 m^2

(3) Building plan

Following buildings shall be constructed in the site area:

a.	Administration Office Building	:	12 m	x	20 m	=	240 m^2
b.	Gate House	:	5	x	4	=	20
c.	Storage and Sorting Building	:	60	x	45	=	2,700
d.	Reusable Material Storage	:	12	x	17	=	204
e.	Generator House	:	20	x	6	=	120
f.	Raw Compost Loading House	:	7	x	8	=	56
g.	Workshop and Restroom	:	30	x	10	=	300
h.	Refining Room	:	30	x	6	=	180

The structure of the buildings shall be of reinforced concrete for the above a. and b. and shall be of steel-frame with slate structure for the above c. to h.

(4) Pavement

The access road and the fermentation area shall be paved with asphalt. Concrete pavement shall be made to the floor of the buildings where heavy vehicles work, and for other buildings the floors shall be applied with level concrete.

(5) Exterior structures

A block masonry fence of 2m height shall be provided around site boundary.

5.3.5 Operation and Personnel Plan

1) Operation plan

The plant shall, as described below, be operated daily except for Fridays and National Holidays, 16 hours per day under 2-shift system and 90,000 tons of wastes will be treated with 300 days of annual operation.

(1)	Yearly operation days	:	300 days
	Non-operation days	:	Fridays and National Holidays
(2)	Daily operation hours	:	16 hr/d (from 7:00 to 23:00)
(3)	Shift system		
	Operation personnel	:	2 shifts
	First shift	:	from 7:00 to 15:00
	Second shift	:	from 15:00 to 23:00
	Other personnels	:	Single shift
(4)	Waste reception	:	8 hr/d from 7:00 to 15:00
(5)	Rejects handling time	:	8 hr/d from 7:00 to 15:00
(6)	Compost and reusable materials delivery time	:	8 hr/d from 7:00 to 15:00

2) Personnel plan

The 105 personnel working in the new Abis Compost Plant shall consist of the administrative personnel of 16 persons who are also in charge of the administration of the existing Abis Compost Plant and the personnel of 89 persons for the operation of the new Abis Plant.

Of the personnel of 89 persons for the new plant, 76 of operative workers shall be devided into 2 shifts. Each shift shall contain 35 operative workers, and the first shift shall also include 6 drivers for rejects haulage other than 35 operative workers. That is, the total number of operative workers is 76; 35 workers and 6 drivers for the first shift and 35 workers for the second shifts.

For successful parallel operation and management of both the existing Abis Plant and the New Abis Plant, the more effective operation of the existing Abis Plant shall be accomplished and the current 74 persons engaged in its operation will be reduced to 65. The detailed personnel plan is shown in Table 5-3-6.

Table 5-3-6 PERSONNEL PLAN

	EXISTING COMPOST PLANT		NEW COMPOST PLANT	TOTAL
Administration				
General Manager		1		1
Financial manager		1		1
Adm. director		1		1
Adm. clerk		3		3
Sales director		1		1
Sales assistant		3		3
Planning director		1		1
Planner		2		2
Worker		3		3
Sub-total		16		16
Compost plant				
Plant manager	1		1	2
Operation director	1		1	2
Operation worker				
Shift chief	2		2	4
Operator (Mechanic)	2		2	4
Operator (Electric)	2		2	4
Driver	10		16	26
Inspector	2		2	4
Worker (Baler)	4		6	10
(Sorting)	16		28	44
(Assistant)	6		10	16
(Clean)	4		4	8
(Guard)	4		4	8
Sub-total	54		78	132
Laboratory engineer	1		1	2
Laboratory worker	1		1	2
Maintenance director	1		1	2
Maint. engineer	3		3	6
Maint. worker	2		2	4
Admi. director	1		1	2
Clerk	2		2	4
Sub-total	11		11	22
Total	65	16	89	170

5.3.6 Construction and Operation Cost

1) Precondition

The cost and expenses for the compost plant construction and operation shall consist of construction cost, machinery and equipment procurement cost, and operation and maintenance cost.
The cost is estimated by accumulation of the respective cost items calculated in the following manner.

(1) Construction cost

The construction cost of the plant is obtained, in the usual manner for construction work, by calculating direct construction costs and expenses for each work category (i.e. personnel cost, construction machinery charge and material cost) and indirect construction cost and expenses including the common temporary installation cost, site administration expenses.

The indirect construction costs and expenses are actually divided among the work categories, such as land reclamation, building, pavement and so on, and the construction cost for each work category is obtained by adding indirect construction cost by work category.

In addition, the engineering fee and physical contingency to be incurred separately shall be included to designate the total construction cost of the project.

(2) Machinery and equipments procurement cost

The machinery and equipments procurement cost is made of ex-factory price of machinery and equipments, transportation cost and engineering fee.

(3) Operation and maintenance cost

The yearly operation cost of the plant is obtained by summing up personnel wages, repairment cost and expendable supplies cost.

2) Construction Cost

The construction cost of the compost plant amounts to 13,108,954 LE the details of which are shown in Table 5-3-7. The amount consists of foreign currency portion of 8,951,025 LE and local currency portion of 4,157,927 LE. Both engineering fee and physical contingency are estimated at 10% of the construction cost repsectively.

3) Machinery and Equipments Procurement Cost

The procurement cost for machinery and equipment, including loader, dump trucks, etc., to be dispatched at the plant amounts to 941,325 LE as indicated in Table 5-3-7. The procurement cost of spare parts for two years is also added. While 5% engineering service fee is added, physical contingency is not included for this cost item.

4) Operation Cost

Total 105 persons will be newly employed at the new ABis Compost Plant. The operation cost of the plant mainly consisting of personnel wages for such personnel is expected to amount to 1,474,287 LE/year including depreciation cost and to 583,472 LE/year excluding depreciation cost as shown in Table 5-3-8.

Renewal purchase of vehicles shall be made every five years for smooth operation of the plant without any interruption. The yearly operation cost of the existing Abis Compost Plant is estimated at 380,000 LE.

Table 5-3-7 CONSTRUCTION COST OF COMPOST PLANT

(LE)

Item	Foreign Currency Portion	Local Currency Portion	Total
1. Construction cost			
Civil work and buildings	1,035,542	388,304	3,423,846
Machinery	6,142,000	1,048,000	7,190,000
Spare parts	220,000	0	220,000
Sub-total	7,397,542	3,436,304	10,833,846
Eng. service	739,754	343,630	1,083,846
Physical contin.	813,729	377,993	1,191,723
Total	8,951,025	4,157,927	13,108,954
2. Machinery and equipments procurement cost			
Machinery and equipments	815,000	-	815,000
Spare parts	81,500	-	81,500
Sub Total	896,500	-	896,500
Eng. Services	35,860	8,965	44,825
Total	932,366	8,965	941,325
Grand Total	9,883,391	4,166,892	14,050,279

Table 5-3-8 OPERATION AND MAINTENANCE COST

(LE/year)

Depreciation		
	Civil and Buildings	138,095
	Machinery	597,740
	Vehicles	154,980
	Sub-total	890,815
Maintenance		
	Machinery	143,800
	Vehicles	65,200
	Sub-total	209,000
Fuel, oils and Lubricants		
	for Vehicles	65,376
	for Machinery	45,000
	Sub-total	110,376
Water and Power		
	Water	5,400
	Power	80,976
	Sub-total	86,376
Personnel Cost		177,720
Grand Total		1,474,287 (16.4 LE/ton)
Total except depreciation		583,472 (6.5 LE/ton)

CHAPTER 6. PROJECT EVALUATION

CHAPTER 6. PROJECT EVALUATION

6.1 Frame of Evaluation

Owing to the non-productive nature of s.w.m., the following basic policy was arranged in order to evaluate this project.

1) Basic policy

a. The project is evaluated from a viewpoint of economic and financial aspects. However, the latter is given major priority, in view of Alexandria's financial capability.

b. The method of minimum costs is applied in comparing and studying project elements.

c. In the economic evaluation, an evaluation standard is formulated for factors such as environment, public helth and landscape appearance, and then a qualitative analysis is carried out. A quantitative analysis is also performed to calculate the economic benefit which can be derived from the compost project if possible.

The procedures used to evaluate the compost project is shown in Fig. 6-1-1.

2) Economic evaluation

An economic evaluation is said to be indispensable for judging the feasibility of a project. In the case of the waste treatment project, however, it is difficult to directly measure the benefits to be obtained from such an operation.

The economic evaluation is thus carried out according to the following steps.

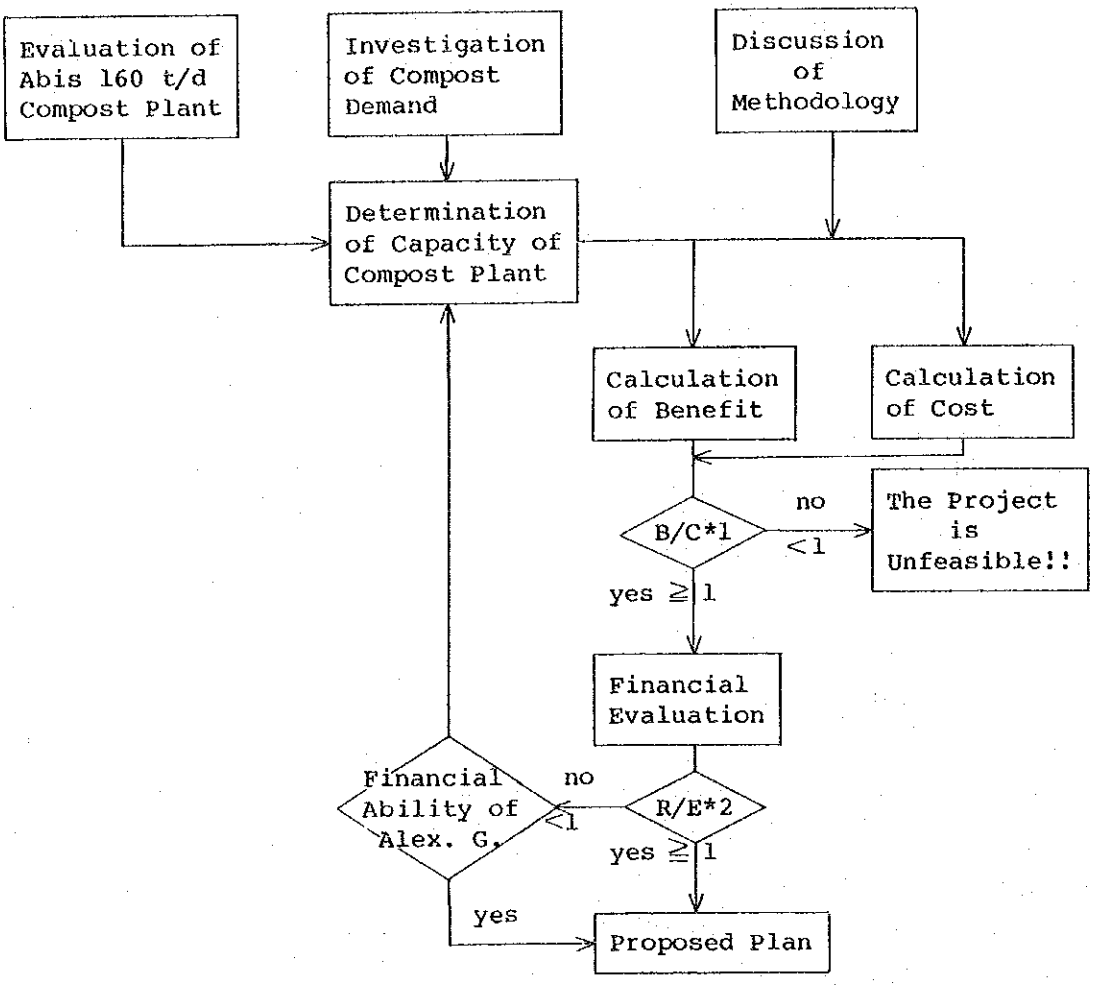

Fig. 6-1-1 EVALUATION PROCEDURES

Note: *1 B: Benefit
C: Cost
*2 R: Revenue
E: Expenditure

- The effects obtained through improvement of the waste collection and street sweeping system, and sanitary landfilling is evaluated on the basis of a qualitative analysis.

- The effects obtained from the compost project is evaluated on the basis of both qualitative and quantitative analyses.

- The benefits and costs relating to the compost plant are calculated based on quantitative analysis as much as possible.

- The project is regarded as feasible from the viewpoint of economic evaluation when the benefit/cost ratio evens or exceeds one.

3) Financial evaluation

Financial evaluations can be broadly divided into two types:

a. financial evaluation of a specific project
b. financial evaluation of the Authority which shall support to the project operation planned in the Master Plan and the priority project.

Here, the first type will be studied, and the second type will be examined in Chapter 8.

The priority project consists of three projects, required for an integrated s.w.m. system, in which, at the same time, aim at different service areas respectively. Namely, the collection and street sweeping improvement project is targeted at the Middle District; sanitary landfilling at Middle, Gomrok and a part of the West District; and the compost plant at all areas of Alexandria.

Also, because a cost management is not clearly divided into collection, treatment and disposal categories at present and a future location of the disposal site is still uncertain, it is impossible to predict a balance of revenues and expenditure with high accuracy as well.

Accordingly, in order to evaluate the project as a whole, here the project is divided into two sub-projects each of which is the subject of a separate financial evaluation. Namely, one sub-project concerns collection and disposal of wastes as a fundamental scheme in a waste treatment project and the other concerns the construction project of a compost plant as the additional. A comprehensive project evaluation is focused on the Middle District and looks at the balance between a sharing cost corresponding to the waste amount and a predicted income.

6.2 Evaluation of Waste Collection and Disposal Improvement Project

6.2.1 Effects of Collection Improvement

Urban waste treatment, needless to say, is designed to achieve rapid removal of waste generated through urban activities, and consequently to conserve and upgrade the public health and the environment.

The waste collection service brings about the undermentioned contents.

Elimination of wastes from city areas	—— Reduction of flies, mosquitoes, rats, etc.	—— Reduction of infectious diseases (hygienic effects)
	—— Clean streets	—— Peace in citizens' mind and better impression to tourists and vacationers
	—— Elimination of piles of waste	—— Elimination of obstacles to traffic

And consequently a comfortable living environment is secured.

Of course up to now, efforts have been made to improve the waste collection service, but actually there are remaining areas where a satisfactory collection is difficult, and areas where a regular collection at fixed time is not being carried out, and therefore, further improvements have being required.

The waste collection experiments carried out during the course of this study indicate that a substantially efficienct improvement can be obtained through the implementation of collection at fixed hours using plastic bags, that the various collection methods should be combined in conformity with the characteristics of each area, and that the door-to-door collection for the City Center and the use of small-sized collection vehicles for narrow alleys are necessary to be adopted.

It is presumed that careful operation of the aforementioned systems, together with efforts on the public relations in its process will change the citizens' consciousness of environment and sanitation, and will enhance in further effects of the aforementioned waste collection service improvement project.

6.2.2 Effects of Disposal Improvement

The subject of the highest priority regarding the waste disposal improvement project is the switching from the current open dumping to the sanitary landfilling to realize the preservation and improvement of the public health and environment. In other words, the sanitary landfill, by cell method with cover earth will make it possible to store the waste without baneful influence to environment with subsequent volume reduction, decomposition and stabilization utilizing the metabolic function of the nature.

The environmental pollution to the adjacent areas which used to occurr by the conventional open dump system, and the resultant difficulty in securing new disposal sites can be solved through the implementation of the sanitary landfill system.

The waste disposal improvement project at MBSDS has the purpose of consolidating appropriate technologies regarding sanitary landfill, which is expected to become a fundamental method for final disposal of wastes in Alexandria. Concurrently the project shall make it possible to transfer the technologies to other landfill sites within the city. Furthermore, positive effects can be expected as underlisted.

a. The disposal site is located at the closest distance from the city Center of Alexandria, and it can minimize the costs of the waste collection and haulage through an effective operation of the collection vehicle, etc.

b. The introduction of the sanitary landfill in the existing disposal site adjacent to the airport will contribute to securing the safety of the aircrafts by minimizing flocks of birds.

c. Leachate shall be prevented from infiltrating in the adjacent drinking water canal by laying filters between the disposal site and the canal, with which the leachate is collected and drained.

d. Scattered waste, spontaneous combustion, rank odors, breeding of rats and insects, etc., can be avoided by the sanitary landfill.

e. The sanitary landfill contributes to the upkeep and maintenance of the landscape at the gateway of Alexandria.

f. In addition, the installation will bring about the underlisted positive collateral effects.

i) Safety of the site will be guaranteed through the prompt removal and dispersion of the generated gases.

ii) Safety of the landfilling work will be guaranteed by preventing the access of scavengers into the site.

iii) Labour conditions of the site workers will be improved.

iv) Access of specific noxious materials will be restricted by inspecting the hauled wastes at the entrance of the site.

g. Effects related to a future utilization of the completed disposal site. The implementation of the sanitary landfill in the site, which is currently a swamp, makes it possible to utilize land resources effectively. It will be practicable thereby to combine the final disposal site plan with the regional and urban planning and an orderly development of the city will be prompted accordingly.

6.2.3 Financial Evaluation

The waste collection and disposal improvement project, which is expected to bring about the aforementioned effects, is evaluated as follows from the financial standpoint, with the conventional budget and the revenue from a forthcoming reinforced charge collection.

The total revenue of the s.w.m. in the Middle District is presumed to amount to approximately 1,900,000 LE in 1985, and a portion of the charge collection accounts for only 16%. The revenue, however, is expected to be raised to 3,300,000 LE in 1990 and 4,000,000 LE in 2000 as a result of the reinforced charge collection and other relevant measures. (Refer to Table 6-2-1).

On the other hand, the expenditure, excluding depreciation, required for the improvement of waste collection and disposal services is expected to amount to 1,700,000 LE in 1990 and 2,000,000 LE in 2000, the above mentioned revenue can fully meet these expenditures. While the financial evaluation taking account of the depreciation is explained as follow.

a. If the depreciation of the facilities for the disposal site and the transfer station is borne by the Middle District in correspondence to the portion of the amount of waste of the Middle District, the project will have up a surplus of 200,000 LE in 1990, when the sanitary landfill of the MBSDS will finish, and in 2000 it will result in a surplus of 900,000 LE.

b. If the total depreciation of the MBSDS and the transfer station is borne by the Middle District, the project would result in a deficit of 400,000 LE in 1990. That being so, the depreciation of the MBSDS and the transfer station shall be borne by other districts as well, proportionally to the amount of waste to be handled therein. After finishing the landfill of the MBSDS however, the project would result into some margin of surplus even in this case.

Such being the case, it is concluded that the project is sufficiently feasible from the financial standpoint as well.

It should be taken into consideration however, that the project is feasible in the Middle District because a high population density results in an efficient collection service, and furthermore because the collection of charges for commercial wastes is easy due to the concentration of commercial and business establishments in the district. Inversely, this financial condition can not be regarded as necessarily applicable to the other districts.

Table 6-2-1 BALANCE OF THE IMPROVEMENT PROJECT

(1,000 LE)

	1985	1990		2000	
		Case 1	Case 2	Case 1	Case 2
Revenue					
Wages	666	815	815	868	868
Chapter 3	714	707	707	352	352
Cleansing fund	209	212	212	217	217
Resident	125	125	690	125	992
Business establishment	175	175	860	175	1,584
Total (A)	1,889	2,034	3,284	1,737	4,013
Expenditure					
Personnel	1,015	1,281	1,281	1,415	1,415
Maintenance	225	307	307	384	384
Fuel	59	136	136	173	173
Others	10	14	14	11	11
Sub-total	1,309	1,738	1,738	1,983	1,983
Depreciation					
Vehicles	387	486	486	640	640
Transfer station	- -	388 (226)	388 (226)	434 (254)	434 (254)
Final disposal		1,072 (626)	1,072 (626)	327 (192)	327 (192)
Sub-total	387	1,946 (1,338)	1,946 (1,338)	1,401 (1,086)	1,401 (1,086)
Total (B) (B')	1,696 (1,696)	3,684 (3,076)	3,684 (3,076)	3,384 (3,069)	3,384 (3,069)
Balance (A-B) (A-B')	193 (193)	-1,650 (-1,042)	-400 (208)	-1,647 (-1,332)	629 (944)

*1 case 1 means no-improvement of charging system
case 2 means improvement of charging system

*2 ( ) means burden of Middle District in proportion of waste amount generated

6.3 Evaluation of New Abis Compost Plant Construction Project

6.3.1 Economic evaluation

Securing landfill sites to dispose of the ever increasing amount of urban waste has become a problem of major importance in recent years. Waste amount reduction has been offered as one possible solution. In this project, composting, which is seen to be advantageous in terms of waste treatment, has been selected as the target project of the Feasibility Study. In additon, the compost is expected to be effective in greening deserts and raising agricultural productivity. Therefore the implementation of a compost project is earnestly looked to in a nation such as Egypt where agriculture plays a major role.

In this Section, a study and quantitative evaluation are made as much as possible on the economic benefits of the compost project at the national level.

1) Evaluation conditions

Fig. 6-3-1 shows the flow of the economic evaluation in the case where composting is adopted for intermediate treatment. The evaluation seeks out the relationship between the costs and benefits generated through the project operation, followed by a feasibility study based on the benefit/cost (B/C) ratio. Benefits of the compost project can be raised as the following six items.

- Increase in the crop yield
- Saving of chemical fertilizers
- Saving of irrigation water
- Recycling of reusable materials
- Saving of waste haulage cost due to the reduction of the amount of waste to be disposed of
- Saving of waste disposal cost due to the reduction of the amount of waste to be disposed of

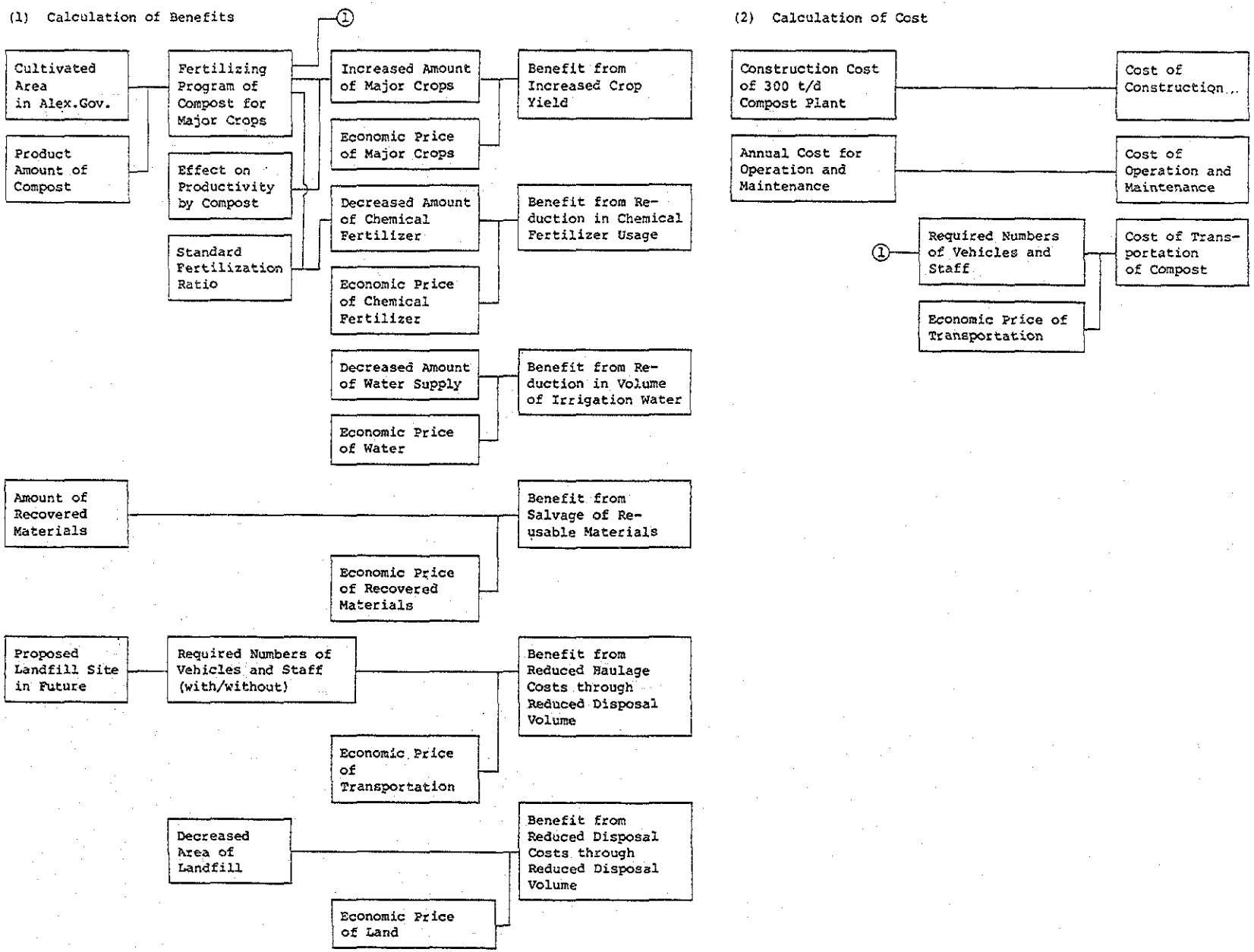

Fig. 6-3-1 FLOWCHART OF ECONOMIC EVALUATION

The following five items may be considered among the costs incurred through implemention of the project:

- Compost plant construction cost
- Vehicle purchase cost (including reject haulage vehicles)
- Compost haulage vehicle
- Plant O/M cost (including reject haulage O/M cost)
- Compost haulage O/M cost

The pre-conditions for calculating these various costs are as follows:

a. The project life is assumed to be 15 years.

b. The benefit in terms of the increase in crop yield (increased earnings) is figured as the total benefit for major crops (wheat, tomatoes, grapes).

c. The benefit in terms of reducing of chemical fertilizer is figured as the total for the same crops just listed above.

d. The final disposal sites are assumed to be used as the following period:

	1985	1990	1995	2000	2005
MBSDS Quarry site (35km from Middle District)					

e. Yearly compost pròduction amount is calculated as follow:

$P = C \times r \times D$

whereas

P : compost production amount (t/year)

C : plant capacity = 300 t/d

r : fine compost productivity ratio = 25%

D : yearly plant operating day = 300 d/year

= 300 t/d x 25% x 300 t/year

= 22,500 t/year

2) Calculation of benefits and costs

Calculation of the benefits and costs are recorded in detail in S.R. 2.8 and 5.1. Here, the general calculation concept and results are summarized.

Benefits are calculated as described below.

a. Increase of crop yield

As representative crops being cultivate in Alexandria, wheat for winter, tomatoes for summer and grapes for year round crops are selected and the increase in these crops yield is calculated as a benefit. The amount of compost to be used, based on a fertilizing design, is assumed to be 15 t/year for wheat, 20 t/year for tomatoes and 10 t/year for grapes. On the anticipation that an increase rate of the harvest will be 30% on the average, the benefit is determined by multiplying the increase rate and the harvest per unit are for each crop of them averaged up on the harvest records for the past eleven years in Alexandria. On the assumption that compost used in farmlands will be 22,500 tons per year, the benefit for the amount of 1,395,000 LE per year can be obtained in the form of increase in crop yield.

b. Reduction in use of chemical fertilizers

The fertilizing component in compost will serve as a substitute for chemical fertilizer, resulting in a corresponding reduction in the amount of chemical fertilizer which is currently used. The benefit is calculated based on a comparison of the amount of chemical fertilizer used for the selected crops (wheat, tomatoes, grapes) when chemical fertilizer is used alone and when it is used together with compost, using the import price of fertilizer. The estimated benefit thereby amounts to 273,000 LE year.

c. Reduction in volume of irrigation water

It is well known that the effectiveness as soil conditioner of compost increases water retention capacity, particularly high effectiveness in the case of sandy soil. Based on the results of an experiment conducted in the Arab Emirates, it is assumed that a 40% saving in irrigation water can be achieved. Benefit is calculated by comparing

the cost for the construction of irrigation water canals and their maintenance for the two cases where compost is used and where not used. Both of the differences gain a benefit of 207,000 LE in reduced construction costs and 6,000 LE in reduced maintenance costs per year.

d. Salvage of reusuable materials

Compost facilities are equipped with a system for salvaging reusable materials. Benefit is calculated based on the sale of such materials to recycling businesses. The reusable materials are to be iron, paper, textile and plastic, with assuming salvage rate at 4.45 - 6.92%. The result of the calculation gains a benefit of 140,000 LE in the first year of the operation and 168,000 LE in fifteen years later.

e. Haulage costs saving through disposal amount reducing

With the introduction of composting, the waste amount hauled to the disposal site becomes only of the rejects while all wastes has to be hauled in case of no composting. As the wastes to be hauled the disposal site are reloaded at a transfer station, the handling capacity of a transfer station differs according with or without the compost plant. Those differences can be considered as benefit calculated to be 166,000 LE/year.

f. Landfilling costs saving at landfill sites through disposal amount reducing

Composting decreases disposal amount at landfill sites. Therefore, this reducing amount can be calculated as a benefit. The calculation shows a benefit of 96,000 - 123,000 LE/year.

Costs incurred in implementing the compost project include construction costs, O/M costs and transportation costs of the compost from the plant site to farmlands. These various costs are calculated as follows:

a. Compost plant construction costs

As described in S.R. 3.3 and 5.1, the compost plant construction costs consist of machinery, electrical work, civil and building work. These costs amount to 13,108,000 LE with 2 years construction period.

b. Vehicle purchase costs

From S.R. 3.3 and 5.1 the costs of 941,000 LE for purchasing turning machines, loaders, dump trucks to transport the rejects and other heavy machinery used in the plant are estimated.

c. Costs for purchasing vehicles to haul the the compost

Although actual executive agency is supposed not to purchase these vehicles, it is considered to be necessary to count this hauling costs for economic evaluation. In this study, the cost for this purpose is calculated as 120,000 LE provided with six vehicles would be at the cost of 20,000 LE for each vehicle.

d. Plant O/M costs

The breakdown consists of the costs for personnel, electricity, water, fuel and maintenance. Calculation comes to 582,000 LE year (including for personnel, fuel and vehicle maintenance concerning haulage of the rejects).

e. Product (compost) haulage cost

As shown in Table 5-1-3 in S.R. 5.1, the compost haulage cost amounts to 61,000 LE per year in total.

3) Benefit/cost ratio

Table 6-3-1 shows the benefits and costs for each of 15 years from the start of operation (17 years from commencement of construction). As the table indicates, total benefit is 31,731,000 LE; total cost is 25,936,000 LE.

The costs given in the table have been calculated with a discount rate of 0%. In this case, the B/C ratio is 1.22. When the discount rates are assumed to be 4.0% and 4.4%, the resulting B/C ratios are 1.02 and 1.00, respectively. In other words, benefits and costs are equal when the discount rate is 4.4%, and the economic internal rate of return (EIRR) can be said to be 4.4%.

Table 6-3-1 ECONOMIC EVALUATION

Year	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
Benefit																		
Increase of Crop Yield	0	0	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	1,395	20,925
Saving of Chemical Fertilizer	0	0	273	273	273	273	273	273	273	273	273	273	273	273	273	273	273	4,095
Saving of Irrigation Water	0	0	102	105	6	6	6	6	6	6	6	6	6	6	6	6	6	285
Salvage of Reusable Materials	0	0	140	143	146	148	151	154	157	160	163	166	168	168	168	168	168	2,368
Saving of Transportation Cost	0	0	166	166	166	166	166	166	166	166	166	166	166	166	166	166	166	2,490
Saving of Disposal Cost	0	0	123	120	115	113	109	106	105	102	99	96	96	96	96	96	96	1,568
Subtotal	0	0	2,199	2,202	2,101	2,101	2,100	2,100	2,102	2,102	2,102	2,102	2,104	2,104	2,104	2,104	2,104	31,731
Cost																		
Construction Cost	6,554	6,554	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13,108
Heavy Equipment Cost	0	0	941	0	0	0	0	941	0	0	0	0	941	0	0	0	0	2,823
Vehicles for Product haulage	0	0	120	0	0	0	0	120	0	0	0	0	120	0	0	0	0	360
O/M Cost	0	0	582	582	582	582	582	582	582	582	582	582	582	582	582	582	582	8,730
O/M Cost for Products	0	0	61	61	61	61	61	61	61	61	61	61	61	61	61	61	61	915
Subtotal	6,554	6,554	1,704	643	643	643	643	1,704	643	643	643	643	1,704	643	643	643	643	25,936

Rate = 0.0% B/C = 1.223

Rate = 4.0% B/C = 1.021

Rate = 4.4% B/C = 1.003

Rate = 4.5% B/C = 0.999

4) Sensitivity analysis

While the abovementioned results were obtained in counting each item of the benefits and costs under the most appropriate conditions, it is needed to check the calculation because some itmes were uncertainty resulted from insufficient data and possibility of the set-up conditions to be altered according to economic changes in the future. Accordingly, trial calculations have been made for the following 3 items which would greatly affect the results of the evaluation, as sensitivity analyses to analize the fluctuation range of the EIRR.

- Change in increased rate of crop yield (30%):
  increase by 33% (40% in increase crop yield), by 10% (33% increase in the same) and decrease by 10% (27% increase in the same), by 20% (24% increase in the same)
- Change in compost plant construction costs: for cases of 33% and 10% increase and 10% and 33% decrease
- Change in base plant O/M costs: for cases of 33% and 10% increase and 10% and 33% decrease

The calculation is made assuming that the respective itmes vary alone and not made for cases of simultaneous changes.

The results of these analyses are shown in Fig. 6-3-2. Among the 3 items listed above, the increase rate of crop yield has the largest effect on EIRR, while the change in O/M costs has the least effect.

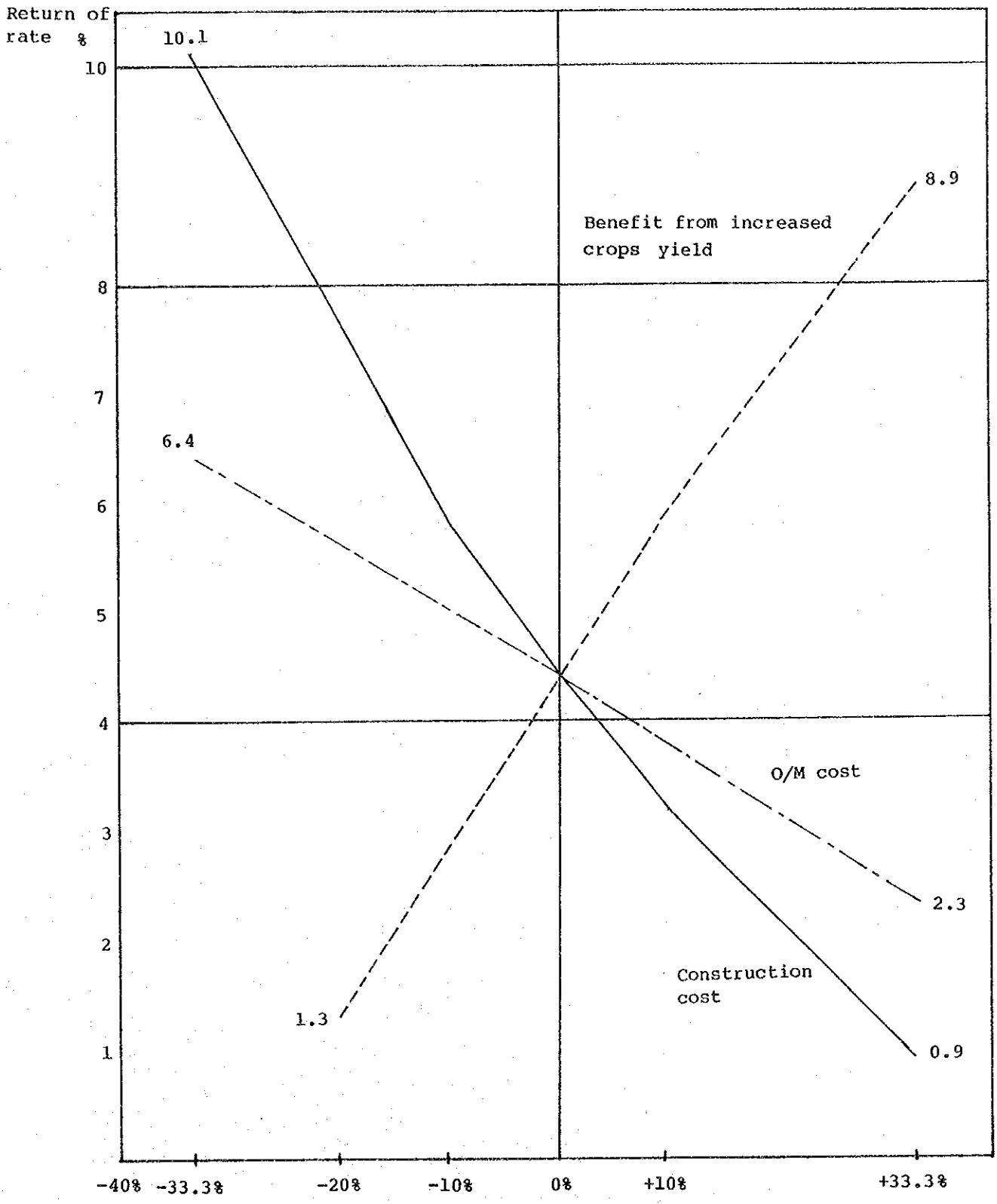

Fig. 6-3-2 SENSITIVITY OF ECONOMIC EVALUATION

5) Feasibility of project implementation from the standpoint of economic evaluation

In light a normal guideline to economic evaluation of a project, an opportunity cost of capital stands quite low in such an EIRR rate as 4.4% then it can not be helped that a priority of the project implementation may be bestowed on another project which is evaluated at a higher EIRR rate.

Nevertheless, much expectation is concentrated on securing soil conditioner of high quality which is indispensable to greening of deserts and raising crop yield and subsequent income. Then the compost obtained through the implementation of the project as a soil conditioner is one of the fundamental elements for achieving Egypt's national policy.

On the other hand, the B/C of 1.02 with a discount rate of 4% means that a 2% economic benefit can be realized if funding can be introduced with an annual interest rate of 4%. In other words, even if the project is carried out, there will be no economic loss at the national level.

Also, as clarified in the preceding sensitivity analysis for the increase rate of crop yield, if the rate can be at 40%, which can possibly occur eventually, then the EIRR will be 8.9%, thereby raising the economic evaluation of the project.

Unfortunately, there is no highly reliable data available in Egypt on the productivity increase rate of crop yield which, as just shown, is so crucially important to the project's evaluation.

Such factors should be kept in mind, however, that crop yield in the areas around Alexandria at present is less than half of that in Japan, and that organic minerals in the soil are extremely scarce. In some test with compost usage have demonstrated productivity increases of 120%, and sales of compost produced at the existing Abis Compost Plant are strong also. For these reasons, it may be said that there is sufficient possibility to set the productivity increase rate even higher.

While waste treatment system is a fundamental infrastructure for environment preservation, and should be operated as a public facility without prospecting much profits from it. In addition, it can be said irrational to expect much benefits from a waste treatment project which materialize waste discharged as the disused in daily lives.

If the project for the development of public facilities like this gains some benefit, in other words if the B/C exceeds 1.00, the implementation as a project to meet Basic Human Needs (BHN) should be approved.

Therefore, the project will be concluded feasible, taking into consideration of the characteristics of BHN type projects when the project can be funded the loan with 4% or lower interest.

6.3.2 Financial evaluation

From the conclusion the project is feasible through an economic evaluation owing to the fact that the B/C ratio exceeded 1.0, a financial analysis undertakes by focusing on the balance of payments relating to the project operation.

1) Pre-conditions of the financial evaluation
   - Number of plant operating days is 300 d/year.
   - The number of personnel required to operate the plant is 105.
   - The fine compost selling price is 9 LE same as market price as of September 1985.
   - The sales revenue derived from reusable materials will be 1.87 LE per ton of waste to be treated in 2000.
   - The basic wage of the personnel is paid by the Central Government, Chapter 1 of the Budget.

2) Balance of revenues and expenditure

The balance of revenues and expenditure for the new Abis Compost Plant is shown in Table 6-3-2 and 6-3-3. As shown, the balance falls into a deficit even excluding depreciation costs.

Although a price of 9 LE/t has been used for the compost in this balance calculation, a compost value would seem to be the same as that of a chemical fertilizer, namely 14 LE/t, in terms of its fertilizer composition. In the case with this price, a deficit comes to 2,000 LE. However, if all costs including depreciation are to be defrayed with the compost selling revenue, then the price of compost will be set at 54 LE/t, which would place the compost in an extremely disadvantageous position compared with other chemical fertilizers.

In addition, a yearly loan repayment amounts to 1,167,000 LE even under the condition of an annual interest rate of 4% with equal repayments over 15 years. In this case, the compost price of 9-14 LE per ton would therefore be inadequate to cover repayment requirements. Also, if only the foreign-currency portion is repaid under the conditions of a 20-year repayment with a 5-year grace period, 382,000 LE interest would be required per year. This means that it is impossible to make repayment based on compost plant operations alone.

As can be seen, it is unavoidable to conclude that the compost plant construction project alone is unfeasible in terms of the financial evaluation. The project will become feasible only when a certain subsidy is provided from the standpoint of farming promotion or when the required costs are borne as an part of the integral s.w.m. system.

Table 6-3-2 BALANCE OF NEW ABIS COMPOST PLANT PROJECT

Items		Remarks
Revenue		
Basic wages	96	105 persons
Selling income		
- Compost	203	fine compost 9 LE/ton
- Reusable materials	169	
Total(A)	468	
Expenditure		
Personnel expenditure	177	
Utilities cost		
- Electricity	81	1,680 MWH
- Water	5	36,000 m^3
- Fuel	110	363 kl for vehicle & 180 kl for machinery
Maintenance	209	2% of machinery cost & 12% of vehicle cost
Total(B)	582	
Balance(A-B)	-114	
Depreciation(D)	891	
Cost including depreciation(E)	1,473	
Deficit(E-A)	1,006	
Interest(F)	382	4% for foreign portion redemption for 20 years after 5 years
Total cost including interest(G=E+F)	1,855	
Deficit(G-A)	1,387	

Table 6-3-3 BURDEN FOR THE NEW ABIS COMPOST PROJECT

Item	Burden (LE 1,000)		Necessary Price for Balance (LE/ton)	
	Cost	Deficit	Compost	Solid waste
Operation cost	582	114	14.1	3.5
Cost including depreciation	1,473	1,006	53.7	13.4
Total cost including interest	1,855	1,387	70.6	17.7

6.4 Overall Financial Evaluation

1) Conditions of the Financial Evaluation

The financial evaluation consists of examining and evaluating the possibility of consolidating independent financial base by 2000 by improvement of the charge collection in the Middle District.

Two criteria are defined for evaluating the prospect of consolidating financial resources.

a. Possibility for every annual repayment of the foreign loan under the condition of 4% interest, a 5-year grace period and a 20-year repayment.

b. Gradual reducing of the grants said for purchase of collection vehicles, down to zero in 2000.

In other words, the financial evaluation of the project is carried out on the premise of liberation from the reliance on foreign aid, securing the continuity of the cleansing operation by using exclusively local self financial resources.

Meanwhile, the area to be covered by these projects are various composite ones, and it is not reasonable to put the total burden on the Middle District. Therefore, this project is evaluated on the premise of the undermentioned financial resources and cost sharing scheme.

a. The wage subsidy provided by the Central Government is assumed to continued, corresponding to the number of personnel required for the implementation of the project in question.

b. The Middle District's share of the Cleansing Fund is assumed to increase proportionally to a population growth in the Middle district. Currently the allotted amount for s.w.m is supposed to be about the half of the fund, without a regular standard, then the allotted amount of the half in 1985 is assumed in such portion as the rate of the waste amount in the Middle District to that of whole Alexandria.

c. As for the Chapter 3 of the Governorate budget, which composes the investment financial resources, a half of its sum relying upon the foreign grants will go down to zero and the remaining half is assumed to increase, but its total sum in 2000 is assumed to decrease to approximately a half of the sum corresponding to that of '85.

d. As for the burden upon the citizens and business establishments, it shall be expanded as Table 6-4-1 through the charge collection in the 1985-1990 period. (The charge collection rate will be improved to 70% in 2000, with a burden of 1 LE/month for high-income households and 0.5 LE/month for low-income households).

e. As for the cost sharing, the Middle District shall bear the total cost for waste collection and street sweeping, and costs of other projects, including haulage, treatment and disposal, shall be borne in proportion to the discharged waste amount by the respective districts.

f. Foreign currency loans are assumed to cost an annual interest rate of 4%, and short-term loans are assumed to cost 5% interest rate, which is the same as in other state-run institutions.

As shown in Table 6-4-1, the required total investment cost of three projects is 23,285,000 LE (16,310,600 LE in foreign portion) by 1990, and the total investment cost including second step investment for collection vehicles is 26,174,100 LE (19,165,400 LE in foreign portion).

Table 6-4-1 TOTAL COST OF THE PROJECTS

(1000 LE)

	First Stage			Second Stage		
	Foreign	Local	Total	Foreign	Local	Total
Coll. & Sweep	4,093.0	709.9	4,802.9	2,730.7	32.8	2,763.5
Disposal	1,864.0	1,735.0	3,599.0	0.0	0.0	0.0
Compost Plant	8,294.0	3,436.3	11,730.0	0.0	0.0	0.0
Subtotal	14,251.0	5,881.2	20,132.2	2,730.7	32.8	2,763.5
Eng. Service	1,131.0	470.4	1,601.4	124.1	1.5	125.6
Phy. Contin.	928.6	622.8	1,551.4	0.0	0.0	0.0
Total	16,310.6	6,974.4	23,285.0	2,854.8	34.3	2,889.1
Pri. Con.	836.1	1,437.7	2,273.8	71.4	7.7	79.1

	Total		
	Foreign	Local	Total
Coll. Sweep	6,823.7	742.7	7,566.4
Disposal	1,864.0	1,735.0	3,599.0
Compost Plant	8,294.0	3,436.3	11,730.3
Subtotal	16,981.7	5,914.0	22,895.7
Eng. Service	1,255.1	471.9	1,727.0
Phy. Contin.	928.6	622.8	1,551.4
Total	19,165.4	7,008.7	26,174.1
Pri. Con.	907.5	1,445.4	2,352.9

2) Financial evaluation

The cash flow of the project in question is shown in Fig.6-4-1, and its financial evaluation is summarized as follows:

a. A considerable shortage of funds will occur in 1990, 1995 and 2000, when the collection vehicles will be renovated, and in 1987 when the MBSDS will be constructed. Some overflow of funds will occur in some other year and even in the case of shortage, it will amount to barely 10% of the revenue in other year.

b. In 2000 there will be no cumulative short-term loan, and a repayment of 2,635,000 LE will be made for foreign loans (26% repayment rate), and the financial performance of the project can be regarded as satisfactory.

Therefore, examining the three projects as a whole, it may safely be said that the project in question is feasible from the standpoint of its financial balance.

3) Sensitivity analysis

A sensitivity analysis is carried out on the construction cost, collection vehicle purchase cost, compost selling amount and price, foreign loan interest rate and charge collection rate.

Results of the sensitivity analysis indicate that the compost selling price does not exert so much influence on the project feasibility, but inversely any change in the construction cost, collection vehicle purchase cost and charge collection rate exerts conspicuous influence on the project feasibility.

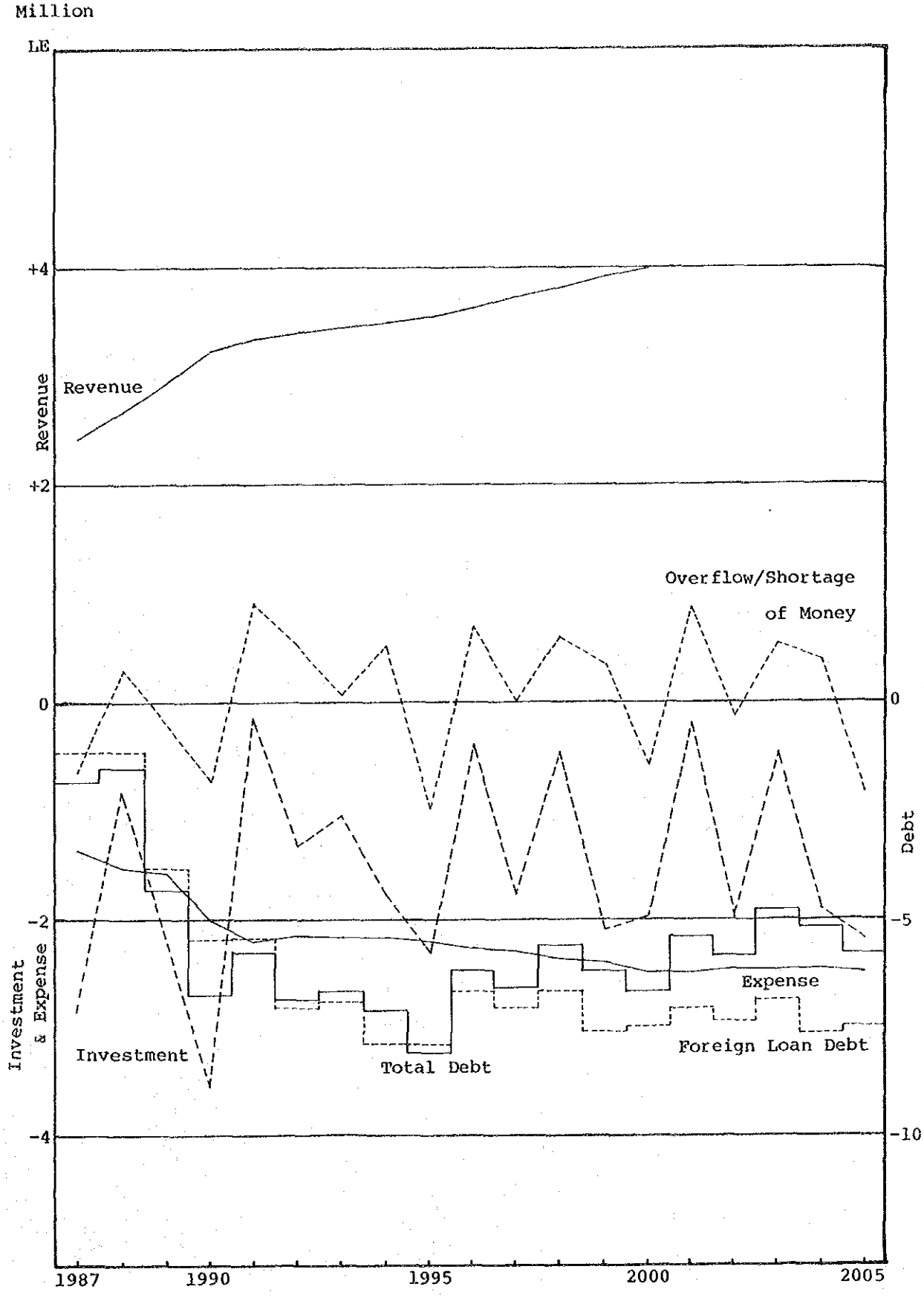

Fig. 6-4-1 MONEY FLOW OF THE PROJECT FOR MIDDLE DISTRICT

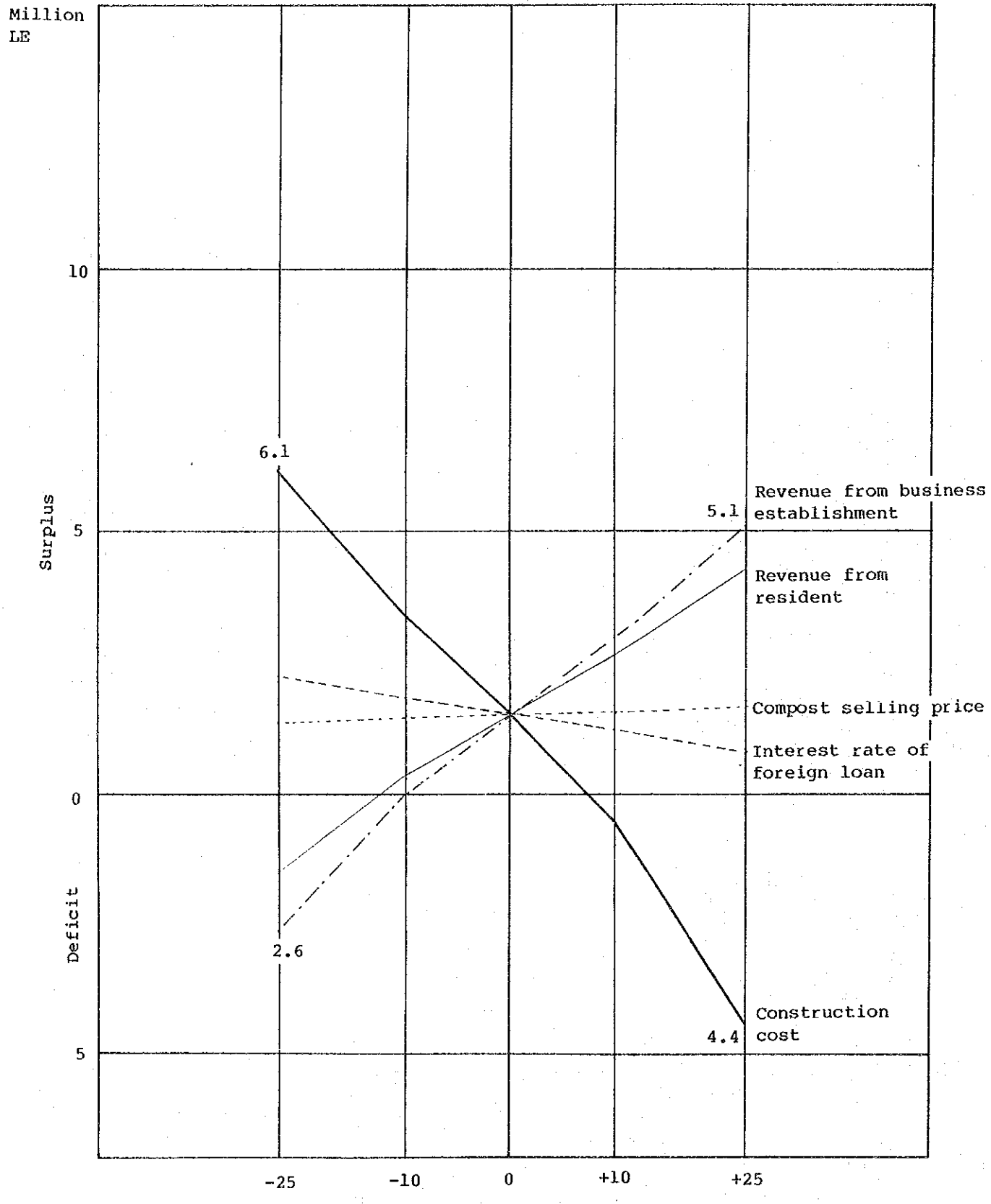

Fig. 6-4-2 RESULTS OF THE SENSITIVITY ANALYSIS

6.5 Conclusion

Following detailed consideration of the feasibility of implementing the s.w.m. improvement project in the selected Middle District, it has been determined that of three sub-projects comprising this project -- the collection project, the Abis Compost Plant project and the sanitary landfilling project -- both the collection and sanitary landfilling projects are feasible in both technical and financial terms. On the other hand, if the Abis Compost Plant were to be constructed independently, it would not be financially feasible even though it may be technically and economically feasible.

Nevertheless, the solid waste improvement project which includes all three of these projects would be financially feasible owing to the expanded financial resources to be derived through collection charges.

Financially, an investment of 26,000,000 LE including 19,200,000 LE in foreign currency, will be required for constructing facility and purchasing equipment relating to the improvement project, and operating expenses will increase nearly two-fold by the year 2000 to 2,500,000 LE.

On the other hand, the scale of financial resources will expand by 4,000,000 LE per annum -- 1.6 times greater than current collection, treatment and disposal management costs -- achieved through the introduction of a new collection fee system and increased income deriving from enhanced services made possible by improved collection.

A look at the cumulative funding situation through the year 200 reveals that while long-term loans reach 25,700,000 LE, repayment is made of 2,600,000 LE, or 10%. Capital surplus (internal reserve) therefore can be achieved in the amount of 1,600,000 LE, and this and other factors eliminate any worries of a financial nature.

Technically speaking, as the operating records of the existing compost plant indicate, the plant is not currently working at its planned capacity. However, it is believed that a recovery to the planned capacity can be achieved if part of the facilities are improved and personnel are trained. It may further be said that the outlook for the project's operation is very bright: e.g., the quality of the compost presently being produced clears Egyptian standards, sales exceed production, and the selling price of compost can be expected to rise in the future.

In the matter of reforming the management organization, which is indispensable to the stable operation of the project, already preparations are under way to establish a Cleansing Authority. It can be expected that organized planning, management, training, public relations work, etc. by this organization will become possible, and thereby contribute to the improvement of the operating base itself.

The following benefits can be expected through implementation of the project:

(1) Improvement in collection, transport and road sweeping

- By rapidly removing waste generated through urban activities from the urban area, the urban environment can be maintained and protected, and public sanitation can be improved.

- The enhancement of the urban environment through the above means can invite increased development of a tourist industry, which in turn can add vigor to the social and economic activities of Alexandria.

- Improvement in collection charges through enhanced collection services will lead to expansion in the project's financial resources. This in turn will enable a financial plan of outstanding self-sufficiency, including acquisition of labor through an independent supply system and allocation of required materials and equipment.

(2) Sanitary landfill project in Moharam Bey

- The project will protect the environment around the disposal site and improve public sanitation.

- By achieving early stabilization and eliminating the polluting effects of the disposed waste, various land uses become possible.

- Based on the above, the public consciousness of the nearby residents toward landfill can be improved, and this in turn will facilitate acquisition of disposal sites in the adjacent areas.

- The project will contribute to the safety of aricraft taking off and landing at El Nozha Airport, as well as to protection water quality in the water canal.

(3) Project introducing compost facilities

- Assuming capital investment at 4% interest per annum, net present value (NPV) of 448,000 LE can be expected during the project's 15-year lifetime.

- The quality of waste will become appropriate for landfill, thereby permitting land reuse within a short period after landfill has been completed.

- The above advantage will make it easier to acquire landfill sites in adjacent areas through temporary conversion of agricultural lands.

- Because the waste amount can be reduced through recycling of resources, the disposal site can be utilized for a longer period of time.

- If the quality of compost and its stable supply can be guaranteed, the market around Alexandria can be expanded and pricing can be improved, thereby enhancing the potential for introducing additional facilities. In this study, it is concluded that the total demand of compost within Alexandria Governorate is that to be produced by the treatment of 660 t/d of waste.

  It is, however desirable to conduct further investigation for the compost marketability along the desert road where compost is applied as soil conditioner on the newly developed farm land.

- It is possible to improve the supply system through independent financial resources, thereby leading to expectations of an expansion in the employment market.

This completes our discussion of the project's feasibility and potential effects. Table 6-5-1 shows the cumulative sum of income revenue by the year 2000 to support the operation of the project. It is seen that the rate of dependency on collection charges is high at 49%; on the other hand, income from the compost project accounts for no greater than 2%, even including reusable products.

Table 6-5-1 CUMULATIVE INCOME BY FINANCIAL RESOURCE BY 2000

Resource	Income (1000 LE)	Percentage
Subsidies	12,423	24
Investment	9,288	18
Cleansing fund	3,413	7
Collection charges	25,255	49
Compost sales profit	590	1
Profit from reusable items	496	1
Total	51,465	100

In other words, the introduction and operation of the compost plant are feasible only when collection fees are included, based on the improvement of services through enhanced collection. It should be kept firmly in mind that the independent introduction of the compost project by itself is not feasible.